IJAREEIE

e-ISSN: 2278-8875
p-ISSN: 2320-3765

International Journal of Advanced Research

in Electrical, Electronics and Instrumentation Engineering

Volume 10, Issue 3, March 2021

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.122

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 10, Issue 3, March 2021||

|DOI:10.15662/IJAREEIE.2021.1003005|

Cloud-Enabled Wireless Ambulatory ECG System Optimized with Hybrid Firefly and Particle Swarm Optimization for Heart Disease Detection

T. Kalaikumaran

Professor, Department of Artificial Intelligence and Data Science, VSB College of Engineering Technical Campus, Coimbatore, India

ABSTRACT: Cloud computing has dramatically changed how SMEs manage accounting functions by incorporating highly innovation-based machine learning methods, such as Gradient Boosting Decision Trees (GBDT), ALBERT, and Firefly Algorithm, for accelerating data processing, scalability, and security. Growth of IoT has resulted in generation of Gigabytes of real-time data. The available mechanisms are incapable of handling comparatively high-dimensional and non-linear type of data, thus bracing limitation in predictive accuracy and scalability. Traditional encryption measures alone cannot resist the continuously evolving threats from the cyberspace thus corresponding risk with the security of cloud-based business banking and healthcare applications. Besides, resource management is found hugely inefficient in the scenario of IoT and clouds thus leading to performance congestion and increased latency. The challenges of nonlinearity, as well as non-stationarity of time-series forecasting, have been addressed by employing Robotic Process Automation (RPA) and big data analytics in finance management and cybersecurity. Additionally, efficient service-selection mechanism is an important consideration in that an efficient system selection result gives a major advantage of improved financial analytics and healthcare predictive modelling. This study proposes some novel adaptable security frameworks with features that include hybrid cryptography, fog computing, and AI-driven techniques to add value to IoT and cloud security. The study proposes the integration of the hybrid Firefly-Particle Swarm Optimization (FF-PSO) for ECG signal analyses in implementing a cloud-enabled wireless ambulatory ECG system for the early detection of heart disease. This includes strong encryption techniques, AI-driven threat intelligence, and blockchain-based authentication that reciprocally underpin critical infrastructure. Further, the analysis here captures artificial intelligence, machine learning, and quantum encryption from financial analytics and HR into a collaborative companion to ensure one has access to robust data security and operational efficiency. Simply put, the results of the various methodologies suggest the rise of sufficiently accurate, scalable, and secure cloud environments needed for newer advanced analytics-predictive or nonpredictive-perfected-the-art systems with respect to SMEs, Healthcare, and Finance.

KEYWORDS: Cloud computing, SMEs, machine learning, IoT, financial analytics, cybersecurity, time-series forecasting, big data analytics, Robotic Process Automation

I. INTRODUCTION

Cloud computing has a significant impact on management accounting procedures concerning SMEs through the above advanced analytical techniques like Content Analysis, Partial Least Squares Structural Equation Modelling, and Classification and Regression Trees. Present-day sets of financial data entail both structured and unstructured datasets requiring very sophisticated machine learning methods for analyzing purposes, as the traditional model being implemented does not cater for high-dimensional complexity, thus limiting its scalability and precision. The research employs a hybrid approach comprising GBDT, ALBERT, and the Firefly Algorithm under a cloud framework to achieve better real-time processing, scalability, and security. In this regard, the RSA Algorithm-Based Comprehensive Approach for Mobile Data Security in Cloud Computing provides an additional strong solution through the application of RSA encryption to secure mobile data in transit and resting across four system layers, that is, client (mobile devices), application (mobile apps), cloud (cloud services), and security (RSA encryption and key management). Rama Krishan et al.'s [1] RSA encryption and key management approach guided the proposed work, enhancing mobile data confidentiality and integrity in cloud environments, especially for securing sensitive healthcare and financial data streams. Within smart cities, the proliferation of IoT devices generates enormous amounts of real-time data which must be processed in an agile way. High volume, velocity, and variety of IoT data present a challenge to the traditional, centralized system, leading to extremely high latencies and inadequate resource utilization. In addition to manufacturing, time series forecasting is essential for analyzing complex systems that exhibit behavioral patterns over

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 10, Issue 3, March 2021||

|DOI:10.15662/IJAREEIE.2021.1003005|

time. But the non-strictly linear and non-stationary nature of these predictive systems complicates the undertaking, making any attempts at an accurate forecast even more challenging[2].

