FUPRE Journal

of

Scientific and Industrial Research

Telemedicine Model for Hyperglycaemia Patients on Emergency in Ughelli, Delta State

IDAMA, R. O. [1,*] iD , OYEMADE, D. A. [2] iD

[1,2]*Department of Computer Science, College of Science, Federal University of Petroleum Resources Effurun, Delta State*

ABSTRACT

Real time telemedicine model especially in the face of emergency has come to stay. In a remote health monitoring system, patient identification is given more consideration as a crucial security requirement. To highlight the difficulties and talk about how complete the answers are, more research is necessary. For real-time telemedicine monitoring systems, a novel authentication mechanism built on models is suggested. To modernize the pattern of the neighborhood hospital's operations, the adoption of the created model as a new authentication mechanism is suggested in the first phase. The creation and data gathering of the recently constructed model are discussed in the second phase to put the methods into context. Our authentication method uses two modalities namely text and visual chat. Key component suggested usability for test users is identified. Also, future simulations and implementations with privacy protection, authentication process ensured resultant applications was robust, scalable, persistent and high-level usability. 81.08% of the medical personnel and 87.21% of the patients agreed telemedicine system should be adopted due to its quick diagnosis during emergency, reduced referrals, strengthens patients' confidence, eased usage, enhanced proficiency and management with user-friendly interface have all become inherent benefits of proposed system.

1. INTRODUCTION

Innovative technologies with excellent network services facilitate interested persons to expand healthcare delivery and make it accessible to people in increasing numbers (Borgonovi & Ferrara, 2022; Cerf, 2020). Telemedicine is a more valuable technology that makes it simpler for people to access precautionary treatment and help their long-term healthiness. It is true for all who tackle economic or provincial grounds to getting valuable treatment (Shoeibi et al., 2022). Telemedicine has the ability to make primary health care very active, well-conducted, and obtainable. The research on this area is still in its timely stages, but it is growing deeper. For example, the telephone-based care and tele-monitoring of dynamic signs in persons with hyperglycemia (high sugar level) decreased

the risk of high rate of mortality, reduces frequent visits to medical centres (Kakhi et al., 2022; Nahavandi et al., 2022) and increased quality of life. There are several rationales for people to get a medical report or healing plan. This can reassure patients of their access to the best healthcare treatment (Joloudari et al., 2022; Og & Ying, 2021; Ojugo & Ekurume, 2021b). Telemedicine is an excellent option for treating hyperglycemia challenges. It eradicates certain number of the sources that prevent patients from receiving this critical form of treatment (Agrafiotis et al., 2015; Datta et al., 2021; Manickam et al., 2022; Ojugo, Eboka, et al., 2015b).

Unexpected fatalities caused by a variety of ailments that arise from poor medical treatment are an issue that affects humans. When someone is sick, medical facilities like

hospitals, rehabilitation centers, health spas, and the like are viewed as beacons of hope. Medical institutions follow complicated and often strict procedures. A majority of patients who are unable to attend hospitals, typically turn to self-medication, which in turn – has led to increased misdiagnosis, error treatment and rise in death overtime (Guntur et al., 2018; Hurt, 2019; Ojugo & Otakore, 2018b).

Healthcare services delivery for patients with chronic diseases can be improved via the remote patient monitoring systems (RPMS) to facilitate better coordination between her professionals and patients; lead to improved patient follow-up cum overall quality of care. Also, RPMS can help to reduce health-related costs by reducing duplication of prescriptions and hospital readmissions. By providing timely and relevant information, RPMS can also help to reduce toxic effects and improve treatment compliance, limiting adverse events (Afifah et al., 2022; Fatahi et al., 2016).

Telemedicine is the use of informatics in health services. It was first used in cardiology with electrocardiographic data transmitted over telephonic wires. It is a form of medical practice that uses information technology to connect healthcare professionals and patients remotely – allowing the exchange, diagnosis, treatment and management of medical data (Charan et al., 2020; Umarani et al., 2021). For patients to self-report high sugar in the blood, an internet-based automated system called iComPAsS has to be created. It aimed to assess how well mobile application can be used by both patients and doctors. With the patients as active participants in their own treatment – it allowed clinic appointments to concentrate on patients with critical health issues (Al-Mhiqani et al., 2021; Verma et al., 2020) and provision patients with enhanced health outcomes in general (Allenotor et al., 2015; Allenotor & Ojugo, 2017); And avails patients with simple techniques to keep their healthcare professionals of their symptoms, these apps do assist to strengthen symptom management (Al-Qudah et al., 2020; Burda, 2020; Ojugo & Eboka, 2014).

Deployment of personalized patient data

as decision support in clinical diagnostics is advanced by informatics (Ojugo, Yoro, et al., 2013; Ojugo & Yoro, 2020c). Hyperglycaemia or high blood sugar results in diabetes – if the body cannot effectively create enough insulin or utilize its supply of insulin. Its symptoms include vomiting, extreme appetite and thirst, palpitation, eye-issues etc – and can result to illnesses linked to diabetes. Hyperglycaemia has been a major source of underlying health issue, if untreated (Ojugo, Abere, et al., 2013; Ojugo, Aghware, et al., 2015; Ojugo, Akazue, Ejeh, Ashioba, et al., 2023; Okobah & Ojugo, 2018; Okuyama et al., 2014; Ometov et al., 2021; Zardi & Alrajhi, 2023).

To reduce onsite visits, telediabetology is committed to assist via online management of diabetes. A meta-analysis on clinical efficacy of telemedicine in diabetes was released in 2019 by (Nasir et al., 2021). Its control group showed appreciable decreases in HbA1c in that older adult with type-II diabetes were the most to benefit. Programs for managing specific disease via telemedicine, are offered by health insurance providers as agreed by (Filippi et al., 2019; Hakonen, 2022).

Telemedicine explores informatic, IoMT (internet of medical things), and medical procedures to provide full performance to the favourable positions of medical/therapeutic centres with progressive medical knowledge and apparatus. Healthcare system have long been plagued and overwhelmed a plethora of issues from medical equipment to untimely patient data and lack of personnel to monitor patients (Ojugo, Akazue, Ejeh, Odiakaose, et al., 2023; Ojugo, Allenotor, et al., 2015; Ojugo & Eboka, 2019; Zawislak et al., 2022). With the growth rate of patients in rural areas seeking medical attention – diagnosis and discussion now create a practitioner-patient bond, so that patients can receive attention, remedy or cure remotely; And in turn, also effectively reduce cost and time economy for both medical practitioners and patients (Charan et al., 2020; Chevalier et al., 2003; Ojugo & Yoro, 2020b; Yuan & Wu, 2021).

