IoT based Covid-19 Patient Monitoring System: A Review

Dr. S.V. Sonekar
Department of Information Technology
J D College of Engineering and Management, Nagpur, India
srikantsonekar@gmail.com

Ekta Paraswani
Department of Information Technology
J D College of Engineering and Management, Nagpur, India
ekunp99@gmail.com

Vidhya Nimje
Department of Information Technology
J D College of Engineering and Management, Nagpur, India
vidhyanimje2000@gmail.com

Vinita Larokar
Department of Information Technology
J D College of Engineering and Management, Nagpur, India
vinitalarokar21@gmail.com

Krushna Malthankar
Department of Information Engineering
J D College of Engineering and Management, Nagpur, India
krishnamalthankar@gmail.com

***Abstract*— The Internet of Things (IoT) - based basic health monitoring systems could be extremely beneficial and much more valuable for the patients who are suffering from major decease just like corona virus. Not only to the patients but it will also help doctors in a more ordered, sufficient and a much more better way. The data that is to be collected by the sensors would be given immediately to the team of doctors, this will indirectly minimize the regular doctor visits. Reduction in regular doctor visits will also help the doctors in getting less infected from the patients. This system's IoT-based platform helps in the remotely transfer of the real-time data of a particular admitted patient directly to the host's system. The doctors can immediately identify any type of changes in the level of oxygen or the temperature that will be kept by notation on the basis daily-based health records and continuously displaying it on graphs. This research would provide an IoT-based real-time health monitoring system that will use the body temperature, heart rate, and oxygen saturation observation of a patients' body, which are toady defined as the most crucial parameters for anyone's critical care. The continuously observed temperature, heart rate, and the oxygen required level will be shown on an LCD display, which is synchronized with a mobile application for a much more rapid access. During the COVID-19 pandemic, these type IoT-based gadgets would have been extremely useful and not only in covid times but also many such virus that are at the peak today would help in saving several lives.**

***Keywords*—BP & Heart Rate Sensor, Temperature Sensor, IOT Healthcare, Active Health Monitoring, COVID-19 Healthcare.**

1. INTRODUCTION

Observing the Covid – 19 pandemic, we tried up to dedicate IOT-based health monitoring system to treat the COVID patients. As the covid was highly infectious (especially in India), it became critical to isolate the covid patients and appoint them with the nurses and doctors to get them a continuous health check-up at regular intervals of time. With the certain increase in the number of covid cases, keeping a regular track on the health problems of several isolated patients had been a much more difficult task[1].

Although patients were offered with the knowledge in order to solve their own health concerns but it wasn't enough as the doctors were getting affected by it too. While providing the best as per as a doctor can, they had to also suffer from covid as they were in regular contact with the patients whom they were treating. And then certainly we saw a serious short of doctors too[3][4]. Observing this certain and a sudden dip in doctors we tried to make better use of technology to improve the above described situation.[5]

As a person enters in their old age, it becomes vital for them at regular interval to undergo from standard medical health check-ups[6][7]. Though it may be their precious time- consuming and prove into difficult task for most of the people to get their regular health check-ups, this IoT-based system can be beneficial to reduce the time required for individual's routine health check-up. Today the IoT technology has been developed into a massive and a much more imperative innovation with several applications innumerous fields[8].

Specifically, IoT that refers to any system of the physical devices that may obtain and exchange their researched information over a speeded up wireless systems and that too without human involvement[10][11].

Today the health-care sensors and microcontrollers have become most important part in detecting and monitoring the physiological characteristics in a particular human body. To address such type of discussed issues, our system will provide the patient's knowledge and information regarding disease diagnosis in real time. Secondly, there would be a need for a dependable and easily accessible patient's health monitoring system[12][13][14].

We can make a better use of this IoT-based technology to improve the above described situation[15].