Robotic Process Automation development changes have contributed to financial management by automating boring tasks, which are prone to errors, and giving real-time reports while also weighing the performance and scalability of RPA in cost accounting and financial systems. With the integration of big data analytics, cloud computing, and attribute-based encryption, security for financial data is meanwhile being enhanced in the digital era, therefore providing some of the sophisticated means needed to shield sensitive information while the banking industry faces an increasingly complex set of cyber threats[3]. The advent of cloud computing changed the face of information technology in that services were offered in a scalable, adaptable, and cost-efficient way for data processing, management, and storage, more so with the application of clouds by many service providers in such numbers which, however, in turn, pose another challenge to SMEs in service selection[4]. The present study proposes a new type of cloud brokerage architecture utilizing an in-house designed B-Cloud-Tree indexing structure for the purpose of optimizing service selection. Therefore, healthcare stands to benefit exceedingly from what is dubbed advanced analytics able to improve predictive accuracy and decision outcomes. In light of this, the paper has developed further cloud-based predictive modeling to the level of actionable intelligence for the healthcare provider through the implementation of Stochastic Gradient Boosting, Generalized Additive Models, Latent Dirichlet Allocation, and Regularized Greedy Forest, thereby addressing scalability, interpretability, and sparsity of data. Analogous requirements confront financial data analytics, which seeks innovative means to deal with non-linearity, noise, and high dimensionality[5]. Accordingly, the study espouses a strong cloud-based framework combining CatBoost for categorical data, ELECTRA for text analytics, t-SNE for dimensionality reduction, and Genetic Algorithms for optimization, thus demonstrating better precision and scalability. Security threats are on the rise with IoT networks requiring more robust data-sharing techniques, and without compromising data security through conventional encryption methods. The method for this study is focused on hybrid cryptography and key generation developed using SSEIC partnered with GWGSO and MSADE. The ever-expanding realm of IoT introduces new challenges concerning security and privacy for data sharing. Therefore, this research integrates isogeny-based hybrid cryptography with ARW and decentralized cultural co-evolutionary optimization to address these challenges. Amid the latency mitigation and performance-enhancing features, fog computing also solves IoT's cloud-based limitations. However, the evolving reality has made it rather complex to share data securely and allocate resources because of the very unstructured nature of IoT data[6]. This new work proposes the adaptation of DBSCAN and fuzzy C-Means combined with a hybrid ABC-DE optimization method towards better accuracy and efficiency in clustering, especially in fog computing environments. Besides, there is developed a methodology that integrates PLONK for secure IoT data sharing with IGMM towards dynamic load balancing to accomplish both real-time workload distribution and cost-effective secure communication. Finally, risk prediction and financial modeling effectiveness are improved through Monte Carlo simulation along with DBN and BSP processing in this secure cloud-based financial analysis system.

Theoretical models on complex networks find applications in various fields such as DNA study, physics, computer science, and medicine, where fractal geometry and graph theory help in DNA sequence interpretation in terms of nucleotide transitions, graph construction, Hurst exponent estimation, and network properties computation. With the onset of cloud computing, AI, and IoT having given a new direction to real-time patient monitoring and diagnosis, hybrid learning models along with neural fuzzy systems have really improved the accuracy of diagnosis based on uncertainties in large medical datasets collected from IoT devices. Predominantly, paradigm acceding to cloud computing, smart networks, and blockchain is making gains in the e-commerce- and finance-related business to manage huge volumes of corresponding data with specific problems such as scalability, security, and efficiency. HF remained a major health issue, thus increasing morbidity and mortality and incurring high costs to the health services; even though advances in clinical care have slightly allowed better prognosis, there is still a gravely undecided eastern in need of predictive models. There are demands for innovative technologies that will ensure high security, scalability, and intelligent management of employee data. Poovendran et al.'s (2020) [7] work introduced advanced DDoS detection methods capable of handling high-dimensional data, which informed the proposed framework's design by improving detection accuracy and scalability for securing cloud computing environments.

II. LITERATURE REVIEW

Thirusubramanian[8] and co-workers put forth advanced techniques for identifying suspicious patterns in huge IoT data streams using anomaly detection, clustering, and machine learning so that the AI can distinguish between an authentic and a fraudulent transaction in real time. In addition to this, they have proposed the P2DS, which is intended to safeguard financial data in a cloud mobile environment and uses the following mechanisms: ABE, A-SAC, and PDA

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 10, Issue 3, March 2021||

|DOI:10.15662/IJAREEIE.2021.1003005|

algorithm for precise access management, the swift detection of threats, and effective encryption. Ganesan and others, working together, have developed the SOA-based solution that implements the Hadoop-managed cluster and gives robust storage and processing capacities for efficient educational resource management and distance learning with a fair and strong footing under heavy loads[9]. They also presented a quantitative method to characterize key IoT components and performed a complete assessment of vulnerabilities that analyzed security measures, such as intrusion detection, encryption, access control, and audits. thus described a framework that would integrate the advanced AI models of Random Forest classifiers, Transformer Networks, and TCN, using cloud computing, cloudlet, and edge layers for distributed processing. According to them, real-time stream analytics is enabled through Apache Flink while blockchain ensures secure data exchange, significantly enhancing the overall security and effectiveness of the system.
The DMHMA was presented by for warehouse order patching optimization, employing TS algorithms to make batching more efficient up to 25% of the time picking up orders and reducing the cost of operations by 15%. IoMT-based and block chained heart disease monitoring systems utilizing BS-THA and OA-CNN have been established by to facilitate secure doctor-patient authentication, data sensing, and blockchain-verified storage while implementing advanced signal processing and machine learning techniques onto heart disease classification[10]. Further, it comes up with a novel approach for solving JSP based on HGA and HPSO, whereby job sequencing is enhanced, production time optimization and an exploration improvement are achieved. Further, they proposed a federated learning and cloud-edge collaborative computing structure meant to ensure secure attack classification validated through time, node count, routing count, and data delivery ratio estimates. [11]. expressed a DL architecture, which designs an automotive environment taking into account the applicability of NS for dynamic resource management in a distributed network dedicated to DLaaS architecture; thus, an onclick of the button proactively implements service management, algorithms are now swiftly developed. This was clearly shown through a case study in a vehicular T/NTN environment. Sharadha et al.'s (2020) [12] hybrid Firefly-PSO mechanism shaped the proposed framework's optimization approach, enhancing scalability and reducing latency to achieve more accurate and efficient heart disease diagnosis.

A hybrid methodology for Resource Allocation and Task Scheduling has been suggested by using IBOA and MSGO, concerning updating speed and searchability[13]. Their approach was verified considering response time, resource utilization, and energy consumption and has successfully demonstrated superiority over the MOTSGWO with 32.5 watts for 100 tasks. Very recently, proposed a security framework for cloud-based healthcare systems, which involves risk assessment, implementation of security, continuous monitoring, and compliance management while providing the enhanced architecture for the integrated use of authentication, encryption, intrusion detection, blockchain, and multi-factor authentication. The authors also proposed an alternate methodology for optimizing resource allocation and service delivery in the cloud computation employing Nash equilibrium principles for negotiating SLAs, wherein the framework was validated through real-time experiments in order to guarantee scalability, security, and usability[14]. The researchers investigated long-term blood sample analysis to predict cardiovascular risk concerning RA populations, biobanking, predictive models, and advanced technologies such as wearables and telemedicine to personalize treatment[15]. They further devised a specialized architecture that combines PSP Net for image feature extraction, HHT for non-linear signal analysis of brain signals, and fuzzy logic for adjusting the classification which enhances the overall classification accuracy and delineation of disorders.

