ISSN:2782-8492

FEDPOLAD JOURNAL OF ENGINEERING *and* ENVIRONMENTAL STUDIES

(FEDPOLADJEES; Volume 2, Issue 1)

https://seemjournals.fedpolyado.edu.ng/index.php/fedpoladjees

October, 2022

tetfund
TERTIARY EDUCATION TRUST FUND
TETFund PROJECTS 2014/2017-2020 (Merged)
(TETFUND/DR&D/CE/POLY/ADO-EKITI/ARJI)

Chairman/Editor-in Chief,
SEEM RJ&MD Unit.

ISSN: 2782-8492

Published by

RhemAP Rhema Academic Publishers Ltd
Ado-Ekiti. Ekiti Sate. Nigeria
E-mail: rhemaacademicpublishers@gmail.com;
Phone: +234 704 774 2214, +234 805 976 6124

ARJ Project 2022 of:

THE FEDERAL POLYTECHNIC, ADO-EKITI, EKITI STATE.

Sponsored by:

tetfund
TERTIARY EDUCATION TRUST FUND
TETFund PROJECTS 2014/2017-2020 (Merged)
(*TETFUND/DR&D/CE/POLY/ADO-EKITI/ARJI*)

EDITORIAL POLICY

FEDPOLAD JOURNAL OF ENGINEERING AND ENVIRONMENTAL STUDIES (FEDPOLADJEES; VOLUME 2, ISSUE 1 [OCTOBER, 2022])
ISSN: 2782-8492

A Publication of:
SEEM (SCIENCE, ENGINEERING, ENVIRONMENTAL, MANAGEMENT) RESEARCH JOURNALS & MANUSCRIPTS DEVELOPMENT (SEEM-RJ&MD) UNIT
THE FEDERAL POLYTECHNIC, ADO-EKITI, EKITI STATE

Introduction:

Federal Polytechnic, Ado-Ekiti Journal of Engineering and Environmental Studies (FEDPOLADJEES) is a multi-disciplinary publication of SEEM (Science, Engineering, Environmental and Management) Research Journals and Manuscripts Development (SEEM-RJ&MD) Unit of Federal Polytechnic, Ado-Ekiti, Ekiti State, Nigeria. It is a medium designed for researchers in the field of engineering and environmental studies, both national and international to publish their research works. It is a bi-annual academic journal of high standard committed to the publication of original research papers in the field of engineering and environmental studies, such as Aerospace/aeronautical engineering, Chemical engineering, Civil engineering, Electrical/electronic engineering, Mechanical engineering, Mining engineering, Engineering management, Earth sciences, Toxicology, Soil sciences, Geology, Hydrology and water management, Climate studies and metrology, Biodiversity and conservation, Sustainable development, etc. The focus of the journal is to assist scholars with collections of quality academic research with practical implications for engineering and environmental studies related practices.

Manuscripts are accepted for publications from academics, researchers and practitioners after a double blinded peer review process. Preference is given to those of general significance that are written in English language, well organized and with outstanding academic significance.

As the journal provides a platform for rendering accurate and prompt research results, it also introduces new concepts that promote academic excellence and push frontiers of knowledge in the fields of engineering and environmental disciplines, the Journal editorial board is interested in publishing wide range of articles from these fields all around the globe. It is on this premise that the journal welcomes contributions in the form of articles (research, review or technical reports), general surveys, case study reports, conference/symposia/workshop reports and book reviews.

Guidelines for Reviewers:

For each manuscript, the individual reviewer:

1) must consider and conclude if the manuscript makes a valuable contribution to existing knowledge and literature, especially in terms of research significance, theory development, quality or newness of data, findings, methodology etc.
2) must conclude if the manuscript is written according to the Journal's 'Manuscript Requirements' and 'General Information' as stated in SEEM-RJ&MD Poster and Flier respectively.
3) must consider and conclude if the manuscript is written and presented up to publishable standards of the Journal in terms of: whether manuscript falls under any of the SEEM-RJ&MD Journal scope, whether concepts have been adequately defined, whether the manuscript is well structured with coherent and integrated argumentation, whether statistical data have concise clarity, whether tables, figures and diagrams are clear and representative, whether modification is needed by cutting out any part of the paper, restructuring, or further developing the paper.

Submission Guidelines for Authors:
Authors should note the followings.

Aim/Objective:
Federal Polytechnic Ado-Ekiti Journal of Engineering and Environmental Studies (FEDPOLADJEES) is a peer review international and bi-annual (April and October) publication of SEEM (Science, Engineering, Environmental and Management) Research Journals and Manuscripts Development unit of Federal Polytechnic, Ado-Ekiti, Ekiti State, Nigeria. It aimed at publishing high-quality articles dedicated to all aspects of engineering and environmental studies such as Aerospace/aeronautical engineering, Chemical engineering, Civil engineering, Electrical/electronic engineering, Mechanical engineering, Mining engineering, Engineering management, Earth sciences, Toxicology, Soil sciences, Geology, Hydrology and water management, Climate studies and metrology, Biodiversity and conservation, Sustainable development, etc. The journal hereby considers only manuscripts that have not been published (or submitted simultaneously) in any language elsewhere. Contributions are in English Language. Articles for publication may be theoretical, experimental, developmental, practical or specific case findings. Copyright is by the publisher. The journal is issued in printed form as bi-annual (April and October) volumes, and it currently accepts 3 types of articles defined as follows:

(i) Research Articles: these are regular articles which aim at presenting new findings.
(ii) Review Articles: these are articles which aim to present comprehensively already existing findings.
(iii) Technical Reports: these are short review articles.

General information:
Each article submitted for publication should not exceed 15 pages, typed in double

line space on A4 size paper; the font size must be 12 and in Times New Roman character. Preferable Microsoft (MS) word should be used and article should be processed on one side of the paper only with adequate top, bottom, side margins of 25mm. Electronic copy of the final version of the accepted paper(s) is required before an article is published. The manuscript arrangement should be in the following order: Title page, Abstract, Introduction, Methodology, Results and Discussion, Conclusion and Recommendation, References, Nomenclature, Tables, Figures and Appendices.

Title Page:
The title page contains the title of the paper which should not be more than 12 words, name(s) and address(es) of the author(s), e-mail address(es) and telephone number. For double or multiple authors, the name of the correspondence author should precede that of others. The surname of the author(s) should be followed by the initials.

Abstract:
An abstract (italicized) must be supplied with all articles by authors and should be kept within the limit of 250 words. The abstract is required to summarize the objective(s) of the article, methodology, results, findings, conclusion and recommendation(s). The abstract page should contain a minimum of 5 and maximum of 8 keywords. The keywords are required to describe the entire work contained in the article.

Introduction:
The introduction should contain clear objectives of the work; describe the problem being addressed and current effort(s) at providing solutions to the problems.

Materials and Methods:
This should contain theoretical analysis which incorporates relevant mathematical principles or theories applied in the study. It should also include the appropriate experimental methods and procedures with vivid description of method of analyses. Case studies and surveys should provide details of data collection, data synthesis and analysis. This section should be described in details; previously published procedures should be cited, and important modifications of such procedures should be briefly stated. Capitalize trade names and include the manufacturer's name and address. Subheadings could be used

Results and Discussion:
The results and discussion could be presented in descriptive, tabular, graphical or photographic form but must relate to the work done. Repetition of information presented should be avoided. Interpretations of findings should be the main focus of the discussion.

Conclusion and Recommendations:
Conclusion should briefly summarize the findings and should state clearly their

relevance and contributions to knowledge. Recommendations should briefly highlight areas where implementation could be made or areas for further work.

References:
All references should conform to APA 7 style. They should contain full reference details and journal titles which should not be abbreviated. All references must be arranged in alphabetical order at the end of the article. For multiple citations of the same year, suffixes a, b, c should immediately follow the year of publication.

Citing:
Citing should be done as follows:

Within the Text:
Authors name should be followed by a comma and the year of publication contained in round bracket e.g. Chukwura (1987a) and Chukwura (1987b), Tijani (1993), Kumasi et al (2001), (Isife 2003), Agindotanet al (2003), Usman and Smith (1992), Chege (1998).

At the End of Article:
A list of reference at the end of the work can be as follows:

Basic Format for Journals:
Surname, Initials. (Year of Publication). Article title, Journal Name, volume number (Issue number), pages.
Basic Format for Journal Article from an Online Periodical:

With DOI:
Oladebeye, D. H. & Olorunnishola, A. A. G. (2018). Characterizing selected south western agricultural residuals for metallurgical purpose. Journal of Fundamentals of Renewable Energy and Applications, 2(8), 6 -11. doi: 10.4172/2090-4541-C1-051.

Keji, S. A., Adeleke, O. & Oguntuase, A. (2019). External debt and economic growth in Nigeria. Journal of African Union Studies, 8(3), 161-177.doi:https://doi.org/10.31920/2050-4306/2019/8

Without DOI, Provide URL:
Momoh, J. J. (2013). Basic sociological concepts, attitude, perception and effects on propagating the message of HIV and AIDS prevention and control on engineering student of some selected tertiary institutions in Ekiti State, Nigeria, Journal of AIDS and HIV Research, 5(12), 443-447, Retrieved July 3, 2018, from - http://www.academicjournals.org/article/article1384430372_Momoh.pdf

Araoye, O. I., Akintoye, K. A. & Adu, M. K. (2018). Performance evaluation models for

a secure agent-based electronic commerce. International Journal of New Technology and Research, 4(4), 116-120.Retrieved April 19, 2020, fromhttps://www.ijntr.org/

Israel, O. T., & Taiwo, O. (2019). Optimizing transportation with spatial databases using Google maps in Ado-Ekiti. American Journal of Aerospace Engineering. 6(2), 39-43. Retrieved April 19, 2020, fromhttp://www.sciencepublishinggroup.com/j/ajae

Journal article without DOI and URL:

Otalu, J. A. (2010). Nigeria today and the year 2020. ECPER Journal of Political and Economic Studies, 2(1), 8 -12.

Adeosun, E.O., Rodiya, A.A., &Abisua, T.A. (2009). Influence of land use on carbon sequestration in the forest. Agro-ecological zone of Ekiti state, Southwestern Nigeria. Journal of Engineering and Earth Sciences, 12(1), 1-7.

Document from Websites:

NBTE. (2018, October). Ranking table of Nigerian Polytechnics. Retrieved July 2, 2019, from National Board for Technical Education: https://net.nbte.gov.ng/2018%20polytechnic%20ranking.

Cain, A., & Burris, M. (1999, April). Investigation of the use of mobile phones while driving. Retrieved January 15, 2000, from http://www.cutr.eng.usf.edu/its/mobile_phone_text.htm

Archer, D. (n.d.). Exploring nonverbal communication. Retrieved July 18, 2001, from http://nonverbial.ucsc.edu

From Books:

Surname, Initials. (Year of Publication). Title (edition – 3rd Ed.). Place of publication: Publisher, e.g.
Highmore, B. (2001). Everyday life and cultural theory. New York, USA: Routledge
Owoeye, C. (2009). Design of typing elements (3rd Ed.). Lagos: Taylor & Francis.

Tables, Figures, Equations: All tables and figures are to be numbered progressively using Roman numerals. The caption of tables should be located above the respective tables while that of the figures should be located below it. All equations must be numbered using Arabic numerals in parenthesis at the right margin of the equations. Tables, Figures and Equations should be cited in the text as shown: Table 1, Figure. 1, and Eq. I.

Paper Submission:

Electronic submission of manuscript(s) is strongly encouraged, provided the text, tables and figures are included in a single Microsoft word file. Authors are to submit

manuscripts as well as e-mail attachment to the Editorial Office at: seemjournal@fedpolyado.edu.ng. Once manuscript is received, a manuscript number will be e-mailed to the corresponding author within 72 hours.

Processing/Publication Fees:
The processing fees is free. Only that author(s) must fulfill the guidelines stated in the SEEM Research and Development Journal manuscript requirements.

Submission Preparation Checklist:
Before submitting the manuscript, author(s) should check, that;

- the manuscript to be submitted has never been published by, nor submitted to, any journal for consideration.
- once submitted, author(s) will not submit the same manuscript to another journal for publication.
- the contents of the manuscript are free from plagiarism, and are the original research work fully copyrighted by the author(s). If the manuscript is found to have been a plagiarized work, the journal reserves the right to reject the manuscript without further notifications, and never will manuscripts be accepted from the concerned author(s).
- except for the purpose of citation and referencing, author(s) did not mention his or her name, affiliation, contact or other personal details in the main text.
- the manuscript file is in Microsoft Word format, and it has been developed in line with the Journal's manuscript submission guidelines as stated in our fliers.
- author(s) has read all the terms and conditions of the journal before submission.

Dr. Oyewusi, P. A.,
Chairman/Editor in Chief,
SEEM-RJ&MD
Federal Polytechnic, Ado-Ekiti

TABLE OF CONTENT PAGES

FEDPOLAD JOURNAL OF ENGINEERING AND ENVIRONMENTAL STUDIES (FEDPOLADJEES)

BIT ERROR PROBABILITY PERFORMANCE OF *M-ary Quadrature Amplitude Modulation* IN ADDITIVE WHITE GAUSSIAN NOISE AND RAYLEIGH FADING CHANNELS

Authors

[*]**Bamisaye, A .J Okereke, C.O and Oloniyo, O**

Department of Electrical and Electronic Engineering

The Federal Polytechnic, Ado-Ekiti, Nigeria

**ayobamisaye@gmail.com, +2347033657792*

Abstract:

Based on the growing rate of digital communication systems, quality of service for signal transmission has become necessary by employing modulation technique that is bandwidth efficient and has low bit error rate at a relatively low signal to noise ratio. In this paper we derive a closed form expression for the average bit error rate of various M-ary Quadrature Amplitude Modulation (4, 16, 64 and 256-QAM) techniques as a measure of performance when the system is subjected to AWGN and multipath Rayleigh fading channels. The theoretical expressions are verified by simulation and the results show good agreement. We also analyze and compare the performance of these techniques. With respect to these performances a required modulation scheme is recommended that offers low Bit Error Rate (BER) at low received Signal-t-Noise Ratio (SNR).

Keywords: *Rayleigh Fading, AWGN, BPSK, Modulation.*

Introduction

Wireless communication system utilizes modulation of electro-magnetic (radio) waves by means of a carrier frequency varying from a few hundred megahertz (MHz) to numerous gigahertz (GHz) depending on the system. The performance of the wireless channel is a function of the radio propagation effects of the environment. Radio-wave propagation through wireless channels is characterized by various effects, such as multipath and shadowing (Simon and Alouini, 2000).

When a received signal experiences fading during transmission, both its envelope and phase fluctuate over time. For coherent modulations, the fading effects on the phase can severely reduce the performance unless measures are taken to compensate for them at the receiver. oftentimes, analyses of systems employing such modulations assume that the phase effects due to fading are perfectly corrected at the receiver, resulting in ideal coherent demodulation (Simon and Alouini, 2000). In case of noncoherent modulations, phase information is not required at the receiver and

consequently the phase variation due to fading does not affect the performance. Therefore, performance analyses for both the ideal coherent and noncoherent modulations over fading channels requires only knowledge of the fading envelope statistics (Simon and Alouini, 2000), (Haykin, 1988), (Ziemer and Tranter, 1990), (Sklar, 1988).

Frequency selectivity is also an important characteristic of fading channels. fading is said to be frequency nonselective or, equivalently, frequency flat if all the spectral components of the transmitted signal are affected. This is the situation for narrowband systems whereby the transmitted signal bandwidth is much smaller than the channel's coherence bandwidth

Multipath fading is due to the constructive and destructive combination of randomly delayed, reflected, scattered, and diffracted signal components. This type of fading is relatively fast and is thus responsible for the short-term signal variations (Simon and Alouini, 2000), (Proakis, 1995), (Peebles, 1987), (Simon et al, 1995), (Chiani and Dardari, 2002). This paper focus on AWGN and Rayleigh fading channel which is a single tap channel that varies from one symbol to the next. Bit error probability (BEP) is one of the essential performance measures of digital communication systems. To calculate the average Bit Error Rate (BER) of a given modulation scheme in fading channels, the corresponding BER of that modulation scheme over AWGN is averaged over the fading statistics of the channel (Viswanathan, 2019). For simplicity of BEP derivation over fading channels, previous works carried out for approximating Q-function (Isukapalli and Rao, 2008), (Karagiannidis and Lioumpas, 2007), (Radaydeh and Matalgah, 2008), (Dyer and Dyer, 2008), (Simon,2002), (Chen and Beaulieu, 2009), (Tellambura and Annamalai, 2000) and for QAM estimation performance (Rugini, 2016), (Zayani et al, 2015), (Son et al, 2015), (Kumar et al, 2017), (Bithas et al, 2015). Section two of this paper describe the system model, BER over AWGN Channel, and symbol error Rate for M-QAM; section three present the average energy of an M-QAM constellation; section four describe SER over Rayleigh fading channel; Simulations carried out and the results are discussed in section five and the conclusion drawn is presented in section six.

SYSTEM MODEL

Considering Additive White Gaussian Noise channel and assume that the transmission time between s and r is zero, also the carrier frequency at s is exact the same one at r. Then with reference to figure 1

$$r = s + n. \qquad \text{(Eq. 1)}$$

Where n is the AWGN with $n \sim N(0, \sigma^2)$, σ^2 is the noise variance $= \frac{N_0}{2}$

Let a signal's energy-per-bit be denoted as E_b and the energy-per-symbol as E_s, then $\gamma_{b=E_b/N_0}$ and $\gamma_{s=E_s/N_0}$ are the SNR-per-bit and the SNR-per-symbol respectively. For uncoded M-ary signaling scheme with $k = \log 2(M)$ bits per symbol, the signal energy per modulated symbol is given by $E_s = kE_b$(the term SNR (γ) refers to $\gamma_b = \frac{E_b}{N_0}$ when the modulation is of binary type (example:

BPSK). For multilevel modulations such as Quadrature Phase Shift Keying (QPSK) and MQAM, the term SNR refers to $\gamma_s = \frac{E_s}{N_0}$)

BER over AWGN Channel: Binary Phase Shift Keying (BPSK)

With Binary Phase Shift Keying (BPSK), the binary digits 1 and 0 maybe represented by the analog levels $+\sqrt{E_b}$ and $-\sqrt{E_b}$ respectively. From figure 1, $SNR = \frac{E[x^2]}{E[n^2]} = \frac{1}{2\sigma^2}$. $b = 0 \Rightarrow x = +\sqrt{E}$; $b = 1 \Rightarrow x = -\sqrt{E}$; E: transmit power. Let $p(e)$ denote the bit error probability, then $p(e) = p(\hat{b} = 0|b = 1).p(b = 1) + p(\hat{b} = 1|b = 0).p(b = 0)$

$p(b = 0) = p(b = 1) = 1/2$ equal probable messages

$p(\hat{b} = 0|b = 1) = p(\hat{b} = 1|b = 0)$ due to symmetry, therefore bit error probability gives

$p(e) = p(\hat{b} = 0|b = 1)$ (Eq. 2)

Under the assumption that b=1 is sent, then $b = 1 \Rightarrow s = -\sqrt{E}$. At the receiver, the received signal is given in (1). Equation (2) becomes

$p(r > 0|b = 1) = \int_0^\infty f(r|b = 1)dr$ (Eq. 3)

$r = s + n \Longrightarrow r - s = n, b = 1 \Rightarrow s = -\sqrt{E}$, $r + \sqrt{E} = n$

Probability distribution function of noise (PDF): $f(n) = \frac{1}{\sqrt{2\pi\sigma^2}} exp^{\left(-\frac{n^2}{2\sigma^2}\right)}$

$= \frac{1}{\sqrt{2\pi\sigma^2}} \int_0^\infty exp\left(-\frac{\left(r+\sqrt{E}\right)^2}{2\sigma^2}\right) dr$ (Eq. 4)

Let $\frac{r+\sqrt{E}}{\sigma^2}$, $dr = \sqrt{\sigma^2}dy$, then (Eq. 4) becomes

$= \frac{1}{\sqrt{2\pi}} \int_{\sqrt{E/\sigma^2}}^\infty exp - \left(\frac{y^2}{2}\right) dy$ (Eq. 5)

The 'classical' definition of Q-function is given by (Eq.6)

$Q(x) = \frac{1}{\sqrt{2\pi}} \int_x^\infty e^{-y^2/2} dy$ (Eq. 6)

Combining (Eq.5) and (Eq. 6) gives $p(e) = Q(\sqrt{E/\sigma^2})$ (Eq.7)

Since $SNR = \frac{E}{\sigma^2}$ defined earlier, therefore (Eq. 7) can be written as $p(e) = Q(\sqrt{SNR})$ (Eq. 8)

The complimentary error function is defined by [17] Gradshteyn and Ryzhik, (1994) as

$erfc(x) \triangleq \frac{2}{\sqrt{\pi}} \int_x^\infty e^{-t^2} dt$ (Eq. 9).

The Q function is related to the erfc(.) by (Eq. 10)

$Q\ (x) = \frac{1}{2} erfc\left(\frac{x}{\sqrt{2}}\right)$. (Eq. 10)

Therefore (Eq. 8) becomes $p(e) = \frac{1}{2} erfc\left(\sqrt{\frac{E_b}{N_0}}\right)$ (Eq. 11)

Symbol Error Rate (SER) For M-QAM

The classical form of the symbol error probability (SEP) for QAM [1] is

$$P_S(E) = 4\left(1-\frac{1}{\sqrt{M}}\right)Q\left(\sqrt{\frac{3E_S}{N_0(M-1)}}\right) - 4\left(1-\frac{1}{\sqrt{M}}\right)^2 Q^2\left(\sqrt{\frac{3E_S}{N_0(M-1)}}\right) \quad \text{(Eq. 12).}$$

For 4QAM, equation (12) reduces to

$$SER_{4QAM} = 2Q\left(\sqrt{\frac{E_S}{N_0}}\right) - Q^2\left(\sqrt{\frac{E_S}{N_0}}\right) \quad \text{(Eq. 13).}$$

Neglecting higher orders of Q, eq. (13) approximately becomes $P_{4QAM} \approx 2Q\left(\sqrt{\frac{E_S}{N_0}}\right)$ (Eq. 14)

For 16QAM, (Eq. 12) will become

$$SER_{16QAM} = 3Q\left(\sqrt{\frac{E_S}{5N_0}}\right) - \frac{9}{4}Q^2\left(\sqrt{\frac{E_S}{5N_0}}\right) \quad \text{(Eq. 15)}$$

$$P_{16QAM}(e) \cong 3Q\left(\sqrt{\frac{E_S}{5N_0}}\right) \quad \text{(Eq. 16).}$$

For 64 QAM, equation (Eq. 12) reduces to

$$P_{64QAM}(E) = \frac{7}{2}Q\left(\sqrt{\frac{E_S}{21N_0}}\right) - \frac{49}{16}Q^2\left(\sqrt{\frac{E_S}{21N_0}}\right) \quad \text{(Eq. 17)}$$

$$P_{64QAM}(E) \cong \frac{7}{2}Q\left(\sqrt{\frac{E_S}{21N_0}}\right) \quad \text{(Eq. 18)}$$

For 256 QAM

$$P_{256QAM}(E) = \frac{15}{4}Q\left(\sqrt{\frac{E_S}{85N_0}}\right) - \frac{225}{64}Q^2\left(\sqrt{\frac{E_S}{85N_0}}\right) \quad \text{(Eq. 19)}$$

$$P_{256QAM}(E) \cong \frac{15}{4}Q\left(\sqrt{\frac{E_S}{85N_0}}\right) \quad \text{(Eq. 20)}$$

3. AVERAGE ENERGY OF AN M-QAM CONSTELLATION

In a general M-QAM constellation where $M = 2^b$ and b the number of bits in each constellation is even, the alphabets used are: $\alpha_{MQAM} = \{\pm(2m-1) \pm j(2m-1)\}$, where $m \in \left\{1,2 \ldots, \frac{\sqrt{M}}{2}\right\}$

For computing the average energy of the M-QAM constellation, the sum of individual alphabet can be calculated using equation below

$$E_\propto = \sum_{m=1}^{\frac{\sqrt{M}}{2}} |(2m-1) + j(2m-1)|^2 = \frac{\sqrt{M}}{3}(M-1) \quad \text{(Eq. 21)}$$

To find the average energy from M constellation symbols, the product of (21) and $2\sqrt{M}$ is divided by M, which give (Eq.22)

$$E_{MQAM}\frac{2\sqrt{M}}{M}E_\propto = \frac{2\sqrt{M}}{M}\frac{\sqrt{M}}{3}(M-1) = \frac{2}{3}(M-1) \quad \text{(Eq. 22)}$$

Let the received symbol be $y = k\sqrt{E_s}S + n$

Where E_s is the energy, $k = \sqrt{\frac{1}{\frac{2}{3}(M-1)}}$ is the normalizing factor, S is the transmit symbol and n is the noise. When M=4(QAM), $k = \frac{1}{\sqrt{2}}$, putting this and (Eq. 10) in (Eq.14) becomes

$$P_{4QAM} \approx erfc\left(\sqrt{\frac{E_s}{2N_0}}\right) \quad \text{(Eq. 23).}$$

Likewise when M=16(16QAM), $k = \frac{1}{\sqrt{10}}$, putting this and (Eq.10) in (Eq. 16) gives

$$P_{16QAM} \cong \frac{3}{2} erfc\left(\sqrt{\frac{E_s}{10N_0}}\right) \quad \text{(Eq. 24)}$$

Also, when M=64 (64QAM), $k = \frac{1}{\sqrt{42}}$, putting this and (Eq. 10) in (Eq. 18) produce

$$P_{64QAM} \cong \frac{7}{4} erfc\left(\sqrt{\frac{E_s}{42N_0}}\right) \quad \text{(Eq. 25)}$$

likewise, when M=256 (256QAM), $k = \frac{1}{170}$, putting this and (Eq. X) in (Eq.20) will approximately produce $P_{256QAM} \cong \frac{15}{8} erfc\left(\sqrt{\frac{E_s}{170N_0}}\right)$ (Eq. 26)

SER OVER RAYLEIGH FADING CHANNEL

In fading channel

$$s = a \times r + n \quad \text{(Eq. 27)}$$

where a is a constant that depends on the specific modulation combination. For BPSK in fading channel "instantaneous SNR" is defined as

$$\gamma = |a|^2 \frac{E}{N_0} \quad \text{(Eq. 28)}$$

$$p(e/a) = Q\left(\sqrt{\frac{2E}{N_0}a^2}\right) = Q\left(\sqrt{2\gamma}\right) \quad \text{(Eq. 29)}$$

$$E_\gamma[p(e)] = \int_0^\infty Q\left(\sqrt{2\gamma}\right) f_\gamma(\gamma) d\gamma \quad \text{(Eq. 30)}$$

For Rayleigh fading channel, $f(a) = \frac{a}{\sigma} exp\left(-\frac{a^2}{2\sigma^2}\right)$ (Eq. 31)

and

$$\bar{\gamma} = E[\gamma] = E\left[a^2 \frac{E}{N_0}\right] = E[a^2]\frac{E}{N_0} = \Omega\frac{E}{N_0} \quad \text{(Eq. 32)}$$

The pdf of γ is given by $f_\gamma(\gamma) = \frac{1}{\gamma} exp\left(-\frac{\gamma}{\bar{\gamma}}\right)$ (Eq. 33).

The Probability Density Function (PDF) and Moment Generating Function (MGF) of the SNR per Symbol for Some Common Fading Channels is shown in table 1. Putting (30) in (33) we have

$$p(e) = \frac{1}{2}\left(1 - \sqrt{\frac{\bar{\gamma}}{1+\bar{\gamma}}}\right) \quad \text{(Eq. 34)}$$

$$= \frac{1}{2}\left(1 - \sqrt{\frac{(E_b/N_0)}{(E_b/N_0)+1}}\right) \quad \text{(Eq. 35)}$$

For QAM, the SEP over the AWGN channel is given by (Eq. XII). To obtain the average SEP of M-AM over a Rayleigh fading channel, one proceeds as for the M-AM case by first obtaining the conditional SEP [i.e., replacing E_s/N_0 with γlog2(M) in (Eq.12)] and then evaluating an integral such as (Eq. 30) for the Rayleigh PDF of (Eq. 33)

$$P_s(E) = 2\left(\frac{\sqrt{M}-1}{\sqrt{M}}\right)\left(1-\sqrt{\frac{1.5\overline{\gamma}_s}{M-1+1.5\overline{\gamma}_s}}\right) - \left(\frac{\sqrt{M}-1}{\sqrt{M}}\right)^2\left[1-\sqrt{\frac{1.5\overline{\gamma}_s}{M-1+1.5\overline{\gamma}_s}}\left(\frac{4}{\pi}tan^{-1}\sqrt{\frac{M-1+1.5\overline{\gamma}_s}{1.5\overline{\gamma}_s}}\right)\right] \text{(Eq. 36)}$$

for 4-QAM equation (Eq. 36) will reduce to

$$P_s(E) = \left(1-\sqrt{\frac{\overline{\gamma}}{1+\overline{\gamma}}}\right) - \frac{1}{4}\left[1-\sqrt{\frac{\overline{\gamma}}{1+\overline{\gamma}}}\left(\frac{4}{\pi}tan^{-1}\sqrt{\frac{1+\overline{\gamma}}{\overline{\gamma}}}\right)\right] \quad \text{(Eq. 37)}$$

And for 16-QAM (Eq. 36) can be re-written as

$$P_s(E) = \frac{3}{2}\left(1-\sqrt{\frac{2\overline{\gamma}}{5+2\overline{\gamma}}}\right) - \frac{9}{16}\left[1-\sqrt{\frac{2\overline{\gamma}}{5+2\overline{\gamma}}}\left(\frac{4}{\pi}tan^{-1}\sqrt{\frac{5+2\overline{\gamma}}{2\overline{\gamma}}}\right)\right] \quad \text{(Eq. 38).}$$

For 64-QAM, (Eq. 36) will be

$$P_s(E) = \left(\frac{7}{4}\right)\left(1-\sqrt{\frac{2\overline{\gamma}_s}{21+2\overline{\gamma}_s}}\right) - \left(\frac{49}{64}\right)\left[1-\sqrt{\frac{2\overline{\gamma}_s}{21+2\overline{\gamma}_s}}\left(\frac{4}{\pi}tan^{-1}\sqrt{\frac{21+2\overline{\gamma}_s}{2\overline{\gamma}_s}}\right)\right] \quad \text{(Eq. 39)}$$

And for 256-QAM, (Eq. 36) becomes

$$P_s(E) = \left(\frac{15}{8}\right)\left(1-\sqrt{\frac{8\overline{\gamma}_s}{255+8\overline{\gamma}_s}}\right) - \left(\frac{225}{256}\right)\left[1-\sqrt{\frac{8\overline{\gamma}_s}{255+8\overline{\gamma}_s}}\left(\frac{4}{\pi}tan^{-1}\sqrt{\frac{255+8\overline{\gamma}_s}{8\overline{\gamma}_s}}\right)\right] \quad \text{(Eq. 40)}$$

Simplifying (Eq. 37), (Eq. 38), (Eq. 39) and (Eq. 40) by replacing $\bar{\gamma}$ with (E_s/N_0) will result in (Eq. 41) for Q-PSK, (Eq. 42) for 16-QAM, (Eq. 43) for 64-QAM and (Eq. 44) for 256-QAM respectively.

$$P_s(E) = \left(1-\sqrt{\frac{(E_s/N_0)}{1+(E_s/N_0)}}\right) - \frac{1}{4}\left[1-\sqrt{\frac{(E_s/N_0)}{1+(E_s/N_0)}}\left(\frac{4}{\pi}tan^{-1}\sqrt{\frac{1+(E_s/N_0)}{(E_s/N_0)}}\right)\right] \quad \text{(Eq. 41)}$$

$$P_s(E) = \frac{3}{2}\left(1-\sqrt{\frac{2(E_s/N_0)}{5+2(E_s/N_0)}}\right) - \frac{9}{16}\left[1-\sqrt{\frac{2(E_s/N_0)}{5+2(E_s/N_0)}}\left(\frac{4}{\pi}tan^{-1}\sqrt{\frac{5+2(E_s/N_0)}{2(E_s/N_0)}}\right)\right] \quad \text{(Eq. 42)}$$

$$P_s(E) = \frac{7}{4}\left(1-\sqrt{\frac{2(E_s/N_0)}{21+2(E_s/N_0)}}\right) - \frac{49}{64}\left[1-\sqrt{\frac{2(E_s/N_0)}{21+2(E_s/N_0)}}\left(\frac{4}{\pi}tan^{-1}\sqrt{\frac{21+2(E_s/N_0)}{2(E_s/N_0)}}\right)\right] \quad \text{(Eq. 43)}$$

$$P_s(E) = \frac{15}{8}\left(1-\sqrt{\frac{8(s/N_0)}{255+8(E_s/N_0)}}\right) - \frac{225}{256}\left[1-\sqrt{\frac{8(E_s/N_0)}{255+8(E_s/N_0)}}\left(\frac{4}{\pi}tan^{-1}\sqrt{\frac{255+8(E_s/N_0)}{8(E_s/N_0)}}\right)\right] \quad \text{(Eq. 44)}$$

SIMULATION RESULTS AND DISCUSSION

The Comparison curve of two modulation techniques for various M in an AWGN and Rayleigh fading Channels are shown in figures 2,3,4 and 5 for N= 700,000 samples.

The study of five digital modulation schemes i.e. 2-PSK, 4-PSK/4-QAM, 16-QAM, 64-QAM and 256-QAM is performed on AWGN and Rayleigh Fading Channels. The results are plotted using MATLAB in terms of bit error rate. Figures 2 and 3 present a comparative study of AWGN channel (M=2, 4, 16, 64 and 256) and Rayleigh fading channel (M=2, 4, 16, 64 and 256). These results

clearly show good agreement between the error probabilities computed for theory and simulation. For large values of SNR, the probability of error decreases exponentially compared with SNR in AWGN channel but decreases linearly with Rayleigh fading channel. It was also observed that as the value of M, i.e., the number of bits in a symbol increases, the error rate also increases.

The smaller the value of BER required, the worse is the performance degradation. Thus the power required to maintain a particular BER, for small values, is much higher in fading channels. From Figure.3 we observe that 2-PSK requires 4dB SNR to maintain 10^{-2} bit error rate in AWGN channel while it requires 14dB SNR to maintain the same error rate in Rayleigh fading. Likewise, 4-PSK requires 8dB SNR to maintain 10^{-2} bit error rate in AWGN channel while it requires 14 dB SNR to maintain the same error rate in Rayleigh fading.

Reading from the graph in Figure 5 and taking the MQAM modulation for different SNR values with a constant BER $=10^{-3}$, with M=16, SNR for AWGN channel is 17dB where SNR for Rayleigh is 27dB. Using the 64QAM modulation scheme, for BER $=10^{-3}$; AWGN channel equals 24dB while SNR for Rayleigh channel remains 32 dB and with 256-QAM modulation scheme for BER=10^{-3} , AWGN channel equals 30dB while SNR for Rayleigh channel is 35 dB. Rayleigh channel has low performance compared to AWGN channel.

6. CONCLUSION

Symbol Error Rate expression for computing the bit error probabilities for BPSK and various M-ary of Quadrature Amplitude Modulation (4, 16, 64 and 256-QAM) techniques in AWGN and Rayleigh fading channels were derived. The theoretical expressions were verified by simulation and the results showed good agreement. Based on the performance analysis of the results, it was observed that for the same values of M with low SER, SNR and throughput, AWGN presented a better performance than Rayleigh fading channel.

REFERENCE

Bithas, P. S., Efhymoglou, G. P., Kanatas, A. G (2015) "SEP of Rectangular QAM in composite fading channels" International journal of Electronics and communications, Elsevier 69 (2015) pp 246-252.

Chen, Y and Beaulieu, N. C (2009) “A simple polynomial approximation to the Gaussian Qfunction and its application,” IEEE Communication. Letters, vol. 13, no. 2, pp. 124–126.

Chiani, M and Dardari, D (2002) “Improved exponential bounds and approximation for the Q function with application to average error probability computation,” in Global Telecommunications Conference, 2002. GLOBECOM '02. IEEE, vol. 2, pp. 1399 – 1402.

Dyer, J. S and Dyer, S. A (2008) “Corrections to, and comments on, ”an improved approximation for the Gaussian Q-function,” IEEE Communucation. Letters, vol. 12, no. 4, p. 231.

Gradshteyn, I.S and Ryzhik, I.M (1994). Tables of integrals, Series and Product, 5th ed. San Diego, C.AAcademic.

Haykin, S (1988). Digital Communications. New York: Wiley.

Isukapalli, Y and Rao, B.D (2008) “An analytically tractable approximation for the Gaussian Qfunction,” IEEE Commun.Lett., vol. 12, no. 9, pp. 669–671, September 2008.

Karagiannidis, G. K and Lioumpas, A. S (2007) “An improved approximation for the Gaussian Q-function,” IEEE Commun.Lett., vol. 11, no. 8, pp. 644–646.

Kumar, N., Bhatia, V., and Dixit, D (2017). "Performance analysis of QAM in amplify-and-forward cooperative communication networks over Rayleigh fading channels" International journal of Electronics and communications Elsevier 72(2017) pp 86-94.

Peebles, P.Z Jr.,(1987). Digital Communication Systems. Upper Saddle River, NJ: Prentice Hall.

Proakis, J (1995) .Digital Communications, 3rd ed. New York, McGraw-Hill, 1995.

Radaydeh, M and Matalgah,M.M (2008) “Results for infinite integrals involving higher-order powers of the Gaussian Q-function with application to average,” IEEE Tran.Wireless Commun., vol. 7, no. 3, pp. 793–798, March 2008.

Rugini, L (2016) “Symbol Error Probability of Hexagonal QAM ” IEEE Communication. Letters, vol. 20, no. 8, pp. 1523-1526.

Simon, M. K (2002) “Single integral representations of certain integer powers of the Gaussian Qfunction and their application,” IEEE Communcation.Letters, vol. 6, no. 12, pp. 532–534.

Simon, M.K and Alouini, M (2000). Digital communication over fading channels: A Unified Approach to Performance Analysis. New York: Wiley.

Simon, M. K. Hinedi, S. M and Lindsey, W. C. (1995). Digital Communication Techniques: Signal Design and Detection. Upper Saddle River, NJ: Prentice Hall.

Sklar, B (1988) Digital Communications: Fundamentals and Applications. Upper Saddle River, NJ: Prentice Hall.

Son, J., Hong, S., Cheun, K., and Yang, K (2015) "Performance of multitone-frequency and quadrature-amplitude modulation over Rayleigh fading channels" IET Communication , vol. 9, no. 14, pp. 1774–1780.

Tellambura, T and Annamalai, A (2000) “Efficient computation of erfc(x) for large arguments,” IEEE Trans.Commun., vol. 48, no. 4, pp. 529–532.

Viswanathan, M (2019) Wireless Communication Systems in Matlab, Singapore.

Zayani, R Shaïek, H. Roviras,D and Medjahdi, Y (2015) “Closed-Form BER Expression for (QAM or OQAM)-Based OFDM System With HPA Nonlinearity Over Rayleigh Fading Channel” IEEE Communication. Letters, vol. 4, no. 1, pp. 38-41.

Ziemer, R.E and Tranter, W.H (1990) Principles of Communications: Systems, Modulation, and Noise, 3rd ed. Boston: Houghton Mifflin.