The sensors and the innovative micro controllers used for the health care have become an important factor in recent years. Physical contact with a human body just for the purpose of monitoring their physiological parameters would be reduced, with the various available sensors, actuators, and latest technology. We can measure a patient's almost every parameter (such as the temperature, pulse rate, heart rate, etc.) in our patient monitoring

information of a particular person, which can then be system [16]. These latest technology occupied sensors can help in capturing the data for such as biometric sent to the Arduino and further also to a subsequent server[18]. Our major goal is focused on to create a Remote Patient Health Monitoring system that can much more easily used to diagnose a patient's health which would be without having a direct physical touch with them [19]. In this situation, providing the people with a proper healthcare assistance who were covid affected had become one of the most difficult challenges, as many of our doctors, nurses, and medical staff were contracting with this the virus and as a result of having a physical contact with the contagious patients, putting their lives at a very high risk [20]. The appropriate deployment of such type of health monitoring devices may provide a safer side to diagnose a home and also a hospital isolated patient whose physical conditions can be monitored on a regular interval basis, necessitating this requirement for a slightly cost effective but a very much fast- responding alarm mechanism[21]. The Internet of Things (IoT)platform is a very much promising technology in order to achieve such types of healthcare services, and it has a high potential to improve the also in medical service platforms even more. IoT wearables can be used to gather all the necessary data of the patient and transmit it wirelessly in real-time, where it can be analyzed or saved in order to track the patient's medical history[22].