A telemedicine monitoring model cracks

the available data of patients in real-time, discerns information of chronic diseases and store their information into their databases. Telemedicine compares accessed symptoms (heart rate, blood pressure, blood sugar level) and environmental factors with the standard values. Human body sensors can be driven on human body such as tiny covers or veiled users' clothes. Normally, the sensors are placed purposefully on the human body permitting always-present health monitoring in their natural environment for lengthy periods of time. The patient's quality of life offers freedom of flexibility. Analyzed data is uploaded to the web (Ojugo & Yoro, 2020b). An increasing of hyperglycemia patients leads to a rise in patients' emergency especially in remote areas. This creates a consequent issue in accommodating all patients and handle different clinical workflows, along with administrative and medical control.

2. LITERATURE REVIEW
2.1. Telemedicine: A New Frontier

Telemedicine, as a nascent field is slowly gaining worldwide adoption as it seeks to bring healthcare services closer to its patients. This knowledge can be applied to several situations; it allows the provision of health services at home or during emergency cases (Yu et al., 2019). A modern replacement for conventional healthcare is telemedicine via the use of informatics. Clinical data and care services are delivered remotely in order to enhance, maintain, or help patients' health state. Thus, telemedicine helps to monitor and retrieve vital patient data using medical sensor devices (Ma et al., 2020) – and then sent to a databank for analysis and storage. These can then be later accessed via smart devices. Telemedicine thus, alerts a patients' healthcare providers of emergency.

Advancements in medicine and informatics – have aided people globally to live better and longer. The management and inventory of medical supplies, administration of patient records, medical diagnoses, and the delivery of patient services all benefit greatly from advancements in medical technology and new information systems (Aslan et al., 2022; Mahmad et al., 2020). To assess if and when health indicators are in range – requires constant physiological data monitoring is necessary for patients with critical conditions and those requiring urgent medical attention who have disabilities. The creation of a new system to aid nurses and patients in critical states has become imperative. It requires the automatic monitor of vital signs, alert system, data integration and connections of various sites to ease coordination of medical facilities (Paliwal et al., 2022; Yang, 2013).

The nuclear nature in traditional care systems does not ease access to patient data access across numerous healthcare facilities and care providers working at separate sites. Also, these traditional health systems employ distinct formats to describe data – and these, prevents integration across various health-care systems used at various locations. Thus, the birth of e-health system. E-health allows for practice of medicine over great distances in addition to information integration from many sources. Today's e-health solutions range from online consultations to remote surgical operations (Fatima & Pasha, 2017; Oyewola et al., 2021).

2.2. Related Literature(s)

Al-Qatf et al., (2018) studied how well telemedicine works from an expert providers' standpoint and how its operational use and impact could be improved in Indonesia. Consequently, this research aimed to examine their fulfilment, supposed benefits and obstacles, and recommendations for eventual development. They used diverse procedures with questionnaires and interviews, and used a purposive sampling mode. The clinicians in the environment of this study were common experts, nurses, and midwives that were using telemedicine equipment in primary care centres in and around Makassar City. With a response ratio was 76.9%, they noted the lack in direct portion of number of referrals rising before and after system was implemented. Some respondents stated their uneasiness and unwillingness to the idea of telemedicine.

They further examined clinicians' perception on telemedicine implementation and enablers and barriers to use, and did not look into precise matters concerning any specialization in telemedicine or procedures of diagnostic or appointment accuracy (Al-Qatf et al., 2018; Bhavani & Mangla, 2023).

Kim et al., (2020) asserted that Remote Patient Monitoring Systems (RPMS) for e-health, nurse navigators (NNs) and patient engagement can improve patient follow-up and have a positive impact on quality of care (limiting adverse events), and costs (reduces readmissions). They noted its impact depends on effective implementation, which is often restricted due to lack of attention to RPMS design phase prior to implementation. Also, a carefully designed RPMS provides insight to its effective management. With data collected based on Medical Research Council (MRC) framework, result showed NNs yields regular follow-up to easily manage patients with care and treatment compliance. Patients contacted NNs via a secure messaging system. Eighty clinical decision support tools enable NNs to prioritise and decide on the course of action to be taken (Drummond et al., 2003; Ileberi et al., 2022; Joshi et al., 2021; Kim et al., 2020; Leira et al., 2021).

Huang et al., (2021) investigated a high-efficiency telemedicine with the international standard exchange formats via a study design. Clinicians expressed satisfaction as system was found to be quick and effective. There is an absence of the sum of appointments really happening earlier and afterwards with the system activated. There were no precise issues concerning specialism in telemedicine or methods of problem-solving or medical appointment truth (Hosseini et al., 2016; Huang et al., 2021).

Amalraj and Lourdusamy (2022) investigated the innovative and improved key management strategy that attempts to address the difficulties associated with the security and privacy concerns of patients' sensitive information through a strong encryption management is provided. Though their research was a well-designed and compact key management system that maintains a high level of security, a prototype was not developed and tested in a real environment.

2.3 Study Motivation

Study seeks to address issues associated with patients' health emergency management for Government and Private Hospitals within and outside Ughelli, which include (Aghware et al., 2023a; Akazue et al., 2022, 2023; Og & Ying, 2021; Oyemade et al., 2016; Oyemade & Ojugo, 2020, 2021; Pearson et al., 2007; Peterson, 2006):

1. Inaccessibility of healthcare services for patients in emergency situations in rural and remote locations without having to visit the hospital. Thus, delays treatment.
2. Inadequate storage and retrieval of healthcare data for patients to support prompt access to patients' medical history during emergency situations.
3. Inability of doctors at various hospitals to share patients' records on real-time (even with referrals) in emergency cases. All of which delays treatment
4. Increased possibility of losing patients in emergency situations due to delayed diagnosis and treatment.

Study seeks to achieve security, privacy of user data, prompt access to medicine and improved user confidence via the deployment of a telemedicine application for Ughelli.

