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Original Research Paper

Healthcare

IOT BASED REAL TIME TELE-HEALTHCARE SYSTEM

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ABSTRACT Tele-healthcare is need of the hour to bridge the vast healthcare gap in developing country like India. Being the second most populous country, quality healthcare facility is not easily accessible in the rural outskirts of India. In this research work the proposed system has acquired ECG, heart rate, SpO2 and body temperature data for better diagnosis and prognosis. The proposed system has been tested on the different patients belonging to different age groups and the result obtained on the health monitoring dashboard is found to be satisfactory. It also provides enhanced accessibility as multiple healthcare professionals can collaborate on the patient's data. This paper concludes with real time audio/ video connectivity, scope of interest of which is very effective and applicable in healthcare world.

KEYWORDS : Tele-healthcare; temperature; SpO2; Heartrate; ECG

INTRODUCTION

Telemedicine system not only provides remote monitoring but also promotes remote diagnosis and generates medical awareness by two-way interactive (audio / image) information exchange between patients and specialists who are miles away. Tele-health system makes modern healthcare more inclusive, synchronized and easily accessible without having to worry about limited time, transportation and mobility.

Patient observation outside of typical clinical settings (such as at home), is made possible by remote patient monitoring arrangements by expanding access to healthcare professionals while reducing costs.

The below par doctor-population ratio leading to unequitable distribution of healthcare services particularly in the rural regions of India. The model is proposed to bridge the gap between doctors and patients and reduce the issue of a smaller number of doctors over a large number of patients. The proposed model equips the primary healthcare centers with enhanced access of patient's vital information to specialists and nodal hospitals as per the requirement.

The developed real-time prototype has the potential to transform the rural healthcare across the whole country, which suffers from the dual challenge of limited resources and poor connectivity.

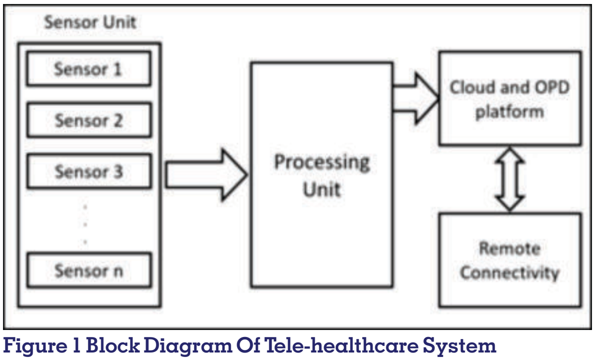

Figure 1 Block Diagram Of Tele-healthcare System

Theory Of Model

For the goal of efficient prognosis, such as when to make therapeutic treatments and the evaluation of those interventions, continuous or repeated observations or measurements of the patient's physiological parameters and the operation of life support equipment.

The portable healthcare model not only provides physiological input data needed to regulate vital health parameters, but also warns doctors and medical workers of potentially fatal situations.

Developing a real time health monitoring system that is economical, user-friendly, and easily accessible is need of the hour. The proposed system uses several IOT based sensors connected to a Wi-fi development board which measures vital body signs of the patient. The measured analog data from the sensors is then sent to the web application and the data sheet enabling doctors to carry out dual real time communication with patients, hence providing proper diagnosis and necessary course of action.

A sensor unit consisting of multiple sensors are used to measure the different physiological parameters of a patient. These sensor converts a physiological parameter into their equivalent electrical signals. These electrical signals are further processed by processing unit. A processing unit is a micro-controller or a microprocessor-based system. After processing of the signal, the processed signal is fed to a communication unit. This communication unit is responsible for communicating with the analyzer.

