International Journal for Modern Trends in Science and Technology
Volume 10, Issue 02, pages 265-273.
ISSN: 2455-3778 online
Available online at: http://www.ijmtst.com/vol10issue02.html
DOI: https://doi.org/10.46501/IJMTST1002034

IoT Based ICU Patient Monitoring System

Sai Srinivas Vellela, G Varshitha, V Suresh, V Sai Vineeth, L Venkata Suresh

Department of CSE – Data Science, Chalapathi Institute of Technology, Guntur-522016, A.P, India.

To Cite this Article
Sai Srinivas Vellela, G Varshitha, V Suresh, V Sai Vineeth, L Venkata Suresh, IoT Based ICU Patient Monitoring System, International Journal for Modern Trends in Science and Technology, 2024, 10(02), pages. 265-273. https://doi.org/10.46501/IJMTST1002034

Article Info
Received: 26 January 2024; Accepted: 18 February 2024; Published: 21 February 2024.

ABSTRACT

The "IoT-Based ICU Patient Monitoring System" is a cutting-edge project designed torevolutionize patient care in Intensive Care Units (ICUs). Leveraging Internet of Things (IoT)technologies, the system integrates various sensors, communication modules, and data analyticsto enable continuous and real-time monitoring of critical health parameters. The project aims toimprovehealthcareefficiencybyprovidinghealthcareprofessionalswithtimelyalertsandcomprehensivepatient data for enhanced decisionmaking.

The advancement of technology in sensors and communication devices to the Internet hasresulted in practical solutions in various networking sectors, public and private sector enterprises,and government organizations worldwide. In addition, the widespread use of Smart Devices and Mobile Technologies in the health care industry has enhanced their global reach and effect. Patient monitoring systems are classified into two basic categories: bedside patient monitoring systemsand distant patient monitoring systems. The specialists in healthcare systems are increasinglyprofiting from the advantages of such technology, resulting in a significant development withinthehealthcaredomain, both within and outsideofclinical settings.

Similarly, untold numbers of regular operators benefit from the advancements in M-Health(MobileHealth) and E-Health, in which health care is delivered using information and communication technology (ICT) to develop and preserve their health. For patients suffering from chronic diseases, the researchers hope to introduce a survey based on ontology, which will be able to track their health overtime and provide standard work out recommendations.

Keywords: NodeMCUESP8266, ECG Sensor.

1. INTRODUCTION

An IoT-based patient monitoring system utilizing ECG sensors represents a pioneering approach to healthcare, merging cutting-edge technology with personalized patient care. This innovative system leverages the Internet of Things (IoT) to enable seamless connectivity between wearable or implantable ECG sensors and a centralized monitoring platform. By continuously monitoring the electrical activity of the heart, ECG sensors capture invaluable real-time data, providing insights into the patient's cardiac health status. Through wireless transmission, this data is securely relayed to a cloud-based platform, where it undergoes sophisticated analysis and interpretation. Healthcare professionals gain immediate access to comprehensive ECG readings and actionable insights, empowering them to make informed decisions and deliver timely interventions. Patients benefit from the convenience of remote monitoring, allowing them to maintain their daily routines while receiving continuous healthcare support. With its potential to revolutionize patient care delivery, this IoT-based system offers a promising paradigm shift towards proactive, personalized, and accessible healthcare management.

In this project, we will learn how to make an IoT based ECG Monitoring System using AD8232ECG Sensor & NodeMCU ESP8266. We will monitor the ECG waveform/Graph generated from AD8232 Sensor online usinganIoT platformcalled Thingspeak. Heart diseases have been becoming a big issue for the last few decades and many peopledie because of certain health problems. Therefore, heart disease cannot be taken lightly. So, thereshould be technology that can monitor the heart rate and heart behavior of the patient regularly.By analyzing or monitoring the ECG signal at the initial stage the various heart disease can beprevented.

This is there as on we are presenting you with this great IoT project.In this project,we will show you how you can interface AD8232 ECG Sensor with NodeMCU ESP8266 Board andmonitortheECG Waveform on Serial PlotterScreen.Similarly, you can send the ECG waveform over the IoT Cloud platform and monitor the signal online from any part of the world using the PC or simply using the Smartphone.There is no need for staying in the Hospital to monitor heart activity/behavior just because you can monitor it online from any where. Thus, it can be said advancement in Patient Health Monitoring System.

2. LITERATURE REVIEW

Intensive Care Unit (ICU) patient monitoring systems incorporating Electrocardiogram (ECG) modules have emerged as essential tools for continuous cardiac monitoring in critical care settings. These systems are designed to provide real-time monitoring of patients' cardiac activity, enabling healthcare providers to detect and respond to cardiac abnormalities promptly. The architecture of ICU patient monitoring systems typically integrates ECG modules alongside other sensors and data processing units. ECG modules capture electrical signals generated by the heart and transmit them to a central monitoring station for analysis. These modules are crucial for monitoring patients at risk of cardiac arrhythmias or other cardiac events, providing clinicians with vital information about the patient's cardiac status.