3. MATERIALS AND METHODS
3.1. System Design

Study uses a store-forward telemedicine mode to search for two types of services: tele-ECG and tele-USG. The tele-ECG is used in early prognosis of suspected patients with heart diseases, and follow-up exams; While, Tele-USG is used in obstetrics. Both the (tele)-ECG/USG records patients' data and the clinician in the primary care clinic uses the apps to send the data via the internet to a professional. The specialist receives reports, and then access the patients' data anywhere via smartphone and other gadgets with internet connectivity access.

The system to be developed is a Web Based Health Tele-Monitoring System for Emergency Management that will help the hospital to bridge the gap caused by time and space between doctors and patients. The system will enable nurses to chat privately and directly with doctors in cases of emergency to ensure that the patient have the correct diagnosis even if when a doctor is not physical present in person.
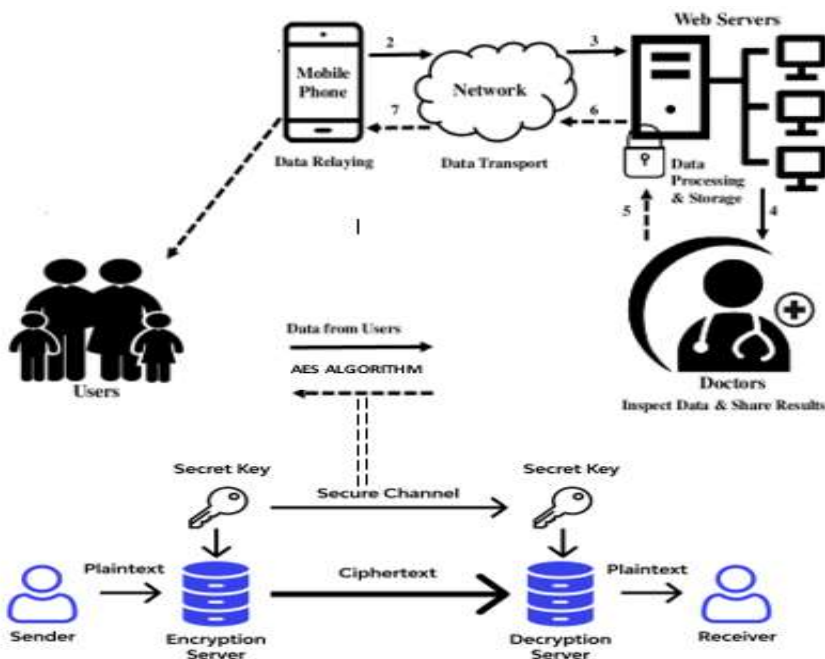
Figure 1. Existing system

Figure 2. Proposed telemedicine for hyperglycaemia framework

3.2. Data Collection Mode and Sampling

Data from respondents and interviewers were inferred in Microsoft Excel. A warm analysis was commenced to categorize the important subjects from respondents' replies in questionnaire and respondents' comments from interviews. Participants' observations were categorized into 3-classes as inspected namely: constructive aspects; adverse aspects,

and future recommendations for upgrading of telemedicine (Eboka & Ojugo, 2020; Yoro, Aghware, Akazue, et al., 2023; Yoro, Aghware, Malasowe, et al., 2023).

The study design approach is used with questionnaires and interviews mode in some selected government and private hospitals within and around the Ughelli North Local Government Area in Delta State. A purposive

sampling technique was used and participants from environ (i.e. doctor, midwives, nurses, and patients) selected via random sample. Selected individuals were using telemedicine equipment in primary care centres in and around city. 20 primary care centres agreed to participate with hyperglycaemia patient from February to August 2023 prior administering the questionnaire (Akazue et al., 2022, 2023; Ojugo, Ugboh, et al., 2013; Ojugo & Otakore, 2020; Ojugo & Yoro, 2020a).

Most facilities had up 40 or more cases a month, and there were facilities with more than 60 cases a month. Staff and patients therefore had regular experience of using the system. Staff and patients from all 20 primary care centres returned the questionnaires, all these regularly carried out teleconsultations.

3.2. Technical Procedure(s)

One hundred and fifty questionnaires were distributed to 20 health facilities based on the number of clinicians and patients using the system (50 experts and 100 to patients) with 123-feedbacks received (86 patients and 37 health practitioners). Clinicians from health centres were either off duty at that time or were not interested in completing the questionnaire while some patients were too sick to fill it. Ten (10) of the fifty (50) participants are medical practitioners chosen for in-depth interviews, which lasted on average of 31.3 minutes (Ibor et al., 2023).

Each health facility had 2 clinicians and 10 patients trained to use the system and they could train additional colleagues and patients locally if required. Of the 123 questionnaires retrieved (82%) – it implies a mean of 4.1 questionnaires per facility (i.e. clinicians and patients trained locally) and suggests a high level of interest in the survey.

4. RESULT FINDINGS & DISCUSSION

4.1. Result Findings
Q1: On Health Service Providers

Table 1 reveals experts' opinion on the use/adoption of the telemedicine application. While, figure 1 is the bar-chart representation showing the experts' opinion.

Table 1: Experts' Opinion on the telemedicine

| Predictors	Frequency (%) with n = 37		
	Yes	No	Und.
Have you undergone training on real time telemedicine?	91.04%	13.51%	2.70%
Is the system easy to use?	89.18%	2.70%	8.10%
Is the data in the system presented clearly and fast?	86.48%	10.81%	2.70%
Is telemedicine beneficial to patients?	94.59%	-	5.40%
In case of emergency, do you find telemedicine applicable?	81.08%	8.10%	10.81%
Has telemedicine reduced mortality rate at emergency?	94.59%	2.70%	2.70%
Does system yield expected results to patient diagnosis?	83.78%	2.70%	13.51%
Is system fast for use on any patient, even at emergency?	37.83%	56.75%	5.40%
Are you practically contented with the system?	78.37%	18.91%	2.70%
Are you captivated to continue with the system?	81.08%	8.10%	10.81%

Keys: * Und. = Undecided
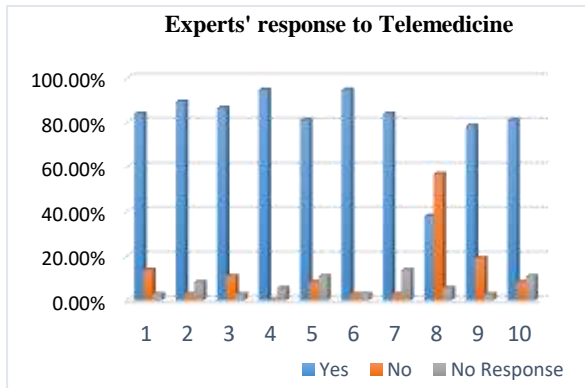
Figure 1. Experts' response on Telemedicine

The first part of the questionnaire with 10-questions was evaluated via 4-dimensions: (i) training, (ii) usage ease of telemedicine application, (iii) perceived usefulness leading to reduction of mortality rate, and (iv) user experience and satisfaction in relation to time management and the continued intention to use. Results show 78.37% of health service providers were satisfied with system; while, 81.08% expressed captivation in continuing to use it. Thus, from the total participants – it is gathered that positive recommendation for the first part of the telemedicine system.