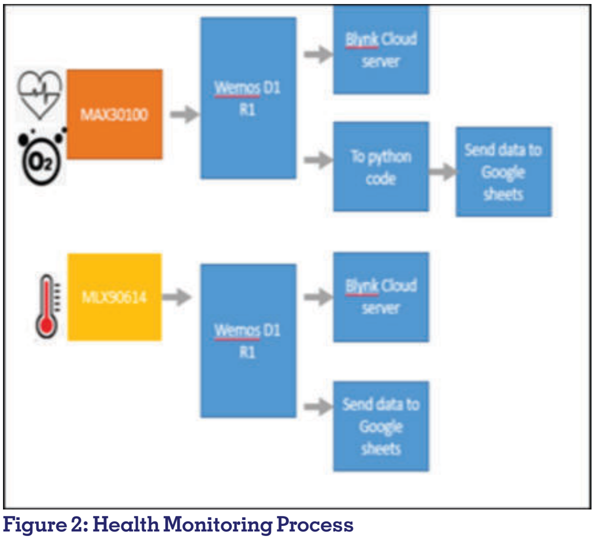

Figure 2: Health Monitoring Process

Proposed Model

At the start of the proposed model, sensor data is read first. After reading the sensor data, the data is pre-processed for the minimum threshold check. Minimum threshold check is done to check the abnormality of the patient physiological parameters. After the abnormality check, the report is displayed as well as sent to the cloud platform.

There are three different sections. The microcontroller forms the center of the entire health monitoring process. First analog signals are received from the sensors, and then, the processor program is written such that the data is separated from each sensor and then digitized. The separated data is then passed on to a Wi-fi development board which transmits the data to the blynk app cloud. The readings are displayed in the blynk cloud and simultaneously updated in the datasheet connected to the website. From the datasheet, patients and doctors should be able to access the information simultaneously.

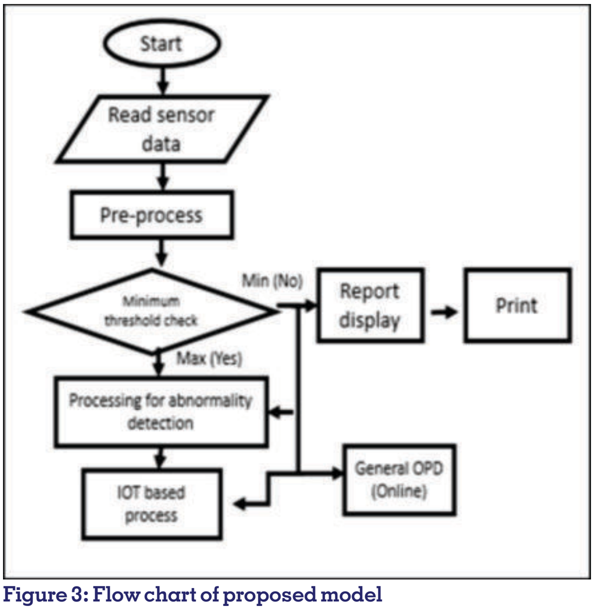

Figure 3: Flow chart of proposed model

Hardware Used

A. Sensors

i.) Temperature Sensor: The temperature of a specific item may be measured with the MLX90614 Contactless Infrared (IR) Digital Temperature Sensor, which has a temperature range of -70°C to 382.2°C. Without any physical touch, the sensor measures the object's temperature using infrared (IR) rays, and it communicates with the microcontroller via the I2C protocol.

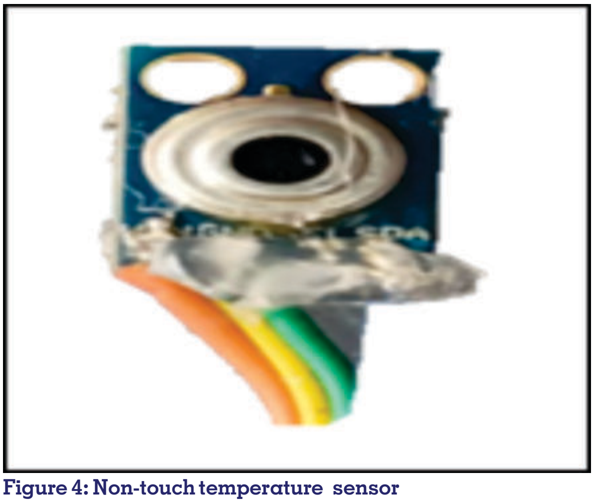

Figure 4: Non-touch temperature sensor

ii.) SpO2 Sensor: The MAX30100 is a sensor system with integrated pulse oximetry and heart-rate monitoring. To detect pulse oximetry and heart rate signals, it incorporates two LEDs, a photodetector, improved optics, and low-noise analogue signal processing. MAX30100 sensor is shown in figure.

