Sys Rev Pharm 2021; 12(5): 239-242
A multifaceted review journal in the field of pharmacy
E-ISSN 0976-2779 P-ISSN 0975-8453

Research Article

IoT Based Handheld Smart Health Monitoring System for COVID-19

Bennet Praba, Anuj Kakar*, Anushri Sharma

Department of Computer Science and Engineering, SRM Institute of Science and Technology, Chennai, India

Article History: *Submitted: 07.04.2021* *Accepted: 21.04.2021* *Published: 28.04.2021*

ABSTRACT

With the COVID-19 cases on the rise this project seems to effectively provide a cost effective and accurate solution for the diagnosis of the novel coronavirus among the mass public. This research paper presents the design and implementation of an IoT based project that is capable of recording the user's vitals such as Heart rate, SpO_2 and Temperature, all of which serve as important indicators of the novel coronavirus. Once recorded, the sensors then send the data over to the Arduino UNO microcontroller which in turn pushes it to private cloud server using a Wi-Fi module wherein the data can be used for various analysis and visualizations such as scatterplot, histograms and so on. A website then shows the entries made using the microcontroller along with the latest COVID-19 statistics and WHO guidelines that have been provided. The results at the prototype stage look really promising and provide a foundation for the project to be scaled upon on a larger scale since the project helps us to curb the virus by introducing viable monitoring methods which can serve as replacements to the traditional and more expensive alternatives.

Keywords: IoT, COVID-19, Microcontroller, Cloud, Data visualizations

***Correspondence:**

Anuj Kakar, Department of Computer Science and Engineering, SRM Institute of Science and Technology, Chennai, India, E-mail: akakar47@gmail.com

INTRODUCTION

The numbers of COVID-19 cases in the world are still on the rise and the only logical way to tackle the problem. The virus has greatly caused economic and social disruption which is devastating. As of March 2021, the virus has led to 117 million cases and 2.7 million deaths worldwide, out of which 158 thousand deaths are from India Corona virus disease (COVID-19) is an infectious disease caused by the group of related RNA viruses. The main cause of transmission of the virus is through droplets generated when an infected person cough, sneezes or exhale.

Since the virus has pneumonia like symptoms is often misunderstood to be a common cold. Since the disease extremely communicable it has an exponential rate of spreading and hence created a pandemic raising the death toll to such extent that it has severely impacted over 185 countries in a matter of few months. The underlying architecture of this project basically consist of combination of hardware and software components wherein the Arduino, Nodemcu and various sensors contribute for the hardware aspect and the software component is subdivided into frontend and backend technologies (Mohammed MN, *et al.*, 2020).

The frontend includes HTML, CSS and JavaScript whereas the backend includes PHP and MySQL. The basic idea lies in the fetching of data from sensors and pushing it to a secure server on the cloud wherein it can be conveniently viewed by the person. Therefore, this project is basically focused upon delivering low cost IoT system which is not only accurate but steady and low on maintenance as well unlike its predecessors this system not only focuses on delivering accurate system but does that at a fraction of the cost of earlier system. This project facilitates the early detection of the novel corona virus (COVID-19) in order to deploy appropriate countermeasures thereby preventing the spread of the virus.

MATERIALS AND METHODS

Existing system

• The existing system basically puts forth the idea of a smart helmet that is essentially built upon the working flow of three subsystems due to the interrelationship between each other to perform the entire application.

• In addition, the necessary system's element, excluding module of decision making, are image processing module that is in charge of data processing of optical and thermal cameras. Furthermore, the specified task of collecting the required data is assigned to the smart helmet when needed (Priambodo R and Kadarina TM, 2020).

• The interfacing of a modular system that is based on IoT communication link and GSM is done. This system triggers a notification in case an abnormality is detected.

• Then the GPS module determine the position coordinates after tagging it and a notification is sent to assigned smart mobile through a GSM module.

Drawbacks

• The existing system which implements the use of a smart helmet inferior to the proposed one in terms of sophistication as the number of parameters taken in the proposed system are more than the existing system which is only responsible for recording the temperature.

• The existing system proposes the problem of high capital cost and high maintenance as well which makes it commercially unfeasible.

• The system relies on the use of facial recognition and thermal scanning and since thermal scanning is not an accurate method, it may produce false negatives in case of general fever.

• The constant logging of the GPS data along with the Facial recognition seems to take a lot of cloud overhead storage making the system slower and difficult to scale.

• The scalability of the existing model seems to be a problem considering the economic viability and sophistication of the system.

Proposed system

• The Proposed system consists of a robust microcontroller prototype that contains various sensors used to measure the user's vitals such as heart rate, SpO_2 and temperature.

