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# IoT based COVID Patient Health Monitoring System

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## ABSTRACT

*The "COVID Patient Health Monitoring System using IoT" project introduces an innovative solution to address the challenges posed by the COVID19 pandemic. Leveraging Internet of Things (IoT) technologies, this system enables continuous and remote monitoring of COVID patients' health conditions. The project focuses on realtime data collecti on, analysis, and communication to healthcare providers, ensuring timely intervention and improving the overall ma nagement of COVID patients.*

*Keywords: IoT, Health monitoring, Sensor interfacing, Cloud platform*

## 1. INTRODUCTION

The spread of the COVID-19 pandemic around the world has changed and influenced the daily life of individuals largely. The slow production and delayed distribution of vaccines have put up much stress on the health system of developing and developed countries. The COVID-19 has reduced the % GDP of most of the countries drastically. So, bringing back the GDP to a higher level is of prime concern as it depends upon the recovery of the population also. Although collaborative efforts have been taken by most of the country from developing, deploying the vaccine up to sanitization has helped the world economy recover at a smooth rate Also, removing the restrictions could trigger another wave and further mutation can't be ruled out as observed in the recent mutated Omicron virus . Thus, monitoring of COVID-19 infected and recovered patients in the wards is of great concern for the health authorities/departments. So the diagnosis and prevention of COVID-19 could be made with the support of sensor technology integration with IoT embedded with machine learning algorithm for process- ing of big data of patients . It was observed that in the winter season, the infection rate of COVID-19 increases, as the conditions for the survival of SARS-CoV-2 virus is much favourable . Internet of things is one of the emerging technologies that is being incorporated in every part of human life. The most common usage of IOT is in the smart home, automated industries, schools, oil refineries, environment monitoring systems, smart cities etc. The challenge of COVID-19 can be reduced by utilizing the internet of things (IoT) based smart health monitoring system. This may be wearable similar to smart watch or could be embedded in the bed of the COVID-19 patients. Biomedical signals can provide information about an individual's health, so much information could be gathered, and necessary inference could be drawn out of observation. The various biomedical signals that could be sensed to detect the COVID-19 includes heart rate, SPO2, CO2, temperature, blood pressure, etc. Machine learning techniques could be deployed to identify the COVID-19 patients out of a large amount of data through measuring the health parameters, storing on the cloud with the help of IoT. The integration of machine learning with IoT is going to be advantageous in many ways. IoT technology would help the health authorities segregate the patients who require immediate treatment and few others that could be home quarantined, thus preventing the giant patient bubble at the hospital/ community health centres. The IoT-based smart health monitoring system could reduce the requirement of O2 in hospitals. This system could also be integrated with GPS chip to track the recovered patient location. As the lockdown has opened in most countries, individuals in the offices, hotels, educational institutes are physically in contact, thus increasing the chance of COVID- 19 infections and moving toward the 3rd wave of the pan- demic. So, in such a scenario, data of the individuals is shared with the health authorities, and the possible infected persons could be quarantined promptly. An automated health monitoring system is to be developed that reacts or creates an alarm in the critical situation of the patient. The data are analyzed through Node MCU microcontroller to send messages via email and twitter to the doctors and concerned people. Additionally, it also records and maintains the earlier diagnostic information regarding the patient health. The patient's actual condition is sent through online portal to the medical professionals and the appropriate treatment can be taken to cure the patient . The smart patient health tracking system involves the installation of the heart rate, temperature and humidity sensors to be placed in the room to track the condition of the patients. After processing, all the values are sent to the doc- tor to check the state accordingly . The signals of sensors such as temperature, EEG and heart beat readings are passed through amplification and signal conditioning system to raise the gain of the signals. Using any microcontroller like Arduino or Raspberry pi or beagle bone black, data can be sent to cloud platform for storage and analysis . The IoT-based system is capable of providing real-time information about the patient parameters, as the internet is a prime communication channel, the security of the cloud and data is one of the challenging issues . With the advancement of internet technologies like cloud computing, edge computing, fog computing, the wearable healthcare monitoring system could be seen in everyday usage in the coming years . The measurement of biomedical signals with the various sensors is a prerequisite in the development of a health monitoring system, that may be utilized for physical rehabilitation and real time tracking of disabled individuals . Portable biosensors integrated with wearable smart devices can provide the record of the individual daily activities and assist in managing the health and thus prevent the complications in the life-related diseases of the individual. The other key challenge in the development of a smart health monitoring system is the personal health dashboard (PHD), through which the biomedical data collected by sensors is easily accessible to the physician and team of specialists for evaluation and analysis purposes. A similar PHD was developed by Brahmni et al. in which a cloud based system is deployed to manage the big data of patients to monitor and detection of presymptomatic COVID19 . The key challenge is to deploy the IoT system with encryption and high level of security to safeguard the data from breach. The other key challenges to store the large chunk of patient data on the cloud from where the data could be retrieved without latency issues. The novelty of this system is that it could be deployed on the individual patient's bed and a real-time data of patients could be shared with physicians with the help of an internet-supported smart device. This health monitoring system could also be transformed into a wearable device to monitor vital health parameters, thus helping take preventive measures against COVID-19 and other diseases.