Q2: On Patients with Telemedicine Services as Provided

Table 2 reveals participant's opinion on the adoption and adaptation of telemedicine application. While, figure 2 is the bar-chart representation showing the experts' opinion.

Table 2. Participant response on telemedicine

Predictors	Frequency (%) with n = 37		
	Yes	**No**	**Und.**
Have you undergone training on real time telemedicine?	82.56%	9.30%	8.14%
Is the system easy to use?	88.37%	8.14%	3.49%
Is the information in system presented clearly and fast?	88.37%	8.14%	3.49%
Is telemedicine beneficial to you?	93.02%	4.65%	2.33%

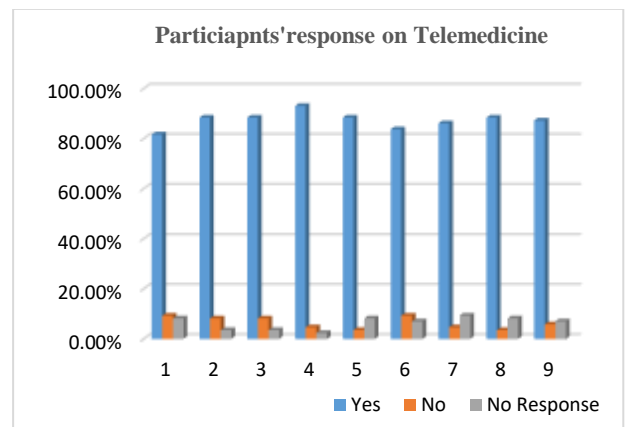| Can you recommend it to family/friend in emergency?	88.37%	3.49%	8.14%
Has telemedicine reduced mortality rate at emergency?	83.72%	9.30%	6.98%
Does system yield expected results to patient diagnosis?	86.05%	4.65%	9.30%
Are you satisfied with the system & its health workers?	88.37%	3.49%	8.14%
Do you wish to continue or with the system?	87.21%	5.81%	6.98%

Figure 2. Participants' response on Telemedicine

The second part of the questionnaire (for patients) contained 9-questions, and was also evaluated via four (4) dimensions: (i) training, (ii) usage ease of the telemedicine application, (iii) perceived usefulness and reduced mortality and adoption, (iv) user experience, satisfaction in relation to time management and the continued intention to use. Results showed 88.37% of the participants expressed satisfaction with health service providers on the adoption of the system; While, 87.21% expressed interest in its continued use. In a nutshell, the total participants (patients) also endorsed and encouraged the continued patronage of the telemedicine system.

4.2. Discussion of Findings

This study acknowledged five reasons that medical practitioners and patients adored

most; And these agrees with (Aghware et al., 2023b; Akazue et al., 2023; Malasowe et al., 2023; Yoro & Ojugo, 2019):

1. **Quick diagnosis especially in the face of emergency:** Majority stated that even when the patient's case is critical and needs to be attended physically, with telemedicine model, the patient will still be undergoing medical examination either through visually or audibly. So, as soon as the patient arrives, the situation must have been arrested reasonably.

2. **Reduce Referrals:** Referral cases reduced meaningfully since a patient's history is stored and a practitioner can consult with a more experienced colleague immediately through the system. Even, patient can consult another specialist accessing the patient history.

3. **Strengthened Patients' Confidence:** Patients' confidence in the health system is strengthened now due to the fact that most times they do not need to go to those health facilities again even in the face of emergency before receiving attention.

4. **Enhance Proficiency and Management:** Most of the respondents (health services providers) were satisfied how they have been able to handle difficult cases that needed urgent attention and such cases were brought under control even without seeing the patient physically.

5. **Comprehensive and Easy Usage:** They confirmed that it is very clear and easy to operate. The technical quality was also commended especially as the visited health facilities are fully using solar system. The internet connectivity is also very good for the period.

Respondents recommended the creation of relationship between patients with many professional health workers and the schools of medicine, in order to build a reporting standard, and add a supportive feature in the system to facilitate the patients or medical professional to establish an uninterrupted communication via this system/consultation.

5. CONCLUSION

Study unveils that real-time telemedicine can effectively and efficiently capture both a medical practitioners and patients' views and practices in a locality. Result specified that the practitioners and patients were satisfied with the delivery and outcome therein of the telemedicine app (Ojugo, Eboka, et al., 2015a; Ojugo & Ekurume, 2021a). In addition, they acknowledged the benefits of telemedicine in healthcare practice as assistive technology to help monitor patients at their comfort. These benefits includes quick diagnosis, reduce cost, reduced avoidable referrals, quick retrieval and access to patients treatment history – to mention a few. These, were also found to improve user confidence and support amidst the growth proliferation of emergency cases in both rural and urban area (Ojugo et al., 2021a; Ojugo & Ekurume, 2021b).

The study employed a mix of qualitative and quantitative research design to increase the scope and depth of understanding (Ojugo et al., 2021b; Ojugo, Odiakaose, Emordi, Ejeh, et al., 2023; Ojugo & Otakore, 2018a) in light of collected and analysed data. With data analysis, the qualitative data was used to support/authenticate quantitative conclusions that were reached.

Conflict of Interest
The authors declare that there is no conflict of interest.