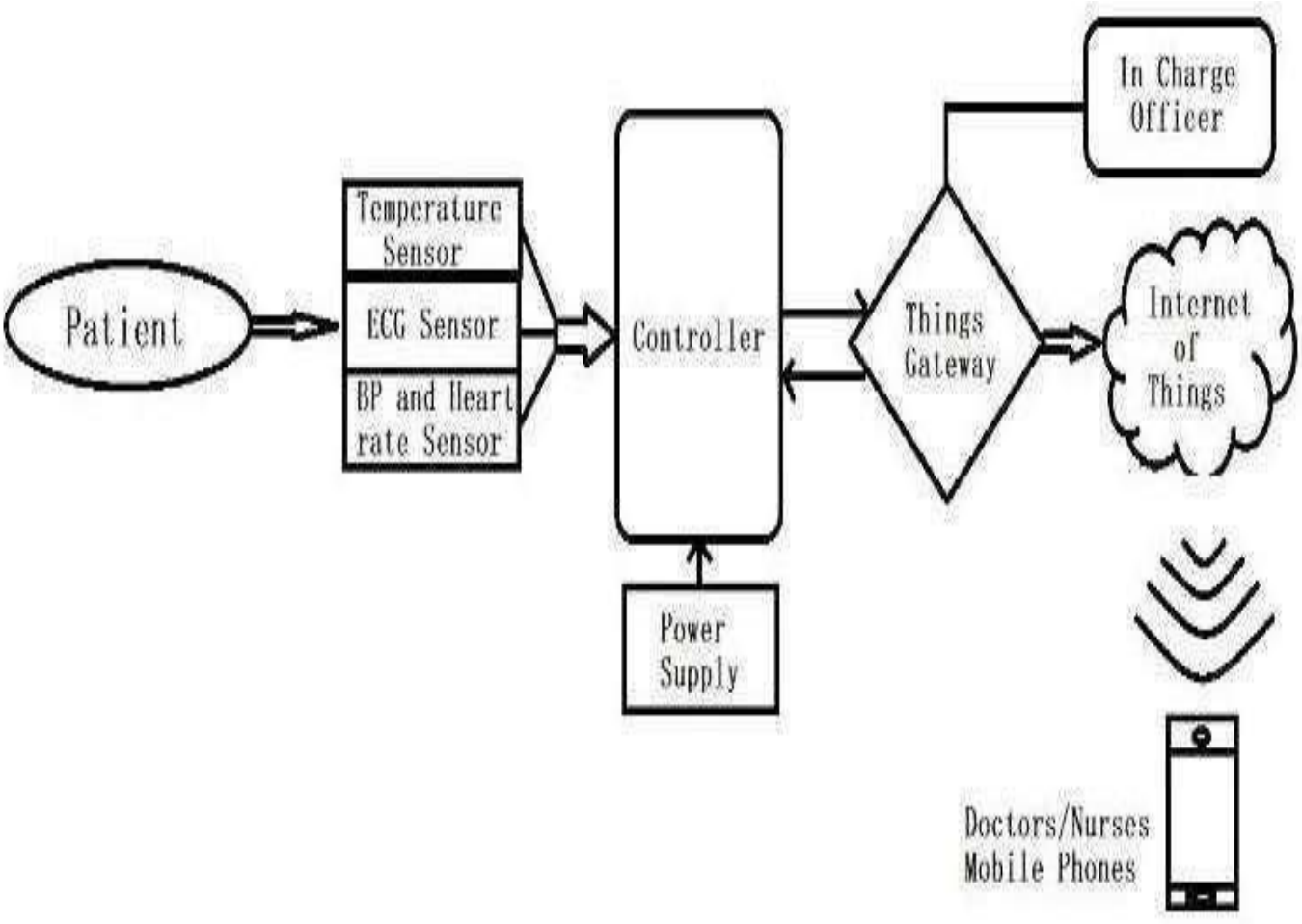

Figure 1. Block Diagram

2. METHODOLOGY

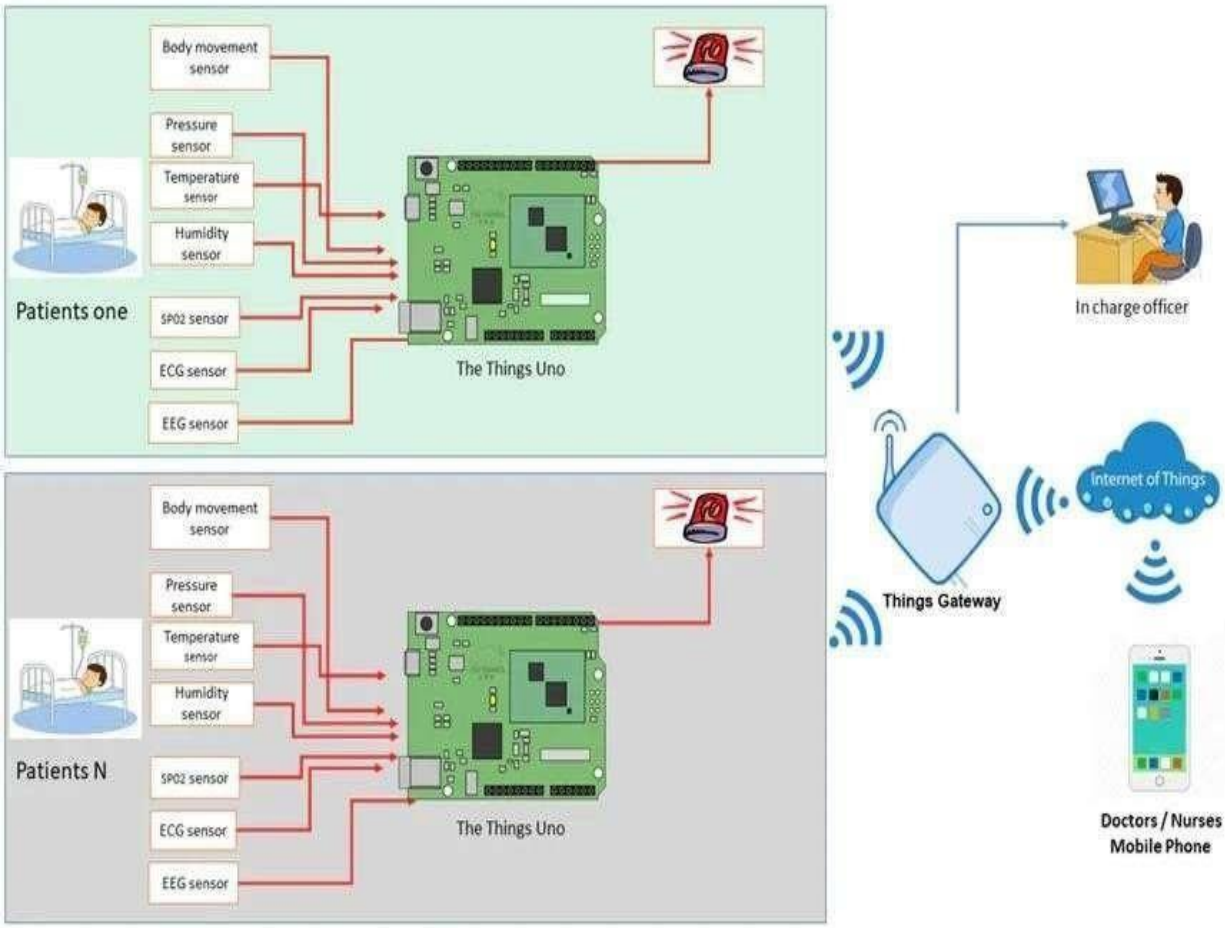

Figure 2. Proposed Methodology

This device will use the body movement sensor, pressure sensor, humidity sensor, SPO2 sensor, ECG sensor, EEG sensor oximeter sensor and temperature sensor which gives the proper values to the controller. Normally, in general condition SpO2 gives range form 95- 97 and temperature from 36-37. The values that will be recorded will be then uploaded to Blynk so they can be easily viewed from anywhere using internet and the access to that information [5][6]. That person must follow the practice of hand hygiene such as washing their hands for at least at a regular interval of 20 minutes. Placing a fingertip on the MAX30100 Oximeter sensor and placing a finger on the LM35. Temperature sensor for measuring the appropriate parameters respectively. These sensors will start recording the data and send it to Node MCU. The Node MCU will transmit the collected data to the mobile phone using a Wi-Fi module. In the Blynk app 2 labeled value widget and one Super Chart will be used to display the collected data. This collected data will be received by the mobile that has an active internet and will be displayed in the Blynk app. The normal body temperature should always range from 36- 38°C and a normal oxygen level (SpO2) level should always range from 95-98%. If the readings are above or below these specified ranges for a long period time then the patient would require a proper medical attention. Then accordingly, the medical staff will take further actions [8][12].

Upon activation, the device begins to measure various health parameters, including temperature, pulse rate, and SpO2, and then transmits this data to both the Arduino Uno and Node MCU. From there, the Node MCU sends the collected data to a designated server for safekeeping. In the event that the measured oxygen saturation falls below 95% or the pulse rate is outside the normal range of 60 to 90 beats per minute, the system is designed to send an alert to both the patient and their doctor. This alert serves as a crucial safety net, helping to ensure that the patient receives prompt medical attention when necessary. Users can access the real-time data on both a mobile application and the device's built-in LCD display, providing a convenient and accessible way to track their health status.[15]

