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IOT BASED WEARABLE PHYSIOLOGICAL PARAMETERS MONITORING SYSTEM

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Abstract: In recent times, wireless sensors and sensor networks have become a great interest to research, scientific and technological community. Though sensor networks have been prevalent for more than a few decades now, the wireless domain has opened up a whole new application space of sensors. In the modern era, patients are being monitored using a network of wireless sensors. The cost of hospitalization is rapidly increasing along with the cost of rehabilitation after a major illness or surgery. During this recovery period, several physiological parameters need to be continuously measured. Hence, telemedicine and remote monitoring of patients at home are gaining added importance and urgency.

An IoT smart-noninvasive-wearable physiological parameters monitoring system can be used to monitor physiological parameters, such as temperature and heart rate, saline level and of a human subject. The system consists of an electronic device which is worn on the wrist and finger. Using several sensors to measure different vital signs, the person is wirelessly monitored within his own home. The device detects if a person is medically distressed and sends an alarm to a receiver unit that is connected to a computer. This sets off an alarm, allowing help to be provided to the user. The device is battery powered for outdoor use. The device can be easily adapted to monitor athletes and infants. The low cost of the device will help to lower the cost of home monitoring of patients recovering from illness.

Keywords: Healthcare, Physiological parameters, Vital signs, Internet of Things, Wearable sensors

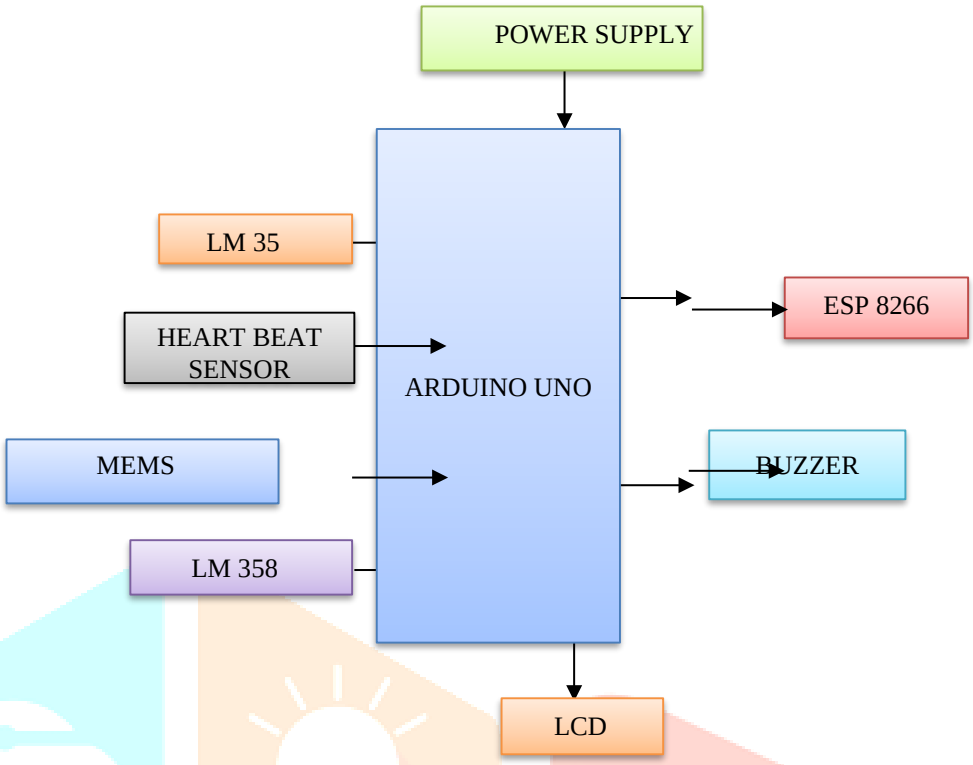
I. INTRODUCTION

In today's world, providing health care services is very important for people dealing with various kinds of health issues. In certain circumstances, people need continuous healthcare which cannot be provided outside hospitals. There are a variety of technologies around us, so to get benefits from connecting such technologies to build a new e-health system platform could help to achieve high quality healthcare services. Here, is our project explaining about one of such technology to monitor the patient continuously using IoT. Internet of Things (IoT) is a rapidly evolving technology that connects everything to the existing Internet infrastructure. The Internet of Things (IoT) is a network of physical objects (sometimes called "objects") that are implanted with sensors, software and other technologies to connect and exchange data with each other devices and systems on the Internet. Any device with sensors can be connected to the internet using the Internet of Things. In this project, we use Heart Beat sensor, Temperature sensor, LM358 and MEMS sensors for measuring the pulse rate, body temperature, saline level and dislocation or movement of the patient respectively. An Arduino board with Atmega328P Microcontroller used for processing the data and to react according the instructions and alert the system whenever there is an emergency occurrence. We also use ESP8266, a Wi-Fi module in order to display the results in the webserver continuously. An LCD here is used to display the different parameter values to the doctor near the patient.