A hybrid data mining approach was represented by for real-time TBM data processing. It comprises association rule mining, decision tree classification, and neural networks, which mainly drive operational efficiency and safety in tunnel projects through sound analysis of TBM parameters, anomaly detection, geological formation classification, and predicting the ROP. The new introduction made was an m-CSRM for enhanced risk assessment and management on critical infrastructures against common limitations emanating from inadequate contextual data and threat intelligence by integrating a decision support system using fuzzy set mechanisms and machine learning for risk prediction, with obtained results achieving an 82.13% success rate[16]. In addition, they developed a Recurrent RFS tactic for improvement of the overall performance of the NIDS) used for IoT security by making use of datasets NSL-KDD and UNSW-NB15 in conjunction with a hybrid rule-based algorithm to select effective attributes, classify and predict attacks in gathered data. proposed the idea of RSA algorithm application to enhance the security of cloud computing, where in encryption and decryption, prime factorization complexity is applied to ensure safe communication, digital privacy, integrity, and authenticity without shared secret keys, hence usable to internet security protocols or email encryption. And later, they used the AHP to determine what the main issues were in cloud security - data integrity, privacy, and unauthorized access - thus advocating for advanced encryption, AI-driven threat detection, multi-factor authentication, and real-time monitoring, with the future study primarily focusing on AI and quantum encryption to further enhance cloud security.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 10, Issue 3, March 2021||

|DOI:10.15662/IJAREEIE.2021.1003005|

III. PROBLEM STATEMENT

Ensuring efficient, secure, and risk management data-driven environments is still a challenge today. TBM operations still lack anomaly detection and predictive capabilities, and threats remain in the area of critical infrastructures security due to less intelligence on threats[17]. Traditional NIDS struggle with feature selection while cloud computing has vulnerabilities to data integrity and unauthorized access. Existing solutions such as hybrid data mining-based and machine learning-based risk management, would require optimization in terms of scalability, accuracy, and real-time application. A comprehensive approach that blends AI, quantum encryption, and advanced decision-support mechanisms is the way forward towards improving cybersecurity, data protection, and operational efficiency.

3.1 Objective

The study presently being conducted aims to develop a cloud-enabled wireless ambulatory ECG system, optimized with a hybrid Firefly and PSO algorithm for the accurate detection of heart disease. In turn, it aims to facilitate the detection of anomalies in real

time, in conjunction with AI-driven threat intelligence for enhanced cybersecurity of critical infrastructures, and upgrading cloud security via advanced encryption. Its other areas of concentration include optimizing NIDS for better detection of attacks to ensure data processing in healthcare and otherwise data-driven environments is scalable, fast, and secure.

IV. Proposed Wireless Ambulatory ECG System Optimized with Hybrid Firefly and Particle Swarm Optimization for Heart Disease Detection

The proposed wireless ambulatory ECG system utilizes cloud computing to provide real-time detection of heart disease and integrates HF-PSO algorithms for signal processing and feature selection enhancement. The HF-PSO algorithm captures ECG signals using wearable sensors, which securely transmit this data to the cloud, where ML is used for anomaly detection. Rajeswaran et al. (2020) [18] provided key insights into optimizing big data analytics for enhanced efficiency and scalability, which the proposed system leverages to improve heart disease detection performance and data processing capabilities.

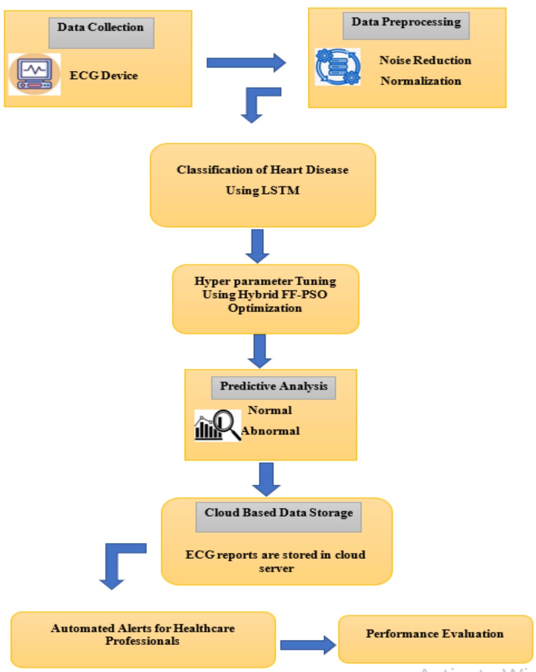


Figure 1: Wireless Ambulatory ECG System Optimized with Hybrid Firefly and Particle Swarm Optimization

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 10, Issue 3, March 2021||

|DOI:10.15662/IJAREEIE.2021.1003005|

4.1 Data Collection

The ECG signals are gathered by a wearable ECG device that continuously touches the heart, keeping track of its activity to real-time capture. The collected signals pass through raw transmission through wireless transfer adequate for further processing. This step is intended to facilitate seamless acquisition of the data for early detection of heart disease and also enables monitoring from a distance by healthcare professionals. The collected unprocessed signal data then moves to the preprocessing phase of noise removal and normalization.