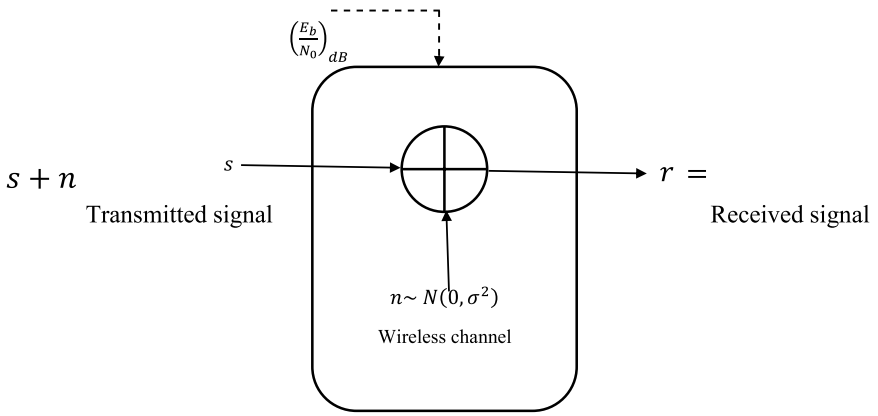


Figure 1: AWGN Channel Model - computes and adds white Gaussian noise vector for a given SNR value

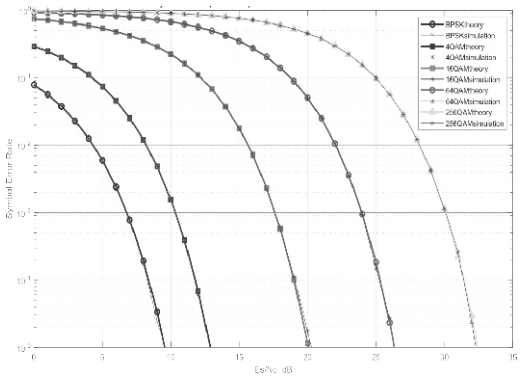


Figure 2: Comparison of theory and simulated result for BEP computation over the AWGN channel for M=2, 4,16, 64 and 256

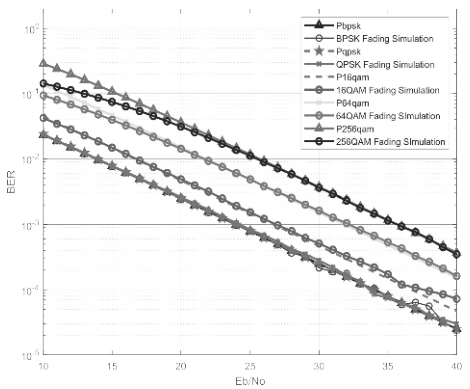


Figure 3: Comparison of theory and simulated result for BEP computation over the Rayleigh fading channel for M=2, 4,16, 64 and 256

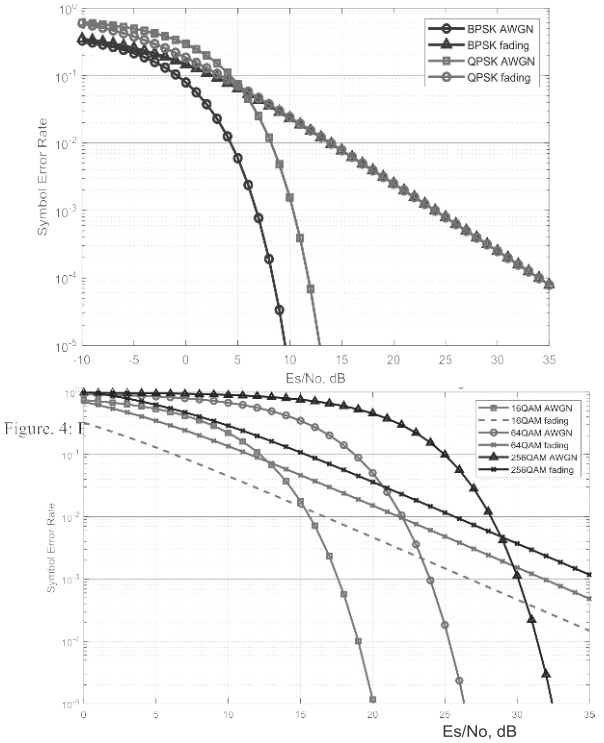


Figure. 4: F

Figure. 5: BER Vs Es/No for QAM, M= 16, 64 and 256

TABLE 1 Probability Density Function (PDF) and Moment Generating Function (MGF) of the SNR per Symbol for Some Common Fading Channels [Simon and Alouini (2000)].

Type of Fading	Fading Parameter	PDF, $\boldsymbol{\rho_\gamma(\gamma)}$	MGF, $\boldsymbol{M_\gamma(s)}$
Rayleigh		$\frac{1}{\bar{\gamma}} exp\left(-\frac{\gamma}{\bar{\gamma}}\right)$	$(1-s\bar{\gamma})^{-1}$
Nakagami-q (Hoy t)	$0 \le q \le 1$	$\frac{(1+q^2)}{2q\bar{\gamma}} exp\left[-\frac{(1+q^2)^2\gamma}{4q^2\bar{\gamma}}\right]$	$\left[1-2s\bar{\gamma}+\frac{(2s\bar{\gamma})^2q^2}{(1+q^2)^2}\right]^{-1/2}$
Nakagami-n (rice)	$0 \le n$	$\frac{(1+n^2)e^{-n^2}}{\bar{\gamma}} exp\left[-\frac{(1+n^2)\gamma}{\bar{\gamma}}\right]$	$\frac{(1+n^2)}{(1+n^2)-s\bar{\gamma}} exp\left[\frac{n^2s\bar{\gamma}}{(1+n^2)-s\bar{\gamma}}\right]$
Nakagami-m	$\frac{1}{2} \le m$	$\frac{m^m\gamma^{m-1}}{\bar{\gamma}\Gamma(m)} exp\left(\frac{m_\gamma}{\bar{\gamma}}\right)$	$\left(1-\frac{s\bar{\gamma}}{m}\right)^{-m}$
Log-normal shadowing	σ	$\frac{4.34}{\sqrt{2\pi}\sigma\gamma} exp\left[-\frac{(10\log_{10}\gamma-\mu)^2}{2\sigma^2}\right]$	$\frac{1}{\sqrt{\pi}}\sum_{n=1}^{N_\rho} H_{x_n} exp\left(10^{(\sqrt{2}\sigma x_n+\mu)/10}s\right)$
Composite gamma/log-normal	$m\ and\ 0 \le \sigma$	$\int_0^\infty \frac{m^m\gamma^{m-1}}{w^m\Gamma(m)} exp\left(\frac{m\gamma}{w}\right) \times \frac{\xi}{\sqrt{2\pi}\sigma w} exp\left[-\frac{(10\log_{10}w-\mu)^2}{2\sigma^2}\right] dw$	$\frac{1}{\sqrt{\pi}}\sum_{n=}^{N_\rho} H_{x_n}\left(1-10^{(\sqrt{2}\sigma x_n+\mu)/10}s /m\right)^{-m}$

FEDPOLAD JOURNAL OF ENGINEERING AND ENVIRONMENTAL STUDIES (FEDPOLADJEES)

PREDICTING CUSTOMERS' RESPONSES TO DIRECT MARKETING CAMPAIGNS USING SUPERVISED MACHINE LEARNING TECHNIQUES

Authors

[1]Sunday Oluwafemi Akinwamide & [2]Fele Taiwo

[1 & 2] Department of Computer Science,
The Federal Polytechnic, Ado Ekiti, Nigeria
Corresponding e-mail: akinwamide_so@fedpolyado.edu.ng
Corresponding Phone No: 08060424945

Abstract:

Direct marketing enables banks and other financial institutions to focus on those customers with the likelihood of subscribing to their products, offers, and other packages. However, identifying these group of customers poses a challenge to financial institutions. In line with the aforementioned, this study considered the typical case of bank direct marketing campaign dataset with the objective of predicting customers' responses to bank direct marketing by applying five classifiers namely: Decision Tree, Random Forest, Logistic Regression, Naive Bayes, and K-Nearest Neighbors given customer's relationship data. Prior to classification exercise, data pre-processing was carried out to ensure that there were no cases of missing values. Feature scaling was performed on the dataset to ensure that all the numbers fall within a particular range. Categorical vales were encoded and the dataset was partitioned into training and test sets in ratio 80:20. The performances of the models were evaluated using: confusion matrix table, accuracy, precision, recall, f1 score, cohen kappa score and Receiver Operating Characteristics Curve-Area Under Curve (ROC-AUC) criteria. Empirical results on Bank Marketing Dataset obtained from UCI machine learning repository showed that Logistic Regression has the best classification performance with the highest accuracy score of 91.01%, while Random Forest achieved the highest ROC-AUC of 93.81%.

Keywords: *Bank, Machine learning, Direct Marketing*

Introduction

The motive behind the establishment of any business organization is to make good profit. A well-planned marketing strategy is needed to achieve this. Generally, business organizations have many products/services through which they can make good profit. Whenever any product/service is introduced, it is very imperative to know how well acceptable it is going to be to the prospective customers. The only way of getting this done is by marketing the products/services to the target customers. The banking industry is no exception. Product introduction is one of the marketing efforts that are considered effective because banks can conduct market

analysis by utilizing the information technology space that can assist in making decisions [1].

One of the efforts made by banks to introduce products to customers is direct marketing. Direct marketing is the process of identifying possible customers to buy or use a product and promoting other products owned by the bank to pre-determine customers' segments [2]. Direct marketing can be done via telephone and direct email to prospective customers who allow the prospect to decide whether to take the product being offered or not [3]. Another benefit of direct marketing is to strengthen the relationship between banks and customers, in order to increase the business continuity of an establishment. However, sometimes marketing officers/agents might need to contact a customer or prospective customer more than once to ascertain whether the customer or prospective customers are willing to subscribe to a term deposit.

There are two major ways by which organizations advertise their products, namely: mass crusades and direct campaign. Mass crusades focuses on the overall populace. The effectiveness of mass crusades is very low, typically, under 1% of the entire populace will have a positive reaction to the mass campaign [4]. The direct campaign focuses just on a little group of people who are thought to have a higher prospect of being attracted to the product being marketed and, in this manner, would substantially be more productive to engage [5].

The choosing of these prospective customers poses a dire challenge of classification in Data Mining which rises by way of matching customer attributes (e.g., age, marital status, educational level etc.) and other characteristics (e.g., loan request/repayment etc.) to different outputs (e.g., whether or not a customer will subscribe to a term deposit).

The contribution of this study is to build a prediction model, which is suitable to predict whether a customer has subscribed to a term deposit or not, given a Portuguese Bank's telemarketing campaign data [7]. In this regard, this study applies and compares Decision Tree, Random Forest, Logistic Regression, Naive Bayes, and K-Nearest Neighbors classifiers.

The remaining part of this paper is organized as follows: Section 2 described the related work and methodology was explained in section 3. Section 4 was dedicated to the building of the classification models considered in this research while different evaluation criteria for measuring the performance of the classifiers were discussed in section 5. Experimental setup and result discussion were carried out in section 6. Lastly, conclusion and future research were discussed in sections 7 and 8 respectively.

2.0 RELATED WORK

Much research has been done using various artificial intelligence for predicting the

future results of marketing companies based on available statistics and, accordingly, formulating recommendations for such companies in the future.

In the work of [2], data mining techniques were proposed to interpret and define the important features in order to increase the campaign's effectiveness, i.e., if the client subscribes the term deposit. Two feature selection methods namely Information Gain (IG) and Chi-square methods were considered to select the important features of bank marketing dataset. The methods were compared using Naive Bayes model. The performance of the classifier was compared based on precision, recall, and F measure values and the best result was achieved with IG feature selection method with 5 features. The experimental results showed that reduced set of features can improve the classification performance. The only classifier used, i.e. Naive Bayes might not be adequate enough to give the true reflection of the classification result.

The work of [8] examined the performance of data mining models on Bank Marketing Dataset to increase the campaign effectiveness by identifying the main characteristics that affect a success (the deposit subscribed by the client) using Multilayer Perceptron Neural Network (MLPNN) and Ross Quinlan New Decision Tree Models (C5.0). The performance of the models was measured by three statistical measures: accuracy, sensitivity, and specificity. The result of the research shows that MLPNN has the highest accuracy, sensitivity, and specificity of 90.32%, 60.12% and 93.45% respectively. In the same vein, the only two models used on the dataset cannot be a true reflection of a generalized outcome.

The research of [9] made a comparison of different classification techniques of data mining to select the one with the most accurate results for classification of bank direct marketing dataset.
Four commonly used techniques consisting of J48-graft, LAD tree, radial basis function network and Support Vector Machine (SVM) were used to analyze the performance of different classification techniques. The performances are measured using sensitivity, specificity, accuracy, mean absolute error and root mean squared error. The result shows that support vector machine achieves highest accuracy, sensitivity, and specificity of 86.95%, 87.00% and 86.70% respectively. However, employing other different techniques and supervised machine learning classifiers can still yield better results.

In [10], application of sampling on the dataset to resolve the imbalance and adopting GA to select informative attributes in achieving significantly good result was proposed using a Three-Layer Perception Neural Network for the training and predicting whether a customer will subscribe a term deposit or not (target variable – y), considering Bank Marketing Dataset. The performance of the classifier was compared based on accuracy, recall, precision, and F measure values of 71% accuracy, 67.31% recall, 24.22% precision and 35.62% of F value. The Three-Layer

Perception Neural Network used here cannot achieve the best performance as there is no room for comparison with other models

The research work of [11] predicted customers' response to bank direct marketing and identified the key features of customers who subscribed and are most likely to subsequently subscribe to term deposits. Multilayer Perceptron Neural Network (MLPNN), Decision Tree (C4.5), Logistic Regression and Random Forest (RF) were applied to predict customers' response to bank direct marketing while cluster analysis was carried out to identify the key features of customers who are most likely to subscribe to term deposits using Direct Marketing Campaign of a Portuguese Banking Institution Dataset. Evaluation of the classifiers was performed using classification accuracy and ROC. The RF classifier produced 86.80% as well as 92.7% respectively to place first among the classifiers while the results from the cluster analysis revealed that, customers on whom more call durations are spent on present a higher likelihood of subscribing to the term deposit. In addition, customers with a minimum of secondary school education are good prospects to be targeted for the bank term deposit subscriptions. Many other performance evaluation metrics apart from accuracy and ROC can be used to achieve better output.
The work of [4] proposed a personal and intelligent Decision Support System using data mining approach for the selection of bank telemarketing clients to model the success of subscribing a long-term deposit using attributes that were known before the telemarketing call was executed while analyzing Portuguese Bank Dataset. Logistic Regression, Decision Tree, Neural Network and Support Vector Machine algorithms were employed. These models were compared using two metrics, i.e., area of the receiver operating characteristic curve (AUC) and area of the LIFT cumulative curve (ALIFT). For both metrics and phases, the best results were obtained by the NN, which resulted in an AUC of 0.80 and ALIFT of 0.67. The outcome of this research can be improved upon by engaging other classifiers such as ensemble techniques.

Association rule mining was proposed in [12] to improve Naïve Bayes classifier using bank marketing dataset. The association phase results showed higher scores of true positive and true negative together with very low scores of false positive and false negative when compared with classic phase result. The results of the performance metrics i.e., true positive, true negative false, positive and false negative together with only classification model i.e., Naive Bayes used in this work are not enough to produce a generalized result of classification.

In [13], Bank Marketing Dataset was one of the three popular datasets used to evaluate and compare the accuracy and performance of Random Forest (RF), Support Vector Machines (SVM), K-Nearest Neighbors (KNN), and Linear Discriminant Analysis (LDA). The result of the dataset with and without essential features selection by RF methods varImp(), Boruta, and Recursive Feature

Elimination (RFE) were compared to get the best percentage accuracy and kappa. Experimental results demonstrated that Random Forest achieves the best performance accuracy of 90.99%, precision of 91.22% and recall of 98.10% with 7 features in all experiment groups. However, using different methods of classification and feature selection techniques can still give room for better results.

The main goal of 14] was to find the most appropriate model by comparing several data mining methods for classifying customers' responses to direct telephone marketing to ascertain whether a customer or prospective customer is willing to subscribe to a product or service using Bank Marketing dataset. SMOTE pre-processing technique was employed to eliminate the class imbalance problem in Bank Marketing dataset before the actual classification using Naïve Bayes, K-NN, Random Forest, SVM, J48 and AdaBoost. Evaluation of the experiment was carried out using accuracy, True Positive Rate, recall, precision and F measure. From the result, it was obtained that Random Forest method has the highest performance in all the evaluations stated earlier. The introduction of SMOTE in this work increased the number of data instances which eventually led to increase in computation time. Instead of SMOTE, attribute selection methods can be used to reduce computation time and increase the accuracy value.

Re-sampling technique was adopted in [15] to deal with the imbalance of Bank Marketing Dataset and three classifiers were applied; Logistic regression, Support Vector Machine, and K-Nearest Neighbors. Comparative analysis was performed using correlation heatmap to identify the main factors that can increase customer subscriptions to a term deposit. Of all the algorithms used, KNN has the best performance with the accuracy of 91.8%. However, this research can further be enhanced by using other techniques like univariate selection and feature importance on the dataset to identify more factors that can influence customer's decision to subscribe to a term deposit in the bank.

The work of [16] proposed to find the number of bank customers who have subscribed for a scheme through different data mining techniques such as Decision Tree (DT), Naïve Bayes, Neural Networks (NN), KNN and Support Vector Machine (SVM) to determine the level of acceptability of the scheme. Among all these techniques SVM gives highest accuracy of 90.35%. This research can better be enhanced by implementing various feature selection process on classification techniques and using latest machine learning models.

Ref. [17] compared the classification performance of Bank Marketing dataset using Adaboost, Bagging and J48 as a base learner. Data balancing was firstly carried out on the dataset followed by Wrapper subset evaluation feature selection. The outcome of the experiment showed that Bagging has the highest accuracy of 86.6% followed by J48 having 85.9% and the lowest results was obtained by Adaboost, 83.5%. It is

obvious that wrapper subset evaluation feature selection method used in this work does not provide significant results, so it is necessary to try using other feature selection methods such as Correlation-Based Feature Selection. Furthermore, Adaboost with J48 as a base classifier does not give good results because J48 is a strong learner. The technique used for data balancing was also not specified.

The implementation of a neural network in bank marketing data was performed in [18] using data encryption to train the model, and compare the results with other classification methods. However, the final result still got a fairly low accuracy of 54% owing to the fact that feature selection process was not carried out in this study.

All the reviews presented here above specified the need for further research based on highlighted limitations among others that affets the classification of the models. Hence, the need for this study arises.

3.0 METHODOLOGY

3.1 Description of dataset

The dataset consists of direct marketing campaigns data of a Portuguese banking institution downloaded from UCI Machine Learning Repository [7]. There were four variants of the datasets out of which we chose “bank-additional-full.csv”, consisting of 41,188 instances and 21 features as shown in Table 1 below, classified into 10 numeric features and 11 categorical features with no missing values. Conducted campaigns were based mostly on direct phone calls, offering bank's clients to place a term deposit. If after all marking efforts, customers agree to place a deposit, target variable is marked 'yes', otherwise 'no'.

Table 1: Dataset Feature Description

S/N	Feature	Data Type	Data Value/Description
Bank Client Data			
1.	age	numeric	integer
2.	job	categorical	admin., blue-collar, technician, services, management, retired, entrepreneur, self-employed, housemaid, unemployed, student & unknown
3.	marital	categorical	married, single, divorced & unknown
4.	education	categorical	university.degree, high.school, basic.9y, professional.course, basic.4y, basic.6y, unknown & illiterate
5.	default	categorical	no, unknown & yes
6.	housing	categorical	yes, no & unknown
7.	loan	categorical	no, yes & unknown
Related with the last contact of the current campaign			
8.	contact	categorical	cellular & telephone
9.	month	categorical	may, jul, aug, jun, nov, apr, oct, sep, mar & dec,

10.	day_of_week	categorical	thu, mon, wed, tue & fri
11.	duration	numeric	last contact duration, in seconds
Other attributes			
12.	campaign	numeric	number of contacts performed during this campaign and for this client (includes last contact)
13.	pdays	numeric	number of days that passed by after the client was last contacted from a previous campaign (999 means client was not previously contacted)
14.	previous	numeric	number of contacts performed before this campaign and for this client
15.	poutcome	categorical	nonexistent, failure & success
Social and Economic Context Attributes			
16.	emp.var.rate	numeric	employment variation rate - quarterly indicator
17.	cons.price.idx	numeric	consumer price index - monthly indicator
18.	cons.conf.idx	numeric	consumer confidence index - monthly indicator
19.	euribor3m	numeric	euribor 3 month rate - daily indicator
20.	nr.employed	numeric	number of employees - quarterly indicator
Output variable (desired target)			
21.	y	binary	'yes' & 'no'

3.2 Data Preprocessing

(i). Scaling of Numeric Data: Feature scaling is an important step of data pre-processing in machine learning. Here in this work, standardization scaling technique was used to standardize the independent variables of the dataset in a specific range. In feature scaling, the variables are put in the same range and in the same scale so that no any variable dominate the other variable. A machine learning model is based on Euclidean distance, and if the variable is not scaled, then it will cause some issue in the machine learning model.

The scaling was done using the formula below:

$$x' = \frac{x - mean(x)}{a} \quad (1)$$

where x' = new value, x = original value, mean(x) = mean and a = standard deviation

(ii). **Encode Categorical Value**: The performance of a machine learning model not only depends on the model and the hyper-parameters, but also on how we process and feed different types of variables to the model. Since most machine learning models only accept numerical variables, encoding categorical variables becomes a necessary step. We converted these categorical variables to numbers using Label Encoding and One Hot Encoding such that the model is able to understand and extract valuable information.

(iii). **Splitting of Data**: Bank Marketing Dataset was split into two categories consisting of 80% (32,950 instances) of the dataset to train the models and the remaining 20% (8,238 instances) to evaluate the performance of the models.

4.0 BUILDING OF CLASSIFICATION MODELS

Here, using 80% of the whole dataset as training set and the remaining 20% as test set, five different classifier models including: Decision Tree, Random Forest, Logistic Regression, Naive Bayes, and K-Nearest Neighbors were trained to build models and their predictions were taken and compared to detect which of the models has the highest performance metrics.

(i). Decision Tree

Decision tree uses divide and conquer approach to construct a decision rule for solving classification problems using information gain ratio which avoids the bias of selecting attributes with many values [19]. In data mining classifications learning, the goal of prediction using decision tree algorithm is to learn a mapping function from input variable *x* to output variable *c*, given a labeled set of input-output pairs as:

$$D = \{(x, c)\}_{i=1}^{N} \quad (2)$$

In equation (2), D is called the training set, and N is the number of training samples. In the simplest setting, each training input x is a D-dimensional vector of numbers, which are called features or attributes. Also the response variable c is the class output variable. Decision tree makes its classification using information gain which is a measure of the differences in entropy from before to after the current set S for which entropy is calculated is split on an attribute A. Therefore, in order to make classification, the attribute with the highest information gain is seen as the best classifier for making decision, and this is calculated as:

$$Entropy\ H(S) = -\sum_{i=1}^{n} p(C)\ log_2\ p(C) \quad (3)$$

where H(S) = entropy of current set, C = set of classes 0 and 1, n = number of attributes

Accordingly, the information gain by a training dataset is defined as:

$$Info\ Gain(S) = H(S) - \sum_{i=1}^{n} \frac{|Si|}{|S|} H(S) \quad (4)$$

where (S) is the number of cases in s and is the number of cases in partition i,

(ii). Random Forest Algorithm

Random forest algorithm is a supervised classification algorithmic technique. In this algorithm, several trees create a forest. Each individual tree in random forest lets out a class expectation and the class with most votes turn into a model's forecast. In the random forest classifier, the more number of trees give higher accuracy. The three common methodologies are:

i. Forest RI (random input choice);
ii. Forest RC (random blend);
iii. Combination of forest RI and forest RC.

It is used for classification as well as regression task, but can do well with classification task, and can overcome missing values. Besides, being slow to obtain predictions as it requires large data sets and more trees, results are unaccountable.

(iii). **Logistics Regression (LR)**
Calculated regression was for the most part utilized in natural research and applications in the mid-20th century [20]. Logistic regression can deal with any number of numerical as well as absolute factors. In addition, it introduces a discrete parallel item somewhere in the range of 0 and 1. Strategic regression processes the connection between the element factors by surveying probabilities (p) utilizing an underlying logistic function. Regression equation given as:

$$p = \frac{1}{1+ e^{-(b_0 + b_1 x_1 + \ldots + b_n x_n)}} \quad (5)$$

(iv). **Naive Bayes.**
Naive Bayes algorithm is a Bayesian Classifier derived from the Bayes theorem. It is a fast-training algorithm for modeling and solving classification problems [21]. The basic idea of naive Bayes as a data mining algorithm can be explained as thus:

Given a set of N samples D = {D_1, D_2..., D_n}(training data set) where every sample D is represented as an n-dimensional vector {X_1, X_2, …, X_n}value correspond to the attribute A_1, A_2, …, A_n respectively, provided there are K classes C_1, C_2 where every sample belong to any of these classes. If there is an additional sample D (unseen sample). The class for D can be predicted using the class with the highest posterior probability.

The basic relation of Bayes theorem is given as:

$$P(C/A) = \frac{P(A/C) * P(C)}{P(A)} \quad (6)$$

where P(A) is constant for all classes, only the product P(A/C) * P(C) will be maximized.

Using the assumption of conditional independence, the estimate class is given as:

$$\text{Estimate} = \text{argmax}P(C). \prod_{t=1}^{n} P(A/C) \quad (7)$$

where A = attribute values of the dataset sample, C = class.

(v). K-Nearest Neighbor (KNN)
The *k*-nearest neighbor (*k*-NN) classifier is a non-parametric classifier used to classify an unknown instance represented by some feature vectors as a point in the feature space that measures the distance between two data points in the training data set [22].

KNN use metrics such as Euclidean distance, Minkowski distance and Manhattan distance as metric system. The research used Minkowski distance as the distance metric for classifying the nearest distance. It can further be expressed as:

$$D(x_i, x_j) = \left(\sum_{i=1}^{d} |x_i l - x_i j|^{\frac{1}{k}}\right)^3 \quad (8)$$

where $x_i l$ = instances, $x_i j$ = test set, l = row number of instances, k = constant

5.0 EVALUATION CRITERIA

In this work, we used five machine learning models to predict whether a customer will subscribe a term deposit or not given customer relationship data. Therefore, the performance measurements of the classifiers were appraised by different statistical procedures, including Confusion Matrix table as shown in Table 2, Accuracy, Precision, Recall, F1 Score, Cohen Kappa Score and Area Under Curve (AUC) [23].

(i). **Confusion Matrix Table**: A confusion matrix table is a technique for summarizing the performance of a classification algorithm.

Table 2: Confusion Matrix

		True Class	
		Positive	**Negative**
Predicted Class	**Positive**	TP	FP
	Negative	FN	TN

where: TP = True Positive; FP = False Positive; TN = True Negative; FN = False Negative.

- True Positive (TP): Number of positively predicted class that is actually (correct) positive
- True Negative (TN): It reflects the number of positively predicted class that is actually (correct) negative
- False Positive (FP): Number of incorrectly classified positive class
- False Negative (FN): Number of incorrectly classified negative class

(ii). **Accuracy**: This is the proportion of true results among the total number of cases examined.

$$\text{Accuracy} = \frac{TP+TN}{TP+TN+FP+FN}$$

(iii). **Precision**: Precision is used to calculate how much proportion of all data that was predicted positive was actually positive.

$$\text{Precision} = \frac{TP}{TP+FP}$$

(iv). **Recall**: Recall is used to calculate how much proportion of actual positives is correctly classified.

$$\text{Recall} = \frac{TP}{TP+FN}$$

(v). **F1 score**: This is a number between 0 and 1 and is the harmonic mean of precision and recall.

$$\text{F1 Score} = \frac{2TP}{2TP+FP+FN}$$

(vi). **Cohen Kappa Score**: Cohen kappa measures the agreement between two raters who each classify N items into C mutually exclusive categories.

$$k = \frac{P_0 - P_e}{1 - P_0}$$

where P_o is the empirical probability of agreement on the label assigned to any sample (the observed agreement ratio), and P_e is the expected agreement when both annotators assign labels randomly. P_e is estimated using a per-annotator empirical prior over the class labels.

(vii). **Area Under Curve (AUC)**: It indicates how well the probabilities from the positive classes are separated from the negative classes

6.0 EXPERIMENTAL SETUP AND RESULTS DISCUSSION

The Bank Marketing Dataset consists of 41,188 instances made up of 4,640 customers that subscribed to a term deposit and 36,548 did not. The training set consists of 80% of each instances of both class which was used to build the models and the remaining 20% of each instances of both class was used in determining the performance of the classification of the individual models. The implementation was carried out using python programming language.

Table 3: The confusion matrix table of the classification models

	LR	RF	KNN	DT	NB
TP	7,084	7,068	7,016	6,837	6,182
TN	413	419	404	507	633
FP	210	226	278	457	1,112
FN	531	525	540	437	311

Table 4: The performance comparison of five supervised machine learning classifiers

Model	Accuracy	Precision	Recall	F1 Score	Kappa	AUC
LR	0.9101	0.6629	0.4375	0.5271	0.4797	0.9342
RF	0.9088	0.6496	0.4436	0.5274	0.4789	0.9381

KNN	0.9007	0.5924	0.4280	0.4969	0.4434	0.8632
DT	0.8915	0.5259	0.5371	0.5314	0.4701	0.7372
NB	0.8273	0.3628	0.6706	0.4708	0.3784	0.8354

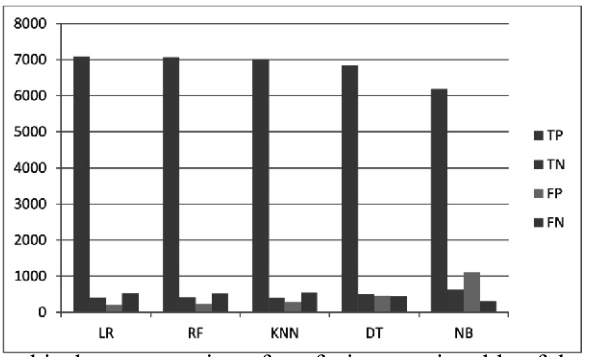


Figure 1: Graphical representation of confusion matrix table of the classification models

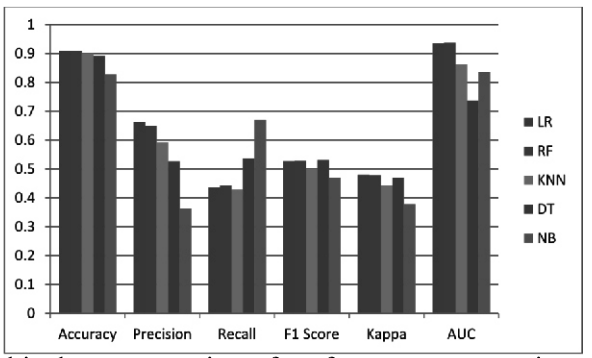


Figure 2: Graphical representation of performance comparison of five classifiers

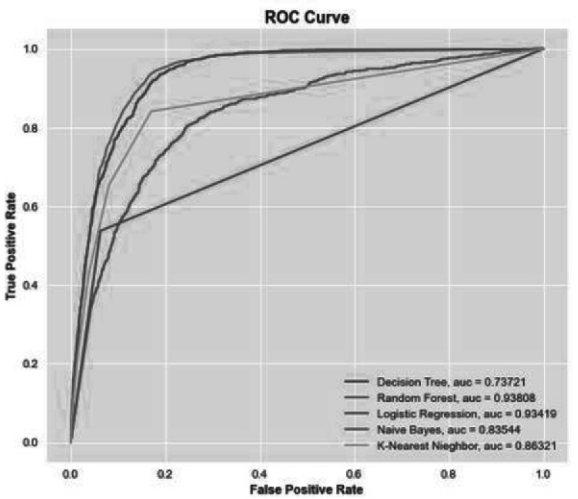


Figure 3: Receiver Operating Characteristic Curve (ROCC)

Tables 3 and 4 show the confusion matrix and performance comparison of five supervised machine learning classifiers considered in this research work while figures 1, 2 and 3 display the graphical representation of confusion matrix table, performance comparison of the five classifiers and Receiver Operating Characteristics Curve (ROCC) respectively.

According to Table 4, Logistic Regression being a fast training and robust classifier has the best classification performance with the highest accuracy, precision and kappa score of 91.01%, 66.29% and 47.97% respectively. Naïve Bayes has the highest recall of 67.06%, Decision Tree recorded highest f1 score of 53.14% and Random Forest achieved the highest AUC (Area Under the Curve) for ROC of 93.81% as also shown in figure 3.

7.0 CONCLUSION

The contribution of this study is to build a prediction model, which is suitable to predict whether a customer has subscribed to a term deposit or not, given a Portuguese Bank's telemarketing campaign data. In this regard, this study applies and compares Decision Tree, Random Forest, Logistic Regression, Naive Bayes, and K-Nearest Neighbors classifiers. However, the highest accuracy among all the different classification techniques used was Logistic Regression. We therefore recommend Logistic Regression technique to be used in this kind of prediction regarding classification problems.

8.0 FUTURE RESEARCH

In our subsequent research work, we intend to improve on this work by employing ensemble techniques to enhance the classification performance of the models.

REFERENCES

Abbas S., “Deposit subscribe Prediction using Data Mining Techniques based Real Marketing Dataset,” Int. J. Comput. Appl., 2015

Parlar, T., & Acaravci, S. K. (2017). Using Data Mining Techniques for Detecting the Important Features of the Bank Direct Marketing Data, 7(2), 692–696

Moro S., Laureano R. M. S., and Cortez P., “Using data mining for bank direct marketing: An application of the CRISP-DM methodology,” ESM 2011 - 2011 Eur. Simul. Model. Conf. Model. Simul. 2011, no. Figure 1, pp. 117–121, 2011

Moro, S., Cortez, P., & Rita, P. (2014). A data-driven approach to predict the success of bank telemarketing. Decision Support Systems. http://doi.org/10.1016/j.dss.2014.03.001

Apampa, O. (2016). Evaluation of Classification and Ensemble Algorithms for Bank Customer Marketing Response Prediction. Journal of International Technology and Information Management, 25(4), 6.

Balaceanu, V. A. (2011). Promotional Strategies Direct Marketing and Technological

Innovations in Banking. Journal of Knowledge Management, Economics and Information Technology, 1(7)

Direct marketing campaigns dataset of a Portuguese banking institution. https://archive.ics.uci.edu/ml/datasets/bank+marketing

Hany. A. Elsalamony and Alaa. M. Elsayad, (2013) "Bank Direct Marketing Based on Neural Network". International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-2, Issue-6, August 2013

Wisaeng, K. (2013). A Comparison of Different Classification Techniques for Bank Direct Marketing, (4), 116–119

Yitong Chen, (n.d.) "Analysis of applying Genetic Algorithm to Simple Neural Network Based on Bank Direct Marketing Dataset"Justice Asare-Frempong and Manoj Jayabalan, (2017) Predicting Customer Response to Bank Direct Telemarketing Campaign. 2017 International Conference on Engineering Technology and Technopreneurship (ICE2T)

Yang, T., Qian, K., & Lo, D. C. (2016). Improve the Prediction Accuracy of Naïve Bayes Classifier with Association Rule Mining, 0–4. http://doi.org/10.1109/BigDataSecurity-HPSC-IDS.2016.38

Big, J., Chen, R. C., Dewi, C., Huang, S. W., & Caraka, R. E. (2020). Selecting critical features for data classification based on machine learning methods. Journal of Big Data. http://doi.org/10.1186/s40537-020-00327-4

Fitriani, M. A., and Febrianto, D. C. (2021). Data Mining for Potential Customer Segmentation in the Marketing Bank Dataset, 9(1), 25–32

Jamiu Olalekan Oni (2020). Exploratory Analysis of Bank Marketing Campaign using Machine Learning; Logistic Rregression, Support Vector Machine and K-Nearest Neighbour. M.Sc Research Project. (Fintech). School of Computing, National College of Ireland

Vaishnavi S., Gattu Divya Lakshmi, Dandu Vinisha Reddy and Majeti Satya Naga Sulochana (2020) Predicting The Success of Bank Marketing using Classification

Techniques. Journal for Research, Volume 06, Issue 6, August 2020. ISSN: 2395-7549

Agus Priyanto and Rila Mandala (n.d). "Comparison of Adaptive Boosting and Bootstrap

Aggregating Performance to Improve the Prediction of Bank Telemarketing". IT for Society, Vol. 05, No. 02. ISSN 2503-2224

Zhang J., "Analysis of Neural Network on Bank Marketing Data Dataset Pre-processing," Coll. Comput. Sci., 2018

Oded, M., and Lior, R. (2010). Data Mining and Knowledge Discovery Handbook. Introduction To Knowledge Discoveries and Data Mining. Isreal: Springer, pp.1-15

Logistic Regression, Retrieve from: https://www.saedsayad.com/logistic_regression.htm Last Accessed: 16 April, 2022

Kaviani, p., and Dhotre (2017). Short Survey on Naive Bayes Algorithm. International Journal of Advance Engineering and Research, 4(11), pp. 607-611

Wang,Y.,Leung,R.,Ma,R.,Luk,A.,Lam,V.,So,W.,Tsui,S.,Ng,M., and Chan,J. (2013). Using a Small Stage Strategy Based on Machine Learning and Mathematical Modeling to Predict Genotype Risk Pattern in Diabetic Kidney Disease: A prospective Case-contro Cohort Analysis, 5(7), pp. 1-9

Classification - Bank Marketing Dataset https://colab.research.google.com/github/rafiag/DTI2020/blob/main/004_Classification_Bank_Marketing_Dataset_(Assignment).ipynb#scrollTo=xL-Nk3m_eQsX

FEDPOLAD JOURNAL OF ENGINEERING AND ENVIRONMENTAL STUDIES (FEDPOLADJEES)

ENABLING Internet of Things (IoT) TECHNOLOGIES FOR CATTLE MONITORING AND MANAGEMENT

Authors

[*1]Bamisaye' A.J, [2]Folowo S.D and [3]Adewale A.S

[1,2,3]Department of Electrical and Electronic Engineering
The Federal Polytechnic, Ado-Ekiti, Nigeria
Corresponding e-mail: ayobamisaye@gmail.com
Corresponding Phone No.: 2347033657792

Abstract:

Internet of Things (IoT), is one of the leading technologies in industry, businesses, agriculture, etc. IoT means the network of things that communicate through the internet. Because of the vastness of the concept of IoT, it has gained attention and usable almost in any field of interest. Cattles are one of the largest sources of meat in the world, and if there is going to be a way to analyse the state of a cow, monitor their patterns, and take accurate records without human supervision perse, the implementation of IoT may be our best option at the moment. The results obtained in terms of the longitude, latitude, and time are parsed in the microcontroller such that only the relevant values are seen. The exact location can be found with the aid of Google maps services. The GPS module has an accuracy of 2.5m.

Keywords:*Technologies, IoT, GPS, cow, accuracy*

Introduction

Animal detection and animal counting are the two tasks stated by Van Gemert et al, 2014. To examine these chores, they employed a quad-copter drone to physically document and clarify a new dataset. To tally animals, the three-liteweight object identification algorithm was employed, and outline-based detections were blended with point tracks recorded by the KLT tracker. Furthermore, the frameworks for monitoring dairy cattle offered by several experts included deep learning-based models, which produced good results (Tiwari, et al 2021).