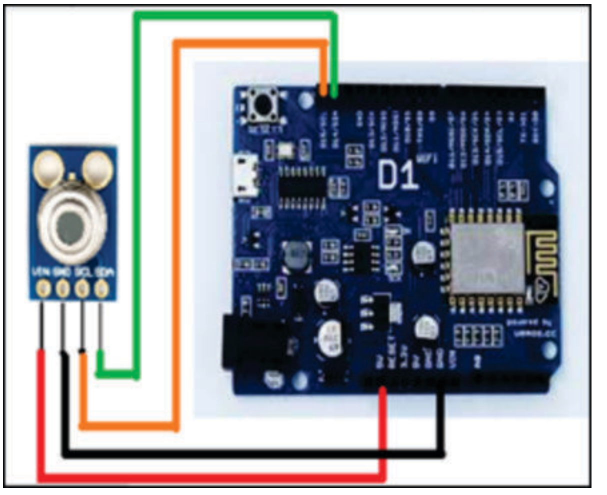

Figure 5: SpO2 Sensor

B. Microcontroller Board

Wi-Fi Development Board: WEMOS D1 R1 is a Wi-Fi development boardbased on the ESP8266 12E. Although the hardware is constructed to resemble the Arduino UNO, the operation is comparable to that of NODEMCU. The BOARDS MANAGER programme may be used to set up the D1 board to operate in the Arduino environment. WeMos D1 R1 is shown on the figure below.

Figure 6: Wemos D1 R1 Microcontroller Board

C. Hardware Setup

The circuit diagram of the interfacing of MLX sensor with the Wemos D1 R1 is shown below

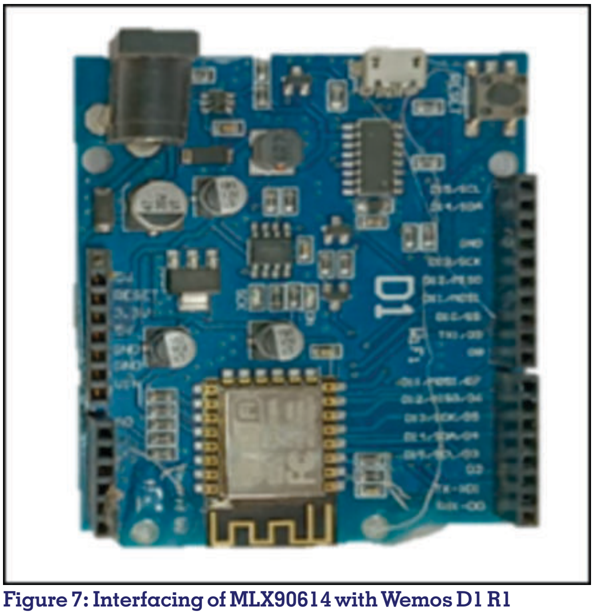

Figure 7: Interfacing of MLX90614 with Wemos D1 R1

The interfacing of MAX30100 with the Wemos D1 R1 is shown below

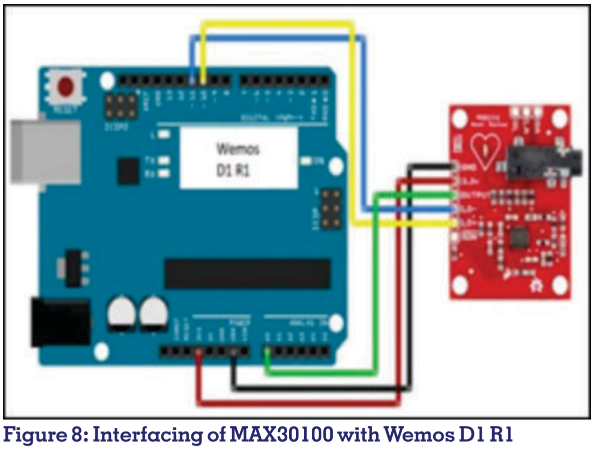

Figure 8: Interfacing of MAX30100 with Wemos D1 R1

The actual hardware setup is shown below.