4.2 Data Preprocessing

The collected ECG signals undergo preprocessing to improve the quality of the data[19]. Noise reduction techniques like wavelet transforms or adaptive filtering remove contaminations sourced from other external artificial external or baseline drifts[20]. Normalization allows for ECG signals to be uniformly scaled, to improve feature extraction and classification accuracy[21]. This is an important part of enhancing the clarity of signals for verifying heart disease detection. Mohan Reddy et al. (2020) [22] pointed out the critical role of preprocessing and outlier removal in healthcare diagnostics, directly supporting the proposed work's approach to enhancing ECG signal analysis accuracy and reliability.

4.2.1 Noise Reduction

Noise cancellation techniques in the case of electrocardiogram signals are the removal of muscle artifacts, the wandering baseline, and powerline noise signals in order to achieve the desired clarity of the signal[23]. Some techniques like wavelet transform and adaptive filtering help to remove those unwanted noises that distort the signals but do not affect their vital features. Bandpass filtering is one of the methods because it does the separation of the low frequencies for baselines wandering and high frequencies of noise[24].

Equation for Noise Reduction (Bandpass Filter):

$$y(n) = \sum_{k=0}^{N} b_k x(n-k) - \sum_{m=1}^{M} a_m y(n-m) \tag{1}$$

Where:

$y(n)$ = filtered output signal
$x(n)$ = input ECG signal
b_k, a_m = filter coefficients
N, M = filter orders

This equation represents a digital filter, commonly used in ECG noise reduction.

4.2.2 Normalization

ECG normalization helps in scaling ECG signals to a standard range for more consistency and improved accuracy in classification[25]. It reduces the variations not only because of the differences in patient physiology but also due to sensor placement differences and signal amplitude. Min-max normalization is one approach that normalizes the data between 0 and 1.

Normalization Equation (Min-Max Scaling):

$$X' = \frac{X - X_{min}}{X_{max} - X_{min}} \tag{2}$$

Where:

X' = normalized ECG value
X = original ECG value
X_{min} = minimum value in the dataset
X_{max} = maximum value in the dataset

This ensures all ECG values fall within a uniform range, improving feature extraction and classification performance.

4.3 Heart Disease Monitoring System Using LSTM

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 10, Issue 3, March 2021||

|DOI:10.15662/IJAREEIE.2021.1003005|

Long Short-Term Memory (LSTM) networks are specialized types of recurrent neural networks (RNN) which are meant to cater sequential data like ECG signals. Swapna et al. (2020) [26] substantiated that the GWO-DBN hybrid model improves disease forecasting accuracy and feature optimization while enabling scalable cloud-based monitoring, which the proposed work adopts to improve healthcare prediction and data management. They eliminate the hindrances such as vanishing gradient problem[27]. They significantly take long dependencies as well as the temporal pattern in time-series data and hence classify heart diseases with proficiency through LSTM's gates: an input gate for incoming information, a forget gate to delete information of less relevance, and an output gate to permit only the needed output inside LSTM[28].

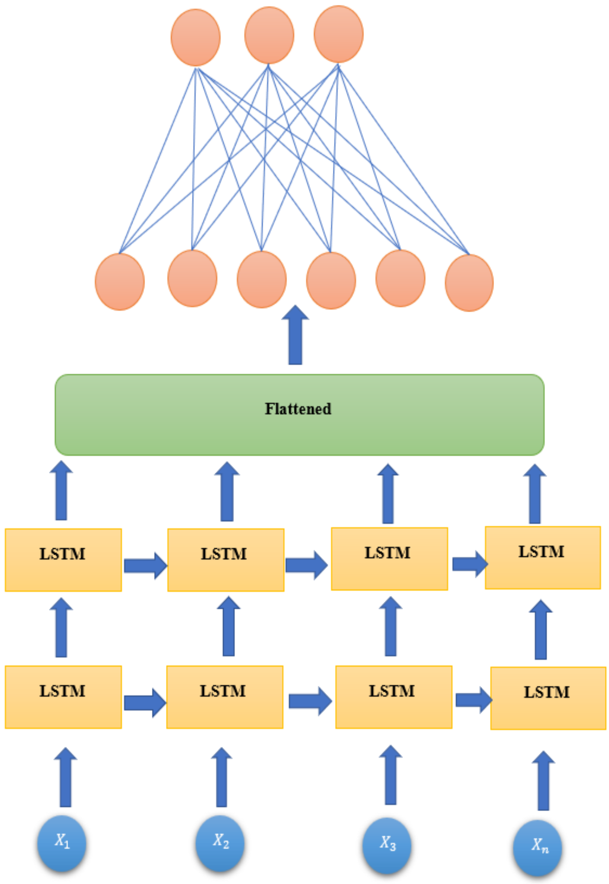


Figure 2: Architecture of Long Short-Term Memory (LSTM)

LSTM Equation (Cell State Update):

$$C_t = f_t \odot C_{t-1} + i_t \odot \tilde{C}_t \quad (3)$$

Were

- C_t = current cell state
- f_t = forget gate
- C_{t-1} = previous cell state
- i_t = input gate
- $\tilde{C}_t$ = candidate cell state
- $\odot$= element-wise multiplication

This equation ensures that important ECG patterns are preserved while irrelevant information is discarded, improving heart disease detection accuracy.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 10, Issue 3, March 2021||

|DOI:10.15662/IJAREEIE.2021.1003005|

4.4 Hybrid Firefly and Particle Swarm Optimization for Heart Disease Detection

Hybrid firefly optimization and PSO are used together in this context in order to combine two strength algorithms to optimize hyperparameters from heart disease detection models[29]. The use of SSEIC, MSADE, and GWGSO in the proposed work elevates encryption speed and scalability, with Bhavya et al. (2020) [30] providing empirical evidence of their quantum-resistant security for IoT applications. Firefly algorithm mimics the flash behaviors of fireflies in order to explore global space, while PSO simulates the movement of particles in a swarm that converges quickly towards an optimal solution by using this hybridization that improves the search efficiency and accuracy of the algorithm and speeds up convergence[31].