REFERENCES
Aghware, F. O., Yoro, R. E., Ejeh, P. O., Odiakaose, C. C., Emordi, F. U., & Ojugo, A. A. (2023a). DeLClustE: Protecting Users from Credit-Card Fraud Transaction via the Deep-Learning Cluster Ensemble. *International Journal of Advanced Computer Science and Applications*, *14*(6), 94–100. https://doi.org/10.14569/IJACSA.2023.0140610

Aghware, F. O., Yoro, R. E., Ejeh, P. O., Odiakaose, C. C., Emordi, F. U., & Ojugo, A. A. (2023b). Sentiment

analysis in detecting sophistication and degradation cues in malicious web contents. *Kongzhi Yu Juece/Control and Decision*, *38*(01), 653.

Agrafiotis, I., Nurse, J. R., Buckley, O., Legg, P., Creese, S., & Goldsmith, M. (2015). Identifying attack patterns for insider threat detection. *Computer Fraud and Security*, *2015*(7), 9–17. https://doi.org/10.1016/S1361-3723(15)30066-X

Akazue, M. I., Ojugo, A. A., Yoro, R. E., Malasowe, B. O., & Nwankwo, O. (2022). Empirical evidence of phishing menace among undergraduate smartphone users in selected universities in Nigeria. *Indonesian Journal of Electrical Engineering and Computer Science*, *28*(3), 1756–1765. https://doi.org/10.11591/ijeecs.v28.i3.pp1756-1765

Akazue, M. I., Yoro, R. E., Malasowe, B. O., Nwankwo, O., & Ojugo, A. A. (2023). Improved services traceability and management of a food value chain using block-chain network : a case of Nigeria. *Indonesian Journal of Electrical Engineering and Computer Science*, *29*(3), 1623–1633. https://doi.org/10.11591/ijeecs.v29.i3.pp1623-1633

Al-Mhiqani, M. N., Isnin, S. N., Ahmed, R., & Abidi, Z. Z. (2021). An Integrated Imbalanced Learning and Deep Neural Network Model for Insider Threat Detection. *International Journal of Advanced Computer Science and Applications*, *12*(1), 1–5.

Al-Qatf, M., Lasheng, Y., Al-Habib, M., & Al-Sabahi, K. (2018). Deep Learning Approach Combining Sparse Autoencoder With SVM for Network Intrusion Detection. *IEEE Access*, *6*, 52843–52856. https://doi.org/10.1109/ACCESS.2018.2869577

Al-Qudah, D. A., Al-Zoubi, A. M., Castillo-Valdivieso, P. A., & Faris, H. (2020). Sentiment analysis for e-payment service providers using evolutionary extreme gradient boosting. *IEEE Access*, *8*, 189930–189944. https://doi.org/10.1109/ACCESS.2020.3032216

Allenotor, D., & Ojugo, A. A. (2017). A Financial Option Based Price and Risk Management Model for Pricing Electrical Energy in Nigeria. *Advances in Multidisciplinary & Scientific Research Journal*, *3*(2), 79–90.

Allenotor, D., Oyemade, D. A., & Ojugo, A. A. (2015). A Financial Option Model for Pricing Cloud Computational Resources Based on Cloud Trace Characterization. *African Journal of Computing & ICT*, *8*(2), 83–92. www.ajocict.net

Aslan, M. F., Sabanci, K., Durdu, A., & Unlersen, M. F. (2022). COVID-19 diagnosis using state-of-the-art CNN architecture features and Bayesian Optimization. *Computers in Biology and Medicine*, *142*, 105244. https://doi.org/10.1016/j.compbiomed.2022.105244

Bhavani, A. D., & Mangla, N. (2023). A Novel Network Intrusion Detection System Based on Semi-Supervised Approach for IoT. *International Journal of Advanced Computer Science and Applications*, *14*(4), 207–216. https://doi.org/10.14569/IJACSA.2023.0140424

Borgonovi, F., & Ferrara, A. (2022). A Longitudinal Perspective on the Effects of COVID-19 on Students' Resilience. The Effect of the Pandemic on the Reading and Mathematics Achievement of 8th and 5th Graders in Italy. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4025865

Burda, Z. (2020). Modelling excess mortality in covid-19-like epidemics. *Entropy*, *22*(11), 1–21. https://doi.org/10.3390/e22111236

Cerf, V. G. (2020). On the internet of medical things. *Communications of the ACM*, *63*(8), 5.

https://doi.org/10.1145/3406779

Charan, D. S., Nadipineni, H., Sahayam, S., & Jayaraman, U. (2020). *Method to Classify Skin Lesions using Dermoscopic images*. http://arxiv.org/abs/2008.09418

Chevalier, K., Bothorel, C., & Corruble, V. (2003). Discovering Rich Navigation Patterns on a Web Site. In *Webometrics* (Vol. 5, Issue 6, pp. 62–75). https://doi.org/10.1007/978-3-540-39644-4_7

Datta, S. K., Shaikh, M. A., Srihari, S. N., & Gao, M. (2021). *Soft-Attention Improves Skin Cancer Classification Performance*. http://arxiv.org/abs/2105.03358

Drummond, S. ., Sudduth, K. ., Joshi, A., Birrell, S. ., & Kitchen, S. . (2003). Statistics and neural method for site specific yield prediction. *Transactions of the ASAE*, *46*(1), 23–32. https://doi.org/10.13031/2013.12541

Eboka, A. O., & Ojugo, A. A. (2020). Mitigating technical challenges via redesigning campus network for greater efficiency, scalability and robustness: A logical view. *International Journal of Modern Education and Computer Science*, *12*(6), 29–45. https://doi.org/10.5815/ijmecs.2020.06.03

Fatahi, M., Ahmadi, M., Ahmadi, A., Shahsavari, M., & Devienne, P. (2016). Towards an spiking deep belief network for face recognition application. *2016 6th International Conference on Computer and Knowledge Engineering (ICCKE)*, 153–158. https://doi.org/10.1109/ICCKE.2016.7802132

Fatima, M., & Pasha, M. (2017). Survey of Machine Learning Algorithms for Disease Diagnostic. *Journal of Intelligent Learning Systems and Applications*, *09*(01), 1–16. https://doi.org/10.4236/jilsa.2017.91001

Filippi, P., Jones, E. J., Wimalathunge, N. S.,

Somarathna, P. D. S. N., Pozza, L. E., Ugbaje, S. U., Jephcott, T. G., Paterson, S. E., Whelan, B. M., & Bishop, T. F. A. (2019). An approach to forecast grain crop yield using multi-layered, multi-farm data sets and machine learning. *Precision Agriculture*, *20*(5), 1015–1029. https://doi.org/10.1007/s11119-018-09628-4