Advancements in ECG technology have led to the development of compact, high-fidelity ECG modules capable of capturing detailed cardiac signals with high accuracy and reliability. These modules are often integrated into wearable or bedside monitoring devices, allowing for continuous monitoring of patients' cardiac activity without the need for intrusive procedures. Moreover, ECG modules are equipped with signal processing algorithms that filter noise and artifacts, ensuring the accuracy of cardiac signal interpretation. Additionally, machine learning algorithms may be employed to analyze ECG data and identify patterns indicative of cardiac abnormalities, providing early warning alerts to clinicians.

However, the implementation of ECG-based ICU patient monitoring systems also presents challenges, including data management, interoperability, and cybersecurity concerns. The sheer volume of data generated by ECG modules requires efficient storage, transmission, and analysis infrastructure to ensure timely access to critical information. Interoperability with existing healthcare systems is crucial for seamless integration of ECG data into electronic health records (EHRs) and clinical decision support systems. Furthermore, robust cybersecurity measures, including encryption, authentication, and access control, are essential to protect patient data from unauthorized access and cyber threats.

Clinical validation of ECG-based ICU patient monitoring systems is essential to assess their accuracy, reliability, and clinical utility. Clinical studies and trials are conducted to evaluate the performance of ECG modules in detecting cardiac abnormalities and guiding clinical decision- making. Moreover, user feedback and usability testing help identify areas for improvement in system design and functionality.

3. EXISTING SYSTEM

The current ICU patient monitoring systems rely on manual data collection and periodic checkups, leading to potential delays in detecting critical conditions. Real-time monitoring is often limited, resulting in missed opportunities for timely interventions. Traditional ECG monitoring systems often require patients to remain stationary in clinical settings, such as hospitals or clinics, limiting their mobility and comfort. This can hinder the ability to continuously monitor patients in real-world settings or during daily activities. Older systems may rely on manual recording of ECG readings by healthcare professionals, which can be time-consuming and prone to human error. This manual process may also result in delays in data analysis and decision-making.

Traditional ECG monitoring systems may lack the capability for real-time data transmission and analysis. This means that healthcare providers may not receive immediate alerts for critical events or changes in the patient's condition, potentially leading to delays in intervention. Patients may have limited access to their own ECG data or may not be actively involved in the monitoring process. This lack of accessibility and patient engagement may result in missed opportunities for early detection of abnormalities or proactive management of chronic conditions.

Older systems often rely on physical storage mediums, such as paper-based ECG charts or standalone devices, for storing patient data. This can present challenges in terms of data organization, retrieval, and long-term preservation, as well as susceptibility to damage or loss. Traditional ECG monitoring systems may involve manual processes for data entry, analysis, and reporting, leading to inefficiencies in healthcare workflows and potential delays in patient care delivery.

Older systems may lack interoperability with other healthcare technologies or electronic health record (EHR) systems, limiting the seamless exchange of patient data and integration into existing clinical workflows. Maintaining and calibrating older ECG monitoring equipment may require specialized expertise and resources. Failure to regularly maintain and calibrate these devices can result in decreased accuracy and reliability of ECG readings.

Overall, while traditional ECG patient monitoring systems have been valuable in clinical settings, they may have limitations in terms of mobility, real-time monitoring, accessibility, workflow efficiency, and integration with modern healthcare technologies.

4. PROPOSED SYSTEM

The proposed "IoT-Based ICU Patient Monitoring System" addresses the limitations of traditional systems by introducing the following key features:

Key Features

4.1.1 Vital Sign Sensors:

Continuous monitoring of vital signs including heart rate, blood pressure, respiratory rate, temperature, and oxygen saturation.

Microcontroller Unit (MCU):

Integration of an MCU to process sensor data, control communication modules, and manage overall system functionality.

IoT Connectivity:

Utilization of IoT communication modules for secure and real-time transmission of patient data to a central monitoring system.

Alert System:

Integration of an alert mechanism for triggering notifications on abnormal vital signs or critical conditions, facilitating prompt intervention.

Data Analytics and Trend Analysis:

Implementation of data analytics tools for analyzing historical and real-time patient data, identifying trends for improved diagnosis and treatment planning.

4.2 Required componentsused forthis project:

4.2.1 NodeMCUESP8266

4.2.2 ECGSensor

1) 4.2.1 NodeMCUESP8266:

The NodeMCU ESP8266 development board comes with the ESP-12E module containing the ESP8266 chip having TensilicaXtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects.

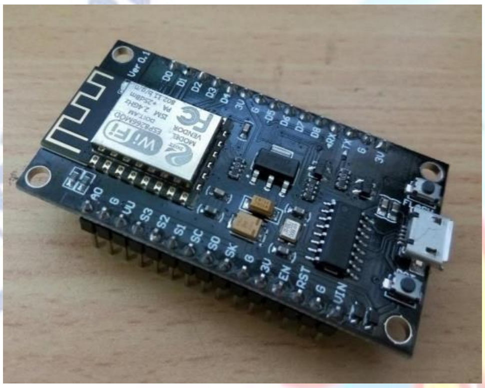

Figure 1: NodeMCUESP8266

NodeMCU is an open-source firmware for which open-source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit). Strictly speaking, the term "NodeMCU" refers to the firmware rather than the associated development kits.Both the firmware and prototyping board designs are open source.