- Once collected, the data is sent to the microcontroller (Arduino-UNO) which is responsible for forwarding the data to the connected Wi-Fi module (Nodemcu).
- The Nodemcu takes the data from the Arduino upload the data to a private cloud server which is handled and maintained by multiple PHP scripts in the background and stored in a database.
- The same can be accessed through a website designed specifically for the tackling and curbing the spread of COVID-19 along with mentioning the current statistics and ways to prevent the virus.

Implementation

The implementation of the system revolves around enhancing and improving the design of its predecessor by not only making it a more efficient and sophisticated system, but also ensuring that we make the system economically viable to serve as a solution. The system basically involves the collection of vitals from the user by means of dedicated sensors and uploading them to cloud server via Wi-Fi module where it is then stored into a SQL database for various types of operations and analysis (Hasan MW, 2021). The vitals can also be observed via a website that not only publishes the result of the vital records but also provides some important WHO COVID-19 guidelines *(Figure 1)*.

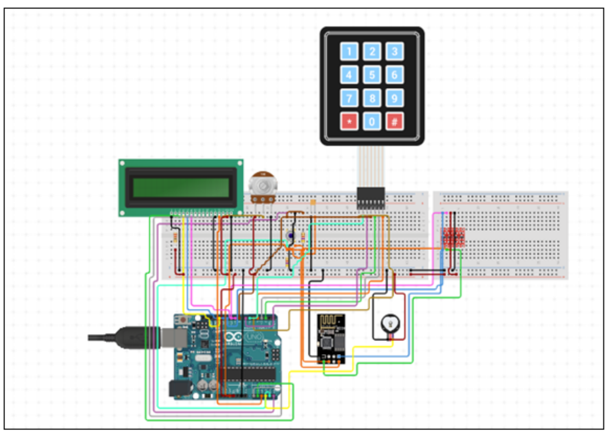

Figure 1: Circuit diagram

The circuit diagram gives us a basic idea of the circuit layout of the system.

The hardware used in the system contains the components mentioned in the table given below *(Table 1)*.

Table 1: Sensors used

S.No.	Component	Use
1	MAX30100	Detect heart rate, SpO_2
2	MLX90614	Detect Temperature
3	Arduino-Uno	Brain of the system
4	Nodemcu	Sending data to Cloud

The coding for the above system made use of Arduino which was used to program the Arduino-Uno microcontroller to record the data from the sensors and was also used to program the Nodemcu module to connect to Wi-Fi and transmit the data. This project also involved server-side PHP scripting to handle the data being send by the Nodemcu. At last, it also used HTML, CSS and JavaScript for the frontend development of the website (Arun M, *et al.*, 2020).

Architecture module

Since the project seems to be complex in nature it has been architecturally broken-down component wise, both software and hardware to have a better grasp about the architecture of the system. Hence it has been divided into six modules which can be seen from the diagram below *(Figure 2)*.

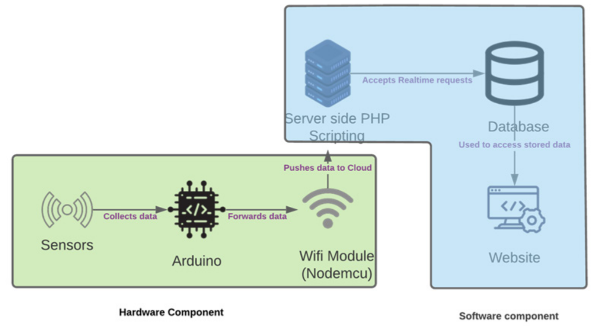

Figure 2: Architecture modules

Hence the architecture module diagram simply explains how the system works as a whole by depicting the workflow of the system right from the start where the sensors record data, all the way to the very end where the data can be seen on the specified website. The following modules work as individual modules following the chain of events for the efficient working of the system (Warsi GG, *et al.*, 2019).

Sensor reading module: It basically consists of intricate sensors such as MAX30100 and MLX90614 that are capable of recording various vitals of the user such as heart rate, temperature and SpO_2 levels which in turn are forwarded to the microcontroller.

Microcontroller module: It is the Arduino UNO microcontroller that basically acts as the brain of the system as it collects all the data and pushes it to the Wi-Fi module.

Wi-Fi module: It is the Nodemcu version 1.0 and it is responsible for fetching the data from the microcontroller and posting it to a dedicated cloud server each time a reading is made.

Server module: Consists of various dedicated PHP scripts that interface with the Wi-Fi module thereby collecting the data so that it can be stored for future use.

Database module: Basically, comprises of a specially designed database used for storing the data received from the module so that various operations and analysis can be performed on the same.

Website module: Acts as the front-end component of the project wherein it not only boasts an API integration for showing the COVID-19 statistics but also displays the readings from the sensor along with the guidelines from WHO.