Guntur, S. R., Gorrepati, R. R., & Dirisala, V. R. (2018). Internet of Medical Things. In *Medical Big Data and Internet of Medical Things* (Issue October 2018, pp. 271–297). CRC Press. https://doi.org/10.1201/9781351030380-11

Hakonen, P. (2022). Detecting Insider Threats Using User and Entity Behavior Analytics. *International Journal of Electrical and Computer Engineering*, *21*(October), 5765–5783. https://www.theseus.fi/handle/10024/786079

Hosseini, S. A., Abyaneh, H. A., Sadeghi, S. H. H., Razavi, F., & Nasiri, A. (2016). An overview of microgrid protection methods and the factors involved. *Renewable and Sustainable Energy Reviews*, *64*, 174–186. https://doi.org/10.1016/j.rser.2016.05.089

Huang, D., Lin, Y., Weng, Z., & Xiong, J. (2021). Decision Analysis and Prediction Based on Credit Card Fraud Data. *The 2nd European Symposium on Computer and Communications*, 20–26. https://doi.org/10.1145/3478301.3478305

Hurt, A. (2019). Internet of Medical Things emerges. *Dermatology Times*, *40*(10), 52–58. http://ezproxy.uct.ac.za/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=cin20&AN=138944526&site=ehost-live

Ibor, A. E., Edim, E. B., & Ojugo, A. A.

(2023). Secure Health Information System with Blockchain Technology. *Journal of the Nigerian Society of Physical Sciences*, *5*(992), 1–8. https://doi.org/10.46481/jnsps.2022.992

Ileberi, E., Sun, Y., & Wang, Z. (2022). A machine learning based credit card fraud detection using GA algorithm for feature selection. *Journal of Big Data*, *9*(1), 24. https://doi.org/10.1186/s40537-022-00573-8

Joloudari, J. H., Alizadehsani, R., & Nodehi, I. (2022). *Resource allocation optimization using artificial intelligence methods in various computing paradigms : A Review*. *March*. https://doi.org/10.13140/RG.2.2.32857.39522

Joshi, C., Aliaga, J. R., & Insua, D. R. (2021). Insider Threat Modeling: An Adversarial Risk Analysis Approach. *IEEE Transactions on Information Forensics and Security*, *16*, 1131–1142. https://doi.org/10.1109/TIFS.2020.3029898

Kakhi, K., Alizadehsani, R., Kabir, H. M. D., Khosravi, A., Nahavandi, S., & Acharya, U. R. (2022). The internet of medical things and artificial intelligence: trends, challenges, and opportunities. *Biocybernetics and Biomedical Engineering*, *42*(3), 749–771. https://doi.org/10.1016/j.bbe.2022.05.008

Kim, A., Oh, J., Ryu, J., & Lee, K. (2020). A review of insider threat detection approaches with IoT perspective. *IEEE Access*, *8*, 78847–78867. https://doi.org/10.1109/ACCESS.2020.2990195

Leira, F. S., Helgesen, H. H., Johansen, T. A., & Fossen, T. I. (2021). Object detection, recognition, and tracking from UAVs using a thermal camera. *Journal of Field Robotics*, *38*(2), 242–267. https://doi.org/10.1002/rob.21985

Ma, C., Wang, H., & Hoi, S. C. H. (2020). Multi-label Thoracic Disease Image Classification with Cross-Attention Networks. *Singaporean Journal of Radiology*, *21*, 1–9.

Mahmad, S., Jebakumar, & Iniyan, S. (2020). Iot based hybrid plant disease detection for yields enhancement. *European Journal of Molecular and Clinical Medicine*, *7*(8), 2134–2153. www.scopus.com/inward/record.uri?partnerID=HzOxMe3b&scp=85098511002&origin=inward

Malasowe, B. O., Akazue, M. I., Okpako, E. A., Aghware, F. O., Ojie, D. V., & Ojugo, A. A. (2023). Adaptive Learner-CBT with Secured Fault-Tolerant and Resumption Capability for Nigerian Universities. *International Journal of Advanced Computer Science and Applications*, *14*(8), 135–142. https://doi.org/10.14569/IJACSA.2023.0140816

Manickam, P., Mariappan, S. A., Murugesan, S. M., Hansda, S., Kaushik, A., Shinde, R., & Thipperudraswamy, S. P. (2022). Artificial Intelligence (AI) and Internet of Medical Things (IoMT) Assisted Biomedical Systems for Intelligent Healthcare. *Biosensors*, *12*(8). https://doi.org/10.3390/bios12080562

Nahavandi, D., Alizadehsani, R., Khosravi, A., & Acharya, U. R. (2022). Application of artificial intelligence in wearable devices: Opportunities and challenges. *Computer Methods and Programs in Biomedicine*, *213*(December). https://doi.org/10.1016/j.cmpb.2021.106541

Nasir, R., Afzal, M., Latif, R., & Iqbal, W. (2021). Behavioral Based Insider Threat Detection Using Deep Learning. *IEEE Access*, *9*, 143266–143274. https://doi.org/10.1109/ACCESS.2021.3118297

Og, S., & Ying, L. (2021). The Internet of Medical Things. *ICMLCA 2021 - 2nd*

International Conference on Machine Learning and Computer Application, 273

Ojugo, A. A., Abere, R. A., Orhionkpaiyo, B. C., Yoro, R. E., & Eboka, A. O. (2013). Technical Issues for IP-Based Telephony in Nigeria. *International Journal of Wireless Communications and Mobile Computing*, *1*(2), 58. https://doi.org/10.11648/j.wcmc.20130 102.11

Ojugo, A. A., Aghware, F. O., Yoro, R. E., Yerokun, M. O., Eboka, A. O., Anujeonye, C. N., & Efozia, F. N. (2015). Dependable Community-Cloud Framework for Smartphones. *American Journal of Networks and Communications*, *4*(4), 95. https://doi.org/10.11648/j.ajnc.2015040 4.13

Ojugo, A. A., Akazue, M. I., Ejeh, P. O., Ashioba, N. C., Odiakaose, C. C., Ako, R. E., & Emordi, F. U. (2023). Forging a User-Trust Memetic Modular Neural Network Card Fraud Detection Ensemble: A Pilot Study. *Journal of Computing Theories and Applications*, *1*(2), 1–11. https://doi.org/10.33633/jcta.v1i2.9259

Ojugo, A. A., Akazue, M. I., Ejeh, P. O., Odiakaose, C., & Emordi, F. U. (2023). DeGATraMoNN : Deep Learning Memetic Ensemble to Detect Spam Threats via a Content-Based Processing. *Kongzhi Yu Juece/Control and Decision*, *38*(01), 667–678.