B.4.2.2 ECG SENSOR:

This sensor is a cost-effective board used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram and output as an analog reading.

Figure 2: ECG Sensor

The AD8232 is an integrated signal conditioning block for ECG and other biopotential measurement applications. It is designed to extract, amplify, and filter small biopotential signals in the presence of noisy conditions, such as those created by motion or remote electrode placement.

The AD8232 module breaks out nine connections from the IC that you can solder pins, wires, or other connectors to. SDN, LO+, LO-, OUTPUT, 3.3V, GND provide essential pins for operating this monitor with an Arduino or other development board. Also provided on this board are RA (Right Arm), LA (Left Arm), and RL (Right Leg) pins to attach and use your own custom sensors. Additionally, there is an LED indicator light that will pulsate to the rhythm of a heartbeat.

4. PROPOSED METHOD OFDCNN-NFS FOR MTD

This section introduces the approach of using a deep CNN-based neuro-fuzzy system for detecting moving targets. Figure 1 illustrates the process of detecting moving targets using the proposed DCNN-NFS. The detection of these targets relies on analyzing the signal transmitted within a specific range. The signal that bounces back from the target is treated as the received signal, which serves as input for the target detection process. This received signal undergoes processing through various steps including short time Fourier transform (STFT), matched filter (MF), and radar signatures-based deep recurrent neural networks (DRNN), and the proposed DCNN to generate an ambiguous function.Additionally, specific radar signatures such as PRI, PD, CF, AAE, EAE, and DE are extracted from the received signal. These extracted signatures are then used as input for the DCNN to accurately detect the location of the targets. Through the analysis of the generated AFs, both correlation values and maximum energy are computed to effectively pinpoint the targets' locations.Finally, the results indicating the target locations are fed into the NFS, which plays a crucial role in accurately detecting the moving targets. This comprehensive approach enhances the overall efficacy of moving target detection.

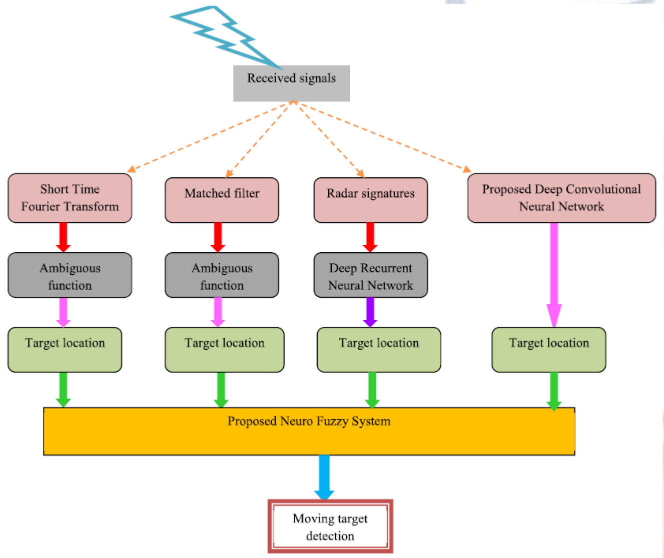

Figure 3: Schematic diagram of the proposed DCNN-NFS for MTD.

Matched Filter - The Matched Filter (MF) exploits the known characteristics of the transmitted radar pulse and the expected Doppler shift caused by moving targets to improve the signal-to-noise ratio and detect weak moving targets in the SAR data. The MF correlates the received radar returns with the time-reversed complex conjugate of the transmitted pulse. After the MF operation, the output contains enhanced signals from the moving targets, making them more distinguishable from clutter and noise. It is particularly effective for detecting slow-moving or weak targets in SAR data.Detection algorithms can then be applied to the filtered data to identify and localize the moving targets.The ratio of powers of signal to noise is given by

$$\left(\frac{SP}{NP}\right)_{out} = \frac{|S_0 t_0|^2}{{n_0}^2\,(t)}. \quad (10)$$

Where, SP= Signal Power, NP = Output Noise Power, S (t_0) = Value of signal at t = t_0 and ${n_0}^2\,(t)$ = mean square value of noise