DISCUSSION

The result of the designed systems can be studied and analyzed in great detail from the given graphs below which have been accessed from the website (corostats.in) *(Figure 3)*.

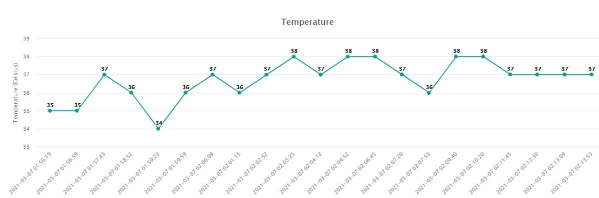

Figure 3: Temperature *vs* time

The above graph gives us an indication of a temperature *vs.* time graph wherein the temperature has been recorded using the MLX90614 sensor and has been plotted against the time stamped reading at which it was recorded (Mohammed MN, *et al.*, 2020). Thus, it gives us a general trend for the variation between temperature and time *(Figure 4)*.

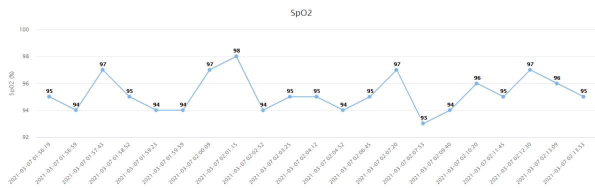

Figure 4: SpO_2 *vs* time

The above graph gives us an indication of a SpO_2 *vs.* time graph wherein the SpO_2 has been recorded using the MAX30100 sensor and has been plotted against the time stamped reading at which it was recorded. Thus, it gives us a general trend for the variation between SpO_2 and time *(Figure 5)*.

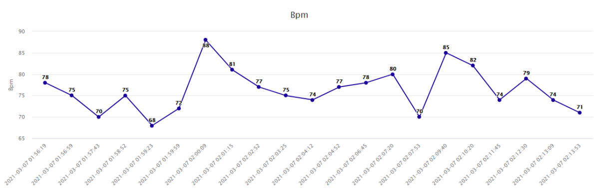

Figure 5: Bpm *vs* time

The above graph gives us an indication of a Bpm *vs.* time graph wherein the Bpm has been recorded using the MAX30100 sensor and has been plotted against the time stamped reading at which it was recorded. Thus, it gives us a general trend for the variation between Bpm and time (Krishnan DS, *et al.*, 2018).

The above trends were general in nature and were not id specific and hence for those purposes we can use the tools provided in the administrative section of the cPanel toolbar of the server that we are using. Hence the graphs below are obtained using the administrative account of the server that is being used and can only be viewed by the administrator *(Figure 6)*.

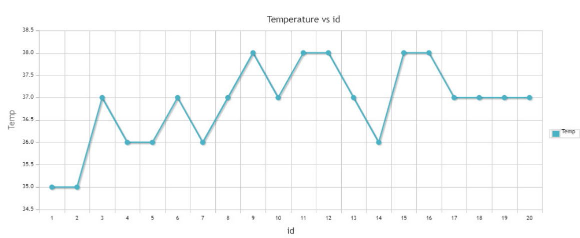

Figure 6: Temperature *vs* id

The above graph has been accessed using the cPanel toolbar and wherein we can see how the Temperature *vs.* id trends can be observed for each and every individual from whom the vitals have been recorded *(Figure 7)*.

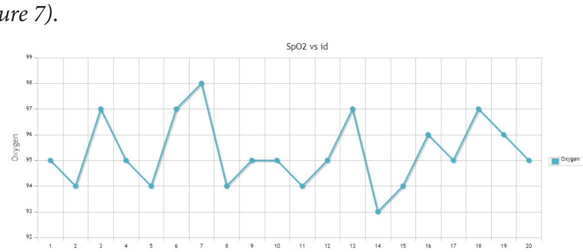

Figure 7: SpO_2 *vs* id

Just like the previous visualization the above graph has been accessed using the cPanel toolbar and wherein we can see how the SpO_2 *vs.* id trends can be observed for each and every individual from whom the vitals have been recorded *(Figure 8)*.

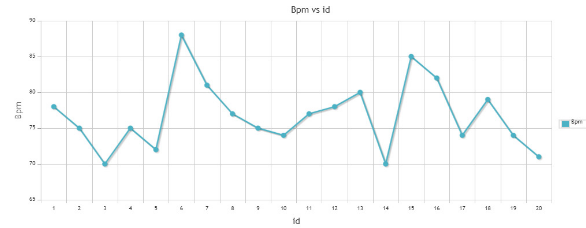

Figure 8: Bpm *vs* id

The above visualization too has been obtained from the same section of the cPanel by means of which the above graph has been accessed wherein we can see how the Bpm *vs.* id trends can be observed for each and every individual from whom the vitals have been recorded (Kumar GV, *et al.*, 2017).