Ojugo, A. A., Allenotor, D., Oyemade, D. A., Yoro, R. E., & Anujeonye, C. N. (2015). Immunization Model for Ebola Virus in Rural Sierra-Leone. *African Journal of Computing & ICT*, *8*(1), 1–10. www.ajocict.net

Ojugo, A. A., & Eboka, A. O. (2014). A Social Engineering Detection Model for the Mobile Smartphone Clients. *African Journal of Computing & ICT*, *7*(3). www.ajocict.net

Ojugo, A. A., & Eboka, A. O. (2019). Inventory prediction and management in Nigeria using market basket analysis associative rule mining: memetic algorithm based approach. *International Journal of Informatics and Communication Technology (IJ-ICT)*, *8*(3), 128. https://doi.org/10.11591/ijict.v8i3.pp12 8-138

Ojugo, A. A., Eboka, A. O., Yoro, R. E., Yerokun, M. O., & Efozia, F. N. (2015a). Framework design for statistical fraud detection. *Mathematics and Computers in Science and Engineering Series*, *50*, 176–182.

Ojugo, A. A., Eboka, A. O., Yoro, R. E., Yerokun, M. O., & Efozia, F. N. (2015b). Hybrid Model for Early Diabetes Diagnosis. *2015 Second International Conference on Mathematics and Computers in Sciences and in Industry (MCSI)*, *50*, 55–65. https://doi.org/10.1109/MCSI.2015.35

Ojugo, A. A., & Ekurume, E. O. (2021a). Deep Learning Network Anomaly-Based Intrusion Detection Ensemble For Predictive Intelligence To Curb Malicious Connections: An Empirical Evidence. *International Journal of Advanced Trends in Computer Science and Engineering*, *10*(3), 2090. https://doi.org/10.30534/ijatcse/2021/8 51032021

Ojugo, A. A., & Ekurume, E. O. (2021b). Predictive Intelligent Decision Support Model in Forecasting of the Diabetes Pandemic Using a Reinforcement Deep Learning Approach. *International Journal of Education and Management Engineering*, *11*(2), 40–48. https://doi.org/10.5815/ijeme.2021.02.0 5

Ojugo, A. A., Obruche, C. O., & Eboka, A. O. (2021a). Empirical Evaluation for Intelligent Predictive Models in Prediction of Potential Cancer Problematic Cases In Nigeria. *ARRUS Journal of Mathematics and Applied Science*, *1*(2), 110–120.

https://doi.org/10.35877/mathscience614

Ojugo, A. A., Obruche, C. O., & Eboka, A. O. (2021b). Quest For Convergence Solution Using Hybrid Genetic Algorithm Trained Neural Network Model For Metamorphic Malware Detection. *ARRUS Journal of Engineering and Technology*, *2*(1), 12–23. https://doi.org/10.35877/jetech613

Ojugo, A. A., Odiakaose, C. C., Emordi, F. U., Ejeh, P. O., Adigwe, W., Anazia, K. E., & Nwozor, B. (2023). Forging a learner-centric blended-learning framework via an adaptive content-based architecture. *Science in Information Technology Letters*, *4*(1), 40–53. https://doi.org/10.31763/sitech.v4i1.1186

Ojugo, A. A., & Otakore, D. O. (2018a). Redesigning Academic Website for Better Visibility and Footprint: A Case of the Federal University of Petroleum Resources Effurun Website. *Network and Communication Technologies*, *3*(1), 33. https://doi.org/10.5539/nct.v3n1p33

Ojugo, A. A., & Otakore, O. D. (2018b). Improved Early Detection of Gestational Diabetes via Intelligent Classification Models: A Case of the Niger Delta Region in Nigeria. *Journal of Computer Sciences and Applications*, *6*(2), 82–90. https://doi.org/10.12691/jcsa-6-2-5

Ojugo, A. A., & Otakore, O. D. (2020). Computational solution of networks versus cluster grouping for social network contact recommender system. *International Journal of Informatics and Communication Technology (IJ-ICT)*, *9*(3), 185. https://doi.org/10.11591/ijict.v9i3.pp185-194

Ojugo, A. A., Ugboh, E., Onochie, C. C., Eboka, A. O., Yerokun, M. O., & Iyawa, I. J. B. (2013). Effects of Formative Test and Attitudinal Types on Students' Achievement in Mathematics in Nigeria. *African Educational Research Journal*, *1*(2), 113–117. http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=EJ1216962&site=ehost-live

Ojugo, A. A., & Yoro, R. E. (2020a). Empirical Solution For An Optimized Machine Learning Framework For Anomaly-Based Network Intrusion Detection. *Technology Report of Kansai University*, *62*(08), 6353–6364.

Ojugo, A. A., & Yoro, R. E. (2020b). Forging A Smart Dependable Data Integrity And Protection System Through Hybrid-Integration Honeypot In Web and Database Server. *Technology Report of Kansai University*, *62*(08), 5933–5947.

Ojugo, A. A., & Yoro, R. E. (2020c). Predicting Futures Price And Contract Portfolios Using The ARIMA Model: A Case of Nigeria's Bonny Light and Forcados. *Quantitative Economics and Management Studies*, *1*(4), 237–248. https://doi.org/10.35877/454ri.qems139

Ojugo, A. A., Yoro, R. E., Oyemade, D. A., Eboka, A. O., Ugboh, E., & Aghware, F. O. (2013). Robust Cellular Network for Rural Telephony in Southern Nigeria. *American Journal of Networks and Communications*, *2*(5), 125. https://doi.org/10.11648/j.ajnc.20130205.12

Okobah, I. P., & Ojugo, A. A. (2018). Evolutionary Memetic Models for Malware Intrusion Detection: A Comparative Quest for Computational Solution and Convergence. *International Journal of Computer Applications*, *179*(39), 34–43. https://doi.org/10.5120/ijca2018916586

Okuyama, S., Tsuruoka, S., Kawanaka, H., & Takase, H. (2014). Interactive Learning Support User Interface for Lecture Scenes Indexed with Extracted Keyword from Blackboard. *Australian Journal of Basic and Applied Sciences*,

8(4), 319–324.