Applied Matched Filter to the received signal - Once STFT is obtained, matched filter is applied. The MF and Ambiguous Filter helps in detecting. Matched filter identifies the shifted signals makes the process more effective. AF is two – dimensional. The delay signal and Doppler frequency are related. It also gets the correlation between P and time distorted Doppler signal. Time response of filter is measured as it refers to the signal arriving with delay & shift. Application of AF to matched filter is given:

$$S(\vartheta,f) = \frac{1}{|S(0,0)|}\int_{-\infty}^{\infty} P(t).P^*(t+\vartheta).e^{j2\pi ft}dt \quad (11)$$

$$S(0,0) = \int_{-\infty}^{\infty} |P(t)|^2 dt \quad (12)$$

Where S(0, 0) is related to normalizing in the received signal. Further identification of time shift by matched filter is done by

$$\int_{-\infty}^{\infty} P(s).P^*(t+\vartheta).e^{j2\pi ft}dt \quad (13)$$

Ambiguity Function - Ambiguity Function is a two-dimensional function that represents the correlation between the transmitted radar pulse and the received radar return as a function of time delay and Doppler frequency. It provides valuable insights into the Doppler shift induced by moving targets and the time-delayed echoes from stationary and moving scatterers. It helps to develop effective algorithms for MTD and compensation of motion-induced distortions in SAR imagery.When the radiation of signalling is done, sufficient time passes for return of echo prior to next radiation. When the time gap is less, echo may arrive after the next pulse in case of high range. Maximum unambiguous range can be expressed as

$$R_{un} = C\,T_P / 2 \quad (14)$$

Here T_P gives the time of pulse repetition.

4.1 Estimation of Correlation Using Maximum Energy

Correlation Function - The correlation function is a technique used to measure the similarity between two signals, such as the transmitted radar pulse and the received radar return. In the context of moving target detection in SAR, the correlation function is used to compare the received radar signals at different time instants and identify the Doppler shift caused by moving targets.

Maximum Energy Function -It measures the energy content of the received radar signals at different Doppler frequencies and identifies the frequency bin with the maximum energy. This frequency bin corresponds to the Doppler frequency shift caused by the moving target

Correlation estimation through maximum energy - Next step is the identification of correlation by both STFT & matched filter responses. The principle is based on maximum energy. For correlation, the expression is:

$$A(\vartheta,P) = \frac{1}{|A(0,0)|}\int_{-\infty}^{\infty} P(t).P^{*}(t+\vartheta).e^{j2\pi f(t+\vartheta)}dt \qquad (15)$$

Where $P^{*}(t+\vartheta)$ gives shifting. Other than AF, correlation is applied to STFT as

$$Cor^{STFT}(\vartheta,P) = \frac{1}{|Cor^{STFT}(0,0)|}\int_{-\infty}^{\infty} R_{\sigma}[a](g)R_{\sigma}^{*}[a](g).e^{j2\pi f(t+\vartheta)}dt \qquad (16)$$

Where $Cor^{STFT}(\vartheta,P)$ gives maximum energy for finding the target.

5. RESEARCH METHODOLOGY

5.1 CircuitDiagram:InterfacingAD8232ECGSensorwithNodeMCU ESP8266

Here is a circuit diagram for Interfacing AD8232 ECG Sensor with NodeMCU ESP8266.There are 6 pins in AD8232 Breakout Board (GND, 3.3v, OUTPUT, LO-, LO+, SDN.The 5 pins in AD8232 is connected to the NodeMCU.SDN is not connected.

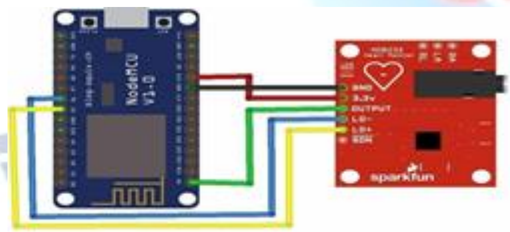

Figure 4: Circuit Diagram :Interfacing AD8232ECG Sensor with Node MCU ESP8266

Connect the OUTPUT to analog A0 of Nodemcu. Connect the LO+ & LO- to D1 & D2 ofNodeMCUrespectively.SupplytheAD8232kitwith 3.3V VCC&Connect its GNDto GND.

Figure 5: AD8232kitwith 3.3V VCC&Connect its GNDto GND

5.2 ECGLeads/ElectrodePlacement :

It is recommended to snap the sensor pads on the leads before application to the body. The closerto the heart the pads are, the better the measurement. The cables are color-coded to help identifyproperplacement.