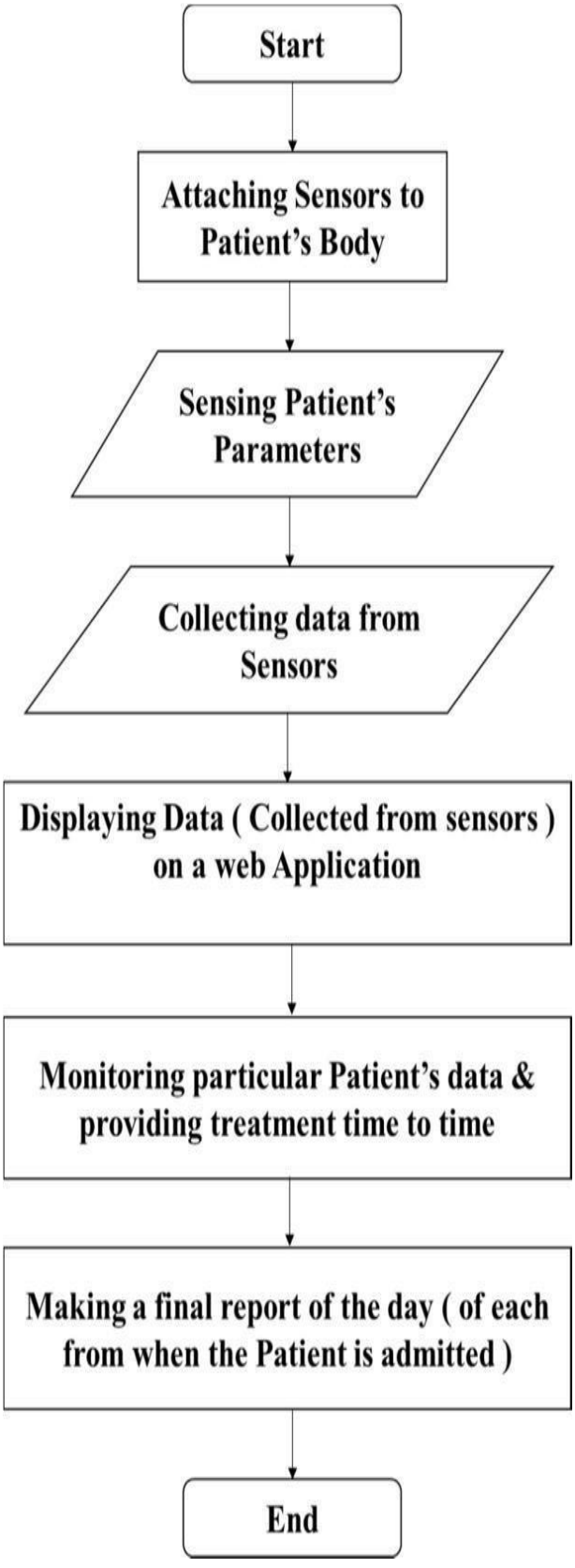

Figure 3. Flow Chart of Covid-19 Patient Monitoring System

3. ALGORITHMS

This proposed algorithm is a much hybrid fusion technique between the feature fusion level and the decision fusion level that is concerned for determining the anomalies to improvise the decision-making quicker and also simultaneously using the hybrid technique that was illustrated for making a much better decision that would be based on adding extra new features from the data and also fusing the decisions from monitoring in each and every sensor [1][2]. This proposed system enables to classify patients in the risk level and make decisions concurrently. It also predicts each patient's evolution case based on a remote monitoring process by using mobile application. The algorithm includes the main six layers.

3.1 Cleaning Data Layer: The nature of time-series data usually includes several noisy data or missing data. So, this layer will target on ensuring the best quality of the input data by ignoring missing data, filtering anomalies or fixing structural errors, and determining error readings. It would also be able to determine the duplicate observations and ignorance to irrelevant notifications. This layer is very much important to make the system highly reliable upon. The steps of this layer are:
Check on the empty records or the terms in each cell.
Check on duplicate records
Check on noisy data
Check on the unstructured data to convert it into a suitablestructure for the dataset [5][6].

3.2 Anatomy Detection Layer: The previous layer can filter anomalies or readings errors. These identified anomalies mean identification of certain rare events that would be happening and affected by the other observations. They will usually require making decisions quickly and concurrently. This classifies something different to improve the forecast of patients. Algorithm describes the main steps of anomaly detection [9].

3.3 Features Layer: The features layer refers to the interaction between extraction features. It will delete the redundant and unused features and the extracted features would be an appropriate medical and require expert knowledge. The combination of these two features can interpret with a new feature for improvising the best results and decision making[12]. To keep an integral part of the respiratory rate and heart rate for a proper standardclinical estimation of people or children presenting. The emergency cases would be identified based on their outranges based on these parameters. Finding each person's age has a different normal range of heart rate and also the respiratory rate [13][14].

3.4 Prediction layer for each patient's case evolution: Artificial intelligent technique is used for monitoring patients and their case evolution. Long- short term memory (LSTM) is a deep learning technique for a highly sequenced data. This layer is completely based on LSTM to predict the future case studies for each patient based on previous disease readings [15][17].

3.5 Fusion Layer: There are several fusion techniquesbut this research applies the Dumpester-Shaferfusion [19].

3.6 Visualization Layer: The physician may be finding concurrently. So, visualizing the data is a very much important layer to classify the serious condition levels for the patients (high risk,medium, low) that may use colors (for example, red color for high-risk cases, yellow for medium risk cases, green for the normal rate or low-risk cases) to get attention from doctors quickly to improving decision making but simultaneouslyaccurate [21][22].

4. LITERATURE REVIEW

Health Surveillance Solutions this study will provide a mechanism to monitor the provision of patient healthcare while they are in quarantine. Additionally, give permission for doctors and family members to keep an eye on your health from a distance. The improvement of the healthcare needs in the developing world will be of the utmost importance in the near future [1]. The significance of Covid- 19 as an infectious agent distinguishes covid-19 people, and also, medical examiners must consider the fitness of covid-
19 sufferers. Utilizing inspiring language circumstances make it challenging to stay up with the health and wellbeing issues of various divorced people can be heard folks. An example of the suggested Wi-Fi is shown below [5][6]. Using sensor network technology, a gadget. I used to gather and transmit often. A buzzer will ring when the patient touches the emergency button. be reachable. The coronavirus outbreak (COVID-19) claimed the lives of billions of individuals, many of whom had already been seriously ill. The keys to lowering the spread and fatality rate are isolation and continued care. New developments are being made in the Internet of Things (IoT). opportunities in several systems, such as smart cities, etc. It provides a useful approach for continual patient observation via attentiveness when paired with machine learning. a patient health system based on the Internet of Things A monitoring system was set up using an Arduino. control. An oxygen meter, a temperature sensor, and a heartbeat sensor are all components of the recommended Arduino-based solution. Support SVM or Vector Machines-Based Machine LearningAlgorithms as well [7].