## 2. LITERATURE REVIEW

Many researchers have carried out the work for the prediction of health using smart healthcare IoT. Hamizah Anuar et.al. discussed the development of wearable CBT (Core Body Temperature) sensor device based on a single heat flux concept. Experiments have been done with the sensor on the various parts of the body and the most reliable CBT estimation is experienced on the forehead because there is lowest mean difference of about 0.05 °C between CBT sensor and clinical thermometer . Po-Wei Huang et.al. demonstrated the use of the algorithm based on Neural Network Regression to increase the length of the distance range between 50 and 100 cm. The automatic face tracking feature requires the human face should be focused appropriately while measuring. The information and results can also be viewed through App and Web . Rahaman et al. discussed the different types of smart health monitoring systems and focused on the advantages and shortcomings of the technologies deployed in health care systems . Huang and co-workers have developed a wearable temperature measurement system that can be utilized in healthcare applications .

## 3. EXISTING SYSTEM

Traditional methods of monitoring COVID patients often involve periodic manual checks by healthcare profession als, leading to delays in detecting deteriorating health conditions. This approach is resource intensive and may not provide realtime insights into critical parameters. The lack of continuous monitoring hinders the ability to respond promptly to emergencies, resulting in suboptimal patient care.

## 4. PROPOSED SYSTEM

The proposed "COVID Patient Health Monitoring System using IoT" aims to overcome the limitations of the existin g manual monitoring system. Key features include:

1.Wearable Health Sensors: Utilizes wearable sensors to continuously monitor vital signs such as heart rate, temperature, and oxygen saturati on.

2. IoT-enabled Data Transmission: Integrates IoT devices for real-time transmission of health data to a central monitoring system.

3.Alert Mechanism: Implements an alert system to notify healthcare professionals of any abnormal readings or critical changes in a pa t ient's health status.

4. User-friendly Interface: Develops a userfriendly interface for healthcare providers to monitor multiple patients simultaneously, view histor ical data, and set personalized thresholds for alerts.

## 5. RESEARCH METHODOLOGY

IoT-based health monitoring system differs from the normal healthcare system in a very efficient way. Therefore, it becomes a bit challenging to achieve the required results and performances through IoT. Working with IoT is related to the embedded world as the sensors use electronic data signals. Initially, devices such as sensors, detectors, monitors and microcontroller are connected altogether for synchronization. The sensors and detectors detect the signals in analog form, which needs to be further converted into digital form. The inbuilt analog to digital conversion is performed through the microcontroller to get data in proper digital for- mat. The data are sent to Raspberry Pi that is being used as a microcontroller. Nowadays, the Raspberry Pi is most commonly and widely used in Internet of Things. After the conversion of data, storage of data is performed. The data are being sent to the cloud or server. In this research, a local server is used, which shows the variations of the values or the readings measured simultaneously. The working of the proposed work is shown as block diagram in shows the flowchart of the steps performed in the whole process. It shows the order of the workflow and steps in the sequential order, including the initialization, setting up of protocols successfully, reading sensor values accurately, sending measure values to display monitor and cloud server to store sensor data. Hardware Materials Used The system consists of two parts: the equipment and the mobile application. Both parts are fundamental to the system. The health monitoring system can measure oxygen saturation, pulse rate. This multifunction system requires several components to be implemented. Implementation is achieved by performing activities portrayed in a work arrangement. For making the system successful, design implementation plays an important role. The components required to execute this system are briefly described below. Table 1 lists the required hardware components, their quantities, and the cost of the products. The total cost of the hardware components for this system is 6120 Bangladeshi Taka, which is equivalent to 71.50 US dollars.