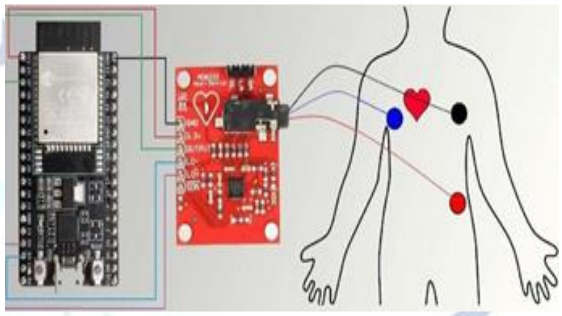

Figure 6: Connection of ECG Sensor to the Human Body

5.3 Flowchart:

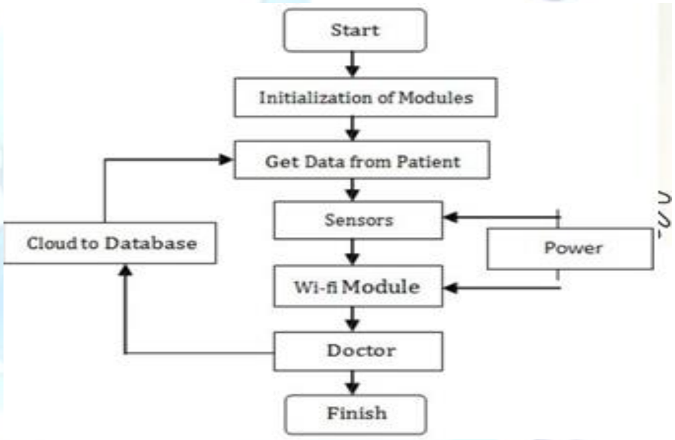

Figure 7: Process of ICU Patient Monitoring System

6. RESULTS & DISCUSSION

The incorporation of an ECG module into the ICU Patient Monitoring System represents a significant advancement in critical care technology. By providing continuous, real-time monitoring of cardiac activity, the ECG module enhances the early detection of arrhythmias, improves the comprehensiveness of patient monitoring, and facilitates seamless data integration and analysis. This ultimately contributes to better patient outcomes and enhances the quality of care in the ICU setting.

The ECG wave form can be seen below as a visualizations effecton Serial Monitor.

Figure 8: ECG Wave Form of a Human Heart Rate

7. CONCLUSIONS

The system developed patient monitoring based on Internet of things, is an alternative that can be used to help patients with chronic diseases. Likewise with this set of solutions the aim is to improve the quality of life of patients, not just monitoring them, but also to enable them directly to improve their eating habits and workout routines.

The context model developed for the system proved to be efficient when making inferences related to the context, such as recommendations for taking measures through sensors, as well as recommendations and workout routines tips to improve the eating habits of patients.

The IoT-based patient monitoring system utilizing ECG sensors presents a transformative approach to healthcare delivery, offering a huge benefit for both patients and healthcare providers. By seamlessly integrating wearable or implantable ECG sensors with advanced IoT technology, this system enables continuous, remote monitoring of cardiac activity, facilitating early detection of abnormalities and timely interventions. The real-time transmission of ECG data to a centralized cloud platform empowers healthcare professionals with instant access to comprehensive patient insights, enhancing diagnostic accuracy and treatment efficacy. Patients experience improved convenience and comfort with remote monitoring capabilities, enabling them to maintain their daily activities while receiving personalized healthcare support. Furthermore, the scalability, interoperability, and data security features inherent in this system ensure its viability and sustainability in diverse healthcare settings. As we continue to witness advancements in technology and healthcare, the IoT-based patient monitoring system stands as a beacon of innovation, ushering in a new era of proactive, patient-centered healthcare management.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

REFERENCES

[1] Chen, N. Su, Y. Huang, and J. Guan, "False-alarm-controllable radar detection for marine target based on multi features fusion via CNNs," IEEE Sensors Journal, vol. 21, no. 7, pp. 9099–9111, 2021.

[2] Li, Z. Sun, and T. S. Yeo, "Computational efficient refocusing and estimation method for radar moving target with unknown time information," IEEE Transactions on Computational Imaging, vol. 6, pp. 544–557, 2020.

[3] Fang, Z. Cao, R. Min, and Y. Pi, "Radar maneuvering target detection based on two steps scaling and fractional Fourier transform," Signal Processing, vol. 155, pp. 1–13, 2019.

[4] Su, X. L. Chen, J. Guan, M. Xiaoqian, and L. Ningbo, "Detection and classification of maritime target with micro–motion based on CNNs," Journal of Radars, vol. 7, no. 5, pp. 565–574, 2018.

[5] Kommineni, K. K., & Babu, A. Y. An approach for the Assessment of the Information Security and Its Measures. International Journal of Soft Computing and Engineering (IJSCE) ISSN, 2231-2307.

[6] Kumar, K. K., Kumar, S. G. B., Rao, S. G. R., & Sydulu, S. S. J. (2017, November). Safe and high secured ranked keyword searchover an outsourced cloud data. In 2017 International Conference on Inventive Computing and Informatics (ICICI) (pp. 20-25). IEEE.

[7] Kommineni, K. K., & Babu, A. Y. (2013). A Cost-Benefit Model for an Enterprise Information Security. International Journal of Innovative Technology and Exploring Engineering (IJITEE), 2(3).

[8] Kommineni, K. K., Pilli, R. B., Tejaswi, K., & Siva, P. V. (2023). Attention-based Bayesian inferential imagery captioning maker. Materials Today: Proceedings.

[9] Kommineni, K. K., Pilli, R. B., Tejaswi, K., & Siva, P. V. (2023). Attention-based Bayesian inferential imagery captioning maker. Materials Today: Proceedings.

[10] Kommineni, K. K., Madhu, G. C., Narayanamurthy, R., & Singh, G. (2022). IoT Crypto Security Communication System. In IoT Based Control Networks and Intelligent Systems: Proceedings of 3rd ICICNIS 2022 (pp. 27-39). Singapore: Springer Nature Singapore.