1.1 Objective

The objective of the physiological parameter monitoring system is to quantitatively evaluate the important physiological variables of the patient during the important period of the patient's biological activity. This strategy lowers healthcare expenses by lowering physician visits, hospitalization, and diagnostic testing procedures. In today's chaotic environment, providing care and health aid to bedridden patients at key phases with improved medical facilities has become one of the primary issues. The necessity for a cost-effective and fast-responding warning system is unavoidable in hospitals where many patients' physical states must be evaluated often as part of a diagnostic procedure. When such systems are properly implemented, they can send timely alerts to medical personnel and doctors, and their services can be engaged in the event of a medical emergency.

II. BLOCK DIAGRAM



Block Diagram of the System

Figure above is the block diagram of the system. It consists of the following components. They are as follows:

1. An Arduino Uno
2. Power Supply
3. LM35
4. Heart Beat Sensor
5. LM358
6. MEMS
7. ESP8266
8. LCD
9. Buzzer

Arduino Uno is an open-source microcontroller board based on the ATMEGA328P 8-bit microchip microcontroller. It has a total of 28 pins and is a Dual Inline Package (DIP). The board is equipped with 14 digital pins and 6 analog pins, which can be connected to various expansion boards, circuits, and sensors. It has UART (Universal Asynchronous Receiver Transmitter) for serial communication. The power module provides power for the entire system. This Arduino board is interconnected with different sensors (such as LM35, heartbeat sensor, MEMS, and LM358) to measure body temperature, heartbeats per second, patient's body movement, and saline level. The buzzer is used to indicate abnormal conditions of the patient. ESP8266 is used to transfer data from the Arduino to the web page, and the physical parameters are displayed on the LCD screen and the web page.