**NODE MCU**

We used the node MCU ESP8266 for this system, which is a wireless module, because the ESP8266 microcontroller has Wi-Fi capability, and the node MCU has a wireless system that can send data to a server. The node MCU has an asynchronous receiver-transmitter serial communication module, which enables it to communicate with the Bluetooth module. The node MCU ESP8266 microcontroller can operate with a power supply of 3.3 V operating voltage and a 7 to 12 V input voltage. It has a flash memory of 4 Mb and an SRAM of 64 Kb. It has 16 digital input and output pins and one analog input pin. The node MCU also has a PCB antenna [30]. The node MCU wireless module sends the measured pulse rate, oxygen saturation, and temperature to the server. This component was chosen because it links the server IP address to the node MCU to obtain the measured value through a mobile application. The node MCU is an open-source Lua-based firmware and an advancement board. It is specially designed for IoTbased applications, and this component plays a vital role in our system. Figure 7 shows the prototype of the node MCU ESP8266 microcontroller

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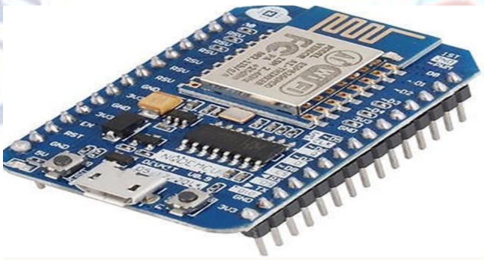

**Figure 1.**NodeMCUESP8266

**PULSE SENSOR (MAX 30100)**

MAX30100 is a sensor that can measure blood oxygen saturation level and pulse rate. Figure 5 shows the prototype of the SpO2 Pulse Sensor (MAX30100). Saturation of peripheral oxygen (SpO2) is a calculation of blood vessel oxygen saturation, which refers to the amount of oxygenated hemoglobin in the blood. In a human body, ordinary SpO2 values range from 90to 100%. In this system, a MAX 30100 pulse oximeter was suitable. It is a coordinated beat oximeter and heart rate sensor arrangement, which provides precise values. This sensor combines two LEDs, a photo detector, optimized optics, and low-noise analog flag handling to identify beat oximetry and heart rate signals; hence, it is suitable for this system.


**Figure 2**. Pulse Sensor(MAX30100)

**5. DESIGN OF SYSTEM**

The whole workflow consists of the three main steps: data capturing, data processing followed by data storage, and displaying patients' parameters on the monitor. Data capturing is the most important step as the precision and accu- racy of measurement system depend solely on this step. In data capturing, the sensors to be used are connected with microcontroller i.e. Raspberry Pi. The sensor outputs are connected with the GPIO pins of Raspberry Pi, which have been selected. The output pin of BP sensor i.e. Tx pin is connected with the Rx pin of the Raspberry Pi. After mak- ing the hardware connections, the power supply of + 5 V is given to the microcontroller and to the sensors. The SMPS based power supply is used for powering the raspberry pi module as well as the various sensors. The maximum power consumption of whole system is 7–8 W as raspberry pi could be configured in power saving mode when no data trans- mission is taking place with Wi-Fi. All the sensors used for measurement and data acquisition are IC based which takes small value of load current. The efficiency of power SMPS used to power up all the devices is relatively high (80–85%), some of the efficiency is lost in heat dissipation. The developed system could be scalable to optimally monitor five patients simultaneously with different biomedical sensors for each patient.

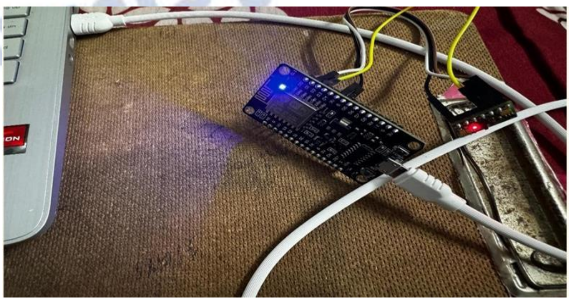

**Figure 3:** biomedical sensors

**Data Capturing**

Initially the sensors which are to be used are connected with microcontroller i.e. Raspberry Pi. The sensor outputs are connected with the GPIO pins of Raspberry Pi which have been selected and configured as input. The output pin of BP sensor i.e. Tx pin is connected with the Rx pin of the Rasp- berry Pi. After making accurate hardware connections, the power supply of + 5 V is given to the microcontroller and to the sensors. The MLX90614 noncontact temperature sensor is placed near the human body and it detects the temperature of patient. The BP sensor is wrapped around the arm and it gives three different values or data to the microcontroller. In these values, first one is systolic, second is diastolic and third is pulse rate which are to be fed to the Raspberry Pi for processing.