Ometov, A., Shubina, V., Klus, L., Skibińska, J., Saafi, S., Pascacio, P., Flueratoru, L., Gaibor, D. Q., Chukhno, N., Chukhno, O., Ali, A., Channa, A., Svertoka, E., Qaim, W. Bin, Casanova-Marqués, R., Holcer, S., Torres-Sospedra, J., Casteleyn, S., Ruggeri, G., … Lohan, E. S. (2021). A Survey on Wearable Technology: History, State-of-the-Art and Current Challenges. *Computer Networks*, *193*, 108074. https://doi.org/10.1016/j.comnet.2021.108074

Oyemade, D. A., & Ojugo, A. A. (2020). A Property Oriented Pandemic Surviving Trading Model. *International Journal of Advanced Trends in Computer Science and Engineering*, *9*(5), 7397–7404. doi.org/10.30534/ijatcse/2020/71952020

Oyemade, D. A., & Ojugo, A. A. (2021). An Optimized Input Genetic Algorithm Model for the Financial Market. *International Journal of Innovative Science, Engineering and Technology*, *8*(2), 408–419. https://ijiset.com/vol8/v8s2/IJISET_V8_I02_41.pdf

Oyemade, D. A., Ureigho, R. J., Imouokhome, F. ., Omoregbee, E. U., Akpojaro, J., & Ojugo, A. A. (2016). A Three Tier Learning Model for Universities in Nigeria. *Journal of Technologies in Society*, *12*(2), 9–20. https://doi.org/10.18848/2381-9251/CGP/v12i02/9-20

Oyewola, D. O., Dada, E. G., Ngozi, N. J., Terang, A. U., & Akinwumi, S. A. (2021). COVID-19 Risk Factors, Economic Factors, and Epidemiological Factors nexus on Economic Impact: Machine Learning and Structural Equation Modelling Approaches. *Journal of the Nigerian Society of Physical Sciences*, *3*(4), 395–405.

https://doi.org/10.46481/jnsps.2021.173

Paliwal, S., Mishra, A. K., Mishra, R. K., Nawaz, N., & Senthilkumar, M. (2022). XGBRS Framework Integrated with Word2Vec Sentiment Analysis for Augmented Drug Recommendation. *Computers, Materials and Continua*, *72*(3), 5345–5362. https://doi.org/10.32604/cmc.2022.025858

Pearson, J. M., Pearson, A., & Green, D. (2007). Determining the importance of key criteria in web usability. *Management Research News*, *30*(11), 816–828. https://doi.org/10.1108/01409170710832250

Peterson, K. (2006). Academic Web Site Design and Academic Templates: Where Does the Library Fit In? *Information Technology and Libraries*, *25*(4), 217. https://doi.org/10.6017/ital.v25i4.3354

Shoeibi, A., Ghassemi, N., Khodatars, M., Moridian, P., Alizadehsani, R., Zare, A., Khosravi, A., Subasi, A., Rajendra Acharya, U., & Gorriz, J. M. (2022). Detection of epileptic seizures on EEG signals using ANFIS classifier, autoencoders and fuzzy entropies. *Biomedical Signal Processing and Control*, *73*, 1–18. https://doi.org/10.1016/j.bspc.2021.103417

Umarani, V., Julian, A., & Deepa, J. (2021). Sentiment Analysis using various Machine Learning and Deep Learning Techniques. *Journal of the Nigerian Society of Physical Sciences*, *3*(4), 385–394. https://doi.org/10.46481/jnsps.2021.308

Verma, S., Bhatia, A., Chug, A., & Singh, A. P. (2020). *Recent Advancements in Multimedia Big Data Computing for IoT Applications in Precision Agriculture: Opportunities, Issues, and Challenges* (pp. 391–416). https://doi.org/10.1007/978-981-13-8759-3_15

Yang, H. H. (2013). New World, New Learning: Trends and Issues of E-Learning. *Procedia - Social and Behavioral Sciences*, *77*, 429–442. https://doi.org/10.1016/j.sbspro.2013.03.098

Yoro, R. E., Aghware, F. O., Akazue, M. I., Ibor, A. E., & Ojugo, A. A. (2023). Evidence of personality traits on phishing attack menace among selected university undergraduates in Nigerian. *International Journal of Electrical and Computer Engineering (IJECE)*, *13*(2), 1943. https://doi.org/10.11591/ijece.v13i2.pp1943-1953

Yoro, R. E., Aghware, F. O., Malasowe, B. O., Nwankwo, O., & Ojugo, A. A. (2023). Assessing contributor features to phishing susceptibility amongst students of petroleum resources varsity in Nigeria. *International Journal of Electrical and Computer Engineering (IJECE)*, *13*(2), 1922. https://doi.org/10.11591/ijece.v13i2.pp1922-1931

Yoro, R. E., & Ojugo, A. A. (2019). An Intelligent Model Using Relationship in Weather Conditions to Predict Livestock-Fish Farming Yield and Production in Nigeria. *American Journal of Modeling and Optimization*, *7*(2), 35–41. doi: 10.12691/ajmo-7-2-1

Yu, Y., Li, M., Liu, L., Li, Y., & Wang, J. (2019). Clinical big data and deep learning: Applications, challenges, and future outlooks. *Big Data Mining and Analytics*, *2*(4), 288–305. doi: 10.26599/BDMA.2019.9020007

Yuan, S., & Wu, X. (2021). Deep learning for insider threat detection: Review, challenges and opportunities. *Computers and Security*, *104*. https://doi.org/10.1016/j.cose.2021.102221

Zardi, H., & Alrajhi, H. (2023). Anomaly Discover: A New Community-based Approach for Detecting Anomalies in Social Networks. *International J. of Advanced Computer Science and Appl.*, *14*(4), 912 https://doi.org/10.14569/IJACSA.2023.01404101

Zawislak, P. A., Reichert, F. M., Barbieux, D., Avila, A. M. S., & Pufal, N. (2022). The dynamic chain of innovation: bounded capabilities and complementarity in agribusiness. *J. of Agribusiness in Developing and Emerging Economies*, *23*, 1–113. https://doi.org/10.1108/JADEE-04-2021-0096