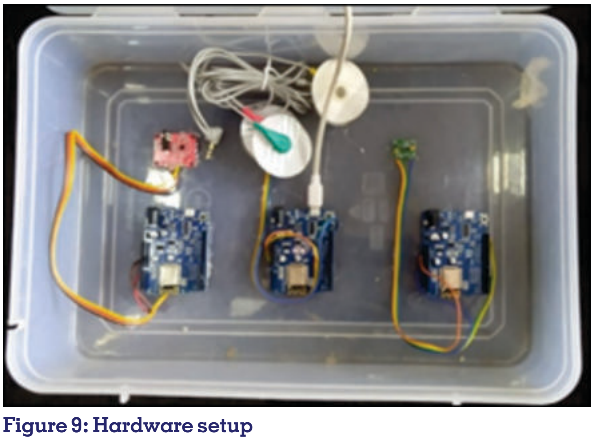

Figure 9: Hardware setup

Processor Programming

Algorithm for MLX 90614 sensor

While (data is available at serial port)
{Read the data
Store in a variable
Start blynk communication
Send data to blynk Cloud
Write data to Google Sheets}

Algorithm For Max30100 Sensor For Heart Rate

While (data is available at serial port)
{Read the heart rate data using get method
Store in a variable
Start blynk communication
Send data to blynk Cloud}

While (data is available at serial port)
{Read the serial port using python script
Write to the google sheet using sheet ID}

Algorithm for MAX30100 sensor for SPO2

While (data is available at serial port)
{Read the SPO2 data using get method
Store in a variable
Start blynk communication
Send data to blynk Cloud}

While (data is available at serial port)
{Read the serial port using python script
Write to the google sheet using sheet ID}

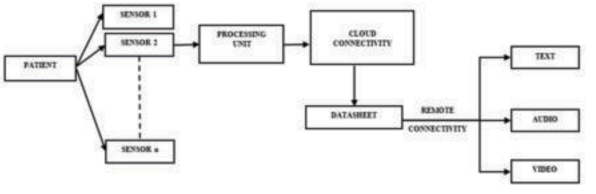

Figure 10: Functioning Of The Developed Prototype Real-time Model

Experimental Results

The developed prototype real-time model has been tested on two subjects of different ages in different conditions. In the test cases three sensors viz. temperature, heartrate and SpO2 sensors have been used. Patient's basic health signs in real time have been monitored. Snapshots of continuously and discretely collected data in web server and that displayed at the user interface are illustrated in Case Study 1 and 2. In both case studies the patient's finger is placed on the temperature sensor and the corresponding data are placed in the data sheet and Blynk dashboard.

CASE STUDY 1

1.) Input Image: the input image is of the first subject while measuring their SpO2 as shown in figure 11(a). Sensor data is then fed to data processing module, which is the heart of the system.
2.) Data Processing unit: This module collects sensor data and wirelessly transmits them to IOT platforms using hypertext transfer protocol or RESTful API protocol. This is displayed in figure 11(b) which shows processor program and processed output.
3.) Data Visualization Using cloud connectivity: a dashboard has been prepared in both the web console and mobile console with time and date stamp. It shows the current status, displays the collected results and also updates in real time as shown in figure 11(c) & 11(d) respectively. The healthcare provider can easily monitor the patient using same Wi-fi credentials as used in our prototype real-time model. These results validate the cloud connectivity feature of the developed model.