[11] Kommineni, K. K. ., & Prasad, A. . (2023). A Review on Privacy and Security Improvement Mechanisms in MANETs. International Journal of Intelligent Systems and Applications in Engineering, 12(2), 90–99. Retrieved from https://ijisae.org/index.php/IJISAE/article/view/4224

[12] Rao, M. V., Sreeraman, Y., Mantena, S. V., Gundu, V., Roja, D., & Vatambeti, R. (2024). Brinjal crop yield prediction using shuffled shepherd optimization algorithm based ACNN-OBDLSTM model in smart agriculture. Journal of Integrated Science and Technology, 12(1), 710-710.

[13] Vellela, S.S., Balamanigandan, R. Optimized clustering routing framework to maintain the optimal energy status in the wsn mobile cloud environment. Multimed Tools Appl (2023). https://doi.org/10.1007/s11042-023- 15926-5

[14] Vellela, S. S., Reddy, B. V., Chaitanya, K. K., & Rao, M. V. (2023, January). An Integrated Approach to Improve E-Healthcare System using Dynamic Cloud Computing Platform. In 2023 5th International Conference on Smart Systems and Inventive Technology (ICSSIT) (pp. 776-782). IEEE.

[15] K. N. Rao, B. R. Gandhi, M. V. Rao, S. Javvadi, S. S. Vellela and S. Khader Basha, "Prediction and Classification of Alzheimer's Disease using Machine Learning Techniques in 3D MR Images," 2023 International Conference on Sustainable Computing and Smart Systems (ICSCSS), Coimbatore, India, 2023, pp. 85-90, doi: 10.1109/ICSCSS57650.2023.10169550.

[16] VenkateswaraRao, M., Vellela, S., Reddy, V., Vullam, N., Sk, K. B., & Roja, D. (2023, March). Credit Investigation and Comprehensive Risk Management System based Big Data Analytics in Commercial Banking. In 2023 9th International Conference on Advanced Computing and Communication Systems (ICACCS) (Vol. 1, pp. 2387-2391). IEEE [6]

[17] S Phani Praveen, RajeswariNakka, AnuradhaChokka, VenkataNagarajuThatha, SaiSrinivasVellela and UddagiriSirisha, "A Novel Classification Approach for Grape Leaf Disease Detection Based on Different Attention Deep Learning Techniques" International Journal of Advanced Computer Science and Applications(IJACSA), 14(6), 2023. http://dx.doi.org/10.14569/IJACSA.2023.01406128

[18] Vellela, S. S., & Balamanigandan, R. (2022, December). Design of Hybrid Authentication Protocol for High Secure Applications in Cloud Environments. In 2022 International Conference on Automation, Computing and Renewable Systems (ICACRS) (pp. 408-414). IEEE.

[19] Vullam, N., Vellela, S. S., Reddy, V., Rao, M. V., SK, K. B., & Roja, D. (2023, May). Multi-Agent Personalized Recommendation System in E-Commerce based on User. In 2023 2nd International Conference on Applied Artificial Intelligence and Computing (ICAAIC) (pp. 1194-1199). IEEE.

[20] Vellela, S. S., Balamanigandan, R., & Praveen, S. P. (2022). Strategic Survey on Security and Privacy Methods of Cloud Computing Environment. Journal of Next Generation Technology (ISSN: 2583-021X), 2(1).

[21] Vellela, S. S., & Krishna, A. M. (2020). On Board Artificial Intelligence With Service Aggregation for Edge Computing in Industrial Applications. Journal of Critical Reviews, 7(07), 2020.

[22] Madhuri, A., Jyothi, V. E., Praveen, S. P., Sindhura, S., Srinivas, V. S., & Kumar, D. L. S. (2022). A New Multi-Level Semi-Supervised Learning Approach for Network Intrusion Detection System Based on the 'GOA'. Journal of Interconnection Networks, 2143047.

[23] Madhuri, A., Praveen, S. P., Kumar, D. L. S., Sindhura, S., &Vellela, S. S. (2021). Challenges and issues of data analytics in emerging scenarios for big data, cloud and image mining. Annals of the Romanian Society for Cell Biology, 412-423.

[24] Praveen, S. P., Sarala, P., Kumar, T. K. M., Manuri, S. G., Srinivas, V. S., &Swapna, D. (2022, November). An Adaptive Load Balancing Technique for Multi SDN Controllers.In 2022 International Conference on Augmented Intelligence and Sustainable Systems (ICAISS) (pp. 1403-1409).IEEE.

[25] Vellela, S. S., Basha Sk, K., & Yakubreddy, K. (2023). Cloud-hosted concept-hierarchy flex-based infringement checking system. International Advanced Research Journal in Science, Engineering and Technology, 10(3).

[26] Rao, M. V., Vellela, S. S., Sk, K. B., Venkateswara, R. B., & Roja, D. (2023). SYSTEMATIC REVIEW ON SOFTWARE APPLICATION UNDERDISTRIBUTED DENIAL OF SERVICE ATTACKS FOR GROUP WEBSITES. Dogo Rangsang Research Journal UGC Care Group I Journal, 13(3), 2347-7180.