Execution, on the other hand, was hampered by the presence of large groups or noticeable movement. (Barbedo et al, 2020) proposed a four-pronged approach to livestock inspection. Defining the area of interest comes first, then animal segmentation using color, bunch detachment, and then picture coordination to address picture overlap. (Wen Shao et al., 2020) developed a Convolution Neural Network (CNN)-based framework called YOLOv2 to quickly and accurately identify

the number of cows in various pictures. Okinda et al, 2020 address recent advances in poultry observation tactics and provide deep learning approaches to chicken monitoring. In an application of a computer vision system, domestic animals (e.g., cows, sheep, poultry, and so on) are monitored by cameras placed at long-term locations, such as roofs and walkways, or on mobility equipment, such as rail systems, ground robots, and drones. Some recording equipment, such as a network video recorder or a mechanized video recorder, is used to gather images or, on the other hand, accounts from multiple perspectives, such as top view, side view, or front view, and various types of accounts (like RGB, profundity, warm, and so forth). Narratives are saved and rearranged to prepare units for further investigation. Unit-based models are utilized to collect interesting data and anticipate positive outcomes, and they serve as the middle segments of the PC vision architecture (Li, et al, 2021). As at year 2012, cows and buffalo contribute 16.5% to the world meat supply (FAO, 2021). Aside from cattle's primary benefit, cattle by-products also involve Cosmetics, Sandpaper, Film, Buttons, Leather, Violin Strings; Medicines for: Insulin and Cholesterol. And many more products (Kamalika, 2021). However, their factors that affect the rate of productivity in cattle farming. Factors like the state of the animal's heart, availability of grazing land and water, pest, and diseases. Also, it is vital to be able to control how and where the cattle graze. There have also been cases of missing cattle to identify poor heart conditions quickly, to prevent the spread of diseases, to know precisely where the cattle are, this where IoT comes in.

Following the growth of items in the inventory network, an IoT (Internet of Things) was proposed in 2003 (Manuj et al, 2015). The Internet of Things (IoT) serves as a link between physical items and technical devices, and it is often referred to as the Context of Things (Datta and Sharma, 2017). The benefits of IoT are undeniable in all sectors of life. With the help of the omnipresent framework, a variety of tasks from the real world can be completed. Huge efforts are being made to integrate sensor data into communal data while maintaining the high value of semantic mix and data entropy. IoT is a platform for things like sensors, actuators, data acquisition devices to connect and talk to each other and/or talk to a remote server using the internet protocol for communication. With each cow wearing an IoT device, there can be improvements on the downsides of cattle management and rearing.
Data that are peculiar to cattle involves temperature, heart rate, feeding pattern, rest pattern. Monitoring heart rate, blood pressure, respiratory rate, digestion level, and other vitals helps farmers stay up to date with their cattle's health (Danielle, 2021).Also, with the addition of location service, the farmer can know if any cattle is not within the permissible range of grazing. This will allow the farmer to take quick measures.

2.0 MATERIALS AND METHODS

In order to measure the parameters in consideration: the heart rate, activities like feeding and resting pattern, number of steps taken per period, and location, different

sensors will be used at specific points on the cattle (figure 1), preferably a collar around the neck. Measuring the animal's temperature would require that the thermometer be inserted through the anus to the rectum of the animal. Since no accurate measurement of temperature can be taken from the skin of the animal, the measure of temperature will not be considered.

2.1 Measuring Heart Rate

The method of measuring the heart rate of the cattle is Electrocardiography (ECG or EKG). An electrocardiogram is a painless and a quick test to gauge the electrical activity of the heart. The electrical impulse that causes each heartbeat passes from the top of the heart to the bottom. (https://www.nadis.org.uk/disease-a-z/cattle/the-healthy-cow/, 2021).

ECG uses at least two electrodes to measure the potential difference of the heart's electrical signal. This signal can be amplified, processed and recorded for observation. A typical ECG chart is shown in figure 2. The difference in time between the two peaks is proportional to the heart rate. If the number of peaks is counted within a period of 60 seconds, the cattle's heart rate will be given in beats per minute. The heart rate of an adult cow ranges from 48 to 84 beats per minute. An increased heart rate can be an indication of discomfort and is associated with a number of disorders. (Masafumi and Kazato, 2015).

To use ECG in cattle, two electrodes are placed on the right and left anterior thorax of the animal, which is regarded to be the appropriate point for heart rate measurement for ruminants [6]. It is proven that when the points to which the electrodes will be placed on the cattle are shaved before fixing the electrode, proper conduction will be the result (www.sparkfun.com/products/12650, 2021).

The AD8232 (figure 3) ECG amplifier will amplify the ECG signals measured from the electrode. The AD8232 is a neat small chip that measures the electrical activity of the heart. An ECG can be used to chart this activity. The integrated signal conditioning block for ECG and other biopotential measurement applications is the AD8232. In the event of noisy situations, such as those created by motion or the deployment of remote electrodes, it is intended to extract, amplify, and filter tiny biopotential signals. (https://extension.psu.edu/heat-detection-and-timing-of-insemination-for-cattle, 2021).

The IC of the AD8232 Heart Rate Monitor is divided into 9 connections, to which solder pins, cables, or other connectors can be connected. Important pins for using this monitor with an Arduino or equivalent development board include SDN, LO+, LO-, OUTPUT, 3.3V, and GND. On this board, there are also RA (Right Arm), LA (Left Arm), and RL (Right Leg) pins for using the customized sensors. Additionally, there is an LED indicator light that will pulsate to the rhythm of a heartbeat.

2.2 Activities of the Cattle

Measuring the physical activities of the cattle can suggest a healthy or an unhealthy pattern. It can also be used to indicate that the cattle is on her oestrus period. The oestrus period of a cattle is so narrow. Cows do have a small fertility window when they are in heat. This can be as small as eight hours a month (Kamalika, 2021). If they are not inseminated within this period, the chance of conception is low. Cows going through their periods are more agitated and aware of their environment. When allowed to interact with other cattle, cows in heat and those who are "proestrus" continuously lag behind to try to mount other cows. Cows in heat rest less frequently than their nonestrous herdmates, according to research. While their herdmates are sleeping down and taking a break, they remain alert and standing before and during heat. For cows with stanchioning, this is more obvious. Estrus might cause cows to bellow more frequently. Cows displaying these behaviors should be closely observed for standing behavior even though these are not definitive symptoms of heat. (https://learn.sparkfun.com/tutorials/accelerometer-basics/all, 2021).

In other to detect heat in cattle, an accelerometer and infra-red proximity sensors are used to measure activities like standing, walking, and running, lying down or feeding. The static or dynamic forces of acceleration are sensed by accelerometers, which are electromechanical devices. Gravity is a static force, whereas movement and vibration are examples of dynamic forces. One, two, or three axes can be used by accelerometers to measure acceleration. The accelerometer can be used to determine the number of steps, the speed (https://www.loc.gov/everyday-mysteries, 2021) as shown in figure 4.

2.3 How Accelerometers Work (as in the case of man)

Figure 5 shows a single step, which is a single cycle of walking behavior. It shows how each stage of the cycle of walking corresponds to a change in vertical and forward acceleration. (https://www.gps.gov/technical/ps/2008-SPS-performance-standard.pdf, 2021).

The conventional arrangement of x, y, and z measurements corresponding to the vertical, forward, and side acceleration of a runner is shown in Figure 5. Depending on how the pedometer is worn, at least one axis will experience periodic acceleration changes that are comparatively large. As a result, peak detection and a dynamic threshold-decision algorithm for acceleration on all three axes are essential for identifying a unit cycle of walking or running.

2.4 Algorithm

Steps Parameter

Digital Filter: First, a digital filter is required to smooth the signals displayed in Figure 6. Figure 7 displayed that four registers and a summing unit can be utilized. Obviously, more registers could be used to make the acceleration data smoother, but the response time would be slower. The filtered data from the most useful axis of a

pedometer worn by a walker are shown in Figure 8. For a runner, the peak-to-peak rate would be higher. Dynamic Threshold and Dynamic Precision: Every 50 samples, the system automatically changes the highest and lowest 3-axis acceleration values. The average value, (Max + Min)/2, is referred to as the dynamic threshold level. This threshold level is used to determine whether actions have been done for the succeeding 50 samples. The threshold is dynamic and is changed every 50 samples. This selection is adaptive and sufficiently fast. Dynamic precision is also applied in addition to dynamic threshold for additional filtering as presented in Figure 9.

To decide whether an actual step has been taken, a linear shift register, and the dynamic threshold are employed. A sample new register and a sample old register are the two registers in the linear-shift register. Sample new and Sample old, respectively, are the names of their data. Sample new is unconditionally relocated to the sample old register when a new data sample is received. However, whether the sample result is shifted into the sample new register or not depends on the following: If the acceleration changes are greater than a predefined precision, the most recent sample result, sample result is shifted to the sample new register; otherwise, the sample new register will not change. The choice will be more accurate as a result of the shift register group's ability to remove the high-frequency noise. When the acceleration curve crosses below the dynamic threshold and the slope of the acceleration plot is negative (sample_new < sample_old), a step is said to have occurred.

Peak Detection: Depending on whatever axis' acceleration change is the biggest, the step counter computes the stages from the x-, y-, or z-axis. A very slight variation in acceleration will be ignored by the step counter. This approach allows the step counter to function properly, but occasionally it appears to be overly sensitive. When the pedometer vibrates very quickly or very slowly due to something other than walking or running, the step counter will also count it as a step. However, such unpleasant vibrations must be disregarded in order to identify the real rhythmic steps. To remedy the issue, a time window and count regulation are used.

To eliminate the useless vibrations, a time window is used. People can supposedly walk as slowly as one step every two seconds and run as quickly as five steps per second. As a result, the time gap between two legitimate steps is defined as [0.2 s to 2.0 s]; any steps with intervals outside of this range should be abandoned. A 50-Hz data rate is used by this algorithm (20 ms). The number of data updates during the course of the two steps are kept in a register called interval. The time between two steps is presumed to be inside the valid window if the value of interval is between 10 and 100; otherwise, the interval is outside the window, and the step is invalid.

Steps' membership in a rhythmic pattern is determined by count regulation. As a result, there are two operational states for the step counter: searching regulation and found out regulation. The step counter operates in searching regulation mode when it

first activates. Let's say there is regulation after four consecutive stages that are still valid. The result is then updated and shown, and the step counter will operate in determined regulation mode. When operating in this manner, the step count would be updated following each legitimate step. The step counter will switch back to searching in the regulation mode and look for four consecutive legitimate steps if even one invalid step is discovered.
The algorithm flowchart for the step's parameter is shown in Figure 10.

2.5 Distance Parameter

Following the algorithmic computation of the steps parameter as shown in figure 10, equation 1 can be utilized to get the distance parameter.

Distance = number of steps × distance per (1)

The distance covered in each step depends on the user's height and speed. If the user is taller or moving more quickly, the step length will be longer. Every two seconds, the reference design updates the distance and speed parameter. Therefore, we measure the current stride length using the steps that are counted every two seconds. The experimental information utilized to assess the current stride is displayed in Table 1. The amount of samples can be used to precisely compute an interval of 2 s. The CPU may transmit the appropriate command to the PC every 100 samples when the data rate is 50 Hz. Every 2-s interval begins with a variable recording the step count, and every 2-s interval ends with a different variable recording the step count. The steps per second are then determined by subtracting the previous value from the most recent value.

Despite the fact that the data rate is 50 Hz, the on-chip FIFO of the ADXL345 eliminates the requirement for the CPU to read the data every 20 ms, hence lessening the stress on the host processor. Bypass, FIFO, stream, and trigger are the buffer's four operating modes. Data from measurements made along the x, y, and z axes are saved in FIFO mode. The watermark interrupt is set once the number of samples in FIFO equates the level stipulated in the samples bits of the FIFO_CTL register. People can move as quickly as five steps per second, so to display the real-time result, the result should be refreshed every 0.2 seconds. The ADXL345 only needs to provide data every 0.2 seconds, and the processor can be prompted by a watermark interrupt. The FIFO can communicate the events prior to the interrupt by using trigger mode. The remaining FIFO functions will not be addressed further because the proposed solution does not make use of them.

Speed Parameter:
Speed = distance/time, so steps per 2s and stride have all been determined using the aforementioned approach; therefore, the speed parameter can be obtained using Equation 2.

Speed = steps per 2 s × stride/2 s ------- (2)

By carefully positioning the accelerometer on the right spot of the cattle, the same

calculations that applies to using it for a man can apply to the cattle with little or no error

Monitoring the speed, the number of steps a cattle has taken over time can help suggest an oestrus cycle.

2.6 Determining the Location

The United States government and the United States Space Force, respectively, own and operate the satellite-based Global Positioning System (GPS) (https://www.loc.gov/everyday-mysteries/item/what-is-gps-how-does-it-work, 2021). One of the Global Navigation Satellite Systems (GNSS), it provides geolocation and time data to a GPS receiver whenever there is a clear line of sight to four or more GPS satellites on or near the Earth. [12] Although these technologies can enhance the accuracy of the GPS positioning data, the GPS does not require users to submit any data and operates independently of any telephonic or internet reception. Military, civilian, and commercial users all across the world have access to the GPS's vital positioning capabilities. Concurrent with the development of GPS was the Russian Global Navigation Satellite System (GLONASS). GLONASS and GPS devices can be coupled to increase the number of satellites available and improve positional accuracy to within 2 meters.

Most GNSS module has both GPS and GLONASS capability on them. With a GNSS module, the location of the cattle can be tracked at any time.

2.7 Implementation of IoT Protocol

After all the data namely speed, number of steps, location and position has been measured, the data will be collected in groups and sent to internet servers using any of the Internet Service Provider (ISP) that is available. The commonly used service are GPRS/3G. By using star-star networking system, it is possible to connect any number of cattle as shown in figure 11. Each endpoint is cattle. All sensors are connected at the endpoints. Also measurements and processing are done here using Precision Analog to Digital Converters, Microcontrollers and Wifi for communications.

The data from a group of endpoint are collected at their corresponding endpoint servers. The endpoint server serves as an intermediary between the endpoint and the midpoint server. A midpoint server can connect up to 5 endpoint servers. The internet server can collect data from up to 5 midpoints. At this junction, the data connected are uploaded to the internet and/or the users' smartphone. With this configuration explained here, at most 125 cattle can be monitored all together at once. The mode of connection between the points is WiFi. The ESP8266 Wifi Module without extra antenna can reach up to 1km line of sight communication.

The endpoint server knows the IP address of each endpoint connected to it. Hence the IP address of the endpoint module stands as a unique identifier for each cattle. For each data stream communicated to the internet server, it will be preceded by the endpoints IP address so that the back end programmer may know which cattle

information is being monitored. The user will be able to monitor the cattle activity on his screen using charts, notification and alert event for special activities that requires intervention.

3.0 RESULTS AND DISCUSSION

The results are collated individually and then processed into a single file for the user to see at once. Here are results generated from each sensor.

3.1 AD8232 ECG Module

Streams of data are recovered from the microcontroller the module is connected to. Using the serial terminal feature of Arduino IDE, the following data and graph were plotted showing the ECG chart. Here is the graph plotted by the data obtained from the ECG module. The peak-to-peak distance signifies the heart rate.

To ensure accurate reading, the electrodes must have good electrical connection to the cattle. Any hair on that region should be shaved and conductive gel can be applied to further enhance conductivity.

3.2 Accelerometer

The accelerometer takes the value of the most active axis and compare it with a set threshold. If it exceeds the threshold, a valid step is recorded, if not, the measurement is discarded

According figure 14, the valid number of steps recorded was 7 steps in 5 secs. The speed can be deduced from this data and hence we can determine the activity of the cattle over time.

3.3 Proximity Sensor

The proximity sensor used can measure distance anywhere from 10 to 80cm. The sensor being attached under the chest region of the cattle; it can measure when the cattle is standing or laying down. Depending on the height of the cattle, the sensor measures anywhere from 60-100cm in standing position. To detect a laying down position, there is a downward going slope down to almost 0cm. By knowing how long some cattle has been standing or laying down, we can predict the rate of activity of the cattle or suggest possible health challenges.

3.4 Location Service

The GPS/GLONASS transmits data to the microcontroller through its serial port. The data includes the longitude, latitude, altitude, direction, time in UTC and even speed. This is the result form a GPS module.

$GPGGA,110617.00,41XX..XXXXX,N,00831.54761,W,1,05,2.68,129.0,M,50.1,M,,*42

$GPGSA,A,3,06,09,30,07,23,,,,,,,,4.43,2.68,3.53*02

$GPGSV,3,1,11,02,48,298,24,03,05,101,24,05,17,292,20,06,71,227,30*7C

$GPGSV,3,2,11,07,47,138,33,09,64,044,28,17,01,199,,19,13,214,*7C

$GPGSV,3,3,11,23,29,054,29,29,01,335,,30,29,167,33*4E
$GPGLL,41XX.XXXXX,N,00831.54761,W,110617.00,A,A*70
$GPRMC,110618.00,A,41XX.XXXXX,N,00831.54753,W,0.078,,030118,,,A*6A
$GPVTG,,T,,M,0.043,N,0.080,K,A*2C
The type of message is indicated by the characters before the first comma. The GP after the $ indicates it is a GPS position. The $GPGGA is the basic GPS National Marine Electronic Association (NMEA) message, that provides 3D location and accuracy data. In the following sentence:
$GPGGA,110617.00,41XX.XXXXX,N,00831.54761,W,1,05,2.68,129.0,M,50.1,M,,*42

110617 – represents the time at which the fix location was taken, 11:06:17 UTC
41XX.XXXXX,N – latitude 41 deg XX.XXXXX' N
00831.54761,W – Longitude 008 deg 31.54761′ W
1 – fix quality (0 = invalid; 1= GPS fix; 2 = DGPS fix; 3 = PPS fix; 4 = Real Time Kinematic; 5 = Float RTK; 6 = estimated (dead reckoning); 7 = Manual input mode; 8 = Simulation mode)
05 – number of satellites being tracked
2.68 – Horizontal dilution of position
129.0, M – Altitude, in meters above the sea level
50.1, M – Height of geoid (mean sea level) above WGS84 ellipsoid
empty field – time in seconds since last DGPS update
empty field – DGPS station ID number
*42 – the checksum data, always begins with *
The other NMEA sentences provide additional information:
$GPGSA – GPS DOP and active satellites
$GPGSV – Detailed GPS satellite information
$GPGLL – Geographic Latitude and Longitude
$GPRMC – Essential GPS pvt (position, velocity, time) data
$GPVTG – Velocity made good
This results are parsed in the microcontroller such that only the values relevant to us are seen, which are, the longitude, latitude and time. With the aid of Google maps services, the exact location can be found. This GPS module has an accuracy of 2.5m.

4.0 CONCLUSION

The implementation of IoT in cattle management and monitoring allows for real time information about each cattle, the user can see a general statistics of the state of the cattle without necessarily being with them. It gives room for better analytic in that industry and finally allows higher productivity.

REFERENCES

Accelerometer Basics", https://learn.sparkfun.com/tutorials/accelerometer-basics/all retrieved on April 5, 2021.

Barbedo J.G.A, Koenigkan LV, Santos PM, Ribeiro ARB, "Counting Cattle in UAV Images Dealing with Clustered Animals and Animal/Background Contrast Changes", Sensors (Basel).2020;20(7):2126. Published 10 Apr 2020.

Danielle M, "Electrocardiogram", https://www.healthline.com/health/electrocardiogram, retrieved on April 2, 2021.

Datta P., Sharma B, "A survey on IoT architectures, protocols security and smart city based applications, 2017, https://ieeexplore.ieee.org/document/8203943.

FAO's Animal Production and Health Division: Meat & Meat Products" http://www.fao.org/ retrieved March 30, 2021.

Global Positioning System Standard Positioning Service Performance Standard : 4th Edition, https://www.gps.gov/technical/ps/2008-SPS-performance-standard.pdf September 2008"(PDF). Retrieved April 5, 2021.

Heat Detection and Timing of Inseminaton", PennState Extension, https://extension.psu.edu/heat-detection-and-timing-of-insemination-for-cattle retrieved on April 3, 2021).

Kamalika S "Why are Cattle Important" http://beef2live.com retrieved March 30, 2021 "Case Studies That Explain How IoT Sensors Redefine Livestock Monitoring", http://www.analyticinsight.net retrieved on 31 March 2021).

Li, Guoming; Huang, Yanbo; Chen, Zhiqian; Chesser, Gary D., Jr.; Purswell, Joseph L.; Linhoss, John; Zhao, Yang. "Practices and Applications of Convolutional Neural Network-Based Computer Vision Systems in Animal Farming: A Review", Sensors 21, no. 4: 1492, 2021.

Manuj Darbari, Diwakar Yagyasen, and Anurag Tiwari, "Intelligent Traffic Monitoring Using Internet of Things (IoT) with Semantic Web. Volume 1", Advances in Intelligent Systems and Computing, 2015.

Masafumi M and , Kazato O, "Application of Overall Dynamic Body Acceleration as a Proxy for Estimating the Energy Expenditure of Grazing Farm Animals: Relationship with Heart Rate" published in 2015).

Okinda, C.; Nyalala, I.; Korohou, T.; Okinda, C.; Wang, J.; Achieng, T.; Wamalwa, P.; Mang, T.; Shen, M., "A review on computer vision systems in the monitoring of poultry: A welfare perspective" Artif. Intell. Agric., 4, 184–208, 2020.

Sparkfun Single Lead Heart Rate Monitor", www.sparkfun.com/products/12650# retrieved on April 2, 2021.

The Healthy Cow", Nadis Animal Health Skills, https://www.nadis.org.uk/disease-a-z/cattle/the-healthy-cow/ retrieved on April 2, 2021.

Tiwari, A Sachdeva, K. and Jain, N. " Computer Vision and Deep Learningbased

Framework for Cattle Monitoring" IEEE 8th Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON), 2021. DOI: 10.1109/UPCON52273.2021.9667617.

Van Gemert J.C., Verschoor C.R., Mettes P., Epema K., Koh L.P., Wich S., "Nature Conservation Drones for Automatic Localization and Counting of Animals". In: Agapito L., Bronstein M., Rother C. (eds) Computer Vision - ECCV 2014

Workshops. ECCV 2014. Lecture Notes in Computer Science, vol 8925. Springer, Cham, 2014.

Wen Shao, Rei Kawakami, Ryota Yoshihashi, Shaodi You, Hidemichi Kawase & Takeshi Naemura, "Cattle detection and counting in UAV images based on convolutional neural networks", International Journal of Remote Sensing, 41:1, 31- 52, 2020.

What is a GPS?. https://www.loc.gov/everyday-mysteries/item/what-is-gps-how-

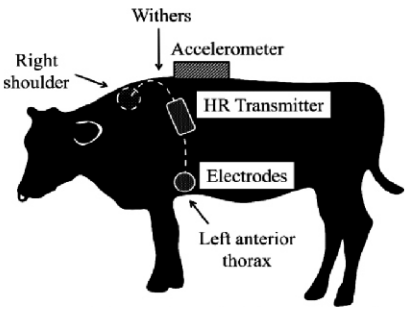


Figure 1: Sensor Positioning on a Cattle

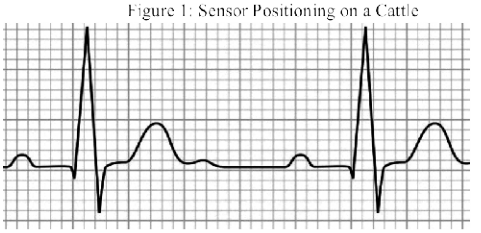


Figure 2: A typical ECG Chart

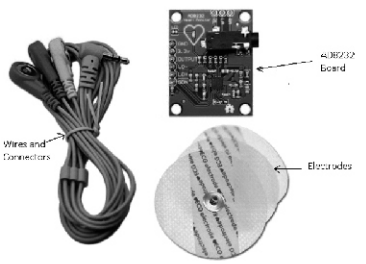


Figure 3: AD8232 breakout board, electrodes and wires

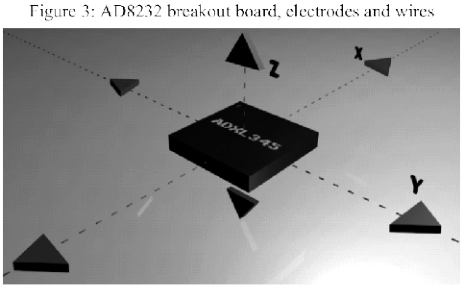


Figure 1: Accelerometer axes

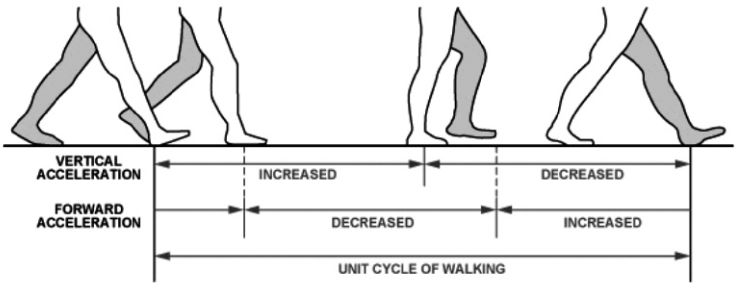


Figure 1: Walking stages and Accelerometer Pattern

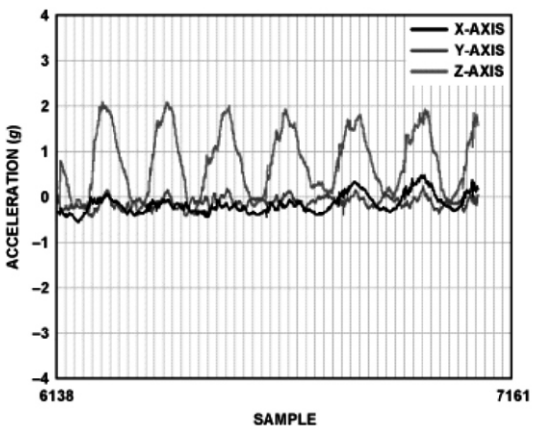


Figure 2:Typical pattern of x-, y-, and z accelerations computed on a running individual.

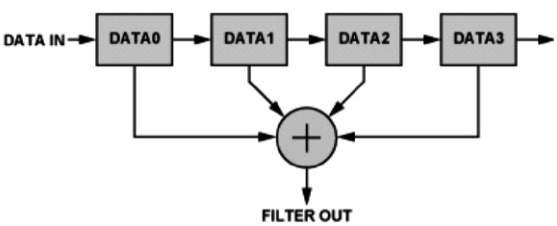


Figure 3: Digital filter

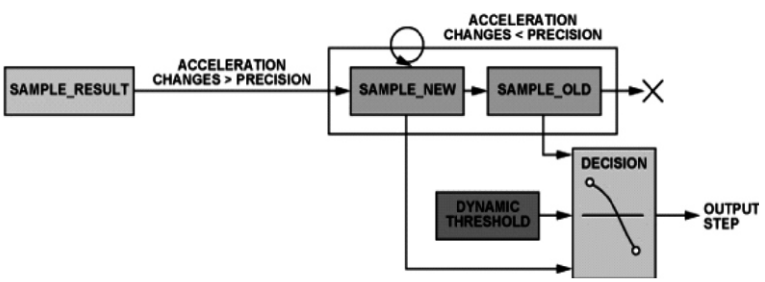


Figure 1: Dynamic Threshold and Precision

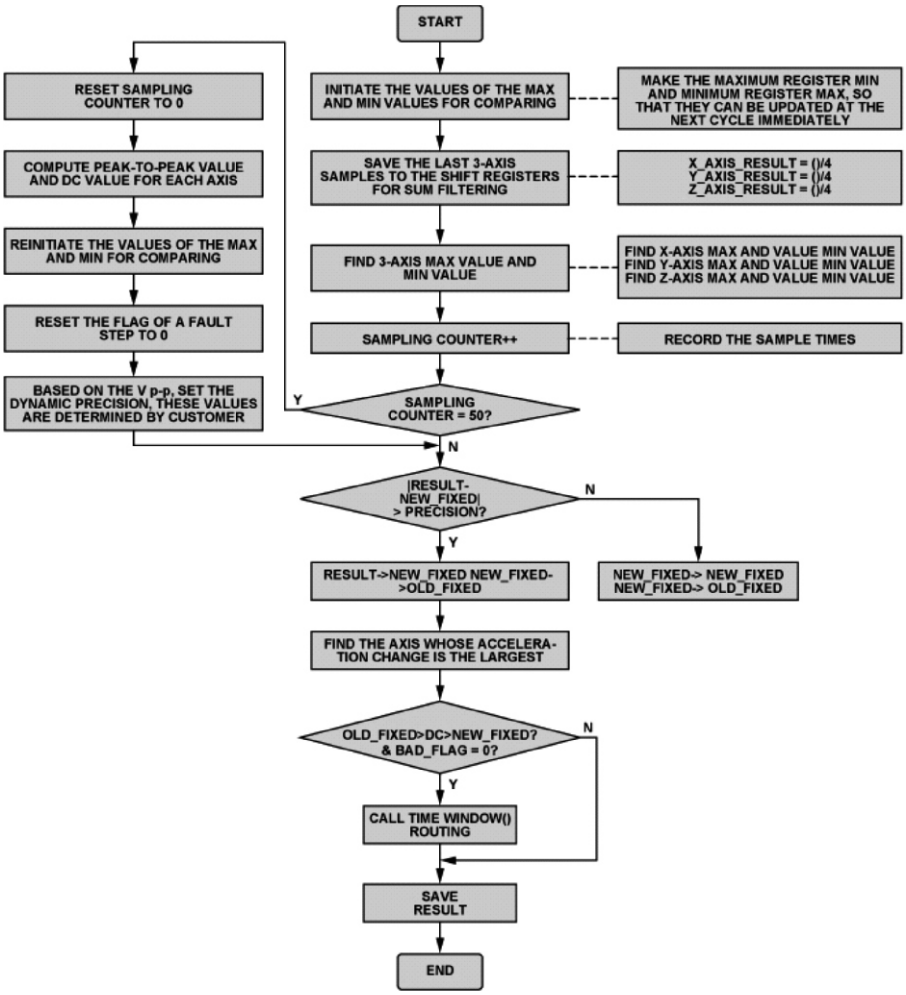


Figure 1: Steps parameter algorithm flowchart.

Figure 1: ECG result

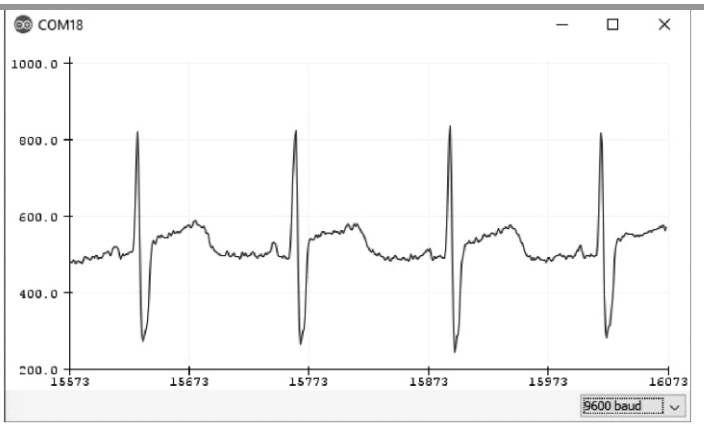


Figure 1: ECG chart

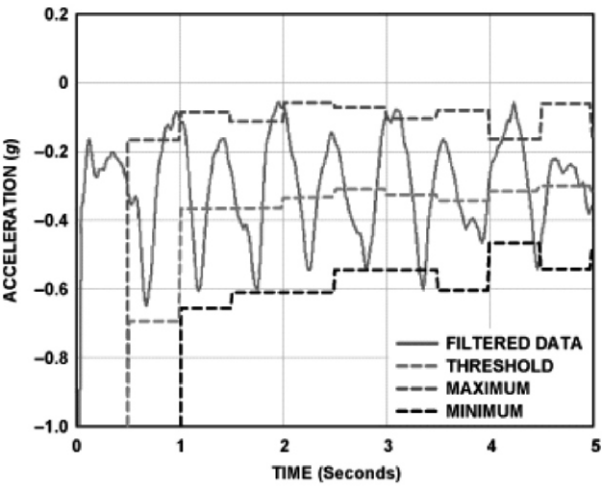


Figure 2: Accelerometer result

Table 1. Stride as a Function of Speed (steps per 2 s) and Height

Steps per 2 s Stride (m/s)	Stride (m/s)
0~2	Height/5
2~3	Height/4
3~4	Height/3
4~5	Height/2

FEDPOLAD JOURNAL OF ENGINEERING AND ENVIRONMENTAL STUDIES (FEDPOLADJEES)

DESIGN AND CONSTRUCTION OF A HEARING AID SYSTEM FOR PARTIAL IMPAIRMENT

Authors

[1]Olumodeji I.A and [2]Ewetumo T

[1]Department of Science Technology, School of Science and Computer Studies, Federal Polytechnic Ado

[2]Department of Physics, Faculty of Science, Federal University of Technology Akure

Corresponding Author: olumodeji_ia@fedpolyado.edu.ng

Abstract:

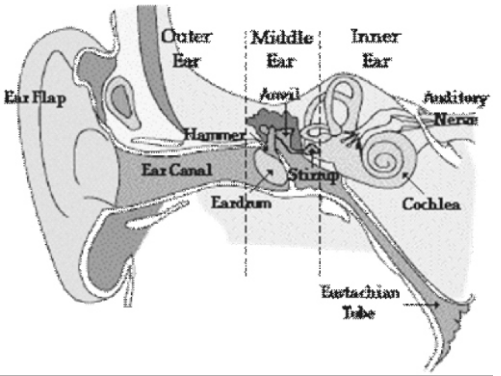
Hearing aid electronics controls how sound is transferred from the environment to the inner ear. All hearing aids amplify sounds, making them louder so that the impaired can hear the sound better. This study reports the construction of a hearing aid system, using a crystal microphone which serves as the input (receiver of the signal). A BC108 Transistor forwards the current to an LM386 integrated circuit which is a power audio amplifier to deliver large amount of power to the low resistance load which is the loudspeaker (stereo output). This study has also simplified the technicalities of sound amplification system, produced proper propagation towards achieving noise-free audio outputs maintained within audio frequency range, thus, improving the quality for the partially impaired.

Keywords: *Hearing Aid, Sound Amplification, Audio Amplifier, Partial Impairment*

Introduction

HEARING PRINCIPLES

Ears are extraordinary organs. They pick up all the sounds around you and then translate this information into a form your brain can understand. One of the most remarkable things about this process is that it is completely mechanical. The sense of smell, taste and vision all involve chemical reactions, but the hearing system is based solely on physical movement.



The human ear serves as an astounding transducer, converting sound energy to mechanical energy to a nerve impulse that is transmitted to the brain. The ear's ability to do this allows us to perceive the pitch of sounds by detection of the wave's frequencies, the loudness of sound by detection of the wave's amplitude and the timbre of the sound by the detection of the various frequencies that make up a complex sound wave.

The ear consists of three basic parts – THE OUTER EAR, THE MIDDLE EAR AND THE INNER EAR. Each part of the ear serves a specific purpose in the task of detecting and interpreting sound. The outer ear serves to collect and channel sound to the middle ear. The middle ear serves to transform the energy of a sound wave into the internal vibrations of the bone structure of the middle ear and ultimately transform these vibrations into a compressional wave in the inner ear. The inner ear serves to transform the energy of a compressional wave within the inner ear fluid into nerve impulses that can be transmitted to the brain. [2]

HEARING LOSS

Hearing loss is a partial or total inability to hear. It is caused by many different factors, such as age, noise, illness, chemicals, physical trauma etc. There is a medical diagnostic process to determine the severity of the hearing impairment, and it is measured in decibels. Hearing loss exists when there is diminished sensitivity to the sounds normally heard. This term is usually reserved for people who have relative insensitivity to sound in the speech frequencies. When describing hearing loss, we generally look at three attributes: type of hearing loss, degree of hearing loss, and the configuration of the hearing loss.

TYPES AND CAUSES OF HEARING LOSS

Difficulty in the external or middle ear, it is known as a CONDUCTIVE hearing. If the trouble lies in the inner ear or the hearing nerve it is known as a SENSORINEURAL or nerve hearing loss. When there are problems in both the middle and inner ear, a combination of conductive and sensorineural impairment exists, it is known as a MIXED hearing loss. Conductive hearing losses may be

correctable with medicine or surgery. Sensorineural hearing is typically permanent. On occasion, the exact nature of the hearing loss cannot be determined. This type of hearing loss is called "INDETERMINATE." Causes of hearing loss are usually classified by the type of hearing loss.

The most common causes of hearing loss are listed below:
Conductive: The most common cause of conductive hearing loss is fluid in the middle ear. This may be a result of repeated or chronic infection (otitis media), or it may develop as a result of Eustachian tube obstruction (eg, due to allergies). Holes in the eardrum (tympanic membrane perforation) and skin cysts (cholesteatoma) are fairly common and may or may not be associated with repeated or persistent ear infections. The hearing bones may be either damaged or fused to surrounding structures as a result of other middle ear problems, birth defects, or certain bone conditions.

Sensorineural: Many problems may cause this type of hearing loss. Many, if not most, cases are
inherited. These may or may not be apparent at birth, and they may very well progress with time. Problems with inadequate oxygen at birth, noise exposure, certain intravenous antibiotics used for serious infections (e.g. gentamicin), viral infection of the inner ear, and infection around the brain (meningitis).

Mixed: Certain birth defects (e.g. large vestibular aqueduct syndrome) and disorders of the inner ear bone (e.g. otosclerosis) may affect both the inner and middle ear. Middle ear infections can cause mixed hearing loss, but the sensorineural component is usually, nearly completely reversible. [3]

IMPACT OF HEARING LOSS
Mild Hearing Loss: Most adults can compensate for a mild hearing loss by addressing the speaker, face-to-face, and avoiding noisy environments. A child with mild hearing loss usually has normal speech, but may have trouble in the school setting because it is more difficult to hear speech from a distance or when there is background noise. This is because much of the meaning in language is contained in the voiceless consonants which are high-pitched and soft. They are s, sh, t, p, k, f, ch, and th. People (children) with a mild hearing loss in both ears will need some amplification in each ear to hear clearly at school, in groups, or at a distance. When they receive hearing aids, they usually find that school is easier.

Moderate Loss: People with moderate hearing loss can clearly hear speech only when the speaker is very close - less than two feet away. They need hearing aids to hear the softest sounds and to acquire understandable speech. Adults with moderate hearing loss will usually have difficulty in both social and work situations, such that hearing aids or other means of amplification will be necessary. If they receive hearing aids before four years of age, they usually progress rapidly in learning to talk. They

can attend regular schools, but may need special help.

Profound Loss: People with a profound hearing loss receive little or no auditory information from hearing aids. Fortunately, a scientific advancement called the cochlear implant now allows many deaf individuals to hear sound. With this device, a deaf person can hear sounds at normal conversation levels, although hearing is not normal. Cochlear implant users need a lot of special training to learn about sounds. All profoundly impaired children - whether they use the cochlear implant or hearing aids - need auditory therapy and continuous use of amplification or the implant. [3]

DEGREE OF HEARING LOSS

Degree of hearing loss refers to the severity of the loss. There are seven categories that are typically used. The numbers are representative of the patient's thresholds, or the softest intensity that sound is perceived:

Normal = 0 dB to 20 dB
Mild loss = 20 dB to 40 dB
Moderate loss = 40dB to 60dB
Severe loss = 60dB to 80dB
Profound loss = 80dB or greater

Normal hearing is classified as being between -10dB and 15dB. Hearing thresholds of humans and other mammals can be found by using behavioural hearing tests or physiological tests. For humans the test involves different tones being presented at a specific frequency (pitch) and intensity (loudness). [4]

DECIBELS	PERCEPTION OF SOUND
0dB	The lowest sound that can be heard by a healthy ear of an 18-year old.
20dB	Very soft whisper
45dB	Softly spoken voice
60dB	An average voice spoken
70dB	A loud shout
80dB	A loud motorbike that is driven on a narrow street
90dB	Lawn mower
100-120dB	Heavy metal rock concert
120-140dB	A jet engine within a range of 250 yards [1]

HEARING AID

A hearing aid is an electro acoustic device which typically fits in or behind the wearer's ear, and is designed to amplify and modulate sound for the wearer. Earlier devices, known as ear trumpets or ear horns, were passive funnel-like amplification cones designed to gather sound energy and direct it into the ear canal. Similar devices include the bone anchored hearing aid, and cochlear implant. [5]

Hearing Aid systems are of great importance for human being. They are small electronic instruments which makes sound louder and speech easier to hear and understand and also help to offset hearing loss. It is designed to pick up sound waves with a tiny microphone (condensed microphone), change weaker sounds into louder sounds and send them to the ear through a speaker (headphone). [6]

TYPES OF HEARING AID

There are many types of hearing aids (also known as hearing instruments), which vary in size, power and circuitry. Among the different sizes and models are:

- Body worn aids [7]
- Behind the ear aids (BTE) [8]
- Receiver in the canal/ear [9]
- In the ear aids (ITE) [9]
- Extended Wear Hearing Aid [10]
- Open-fit devices [9]
- Bone anchored hearing aid [10]

It has been observed that most partially impaired individuals are not totally impaired but occasionally respond to sounds above certain frequency threshold. This study is to develop a system that will amplify an audio signal in such a way that it becomes audible to the impaired which will also improves communication.

