DEPLOYMENT OF WEARABLE SENSORS FOR PATIENT MONITORING SYSTEM USING AUGMENTED REALITY AND IoT

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Abstract - *Medical practitioner are regularly on the lookout for technologies that will accomplish their operating environment. The continuing enhancement of the clinical environment within the digital age has led to variety of innovations within the surgical workplace. This paper aims to deliver higher quality care to patients with a lower risk of burnout. The sensors present in the system gives body temperature, heart rate and respiratory rate using LM35 and pulse sensor. These sensors are interfaced with controller Arduino UNO board. The data transmitted through WiFi module are monitored via Augmented Reality glass (AR). The WiFi module ESP8266 reserves the sensor values on IoT platform i.e. Adafruit. So that record of knowledge of the patients can be retrieved at any moment. Surgeon is given an alert, whenever the sensor output exceeds a traditional threshold value. Thus, this prototype helps the doctor to monitor patient data continuously.*

Keywords-*Patient monitoring system, controller, pulse rate sensor, temperature sensor, AR glasses, IoT*

1. INTRODUCTION

Surgeons are showing interest in adopting the newer technologies that provide them a better surgical environment. The main need of medical AR came from the need of visualizing medical data. The innovations of AR can enhance doctors and surgeon's ability to diagnose, treat, and perform surgery on their patients more accurately by giving them access to real-time data and patient information faster and more precisely than ever before.

Basically, the doctors are in necessity of valuating important body vitals of the sufferer during manual surgery. And this may increase the complexity for the medical practitioners. So, there is a need for the system to monitor the parameters continuously during surgery.

In the recent years wireless technology offers greater accuracy, avoids manual tasks and allows to access the data in Real-time. IoT enables health care professionals to be more watchful and connect with the patients proactively.

In traditional method, doctors play an important role in health checkup. For this process it requires a lot of time for registration, appointment and checkup. This modern approach provide better patient experience and reduces the time consumption, medical errors

2. RELATED WORKS

This related work provides an overview of recent researches made on the AR, Wireless technology, IoT in healthcare.

Egui Zhu et al.[1] presented the AR to the real world with virtual objects, appears to coexisting the same space as the real world. AR is used in clinical care as it provides with an internal view of patients without any invasive procedures. It did not clearly describe which kind of learning theory was used to guide design of AR in healthcare education. So, in this paper it is provided with a clear idea for the use of AR in surgeries by providing the surgeons the semi-transparent glass where they will be alerted if any parameters go above the threshold ranges. Filip Malwski et al.[2] developed the AR for car assistive system. Based on this paper we got the idea of developing the same system for assisting doctors. The AR technology can be used in Handheld Devices, Stationary AR Systems, Spatial Augmented Reality (SAR), Systems Head-mounted Displays (HMDs), Smart Glasses, Smart Lenses. Major medical applications deals on robot-assisted surgery and image guided surgery. Because of this, substantial research is going on to implement AR in instruments which incorporate the surgeon's intuitive capabilities

Siddhant patil et al.[3] The system proposed in this allows the user to manipulate the object through virtual buttons, while also allowing him/her to access the object's properties. Furthermore, the system provides interactive videos to aid the users understanding as well as a quiz by which the user can assess his/her knowledge of the three-dimensional concepts. Proniewska. K et al.[4] The entire idea of the system consists of the holography and wireless technology, in which a doctor can monitor a patient and collects the information from the patient and can view the stored data at any time.

Afef Mdhaffar et al.[5] explained the low power WAN network to perform analysis of monitored data in health

caring system. The IoT architecture has been given for step wise working for understanding of IoT. Maximum data rate in LoRaWAN is 50kbps (uplink), 50 kbps downlink while in GPRS is 86.5 kbps (uplink ,14kbps(downlink). These results gives demonstration of IoT for health monitoring system. Mohammad M. et al.[6] described the measurement of ECG signals at various intervals and at different situations. They have considered energy aware, limited computing resources and lose network continuity challenges. For these challenges; mathematical model has been developed to execute each task sequentially. There are three approaches designed to work out the process. One is mobile based monitoring approach, data mining and third is machine learning approach.

Ayush Bansal et al.[7] focuses on development of a system which is capable of detecting critical cardiac events. An advanced remote monitoring system is used to detect symptoms which leads to fatal cardiac events. Hamid Al-Hamadi et al. [8] This paper is based on a novel trust-based decision making protocol that uses trust-based information sharing among the health IoT devices, so that a collective knowledge base can be built to rate the environment at a particular location and time.