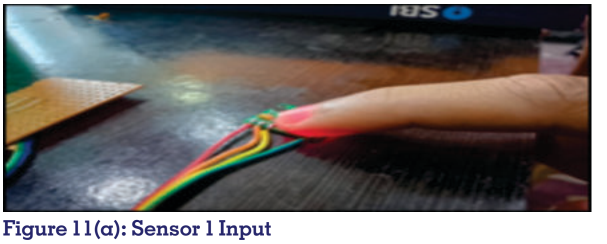

Figure 11(a): Sensor 1 Input

Figure 11(b): Digitized Input sensor data

Figure 11(c): Data monitoring in Arduino IDE

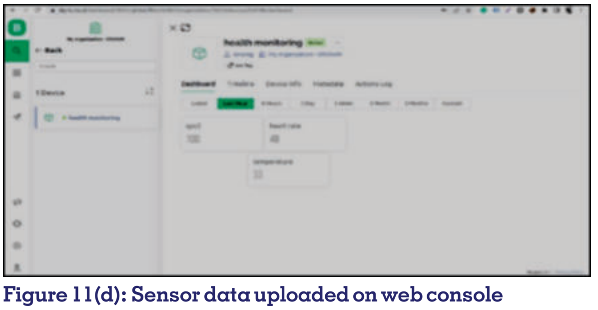

Figure 11(d): Sensor data uploaded on web console

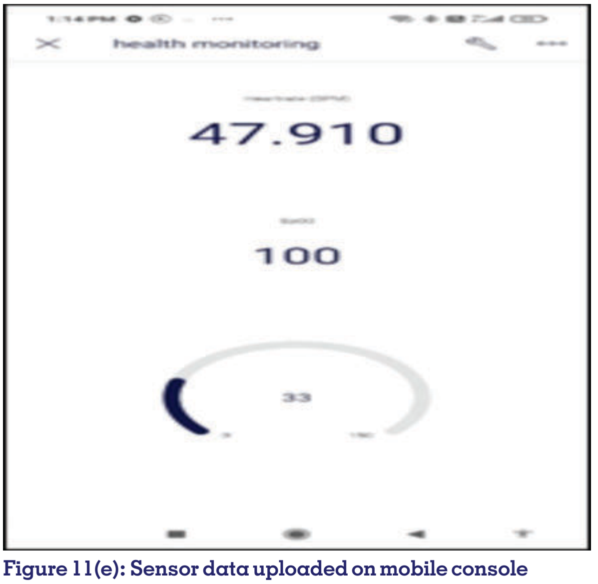

Figure 11(e): Sensor data uploaded on mobile console

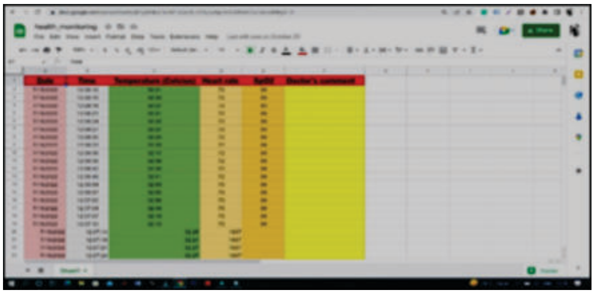

Figure 11(f): Real time monitoring in data sheet
Figure 11: Real-time results of case study 1

CASE STUDY 2

1.) Input Image: the input image of the second subject while measuring their SpO2 is shown in figure (a). The sensor data is sent to the data processing unit.
2.) Digitized Sensor Data: the collected data from the sensor is digitally displayed in Arduino IDE which is then transmitted to the cloud. Baud rate of processor is 9600 and its resolution is 4.9 mV/unit.
The processed sensor data is obtained in discrete form using I2C protocol. The processor programming has been done in such a way that the developed prototype real-time model is compatible with all operating systems which have internet access.
3.) Cloud connectivity: The web console and mobile console show the current status and collected results which is updated in real time as shown in figure (c) and (d).