Hybrid FF-PSO Equation:

$$V_i^{t+1} = wV_i^t + c_1r_1(P_i^t - X_i^t) + c_2r_2(G^t - X_i^t) + \beta e^{-\gamma d_{ij}}\left(X_j^t - X_i^t\right) \tag{4}$$

Where:

V_i^{t+1} = updated velocity of particle i
w = inertia weight (controls exploration vs. exploitation)
c_1, c_2 = cognitive and social acceleration coefficients
r_1, r_2 = random numbers in [0,1]
P_i^t = personal best position of particle i
G^t = global best position
X_i^t, X_j^t = positions of particles (fireflies)
β = attractiveness factor of firefly algorithm
γ = light absorption coefficient
d_{ij} = distance between fireflies i and j

This hybrid equation integrates PSO's fast convergence with FF's global search capability, improving the classification performance of heart disease detection systems[32].

4.5 Cloud Infrastructure

Cloud storage for data has the capacity of storing ECG reports securely with real-time proximity, scalable and thus supporting remote access[33]. It is thereby assured that the data would have an intact, secured and automated alert-wired integrated with it, which augments heart disease detection and overall efficiency in healthcare.

V. RESULTS AND DISCUSSION

It is a wireless ECG system which is cloud-enabled, and it makes uses of a Hybrid Firefly-PSO algorithm for heart disease detection with high accuracy, fast processing, and few false detections in real time monitoring and early diagnosis[34].

Performance Metrics

In Figure 3, The four parameters used to test the performance of the ECG system in the bar graph are Accuracy (99.23%), Precision (99.46%), Recall (93.04%), and F1-Score (98.00%). The system is highly accurate and precise, assuring its reliability in the detection of heart disease. The recall is somewhat low since it indicates some missed cases, but the F1-score indicates a good performance overall[35].

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 10, Issue 3, March 2021||

|DOI:10.15662/IJAREEIE.2021.1003005|

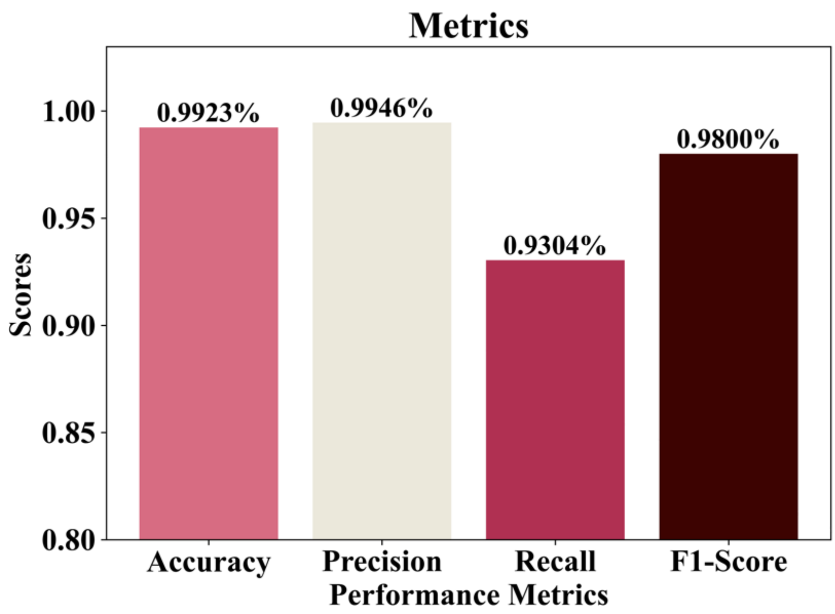


Figure 3: Performance Metrics

Data Latency

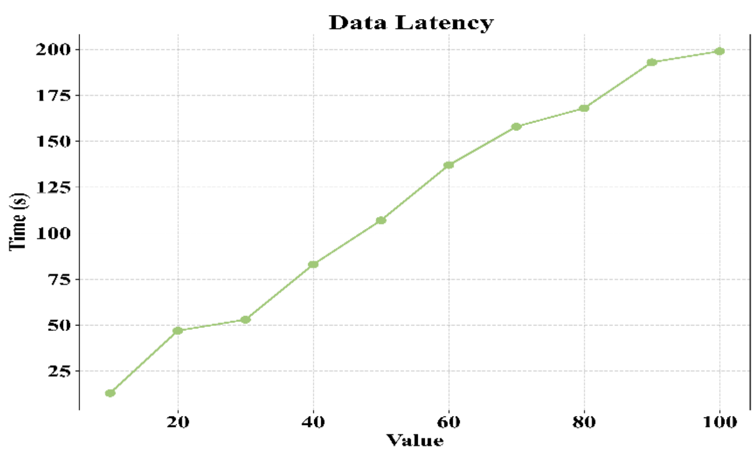


Figure 4: Data Latency

In Figure 4, Data Latency Plot presents the correlation of Value, on X-Axis, as well as Time in seconds, as the Y-Axis and indicates a positive trend. When the value increases, latency increases from the lowest value, i.e., almost 0 seconds, to the highest latency value of almost 200 seconds at the highest value. This indicates that bigger sizes of data tend to increase latencies that may affect the real-time processing. Venkat et al. (2020) [36] provided a cloud-based platform utilizing GRU models for attack detection, traffic classification, and dynamic resource allocation, which the proposed work draws on to improve performance and scalability in cloud traffic management.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 10, Issue 3, March 2021||