**Data Logging**

This is the last step in the design of the system. In this step, the communication channel on ThingSpeak is created for data logging.

1. Signup for ThingSpeak.
2. Creation of own channel.
3. Getting API Key in ThingSpeak
4. Making file of python code with.py extension.
5. Run the python code.
6. See the values of sensors on the screen output.
7. Check ThingSpeak site for Data Logging.
8. Chart on the ThingSpeak channel which shows the various graphs according to the varying values..

The outputs of the sensor values captured by Raspberry Pi are now sent to the display monitor to view the corresponding values. By creating channel on ThingSpeak, the required information is displayed on the screen and at the same time is stored on the cloud for maintaining further records. In this way, the required information is displayed on screen and at the same time is stored on the cloud which can be retrieved by the doctors for future analysis. The data from the cloud can be easily assessed by other users and researchers.

## 6. RESULTS & DISCUSSION

The designed prototype is tested on different patients or subjects to obtain the performance of health monitoring system. For performance analysis, four patient parameters i.e. heart rate, body temperature, blood pressure and SPO2 were measured. The efficacy of the system can be evaluated by comparing the measurement data with commercial sensors available.

**Table 1:** Comparison of data values measured by Heart rate sensor and commercial sensor

| Number of samples | Actual bpm | Observed bpm | Relative error (%ε) |
|---|---|---|---|
| D1 | 68 | 69 | 1.47 |
| D2 | 69 | 71 | 2.89 |
| D3 | 70 | 70 | 0.00 |
| D4 | 72 | 70 | 2.77 |
| D5 | 71 | 73 | 2.81 |

**Table 2** Comparison of developed SPO2 system with commercial oximeter

| Number of samples | Actual SPO2 (in %) | Observed SPO2 (in %) | Relative error (%ε) |
|---|---|---|---|
| D1 | 98 | 98 | 0.00 |
| D2 | 96 | 97 | 1.04 |
| D3 | 97 | 97 | 0.00 |
| D4 | 98 | 99 | 1.02 |
| D5 | 95 | 96 | 1.05 |

**Table 1:** illustrates the comparison of measured data of heart rate with the commercial sensor

. The relative error was found to be in the range of 0.00–2.89. shows the plot between the relative error and the number of sub- jects. The patient's body temperature was measured with MLX90614 sensor and was compared with a commercial noncontact sensor. (Table 2). The maximum relative error was found to be 1.05 which indicate the high accuracy of O2 measurement system The snapshots of the ThingSpeak online server storing the patient's data The prototype of a smart health moni- toring system can be placed and installed on the bed of the COVID-19 patient. The real-time measured data are col- lected, stored and deployed to cloud. From the cloud application ThingSpeak, the doctors/physicians can access the data related to a particular patient. An online access point link is to be shared with the nurse and doctors for monitoring purposes. This link could be opened from any smartphone, smart-tablet or internet-connected computer. Each patient is identified with unique identification number generated when a patient is admitted for observation and treatment. Even the COVID-19 patient can be removed from the COVID ward when all the patient parameters are under the limit. This type of system would assist the doctor in deciding the treatment of COVID-19 patient. The limitation of this system is that the same set of sensors are to be used for measurement purposes.

The other major limitation of this system is the security as data spoofing could be done. So, a separate cloud with encryption-based technology could be required to make the whole system highly secure. The data would be encrypted before it is shared with any of the physician/ doctor. A future upgrade would be the prescription of the patient could be linked to its country identification id or health card digital id. For individual patient monitoring, separate pair of biomedical sensors are to be deployed to individual COVID-19 patient's bed.

The added advantage of this system is that this system can be even deployed to non- COVID-19 patient treatment, and the cost of this system is relatively low. This smart system can reduce the burden on the hospitals and physicians, which ultimately helps in the early detection and treatment of COVID-19 disease. This developed system would be beneficial to a large society as the people from low-income sections are mainly dependent upon the Government hospitals and large number of these systems due to its low cost, could be deployed with much ease and could assist the patients.