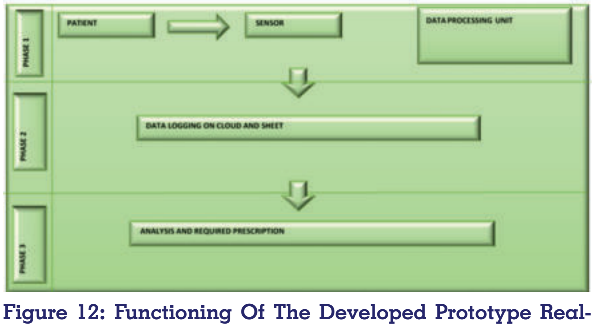

Figure 12: Functioning Of The Developed Prototype Real-time Model

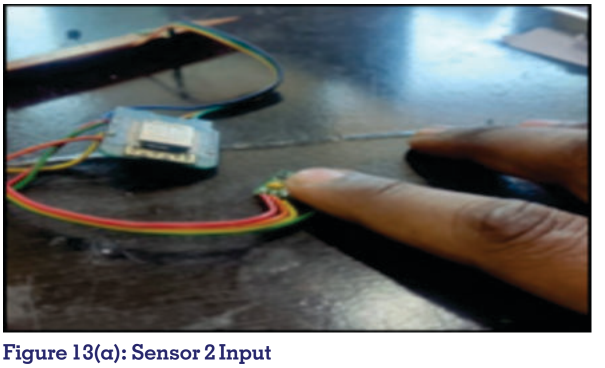

Figure 13(a): Sensor 2 Input

Figure 13(b): Data monitoring in Arduino IDE

Figure 13(c): Sensor data uploaded on web console

Figure 13(d): Sensor data uploaded on mobile console

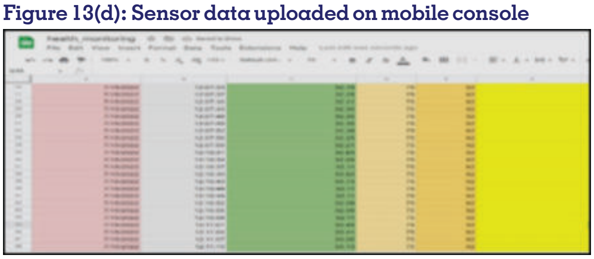

Figure 13(e): Real time monitoring in data sheet
Figure 13: Real-time data of Case Study 2

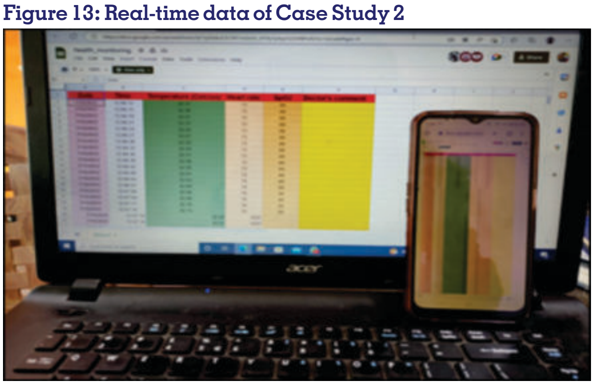

Figure 14(a): Remote Connectivity displayed on android phone and Windows operating system

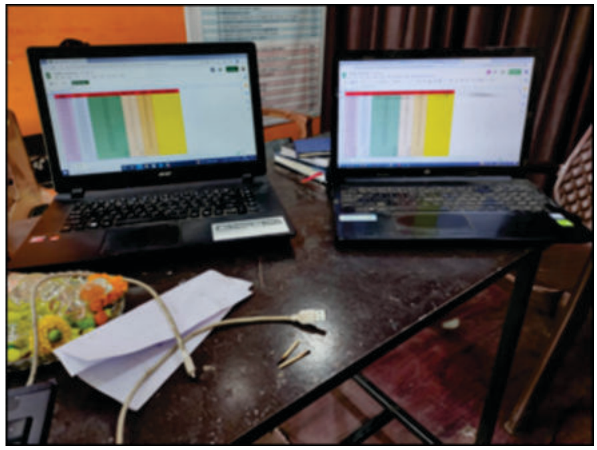

Figure 14(b): Remote Connectivity displayed on two separate devices
Figure 14: Remote Connectivity

Table I : Comparision Of Proposed Model With Existing Model

Reference Work	Sensors and Hardware used	Model Output	Cloud connec -tivity	Remote connec -tivity
[1]	MLX90614, Arduino micro-controller board	real time temperature monitoring data can be transferred to authentic observer by utilizing internet of things (IoT)	Yes	No
[2]	LM35, DHT11, MQ9, MQ135 ESP32 micro-controller board	The condition of the patients is conveyed via a portal to medical staff	Yes	No
[3]	LM35, AD8232, MAX30100, Nodemcu	The data collected from the sensors will be sent to a Wi-Fi module called NodeMCU, ESP8266through which the data will be uploaded on cloud	Yes	No
[4]	Blood Pressure Monitor (Kodea KD-202F), Pulse Oximeter (Contec CMS50D+), Air Flow, Galvanic Skin Response, Temperature, Raspberry-pi	The software components for sensor access work independently, offering improved system stability in case of sensor failure	Yes	No
Proposed Model	MAX30100, MLX90614, Wemos D1, r1	The data from the sensor is send to the Blynk cloud server as well as Google Sheets	Yes	Yes

Comparison Table

Table I shows the comparison between the proposed model And the pre-existing models. The result shows that the proposed model performs better than the models developed before on the grounds of hardware used, software and remote connectivity.