MATERIALS AND METHOD

To achieve the design and construction of this system, here are the list of materials and components used.

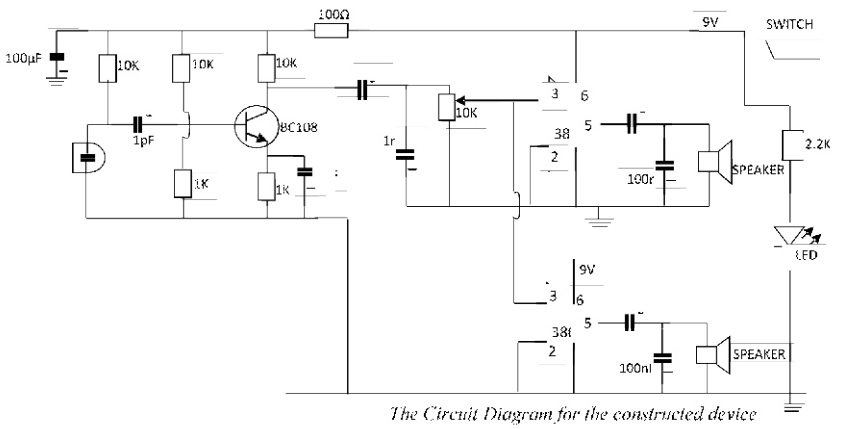
- Resistors – (100ohms, 10kilo-ohms, 1 kilo-ohm, 2.2kilo-ohm)
- Capacitors – (100uF, 1uF, 1pF, 100nF, 1nF)
- Transistor – (BC108)
- Integrated Circuit – (LM386)
- Battery – (9V)
- Microphone – (Condensed Mic.)
- Loudspeaker – (Stereo: 8ohms)
- LED (Green)
- Brief explanation of some components:

Audio Amplifier: The properties of an amplifying circuit using an op-amp depends primarily on the characteristics of the feedback network rather than on those of the op-amp itself. A typical feedback network consists of resistors and capacitors, because these components are available in conditions of high precision and low drift, the accuracy and stability of circuits using them is very high. Audio receiver systems consist of a number of amplifying stages since the gain of each stage has to be kept low due to the frequency range required for audio signals. Because of thermal drift, component tolerance and variation, a DC level is produced. In order to prevent the amplification of such DC levels, coupling capacitors must be used between the stages. The coupling capacitor not only blocks the DC voltage but also sets a low frequency cutoff limit; it acts as a filter. Such an amplifier with a coupling capacitor is called an AC amplifier. [11]

Adjustable control: The audio circuit is analog with electronic components that can be adjusted. The hearing professional determines the gain and other specifications required for the wearer, and then adjusts the analog components either with small controls on the hearing aid itself or by having a laboratory build the hearing aid to meet those specifications. After the adjustment the resulting audio does not change any further, other than overall loudness that the wearer adjusts with a volume control. This type of circuitry is generally the least flexible. [11]

Batteries: While there are some rare instances that a hearing aid uses a rechargeable battery or a long-life disposable battery, the majority of modern hearing aids use one of five standard Button Cell Zinc-air batteries. (Older hearing aids often used mercury battery cells, but these cells have become banned in most countries today.) Modern hearing aid button cell types are typically referred to by their common number name or the color of their packaging. They are typically loaded into the hearing aid via a rotating battery door, with the flat side (case) as the positive terminal (cathode) and the rounded side as the negative terminal (anode). These batteries all operate from 1.35 to 1.45Volts. The type of battery a specific hearing aid utilizes depends on the physical size allowable and the desired lifetime of the battery, which is in turn determined by the power draw of the hearing aid device. Typical battery lifetimes run between 1 and 14 days (assuming 16 hour days). [12]

Processing: Every electronic hearing aid has at minimum a microphone, a loudspeaker (commonly called a receiver), a battery, and electronic circuitry. The electronic circuitry varies among devices, even if they are the same style. The circuitry falls into three categories based on the type of audio processing (analog or digital) and the type of control circuitry (adjustable or programmable). [12]



The Circuit Diagram for the constructed device

RESULTS AND DISCUSSION

The various electronic components stated above in Chapter 3 were arranged carefully on the Vero board and soldered as designed in the circuit.

After the whole construction of the circuitry, it was tested and confirmed okay in the laboratory where the construction was carried out.

TESTING

Frequency is fed into hearing aid via audio signal generator and the output is monitored via the oscilloscope to measure the input signal and output signal voltage.

Frequency	Vin(mV)	Vout(V)	dB=20Log(V_0/V_{in})
70	1	0.8	58.0
100	1	1.5	63.5
200	1	1.5	63.5
1000	1	1.5	63.5
1200	1	1.5	63.5
1400	1	1.6	64.0
1500	1	1.6	64.0
2000	1	1.6	64.0
3000	1	1.6	64.0
4000	1	1.5	63.5
5000	1	1.5	63.5
10000	1	1.1	60.8
15000	1	0.80	58.1
19000	1	0.65	56.3
20000	1	0.60	55.6

Table 1 Relationship between Frequency and Decibel

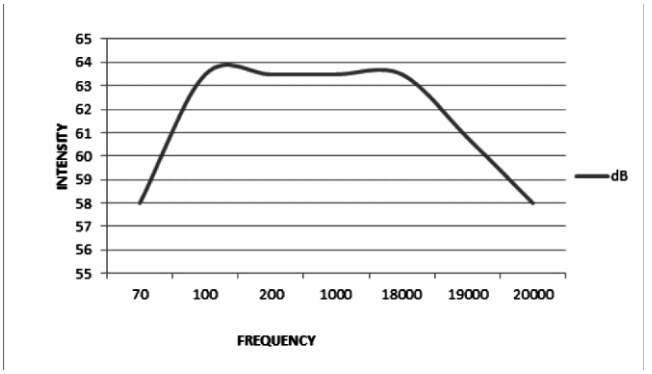


Fig.3 Frequency Response of the Hearing Aid

ASSEMBLING

After construction of the circuit was completed, an acrylate paspet of dimension 3cm x 2cm was used for the casing. Several holes were bored into the casing to provide opening for the phone socket, microphone, the volume control knob and the switch. Then entire circuit was carefully and neatly fit into the casing while the lid was screwed into it.

Fig. 4 Block Diagram for the Analog Hearing Aid System

Like a loudspeaker system in an auditorium or church, hearing aids have the following components: Power source was provided by a 9V battery. The microphone (Crystal Mic.) picks up audio signals allowing the audio amplifier (LM386) to amplify the sounds which is conveyed a loud sound into the ear by the speaker (Head phone). Volume Control makes sound softer or louder.

CONCLUSION

The Hearing aid system outcome can be represented by three dimensions: hearing aid usage, aided speech recognition, benefit/satisfaction. This study has successfully produced a hearing aid system needed mostly by persons/people with mild and moderate hearing loss. Moreso, it's more affordable for the average man in Nigeria supposedly living below the $1 mark. From the results of the tests carried out, it can be deduced that:

* The amplification is 62dB maximum and -31dB minimum.
* The input impedance is 47kΩ while the output impedance is 3kΩ.

REFERENCES

Bastul Nafisa Baxamusa (2012): "Diagram of the Ear and its Functions". Buzzle.

Tom Harris (2007): "Introduction to how hearing works" University of North Carolina at Chapel Hill.

Patrick J. A. (2007): "Hearing Loss": Otology & Neurotology Department of Otolaryngology University of Florida 352-265-6808

General Practice Notebook (2012): "Pure tone audiometry in Otosclerosis: Insufficient Evidence for the Diagnostic Value of the Carhart Notch" Research Article published July 1, 2013. https://doi.org/10.1177%2F0194599813495661

Howard, Alexander (1998) "Hearing Aids: Smaller and Smarter". New York Times, November 26, 1998

Bentler, R.A (2000): "Comparison of Hearing Aids over the 20th century". Ear & hearing 21(6): 625-639, December 2000

William M. Hartmann (1997): "Signals, Sound and Sensation" Amer Institute of Physics. Cited by 848

Food And Drug Administration (2012): "Types of Hearing Aids". URL: https://www.fda.gov/medical-devices/hearing-aids/types-hearing-aids accessed on 14 December.

American Academy of Audiology (2009): | 11730 Plaza America Drive, Suite 300, Reston, VA 20190 | 800-AAA-2336 | www.HowsYourHearing.org ©2009

Dybala, P.D. (2006): "ELVAS Sightings: Cochlear Implants and Hearing Aids get Wired". The Hearing Journal, 59(3), 10-15. Audiology Online

William, K (1923): "Transistor in need of improvement. New York Times pp. E9 www.umweltmesstechnik-bayreuth.de|info@umweltmesstechnik-bayreuth.de

Levitt, H.(2007): "Digital Hearing Aids: wheelbarrows to ear inserts". ASHA Leader 12, no. 17 (December 26, 2007): Pp 28-30 https://doi.org/10.1044/leader.FTR4.12172007.28

FEDPOLAD JOURNAL OF ENGINEERING AND ENVIRONMENTAL STUDIES (FEDPOLADJEES)

DESIGN AND CONSTRUCTION OF LABORATORY MINI PYROLYSIS REACTOR RIG

Authors

***Erinle, Tunji John; Emmanuel, Abraham Adesina; Akerele, Olalekan Victor**

Mechanical Engineering Department, Federal Polytechnic, Ado- Ekiti, Ekiti State, Nigeria.

**Corresponding Author: erinle_tj@fedpolyado.edu.ng; +2348069635034*

ORCID: https://orcid.org/0000-0003-0557-9931

Abstract:

There is a need to identify sustainable energy sources for producing energy without harming the environment. Renewable energy sources have the potential to significantly contribute to long-term development. A pyrolysis reactor is a device that pyrolyzes biomass materials in the absence of oxygen to produce bio-char, bio-oil, and bio-gas. The research focuses on creating and executing a sustainable pyrolysis reactor rig that converts waste products into valuable chemical products, using important equipment such as fixed bed reactors, heating element bands, temperature controllers, thermocouples, and power switches. The pyrolysis reactor rig was put to the test by performing a performance evaluation. Conclusively, the pyrolysis reactor could be employed in thermodynamics and energy laboratories for experimental research on any biomass and some organic compounds.

Keywords: *Biomass, Pyrolysis, Renewable energy, Reactor, Sustainable*

Introduction

The demand for fossil fuel energy is rapidly increasing as a result of global development and the use of fossil fuels but generating environmental contamination and posing a health risk. There is a need to develop sustainable energy sources for producing energy while minimising environmental impact. Renewable energy is crucial for long-term growth. Agriculture and forest wastes (often referred to as biomass) can be used to generate power, which is one of the renewable energy options (Musale et al., 2013). Many researches claimed that materials such as tea residue, safflower seed waste, rice husk, sugarcane, coconut shell, empty fruit bunches, and so on were transformed to bio-oil employing these three essential technologies of reducing, reusing, and recycling. Energy is the essence of Nigeria's economic development. It is important in the country's international diplomacy and acts as a traded commodity for producing national income, which is used to fund government development programmes. It also acts as a raw material for the manufacture of goods and services in the nation's industries,

transportation, agriculture, health, and education sectors, as well as a tool for politics, security, and diplomacy (Oyedepo, 2012). The growing worldwide energy demand and the negative environmental effects of non-renewable fossil fuels have sparked significant academic interest in a wide range of engineering applications of renewable resources such as biomass (Adaramola et al., 2011).

Biomass technology provides an attractive platform for utilising certain categories of biomass for satisfying both urban and rural energy needs, if effectively utilised. Various cellulosic biomasses (cattle dung, agricultural waste) are available in our rural areas and can be used to produce bio-energy (Rahman et al., 2009). It has been recognised that the by-products of biomass found in urban and industrial regions are wastes, and that poor waste management results in numerous urban and environmental health problems in developing nations like Nigeria. Instead of creating environmental problems, energy from these wastes has the potential to provide job opportunities and improve the nation's economy (Sambo, 2005). According to recent research, fossil fuels are quickly becoming rare and constrained in terms of availability around the world. China, India, Nigeria, and other developed and emerging countries recognised the need for alternate, sustained (renewed) types of energy to meet the ever-increasing demand for basic requirements by rural and urban inhabitants, and thus strongly supported it. In 2011, the United States, Brazil, and the European Union produced 48%, 22%, and 17% of the world's biofuels, respectively (Duku et al., 2011a).

Biomass refers to energy derived from plant sources such as trees, grasses, agricultural crops, and their derivatives, as well as animal wastes, food processing wastes, aquatic plants, and algae (Duku et al., 2011b). As an energy resource, biomass can be used as a solid fuel or transformed to liquid or gaseous forms via a number of processes (bio-fuel or bio-gas) for the generation of electric power, heat, or fuel for motive power. Biomass resources are considered renewable because they occur naturally and, when managed appropriately, may be collected without major depletion. In general, biomass comes from virgin wood (fuel wood), energy crops and agricultural residues, industrial wastes/effluents, municipal solid waste (MSW), food wastes, and other sources (Sambo, 2009; Akorede et al., 2017).

Sugarcane, sweet sorghum, maize, and cassava for ethanol, and oil palm, coconut, cotton, sunflower, soy bean, and Jatropha for bio-diesel, are among the energy crops with promise as feedstock for bio-fuel production in Nigeria (Ozoegwu et al., 2017).
This apart from the energy crops grown by farmers, various feedstock for bio-energy production can be found throughout the country. Among these are agricultural crop leftovers, which are materials left on the farm after the target crops have been harvested (David and Nosa, 2012). Crop leftovers in Nigeria, such as straws, leaves, and stalks of cereals such as rice, maize/corn, sorghum, and millet, cassava stalk/peelings, and cocoa pods, are excellent sources of bio-fuels, as indicated in table 1.

.

Table 1: Major Agricultural Crops Output and Bio-Fuel Type in Nigeria

Agricultural Resource	Derivable Bio-Fuel Type
Cassava	Bioethanol
Yam	Bioethanol
Millet	Bioethanol
Maize	Bioethanol
Sorghum	Bioethanol
Rice	Bioethanol
Potato	Bioethanol
Cowpea	Bioethanol
Groundnut	Biodiesel
Oil palm	Biodiesel
Sugar cane	Biodiesel
Sweet potato	Bioethanol
Cocoyam	Bioethanol
Cotton	Bioethanol
Coffee.	Biodiesel
Cocoa	Biodiesel
Plantain	Biodiesel

(Simonyan and Fasina, 2013)

According to Mckendry (2002), the type and quantity of biomass feedstock, as well as the intended form of energy, impact the suitable conversion process for a biomass (end-use requirements, environmental standards, economic considerations and project specific factors). Bio-fuels derived from sugar and starchy crops are ready for commercial or industrial use, but their feedstock is first-generation biomass, which poses a sustainability challenge (Amigun and Musango, 2011). The aim of this study is to develop and build an externally heated fixed bed pyrolysis reactor that will produce alternate liquid fuel, char, and gaseous fuel. This research would also be used to convert wastes into wealth. The work includes designing and building a fixed bed reactor to create bio-char, bio-oil, and bio-gas/syngas from biomass.

3. METHODOLOGY

3.1 Materials

i. Mild Steel 3 mm thickness
ii. Angular Bar 3 mm thickness
iii. Temperature Controller
iv. Refrigerant Cylinder
v. Fiber Glass (Elements Separator)
vi. Heat Resistance Wire - 4mm Thickness
vii. Heat Resistance Wire - 2.5mm Thickness
viii. Sleeves
ix. Knob Switch
x. 60 A Circuit Breaker

xi. 125 A Contactor
xii. Ceramics Insulator Connector
xiii. Clay Soil
xiv. Gasket
xv. Indicator light
xvi. Heating Element of 3200 watts
xvii. K Type Thermocouple

3.2 Design Calculation and Analysis

According to Rajput (2012), heat transfer attributed to conduction in the fixed bed pyrolysis reactor was calculated using equation 1.

$$Q = \frac{kA\,(T_i - T_o)}{L} = \frac{kA\,(\Delta T)}{x} \quad (1)$$

where:
Q = Heat Flow (Watt)
T_i = Inner Temperature (^oC)
T_o = Outside Temperature (^oC)
k = Thermal Conductivity (W/mK)
A = Cross Sectional Area (m^2)

According to Rajput (2012), heat transfer due to convention in the fixed bed pyrolysis reactor was calculated using equation 2.

$$Q = hA\,(T_i - T_o) = hA\,(\Delta T) \quad (2)$$

where:
Ti = Inner Temperature (^oC)
To = Outside Temperature (^oC)
h = Heat Transfer Coefficient (W/m^2K)
A = Cross Sectional Area (m^2)

Equation 3 was used to determine the solid shape of the fixed bed pyrolysis reactor housing.

$$V = L \times B \times H \quad (3)$$

Equation 4 was used to determine the solid shape of the fixed bed pyrolysis reactor container.

$$V = \pi \frac{d^2}{4} h \quad (4)$$

3.2.1 Conduction Heat Transfer Analysis

Figures 1 and 2 show how heat is transferred by conduction through solid materials. The heating element used has a rating capacity of 3200 watts.

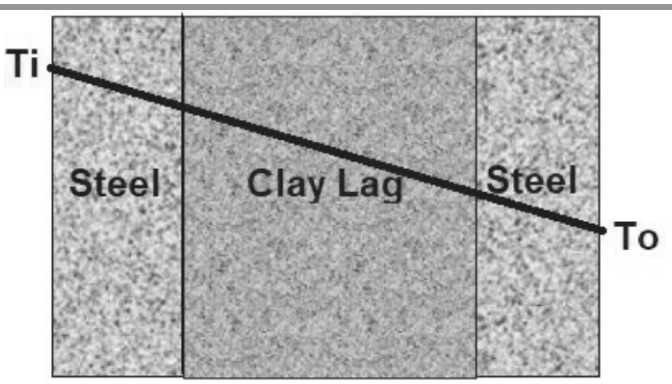


Figure 1: Conduction of Heat in Solid Materials

3.2.2 Determination of Temperature Difference in the Heating Chamber

$$Q = \frac{kA\,(T_i - T_o)}{x} = \frac{kA\,(\Delta T)}{x}$$

Q = 3200 W

$\Delta T = T_i - T_o$

A = L × B

Thermal Conductivity of steel, k = 45 W/mK; Thickness, x = 0.002 m; Length, L = 0.14 m; Width, B = 0.14 m

$A = L \times B = 0.14 \times 0.14$

$$Q = \frac{kA\,(\Delta T)}{x}$$

$$\Delta T = \frac{Q \times x}{kA}$$

$$\Delta T = \frac{3200 \times 0.002}{45 \times 0.14 \times 0.14} = \frac{6.4}{0.882}$$

$\Delta T = 7\ \mathbf{K}$

3.2.3 Determination of Temperature Difference in the Lagged

$$Q = \frac{kA\,(T_i - T_o)}{x} = \frac{kA\,(\Delta T)}{x}$$

Q = 3200 W

$\Delta T = T_i - T_o$

A = L × B

Thermal Conductivity of Clay (dry to moist), k = 1.8 W/mK; Thickness, x = 0.09 m; Length, L = 0.46 m; Width, B = 0.46 m

$A = L \times B = 0.46 \times 0.46$

$$Q = \frac{kA\,(\Delta T)}{x}$$

$$\Delta T = \frac{Q \times x}{kA}$$

$$\Delta T = \frac{3200 \times 0.09}{1.8 \times 0.46 \times 0.46} = \frac{288}{0.45}$$

ΔT = **640 K**

3.2.4 Determination of Temperature Difference of the Reactor Cabin

$$Q = \frac{kA\,(T_i - T_o)}{x} = \frac{kA\,(\Delta T)}{x}$$

Q = 3200 W

$\Delta T = T_i - T_o$

A = L × B

Thermal Conductivity of steel, k = 45 W/mK; Thickness, x = 0.002 m; Length, L = 0.5 m; Width, B = 0.5 m

A = L × B = 0.5 × 0.5

$$Q = \frac{kA\,(\Delta T)}{x}$$

$$\Delta T = \frac{Q \times x}{kA}$$

$$\Delta T = \frac{3200 \times 0.002}{45 \times 0.5 \times 0.5} = \frac{6.4}{11.25}$$

ΔT = **1 K**

3.2.5 Determination of Temperature Difference of the Reactor

Figure 2 depicts how heat is transmitted in the reactor by conduction through solid material.

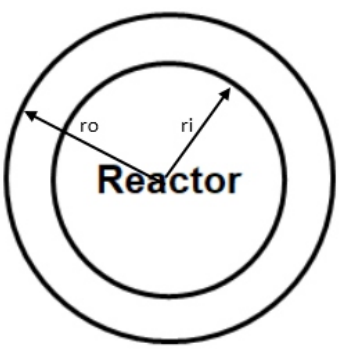


Figure 2: Heat Transferred through Conduction in the Reactor

$$Q = \frac{2\pi Lk\,(\Delta T)}{In(\frac{r_o}{r_i})}$$

Q = 3200 W

$$\Delta T = \frac{Q \times In(\frac{r_o}{r_i})}{2\pi Lk}$$

Thermal Conductivity of steel, k = 45 W/mK; Thickness, L = 0.001 m; r_o= 0.12 m; Width, B = 0.121 m

$$\Delta T = \frac{Q \times In(\frac{r_o}{r_i})}{2\pi Lk} = \frac{3200 \times In(\frac{0.121}{0.12})}{2\times 3.142\times 0.001\times 45} = \frac{3200 \times 0.0083}{2\times 3.142\times 0.001\times 45}$$

$$\Delta T = \mathbf{94\ K}$$

3.2.6 Convention Heat Transfer Analysis

Figure 3 depicts how heat is transferred by convention through fluid in a space.

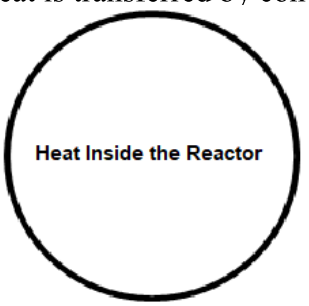


Figure 3: Heat through Convention inside the Reactor

3.2.7 Determination of Temperature Difference inside the Reactor

Q = hA $(T_i - T_o)$ = hA (ΔT)

Q = 3200 W

$\Delta T = T_i - T_o$

A = πr^2

Heat Transfer Coefficient of air, h = 100 W/m^{2}K; Radius, r = 0.12 m

A = πr^2 = $3.142 \times 0.12 \times 0.12$ = 0.045 m^2

Q = hA $(T_i - T_o)$ = hA (ΔT)

$$\Delta T = \frac{Q}{hA}$$

$$\Delta T = \frac{3200}{100 \times 0.045}$$

$$\Delta T = \mathbf{710\ K}$$

3.2.8 Overall Conduction Heat Transfer Analysis

$$Q = \frac{(T_i - T_o)}{\frac{L_1}{k_1\ A_1} + \frac{L_2}{k_2\ A_2} + \frac{L_3}{k_3\ A_3}} = \frac{(\Delta T)}{\frac{L_1}{k_1\ A_1} + \frac{L_2}{k_2\ A_2} + \frac{L_3}{k_3\ A_3}}$$

Q = 3200 W

$$\Delta T = Q\left[\frac{L_1}{k_1\ A_1} + \frac{L_2}{k_2\ A_2} + \frac{L_3}{k_3\ A_3}\right]$$

Thermal Conductivity of steel, $k_1 = k_3$ = 45 W/mK; k_2 = 1.8 W/m; $L_1 = L_3$ = 0.002 m; L_2 = 0.09 m

$$\Delta T = 3200 \times \left[\frac{0.002}{45 \times 0.14 \times 0.14} + \frac{0.09}{1.8 \times 0.46 \times 0.4\,6} + \frac{0.002}{45 \times 0.5 \times 0.5}\right]$$

$$\Delta T = 3200 \times [0.0023 + 0.24 + 0.00018]$$

ΔT = **780 K**

3.2.9 Determination of the Pyrolysis Reactor Housing

$$V = L \times B \times H$$

Length, $L = 0.5$ m; Width, $B = 0.5$ m; Height, $H = 0.8$ m

$$V = 0.5 \times 0.5 \times 0.8$$

$$V = \mathbf{0.2\ m^3}$$

3.2.10 Determination of the Pyrolysis Reactor Container Volume

Diameter, d = 0.24 m; Height, h = 0.34 m

$$V = \pi \frac{d^2}{4} h$$

$$V = 3.142 \times \frac{0.24 \times 0.24}{4} \times 0.34$$

V = **0.02 m^3**

Figure 4 illustrates the pyrolysis reactor design drawing.

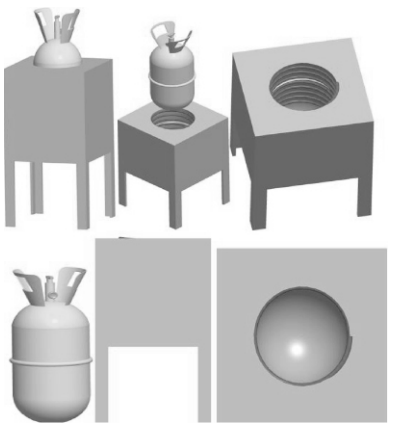


Figure 4: Design Drawing of the Pyrolysis Reactor

3.3 Construction of Pyrolysis Reactor Rig

As shown in table 2, fabrication of a Pyrolysis Reactor Rig is the act of constructing and developing a structure such as a machine capable of producing bio-char, bio-fuel, and bio-gas. A rectangular frame, welded rectangular box, flanges, cylinder, heating element frame, bolts, control switch, indicator light, thermocouple, and temperature controller comprise the pyrolysis reactor. Plates 1 and 2 depict the fabrication and process of filling the reactor by lagging with clay soil. The 3 mm Mild Steel Plate was

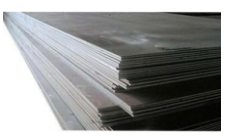
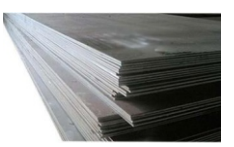
marked and cut into five 50 mm x 50 mm pieces. And the 3 mm Angular bar, which is marked to length of 80 mm in four pieces. Another 3mm mild steel piece was marked and cut into five 25 x 25 mm pieces. The 2 mm rectangular bar was then marked and cut.

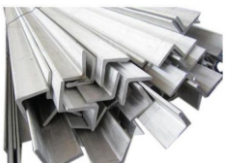
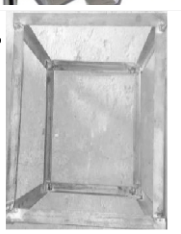
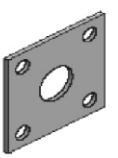
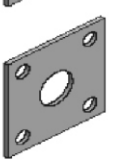
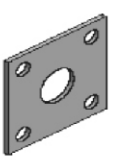
The five pieces of 50 x 50 mm mild steel were then welded together to form a rectangular box. Also, an angular rod 80 mm long welded to the four edges of the box, creating a rectangular box to stand on. The five pieces of 25 x 25 mm mild steel were then welded together to make a rectangular box, followed by the welded 2 mm angular bar to produce a rectangular box with a clearance for the placement/insertion of the 25 x 25 mm rectangular box.

Then, all four sides of the welded 2 mm rectangular box were drilled together, with the fibre glass bolted to it, and the fibre glass serves as an insulator, which was drilled for the passage of the heating element band around it into the ceramic Insulator connector, where a shelf connection of the heating band was done to give a three face. Furthermore, there are two forms of current passage: delta and star (which contain a neutral). And the delta connection was considered for the project's construction because the types consume less voltage.

The heating element band was then passed from the ceramic Insulator connector through a hole drilled in the side of the rectangular box to the temperature controller, thermocouple, and switch. Figure 4 depicts the design drawing of the pyrolysis reactor.

Table 2: Fabrication Processes

S/N	Processes	Tools and Equipment Used	Shape/Diagrams
1	The mild steel plate was marked and cut out in five pieces (50 x 50 x 3 mm) from the entire length of the plate for the outside cabin.	Metre rule, Scriber, Try Square, Guillotine machine	
2	The mild steel plate was marked and cut out (25 x 25 x 3 mm) in five pieces for the inner cabin from the entire length of the plate.	Metre rule, Scriber, Try Square, Guillotine machine	
3	The mild steel angle bar was marked and cut out of 3 mm thickness by holding it with a vice, and four pieces were cut out of 80 mm from the entire length, as well as 50 mm in ten pieces from the entire length of the angle bar.	Metre rule, Scriber, Try Square, Vice, Blade, Hacksaw	

4	12 pieces of 1 mm angular bar were marked and cut from the entire length.	Metre rule, Scriber, Try Square, Vice, Saw blade, Hacksaw,	
5	The exterior frame was created by welding four pieces of 50 x 50 mm mild steel plate together. Four pieces of mild steel plate measuring 25 x 25 mm were also welded together to form the interior frame (cabin).	Welding machine, Electrodes, Try Square, Slot Hammer	
6	Four pieces of 50 x 50 mm angle bar were welded together to form the cabin braze. Four 80 × 80 mm pieces were welded together to construct a stand for the frame (cabin), and 50 x 50 mm angle bar was welded together to produce a braze for the entire cabin component.	Welding machine, Electrodes, Try Square, Slot Hammer	
7	The top of the reactor (cylinder) was cut, and a flat flange was welded all around two faces of the separate parts.	Welding machine, Electrodes, Try Square, Slot Hammer	
8	Some holes were drilled through the flange and for the two parts of the cylinder to fasten together with bolts and nuts using a drilling machine and suitable drilling tools.	Drilling machine, Drilling bits, Punch tool	
9	To prevent heat loss, a suitable size gasket (cardboard gasket) was cut and placed in between the two components of the reactor (cylinder) using adhesive glue.	Adhesive glue	
10	To prevent heat loss, clay soil (mould) was placed between the outer and inner frames, as well as at the bottom of the outer frame.	Rammer, Shovel, Digger, Head pan	

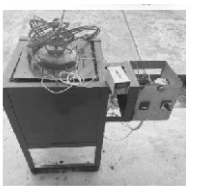
11	To prevent electric shock, the heating element was wrapped around the interior frame (cabin) with fibre glass. The entire frame (cabin) was painted with an appropriate paint for aesthetic purposes.	Saw Blade, Marker, Paint brush	
12	The temperature controller, indicator light, circuit breaker, and contactor were all fastened to a plate bolted to the frame's outer side (cabin).	Screwdriver, Spanner	
13	To measure both the interior and exterior (ambient) temperatures, K-type thermocouples were fitted.	Screwdriver	

Plate 1: Fabrication Process

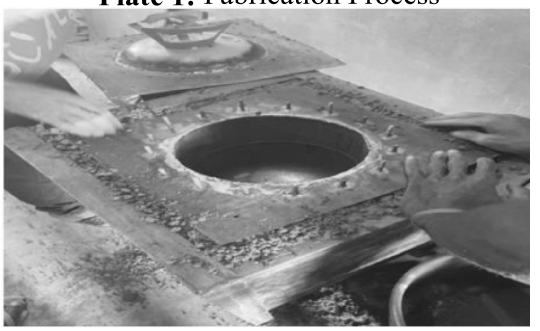


Plate 2: Process of Filling the Reactor by Lagging with Clay Soil

4. RESULTS AND DISCUSSION

Plate 3 depicts the testing of the designed and built pyrolysis reactor rig. The thermometer used to measure ambient temperature has a temperature range of 300 - 400 °C, whereas the thermometer used to measure within the reactor has a temperature range of 1200 - 1300 °C. When tested without the heating element, the inside and exterior temperatures were 27 and 28 degrees Celsius, respectively.

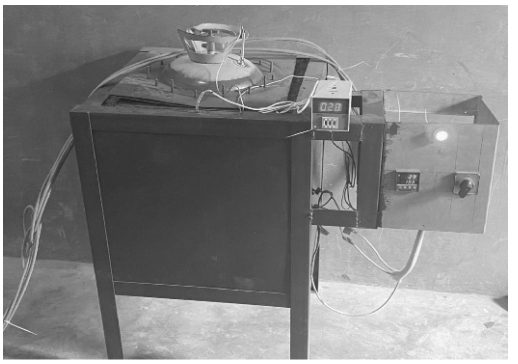


Plate 3: Reactor Testing Performance

5. CONCLUSION

In conclusion, the project's objectives of designing and constructing a pyrolysis reactor rig were achieved. The pyrolysis was simple to construct and required little maintenance. There are no sophisticated components required in the reactor system. Fixed bed reactors, temperature measurement devices, heating elements, thermocouples, contactor, circuit breaker, and power indicator are some major components. When the heating element was switched off, the inside and ambient temperatures were 27 and 28 degrees Celsius, respectively.

REFERENCES

Adaramola, M. S., and Krogstad, P. (2011). Experimental Investigation of Wake Effects on Wind Turbine Performance. Renewable Energy. Open Journal of Fluid Dynamics, 7 (1).

Akorede, M. F., Ibrahim, O., Amuda, S. A., Otuoze, A. O., and Olufeagba, B. J. (2017). Current Status and Outlook of Renewable Energy Development in Nigeria. Nigerian Journal of Technology.

Amigun, B., and Musango, J. K. (2011) Biofuels and Sustainability in Africa. Stellenbosch University William Stafford Council for Scientific and Industrial Research, South Africa.

David, E. A., and Nosa, O. (2012). A comprehensive review of biomass resources and biofuel production potential in Nigeria. University of Leeds Petroleum Training Institute, Effurun.

Duku, M. H., Gu, S., and Hagan, E. B. (2011a). A Comprehensive Review of Biomass

Resources and Biofuels Potential in Ghana, Renewable and Sustainable Energy Reviews, Journal of Sustainable Bioenergy Systems, 4 (1).

Duku, M. H., Sai, G., and Hagan, E. B. (2011b). Biochar Production Potential in Ghana: A Review. Renewable and Sustainable Energy Reviews, 15(8), 3539-3551.

https://doi.org/10.1016/j.rser.2011.05.010

McKendry, P. (2002). Energy Production from Biomass (Part 1): Overview of Biomass. Bioresource Technology.

Musale, H. K., Bhattacharyulu, Y. C., and Bhoyar, R. K. (2013). "Design Consideration of Pyrolysis Reactor for Production of Bio-Oil". International Journal of Engineering Trends and Technology (IJETT), 5 (2).

Oyedepo, S. O. (2012). Effect of Climate Change on Power Generation and Consumption in Gas Turbine Power Plant. Covenant University Ota, Ogun State, Nigeria.

Ozoegwu, C., Eze, C., Onwosi, C., and Mgbemene, C. A. (2017). Biomass and Bioenergy Potential of Cassava Waste in Nigeria: Estimations Based Partly on Rural-Level Garri Processing Case Studies. Renewable and Sustainable Energy Reviews, 72, 625-638.

https://doi.org/10.1016/j.rser.2017.01.031

Rahman, M. M., Alim, M. A., and Mamun, M. A. (2009). Finite Element Analysis of Mixed Convection in a Rectangular Cavity with a Heat-Conducting Horizontal Circular Cylinder. Nonlinear Analysis: Modeling and Control, Applied Mathematics and Physics, 14 (2), 217-247.

Rajput, R. K. (2012). Heat and mass Transfer. S. Chand & Company, Ram Nagar, New Delhi, 110 055.

Sambo, A. S. (2005). Renewable Energy for Rural Development: The Nigerian Perspective. ISESCO Science and Technology Vision, 12-22.

Sambo, A. S. (2009). The Place of Renewable Energy in the Nigerian Energy Sector. World Future Council Workshop on Renewable Energy Policies, Addis Ababa, Ethiopia.

Simonyan, K. J., and Fasina, O. (2013). Agricultural Research Biomass Resources and Bioenergy Potentials in Nigeria. Michael Okpara University of Agriculture, Umudike.

FEDPOLAD JOURNAL OF ENGINEERING AND ENVIRONMENTAL STUDIES (FEDPOLADJEES)

OCCUPATIONAL NOISE MEASUREMENT IN SOME SELECTED AREAS IN ADO-EKITI (WELDING, SAW-MILL & ALUMINIUM WORKSHOPS)

Authors

[1]Fasae K.P and [2]Olumodeji I.A.

[1,2]Science Technology Department,

Federal Polytechnic Ado-Ekiti

Corresponding e-mail: olumodeji_ia@fedpolyado.edu.ng

Abstract:

This paper present result obtained from the measurement of occupational noise in selected locations in Ado-Ekiti - Welding Workshop, Saw Milling Workshop and Aluminium Workshop at Omisanjana, Falegan and NTA Road respectively. Using Sound Level Meter D.T. 8852, the Average daily occupational noise level (L_{Aeq}) varied from 88.2dBA to 95.15dBA which is totally unacceptable by WHO (World Health Organisation) and FHWA (Federal Highway Administration) Noise Standards. The result of this study is very useful as reference and guideline for future regulations on occupational noise limit to be implemented for Ado-Ekiti and other urban areas in Nigeria.

Keywords: *Average Noise Level, Noise Limit, Occupational Noise, Heavy-duty Machines, Ado-Ekiti.*

Introduction

Sound is a rapid variation of atmospheric pressure caused by some disturbance of the air. Sound propagates as a wave of positive pressure disturbances (compressions) and negative pressure disturbances. In human physiology and psychology, sound is the reception of such waves and their perception by the brain. Humans can hear sound waves with frequencies between about 20 Hz and 20 KHz. Sound above 20 KHz is ultrasound and below 20 Hz is infrasound.[1]

Noise: is derived from the Latin word “nausea” implying unwanted sound; sound that is intense enough to damage hearing is unwanted and is considered to be noise. Noise originates from human activities especially the urbanization, urban population is much more affected by such pollution which is becoming increasingly omnipresent, yet unnoticed form of pollution even in developing countries.[2]

Its intensity (loudness) is measured in decibels (dB). The decibel scale is logarithmic, so a three decibel increase in the sound level already represents a doubling of the noise intensity. For example, a normal conversation may be about 65dB and someone

shouting typically can be around 80dB. The difference is only 15dB but the shouting is 30 times as intensive. To take into account the fact that the human ear has different sensitivities to different frequencies, the strength or intensity of noise is usually measured in A-weighted decibel (dBA).[3]

Occupational noise: is commonly defined as any unpleasant or undesirable sound that is generated at a work place. The normal human ear and nervous system have the remarkable capacity to receive and perceive sound (and noise). However, numerous diseases can impair or completely nullify normal hearing capabilities. Although there are many sources of hazardous noise and types of hearing impairment, workplace noise or occupational noise exposures are the best predictor of hearing impairment other than old age. Occupational Noise is 100 percent preventable, but remains a substantial contributor to the overall hearing impairment of the working population.[4]

EFFECTS OF OCCUPATIONAL NOISE

Some effects of noise on man are: contraction of blood vessels, making skin pale, excessive secretion of adrenalin in the blood stream which is responsible for high blood pressure, mental distress, heart attack, muscular contraction, impairment of night vision, decrease in rate of colour perception and many more.