3. PROPOSED SYSTEM

We propose a system in which it provides real-time information for the doctors of victim's body vitals by displaying on semi-transparent glass which is said to be AR-glass. This will have a quantitative assessment of the important physiological variables of the patient during critical periods. In this paper, the real-time data of patients is collected by the sensors attached to sufferer, once the sensor measured the values, it is processed and sent to doctor's wireless augmented reality glass and alert through buzzer if an abnormal condition occurs. The Medical IoT devices used here gather vital data and transfer them to doctor's for Real-time tracking, and it will update the collected data for every 60 seconds. Thus the proposed system aims to promote healthy relationship between the patient and the caregiver and also increases zest for life.

Advantages

Reducing the risks of Intensive Care Unit (ICU) patient monitoring system.

Highly Implemented in the Covid-19 care centers.

Massively recommendable in the areas of mentally retarded centers and old age homes

With IoT, patient monitoring can be done in real-time, drastically cutting down the need for doctors going out and making visits.

4. METHODOLOGY

The purpose of this entire system is to consign patients with good care and reduce their critical situations by monitoring their body vitals in a consistent manner. Necessary components need to perform the above mentioned technique requires temperature sensor, heart beat sensor, respiratory sensor, Arduino UNO, WiFi module chip, LCD display, IoT and AR wearable glass, buzzer.

4.1 TRANSMITTER SECTION

Arduino board is connected to external power supply. The Arduino sketch running over the device implements various functionalities of the project like reading sensor data, converting them into strings, passing them to the IoT platform. Then the heartbeat sensor, Respiratory sensor, Temperature sensor are interfaced with controller Arduino UNO board and it is programmed using Embedded C.

Heart beat sensor provides a way to study the function of heart which can be measured based on the amount of blood in finger changes with respect to time. LM35 is the precision IC temperature sensor with its output proportional to the body temperature (in °c). Respiratory sensor measures minute flow rate around the zero point of respiratory flow. These sensor collects the values from the patient and display the values on LCD connected to the Arduino. Then all sensor values are transmitted by the Wireless transmitter and permits to the IoT which is implemented to retain the data of the patient. The IoT gateway collects and creates the database of the sufferer sensor values that can be estimated during their critical periods

TRANSMITTER SECTION BLOCK DIAGRAM

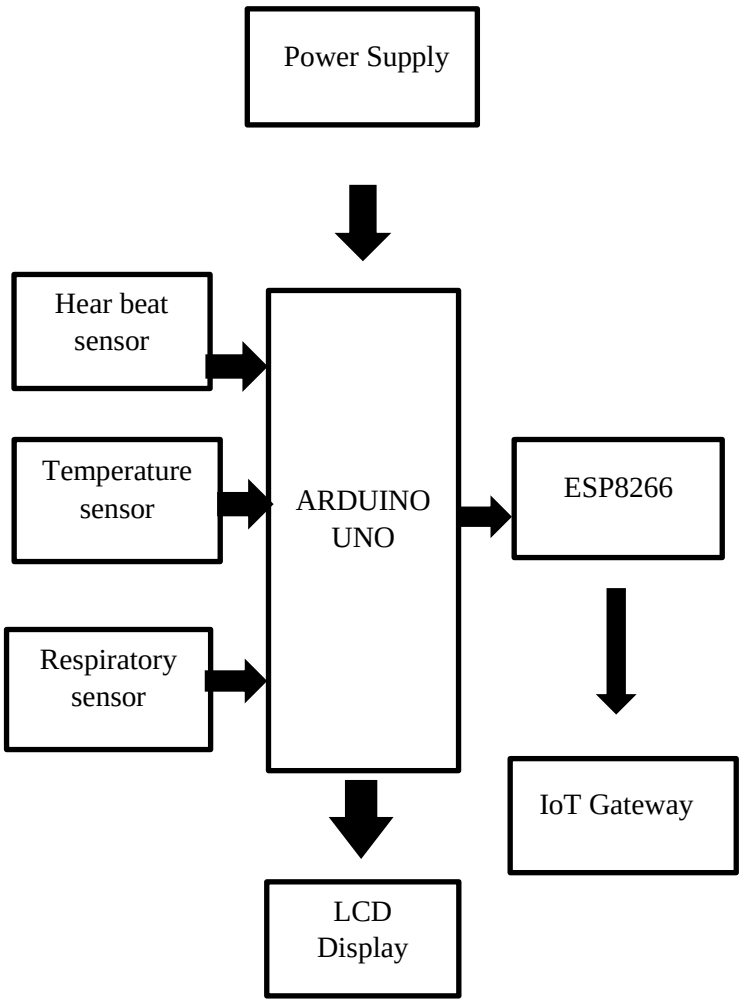

Fig 1 Block Diagram of Transmitter section

4.2 RECEIVER SECTION

The WiFi module at the receiver section transmits the sensor data to the OLED display attached to the AR wearable glass. This AR semi-transparent glass can wear during surgery which make the surgeons to provide better outcomes. The buzzer presented at the receiver side gives alert. In case of emergencies, the temperature spike or heart beat spike or respiratory spike, the buzzer warns the medical practitioner as an alert in accordance to their respective threshold values.