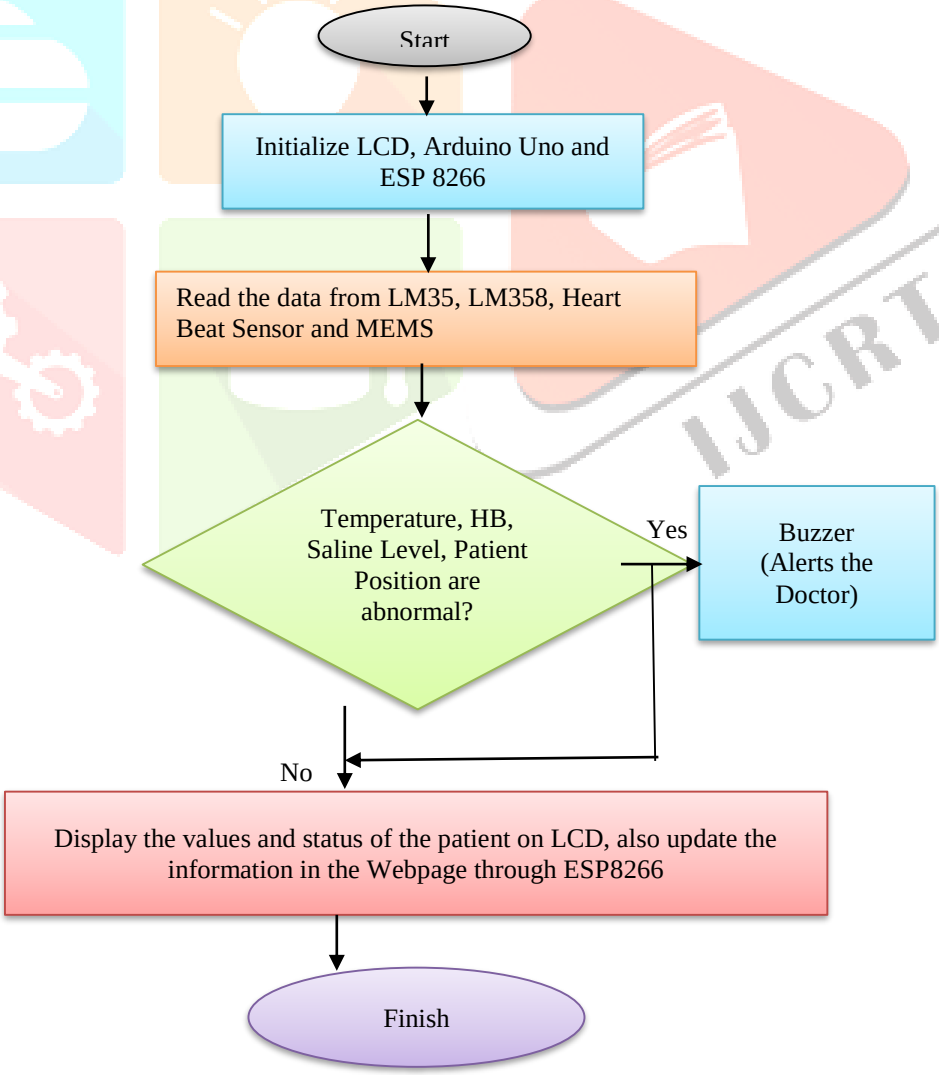
III. WORKING PROCEDURE

The proposed system includes a Power Supply Module, four types of sensors (Temperature Sensor (LM35), Soil Moisture Sensor (LM358), Heart Beat Sensor, and MEMS), an Arduino Uno, a Wi-Fi Module, and an LCD. Each of the above-mentioned modules and sensors has its own functioning that is dependent on the conditions. To begin, the system's Power Supply Unit undertakes a series of activities in a sequential order. It is made up of a step-down transformer that converts the high voltage 230V AC power supply voltage on the main side of the transformer to the low voltage 12V AC on the secondary side. The bridge rectifier is then supplied this lowered 12V AC to convert AC to DC output voltage. Furthermore, because the bridge rectifier's output is simply pulsating DC, we must use a capacitor filter to remove the ripples. Finally, the capacitor output is fed into the regulator, which generates a constant dc voltage of either 5V or 12V, depending on our needs (here, it is 5V DC).

There are 14 pins on the LCD. Pin 1 is connected to Vcc, pin 2 to ground, and pin 4 is used to select the register. If RS is zero, the command register is chosen, and if RS is one, the data register is chosen. Pin 5 is an R/W pin. If it is 0, a write operation is performed, and if it is 1, a read operation is performed. Pin6 is given a high to low enable signal to allow communication between the LCD and the Arduino Uno. The ESP8266 Wi-Fi Module is a self-contained SOC with an integrated TCP/IP protocol stack that can provide access to your Wi-Fi network to any microcontroller. The ESP8266 may either host an application or offload all Wi-Fi networking functionality to a separate application processor. Vcc, ground, and Vout are the three pins that make up a temperature sensor. Vout is connected to the Arduino uno's digital pin, while Vcc and ground are connected to the power supply unit of supply. A temperature sensor generates analogue data. With the help of the integrated ADC, this analogue data is transformed to digital data and presented on the LCD as well as on the webpage via the ESP 8266. This sensor is programmed with specified threshold values, which are used to continuously monitor and treat the patient.

The Heart Beat Sensor, like the Temperature Sensor (LM35), has three pins: Vcc, ground, and Vout. Vout is connected to an Arduino uno's digital pin, while Vcc and ground are connected to the power source. It takes the patient's pulse rate and shows the associated value on the LCD every 10 pulses, as well as updating the same information on the webpage via the Wi-Fi Module (ESP 8266). MEMS is a micro electro-mechanical sensor that connects to the analogue pin of the Arduino Uno and converts the received data to digital data using the ADC. We can tell whether the individual is upright or has fallen down if there is any tilt in the MEMS. The patient's saline level is determined by the Soil Moisture Sensor (LM358), which returns 0 or 1 depending on how much saline is left in the bottle. The LM358 should return 0 if the saline level is full, and 1 if the saline level is empty. As a result, all of the patient's data is continuously monitored and presented on the LCD, as well as updated in real time on the webpage, based on the threshold levels and set criteria. With these indicators and constant monitoring, doctors and other healthcare workers have greater opportunities to take fast action on a patient who is in danger and save his or her life by giving timely treatment.

IV. FLOW CHART



Flow Chart of the Project

Let's now understand the flow of the project as mentioned in the figure above clearly as follows:

While starting the procedure initialize Arduino Uno, Wi-Fi Module and LCD using Power Supply. Then the data is read from different sensors like LM35 (Temperature Sensor), Clip Sensor, LM358 (Saline level), MEMS (ADXL345 Accelerometer Module) by the Microcontroller. Later, checks the Sensor values. It then, compares the values with the predefined/ Threshold values. Depending on the threshold value and the condition, transfer data and on to the LCD. If the condition is satisfied mentioned in the condition box, the alerting signal is sent to the doctor through the buzzer. At the same time, update the information regularly in the webpage through Wi-Fi Module (ESP8266). If the condition fails only the information is passed on to the LCD and the webpage., there will be no buzzing sound. Buzzer helps in alerting the doctor in case of emergency on measuring the physiological parameters so that doctor can take immediate required action on the patient. This system helps in proving the treatment in time to the patient at any time.