NOISE STANDARDS AND GUIDELINES

Table 1: FHWA (Federal Highway Administration) noise standards [5]

S/N	NOISE LEVEL	DESCRIPTION OF CATEGORY
1	60dBA (Exterior Limit)	For parks and open spaces
2	70dBA (Exterior Limit)	Residential areas, Hotels, Schools, Libraries, Hospitals etc
3	75dBA	Developed areas
4	55dBA (Interior Limit)	Residential area, Hotels, Libraries

Table 2: WHO (World Health Organization) guidelines for community noise [6]

Environment	Critical Health Effect	Sound Level (dBA)	Time hours
Outdoor living areas	Annoyance	50-55	16
Indoor dwellings	Speech intelligibility	35	16
Bedrooms	Sleep disturbance	30	8
School Classrooms	Disturbance of communication	35	During class
Industrial, Commercial and traffic areas	Hearing impairment	70	24
Music through earphones	Hearing impairment	85	1
Ceremonies and entertainment	Hearing impairment	100	4

RECEPTOR	ONE HOUR LAeq (dBA)	
Residential; Institutional; Educational	DAY	NIGHT
	55	75
Industrial; Commercial	DAY	NIGHT
	55	75

Table 3: Environmental, Health and Safety (EHS) Guidelines

As shown in Table 1 and according to FHWA, the noise level for developed areas should not exceed 75dBA, in Table 2, WHO states that the noise level for industrial areas should not exceed 70dBA likewise EHS also affirms the noise level for industrial area does not exceed 70dBA in every 8hours.

MATERIALS AND METHODS

MATERIALS:

A digital Sound Level Meter (SLM) model GM1352 was used to determine the noise level in Seven (7) different locations across Ado-Ekiti.

STUDY AREA:

Ado-Ekiti is located between $7^0$34'N to $7^0$44'N and longitude 5^0 12'N to 5^0 16'N. It has a population of 2,384,212 according to 2006 census. Omisanjana, NTA road and Ola Oluwa were the locations used in Ado-Ekiti at several occupational areas which are situated close to major roads in Ado-Ekiti town.

METHODOLOGY:

The instrument was held comfortably in hand with the Microphone pointed at the suspected noise source at a distance not less than 1 meter at ear level. Measurements were taken at intervals of 600s for a period of 60 mins. This procedure was carried out in the morning and afternoon. Noise measurements were done when the effects on the noise sources of variable factors (e.g. wind speed, rainfall, etc) were at minimum. All the data were obtained on week days and under suitable meteorological conditions.

RESULT AND DISCUSSION:

LOCATION 1

Table 3

WORKSHOP	MINIMUM (dBA)	MAXIMUM (dBA)
Omisanjana	87.50	102.80
NTA Road	84.80	99.40
Ola-Oluwa	85.00	96.70

LOCATION 2

Table 4

WORKSHOP	MINIMUM (dBA)	MAXIMUM (dBA)
Falegan (A)	85.5	90.9
Falegan (B)	83.5	91.6

LOCATION 3

Table 5

WORKSHOP	MINIMUM (dBA)	MAXIMUM (dBA)
Ilawe Road	54.9	120.2
Falegan	58.1	125.1

**Location 1,2,3 are Welding, Sawmilling and Aluminium Workshops respectively.*

DISCUSSION:

In Location 1, noise from this job was mainly from soldering, grinding and cutting of iron and metals. The average noise level in the three workshops is 95.15dBA, 92.10dBA and 90.85dBA respectively.

In Location 2, noise generated from this job was from cutting and filing of felled stem of trees. The average noise level in the two workshops is 88.2dBA and 87.60dBA respectively.

In Location 3, noise from this job was from the cutting, drilling and filling of aluminium sheets. The average noise level in the two workshops is 87.60dBA and 91.60dBA respectively.

The noise level generated at these different locations was high and extremely detrimental to the workers. According to the regulations and standards of environmental, health and safety (EHS) guidelines as shown in Table 3, that noise generated at industries should not be more than 70 (dBA) for 8 hours.

The residents are also exposed to noise levels of 80-90dBA or more daily which is

higher than FHWA noise standards as shown in Table 1. Moreso, according to the WHO, generally 60dBA sounds can result into temporary hearing impairment and 100dBA sound can cause permanent impairment.

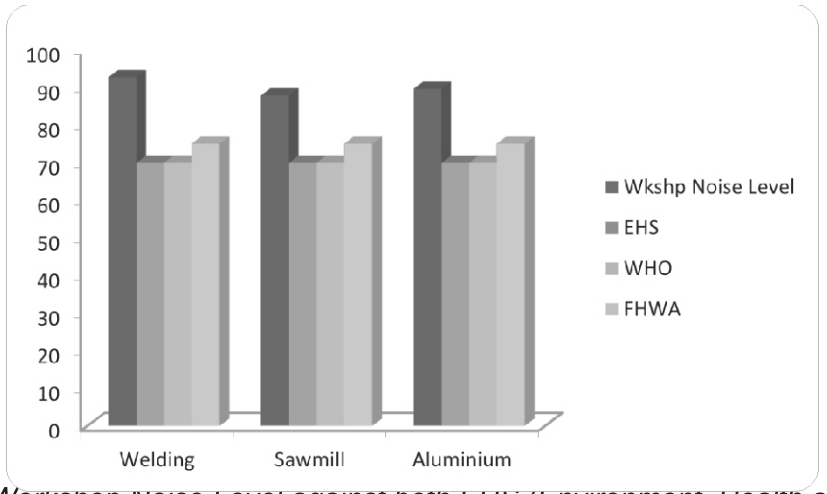


Fig.1: Workshop Noise Level against both EHS (Environment, Health and Safety) and FHWA (Federal Highway Administration) Noise Level Standards

CONCLUSION:

The result obtained from this research work has shown that the level of sound generated in these workshops is very high and poses several severe health threats not only to workers but also to residents close by. This requires urgent attention, because these workers are been exposed to these noise levels for more than 8 hours daily in the last 3 years with no protection. Workers in these locations should be informed about the result from this research work, educated about the effects of occupational noise and advised to report for immediate medical examinations and rehabilitation. Industries and Workshops owners are to strictly conform/adhere to the regulations and standards on industrial noise control; to re-design their workshops in order to extract/limit noise generated. Workers of factories, industries and workshops are to make use of ear mufflers/plugs to reduce the level of exposure to noise.

REFERENCES:

Acoustical Society of America. "PACS 2010 Regular Edition—Acoustics Appendix". Archived from the original on 14 May 2013. Retrieved 22 May 2013.

Valentine B, et al (2010): “Noise Pollution in Port Harcourt Metropolis: Sources, Effects and Control” Working and Living Environmental Protection Vol.7,

N°1, 2010, Pp 33-42.

"Occupational Noise Exposure: Standards". Occupational Safety and Health Administration. Retrieved 2016-07-14.

Talty, J.T (1998): Industrial Hygiene Engineering, 2nd Edition, Stecom Publishers Nigeria. Pp 16-42.

Dhananjay K.P et al (2007): "Assessment and ANN modeling of noise levels at major road intersections in an Indian intermediate city", J. of Research in Science, Computing and Engineering, 4(3): 39-49.

Mansouri N et al (2006): "Road traffic noise in downtown area of Tehran", Iranian J. of Environmental Health, Science and Engineering, 3(4): 267-272

FEDPOLAD JOURNAL OF ENGINEERING AND ENVIRONMENTAL STUDIES (FEDPOLADJEES)

EMPIRICAL ASSESSMENT OF SOCIO-ECONOMIC CONTRIBUTIONS OF ESTABLISHMENT OF FEDERAL POLYTECHNIC, ILE-OLUJI TO THE HOST COMMUNITY

Authors

Olaniyan Joseph Olawale; Aliu Abbas Hassan and Ikotun David Oluwafisayo

Department of Statistics,
Federal Polytechnic Ile-Oluji, Ondo State.
olawalelink2007@yahoo.com

Abstract:

Institutions have been acknowledged as powerful mechanism for socio-economic transformation of the areas where they are established. This study investigated the socio-economic contributions of establishment of Federal Polytechnic, Ile-Oluji to the development of the host community, Ile-Oluji. In achieving this, 1000 respondents were randomly selected from various classes of people living in the community and administered questionnaires. Data collected was presented and analyzed using Excel and Statistical Package for Social Science, (SPSS). Chi-square test of independence was employed to determine and test for associations between establishment of the Federal Polytechnic, Ile-Oluji and various important socio-economic variables assessed in this study. Consequently, majority of various socio-economic variables assessed and tested confirmed that the establishment of Federal Polytechnic Ile-Oluji significantly contributed to the socio-economic development of the host community, Ile-Oluji in Ile-Oluji/Oke-Igbo Local Government Area, Ondo State, Nigeria. It was however observed that a few number of variables like, improvement in farming activities, security of the community and property acquisitions were independent of establishment of the institution in the community.

Keywords: *Acquisition, Community, Economic, Establishment, Institution, contributions Questionnaires*

Introduction

The Federal Polytechnic, Ile-Oluji, was established by the government of the Federal Republic of Nigeria in 2014. It however, took off effectively in April 2015. Ile-Oluji is bounded on the south by otasun hills, Okurughu and Awo rivers and on the south West by Oke-Igbo (in Ile-oluji/Oke-Igbo Local Government Council) and on the North side East by Oni rivers and Ikeji hills. On the East partly by river Owena and partly by Ondo (in Ondo Local Government council), and on the West by the

tributary of the Oni river. Her immediate neighbours are Ondo, Okeigbo, Idanre and Ipetu-Ijesha. The population of Ile-Oluji is about 172, 870, with a landed area of 698km2 (Adefusisoye A. A. et al, 2016).

The contributions of tertiary institutions to host communities' socio-economic development cannot be under-rated. This is because institutions of higher learning draw their resources from both local, national and sometimes international economies, even though their operations are mostly local. In view of this, colleges or universities would justify their earnings to the host localities/communities by creating jobs, boosting internally generated revenue and thereby stimulating the local economy (Garlick S., 2005). This could be the reason why establishment of tertiary institutions of recent was generating a lot of discords and political quarrel among Communities on the specific location where it should be sited in Nigeria (Fatoki O., 2017). It is a known fact that tertiary institutions contribute to the development and advancement of the society and assist the communities that host them in having a democratic voice in the process of globalization (Ali A., 2010). Indubitably, higher education remains a major investment in human capital to enhance capabilities and advancement. It is also an indispensable ingredient for national development, not just in the economy but other facets of national life including communities where such institutions are located.

Consequently, communities hosting a tertiary institution will, therefore, have to prepare to allow innovations and development which cannot but compromise some social, environmental and cultural interests of the people. Such is the case where Federal Polytechnic, Ile-Oluji is located. The Communities require tertiary institutions more than ever before because it serves the people, advises governments in policy-making decisions, helps develop skills, creates knowledge and train leaders. They are at the centre of crucial research, through which a country can stimulate innovations as well as attract foreign investments and engage in scientific commerce. When an institution is given the opportunity to thrive, they can also help to promote an open, modern, civil, tolerant and democratic community, because it is a medium through which higher education that deepens ethical and moral values can be enculturated (Fatoki O. et al, 2017).

According to Garlick (2005), the relationship between Tertiary institution and its community can be described in three different ways; it can be described through the structural perspective as a situation in which tertiary institutions are seen as economic boosters, through the spatial perspective as the association with equity measures such as student placement and also through a third stream perspective which is based on the appreciation of the importance of a region to the tertiary institution that are located there. Thus, higher institutions have always had an impact on the local, regional and central development apart from producing trained and educated skilled labour; Institution Research and Innovation are often seen as engines of growth for

development while peaceful coexistence is given priority (FME, 2016).

The association between tertiary institutions and cities has continued to the present: Yale, Stanford and so on. The often heard expression; "town and grown" derives from the integration of an institution within a town. The British experience of the so-called red brick universities started around 1910 and is an excellent example. Cities like Birmingham, Sheffield, Bristol, Southampton, are after others have created a university to serve their urban community (Kyazze, 1993).
Nearer home in Nigeria, several communities see the advantage and pride in having schools bear their names. For instance, the University of Ibadan developed out of a very small settlement. The people of Nigeria took pride in knowing that a good educational institution could emanate from their country then, Ibadan in those days was a rural settlement with its red-roof houses. But now, it has metamorphosed into a big urban settlement. Also, the University of Port Harcourt developed from a small rural settlement, but now, it is a bustling urban settlement. Other examples are the University of Nsukka, University of Benin, Yaba college of Technology, to mention but few.

From a global perspective, one could say that economic and social development is progressively driven by the application of knowledge. Education generally (tertiary education precisely) are fundamental to the construction of knowledge economy and society in all nations. Complementing this, (Hayward 2006) reiterated that, active participation in societal knowledge is essential to economic growth; higher education institutions are the potential engines for that growth. Therefore, the attention given to higher education by a nation determines the extent to which the dividends will be reaped. Fatoki O. et al, (2017) place as a principal player in a global system increasingly driven by knowledge, information and ideas. Knowledge is replacing other resources as the main driver of economic growth, social Integration and Cohesion and education has increasingly become the foundation for individual prosperity and social mobility (Fatoki O. et al, 2017).

Societies have witnessed different stages of human civilization centering around knowledge. Based on advancement in knowledge, societies have been changing, transitioning and transforming Fatoki O. et al, (2017). In appreciating this and recognizing the critical role of tertiary institutions in socio-economic sphere and while expressing his view on the special role of open university buttressed the desire of nations for a progressive, stable and peaceful community as the one that is economically, socially, materially and spiritually complete as well as able and consistent to contribute to the wellbeing of countries (Ali 2010).

In view of the contributions of establishment of tertiary institutions to the community where the institutions are domiciled, this study focuses on assessing socio-economic contributions of establishment of Federal Polytechnic, Ile-Oluji to the host community,

Ile-Oluji in Ondo State, Nigeria.

1. Materials and Methods

This study used survey method that depends on a sample of respondents drawn as representative of the population. The target populations were residents of Ile-Oluji, Ondo State. The population of Ile-Oluji was about 172,870 according to 2006 population census. The survey was distributed to 1000 people in Ile-Oluji community using non-probabilistic sampling technique called Convenience sampling.

A questionnaire which consists of two major parts was developed: The first part contained questions about demographic distribution. In the second part, statements with 3-point Likert scale options as Agree, Disagree and Undecided were used to explore people' perceived notion on socio-economic impact of establishment of Federal Polytechnic, Ile-Oluji in Ile-Oluji. The data were analyzed using the statistical software SPSS and Microsoft Excel.

In order to answer research questions, both descriptive and inferential statistics were employed in the analysis. Descriptive statistics includes frequency distributions and percentages, tables and bar-chart. While in inferential statistics, Chi-Square test of independence was used.

According to Murray R. Spiegel and Larry J. Stephens (2008) and Bewick V, Cheek L, Ball J (2004), Chi square ($\chi 2$) statistic is a test that measures how expectations compare to actual observed data (or model results). The data used in calculating a chi square statistic must be random, raw, mutually exclusive, drawn from independent variables, and drawn from a large enough sample. There are two main kinds of chi square tests: the test of independence for data and tests of goodness of fit for a model. Based on the scope of this study, Chi-Square Tests of Independence was employed. These tests can be used to determine whether a certain null hypothesis can be rejected in hypothesis testing that there is independence/no association between the variables of a contingency table or not. The statistic is calculated by first obtaining for each cell in table, the expected number of events that will occur if the null hypothesis is true. When the observed number of events deviates significantly from expected counts, then it is unlikely that the null hypothesis is true, and it is likely that there is a row-column association. Conversely, a small chi-square value indicates that the observed values are similar to the expected values leading us to conclude that null hypothesis is plausible. For the Test of Independence, the chi-square ($\chi 2$) test statistic is given as

$$\chi^2_{cal} = \sum_{i=1}^{n}\sum_{j=1}^{r}\frac{(O_{ij} - E_{ij})^2}{F_{ij}} \quad (1)$$

$$\chi^2_{\alpha} = t_{\alpha,(r-1)(c-1)} \quad (2)$$

Where O_{ij} is observed count in category; E_{ij} is expected count in the category under the null hypothesis ; c, r represents the number of columns and rows in the contingency table respectively; The number of the degree of freedom is equal to the number of cells, rc, minus the reduction in degree of freedom, p, which reduces to $(r-1)(c-1)$.

Hypothesis statement

H_0: There is independence between the economic growth of Ile-Oluji and establishment of the Federal Polytechnic, Ile-Oluji in Ile-Oluji

H_1: There is no independence between the economic growth of the Ile-Oluji and establishment of Federal Polytechnic, Ile-Oluji in Ile-Oluji

3. Results and Discussions

3.1 Presentation of Data

Presented below is the analysis of the data collected from the survey purposefully aimed at socio-economic contributions of Federal Polytechnic Ile-Oluji to the host community. These are shown on tables and charts (frequencies and percentages) below.

SECTION A: Social- Demographic Distribution of the Respondents

Table 1: *Gender Distribution of the Respondent*

Sex	No of Respondents	Percent % of Respondents
Male	493	49.3
Female	507	50.7
Total	**1000**	**100.0**

Source: Field Survey, 2021

Figure 1: *Chart Showing Sex and Percentage Sex Distributions of the Respondents*

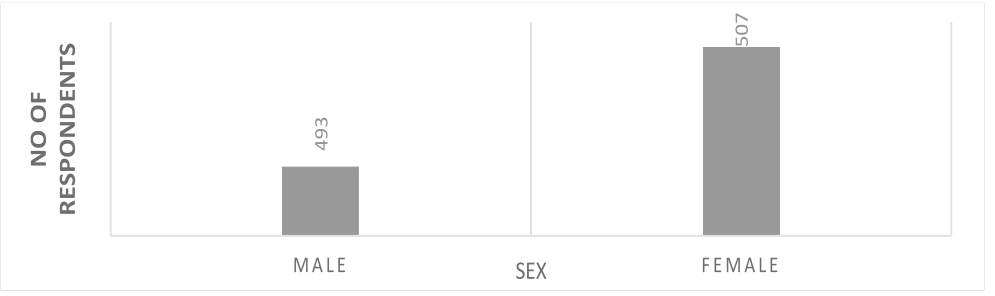


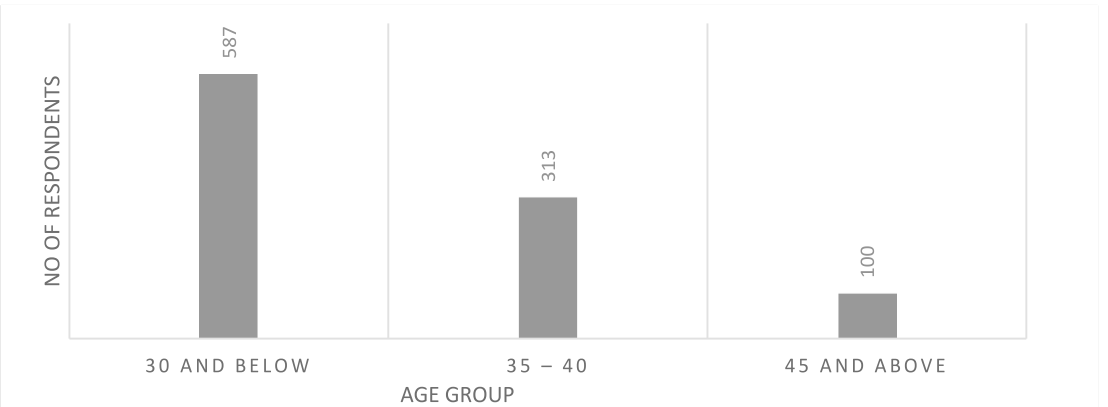
Table 1 above shows that 50.7% of the respondent were female while 49.3% were male while Chart 1 further reveals that the respondents were almost equal in relation to gender distribution. i.e. 50.7% of the respondent were female while 49.3% were male. It also shows that majority of the respondent are below the age of 30.

Table 2: Age Distribution of the Respondents

Age Group	No of Respondents	Percent % of Respondents
30 and below	587	58.7
35 – 40	313	31.3
45 and above	100	10.0
Total	**1000**	**100.0**

Source: Field Survey, 2021

Figure 2: *Chart showing the Age and Percentage Age Distributions of the Respondents*



From Table 2 and Figure 2 above, the result show that 58.7% of the respondents were age 30 and below, 31.3% of the respondent were between age 35 to 40 while 10.0% of the respondents were age 45 and above. This research deal with the Economic Impact of Federal Polytechnic, Ile-Oluji on the host community, Ile-Oluji in Ondo state.

Table 3: Religious Distribution of the Respondent

Religions	No of Respondents	Percent % of Respondents
Christianity	787	78.7
Islam	173	17.3
Other	40	4.0
Total	**1000**	**100.0**

Source: Field Survey, 2021

Figure 3 : *Chart showing the Religion and Percentage of Religion Distributions of the Respondents*

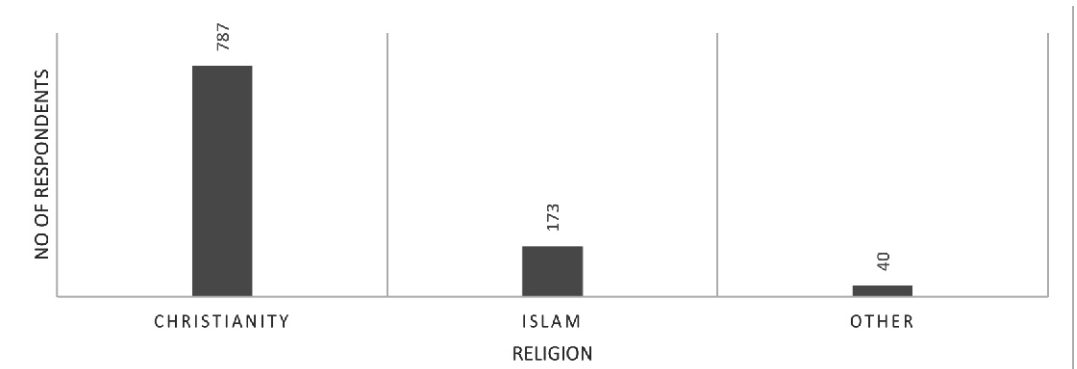


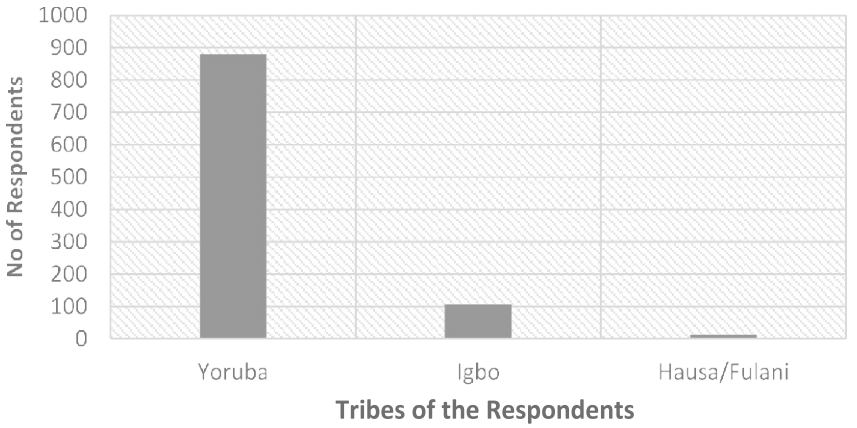
Table 3 and Figure 3 above show that 78.7% of the respondent were Christians while 17.3% of the respondent were Islam. It means that the community is majorly populated by Christians.

Table 4 : *Tribes Distribution of the Respondent*

Tribes	Frequency	Percent %
Yoruba	880	88.0
Igbo	107	10.7
Hausa/Fulani	13	1.3
Total	**1000**	**100.0**

Source: Field Survey, 2021

Figure 4: Chart showing the Tribes Distribution of the Respondents



From table 4 and Figure 4 above, the findings show that 88.0% of the respondents were from Yoruba tribe, 10.7% of the respondents were Igbo tribe while 1.3% of the respondents were from Hausa. This is because the institution is situated in the southwestern part of Nigeria which is known to be predominantly Yoruba people.

Table 5 : Result Collated from the Respondents using SPSS

Questions	**Agree**	**Disagree**	**Undecided**	**Remark**
There is an access to high education for the indigenous student	887	93	20	Agree
There are increase employment opportunities	747	173	80	Agree
Increase in small scale enterprise opportunities	834	126	40	Agree
There is increase Training on entrepreneurial skills	714	173	113	Agree
There is an increase in farming activities	800	140	60	Agree
Due to immigration, there has been increase pressure on public service like health/transportation?	694	166	140	Agree
Due to immigration there has been increase cost of housing/renting	773	160	67	Agree
There is improved quality of life in ile oluji	754	166	80	Agree

There is innovation and establishment of new companies	647	213	140	Agree
There is increase in crime?	620	293	87	Agree
There is increase in pollution; noise, garbage, etc.	720	220	60	Agree
There is an increase social gathering?	714	173	113	Agree
There are more congestion, accident and parking problems?	740	140	120	Agree
There is an improvement in the security of the community?	674	213	113	Agree
The federal polytechnics ile-oluji has brought more property acquisitions to the people in the community?	767	160	73	Agree

From Table 5 above, the result indicated that majority of the respondents agreed that the factors outlined in the research had Impact on the economy of Ile-Oluji due to the establishment of the Institution.

3.2 Analysis and Discussions

Test of independence between Selected socio-economic variables and establishment of the Federal Polytechnic Ile-Oluji using Chi-square test of independence are shown below.

Hypothesis Testing

Hypotheses	Determinant Variables	Chi-Square	Df	P-value	Decision	Conclusion
1	There is an access to high education for the indigenous student	21.97	4	0.00	H_0 rejected	Dependent
2	There are increase employment opportunities	13.78	4	0.01	H_0 rejected	Dependent
3	Increase in small scale enterprise opportunities	3.16	4	0.53	H_0 accepted	Independent
4	There is increase Training on entrepreneurial skills	11.50	4	0.02	H_0 rejected	Dependent
5	There is an increase in farming activities	4.77	4	0.31	H_0 accepted	Independent

6	Due to immigration, there has been increase pressure on public service like health/transportation?	14.13	4	0.01	H_0 rejected	Dependent
7	Due to immigration there has been increase cost of accommodation?	19.84	4	0.00	H_0 rejected	Dependent
8	There is improved to quality of life in ile-oluji	19.34	4	0.00	H_0 rejected	Dependent
9	There is innovation and establishment of new companies	17.51	4	0.00	H_0 rejected	Dependent
10	There is increase in crime?	21.51	4	0.00	H_0 rejected	Dependent
11	There is increase in pollution; noise, garbage, etc.	13.51	4	0.01	H_0 rejected	Dependent
12	There is an increase social gathering?	30.11	4	0.00	H_0 rejected	Dependent
13	There are more congestion, accident and parking problems?	15.12	4	0.004	H_0 rejected	Dependent
14	There is an improvement in the security of the community?	5.79	4	0.22	H_0 accepted	Independent
15	The federal polytechnics ile-oluji has brought more acquisition to the	8.59	4	0.07	H_0 accepted	Independent

From table 6 above, the determinant variable 1 (There is an access to high education for the indigenous students) shows that Federal Polytechnic Ile-Oluji and access to higher education by the indigenous students are related. This implied that the establishment of the institution in the community had improved the enrolment of indigene in the institution for higher education. This implied that the institution had benefitted the community in this area of indigenous students for higher learning.

The determinant variable 2 (There are increase employment opportunities) shows that there is an association between the establishment of the Federal Polytechnic Ile-Oluji and increase employment opportunities. This implied that establishment of Federal Polytechnic Ile-Oluji had also contributed to the economic growth of the community through increase in employment opportunities such as skilled and unskilled labour.

The determinant variable 3 shows that increase in small scale enterprise was independent of the establishment of Federal Polytechnic Ile-Oluji in the community. This may rely largely on other factors not discussed in this study like farming activity and nearness to a city. The result however implied that there is no relationship between the two variables.

The determinant variable 4 indicates that Federal Polytechnic Ile-Oluji and increase in Training and entrepreneurial skills in the community are related. This implied that more entrepreneurial skill had been generated as a result of establishment of the institution in the community. By extension, it has had positive effect on the economic growth of the community.

Variable 5 shows that Federal Polytechnic Ile-Oluji and increase in farming activities are not dependent. This may be responsible to the fact that the community was originally known for farming activities even before the establishment of the institution.

Variable 6 shows that Federal Polytechnic Ile-Oluji and increase in pressure on public utilities like health/transportation etc. are dependent. This may be responsible to increase in the number of people residing and migrating into the community to seek for greener pasture as well as survivorship as a result of establishment of the institution.

Variable 7 shows that establishment of the institution and increase in cost of accommodation, are dependent. It implied that the establishment of the institution had encouraged the influx of more people to the community thereby creating more demand than the available accommodation facilities.

The Variable 8 shows that there is an association between establishment of Federal Polytechnic Ile-Oluji to improved quality of life in Ile-Oluji. This could be as a result of better access to education and other human development variables.

The determinant variable 9 shows that the establishment of Federal Polytechnic Ile-Oluji had led to enhancement of innovation and establishment of new companies. This would also improve quality of life in the community.

Variable 10 shows that Federal Polytechnic Ile-Oluji and increase in crime are dependent. This implied that the more the number of people living in the community, the more the criminal activities in the community.

The Variable 11 shows that Federal Polytechnic Ile-Oluji and increase in pollution; noise, garbage, etc. are dependent. This was as a result of increase in socio-economic activities in the community happening as a fallout from the establishment of the institution.

Variable 12 indicates that Federal Polytechnic Ile-Oluji had contributed significantly to increase in social gathering. This implied that establishment of the institution was responsible for increase in social gathering in the community.

The determinant variable 13 shows that there is an association between establishment Federal Polytechnic Ile-Oluji and more congestion, accident and parking problems. This was as a result of more people entering the community because of the institution.

Variable 14 reveals that Federal Polytechnic Ile-Oluji and improvement in the security of the community are not dependent This implied that there was no synergy between improvement in security of the community and establishment of the institution. In effect, security machinery of the community needed to be rejigged to curtail the increase in criminal activities in the community because of the attended increase in the influx of people as a result of establishment of the institution.

The determinant variable 15 indicates that Federal Polytechnic Ile-Oluji has helped the people of the community in more property acquisition.

1. Conclusion and Recommendations

4.1 Conclusion

This study investigated the economic impact of Federal Polytechnic, Ile-Oluji on the host community Ile-Oluji, Ile-Oluji/Oke-Igbo Local Government Area, Ondo State. Considering various findings emanated from the analysis, it could be concluded that the establishment of the institution in the community had provided increased socio-economic opportunities to both residents and the community in general. This implied that establishment of the institution had impacted on both the social and economic growth of Ile-Oluji, the host community. Though, variables like “increase in small scale business”, “increase in farming activities” and “improvement in the security” of the community and “acquisition” did not reflect directly link to the establishment of the Polytechnic in the community, Ile-Oluji.

4.2 Recommendations

It is hereby recommended that;

i. The Institution should involve more indigenes in developmental projects so that they can benefit from the Institution directly and enhance property acquisition.

ii. More training/workshop /skill acquisition programmes in partnership with the existing skill acquisition Centre in the Community to boost skills acquisition and technical-know-how of the populace should be enhanced by the Polytechnic.

iii. More collaboration with the Community in the area of modern farming since the people in the Community are mostly agrarians be strengthened.

Reference

Richard Odunayo Akinyeye, *Adefusisoye Adegalu Adebawore, Emmanuel Eyitayo Awokunmi and Edward Olorunsola Olanipekun (2016). "Evaluation of polycyclic aromatic hydrocarbons in water from hand dug wells at Ile-Oluji, Nigeria". IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT) e-ISSN: 2319-2402, p- ISSN: 2319-2399. Volume 10, Issue 9 Ver. I, PP 113.

Ali, A. (2010). The role of universities and open and distance learning, "Being a text delivered at the 6th Pan-Commonwealth forum on open learning", Developing the community, India, 24-28 November.

Bewick V, Cheek L, Ball J (2004). Statistics review 8: Qualitative data-test of association. Crit care. 8:46-53.

Ehinmowo, A. A. & Eludoyin, M. O. (2010). The university as a nucleus for growth pole: Example from Akungba - Akoko, Southwest, Nigeria. International Journal of Sociology and Anthropology. 2(7), 149-154.

FME. (2016). List of Nigerian Tertiary institutions. Abuja, FCT, Nigeria: Federal Ministry of Education (FME).

Garlick, S. (2005). The role of higher education institutions in regional development – the case of Australia. Paper presented at a seminar at Karlstad Uni., Sweden. https://www.oecd/longabstract

Hayward, F. M. (2006). Accreditation and quality assurance in African Higher Education: Feelings and lessons learned from a survey of Africa. Paper presented at the 1st international conference of assessing quality of Higher Education. Dec. 11– 13 University of Punjab, Lahore.

https://gazettes.africa/archive/ng/2009/ng-government-gazette-dated-2009-02-02-no-2.pdf

Kyazze, J. (1993). The Effect of School Community Relation on Enrolment and Retention. Journal of Education. Issue 20.

Murray R. Spiegel and Larry J. Stephens (2008). Schaum's Outlines Statistics, McGraw Hill 3rd Edition, 261-276

FEDPOLAD JOURNAL OF ENGINEERING AND ENVIRONMENTAL STUDIES (FEDPOLADJEES)

EXAM PROCTORING TECHNIQUES BEFORE 2020 AND DURING THE COVID-19 ERA AS REVIEWED

Authors

Ojo Olufemi A.[1*], Olatunji–Ishola C. O.[1] Ojo, Adedayo D[2]

1 Department of Computer Science Federal Polytechnic, Ado Ekiti, Ekiti State. Nigeria.

2 Department of Computer Science Osun State Polytechnic, Iree, Osun State. Nigeria

**Corresponding author details: jdfemi@gmail.com*

Abstract:

Examination, popularly refers as a test in an ICT environment, is an age-long practice that has shifted in forms over the years. Globally, tests are conducted for students at all levels of academic pursuit to assess assimilation, performance and progression. Examinations, no doubt, have to be invigilated or proctored, except in very few instances, to ensure test takers abide by stipulated rules and avoid chances of malpractices during the exam period. Unprepared, the COVID-19 pandemic began in 2019 and almost crumbled virtually all areas of human endeavour, including educational settings. After a while, schools and administrators have to conduct remotely proctored examinations for their students that were almost writing exams or engaged on e-learning platforms. This e-learning led to a paradigm shift in a proctoring method which has generated a lot of reactions globally amongst students. Thus, this paper presents a comprehensive review of the testing proctoring procedures considering factors such as a response, method, format, design, exam characteristic, proctoring tool, environment etc. The outcome of this research paper is considered helpful for literature and stakeholders involved in the design, development, implementation and administration of current and future online-proctored examinations.

Keywords: *Exam, Proctoring Techniques, 2020, Covid-19 Era.*

Introduction

Examination or test in an educational /organisational environment is an age-long practice used by schools, organisations and administrators to assess or evaluate examinees or test takers' knowledge, assimilation, skill, talent and classification etc. Formal examinations, significantly the ones administered in the higher institutions of learning, vary in formats, styles, lecturer in charge, of course, difficulty levels, size of the class, policies of the institution or high-stake exam owner such as CISCO, and bodies governing the schools like National Board for Technical

Education. Proctoring, also known as invigilation, is a related procedure that takes place in conjunction with the examination to confirm the validity of the test (Milone et al., 2017) void of malpractices and compliance with the examination rules. These two concepts have transformed from Pencil and Paper Test (PPT) in-person proctoring and Computer Based Test in-person proctoring to the Remotely Invigilated Online Exams (Joshua et al. 2019). It is also worthy to note that this transformation has its associated pros and cons.

The COVID-19 epidemic increased interest the use of e-learning, which made RIOE, or online test proctoring, a now acceptable tactic (Mariana et al., 2016; Joshua et al., 2021).

The COVID-19 pandemic, no doubt, disrupted the global educational system, yet, the Internet's accessibility, e-learning and distance learning tools like Google Classroom, other Learning Management Systems (LMS), and ultimately proctoring tools that helped to save the situation. As timely and useful the online proctoring tools in ensuring examinee identification and monitoring during examination, the usage has generated a lot of issues of concern from students. According to researchers, a lack of psychological understanding of cognitive load effect, lack of adequate knowledge of the best practices to the approach e-proctoring (which emerge in haste) in examination and Exam content organisation (Faten & Ajayeb, 2021; Josual et al.,2019) contributed a lot to the reactions.

To demonstrate how variables like method, performance, format, design, exam characteristic, tool and environment can contribute to the current experience and unfavourable reactions toward the existing exams and e-proctoring procedure, a thorough review of various research findings on exam proctoring methods are taken into consideration in this study.

2.0 LITERATURE REVIEW

Faten et al. (2021), in their research, used focus groups to collect data that were organised by two researchers and administered to 350 students from two Universities in UAE who participated in e-proctored exams during the COVID-19 pandemic. They used qualitative and quantitative methods in their research to show student perceptions, performance, privacy and environmental concerns during the e-proctored exams. Insights from their findings could help minimise difficulties, examinees' situations and institutions of learning in maximising the capabilities of technological transition for better learning and educational implementations.

Mariana et al. (2021) conducted a small-scale pilot study where 17 students from seven countries were subjected to Online Proctored Examination (OPE). Their result followed Samuel et al. (2014) on secure authentication and reduced cheating in online exams. Their influence also shows that OPE does not affect the assessment know-

how of the examinees.

Mahammed et al. (2020) researched the proper evaluation of proctoring tool selection using a four-phase approach to eliminating the tool based on "survival of the fittest". They found out in their work that unnecessary costs on the student and institution side can be avoided using remote proctoring. Also, LMS like Moodle can be integrated with online proctoring without further infrastructure, and students' disposition to the remotely proctored exams is on the positive side.

Joshua et al. (2019) present facts and methods to avert or resolve concerns, especially mental load on students, and implement RIOE in a seamless manner following an action learning approach. They established that RIOEs implementation requires systematic and operational design considering bandwidth, the system's technical requirements, and the essentiality of students' inclusion as part of the stakeholder. Their paper focuses on issues identification and resolutions that have been put in place in UniSA Online.

Michael and Samuel (2014) conducted an exploratory, experimental study to show whether the new organisational phenomenon of e-proctoring is effective in cubing cheating and connects with students' performances. Data from 295 participants subjected to proctored exams were analysed by examining the test score pattern across two honour code conditions. Their organisational-based research showed that e-proctoring reduces cheating and does not affect test performance but has privacy issues and increases pressure on the exam-takers.

3.0 PROCTORING

As mentioned earlier, students at all levels of an academic or professional pursuit, either in the traditional or online environment, have to terminally or at the final stage take the assessment in the form of an examination to test their knowledge, skill, assimilation and retention. Doing this will help the institution and exam owners to determine students' performances to grade and classify them appropriately. As crucial as the examination is, exam integrity (Mariana et al.,2021) is paramount to the institutions of learning and test owners. This is one of the contributory factors to an institution's rating, among others. Whatever the format of an exam, invigilation, as called in the traditional examinations, is an essential practice put in place to help avoid malpractices and students' compliance with the exam rule and regulations. In the PPT examination, the effectiveness of invigilation or proctoring depends on the integrity of the proctors/invigilators. Globally, the adoption of E-learning has increased for some years.