[27] Venkateswara Reddy, B., Vellela, S. S., Sk, K. B., Roja, D., Yakubreddy, K., & Rao, M. V. Conceptual Hierarchies for Efficient Query Results Navigation. International Journal of All Research Education and Scientific Methods (IJARESM), ISSN, 2455-6211.

[28] Sk, K. B., Roja, D., Priya, S. S., Dalavi, L., Vellela, S. S., & Reddy, V. (2023, March). Coronary Heart Disease Prediction and Classification using Hybrid Machine Learning Algorithms. In 2023 International Conference on Innovative Data Communication Technologies and Application (ICIDCA) (pp. 1-7). IEEE.

[29] Sk, K. B., & Vellela, S. S. (2019). Diamond Search by Using Block Matching Algorithm. DIAMOND SEARCH BY USING BLOCK MATCHING ALGORITHM. International Journal of Emerging Technologies and Innovative Research (www. jetir. org), ISSN, 2349-5162.

[30] Yakubreddy, K., Vellela, S. S., Sk, K. B., Reddy, V., & Roja, D. (2023). Grape CS-ML Database-Informed Methods for Contemporary Vineyard Management. International Research Journal of Modernization in Engineering Technology and Science, 5(03).

[31] Vellela, Sai Srinivas and Chaganti, Aswini and Gadde, Srimadhuri and Bachina, Padmapriya and Karre, Rohiwalter, A Novel Approach for Detecting Automated Spammers in Twitter (June 24, 2023). Mukt Shabd Journal Volume XI, Issue VI, JUNE/2022 ISSN NO : 2347-3150, pp. 49-53 , Available at SSRN: https://ssrn.com/abstract=4490635

[32] Vellela, Sai Srinivas and Pushpalatha, D and Sarathkumar, G and Kavitha, C.H. and Harshithkumar, D, ADVANCED INTELLIGENCE HEALTH INSURANCE COST PREDICTION USING RANDOM FOREST (March 1, 2023). ZKG International, Volume VIII Issue I MARCH 2023, Available at SSRN: https://ssrn.com/abstract=4473700

[33] Dalavai, L., Javvadi, S., Sk, K. B., Vellela, S. S., & Vullam, N. (2023). Computerised Image Processing and Pattern Recognition by Using Machine Algorithms.

[34] Vellela, S. S., Basha Sk, K., & Javvadi, S. (2023). MOBILE RFID APPLICATIONS IN LOCATION BASED SERVICES ZONE. MOBILE RFID APPLICATIONS IN LOCATION BASED SERVICES ZONE", International Journal of Emerging Technologies and Innovative Research (www. jetir. org| UGC and issn Approved), ISSN, 2349-5162.

[35] Vellela, Sai Srinivas and Sk, Khader Basha and B, Venkateswara Reddy, Cryonics on the Way to Raising the Dead Using Nanotechnology (June 18, 2023). INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS), Vol. 03, Issue 06, June 2023, pp : 253-257,

[36] Vellela, Sai Srinivas and D, Roja and B, Venkateswara Reddy and Sk, Khader Basha and Rao, Dr M Venkateswara, A New Computer-Based Brain Fingerprinting Technology (June 18, 2023). International Journal Of Progressive Research In Engineering

Management And Science, Vol. 03, Issue 06, June 2023, pp : 247-252 e-ISSN : 2583-1062.,

[37] Gajjala, Buchibabu and Mutyala, Venubabu and Vellela, Sai Srinivas and Pratap, V. Krishna, Efficient Key Generation for Multicast Groups Based on Secret Sharing (June 22, 2011). International Journal of Engineering Research and Applications,Vol. 1, Issue 4, pp.1702-1707, ISSN: 2248-9622

[38] Kiran Kumar Kommineni, Ratna Babu Pilli, K. Tejaswi, P. Venkata Siva,Attention-based Bayesian inferential imagery captioning maker,Materials Today: Proceedings,2023,ISSN 2214-7853,https://doi.org/10.1016/j.matpr.2023.05.231.

[39] Venkateswara Reddy, B., &KhaderBashaSk, R. D. Qos-Aware Video Streaming Based Admission Control And Scheduling For Video Transcoding In Cloud Computing. In International Conference on Automation, Computing and Renewable Systems (ICACRS 2022).

[40] Reddy, N. V. R. S., Chitteti, C., Yesupadam, S., Desanamukula, V. S., Vellela, S. S., & Bommagani, N. J. (2023). Enhanced speckle noise reduction in breast cancer ultrasound imagery using a hybrid deep learning model. Ingénierie des Systèmesd'Information, Vol. 28, No. 4.

[41] Vellela, S. S., & Balamanigandan, R. (2023). An intelligent sleep-awake energy management system for wireless sensor network. Peer-to-Peer Networking and Applications, 16(6), 2714-2731.

[42] Rao, D. M. V., Vellela, S. S., Sk, K. B., &Dalavai, L. (2023). Stematic Review on Software Application Under-distributed Denial of Service Attacks for Group Website. DogoRangsang Research Journal, UGC Care Group I Journal, 13.