|DOI:10.15662/IJAREEIE.2021.1003005|

Storage Efficiency

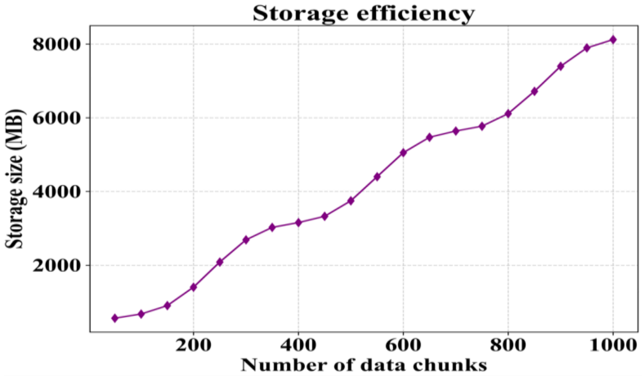


Figure 5: Storage Efficiency

Figure 5 shows the growth of storage with respect to the number of chunks against x-axis data chunks and storage size in MB against y-axis data storage. Hence, with increasing chunks of data, there is an increase in stored data, which virtually reaches about 8000 MB at around 1000 chunks[37]. The system has shown a steady increase in usage storage data, which highlights its efficiency in terms of data management[38]. Winner et al. (2020) [39] made clear the pivotal role of RSA encryption for mobile data security in cloud environments, enabling the proposed ECG system to ensure safe healthcare data transfer.

VI. CONCLUSION

The optimized cloud-enabled ECG system offers more than 99.23% high accuracy, along with heart disease detection, very much more efficiently. Though the increasing data latencies and storage requirements are putting the efficiency of real-time monitoring in jeopardy, they are still affecting reliable real-time monitoring, hence improving early diagnosis and telehealth.

REFERENCES

[1] M. K. Y. Rama Krishna and G. Y. Akhil Raj, “Comprehensive Approach for Mobile Data Security in Cloud Computing Using RSA Algorithm,” Curr. Sci. Humanit., vol. 8, no. 3, 2020.

[2] C. H. Wu, R. K. Chiu, H. M. Yeh, and D. W. Wang, “Implementation of a cloud-based electronic medical record exchange system in compliance with the integrating healthcare enterprise’s cross-enterprise document sharing integration profile,” Int. J. Med. Inf., vol. 107, pp. 30–39, Nov. 2017, doi: 10.1016/j.ijmedinf.2017.09.001.

[3] Z. E. Dawahdeh, S. N. Yaakob, and R. Razif Bin Othman, “A new image encryption technique combining Elliptic Curve Cryptosystem with Hill Cipher,” J. King Saud Univ. - Comput. Inf. Sci., vol. 30, no. 3, pp. 349–355, Jul. 2018, doi: 10.1016/j.jksuci.2017.06.004.

[4] L. L. Fragidis, P. D. Chatzoglou, and V. P. Aggelidis, “Integrated Nationwide Electronic Health Records system: Semi-distributed architecture approach,” Technol. Health Care, vol. 24, no. 6, pp. 827–842, Nov. 2016, doi: 10.3233/THC-161231.

[5] K. Sorensen, “A publication of ISCA:,” Int. Soc. Comput. Their Appl., 2018.

[6] D. D. Olatinwo, A. Abu-Mahfouz, and G. Hancke, “A Survey on LPWAN Technologies in WBAN for Remote Health-Care Monitoring,” Sensors, vol. 19, no. 23, Art. no. 23, Jan. 2019, doi: 10.3390/s19235268.

[7] A. Poovendran, “ANALYZING THE COVARIANCE MATRIX APPROACH FOR DDOS HTTP ATTACK DETECTION IN CLOUD ENVIRONMENTS,” Int. J. Inf. Technol. Comput. Eng., vol. 8, no. 1, pp. 29–47, Jan. 2020.

[8] G. Thirusubramanian, “Machine Learning-Driven AI for Financial Fraud Detection in IoT Environments,” Int. J. HRM Organ. Behav., vol. 8, no. 4, pp. 1–16, Oct. 2020.

[9] Dr. S. Shakya, “Computational Enhancements of Wearable Healthcare Devices on Pervasive Computing System,” J. Ubiquitous Comput. Commun. Technol., vol. 2, no. 2, pp. 98–108, May 2020, doi: 10.36548/jucct.2020.2.005.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 10, Issue 3, March 2021||

|DOI:10.15662/IJAREEIE.2021.1003005|

[10] J. Wang, Y. Gao, W. Liu, A. K. Sangaiah, and H.-J. Kim, "An intelligent data gathering schema with data fusion supported for mobile sink in wireless sensor networks," Int. J. Distrib. Sens. Netw., vol. 15, no. 3, p. 1550147719839581, Mar. 2019, doi: 10.1177/1550147719839581.

[11] T. Bhardwaj and S. C. Sharma, "Cloud-WBAN: An experimental framework for Cloud-enabled Wireless Body Area Network with efficient virtual resource utilization," Sustain. Comput. Inform. Syst., vol. 20, pp. 14–33, Dec. 2018, doi: 10.1016/j.suscom.2018.08.008.

[12] K. Sharadha, "ADVANCED DATA ANALYTICS IN CLOUD COMPUTING: INTEGRATING IMMUNE CLONING ALGORITHM WITH D-TM FOR THREAT MITIGATION," Int. J. Eng. Res. Sci. Technol., vol. 16, no. 2, pp. 30–42, Jun. 2020.

[13] G. Manogaran, R. Varatharajan, D. Lopez, P. M. Kumar, R. Sundarasekar, and C. Thota, "A new architecture of Internet of Things and big data ecosystem for secured smart healthcare monitoring and alerting system," Future Gener. Comput. Syst., vol. 82, pp. 375–387, May 2018, doi: 10.1016/j.future.2017.10.045.