Moreover, the COVID-19 pandemic significantly compelled Institutions of learning at all levels to switch to E-learning tools/ platforms/ technologies to keep up with

students, ensure learning, assess learning outcomes, and adjust to the disrupted academic calendar. This sporadic switch was accompanied by challenges of how to cope with proctoring methods. The way out is RIOE or OPE!

3.1 E-PROCTORING

Electronic proctoring, no doubt, is an antidote to the challenges of invigilation in the online exam environment. During the COVID -19 pandemic, the prevalence and usage of E-leaning tools and platforms increased. Still, means or methods of monitoring online tests became challenging for schools and educators. Many institutions and instructors, especially in developing countries, were forced to learn and use LMS, platforms such as Google Classroom, Zoom meetings and WhatsApp to deliver and ensure learning. However, the assessment given to students, though controlled with strict time, chances for cheating are at large since there was no room for monitoring and control. This process led the schools and administrators to seek the services of proctoring companies to monitor their exams remotely. Unfortunately, the understanding of proctoring tools for remote examination is still limited as many of the tools used during the pandemic are not adequately tested, tried and proven on a large scale (Faten et al., 2021; Mohammed et al., 2020, Burgress and Sieversten, 2020). Thus, much research is ongoing in evaluating OPE experience during COVID-19 and future implementations. Proctoring high-stake such as CISCO and Microsoft certification exams years back are done at VUE and Prometric centres. Though the examinees are in transparent rooms, surveillance cameras present records of every scene and client computers deliver the mix-format exam with a particular browser. Whether live, recorded or automated, E-proctoring has two components: (1.) Web came activated to video mode (2.) A Lockdown system prevents examinees from other computer-related activities that lead to cheating. Some examples of proctoring tools are ProctorU, Respondus, Proctorio, and AI-proctor.

E-proctored examination usually has the following features (Mohammed et al. 2020) :

- Authentication
- Browsing or operation tolerance
- Remote control by the proctor
- Report generation

3.1.1 COMMON ATTRIBUTES OF TYPICAL RIOE OR OPE.

Proctoring tools from proctoring companies may vary in characteristics and design, but basically, they have the following attributes in common:

- Setting up of tests with Exam service providers
- Students are invited to book exam time slots within the available dates
- Student login on the exam day, and software connects examinees' desktops to the remote proctor
- The authentication process begins when the student presents their I.D. card. Proctors confirm if the Card matches that of the exam scheduler.
- Students are asked to Pan the work area using a Web scan

- If the above stages are successful, the student is allowed to login in person or by the proctor
- The examinee begins the examination where proctors monitor live or record student activities for unusual behaviours. If there is any, the student stands warned or flagged; if persistent, the proctors can judge the situation with evidence that is processed to the institution.

3.1.2 ADVANTAGES

With the help of remote proctoring companies, institutions worldwide respond actively to the rise in academic cheating in remote learning environments. Therefore, there is an urgent need to develop tools to help take charge of the domain (Michael et al., 2018). Remotely proctored tools are more efficient than proctoring traditional PPTs. It has more coverage, reduces the cost of printing and using in-person proctors, performs automated making and perfects issues related to cheating and authentication. Students are not just left alone during the exams; online proctors can actually attend to fix the technical problems aroused (Joshua et al., 2021, Mariana et al.,2016; Derek Newton, 2020).

3.1.3 ISSUES RELATED TO ONLINE EXAM/E-PROCTORING

There are issues of concern beyond just the need to adapt technology or tools that have to do with examination and proctoring implementation effectively and efficiently in the educational sector. Some of these are highlighted below:

(a.) Students' reactions.

In line with the theory of reactance (Brehm and Brehm, 2013), students' opinions, especially when they are not in line with an approach or method, might not be good enough to follow; at the same time. The issues of reactions aroused from e-proctoring must be looked into (Faten et al. Rather than seeing RIOE or OPE from a cheating curbing angle, students often see e-proctoring methods as punishing because every move is scrutinised (Michael and Samuel, 2014; Joshua et al.). Distractions or cognitive loads and anxiety are caused by flags and warnings raised, even for harmless moves. We should also not put away the fact that another logical reaction is that of Privacy and Data protection. Students from more than ten universities USA signed petitions to cancel RIOE. Some universities also banned RIOE on privacy issues.

(b.) Performance

There are mixed research results regarding performances in remotely invigilated exams. Alessio et al. (2017); Richaldson and North (2013); Carstairs et al., 2009 and Schultz et al. (2007) reported in their studies of lower test performances by the students who partake in online proctored exams than the ones in un-proctored settings. Meanwhile, Davis et al. (2016); Micheal and Samuel (2014) attributed the

performance degradation not to the technology in use but to giving room to examination misconduct. Similarly, Wibowo et al. (2016) agreed that online exam is stressful because of the unfamiliarity of the exam proctoring mode to the test taker. Finally, Micheal and Samuel 2014, critical points of consideration for performance are (1.) the students' understanding of the course and (2.) familiarity with online exam and proctoring methods (3.) technological competence.

(c.) Exam Characteristics

Depending on the intention, the objective of the exam, owner expectation (measurement of traits, intelligence, abilities or absorption) from the test takers, norms and practicability, online exams, for instance, come in various formats (paper-based, offline-computer provided, online-computer provided and Online Bring Your Device) types such as multiple choice (MCQSA and MCQMA), short answer, True/False, Simulation, Essay, Oral, Computational etc. The validity of the test would determine the type. For instance, an exam to test various aspects or areas of studies could employ a combination of test types. Tests or Exams could be timed or timeless (Joshua et al.2016), have various complexity levels or stages, proctored or not, and formative or summative.

(d.) Exam design/Organisation

According to Joshua et al. (2019), exam organisation should be looked at from 3 spectrums - exam formats, proctoring methods and location of the exam. Also, effective online exam design is a critical factor that must be considered. For instance, a cognitive test should not be only measured with a multi-choice question. Exam design should not only be paper-based exam conversion and programming by an I.T. guy but also be designed in a friendly manner with easy navigation to reduce unnecessary stress on the examinees. I.T. Practitioners need psychologists and other stakeholders, including students, to design and implement an exam.

(e.) Environment

The research showed that examinees familiar with tech tend to perform better and have less cognitive load than their peers who are not I.T. literate or familiar with the method of exam conduct. Global observation of the environment should be considered when selecting tools and techniques, especially in the developing world where students' electricity, internet, and computer possession could be challenging (Boitshwarelo et al. 2017.)

(f.) Proctoring tool selection

The upsurge and attractiveness of E-learning and online exam with the current proctoring methods during the CoVID 19 pandemic do not give enough room to pay close attention to the proper selection, effectiveness and adoption of proctoring tools. Mohammed et al.(2020), in their research, suggested the following approach must be adopted for the proctoring tool selection process: (1.) Prepare recommended online

examination procedure (2.) ensure proctoring system trial testing on a large scale (3.) Prepared a computer lab that met hardware and software requirements, (4.) Lastly, ensure that hardware and software requirement of the proctoring tool are meet. It is also advisable to use tools that support integration with the institution existing LMS.

4.0 COMPARATIVE ANALYSIS OF PROCTORING METHODS

Table 1

	In-person Proctoring		Remote Proctoring		
	PPT	CBT	Live	Recorded	Automated
Cost	According to the literature, its costlier; the numbers of proctors depend on the number of examinees. Associated with material, travelling, marking and logistics cost	Not as costly as PPT, Lesser number of proctors is required. The cost of materials printing and transportation is eliminated. Materials and logistics costs are eliminated.	It is the most costly, requiring a proctor to an examinee*. The limited exam can be taken. Irrelevant costs are eliminated. Difficult to scale	Expensive and difficult to scale accommodates more examinees as proctors perform their duties on Auto recorded video* Irrelevant costs are eliminated.	Significantly reduced cost, allow highest no of examinees, no human proctor is needed. Cost of printing, Irrelevant costs are eliminated*
Reactions	No Reaction is associated as examinees are used to this traditional method. The in-person proctor attends to issues and controls the exam.	Not much reaction either; once the examinees start the exam, they are left alone. In-person proctors attend to technical issues.	Cognitive load and stress, privacy intrusion, and data security issues are high with this method.	Cognitive load and stress, privacy intrusion, and data security issues are lower than live*	Has the highest Cognitive load and stress, issues such as judgment are done with AI algorithms*

Performance	Where malpractices are allowed, performance is higher than in other methods	Performance is comparable to PPT if cheating is prohibited	Research shows that performance can only be degraded because these new methods give zero tolerance to affairs, and the cognitive load's effect is reduced with student understanding, technology competence and compliance with exam rules		
Environment	The environment does not affect PPT proctoring. It is	Examinees from the developing world perform better and have less cognitive load because of high I.T. compliance than their counterparts in			
	a traditional method accustomed by all.	the developing world. The use of the above methods can also suffer poor internet bandwidth, epileptic power supply, inability to own a computer			
Cheating	The level depends on how strict the proctors are. This method is associated with voice and signal communication , bringing into the exam forbidden materials etc	Cheating with this proctored method is reduced than PPT. Students are searched, randomised questions & answers are used, CCTV is in place etc	No room for cheating with video monitoring, screen lock, operation lock, screen monitoring, eye gazing, gesture tracking, facial recognition and detection, device detection, and body detection.		
Judgment	Proctors fill out forms and make a report for the culprit. Judgments are done by the school authority based magnitude of malpractices	Proctors report incidence with evidence; If proven guilty, an exam may be cancelled or withheld	Done by proctors who can stop the exam or warn the examinees in question	Proctor reports that incidences of cheating and action are carried out by the institution authoring the exam.	Decisions & Judgments on malpractices are made A.I. Algorithms*

Proctor Location	Exam Venue: Done mainly by academic staff	Exam Venue: Done by academic Staffs/Recruited staff depending on the nature exam	Remote	Remote	Remote

5.0 FINDINGS AND RECOMMENDATIONS

1. Course coordinators should be involved in the assessment design using existing tools or tools that are proven and tested to ensure strategies for testing learning outcomes.
2. Academic communities should consider student difficulties and concerns about e-proctoring before implementing them (Faten et al., 2020)
3. Examinations and proctoring (online especially) must be designed to reduce distractions or cognitive loads and comply with privacy and data protection laws.
4. E-proctors software application designers need to incorporate not dangerous dataset waivers into their decision-based A.I. tools.

6.0 CONCLUSION

This paper highlights the significance and roles of the Online Proctored Exam in ensuring exam integrity and gives a comprehensive analysis of the new method alongside other existing proctoring methods. It also highlights that the institutions and exam owners should pay attention to cost and other factors such as exam design and organisations, proctoring tool selection procedure, student reactions, privacy and data protection enhancement, bandwidth consideration and environment etc. E-proctoring is still at an early stage, and researchers have a lot to do for improvement, especially in the area of A.I.-based proctoring. Institutions of learning considering e-proctor implementation have much to learn from literature and timely insight into the technological transitions using an action-leaning approach involving all stakeholders.

References

Alessio, H M, Malay, N, Maurer, K, Bailer, AJ & Rubin, B 2017, 'Examining the effect of proctoring on online test scores', Online Learning, vol. 21, no. 1, pp. 208-208.

Boitshwarelo, B., Reedy, A. K., & Billany, T. (2017). Envisioning the use of online tests in assessing twenty-first-century learning: A literature review. Research and Practice in Technology Enhanced Learning, 12, 16.

Brehm, S. S., & Brehm, J. W. (2013). Psychological reactance: A theory of freedom and control. New York: Academic Press.

Burgess, S., Sievertsen, H. H. (2020). Schools, skills, and learning: The impact of COVID-19 on education. VoxEu. Org. https://voxeu.org/article/impact-covid-19-education. Accessed 12 Feb 2021.

Carstairs, J., & Myors, B. (2009). Internet testing: A natural experiment reveals test score inflation on a high-stakes, unproctored cognitive test. Computers in Human Behavior, 25(3), 738–742. https://doi.org/10.1016/j.chb.2009.01.011

Derek Newton (2021), Research Shows Remote Exam Monitoring Reduces Cheating, retrieved from https://www.forbes.com/sites/dereknewton/2021/02/22/research-shows-remote-exam-monitoring-reducing-cheating/?sh=b9e54ba89f2a

Faten F. Kharbat, Ajayeb S.Abu Daabes (2021), "E-proctored exams during the COVID-19 pandemic: A close understanding", Education and Information Technologies, https://doi.org/10.1007/s10639-021-10458-7

Joshua Cramp, John F. Medlin, Phoebe Lake, Colin Sharp (2019). "Lessons learned from implementing remotely invigilated online exams", Journal of University Teaching & Learning Practice, 16(1),

Mariana Lilley, Jonathan Meere, Trevor Barker (2021), "Remote Live Invigilation: A Pilot Study", 13(1).

Michael N. Karim, Tara S. Behrend, Samuel E. Kaminsky, (2014)," Cheating, Reactions, and Performance in Remotely Proctored Testing: An Exploratory Experimental Study", Journal of Business and Psychology

Milone, A. S., Cortese, A. M., Balestrieri, R. L., & Pittenger, A. L. (2017). The impact of proctored online exams on the educational experience. Currents in Pharmacy Teaching & Learning, 9,108–114. https:// doi.org/10.1016/j.cptl.2016.08.037.

Mohammed Juned Hussein, Javed Yusuf, Arpana Sandhya Deb, Letila Fong & Som Naidu (2020), An Evaluation of Online Proctoring Tools, The University of the South Pacific (Fiji), Vol 12, No 4

Mohamed M. Abbassy,(2018), "Monitor Remote Mobile Examination System, International Journal of Scientific & Engineering Research" Volume 9, Issue 9

Oksana Mikhalchuk(2020), "Using A.I. and biometrics to enhance exam proctoring", https://www.biometricupdate.com/202001/using-ai-and-biometrics-to-enhance-exam-proctoring.

Richardson, R., & North, M. (2013). Strengthening the trust in online courses: a common sense approach. Journal of Computing Sciences in Colleges, 28(5), 266–272.

Schultz, M. C., Schultz, J. T., & Gallogly, J. (2007). The management of testing in distance learning environments. Journal of College Teaching & Learning, 4(9), 19-26

Wibowo, S, Grandhi, S, Chugh, R & Sawir, E (2016), 'A pilot study of an electronic exam system at an Australian university, Journal of Educational Technology Systems, vol. 45, no. 1, 09/01/, pp. 5-33.

Yousef Atoum, Liping Chen, Alex X. Liu, Stephen D. H. Hsu, Xiaoming Liu (2015), "Automated Online Exam Proctoring" Vol. 19, No. 7, pp.1609-1624

FEDPOLAD JOURNAL OF ENGINEERING AND ENVIRONMENTAL STUDIES (FEDPOLADJEES)

THE ROLE OF CREATIVE ARTS IN POVERTY ALLEVIATION IN NIGERIA

Authors

John Oluwafemi Adedamola; Olanrewaju David Ayeni
Department of Arts and Industrial Designs,
The Federal Polytechnic, Ado-Ekiti, Ekiti State, Nigeria
adedamola_jo@fedpolyado.edu.ng, jofegg@gmail.com,
davidayenix@gmail.com

Olagunju, Lasisi Richard
Dept. Of Fine& Applied Arts
School of Vocational & Technical Education
Federal Coll. Of Education (Special) Oyo.
olaquality@yahoo.com
Tel.0803426166

and

Olayemi, Sunday Opeyemi
Dept. Of Fine& Applied Arts
School of Vocational & Technical Education
Adeyemi Coll. Of Education Ondo.
Solayemi17@gmail.com
Tel.08166626225

Abstract:

The role of creative art in national development has not been fully appreciated. Creative art for long had been treated as an insignificant aspect of the country's educational programme. A consequence of this neglect in the creative artworks of the people's potential and locally designed products remain very low.

The same international organizations that set the poverty line made it a global goal to end extreme poverty. Goal number one of the Sustainable Development Goals (SDGs), agreed on by all nations in the world, is the "eradication of extreme poverty for all people everywhere".

while most countries especially in Africa, rather than achieve the goal, slumped deeper into poverty. The thrust of this paper explores the meaning of Creative Arts

and how poverty can be alleviated through creative arts work like: graphic digital, 2&3D painting, weaving, leather, pottery, carving, etc in Nigeria. After a careful exploration of the meaning of arts, the paper highlights the role of creative arts with special reference to Nigeria. Art empowers individuals with creative skills that widen the base of participation in society, and create jobs, self-reliance, identity, and communicates by creating, recording, and transferring ideas. It builds and perpetuates social, religious, political, and economic stability and indeed poverty alleviation which is a necessity for economic state of the living
The paper, therefore, advocates for policies that would guarantee optimal utilization of creative art for sustainable and effective measures for national development

Keywords: *Creative Arts, Poverty Alleviation, Potentials, and Economy.*

Introduction

In Nigeria, the role of creative art in national development has not been fully appreciated. Creative art for long had been treated as an insignificant aspect of the country's economic development. It is well known that education plays an important role in national development. Creative art is one of the subjects in the curriculum of education, the subject has many components namely, pottery, drawing, graphics, painting, textile design, art history, sculpture, and craft. Creative art could be defined as a discipline that trains the organizational elements, line, shape, colour, texture, and space to obtain certain emotional and visual effects (Adejumo, 1986).

This allows individuals to reason alongside their various fields of learning as in the visual arts to see how to solve the problems of poverty. Since the economy of the country has not achieved the desired goals, there is a need to address the possible alternatives for solving the problems. The challenges encountered at present include how to manage the economic crisis with an emphasis on some subject areas like visual arts to the advantage of a large fraction of Nigeria's citizenry. In an attempt to meet the socio-economic challenges posed by the country, visual arts would be one of the major keys to alleviating the poverty of the people. Given this, a series of questions come to mind such as; What is art? What is poverty, what are the causes? The role of art and its functions in society is remarkable in alleviating poverty in Nigeria through visual arts. This we promote, develop and contribute immensely to the growth of education in the Nigeria.

According to Ogunmola (2006), art is often considered the highest form of human expression, it is of great importance in education and thus helps the individual to fit into society. Considering the product of art in the society, art can be used, mostly in commercial art work to promote and sell a variety of products and to advertise religious

programmes.

Art plays a meaningful role in developing and changing a dynamic child who becomes increasingly aware of himself and his environment (Ajayi, 1985).

Art is the reflection of the ideal (Idealism); Art is the imagination of actuality or unachievable ideal (fiction)" (Osborne, 1968). Ralph (1970) stresses that “art is especially well suited to such growth because it encourages freedom of expression; emphasizes emotional and spiritual values, integrates all human capacities and universalizes human expression”. Because of this; one has to realize the effect of art on child development as a result of being skillful and creative which results in self-discovery and experimentation with a series of art materials found within his environment.

Nigeria is a rich country with an abundance of natural resources most of which have not been exploited and utilized for the people, social and economic development. But poverty in Nigeria remains significant despite high economic growth. Geoffrey (2001) stresses that Nigeria has one of the world's highest economic growth rates (averaging) 7.2% over the last decade, a well-developed economy, and plenty of natural resources, however, poverty remains very high in Nigeria.

So one of the solutions to the reduction of poverty is a creative art is existence of a work of art implies processes outside itself linking it to the life from which it has emerged and whose product it is. Even though Nigeria is rich in natural resources, the majority of its people are poor. Nigeria is the 20th poorest in the world; the poverty level in Nigeria has reached an alarming stage where 70% of its population lives below the poverty line. (nigerianfinde.com).

According to Max and Esteban (2013), “Increasing productivity around the world meant that many left the worst poverty behind. More than a third of the world's population now lives on more than 10 dollars per day. Just a decade ago it was only a quarter. In absolute numbers, this meant the number of people who live on more than 10 dollars per day increased by 900 million in just the last 10 years.

This expansion of the global middle class went together with progress in reducing global poverty no matter what poverty line you want to compare it with, the share of the world population below this poverty line declined. In 1990 international organizations adopted a definition of poverty in line with the poverty lines in low-income countries. In the latest adjustment, the international poverty line is set to the threshold of living on less than $1.90 per day. That is a very low poverty line and focuses on what is happening to the very poorest people on the planet. The same international organizations that set the poverty line made it a global goal to end extreme poverty. Goal number one of the Sustainable Development Goals (SDGs),

agreed on by all nations in the world, is the “eradication of extreme poverty for all people everywhere”. The deadline for achieving this goal is 2030. Can we expect to achieve this? The global economic fallout of the COVID-19 pandemic has resulted in a large setback to the international community's goal to achieve SDG 1 of “no poverty” by 2030. Extreme poverty around the world is increasing, the first time that has happened this century after decades of global poverty reduction. Over 700 million people worldwide are currently estimated to be living in extreme poverty”

Creative Art Work To Allivate Poverty

Craft articles possess artistic qualities which enhance their attraction and market value. Crafts are medium of wealth creation that the government can explore through industrialization to enhance growth and development. (Irivwieri, g. O 2009). The local crafts includes:

Weaving: his embraces a whole galmut of crafts such as making of clothes, baskets, hats, fans, carpet, rug, bags, chairs, mats and other items peculiar to almost all the states in the six geo-political zones in Nigeria particularly those in the core North and South-south. The materials for production of these articles are derived from raffia fibers, grass, palm fronds and canes among others.

Pottery: It involves moulding or hand building of clay objects like utensils, animals and other-shapes. Where possible they are decorated, fired and glazed.

Carving: This is another craft which involves making of patterns on calabashes, wood, slab of clay and cement. Objects produced include wooden ash-trays, stools, chests, walking sticks, candle holders, canoe paddle, ebony rings, ear-rings and carved iroko paneled doors.

Blacksmithing: This work provides farmers with cutlasses, and housewives with articles such as kitchen knives and hair-pins, wrought iron gates and window grills.

Graphic: Graphic Arts are concerned with the problems of preparing and organizing visual symbols for the communication of ideas and information and satisfying the needs of the advertising industries. Diverse creative graphic artworks can readily be established from a very humble beginning with little cost, which in no distant period, create further jobs for the teeming population. Crafts workshops and art studios where some hand and machine-crafted articles are produced and sold could be set up. In this area, is book-binding which entails the making of prints into book covers and folders, cutting paper and cloth prints to make jackets and the binding of old and new books.

Leather work: This is another veritable occupation particularly in the northern part of the country where most of the people are engaged in livestock, cattle, goat, and donkey rearing trade amongst other animals. Decoration of leather by printing and

sewing on patterns, bags, footwear, wallets, belts, pouffes, dresses, etc

Painting: This is an art of creating pictures, images, through pigment on different surface of materials or objects like wall, paper, canvas, card, wood, iron, etc

Drawing: this is an aspect of art that deal with creating pictures or images with lines through the use of pencil, charcoal, pastel, etc on paper, cardboard, etc

Sculpture: This deals with the use of molding, casting, construction, and carving of figures or objects.

Textile: this is the art that deals with the production and decoration of fabric, rug, knitting, batik, tie & dye, etc

Photography: this is an act of creating pictures through the action of light

Digital Designs: this is the act of creating pictures or images through computer machines and technological means. (G.F. Ibrahim 2012)

Vocational Skills Acquisition And Poverty Reduction

Skills acquisition is simply the practice of teaching or educating people on the basic skills needed in various vocations such as in the areas of business, technology, creative arts, computers, etc. The programme is offered through outlets or media such as skills acquisition centers, adult literacy centers, adult schools, distance learning, continuing education schemes, lifelong learning schemes and e-learning. Programmes are designed to meet the needs of a person that did not acquire enough formal education or none at all as well as those that need to sustain learning for themselves. Skills acquisition programmes are, therefore, designed under structured programmes of adult education to meet the needs of adult learners.

Skills acquisition is very important and central to the development of any contemporary society. It is one means of tackling poverty level, unemployment, and underemployment and affording massive job creation. With a huge number of graduates' turnover of over 600,000 yearly in Nigeria seeking white collar jobs that are not available, coupled with the large numbers of youths who do not attend formal school, there is the need to strengthen vocational skills acquisition to reduce poverty and foster jobs creation. This will engage people meaningfully thereby reducing insecurity to its barest level. When everyone is busy with one form of job or the other, there would be little activities that can jeopardize the peace of the State particularly and the country at large. At this time when the world is recovering from the global recession, the acquisition of vocational skills is the only cure for poverty and to increase the number of employed youths in Nigeria.

He further observed that the structure of the Nigerian education system which lays much emphasis on University education needs to be re-addressed if the country must achieve its goals in poverty alleviation and employment creation. Poverty is the state of having insufficient resources. It is lack basic needs such as food, clothing, housing, water, and health services. Nigeria is having a large percentage of poor people that suffers from poverty. While every individual is expected to live a comfortable life, well-nourished with a sound economic base, an avenue through which this can be realized is through vocational skills acquisition.

Vocational skills acquisition programmes have greater potential to achieve the goal because it is geared toward skills acquisition and occupational preparedness. Coupled with the above, the present world is changing through the forces of globalization and technological advancement which require advances in vocational and technological education. To prepare for these challenges, creativity and innovation in vocational skills acquisition and entrepreneurship are highly relevant and sustainable, and living depends on the ability of the citizenry to create wealth, generate employment for others and become self-reliant through the innovative application of ideas and skills, to make them useful members of the society and to be free from deprivation and poverty of whatever forms and types.

In this regard, vocational skills acquisition is the most viable and veritable means to equip the youths with the skills and techniques to develop their potential and create a conducive environment where individuals strive to match with the current world development patterns. It is expected in this democratic dispensation that, all efforts must be geared towards poverty reduction through vocational skills acquisition.

This will help in self-reliance or self-employment attitude in the individuals and the ability to develop our technology based on economic and social environmental factors. Ogunmola (2006), observed that a lot of skills can be learned through vocational skills acquisition with the potential for developing manpower to promote both social and economic growth and development. These skills provide meaningful occupations and entrepreneurial activities particularly in manufacturing, building, construction industries, production, operation, commercial venture services, etc.

Top Reasons for Poverty in Nigeria.

While Nigeria is known for its oil riches, the reality of the nation is that corruption, unemployment, and inequalities have destroyed the nation's economic framework, causing it to be the poverty capital of the world (Krishna 2020). Nigeria, a third-world country in Africa, is known as the poverty capital of the world. The nation just exceeded India with the largest rate of people living in extreme poverty. In Nigeria, about 86.9 million people live in severe poverty, which is about 50% of its entire population. While the nation is smaller both geographically and in terms of population, it is failing at

lowering the rates of poverty. This is partly due to the mismanagement of the oil business and the presence of corruption. However, the top reasons for poverty in Nigeria can be summarized as follows:

1. **Corruption:** Corruption is the major reason why poverty is at such a high rate in Nigeria. Many economists have declared that it is the "single greatest obstacle" that prevents Nigeria from prospering. Corruption is present in the everyday lives of citizens from businesses to the government. Consequently, poorer communities are suffering and the economic structure has experienced disruption.

2. **Unemployment:** The high rates of unemployment also lead to extreme poverty. Unemployment typically exists among the younger population. A major cause of unemployment is the fact that people tend to focus more on oil production rather than a variety of other industries. Not only does the country suffer from a lack of employment but it also suffers from a lack of development, progress, and diversification of its industries.

3. **Inequality:** Along with corruption and unemployment, another major driver of poverty in Nigeria is the presence of inequality within the nation. Nigerian women are subject to unequal treatment in terms of labor, education, and property. While about 79% of women make up the rural labor force, they are the least likely to own their property. Along with this, only about 6% of Nigerian women have achieved literacy, the rest are still illiterate. Inequalities in Nigeria is as a result of poorly allocated resources and corruption, while Nigeria has plenty of resources, these resources are typically reserved for wealthy citizens. Along with this, corruption within the government leads to further inequalities between the political elite and those living in poverty.

Poverty is expected to increase by nearly 13 million people in Nigeria, pushing the total estimated number of Nigerians living in extreme poverty to over 105 million which is over half of the 205 million population. Source: World Poverty Clock

Measures to Reducing Poverty in Nigeria

There are various measures to reduce the level of poverty. However, each of these measures requires a holistic approach, some of the suggested measures are:

1. Increase in literacy rate and skill development: One of the major steps in reducing poverty in Nigeria is through education. Quality education can provide a lasting solution to poverty in Nigeria. Ogunmola (2018), reveals that quality education improves economic efficiency by expanding labor force value and efficiency, and subsequently moving people out of poverty. Lack of education is one of the significant causes of poverty in Nigeria. The National Commission for Mass Literacy, Adult and Non-formal Education revealed that more than 38% of Nigerians illiterates. The inability to function in society due to the absence of knowledge and skill set leads to poverty

According to UNICEF, one in every five out-of-school children in the world is in Nigeria, with the situation looking more severe in Northern Nigeria. This invariably creates the poverty problem due to a lack of human capital development. In 2015, the adult literacy rate was about 40% of the total population.

2. Fight against corruption: Unlike education which reduces poverty in the long-runs, the fight against corruption leads to an immediate reduction in the level of poverty. Hence, there is a need for a total fight against corruption, and effective monitoring of public finances. Similarly, the lack of punishment for corrupt public office holders has continuously resulted in the diversion of funds meant for development projects, which trickles down to poor infrastructural development and social welfare, resulting in poverty. Corruption undermines the rule of law and threatens socio-economic development. It as well increases poverty by retarding investment and employment opportunities. It reduces revenue from tax as well as the effectiveness of government intervention programs. According to Ajisafe (2016), corruption diverts government spending away from socially valuable goods such as education and health.

3. Economic Diversification: Another major cause of poverty in Nigeria is the fragility of the economy due to over-dependency on oil revenue. There is thus, an urgent need for the diversification of economic activities to create opportunities for Nigerians and ensure the stability of the economy. Diversifying the Nigerian economy and improving value addition in the agriculture sector can aid the reduction of poverty. Abu et al.(2016) points to the fact that the majority of agricultural produce in Nigeria is sold raw leading to lower returns to farmers. The Food and Agricultural Organisation,(2018) also revealed that over 50% of farm produce in Nigeria is rural-based and below commercial value.

4. Income redistribution: Finally, emphasizesise the importancethe importance on of income. This simply meaa ns, reductmeansin wages and allowances for high-income earners (particularly, the political class), and increase in wages and allowances for low- and middle-income earners. This will boost overall productivity through an increase in demand, thereby increasing employment and reducing poverty.

5 The unstable political environment: This can also be observed to be a root cause of poverty in Nigeria. Political instability hurts economic growth, which precipitates poverty. A clear example is the Northern Niger crisis where the war against Boko Haram has destroyed the economy of North-east Nigeria, North-central Nigeria without a livelihood, a situation that has resulted in poverty.

The Measurement of Poverty in Society

Various relevant data cause disuniformity in social strata such as income, cost of living, unemployment, consumer expenditure, housing, the interest of the people towards arts, and lack of confidence and competency among others. These have paved the way for poverty in society. Even though, those who have real knowledge of art do not have enough capital to establish their tor to employ and train the younger ones (Ajayi, 1985). The lukewarm attitude of the government to the subject affected many parents who thought visual arts are for the talented ones. Nowadays, the knowledge of people has been widened to realize the value of visual arts and its socio-economic importance especially in alleviating poverty in Nigeria (Ogunmola, 2006).

Employment: Since visual arts spread their tentacles to all subjects and disciplines in the school system; it is valuable in alleviating poverty in many ways (Ogunmola, 2006). Those who involve in visual arts derive their value in terms of employment. Some of the students who study arts after their training establish on their own and also they employ some people to assist them in their various studios and galleries, thereby creating means of livelihood for those would have been in a complete state of abject poverty (Ogunmola, 2006).

Income: Arts could also be seen as a means of income generation in that most of the works being carried out by an artist are sold to the people for beautification, religious purposes and culture as well as other purposes (Ogunmola, 2006). According to Agbo (1993), urban sculpture has often complemented man's efforts in environmental beautification in many years. Ever since man has been living and congregating in urban clusters, towns and cities, he has used sculpture to commemorate important civic events and glorify worthy personalities (Agbo, 1993). One could realize that this serves as a means of income to the artist who engages in production of the various sculptural, painting and industrial works of arts.

Creativity and Imaginative Reasoning:

Individual's power of imagination helps in alleviating poverty in the field of arts. Aremu (1993) stresses the importance of art as a means of reasoning and creativity. Art involves a great deal of reasoning and artistic activities pass judgments on the relevance of a theme or subject matter without consciously knowing why.

The idea of reasoning and skillful execution artworks can alleviate poverty by making the audience to develop quality taste in the aesthetic value that is embedded in works of art through creative potentials or abilities of the individual artist. This gives room for patronage and economic revival. The exhibition could be organized by artists to alleviate poverty.

By this means, an individual artist can sell his products to buyers or art collectors. Also the community can benefit from this in that those who are selling snacks and other items could be around at the exhibition ground to sell their commodities to for those who are around to watch the exhibition. This is a way of projecting individual artists and making t to get more exposure to the public. (Ogunmola, 2006) Hence, many

commissioned works are won through this avenue and consequently increasing the business link of the people.

Organizing Workshop Centres:

As a means of alleviating poverty artistst can group themselves to organize workshop centers to train the younger on Haggerty (1940- 1965) cited in Ajayi (1985) states that creative arts are essential to a balanced programme of education which is to develop the social orientation of youth and realization of all constructive potentialities of the individual which can lead to alleviating poverty

Creativity of Artists:

All artists are creative people but there are a lot of jobs that are not visual arts related that calls for mere technical skills which fetch practitioners some money for their living. However, Lowenfeld and Britain (1975) observed that creativity is thought of as being a constructive, productive behavior that can be seen in action accomplish. It does not have to be a unique phenomenon in the world, but it does have to be basically a contribution from the individual
(Lowenfeld and Britain 1975). A creative gift is an act of innovation which can help to arouse the interest of the people toward the creative value of the art objects (Agbo,1993).For instance, ceramics is one of the useful arts developed by man and it has remained important ever since . An excellent vocation can be made in ceramics provided that the artist has the requisite skill, imagination and artistic vision (Ogunmola, 2006). Artists whoever acquired this creative gift may be absorbed into one of the ceramic industries springing up in the country or he may better still, work in a freelance capacity. The ceramic medium (clay) has rich potential, it is “one of the few materials which has no apparent value of its own in a raw state, yet can be made into valuable objects” (Adejumo, 1986.)

Loans:

The government can help to alleviate poverty by giving out loans directly to promote creative artists to set up and run workshop centers and studios where people could be trained. An example of this is the scheme introduced by the Federal Government under the auspice of National Directorate of Employment (NDE). The loan granted the artist could be used to produce works of art with a view to selling them. This can encourage those who are artistically talented but have no money to set up a business. The artist too can alleviate poverty by joining co-operative societies where he can borrow money for important projects to fetch him some amount in return.

Monumental Projects:

The artist can work towards the production of monumental projects for the society as well as for the government which can later be launched and thus derive his own income from them. This would serve as a means of alleviating poverty and gaining self-recognition for the artist.

What Is NEEDS?

NEEDS—the National Economic Empowerment and Development Strategy—is Nigeria's plan for prosperity. The 2001 Kuru Declaration embodies the vision we have for Nigeria: to build a truly great African democratic country, politically united, integrated and stable, economically prosperous, socially organized, with equal opportunity for all, and responsibility from all, to become the catalyst of (African) Renaissance, and making adequate all-embracing contributions, sub-regionally, regionally, and globally.

NEEDS envisages forging stronger links between educational institutions and industry to stimulate rapid industrial growth and efficient exploitation of resources.

Empowering people

By allowing the private sector to thrive, NEEDS creates opportunities for employment and wealth creation. It empowers people to take advantage of these opportunities by creating a system of incentives that reward hard work and punish corruption, by investing in education, and by providing special programmes for the most vulnerable members of society.

Promoting private enterprise

The private sector will be the engine of economic growth under NEEDS. It will be the executor, investor, and manager of businesses. The government will play the role of enabler, facilitator, and regulator, helping the private sector grow, create jobs, and generate wealth. Deregulation and liberalization will diminish governmental control and attract private sector investment. Changing the way the government does its work. NEEDS aims to restructure the government to make it smaller, stronger, better skilled, and more efficient at delivering essential services. It seeks to transform the government from a haven of corruption to an institution that spurs development and serves the people. The number of government jobs will decline, and the cost of running the government will fall dramatically, as in-kind benefits for civil servants, such as subsidized housing, transport, and utilities, are monetized. Reforms and regulations will be implemented to ensure greater transparency and accountability, and corrupt practices will be outlawed. Government activities and budgeting will be informed by a framework that connects policy with government income and expenditure.

CONCLUSION

Art is a subject that can bring gainful employment for the talented and school leavers, there is need to change the societal attitudes towards this discipline in order to motivate the creative artists and those who may be interested in the discipline. There has never been dearth of plans and programmes designed to address the issue of poverty alleviation, yet it is sad to note that little has been done in practical terms above all, the poor perception, short –sightedness, non- implementation of policies

whatsoever, mass corruption, despotic and non –committed regimes are responsible for the plight of the poor. Unless fundamental structural changes are made both at the policy and management levels, which implies internally taken into consideration of the ideological and social imperatives, vis-a-vis overhauling the whole planning and implementation machinery, situation may not change for better (islamicmarkets.com. 2018).

REFERENCES

Abubakar, U.S; Abdulkadir, A.L & Sirajo, I.A. (2010). Alleviating poverty through Vocational Education for National Development in Nigeria. A paper presented at the First National Conference at Adamu Augie College of Education, Argungu: Kebbi State. Wed. 24th - Friday 26th

Adam S. A. , Muhammad B. M. , Usman Kudu Ibrahim (2019).Impact of Vocational Skills Acquisition Programme on Poverty Reduction in Katsina State, Nigeria " International Journal of Humanities and Social Science Invention (IJHSSI), vol. 08, no. 7, 2019, pp.02-03

Adejumo, E.A. (1986) Artistic Creativity in the Age Technology. Nigeria Society for Education through Arts (NSEA), Nigeria Journal of Art Education 4th National Convention Issue Vol. 2, No 1 Pp. 17-22

Agbo, F. (1993) “Urban Sculpture in Metamorphosis” in Diversity of Creativity in Nigeria Campbell B, Ibigbami R., Aremu P.S.O and Agbo, F. (Eds) Obafemi University, Ile-Ife Nigeria (Pp. 1-12).

Ajayj F. (1985) Handbook on Art Methodology Book One. Ipetu-Ijesa: Oyoyo Press.

Ajisafe, R. (2016). Corruption and Poverty in Nigeria: Evidence from Ardl Bound Test and Error Correction Model. Journal of Emerging Trends in Economics and Management Sciences, 7(3), 156-163.

Aremu, P. S. O. (1993) Memory and Imagination: The idea Image Creation Amongst the People of Africa. In Campbell B, Ibigbami R, Aremu, PSO and Agbo, F. (eds) Diversity of Creativity in Nigeria. Obafemi Awolowo University, Ile-Ife Nigeria 9 (Pp.13).

Geoffrey P. (2001), Europe in Crisis 1598-1648 Wiley- Blackwell P11.

G.F. IBRAHIM (2012)Modern approach to cultural & creative art, Yemark Nig ENT., Akure, pages 5-7.

Irivwieri, G. O (2009) Arts and crafts as springboard for sustainable development and industrialization in Nigeria. International Journal of Creativity and Technical Development Vol. 1 No. 1 - 3, 2009Dalta state, Nigeria

https://ourworldindata.org/extreme-poverty

https// nigerianfinde.com poverty alleviation.

islamicmarkets.com. 2018

Krishna P.,(2020), The Poverty Capital of the World: NIGERIA, Borgen magazine.com

Lowenfeld and Britain L. (1975) Creative and Mental Growth (six editions). New York:

Macmillan Publishing.
Max R. and Esteban O.O. (2013) Global Extreme Poverty, First published in; substantive revision March 27, 2017
Nigeria: Poverty Reduction Strategy (2005), Meeting Everyone's Needs- National Economic Empowerment and Development Strategy International Monetary Fund December IMF Country Report No. 05/433
Ogunmola,M.O. (2006). Visual Arts and Poverty Alleviation in Nigeria, .Arts Courier African Journal of Art and Ideas, No 5, Department of Fine and Applied Arts, College of Education, Ikere Ekiti Nigeria.
Ogunmola M. O. (2018)The Challenges and Prospects of Promoting Visual Arts Education for Poverty Alleviation in Nigeria, Journal of Research in Education and Society Volume 9, Number 3,156-163
Osborne I.I. (1968) Aesthetic and Art Theory: An historical introduction. London: Longmans. Read, II. (1958) Education Through Art. London: Faber & Faber.
William, D. (1964) The Konology of the Yoruba Edan Ogboni. African Journal April.