Remote Connectivity

As shown in figure 14(a) and 14(b), results of the proposed healthcare system can be collaborated without any physical connection. The files can be accessed on any device with internet connection irrespective of its distance from the patient. This denotes remote connectivity of the developed prototype real-time model. These files can be simultaneously edited in real time. Audio and video connectivity can be provided in real time for effective diagnosis and prognosis by the healthcare professional. The developed prototype real-time model is compatible with all operating systems which have internet access.

CONCLUSION

In this paper, the prototype real-time model of the telemedicine system equipped with web and app-based precise monitoring has been effectively actualized. The system has been tested on a number of users for validation and results obtained are found to be satisfactory. Providing genuine time communication between doctor and patient is the key objective achieved in this research work. Having urban centric health infrastructure and non-existent health insurance will no longer be an issue, particularly for rural outskirts of developing countries. Proper diagnosis and respective treatment is successfully made possible with the help of proposed telemedicine model. This paper concludes that proposed model is efficiently applicable in the field of remote health-care world as it transforms hospital centric healthcare facility to a patient centric one.

REFERENCES

[1] Ahmed, Asif & Abdullah, Mohd Noor & Taib, Ishkrizat. (2020). Design of a contactless body temperature measurement system using Arduino. Indonesian Journal of Electrical Engineering and Computer Science. 19. 1251. 10.11591/ijeecs.v19.i3.pp1251-1258.

[2] Islam, Md & Rahaman, Ashikur & Islam, Rashedul. (2020). Development of Smart Healthcare Monitoring System in IoT Environment. SN Computer Science. 1. 185. 10.1007/s42979-020-00195-y.

[3] Marathe, Sachi & Zeeshan, Dilkas & Thomas, Tanya & Vidhya, S.. (2019). A Wireless Patient Monitoring System using Integrated ECG module, Pulse Oximeter, Blood Pressure and Temperature Sensor. 1-4. 10.1109/ViTECoN.2019.8899541.

[4] I. A. Pap, S. Oniga, I. Orha and A. Alexan, "IoT-based eHealth data acquisition system," 2018 IEEE International Conference on Automation, Quality and Testing, Robotics (AQTR), 2018, pp. 1-5, doi: 10.1109/AQTR.2018.8402711.

[5] T. K. Gannavaram V, U. MaheshwarKandhikonda, R. Bejgam, S. B. Keshipeddi and S. Sunkari, "A Brief Review on Internet of Things (IoT)," 2021 International Conference on Computer Communication and Informatics (ICCCI), 2021, pp. 1-6, doi:10.1109/ICCCI50826.2021.9457009.

[6] Joshua Ernest Pedi Reddy, C. Naga Bhuwaneshwar, Shiva Palakurthi, AmeetChavan, "AI-IoT based Healthcare Prognosis Interactive System" 2020 IEEE International Conference for Innovation in Technology (INOCON) Bengaluru, India, Nov 6-8, 2020.

[7] P. SaleemAkram, Ramesha. M, SaiAamaniSindhuValiveti, ShaikSohail, "IoT based Remote Patient Health Monitoring SYSTEM", 2021 7th International Conference on Advanced Computing & Communication Systems (ICCMC).

[8] LalithadeviBalakrishnan, Krishnaveni, "AN INTERNET OF THINGS (IoT) BASED INTELLIGENT FRAMEWORK FOR HEALTHCARE-A SURVEY", 2021 3rd International Conference on Signal Processing and Communication (ICPSC) | 13-14 May 2021 | Coimbatore.

[9] VaniYeri, Dr. Shubhangi D C,"IoT based Real Time Health Monitoring", Proceedings of the Second International Conference on Inventive Research in Computing Applications(ICIRCA-2020).