The use of the Internet of Things (IoT) to provide health services has garnered a lot of attention in the literature. IoT application in healthcare systems was the subject of a thorough literature review by Usak et al. Along with a classification of the examined work in the literature, that paper also discussed the primary difficulties in using IoT to offer health services [8]. Wu et al. a hybrid IoT safety and health monitoring system was presented. It was intended to increase outdoor safety. The system has two levels, with the first layer collecting user data and the second layer aggregating that data through the Internet. Wearable technology was utilised to gather user health information and environmental safety indicators [9].Hamidi researched IoT smart health data authentication to safeguard the security and privacy of patient data. A biometric-based authentication method was suggested in thepaper [10].

Inspired by the book, Rath and Pattanayak developed a smart healthcare facility employing IoT technology in metropolitan settings. In the VANET zone, topics including patient care timeliness, security, and safety were explored. Simulators like NS2 and NetSim were used to evaluate the proposed system [11].

Based on the pertinent literature, Darwish et al. suggested a Cloud IoT-Health paradigm that unifies cloud computing with IoT in the field of health. The paper discussed new Cloud IoT- Health trends as well as integration challenges. Three categories—technology, communication and networking, and intelligence—are used to categories these problems [12]. Zhong and Li investigated how college students were observed while engaging in physical activity. The Physical Activity Recognition and Monitoring (PARM) paradigm, which calls for data pre-processing, was the main topic of the article. There have been tests and discussions of a number of classifiers, including decision trees, neural networks, and SVM [13].

An IoT-based smart health monitoring and management architecture was presented by Din and Paul. The architecture is made up of three levels: application layers, Hadoop processing, and data production via battery-operated medical sensors. The experiment adopted an energy-harvesting strategy employing piezoelectric devices connected to the human body due to the restricted capacity of batteries to power the sensors [14].

Nguyen presented an overview of the artificial intelligence (AI) techniques applied to the COVID-19 project. The utilization of IoT was included in this work's classification of these techniques into several groups [15]. Maghdid suggested using smartphone sensors to gather health information, such as temperature [16]. To find potential COVID-19 cases, Rao and Vazquez suggested using machine learning methods. Through web surveys that can be accessed from cellphones, user data is gathered and used for learning [17]. Allam and Jones talked on the necessity to create uniform methods for information sharing between smart cities during pandemics, which was driven by the COVID-19 epidemic. For instance, AI techniques may be used to identify potential COVID-19 instances using data gathered from thermal cameras deployed in smart cities [18]. An IoT-based strategy to identify coronavirus cases was suggested by Fatima et al. A fuzzy inference system is the foundation of the method [19]. Peeri et al. compared MERS, SARS, and COVID-19 using the

literature that was accessible. They recommended use IoT to map the infection's spread [20]. A real-time blood sugar control prototype built on the Internet of Things was created by Otoom et al. The ideal insulin dosage was established using statistical models based on ARIMA and Markov chains [21].

An IoT-based system for the identification of cardiovascular disease was proposed by Alshraideh et al. For CVD detection, a number of machine learning methods were employed [22].

5. CONCLUSION

From the review of these inquiries we came across the knowledge about a particular mind- set of the originators to develop similar types of the systems using common advanced detectors like approx. to accurate temperature detectors, the Arduino as a microcontroller board, original waiters and the pall warehouses[1][2]. With this proposed IoT- grounded Covid19 case monitoring system, the croakers may fluently identify each and every case's real time data on the display examiner system at their cabins. The croakers would be suitable to separate between a case's data for previous values and current real time values[5][8]. The IoT also offers advanced chances to add fresh extraordinary features or advantages to this particular system. This system can also be controlled by a mobile IoT operation, and during extremities, the croaker can admit announcements from this system[13][16].. The entire system is IoT- grounded, has further sophisticated functions may be add numerous further in the future. The early identification of any health problem can help the case to take necessary exigency parameter measures, while will reduce health issues and unwanted deaths[21].

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