FEDPOLAD JOURNAL OF ENGINEERING AND ENVIRONMENTAL STUDIES (FEDPOLADJEES)

DETERMINATION OF SIGNIFICANT FACTORS THAT INFLUENCE SCHOLARLY PUBLICATION PRODUCTIVITY AT FEDERAL POLYTECHNIC ILE-OLUJI, NIGERIA

Authors

Olaniyan Joseph Olawale; Ademuyiwa Justus Adeniran and Ikotun Oluwafisayo

Department of Statistics,
Federal Polytechnic Ile-Oluji, Ondo State,
Author's Corresponding e-mail: olawalelink2007@yahoo.com
Author's Corresponding Phone No: 08064212237

Abstract:

In many studies in academic world, factors that influence scholarly publication productivity had been discovered but the significance of these factors still remained unraveled and this had created serious gap that must be filled for management and planning purposes. Consequently, this study was carried out to determine the significant factors that influence scholarly publication productivity at Federal Polytechnic Ile-Oluji, Nigeria as well as formulate a significant model for the factors with Poisson Regression model. In view of this, 22 academic staff selected through Convenience sampling procedure were administered structured questionnaires and information gathered on both dependent variable (Number of publication produced in an academic session) and independent variables (age of lecturers, gender of lecturers, years spent in academic i.e. experience of the lecturer, and weekly hours spent on research/ publication) was analyzed using SPSS package. Findings indicated that only hours spent on research /publication was significant at 0.05 level of significance and significantly contributed to the general model. It also suggested that there would be 4.6% increase in the publication productivity for every extra hour work on publication.

Keywords: *Poisson Regression Model, Publication, Productivity, Academic, Significance, Overall.*

Introduction

Writing for publication is a rewarding task in academic environment. Although, some were of the opinion that writing papers for publication is time consuming, intimidating and stressful but knowledge, discoveries and expertise cannot be explicitly and optimally disseminated for the advantage of others

without research (Diane Duff, 2001).

For over a century, the academic publishing world has changed drastically in volume and velocity (Ware and Mabe 2015). The wave of volume of papers has increased sharply from below 1 million papers published in 1980 to above 7 million papers published in 2014 (Herrmannova D, et al 2016). Furthermore, the speed at which researchers can share and publish their studies have increased significantly and suitably.

Publication productivity is among the most imperative metrics for researcher's performance in the academic world (Fischer et al, 2012). Assessing the research productivity is always a productive exercise to gauge individuals, universities and countries (Gonzalez-Brambila and Veloso, 2007). Scholarly publications in any specialized field are the sources of recent information for progress and development of society. They lead to create and transform new knowledge and stimulate innovation. In the current academic scenario, promotions, career development and recruitment of the individuals are affected by their publications and citations. In general, publishing in journals promotes one's recognition, career, opportunities, and advancement. In general, publishing in journals promotes one's recognition, career, opportunities, and advancement (Diane Duff, 2001) Specifically, the number of publications by an academic is an inevitable factor upon which such an academic's qualification is considered for career progression. It designates how advanced or updated an academic is. For that reason, the number of publication turned in by academic is viewed as a professional accomplishment, and it's therefore reviewed periodically. By extension, the scholarly publications raise the reputation and economic status of the institutions (Dhillon et al, 2015). All these conclude the significance of scholarly publications to an individual, higher education institutes and countries. In other words, the significance of scholarly publication is essential for research performance, evaluation purposes and societal development and growth.

This phenomenon of increasing emphasis on publications and citations count leads to explore the influencing factors of research productivity. As publications and citations as performance evaluation measures are significant for individuals and institutions, many scientometric indicators such as h-index, g-index and their variants are introduced for the evaluation of the research performance and got attention of researchers and policy makers (Tahira et al., 2013). Today's researchers can publish not only in an ever-growing number of traditional venues, such as conferences and journals, but also in electronic pre-print repositories and in mega-journals that provide rapid publication times (Ware M, 2015 and B jork BC. 2015).

A number of research studies has been conducted to explore the determinants for the enhancement of publication productivity including a comprehensive review of factors affecting the number of citations conducted Tahamtam et al. (2016). Others explored

either single or multiple factors to increase the publications output at different levels of population/discipline specific. Greatest of the studies addressed the factors of citation/impact of scholarly publications. However, a review of these influencing factors that affect the number of publications at various levels was missing in their scholarly literatures but was holistically carried out in the work of Nazia Wahid et al. (2021). A detailed systematic review of the studies that explored different factors affecting publication productivity was carried out and concluded that several factors play a significant role in the determination of publication productivity. According to the authors, a total of thirty factors were researched on and found to have influence on publication productivity. All the identified factors were clustered into three major categories namely; personal, environmental and situational categories. Most of the factors belong to personal category while two top dominant factors, funding and collaboration fall into situational category. Other most influential factors, time, academic rank and academic qualification are personal. Nazia Wahid et al, (2021) concluded that publication output at individual level was strongly influenced by personal factors while few environmental and situational factors also affect the number of publications (Nazia Wahid et al. 2021).

Though, according to Nazia Wahid et al. (2021) all factors raised were responsible for scholarly publication productivity in higher learning. However, the following factors extracted from personal and situational categories are factors of interest in this work. The factors include; academic experience (number of years spent in academics), gender (dichotomous variable) and age of academics as well as the time (weekly hours) spent on research, workload of lecturers and number of publication produced in a session. In fact, Age and experience of researchers are positively associated with their publication productivity (Dhillon, et al, 2015). All these selected factors are considered important in this study.

Considering all the submissions of the reviewed research works, it was observed that none was able to determine the significance of the influence of those factors on publication productivity. This is the area where foremost authors failed to look into. This is the gap this research work is specifically looking into. Therefore, the main objective of this study is to determine how significant are some selected factors that influence scholarly publication productivity at Federal Polytechnic Ile-Oluji, Nigeria in an academic session. Furthermore, a goodness of fit will be carried out with Poisson regression model. It will also forecast publication productivity in the institution if there is a unit increase in the independent variables with the condition that they have significant influence.

Poisson Regression is used for the purpose of predicting a dependent variable that consists of "count data" or discrete data given one or more independent variables (Cameron and Trivedi (1999). The variable of interest for prediction is called the dependent variable. The variables used to predict the value of the dependent variable are called the independent variables.

Having carried out a Poisson regression, it will be able to determine which of the independent variables (if any) has a statistically significant influence on publication productivity. Since the independent variables are continuous, this will be able to interpret how a single unit increase or decrease in that variable is associated with a percentage increase or decrease in the counts of the dependent variable.

Assumptions of Poisson Regression Model

Before the use of this model, the dataset must comply with the following five assumptions.

i. The dependent variable must consist of count data i.e. a non-negative integer valued data.

ii. It must contain one or more independent variables, which can be measured on a continuous, ordinal or nominal/dichotomous scale.

iii. The observations are independent of each other.

iv. The distribution of counts (conditional on the model) follow a Poisson distribution.

v. The mean and variance of the model are identical.

Materials and Methods

Study Design, Period and Data Source

Primary data was collected through both structured and unstructured questionnaires from the academic staff of the Federal Polytechnic Ile-Oluji. These covered both experienced and recently employed academic staff of the polytechnic in almost equal proportionality. In all, a total of 22 staff were respondents in the research selected through Convenience Sampling. The number selected took into consideration the total number of academic staff available in the institution and gender of the staff. Federal Polytechnic Ile-Oluji is a young Polytechnic with a few number of academic staff.

Target Population and Data Collection

The target population was primary data on mainly some academic staff working at Federal Polytechnic Ile-Oluji and collected with the aid of designed questionnaires administered to the lecturers. The target information included the bio-data of the respondents which formed personal categorization of factors responsible for publication productivity in the tertiary institution. Other major factors were the hours (length of time spent) on research per week and workload by lecturers in the institution.

Data Analysis

Poisson regression model was used in the data analysis with the aid of SPSS packages. This helped to determine whether or not age of lecturers, gender of a lecturers, years spent as a lecturer and weekly hours spent on publication/research

have significant influence on publication productivity in the institution. It also modelled publication productivity on the basis of those selected influencing factors and predicted the number of publication for an extra hour work on research.

According to John Nelder and Robert Wedderburn who formulated Generalized Linear Model (GLM), the Poisson regression model is a statistical model aims at modeling number of publication produced "Y" on the influence of counting the number of times that a certain event occurs during a given time period. We observe a sample Y1, . . ., Yn. The Poisson distribution models the probability of y events with the formula

$$P_r(Y=y/\mu) = \frac{e^{-\mu}\mu^y}{y!}; \ (0,1,2,...) \qquad \text{i}$$

Note that the Poisson distribution is specified with a single parameter μ. This is the mean incidence rate of a rare event per unit of *exposure*. Exposure may be time, space, distance, area, volume, or population size. Because exposure is often a period of time; we use the symbol *t* to represent the exposure. When no exposure value is given, it is assumed to be one.

The parameter μ may be interpreted as the risk of a new occurrence of the event during a specified exposure period, *t*.

The probability of *y* events is then given by

$$P_r(Y=y/\mu, t) = \frac{e^{-\mu}\mu t^y}{y!}; \ (0,1,2,...) \qquad \text{ii}$$

The Poisson distribution has the property that its mean and variance are equal.

$$E(y) = V(y) = \mu$$

In Poisson regression, it's supposed that the Poisson incidence rate μ is determined by a set of *k* regressor variables (the *X's*). The expression relating these quantities is

$$\mu = te^{(\beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k} \qquad \text{iii}$$

Note that often, $X_1 \equiv 1$ *X* and β_1 is called the *intercept*. The regression coefficients, $\beta_1, \beta_2, \beta_3, \ldots, \beta k$ are unknown parameters that are estimated from a set of data. Their estimates are labeled b_1, b_2, …, b_k. Using this notation, the fundamental Poisson regression model for an observation *i* is written as

$$P_r(Y_i = y_i/\mu_i, t_i) = \left(\frac{e^{-\mu}(\mu_i t_i)^{y_i}}{y_i!}\right) \qquad \text{iv}$$

$$\mu_t = t_i\,\mu(x_i\,\beta) \quad \text{v}$$

$$= t_i e^{(\beta 1X1 + \beta 2X2 + \beta_3 X_3 + \beta_4 X_4 \ldots + \beta i\, Xi)} \quad \text{vi}$$

Taking the log of μ_t and $X_1 = 1$, then the model becomes;

$$\text{Log}(\mu_t) = \beta_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 \ldots \beta i\, Xi \quad \text{vii}$$

That is, for a given set of values of the independent variables, the outcome follows the Poisson distribution.

Definition of the Model

In the Model given in **(vii)**, the variables are defined as follows;

X_2, X_3, and X_4 were the age, gender, years spent in academic and weekly hours spent on research respectively while $\text{Log}(\mu_t)$ is the log of number of publication produced in an academic session.

Hypothesis Statement

Hypothesis testing was used here to test the significance of the overall model as well as the statement of hypothesis used in the study is given as follows:

H_0: The influence of selected factors on publication productivity in the institution was not significant

H_1: The influence of selected factors on publication productivity in the institution was significant

The significant level, $\alpha = 0.05$

Decision Rule**:** $\boldsymbol{H_0}$ is rejected if P-value < α.

Result and Discussion

Table 1 shows that number of cases was 22 and percentage of cases included was 100%. This implied that there were no missing cases in the analysis.

Table 1: Case Processing Summary

	Number of Case	Percent
Included	22	100.0%
Excluded	0	0.0%
Total	22	100.0%

		N	Minimum	Maximum	Mean	Std. Deviation
Dependent Variable	Number of Publications per session	22	1	6	2.23	1.510
Covariate	Hours Spent Per Week on Research	22	7.00	35.00	19.73	8.81115

Table2: Categorical Variable Information

			N	Percent
Factor	Age of the Academic	21-30	2	9.1%
		31-40	10	45.5%
		41-50	8	36.4%
		51-60	2	9.1%
		Total	22	100.0%
	Gender of the Academic	Male	13	59.1%
		Female	9	40.9%
		Total	22	100.0%
	Years Spent as an Academic	1-5	9	40.9%
		6 +	13	59.1%
		Total	22	100.0%

Table 2 gives the number and percentage of subjects in each group of each factor that influences publication productivity (independent categorical variable) in the study. there were three categorical independent variables which were “Years Spent as an Academic” and “Age of the Academic” and “Gender of the academic”. However, the “Years Spent as an Academic” was not highly unbalanced in the numbers between its categories (i.e. 59.1% and 40.9%).

Table 3: Continuous Variable Information

	Value	df	Value/df
Deviance	5.914	15	1.012
Scaled Deviance	15.180	15	
Pearson Chi-Square	15.840	15	1.056

In Table 3 above, the mean and variance of the Number of Publications per session are very important. The ratio of the two indices i.e. variance (2.28) to mean (2.23) is 1.02, indicated that over-dispersion problem is very minimal even though the ratio could be 1 for equality of mean and variance which is an important property and assumption of Poisson distribution. However, it would not cause serious problem on the result of the analysis.

Table 4: Goodness of Fit

Dependent Variable: Number of Publications per session

Model: (Intercept), Age, Gender, years_Spent_in_Academics, Hours_spent) [a]

In Table 4, the "Pearson Chi-Square" (1.056) indicated that the sample is slightly over-dispersed which further buttressed the ratio of mean and variance in table 3, but unlikely to be a serious violation of the assumption of Poisson regression model. So, the sample fits the distribution.

Table 5: Omnibus Test

Likelihood Ratio Chi-Square	df	Sig.
13.523	6	.035

(Dependent Variable: Number of Publications per session
Model: (Intercept), Age, Gender, years Spent in Academics, Hours spent[a])

Table 5 above showed that the overall model is statistically significant since the p-value of 0.035 is less that the significant level (0.05). This implied that all independent variables contributed to the statistical significance of the model.

Table 6: Tests of Model Effects

Source	Type III		
	Wald Chi-Square	df	Sig.
(Intercept)	.076	1	.783
Age	1.436	3	.697
Gender	.242	1	.623
years_Spent_in_Academics	2.133	1	.144
Hours spent	6.784	1	.009

*(Dependent Variable: Number of **Publications per session***

Model: (Intercept), Age, Gender, years_Spent_in_Academics, Hours_spent)

In the table 6 above, Age of lecturers, Gender of lecturers, Years spent in academics by lecturers were not statistically significant. It's only "hours spent on research per week" that was significant with sig (0.009) <0.05. This implied that, the significance of the overall model in table 6 was heavily contributed by hours spent on research by lecturers. In other words, if the number of publication would be increased or decreased, the number of hours spent on research weekly would be considered and adjusted.

In table 7, the interested value is the exponential value of the hours spent on research since it is the only significant independent variable. The Exponential value of the hours spent on research (1.046) with 95% C.I (1.011, 1.083) implied that there would be a 4.6% increase in the number of publications for each extra hour

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			Exp(B)	95% Wald Confidence Interval for Exp(B)	
			Lower	Upper	Wald Chi-Square	df	Sig.		Lower	Upper
(Intercept)	.324	.7801	-1.205	1.853	.173	1	.678	1.383	.300	6.381
[Age=1.00]	.187	.7548	-1.292	1.666	.061	1	.804	1.206	.275	5.293
[Age=2.00]	-.426	.5381	-1.481	.629	.626	1	.429	.653	.228	1.876
[Age=3.00]	-.165	.4731	-1.093	.762	.122	1	.727	.848	.335	2.142
[Age=4.00]	0[a]	.	.	.	.	.	.	1	.	.
[Gender=1.00]	-.169	.3440	-.843	.505	.242	1	.623	.844	.430	1.657
[Gender=2.00]	0[a]	.	.	.	.	.	.	1	.	.
[years_Spent_in_Academics=1.00]	-.529	.3624	-1.240	.181	2.133	1	.144	.589	.289	1.198
[years_Spent_in_Academics=2.00]	0[a]	.	.	.	.	.	.	1	.	.
Hours_spent (Scale)	.0451[b]	.0174	.011	.079	6.784	1	.009	1.046	1.011	1.083

(Dependent Variable: Number of Publications per session
Model: (Intercept), Age, Gender, years_Spent_in_Academics, Hours_spent)

Conclusion and Recommendations

Conclusion

It can be concluded that weekly hours spent on research was the only significant factor in determining scholarly publication productivity at Federal Polytechnic Ile-oluji. Also, with an hour extra work on research by lecturers in the Polytechnic, there will be 4.6 % increase in the number of publication productivity. The model formulated was significant.

Recommendations

It is hereby recommended that;

i. The workload per lecturer per week be friendly to give room for increase in the weekly hours spent on research.

ii. The age and gender of lecturers as well as years spent in academic should not be prioritized as they contribute no significant effect on scholarly publication productivity in the Polytechnic.

References

Björk B.C. (2015), Have the "mega-journals" reached the limits to growth? PeerJ. 981. 3/11

Cameron A. and Trivedi Pravin (1999). Essentials of Count Data Regression: https://www.researchgate.net › publication › 210052843

Daine Duff (2001). "Writing for publication" – ResearchGate" https://www.researchgate.net › publication › 9004562_Wrinting for Publication.

Dhillon, S.K., Ibrahim, R. and Selamat, A. (2015), "Factors associated with scholarly publication productivity among academic staff: case of a malaysian public university",Technology in Society, Vol. 42, pp. 160-166.

Fischer, J., Ritchie, E.G. and Hanspach, J. (2012), "Academia's obsession with quantity", Trends in Ecology & Evolution, Vol. 27No. 9, pp. 473-474.

Gonzalez-Brambila, C. and Veloso, F. (2007), "The determinants of research productivity: a study of Mexican researchers", Research Policy, Vol. 36No. 7, pp. 1035-1051

Herrmannova D. Knoth P. (2016). An analysis of the Microsoft Academic Graph. D-Lib Mag;22(9/10), DOI:10.1045/september2016-herrmannova.

https://feb.kuleuven.be/public/u0017833/courses/advanced_econometrics/poisson.pdf

Nazia Wahid, Nosheen Warraich and Muzammil Tahira (2021). Factors influencing scholarly publication productivity: a systematic review. Information Discovery and Delivery © Emerald Publishing Limited [ISSN 2398-6247] [DOI 10.1108/IDD-04-2020-0036] page 1,2

Tahamtam, I., Afshar, A.S. and Ahmadzadeh, K. (2016), "Factor affecting number of citations: a comprehensive review of the literature", Scientometrics, Vol. 107, pp. 1195-1225.

Tahira, M., Alias, R.A. and Bakri, A. (2013), "Scientometric assessment of engineering in Malaysians universities", Scientometrics, Vol. 96No. 3, pp. 865-879.

Ware M, Mabe M. (2015). The STM report: An overview of scientific and scholarly journal publishing. https://www.stm-as soc.org/2015 02 20 STM Report 2015.pdf.

Wilsdon, J., et al. (2015). The Metric Tide: Report of the Independent Review of the Role of. Metrics in Research Assessment and Management. 179 pages Sage publisher Ltd;10.

FEDPOLAD JOURNAL OF ENGINEERING AND ENVIRONMENTAL STUDIES (FEDPOLADJEES)

EMPIRICAL APPRAISAL OF INTERVENTIONS AGAINST THE FIRST AND SECOND PHASES OF CORONAVIRUS PANDEMIC IN NIGERIA

Authors

Ademuyiwa, Justus Adeniran; Olaniyan, Joseph Olawale and Obabire, Akinleye Alaba

Department of Statistics, Federal Polytechnic, Ile-Oluji, Ondo State Nigeria

Author's Corresponding Email: ademuyiwajustus@yahoo.com

Abstract:

Nigeria, like other affected countries in the world fought the Coro-virus pandemic with several mitigating interventions which include both pharmaceutical and non-pharmaceutical interventions, to arrest the incidence of the pandemic. This study appraised the overall effectiveness of various interventions in the fight against Coronavirus in Nigeria with a view to having better result-oriented and sustainable response strategy. Data on the number of confirmed and discharged cases, death and number of cases on admission in each state of the federation from 27th February, 2020 to 7th June 2021 (467 days of the pandemic in Nigeria) were collected online (www.covid-19.ncdc.gov.ng) and analyzed using SPSS and Excel packages. Bar-chart and Pie- chart were prominently used to describe the performance of overall of the mitigating interventions against rampaging pandemic. Analysis of variance showed that the respective cases were significantly different. Similarly, T-test for two samples with equal variance carried out disclosed that Confirmed and Discharged cases were not significantly different indicating the rate at which people contacted and discharged of the pandemic were the same; this is a clear indication of positive results in the treatments administered against the corona-virus pandemic in Nigeria.

Keywords: *Admission, confirmed cases, Discharged cases, Interventions, Lockdown, Pandemic.*

Introduction

Nigeria faced growing burden of Covid-19 pandemic like other countries in the world. The pandemic in Nigeria was part of the worldwide corona-virus disease in 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The first case of COVID-19 in Nigeria was confirmed on 27 February 2020. The case was a 44-year old Italian citizen who arrived Nigeria through the Murtala Mohammed International Airport, Lagos, on a flight via Milan, Italy [NCDC, 2020]. This index case led to the activation of COVID-19 Public Health Emergency Operation Canters (PHEOC) at national and sub-national levels, with

associated active case finding via contact tracing. By 9 March 2020, 217 contacts were linked to this index case [NCDC, 2020], out of which 136 (63.0%) were under follow-up, with one contact confirmed positive [Ebenso and Otu, 2020]. The 14-day follow-up for contacts of the index case ended on 12 March 2020. During this period, two additional unlinked cases were reported in Nigeria. In addition, 42 suspected cases were identified across seven states in Nigeria namely the Federal Capital Territory (FCT), Edo, Kano, Lagos, Ogun, Rivers and Yobe [NCDC, 2020].

Since the confirmation of the first COVID-19 case in Nigeria, cases and deaths rose steadily in the country, the impact had negatively affected socio-economic life of Nigeria. Sociologically, the pandemic has caused global social disruption by limiting global social relations.

This negative influence made both national and various sub-national governments in the country to undertake and declare several response strategies at combating the spread of the disease. Some of these strategies were targeted at eradicating community transmission of the virus while others aimed at preventing inter-borders transmission because Nigeria is also among the vulnerable African nations, given the weak state of the healthcare system [Marbot, 2020]. In Africa, there are still communities without healthcare facilities, apart from the scarcity of health workers [Amzat, 2011].

The Nigeria Centre for Disease Control (NCDC) coordinated the public health response to COVID-19 in the country. Through NCDC's surveillance and laboratory network as well as coordination of state PHEOCs, epidemiological information on COVID-19 cases were captured into a real-time networked platform called Surveillance Outbreak Response Management and Analysis System (SORMAS). This formed the basis for the release of daily situation reports for COVID-19 on NCDC COVID-19 microsite [NCDC,2020]

On 24 March 2020, Yobe State government announced the closure of all their schools from 26 March [Duku Joel, 24 March 2020]. Joint Admissions and Matriculation Board suspended all their activities for two weeks [Ikpefan Frank, 24 March 2020]. The Nigerian Senate adjourned plenary to 7 April 2020, while the Nigerian House of Representatives adjourned indefinitely[Aborisade, Sunday,24 March 2020] and [Baiyewu, Leke, 24 March 2020]. Edo State government reduced the number of people allowed in any public gathering from 50 to 20, closing markets in the state and allowing only sellers of food items, medicines and other vital commodities to operate. [. 24 March 2020]. Kaduna State government confirmed that three suspected persons tested negative for the virus in the state [Alabelewe AbdulGafar, 24 March 2020].

Nasarawa State government ordered the indefinite closure of all their schools with immediate effect. [. 24 March 2020] Osun state government banned weekly markets

indefinitely in the state. [Adedeji Toba, 24 March 2020]. Lagos State and Ogun state government were the epic-centre of the fight against the pandemic because they have major international business activities and centers in Nigeria. It ordered the closure of stores and markets from 26 March, allowing only sellers of food items, medicines, water and other essential commodities to operate. There was restriction on interstate travel to prevent interstate transmission of the deadly virus [, 24 March 2020].

The National Examination Council announced an indefinite postponement of the 2020 common entrance examination into 104 Unity schools in Nigeria, which was supposed to hold on 28 March.[Ikpefan, Frank, 24 March 2020]. Enugu State government banned all social and political gatherings in the state.[Oji, Chris, 24 March 2020]. Actors Guild of Nigeria banned movie sets across Nigeria [Anokam, Sam, 24 March 2020]. Every other component state in the country including Local Governments also independently declared restriction on movement and socio-economic activities in their domains although, the idea of "social distancing" negates regular social interaction, which is the bedrock of human society [Amzat and Razum, 2014].
closure of all their schools from 26 March [Duku Joel, 24 March 2020]. Joint Admissions and Matriculation Board suspended all their activities for two weeks [Ikpefan Frank, 24 March 2020]. The Nigerian Senate adjourned plenary to 7 April 2020, while the Nigerian House of Representatives adjourned indefinitely[Aborisade, Sunday,24 March 2020] and [Baiyewu, Leke, 24 March 2020]. Edo State government reduced the number of people allowed in any public gathering from 50 to 20, closing markets in the state and allowing only sellers of food items, medicines and other vital commodities to operate. [24 March 2020].

Kaduna State government confirmed that three suspected persons tested negative for the virus in the state [Alabelewe AbdulGafar, 24 March 2020]. Nasarawa State government ordered the indefinite closure of all their schools with immediate effect. [. 24 March 2020] Osun state government banned weekly markets indefinitely in the state. [Adedeji Toba, 24 March 2020].

Lagos State and Ogun state government were the epic-centre of the fight against the pandemic because they have major international business activities and centers in Nigeria. It ordered the closure of stores and markets from 26 March, allowing only sellers of food items, medicines, water and other essential commodities to operate. There was restriction on interstate travel to prevent interstate transmission of the deadly virus [, 24 March 2020]. The National Examination Council announced an indefinite postponement of the 2020 common entrance examination into 104 Unity schools in Nigeria, which was supposed to hold on 28 March.[Ikpefan, Frank, 24 March 2020]. Enugu State government banned all social and political gatherings in the state.[Oji, Chris, 24 March 2020]. Actors Guild of Nigeria banned movie sets across Nigeria [Anokam, Sam, 24 March 2020]. Every other component state in the country including Local Governments also independently declared restriction on movement

and socio-economic activities in their domains although, the idea of "social distancing" negates regular social interaction, which is the bedrock of human society [Amzat and Razum, 2014].

In September, 2020, socio-economic activities started reviving after easing a long period of lockdown which had been in place since March 29, 2020. This marked the end of first phase of Coronavirus in Nigeria.

On December 10, It was apparent that the second wave of the pandemic was looming because of the rising number of cases, shortly after partial relieve from the first wave that led to gradual opening of the nation's economy that had been partially lockdown, The Federal government declared the second wave adding that the rise in cases was mostly driven by an increase in infections within communities and, to a lesser extent, travelers entering Nigeria [Onuah Felix, 2020]. On the same day, the Presidential Task Force on COVID-19, declared that the second wave of the pandemic had begun, following the increase in the number of COVID-19 cases detected in the country [Guardian.ng, 2020].

This again resulted in another round of partial lockdown which was later eased to allow unhindered socio-economic activities in the country having realized a reduction in the rate of infection. However, on 11 May, 2021, because of noticeable rising trend of coronavirus in several countries, the Federal government declared another round of coronavirus restrictions and kick started giving coronavirus vaccination to her citizens. These were part of various interventions by the government to stamp out coronavirus in Nigeria. It's on this ground that this study aimed at appraising the performance of various interventions in the fight against Coronavirus in Nigeria with a view to having better understanding of its result-oriented and sustainable response strategy. This study relied on secondary source and the objective analysis of official media report.

2.0 Methodology

2.1 Study Design, Period and Data Source

Secondary data on recorded incidence of corona-virus between 27th February and 7th June 2021 was collected through transcription from www.covid-19.ncdc.gov.ng [NCDC, June 2021]. Nigeria is administratively divided into 36 states plus the FCT, which are zoned across six geopolitical areas: South-South; South-West; South-East; North-East; North-West and North-Central. During the study period, 36 states plus FCT had reported confirmed COVID-19 cases; all states were actively monitoring cases through the Integrated Disease Surveillance and Response system (IDSR) system [NCDC, 2020].

2.2 Target Population and Data Collection

The target population was Secondary data on persons investigated and confirmed for

SARS-CoV-2 infection during the study period was collected from the Nigeria Centre for Disease Control (NCDC) Microsite. This included number of confirmed cases, discharged cases, deaths and cases on admission in each state of the federation from February 27 2020 to 7 June, 2021.

2.3 Data Analysis

The data collected was analyzed with SPSS and Microsoft Excel packages. The data were presented with Bar chat and Pie chart. Analysis of variance (ANOVA) was used to determine whether number of discharged cases, deaths and number of cases on admission were significantly different. T-test for two sample with equal variance for significant difference between confirmed cases and discharged cases was carried out. Similarly, significant difference among geo-political zones was carried out with the same T-test. However, a normality test by Kolmogorov-Smirnov test initially conducted encouraged the use of parametric approach for the data

One-Way ANOVA Test

According to Eva Ostertagová et al (2013), a one-way analysis of variance is used when the data are divided into groups according to only one factor. It assumes that the data $x_{11}, x_{12,}, x_{13}, \ldots, x_{1n}$ are sample from population 1; $x_{21}, x_{22,}, x_{23}, \ldots, x_{2n}$ are sample from population 2,… $x_{k1}, x_{k2,}, x_{k3}, \ldots, x_{knk}$, are sample from population *k*. Let x_{ij} denote the data from the *i*th group (level) and *j*th observation.

The Model is given as $X_{ij} = \mu + \alpha_i + \varepsilon_{ij}$; where μ is the grand mean, α_i is the treatment effect and ε_{ij} is the error term.

We have values of independent normal random variables x_{ij}=1, 2, 3,…,k and j= 1, 2, 3,.,n with mean μ and constant standard deviation δ, Xij ~ (μ, δ). Alternatively, x_{ij}= $\mu_i + \varepsilon_{ij}$ each where εij are normally distributed independent random errors, $\varepsilon_{ij} \sim (0, \delta)$.

Let N = $n_1 + n_2 + n_3 + \cdots + n_k$ is the total number of observations (the total sample size across all groups), where n_i is sample size for the *i*th group.

The parameters of this model are the population means $\mu_1, \mu_2, \mu_3, \ldots \mu_k$ and the common standard deviation δ.

We will be interested in testing the null hypothesis;

H_0: $\mu_1=\mu_2=\mu_3=, \ldots,= \mu_k$

Against the alternative hypothesis;

H_A: ɔ≤I; I≤K: $\mu_1 \neq \mu_K$. (there is at least one pair with unequal means).

ANOVA is centered around the idea to compare the variation between groups (levels) and the variation within samples by analyzing their variances. Define the total sum of squares *SST*, sum of squares for error (within groups) *SSE*, and the sum of squares for treatments (between groups) *SSC*:

$$\text{SST(Total Variation)} = \sum_{i=1}^{k}\sum_{j=i}^{n1}\left(x_{ij} - \bar{x}\right)^2 \quad \text{i}$$

$$\text{SSE (Within Variation)} = \sum_{i=1}^{k}\sum_{j=i}^{n1}\left(x_{ij} - \bar{x_i}\right)^2 \quad \text{ii}$$

$$\text{SSC (Between Variation)} = \sum_{i=1}^{k}\sum_{j=i}^{n1}(x_i - \bar{x})^2 \quad \text{iii}$$

Notice that the left side is at the heart of *SST*, and the right side has the analogous pieces of *SSE* and *SSC*. It actually works out that:

$$\text{SST} = \text{SSE} + \text{SSC} \quad \text{iv}$$

The total mean sum of squares *MST*, the mean sums of squares for error *MSE*, and the mean sums of squares for treatment *MSC* are:

$$\text{MSST} = \frac{SST}{N-1};\ \text{MSSE} = \frac{SSE}{N-k};\ \text{MSSC} = \frac{SST}{K-1} \quad \text{v}$$

The one-way ANOVA, assuming the test conditions are satisfied, uses the following test statistic:

$$\text{F} = \frac{MSSC}{MSSE} \quad \text{vi}$$

Under H_0 this statistic has Fisher's distribution. In case it holds for the test criteria F (k-1, N-k)

$$\text{F} > F_{1-\alpha}, \text{k-1, N-k} \quad \text{vii}$$

Where $F_{1-\alpha}$, k-1, N-k is $(1\text{-}\alpha)$ *is* quantile of *F*-distribution with k-1 and N-k degrees of freedom, then hypothesis

H_0 is rejected on significance level α

The results of the computations that lead to the *F*-statistic are presented in an ANOVA table, the form of which is shown in the Table 1. *Table 1: Basic One-Way ANOVA Table*

Source of Variations	**Sum of Square**	**Degree of Freedom**	**Mean Sum of Square**	**F- Ratio**	**Tail Area Above F**
Between	SSC	k-1	MSSC=$SSC/k-1$	$MSSE/MSSE$	p-value
Within	SSE	N-k	MSSE= $SSE/N-k$	-	-
Total	SST	N-1	-	-	-

This *p*-value is the probability of rejecting the null hypothesis in case the null hypothesis does not hold. In case p < α, where α is the chosen significance level.

Student's T-Distribution (T-Test)

Student's t-statistic is defined as

$$\text{t} = \frac{\bar{X}-\mu}{S/\sqrt{n-1}} = \frac{\bar{X}-\mu}{\tilde{S}/\sqrt{n}} \quad \text{viii}$$

Student's *t*-distribution (or simply the *t*-distribution) arises when estimating the mean of a normally distributed population in situations where the sample size is small. It plays a role in a number of widely-used statistical analyses, including the Student's *t*-test for assessing the difference between two sample means among others.

The *t*-distribution is symmetric and bell-shaped, like the normal distribution, but has heavier tails, meaning that it is more prone to producing values that fall far from its mean. Student's t-statistic is analogous to the z-statistic given by

$$Z=\frac{\bar{X}-\mu}{Q/\sqrt{n}}$$

According to the central limit theorem, the sampling distribution of a statistic (like a sample mean) will follow a normal distribution, as long as the sample size is sufficiently large. However, researches have proven that t-test can also conveniently be used for large sample size (n>30) which is better for higher and valid power of the test except that it approaches normal as the size is large. Meanwhile the use of t-statistic is considerably suitable for small sample of size, n<30 (Murray R. Spiegel, 2008).

Difference of two means

In testing the null hypothesis that two samples of sizes, $n_1 \; and \; n_2$ are drawn from the same normal population whose means and standard deviations are equal ($\mu_1 = \mu_2 \; and \; Q_1 = Q_2 respectively$) if the two samples have means $\bar{x}_1 \; and \; \bar{x}_2$ and the standard deviations $s_1 \; and \; s_2$, the t-statistic in this case is given as;

$$t_{cal} = \frac{(\bar{X}_1-\bar{X}_2)}{\frac{S_P}{\sqrt{n_1+n_2}}} \text{ where;}$$

$$S_P=\sqrt{\frac{S_1^2(n_1-1)(n_2-1)S_2^2}{n_1-n_2+2}}$$

$n_1 and \; n_2$ are the samples sizes and the degrees of freedom used in this t-test is $n_1 + n_2 - 2$.

Decision is taken to reject the hypothesis of no difference in means, H_0, when $t_{\alpha/2};\; n_1 + n_2 - 2$ (two tail test) or $t_{\alpha};\; n_1 + n_2 - 2$ (one tail test) is less than t_{cal} at a given significant level, α or probability value p-value is less than α.

3.0 Data Presentation, Results and Discussion

3.1 Data Presentation

Table 2: Data on Coronavirus Incidence in Nigeria from 27 February 2020 to 6 June 2021

S/N	States Affected	No. of Cases (Lab Confirmed)	No. Discharged	No of Deaths	No. of Cases (on admission)
1	Abia	1,693	1,669	22	2
2	Adamawa	1,131	1,098	32	1
3	Akwa-Ibom	1,923	1,886	18	19
4	Anambra	1,909	1,826	19	64
5	Bauchi	1,549	1,518	17	14
6	Bayelsa	906	879	26	1
7	Benue	1,366	1,327	24	15
8	Borno	1,337	1,200	38	99
9	Cross River	402	384	18	0
10	Delta	2,639	2,556	72	11
11	Ebonyi	2,038	2,002	32	4
12	Edo	4,910	4,723	185	2
13	Ekiti	876	862	11	3
14	Enugu	2,464	2,335	29	100
15	FCT	19,872	19,110	166	596
16	Gombe	2,064	2,006	44	14
17	Imo	1,661	1,620	37	4
18	Jigawa	532	512	16	4
19	Kaduna	9,103	9,014	65	24
20	Kano	4,000	3,868	110	22
21	Kastina	2,110	2,055	34	21
22	Kebbi	450	392	16	42
23	Kogi	5	3	2	0
24	Kwara	3,130	3,068	55	7
25	Lagos	59,229	58,484	456	289
26	Nasarawa	2,383	2,344	39	0
27	Niger	935	913	17	5
28	Ogun	4,683	4,633	50	0
29	Ondo	3,409	3,229	64	116
30	Osun	2,578	2,520	52	6
31	Oyo	6,858	6,731	124	3
32	Plateau	9,063	9,005	57	1
33	Rivers	7,276	7,151	101	24
34	Sokoto	775	747	28	0

35	Taraba	1,001	977	24	0
36	Yobe	478	451	9	18
37	Zamfara	244	233	8	3
Total		**166,982**	**163,331**	**2117**	**1534**
Percentage			**97.81**	**1.27**	**0.92**

Source: www.covid-19.ncdc.gov.ng

On Table 2, a total of 166,982 confirmed cases, out of which 2,117 deaths and 163,331 discharged cases were recorded in Nigeria within the period under review. These were represented in percentages as; out of 100% confirmed in the laboratory as positive, 97.81% were deaths and discharged cases after making full recovery and 1.27% as deaths. A little 0.92% were still on admission. Lagos state had the highest number of confirmed, discharged and death cases which stood at 59,229, 58,484 and 456 respectively.

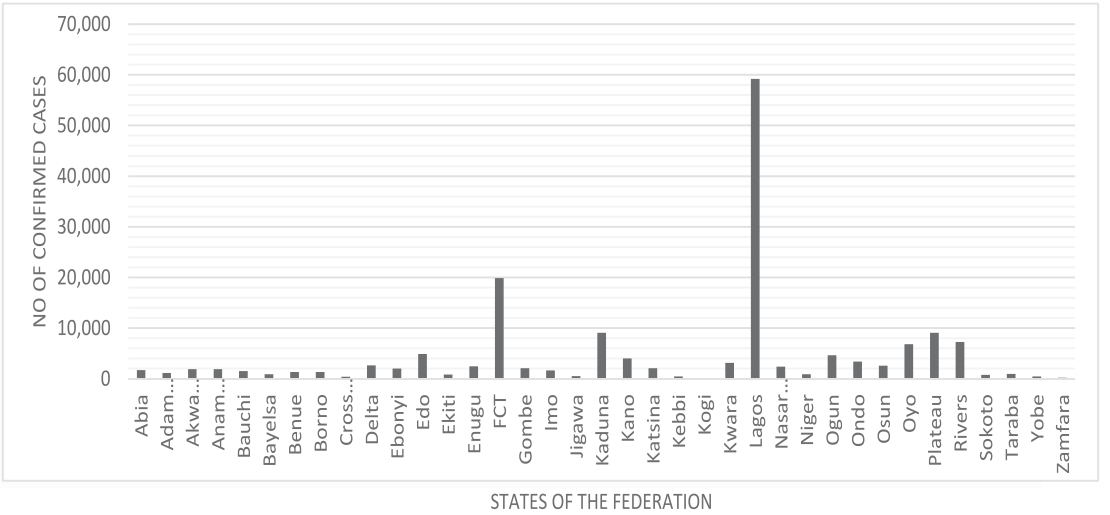


Figure 1: Bar-Chart Showing the Monthly Confirmed Cases of Corona-Virus in Nigeria

According to the chart in **Figure 1**, Lagos state had the highest number of confirmed cases of the pandemic (**35.47%)** and followed by FCT (**11.90%**). While Cross River, Ekiti, Kebbi, Kogi, Jigawa and Sokoto recorded relatively fewest number of cases.