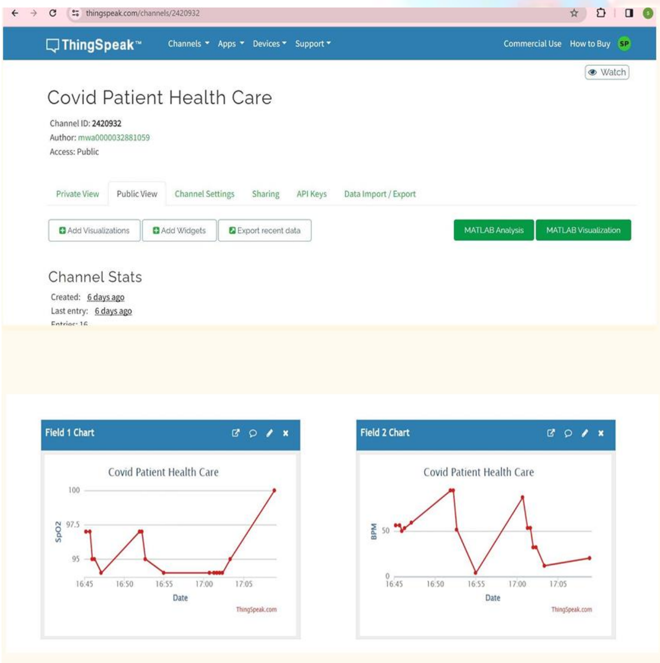


**Figure 4**:Graph Representation

## 7. CONCULSIONS

The COVID-19 pandemic has resulted in a global health crisis as thousands of people die from the disease every day. The fatality rate can be minimized if proper treatment is administered at the right time. Various steps, including regular monitoring of pulse rate, SpO2 level, and temperature, have been taken to ensure proper treatment. However, the oxygen level of a COVID-19 patient decreases with time, and the patient can die shortly if emergency steps are not taken. Considering the abovementioned facts, an IoT-based smart health monitoring system was developed for COVID-19 patients. The system runs through an IoT-based mobile application, and both the doctor and the patient can receive alerts from this system during emergencies. Therefore, individuals can use this system effectively anywhere. Advanced features can be added in the future because the entire system is IoT-based. Moreover, this study broadly explores the components utilized within the system and the usefulness of each component. It provides a list of strategies that can be actualized to plan this system. From the beginning of the development of this system, we aimed to develop a well-organized application-based device that could be used in the current pandemic. COVID-19 patients and people enduring numerous other infections like chronic obstructive pulmonary disease (COPD) and asthma can use this gadget. The system is cost-effective, noninvasive, and versatile in nature, which makes it easier to screen patients' well-being regardless of where they are. Additionally, it provides real-time alerts to concerned individuals and medical experts about any circumstance that requires prompt consideration. This system can offer assistance to guarantee appropriate medical care all over Bangladesh, including in rural zones, thereby decreasing the number of patients. Early distinguishing proof of any medical condition can help the patient to take essential critical measures, which can possibly save the patient's life. Therefore, to make all lives risk-free, we must use smart health monitoring systems. To conclude, this system is extremely important in the medical sector because it can help increase the life expectancy of people worldwide. In the future, more sensors can be added to this system to monitor more physiological parameters of the human body.

### Conflict of interest statement

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

## References


[1] N. El-Rashid, S. El-Sappagh, S. M. R. Islam, H. M. El-Bakry, and S. Abdelrazek, "End-to-end deep learning framework for coronavirus (COVID-19) detection and monitoring," Electronics, vol. 9, no. 1439, pp. 1–25, 2020. View at: Google Scholar

[2] D. Hongru and T. Goyea, "Novel coronavirus (COVID-19) cases. Johns Hopkins University, Baltimore, Maryland," 2020, https://coronavirus.jhu.edu/. View at: Google Scholar

[3] "Hypoxemia: Symptoms, Causes, Treatments. Cleveland Clinic," 2020, https://my.clevelandclinic.org/health/diseases/17727-hypoxemia. View at: Google Scholar

[4] 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.

[5] 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.

[6] 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).

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

[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., 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.

[10] 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

[11] 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.

[12] 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

[13] 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.

[14] 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.

[15] 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]

[16] 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

[17] 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.

[18] 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.

[19] 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).

[20] 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.

[21] 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.

[22] 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.

[23] 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.

[24] 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).

[25] 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.

[26] 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.

[27] 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.

[28] 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.

[29] 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).

[30] 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

[31] 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

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

[33] 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.

[34] 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,

[35] 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.,

[36] 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

[37] 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.

[38] 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).

[39] 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.

[40] 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.

[41] 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.

[42] 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.

[43] 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.

[44] 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.

[45] 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).

[46] 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.

[47] 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.

[48] 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.

[49] 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.
[50] 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.
[51] 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.
[52] Vellela, S. S., Sk, K. B., & Reddy, V. An Intelligent Decision Support System for retrieval of patient's information.
[53] 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
[54] 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.
[55] 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.
[56] 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