SI.NO	Sensors Used	Normal Rate	Threshold Rate
1	Temperature	36.1°C-37.2°C	38°C and above
2	Heart beat	60-100 bpm	Above 100bpm or below 60bpm
3	Respiratory	16-20 breadths per min	Above 25bpm and below 12bpm

Table 1 represents the Normal and Threshold values of sensors used

The above mentioned range of temperature and is stated by medlineplus govt. article. Similarly, the range of heartbeat and respiratory rates are stated by URMC medical institute.

RECEIVER SECTION BLOCK DIAGRAM

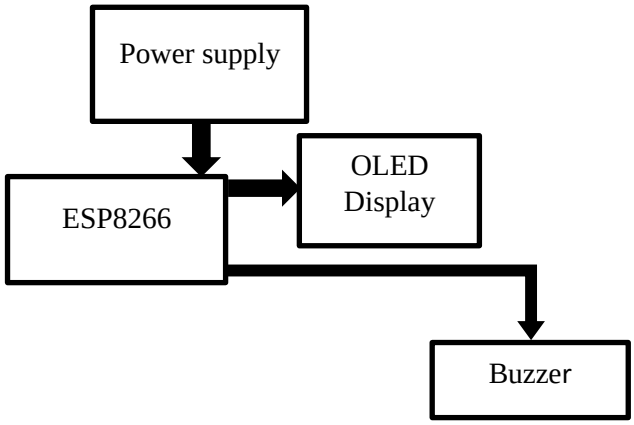

Fig 2 Block Diagram of Receiver section

5. RESULTS

Fig 3 AR Goggle setup

Fig 3 shows the AR goggle setup with OLED attached exposing the body temperature, respiratory rate, heart beat rate through the display.

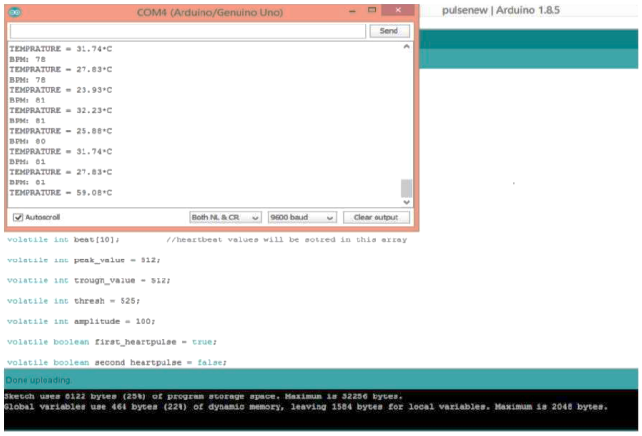

Fig 4 Simulation of system on Arduino IDE

Fig 4 is the simulation window of Arduino IDE program in which the peak value of each sensor fixed in the code and this helps to provide the alert.

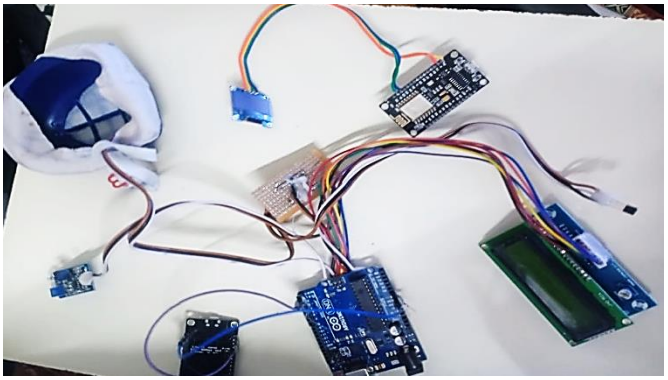

Fig 5 prototype of a system

Fig 5 represents the entire system as hardware implementation. LCD and OLED in the setup displays the temperature, heartbeat and respiratory values that are processed by the Arduino.

6. CONCLUSION

Increasing rate of chronic diseases in aging population is becoming serious concern due to lack of sufficient facilities and extremely high cost. Timely diagnosis and treatment can reduce the risk to great extend. The potential ability of Augmented Reality is to display imaging data and patient information which save lives and decrease medical errors. IoT in healthcare make accessible information for wellbeing and performs risk evaluation. This paper conveys the remote monitoring system technology which is enabled for monitoring of patients outside of clinical settings and leads to increasing access to health care. From the evaluation and the result obtained from analysis of this system is better for patients and surgeons to improve their patients' medical evaluation.

7. REFERENCES

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