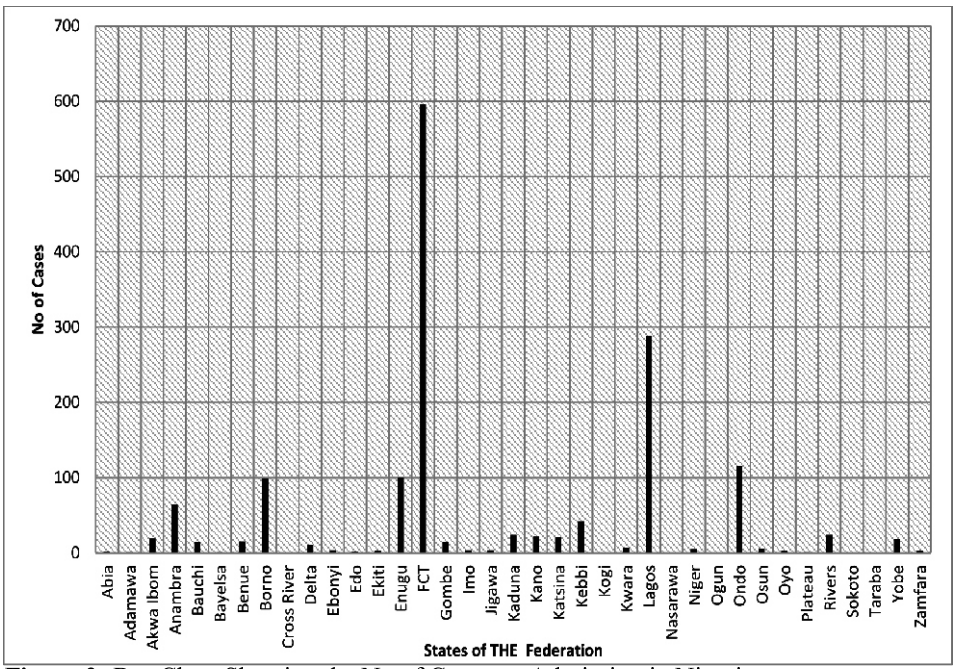


Figure 2: Bar-Chart Showing the No of Cases on Admission in Nigeria

In **Figure 2**, it's shown that FCT (**38.85%**)had the highest number of cases on admission followed by Lagos (**18.84%)** which had highest number of cases confirmed in Fig.1. Cross-River, Kogi, Ogun, Nasarawa, Sokoto and Taraba had no cases on admission. Ondo, Borno and Enugu also had high number of cases on admission.

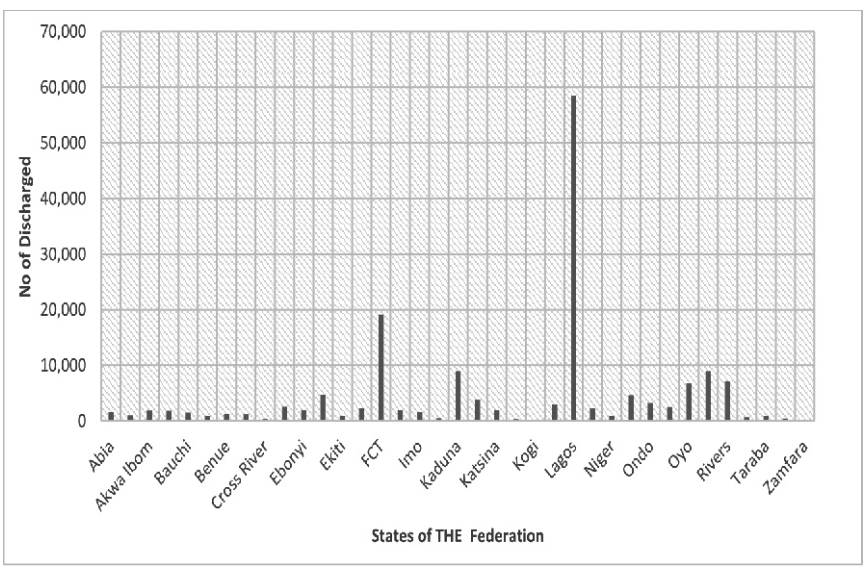


Figure 3: Bar-Chart Showing the Discharge Cases of Corona Virus in each State in Nigeria

In Figure 3, Lagos State recorded noticeable highest number of discharged cases **(35.80**%) in Nigeria within the specified period while FCT had **11.68%** of the total discharged cases. Oyo, Plateau, Rivers and Kaduna trailed behind Lagos and FCT with **4.12%, 5.51%, 4.38%** and **5.52%** respectively.

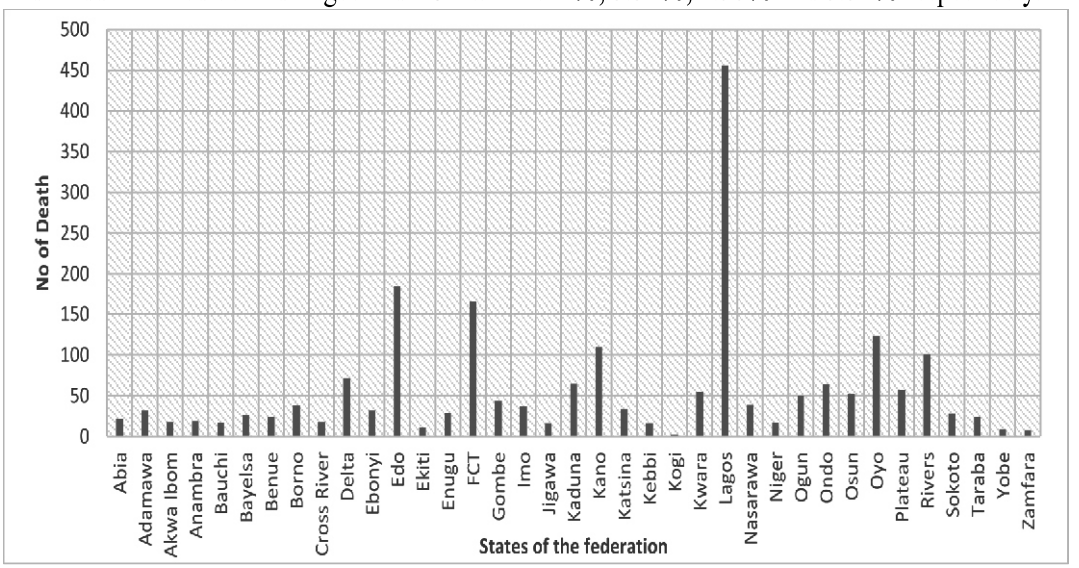


Figure 4: Bar-Chart Showing No of Deaths due to Coronavirus in each State in Nigeria

Figure 4 indicated that deaths recorded as a result of COVID-19 within the specified period was mostly pronounced in Lagos. Lagos had **21.54%** of the total deaths recorded. Edo state followed Lagos with **8.74%** and FCT with **7.84%.**

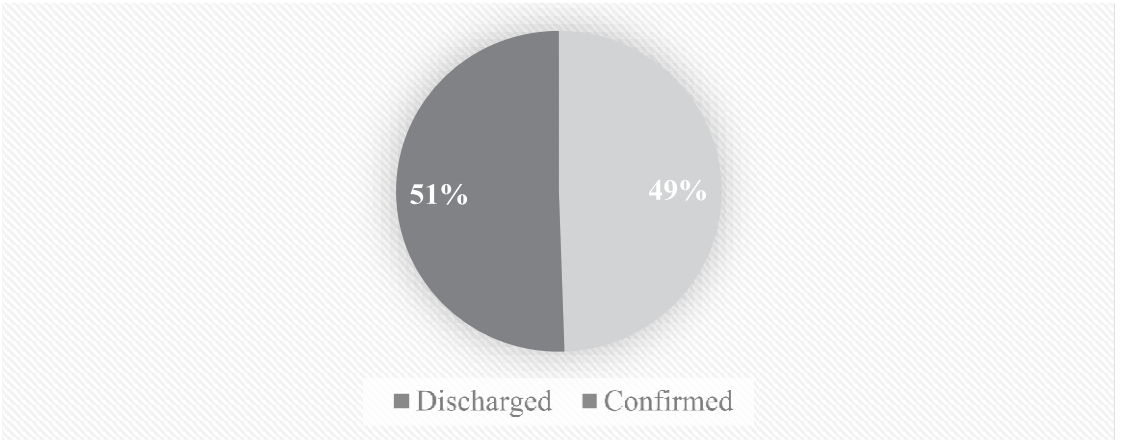


Figure 5: Pie-Chart Showing Percentages of Confirmed and Discharged Cases in Nigeria

In **Figure 5,** The percentage ratio between confirmed discharged cases is **51%:49%.** This showed that the rate at which confirmed cases got discharged of the pandemic from isolation centers across the country was very close. This implies the proportion of confirmed cases and discharged cases was almost the same.

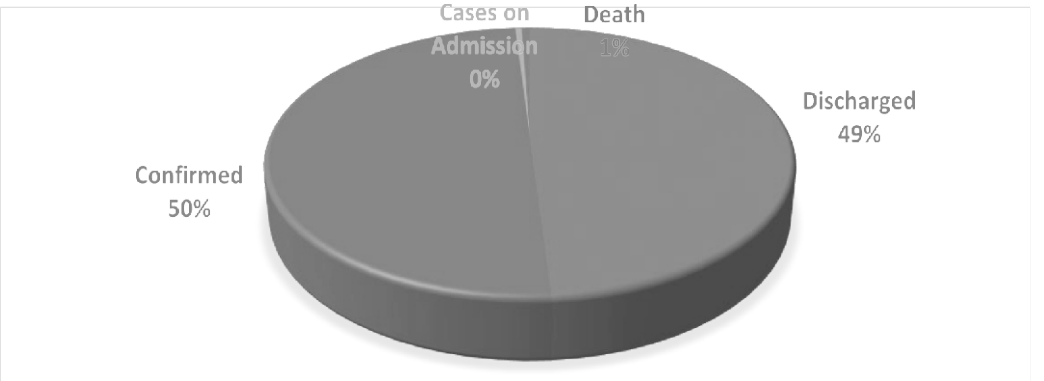


Figure 6: Showing the percentages of Confirmed, Discharged, Death and Cases on Admission of Corona virus in each state in Nigeria

Figure 6 showed that the percentage cases on admission and deaths were insignificant. This showed that the cases on admission were asymptotically low. This is an indication that few patients were on admission as a result of efficacious performance of various interventions on the pandemic.

3.2 Results and Discussion

Table 3: Test of Normality

Incidence	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Log of No. of Cases on Admission	.123	37	.172	.924	37	.015
Log of No. of Deaths	.112	37	.200*	.975	37	.561
Log of No. Discharged	.142	37	.059	.863	37	.000
Log of No. of Cases (Lab Confirmed)	.128	37	.133	.883	37	.001

Interpretation:

H_0: Cases follow normal distribution

H_1: Cases do not follow normal distribution

Decision Rule: Reject H_0 if p-value < 0.05

Conclusion: All cases with Kolmogorov-Smirnov followed normal distribution.

Table 4: Test of Significance Between Discharged, Death and Cases on Admission

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	469,987,053.10	2.00	234,993,526.55	7.33	0.00	3.08
Within Groups	3,462,352,213.89	108.00	32,058,816.80			
Total	3932339267	110				

Interpretation: P-value (**0.00**) indicated that the number of cases discharged, number of deaths as a result of the disease and cases on admission were significantly different at 0.05 significant level.

Table 5: Test of Significance Between Cases and Among States

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows (Cases)	3,561,333,967.00	36	98,925,943.53	3.09	0.00	1.53
Columns (States)	721,185,146.10	3	240,395,048.70	7.50	0.00	2.69
Error	3,462,352,214.00	108	32,058,816.80			
Total	7,744,871,327.00	147				

Interpretation: P-value (**0.00**) indicated that the number of cases confirmed in the laboratory, number of cases discharged, number of deaths as a result of the disease and cases on admission were significantly different. It also revealed that cases corresponding to States were significantly different at 0.05 significant level.

Table 6: Distribution of Corona-virus Cases in each Geo-Political Zone in Nigeria

Regional Incidence	No of Cases (Lab Confirmation)	No of Discharged	Deaths	Cases on Admission
South-west	77,633	76,459	757	417
South-South	19,347	18,864	424	59
South-east	8,474	8,167	135	172
North-central	36,820	35,834	367	619
North-west	17,617	17,222	278	117
North-east	7,091	6,785	156	150

Source: ***Table 2 above***

In Table 6, South-west had the highest confirmed, discharged cases and deaths while North-east recorded the least

confirmed and discharged cases. Northcentral had the highest cases on admission with 619 cases while South-west had 417 cases on admission.

Table 7: Test of Significance of Cases of Incidence and Geo-Political Zones Effects

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows (Geo-Political Zones)	4,698,731,069	5	9.4E+08	4.0987	0.0276	3.3258
Columns (Number of Cases)	2,954,652,879	2	1.48E+09	6.4433	0.0159	4.1028
Error	2,292,784,636	10	2.29E+08			
Total	9,946,168,584	17				

Interpretation: P-value (0.0276) indicated that the number of cases confirmed (laboratory), number of cases discharged, number of deaths and cases on admission in each Geo-Political Zone showed a significant difference at 0.05 significant level. In the same vein, number of cases showed a significant difference.

Table 8: Test of Significance between Cases using Student's T Distribution with Assumed Equal Variance at α=0.05

S/n	Factor: Test of Significance	P(T<=t) two-tail (T-Stat)	Remarks
1	Between Confirmed and Discharged Cases	0.9658 (-0.0429)	No significant difference
2	Between Confirmed and Cases on Admission	0.0092(-2.7529)	There is significant difference
3	Between Discharged Cases and Deaths	0.0086 (-2.7074)	There is significant difference
4	Between Confirmed and Death Cases	0.0080 (2.7249)	There is significant difference

4.0 Conclusion and Recommendation

Findings from the analysis carried out showed that there was no significant difference between the confirmed cases and discharged cases within the period specified. This implied that the rate at which people were diagnosed of the pandemic and recovered were the same. This was a clear indication of positive response from various intervention against the virus. It could be concluded also that cases confirmed in each state were significantly different. It could also be concluded that during the period under review, the rate of recovered and death cases was significantly different. Moreover, regional transmission of the pandemic was significantly different. This implied also that prevalent rates among geo-political zones were not the same. However, the fight against COVID-19 cannot be effective and sustained without properly sustaining motivation of health workers. Again, the lockdown introduced by government to curtail community transmission of the pandemic might be helpful. The government should improve on its sensitization, by emphasizing more on adequate use of non-pharmaceutical protocols to checkmate the pandemic from spreading. However, proper care and incentives should be given to all citizen of the country to ameliorate the suffering being faced because of incidence of the pandemic in Nigeria in relation to economic downturn. Generally, there was a positive response as a result of overall intervention in Nigeria.

5.0 Reference

Aborisade, Sunday (24 March 2020). "COVID-19: Senate adjourns till April 7". The Punch Newspaper. Retrieved 24 March 2020.

Adedeji, Toba (24 March 2020). "Osun suspends weekly markets indefinitely over coronavirus". The Nation Newspaper. Retrieved 24 March 2020.

Alabelewe, AbdulGafar (24 March 2020). "COVID-19: Three suspected cases test negative in Kaduna". The Nation Newspaper. Retrieved 24 March 2020.

Amzat, J. and Razum, O. (2014) Medical Sociology in Africa. Cham, Switzerland: Springer International Publisher.

Amzat J. Health inequality in Nigeria In: Ogundiya I.S., Olutayo A.O., Amzat J., editors. Assessment of Democratic Trends in Nigeria. Gyan Books; New Delhi: 2011. pp. 313–322. [Google Scholar] [Ref list]

Anokam, Sam (24 March 2020). "COVID-19: AGN bans movie sets across Nigeria". The Nation Newspaper. Retrieved 24 March 2020

Baiyewu, Leke (24 March 2020). "Reps adjourn plenary indefinitely". The Punch Newspaper. Retrieved 24 March 2020.

"COVID-19: Nigeria now in second wave, PTF says". guardian.ng. Retrieved 17 January 2021.

"COVID-19: Nasarawa government shutdown schools". The Nation Newspaper. 24 March 2020. Retrieved 24 March 2020.

Coronavirus: Edo restricts gatherings to 20 persons". The Nation Newspaper. 24 March 2020. Retrieved 24 March 2020.

Duku, Joel (24 March 2020). "COVID 19: Gov.Buni shuts down Yobe schools in Yobe". The Nation Newspaper. Retrieved 24 March 2020

Ebenso B and Otu A (2020) Can Nigeria contain the COVID-19 outbreak using lessons from recent epidemics? The Lancet Global Health 8, e770. [PMC free article] [PubMed] [Google Scholar]

Eva Ostertagová, Oskar Ostertag (2013), “Methodology and Application of One-way ANOVA” American Journal of Mechanical Engineering, 2013, Vol. 1, No. 7, 256-261.

Gilbert, M., Pullano, G., Pinotti, F., Valdano, E., Poletto, C., Boëlle, P., D'Ortenzio, E., Yazdanpanah, Y., Eholie, S. Y., Altmann, M., Gutierrez, B., Kraemer, M. U. G., & Colizza, V. (2020). Preparedness and Vulnerability of African Countries against Importations of15. COVID-19: A Modelling Study. The Lancet, 395,871-877. https://doi.org/10.1016/S0140-6736(20)30411-6.

Ikpefan, Frank (24 March 2020). "COVID- 19: JAMB suspends services nationwide". The Nation Newspaper. Retrieved 24 March 2020.

Marbot O. 2020. Coronavirus Africa Map: Which Countries are Most at Risk? https://www.theafricareport.com/23948/coronavirus-africa-which-countries-are-most-at-risk/ [Google Scholar]

Murray R. Spiegel and Larry J. Stephens: Schaum's Outlines Statistics, McGraw Hill 3rd Edition, 2008; 261-276.

Nigeria Centre for Disease Control. COVID-19 Outbreak in Nigeria Situation Report 009. pp. 1–3 & S/N 65.

Oji, Chris (24 March 2020). "Enugu locks down, bans all social activities". The Nation Newspaper. Retrieved 24 March 2020.

Onuah, Felix (11 December 2020). "Nigeria warned of possible new COVID-19 wave, authorities eye vaccine in early 2021". Reuters. Retrieved 17 January 2021.

The Nation Newspaper. 24 March 2020. "BREAKING: Sanwo-Olu shuts down Lagos markets". Retrieved 24 March 2020.

The Nation Newspaper. 25 March 2020. “Ekiti closes markets over COVID-19". Retrieved 25 March 2020.

FEDPOLAD JOURNAL OF ENGINEERING AND ENVIRONMENTAL STUDIES (FEDPOLADJEES)

KEY INDICATORS OF COVID-19: A COMPARISON OF CASES FROM NIGERIA AND GHANA

Authors

Adetunji, A.A., Ademuyiwa, J.A., and Olorunlogbon, O.R.

Department of Statistics, Federal Polytechnic, Ile-Oluji, Nigeria

Abstract:

Socio-economic impacts of COVID-19 are still being felt world over. In assessing the rate of infection and its adverse effect in countries, three key indicators (confirmed cases, recovery, and death) are of interest. This study assesses variations in confirmed cases, recovery, and death due to COVID-19 between Nigeria and Ghana. Data for the study was obtained from the coronavirus package in R-language (R Core Team, 2022) from January, 2020 till June, 2022. The data provides a daily summary of the Coronavirus for different countries using record from the Johns Hopkins University Center for Systems Science and Engineering. For relative comparison of variables from two populations, the three variables are standardized into variable per ten million of a population. Time plot shows that Ghana has higher confirmed cases, recovery rate, and death per ten million of population. Confirmed cases peaked in both countries in the middle of 2020, first quarter of 2021, and third quarter of 2021. Ghana confirmed significantly lower cases in 2022 in comparison to Nigeria. Death due to the disease peaked in both countries in the first and the third quarter of 2021 while recovery peaked in both countries second quarter of 2020 and first quarter of 2021. Bivariate correlation between the countries for the three considered indicators shows a relatively higher positive relationship. The paired sample t-test reveals that Ghana has significantly higher relatives confirmed cases, recovery, and death per ten million of the population when compared to Nigeria.

Keywords: *Bivariate Correlation, Comparisons, COVID-19, t-test.*

Introduction

COVID-19 is a novel Coronavirus disease and an infectious disease caused by the SARS-CoV-2 virus that spreads in small particles of fluid from an infected person's mouth or nose when they cough, sneeze, speak, sing or breathe (WHO, 2022a). The disease was declared a global pandemic by the World Health Organization (WHO) on March 11, 2020 (Cucinotta & Vanelli, 2020) after the first case was reported in Wuhan City, China in December 2019 (WHO, 2020a). As of June 29, 2022, a total of 541,313,815 million confirmed COVID-19 cases worldwide have been

reported with 6,327,547 million deaths (WHO, 2022b).

Coronaviruses are zoonotic pathogens, mainly found in animals but also in humans, with the ability to show clinical features in humans. When a person is infected with the virus, such a person may be asymptomatic or symptomatic and this affects their gastrointestinal, respiratory, hepatic and neurological systems, which may result in hospitalization (Drexler et al., 2010; Woo et al., 2010; and Yin et al., 2018). The virus can be transmitted from person to person by droplet infection from an infected person (NCDC, 2020). The viral nucleic acid in patients infected with the Coronavirus is similar to that of influenza patients (Zou et al., 2020). The virus has a fast and easier transmission route between clusters such as family, boardroom, restaurant, marketplace, etc. This accounts for 50-80% of all confirmed cases of COVID-19 (Zhonghua et al., 2020). Transmission of the virus between groups of family members occurred in 13–21% of MERS patients and 22–39% of SARS cases (Yin & Wunderink, 2018), showing how infectious SARS-COV and MERS-COV are through nosocomial human-to-human -Transfer are are rating transfers. COVID-19 causes clusters of fatal pneumonia (Huang et al., 2020). In severe cases, thrombosis and pulmonary embolism have also been reported (Yuki et al., 2020). In addition, lung abnormalities, neurological complications, and exercise intolerance are commonly noted complications in survivors (Elhiny et al., 2021). Patients die from multi-organ failure, shock, acute respiratory distress syndrome, cardiac failure, anemia, arrhythmias, secondary infections, and renal failure (Huang et al., 2020; Huang et al., 2020).

The first case of the deadly Coronavirus in Nigeria was noticed on February 27, 2020, the case is an Italian national working in Nigeria who returned to Lagos, Nigeria on February 25, 2020 from Milan, Italy due to the epidemic. The widespread route has been somewhat sluggish as public health contributions collected in Nigeria condensed both local distribution and import (Ebenso, 2020; NCDC, 2020; WHO, 2020b). In response to the novel Coronavirus disease of 2019 (COVID-19), the Nigerian government has launched an immediate intervention. The Nigerian government imposed a ban on all international flights active from March 23, 2020 except for essential flights and emergency flights, and all private and government schools (primary, secondary and universities) have been closed to restrict mass gatherings. An epidemiological study of the Coronavirus outbreak in Nigeria is included in this research report. With the cumulative overview of Coronavirus disease 2019 (COVID-19) in Nigeria, a huge disease outbreak is imminent as is usual with experimental cases in countries that are epicenters. The Federal Department of Health has moved a top-level emergency response through the Nigeria Center for Disease Control (NCDC) through the National Emergency Operations Center (EOC) and is leading the national public health response to the outbreak in Nigeria, with state EOCs acting prominently at state level. All affected states, through the Nigeria Center for Disease Control (NCDC), are working hard to deploy national Rapid Response

Teams (RRTs) to fully support contact tracing efforts. The Presidential Task Force on coronavirus disease 2019 (COVID-19) has taken sufficient measures to work with the Federal Ministry of Health to contain the spread of the disease and protect the health of Nigerians as soon as possible (NCDC, 2020). The federal government imposed a lockdown on non-essential activities in Lagos State, FCT and Ogun State on March 30, 2020. On April 27, 2020, President Muhammadu Buhari announced that there would be a gradual relaxation of the lockdown in these locations. This policy has now been implemented. However, as of June 19, 2022, a total of 256,695 confirmed cases, 250,155 recovery cases and 3,144 deaths had been reported to the NCDC (NCDC, 2020).

In Ghana, the COVID-19 pandemic started much more slowly. The first two cases were confirmed in March 2020 when infected foreigners arrived from Norway and Turkey (Duncan, 2020). Since then, the number of infected people has continued to rise. The President of Ghana, Nana Akuffo Addo, introduced public health measures and guidelines that included temporary lockdowns in the Greater Kumasi and Accra metropolitan areas, which were strictly enforced by the security services. There was a ban on public gatherings of more than 25 people and schools were closed (Leah & Frimpong, 2020; Sibiri et al., 2020). Likewise, all borders with neighboring countries were closed and the airport closed. Also, social distancing and public education were promoted to create COVID-19 protocols and awareness among the general public. Just 21 days after the lockdown, the government relaxed with another directive easing restrictions that followed in June 2020, at a time when COVID-19 cases were rising in the country. By June 2020, the total number of COVID-19 cases had increased to 17,741 from 7,881 in May 2020, and the death toll had tripled to 112 (WHO, 2020c). Despite Ghana having the third highest number of cases in West Africa, the government continued to ease restrictions, bans on social gatherings and other restrictions until October 2020. The COVID-19 situation update in Ghana dated June 19, 2022 shows a total number of cases (confirmed cases) of 164,612, recovered/discharged cases of 161,879 and 1,448 deaths (COVID-19 Ghana's Outbreak Response Management Updates, 2022).

This study aims at assessing trend and comparing key indicators of the disease (confirmed cases, recovery and death) in Ghana and Nigeria, for more informed decision on the disease in both West African power houses.

MATERIALS AND METHODOLOGY

The data for this study was obtained from the coronavirus package in R-language (R Core Team, 2022) for reported indicators (confirmed cases, recovery, and death) from January, 2020 till June, 2022. The data provides a daily summary of the Coronavirus (COVID-19) for different countries using record from the Johns Hopkins University Center for Systems Science and Engineering (JHU CCSE). For relative comparison of variables from two the populations, the three utilized variables are standardized into

variable per ten million of population. Descriptive statistics are used to describe the data while the time plot is used to observe trends of the considered variables with respect to time being studied. The bivariate Pearson's correlation is employed in the study to examine the degree of the strength and direction of the relationship among the three considered indicators while the independent sample t-test is used for the comparison of each indicator between the two countries.
For any bivariate variables

$$\rho = \frac{n\sum XY - \sum Y \sum Y}{\sqrt{(n\sum X^2 - (\sum X)^2)(n\sum Y^2 - (\sum Y)^2)}}$$

The independent-Samples t-test compares means for two groups of cases. Data for such test should be sampled independently from the two populations being compared. Assuming n_1 sample is taken from the first population with mean $\bar{X}_1$ and n_2 is the sample size from the second population with mean $\bar{X}_2$, the test statistics for the independent sample t-test is given as:

$$t = \frac{\bar{X}_1 - \bar{X}_1}{S_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

where

$$S_p = \sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}}$$

RESULTS AND DISCUSSION

Assessing the trend of the considered indicators of Coronavirus in this study, Figure 1 shows that the confirmed cases per ten million of population for both countries (Ghana and Nigeria) peaked in the middle of year 2020, first quarter of 2021 and third quarter of 2021. Although the frequency of total confirmed cases in Nigeria is higher than the records in Ghana, relative comparison with respect to the population of each country shows that Ghana has higher confirmed cases per ten million of population with peak at above 5,000 per ten million while Nigeria's confirmed cases peaked at just about 2,000 per ten million of her population. *Table 1 shows the summary statistics for the considered indicators for the two countries. The table shows that Ghana has higher indicators per ten million of the base population (confirmed cases, recovery, and death) than Nigeria.*

*E*xamining the relationship between the two countries for the three indicators (confirmed cases, recovery cases and death cases) considered in the study, the bivariate correlation between them reveals a relatively high positive correlation with 0.77, 0.75 and 0.74 respectively.

Table 1 *Summary statistics for the indicators for the two countries*

Indicator	Country	Mean	Std. Dev.	Std. Error	Correlation Coeff.
Confirmed	Nigeria	415.16	497.53	90.84	0.77
	Ghana	1765.87	1789.54	326.72	
Recovery	Nigeria	267.15	420.97	76.86	0.75
	Ghana	1058.41	1646.51	300.61	
Death	Nigeria	5.09	5.53	1.01	0.74
	Ghana	15.53	18.51	3.38	

Since Ghana has higher confirmed cases per ten million of her population, recovery (which is a function of total confirmed cases) is also higher in Ghana has shown in the figure 2 when compared to the record in Nigeria. The figure also reveals that the recovery peaked in both countries in the second quarter of 2020 and first quarter of 2021. Also, figure 3 shows that death due to COVID-19 peaked in both West African countries peaked in the first and third quarters of 2021.

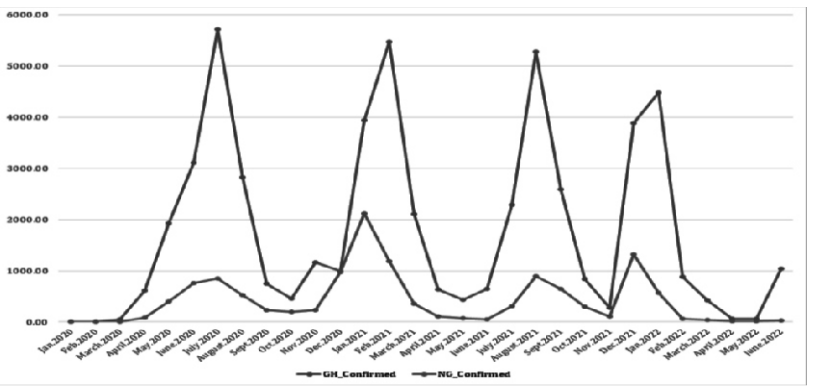


Figure 1: Time Plot for Confirmed Cases of COVID-19

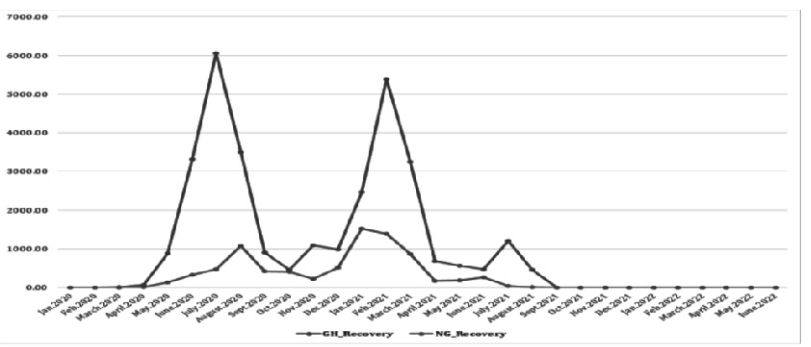


Figure 2: Time Plot for Confirmed Cases of COVID-19

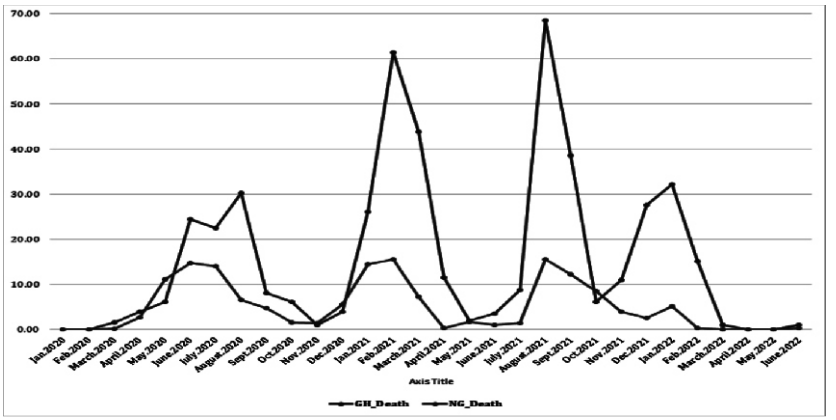


Figure 3: Time Plot for Death Cases of COVID-19

Table 2 Independent Samples Test *for the indicators for the two countries*

Indicator	t	P-value	Mean Diff.	Std. Err. Diff.	95% Conf. Inter.
Confirmed	-3.983	0.000	-1350.710	339.115	(-2029.523, -671.897)
Recovery	-2.550	0.013	-791.267	310.279	(-1412.359, -170.176)
Death	-2.961	0.004	-10.442	3.527	(-17.502, -3.382)

Considering the three indicators, a confirmatory test on the significance difference between the two countries is carried out using the independent sample t-test. Results reveal significantly higher indicators in Ghana in comparison to Nigeria with P-values of 0.000, 0.013 and 0.004 respectively for the number of confirmed cases, recovery, and death as shown in table 2.

CONCLUSION

Although the attention given to the outbreak of COVID-19 is reducing over time, the disease is still not completely eradicated. The economic impacts of the pandemic will take years to normalize across countries in the world, it is therefore pertinent to assess the trend of the key indicators in different countries of the world in order to have a better preparedness in case similar unforeseen disease breakout in the future. Challenges associated with the COVID-19 pandemic could be enormous in the long run, identifying factors that culminate into increment in the respective countries and at respective time is vital towards prevention of a repeat of such scenario in the future.

Fluctuations observed in the trend of confirmed cases in both countries are dynamic and unpredictable indicating that there was no proper plan in place to effectively curb the spread of the disease in early stages. Early coordination of different agencies of government responsible for quick response to the overall management of such pandemic could go a long way in ameliorating some of the negative impacts of the disease in African countries in particular and the world at large. The outbreak of the

disease exposes decay in the health infrastructure of many African countries with the attending death of many people who were denied opportunity to access health facilities in foreign countries. COVID-19 outbreak therefore should serve as clarion call to political class to channel resources to the healthcare of different countries.

During the heat period of the disease, Nigeria was seen as the epicenter among countries in West Africa but due credence was not given to the overall size of the population of the country. Comparing indicators with countries like Ghana with just a little above 30 million with Nigeria with more than 200 million populations is biased. This study had shown importance of relative comparison and results obtained had shown Ghana to be much more affected by the pandemic relative to her population size when compared to Nigeria. Similar comparisons are encouraged for efficient decision making.

REFERENCES

Central People's Government of the People's Republic of China. 14 key questions and answers.

COVID-19 Ghana's Outbreak Response Management Updates (2022). Situation Update. https://ghs.gov.gh/covid19/archive.php#

Cucinotta, D., & Vanelli, M. (2020). WHO declares COVID-19 a pandemic. Acta Biomed. 91(1):157–160. doi:10.23750/abm.v91i1.9397

Drexler, J.F., Gloza-Rausch, F., Glende, J., Corman, V.M., Muth, D., Goettsche, M., & Drosten, C. (2010). Genomic Characterization of Severe Acute Respiratory Syndrome-Related Coronavirus in European Bats and Classification of Coronaviruses Based on Partial RNA-Dependent RNA Polymerase Gene Sequences. Journal of Virology. 84(21), 11336–11349. https://doi.org/10.1128/jvi.00650-10

Duncan, J. (2020). Two cases of the coronavirus confirmed in Ghana. Citi Newsroom. Retrieved March 16, 2020 from https://citinewsroom.com/2020/03/two-cases-ofcoronavirus-confirmed-in-ghana/

Ebenso, B. (2020). Out, A. Can Nigeria Contain the COVID-19 outbreak using lessons from recent epidemics? Lancet Glob. Health.

Elhiny, R., Al-Jumaili, A.A., & Yawuz, M.J. (2021). An overview of post-COVID-19 complications. Int J Clin Pract. 75(10):1–2. doi:10.1111/ijcp.14614

Huang, D., Lian, X., Song, F. (2020). Clinical features of severe patients infected with 2019 novel coronavirus: a systematic review and meta-analysis. Ann Transl Med. 8(9):576. doi:10.21037/atm-20-2124

Huang, C., Wang, Y., Li, X. (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 395 (10223):497–506. doi:10.1016/S0140-6736(20)30183-5

Nigeria Centre for Disease Control. (2020) National Interim Guidelines for Clinical Management of COVID-19.14.

Nigeria Centre for Disease Control (2020). COVID-19 Outbreak in Nigeria Situation Report.

R Core Team (2022). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Woo, P.C.Y., Huang, Y., Lau, S.K.P., & Yuen, K.Y. (2010). Coronavirus genomics and bioinformatics analysis. Viruses, 2:1805-1820. https://doi.org/10.3390/v2081803

World Health Organization, WHO (2022a). Weekly epidemiological update on COVID-19 – 29 June 2022. Edition 98 from https://www.who.int/publications/m/item/weekly-epidemiological-update-on-covid-19---29-june-2022

World Health Organization, WHO (2022b). Coronavirus. Available from: https://www.who.int/health-topics/coronavirus#tab=tab

World Health Organization, WHO (2020a) Director-General's Opening Remarks at the Media Briefing on COVID-19, 11 March 2020; World Health Organization: Geneva, Switzerland, 2020.

World Health Organization, WHO (2020a). Coronavirus disease 2019 (Covid-19) Situation Report-94; 2020:61–66.

World Health Organization, WHO. (2020c). Coronavirus disease (COVID-19) situation report 163. World Health Organization. Retrieved September 20, 2020 from https://reliefweb.int/report/world/coronavirus-disease-covid-19-situation-report-163-1-july-2020

Yin, Y., & Wunderink, R.G. (2018). MERS, SARS and other coronaviruses as causes of pneumonia. Respirology, 23: 130-137. https://doi.org/10.1111/resp.13196

Yuki, K., Fujiogi, M., & Koutsogiannaki, S. (2020). COVID-19 pathophysiology: a review. Clin Immunol. 215:108427. doi:10.1016/j.clim.2020.108427

Zhonghua, L., Xing, B., & Xue, Z. Z. (2020). Special Expert Group for Control of the Epidemic of Novel Coronavirus Pneumonia of the Chinese Preventive Medicine Association. [An update on the epidemiological characteristics of novel coronavirus pneumonia COVID-19. 41: 139-144.19.

Zou, L., Ruan, F., Huang, M., Liang, L., & Huang, H. (2020). SARS-CoV-2 Viral Load in Upper Respiratory Specimens of Infected Patients. N Engl J Med, 382: 1177-1179. 18.

tetfund
TERTIARY EDUCATION TRUST FUND
TETFund PROJECTS 2014/2017-2020 (Merged)
(*TETFUND/DR&D/CE/POLY/ADO-EKITI/ARJI*)

RC NO: 1903473

ISSN: 2782-8492

RhemAP Rhema
Academic Publishers Ltd
Ado-Ekiti, Ekiti State, Nigeria
E-mail:rhemaacademicpublishers@gmail.com;
Phone: +234 704 774 2214, +234 805 976 6124