[14] K. Hasan, K. Biswas, K. Ahmed, N. S. Nafi, and M. S. Islam, "A comprehensive review of wireless body area network," J. Netw. Comput. Appl., vol. 143, pp. 178–198, Oct. 2019, doi: 10.1016/j.jnca.2019.06.016.

[15] V. S. T. Gollapalli, "Scalable Healthcare Analytics in the Cloud: Applying Bayesian Networks, Genetic Algorithms, and LightGBM for Pediatric Readmission Forecasting," Indo-Am. J. Life Sci. Biotechnol., vol. 17, no. 1, pp. 23–40, Jan. 2020.

[16] X. Ma, Z. Wang, S. Zhou, H. Wen, and Y. Zhang, "Intelligent Healthcare Systems Assisted by Data Analytics and Mobile Computing," Wirel. Commun. Mob. Comput., vol. 2018, no. 1, p. 3928080, 2018, doi: 10.1155/2018/3928080.

[17] A. N. Navaz, M. A. Serhani, N. Al-Qirim, and M. Gergely, "Towards an efficient and Energy-Aware mobile big health data architecture," Comput. Methods Programs Biomed., vol. 166, pp. 137–154, Nov. 2018, doi: 10.1016/j.cmpb.2018.10.008.

[18] A. Rajeswaran, "Big Data Analytics and Demand-Information Sharing in E- Commerce Supply Chains: Mitigating Manufacturer Encroachment and Channel Conflict," Int. J. Appl. Sci. Engінerring Manag., 2020.

[19] X. Wang and Z. Jin, "An Overview of Mobile Cloud Computing for Pervasive Healthcare," IEEE Access, vol. 7, pp. 66774–66791, 2019, doi: 10.1109/ACCESS.2019.2917701.

[20] R. Punj and R. Kumar, "Technological aspects of WBANs for health monitoring: a comprehensive review," Wirel. Netw., vol. 25, no. 3, pp. 1125–1157, Apr. 2019, doi: 10.1007/s11276-018-1694-3.

[21] S. Oueida, Y. Kotb, M. Aloqaily, Y. Jararweh, and T. Baker, "An Edge Computing Based Smart Healthcare Framework for Resource Management," Sensors, vol. 18, no. 12, Art. no. 12, Dec. 2018, doi: 10.3390/s18124307.

[22] S. Mohan Reddy and O. Llc, "Next-Generation Workforce Optimization: The Role of AI and Machine Learning," Int. J. Comput. Sci. Eng. Tech., vol. 5, no. 5, 2020.

[23] V. Gandhi and J. Singh, "An automated review of body sensor networks research patterns and trends," J. Ind. Inf. Integr., vol. 18, p. 100132, Jun. 2020, doi: 10.1016/j.jii.2020.100132.

[24] M. T. Mardini, Y. Iraqi, and N. Agoulmine, "A Survey of Healthcare Monitoring Systems for Chronically Ill Patients and Elderly," J. Med. Syst., vol. 43, no. 3, p. 50, Jan. 2019, doi: 10.1007/s10916-019-1165-0.

[25] A. Rizwan et al., "A Review on the Role of Nano-Communication in Future Healthcare Systems: A Big Data Analytics Perspective," IEEE Access, vol. 6, pp. 41903–41920, 2018, doi: 10.1109/ACCESS.2018.2859340.

[26] N. Swapna, V. Dharma Teja, and P. Sreekar, "Cloud Computing with Artificial Intelligence Techniques: GWO-DBN Hybrid Algorithms for Enhanced Disease Prediction in Healthcare Systems," Curr. Sci., 2020.

[27] A. S. Abiodun, M. H. Anisi, and M. K. Khan, "Cloud-Based Wireless Body Area Networks: Managing Data for Better Health Care," IEEE Consum. Electron. Mag., vol. 8, no. 3, pp. 55–59, May 2019, doi: 10.1109/MCE.2019.2892244.

[28] A. Mukherjee, D. De, and S. K. Ghosh, "FogIoHT: A weighted majority game theory based energy-efficient delay-sensitive fog network for internet of health things," Internet Things, vol. 11, p. 100181, Sep. 2020, doi: 10.1016/j.iot.2020.100181.

[29] T. Bhardwaj and S. C. Sharma, "Cloud-WBAN: An experimental framework for Cloud-enabled Wireless Body Area Network with efficient virtual resource utilization," Sustain. Comput. Inform. Syst., vol. 20, pp. 14–33, Dec. 2018, doi: 10.1016/j.suscom.2018.08.008.

[30] K. Bhavya, "Multi-Swarm Adaptive Differential Evolution and Gaussian Walk Group Search Optimization for Secured Iot Data Sharing Using Super Singular Elliptic Curve Isogeny Cryptography," Int. J. Electr. Power Energy Syst., vol. 8, no. 3, 2020.

[31] Ayed, S., Chaari, L., & Fares, A. (2020). A survey on trust management for WBAN: Investigations and future directions. Sensors, 20(21), 6041

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 10, Issue 3, March 2021||

|DOI:10.15662/IJAREEIE.2021.1003005|

[32] N. Bilandi, H. K Verma, and R. Dhir, "An Energy Efficient Health Monitoring System using Relay Node in Wireless Body Area Networks," EAI Endorsed Trans. Pervasive Health Technol., vol. 5, no. 20, p. e6, Nov. 2019, doi: 10.4108/eai.13-7-2018.164098.

[33] L. Sun, X. Jiang, H. Ren, and Y. Guo, "Edge-Cloud Computing and Artificial Intelligence in Internet of Medical Things: Architecture, Technology and Application," IEEE Access, vol. 8, pp. 101079–101092, 2020, doi: 10.1109/ACCESS.2020.2997831.