The cPanel toolbar can also be used for plotting multiple values in the same graph in different manner which can be observed from the graphs given below *(Figure 9)*.

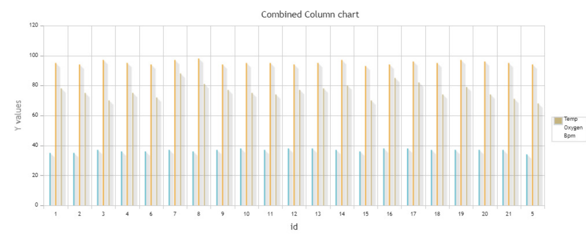

Figure 9: Combined Column Chart

The above graph is a combined column chart which includes all the parameters, namely Bpm, SpO_2 and Heart rate in a columnar fashion (Swaroop KN, *et al.*, 2019; Sinnapolu G and Alawneh S, 2018). The above parameters have been correspondingly plotted against the unique id of the user *(Figure 10)*.

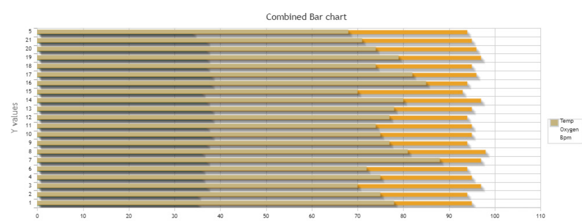

Figure 10: Combined Bar Chart

The above graph is a combined bar chart which includes all the parameters, namely Bpm, SpO_2 and Heart rate in a bar fashion. The above parameters have been correspondingly plotted against the unique id of the user just like the previous combined column chart (Valsalan P, *et al.*, 2020; Gómez J, *et al.*, 2016).

CONCLUSION

The main aim of the project is to provide a prototype which acts as a COVID-19 countermeasure by slowing down the spread. It is not only an informative project but also acts as a diagnostic tool that can be used to curb the virus. The project not only promises a certain degree of accuracy but does so at a fraction of its predecessors.

ACKNOWLEDGMENT

We would like to express our deepest gratitude to our guide Bennet Prabha without whose support this project would have never been possible. We also love to express our deepest gratitude to our college, SRM Institute of Science and Technology that not only provide an interactive and interesting curriculum but also provides us with a knowledgeable and helpful project mentor for the same.

REFERENCES

1. Mohammed MN, Syamsudin H, Al-Zubaidi S, Karim SRR, Yusuf E. Novel COVID-19 detection and diagnosis system using IOT based smart helmet. Int J Psychosoc Rehabil. 2020; 24(7): 2296-2303.
2. Priambodo R, Kadarina TM. Monitoring Self-isolation Patient of COVID-19 with Internet of Things. 2020 IEEE International Conference on Communication, Networks and Satellite. 2020; 87-91.
3. Hasan MW. Covid-19 fever symptom detection based on IoT cloud. Int J Electr Comput Eng. 2021; 11(2): 1823.
4. Arun M, Baraneetharan E, Kanchana A, Prabu S. Detection and monitoring of the asymptotic COVID-19 patients using IoT devices and sensors. International Journal of Pervasive Computing and Communications. 2020.
5. Warsi GG, Hans K, Khatri SK. IOT based remote patient health monitoring system. 2019 International Conference on Machine Learning, Big Data, Cloud and Parallel Computing. 2019; 295-299.
6. Mohammed MN, Hazairin NA, Syamsudin H, Al-Zubaidi S, Sairah AK, Mustapha S, *et al.* 2019 novel coronavirus disease (Covid-19): detection and diagnosis system using IoT based smart glasses. Int J Adv Sci. 2020; 29(7).
7. Krishnan DS, Gupta SC, Choudhury T. An IoT based patient health monitoring system. 2018 International Conference on Advances in Computing and Communication Engineering. 2018; 1-7.
8. Kumar GV, Bharadwaja A, Sai NN. Temperature and heart beat monitoring system using IOT. 2017 international conference on trends in electronics and informatics. 2017; 692-695).
9. Swaroop KN, Chandu K, Gorrepotu R, Deb S. A health monitoring system for vital signs using IoT. Internet of Things. 2019; 5: 116-129.
10. Sinnapolu G, Alawneh S. Integrating wearables with cloud-based communication for health monitoring and emergency assistance. Internet of Things. 2018; 1: 40-54.
11. Valsalan P, Baomar TA, Baabood AH. IoT based health monitoring system. J Crit Rev. 2020; 7(4): 739-743.
12. Gómez J, Oviedo B, Zhuma E. Patient monitoring system based on internet of things. Procedia Comput Sci. 2016; 83: 90-97.