[43] Priya, S. S., Vellela, S. S., Reddy, V., Javvadi, S., Sk, K. B., & Roja, D. (2023, June). Design And Implementation of An Integrated IOT Blockchain Framework for Drone Communication. In 2023 3rd International Conference on Intelligent Technologies (CONIT) (pp. 1-5). IEEE.

[44] Vullam, N., Yakubreddy, K., Vellela, S. S., Sk, K. B., Reddy, V., & Priya, S. S. (2023, June). Prediction And Analysis Using A Hybrid Model For Stock Market. In 2023 3rd International Conference on Intelligent Technologies (CONIT) (pp. 1-5). IEEE.

[45] K. K. Kumar, S. G. B. Kumar, S. G. R. Rao and S. S. J. Sydulu, "Safe and high secured ranked keyword searchover an outsourced cloud data," 2017 International Conference on Inventive Computing and Informatics (ICICI), Coimbatore, India, 2017, pp. 20-25, doi: 10.1109/ICICI.2017.8365348.

[46] Sk, K. B., Vellela, S. S., Yakubreddy, K., & Rao, M. V. (2023). Novel and Secure Protocol for Trusted Wireless Ad-hoc Network Creation. Khader Basha Sk, Venkateswara Reddy B, Sai Srinivas Vellela, Kancharakunt Yakub Reddy, M Venkateswara Rao, Novel and Secure Protocol for Trusted Wireless Ad-hoc Network Creation, 10(3).

[47] Vellela, S. S., Sk, K. B., Dalavai, L., Javvadi, S., & Rao, D. M. V. (2023). Introducing the Nano Cars Into the Robotics for the Realistic Movements. International Journal of Progressive Research in Engineering Management and Science (IJPREMS) Vol, 3, 235-240.

[48] Kumar, K. & Babu, B. & Rekha, Y.. (2015). Leverage your data efficiently: Following new trends of information and data security. International Journal of Applied Engineering Research. 10. 33415-33418.

[49] Vellela, S. S., Reddy, V. L., Roja, D., Rao, G. R., Sk, K. B., & Kumar, K. K. (2023, August). A Cloud-Based Smart IoT Platform for Personalized Healthcare Data Gathering and Monitoring System. In 2023 3rd Asian Conference on Innovation in Technology (ASIANCON) (pp. 1-5). IEEE.

[50] Davuluri, S., Kilaru, S., Boppana, V., Rao, M. V., Rao, K. N., & Vellela, S. S. (2023, September). A Novel Approach to Human Iris Recognition And Verification Framework Using Machine Learning Algorithm. In 2023 6th International Conference on Contemporary Computing and Informatics (IC3I) (Vol. 6, pp. 2447-2453). IEEE.

[51] Vellela, S. S., Vuyyuru, L. R., MalleswaraRaoPurimetla, N., Dalavai, L., & Rao, M. V. (2023, September). A Novel Approach to Optimize Prediction Method for Chronic Kidney Disease with the Help of Machine Learning Algorithm. In 2023 6th International Conference on Contemporary Computing and Informatics (IC3I) (Vol. 6, pp. 1677-1681). IEEE.

[52] Vellela, S. S., Roja, D., Sowjanya, C., SK, K. B., Dalavai, L., & Kumar, K. K. (2023, September). Multi-Class Skin Diseases Classification with Color and Texture Features Using Convolution Neural Network. In 2023 6th International Conference on Contemporary Computing and Informatics (IC3I) (Vol. 6, pp. 1682-1687). IEEE.

[53] Vellela, S. S., Sk, K. B., & Reddy, V. An Intelligent Decision Support System for retrieval of patient's information.

[54] Rao, M. V., Sreeraman, Y., Mantena, S. V., Gundu, V., Roja, D., & Vatambeti, R. (2023). Brinjal Crop yield prediction using Shuffled shepherd optimization algorithm based ACNN-OBDLSTM model in Smart Agriculture. Journal of Integrated Science and Technology, 12(1), 710. Retrieved from https://pubs.thesciencein.org/journal/index.php/jist/article/view/a710

[55] Vellela, S. S., Narapasetty, S., Somepalli, M., Merikapudi, V., & Pathuri, S. (2022). Fake News Articles Classifying Using Natural Language Processing to Identify in-article Attribution as a Supervised Learning Estimator. Mukt Shabd Journal, 11.

[56] V. R. B, K. Basha Sk, R. D, N. Rao Purimetla, S. S. Vellela and K. K. Kumar, "Detection of DDoS Attack in IoT Networks Using Sample elected RNN-ELM," 2023 International Conference on Recent Advances in Science and Engineering Technology (ICRASET), B G NAGARA, India, 2023, pp. 1-7, doi: 10.1109/ICRASET59632.2023.10420193.

[57] E. S. R. R. Kumar et al., "UAVC: Unmanned Aerial Vehicle Communication Using a Coot Optimization-Based Energy Efficient Routing Protocol," 2023 International Conference on Recent Advances in Science and Engineering Technology (ICRASET), B G NAGARA, India, 2023, pp. 1-5, doi: 10.1109/ICRASET59632.2023.10420027