[34] M. Tavana, V. Hajipour, and S. Oveisi, "IoT-based enterprise resource planning: Challenges, open issues, applications, architecture, and future research directions," Internet Things, vol. 11, p. 100262, Sep. 2020, doi: 10.1016/j.iot.2020.100262.

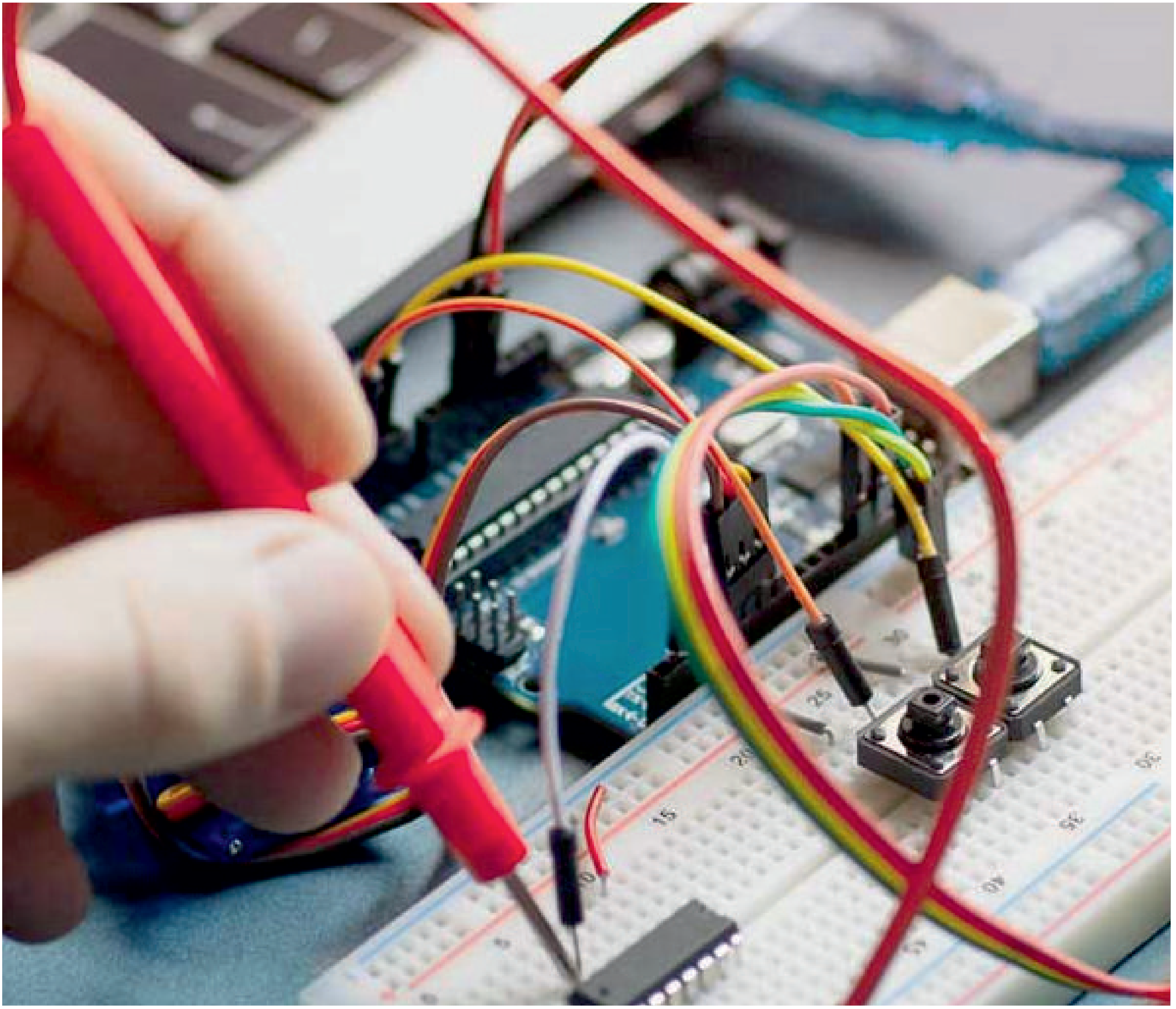
[35] A. Alabdulatif, I. Khalil, X. Yi, and M. Guizani, "Secure Edge of Things for Smart Healthcare Surveillance Framework," IEEE Access, vol. 7, pp. 31010–31021, 2019, doi: 10.1109/ACCESS.2019.2899323.

[36] G. Venkat and K. Veerandra, "View of Optimizing Traffic Management and Cloud Security in Software Networks Using Advanced Deep Learning Models for Application and Attack Classification," Int. J. HRM Organ. Behav., vol. 8, no. 3, 2020.

[37] A. Malekian Borujeni, M. Fathy, and N. Mozayani, "A hierarchical, scalable architecture for a real-time monitoring system for an electrocardiography, using context-aware computing," J. Biomed. Inform., vol. 96, p. 103251, Aug. 2019, doi: 10.1016/j.jbi.2019.103251.

[38] G. Manogaran and D. Lopez, "Health data analytics using scalable logistic regression with stochastic gradient descent," Int. J. Adv. Intell. Paradig., vol. 10, no. 1–2, pp. 118–132, Jan. 2018, doi: 10.1504/IJAIP.2018.089494.

[39] P. Winner and S. Vamshi Krishna, "Automated Threat Intelligence Integration To Strengthen SHACS For Robust Security In Cloud-Based Healthcare Applications," Int. J. Eng., vol. 10, no. 4, 2020.



INNO SPACE
SJIF Scientific Journal Impact Factor

Impact Factor:
7.122

INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

निस्केयर
NISCAIR

International Journal of Advanced Research

in Electrical, Electronics and Instrumentation Engineering

9940 572 462 6381 907 438 ijareeie@gmail.com