V. RESULTS AND DISCUSSION

Figure 1 All Parameters values

Figure 2 MEMS Result

Figure 3 Saline Level

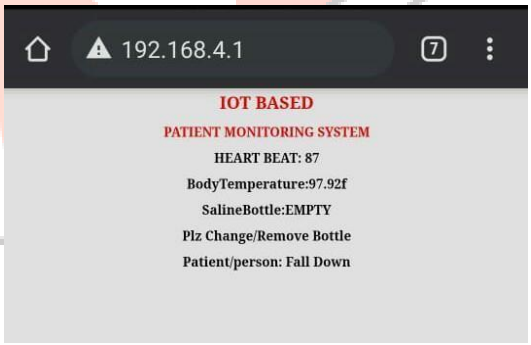


Figure 4 Webpage

As per the procedure mentioned in the operation of the system, the results are displayed on LCD and on to the webpage as shown in the above figures.

- Figure 1 shows different parameters values on the LCD.
- For example, here in our present proposed system we have specific conditions and threshold values for displaying the different parameter values to be monitored (such as, the Temperature Sensor reads the values and checks them, compares with the given threshold i.e., 38 degrees centigrade. If, the value exceeds the specified threshold then it takes the action accordingly. It continuously monitors the body temperature of the patient and sends information on to the LCD and Webpage).
- Similarly, Heart Beat Sensor calculates the value for every 10 seconds and displays. Change in the MEMS position/orientation or tilt represents the physical movement (here, standing/ fallen down position of the patient) and displays the same. Saline level of the patient is read by the LM358 Sensor (Level 1). It helps to know whether the saline bottle is empty or full.
- All the parameters monitored are finally displayed on to the LCD and updated continuously in the webpage too. If the condition satisfies, the buzzer indicates the state of urgency alerting the doctor additionally.

- These details will definitely help the patient in getting the treatment in time.
- Figure 2 shows the MEMS sensor result which represent the current state of the patient. The patient here in this case has been fallen down.
- Figure 3 shows the LCD display of the patient Saline Bottle Level. Here, the Saline Level is empty. This indication is sent to the doctor through the Buzzer sound.
- Figure 4 shows the different parameters values in the Webpage.
- The results mentioned in the above figures are the practical examples of the real time monitoring system.
- All the results mentioned above are very much helpful for the bedridden patient to get the treatment at an early stage.

VI. ADVANTAGES

- Doctor can access the webserver via smartphone or computer to monitor real-time parameters data.
- Appropriate treatment at an early stage.
- Doctors may keep an eye on their patients' health at all times.
- Visualization of patient health and medical indicators in real time.
- Lowers costs and workload.

VII. DISADVANTAGES

- Failure or bugs in the hardware or even power failure can impact the performance of sensors and connected equipment placing healthcare operations at risk.
- Furthermore, skipping a planned software update could be much riskier than skipping a doctor's appointment.
- While the Internet of Things (IoT) has the potential to lower healthcare costs in the long run, the cost of implementing it in hospitals and staff training is relatively significant.

VIII. APPLICATIONS

- We can use it in a device such as a fitness tape that measures the heartbeat and blood pressure.
- We can use monitoring applications of routine activity.
- It is available in mobile places such as cars to track the temperature.
- It can be used to control load switching such as motors and temperature-based heaters.
- It is also available in smart parking, a smart home, a smart city, an industrial place and an agricultural process.

IX. CONCLUSION

The **"**IoT Based Wearable Physiological Parameters Monitoring System" project was designed and tested successfully. The suggested method allows doctors to keep track of their patient's health from any location. On the webserver, the data is stored and visualized. It was created by integrating functionality from all of the hardware components used. Every module's presence has been carefully considered and arranged, resulting in the best possible operation of the unit. Second, the idea was effectively implemented employing modern integrated circuits and growing technology. This has the potential to lead to better health outcomes, lower healthcare expenditures, greater independence and a higher quality of life.

The healthcare market is one of the majors in which there is a huge growth. Everyone can afford a health monitoring system or a wearable band which keeps them in regular update with body fitness. As the technology decreases travel time, it can be used for regular check-ups of patients who live a long distance away. All people's data can be linked to an Aadhar card to track the country's health. In the future, this system will be built using modern GSM and GPRS technology. Despite the downsides, further digital transformation in healthcare is inevitable and the concept of IoT will continue to capture and change the landscape of healthcare services. The future of the healthcare industry is more reliable on health monitoring systems for consumer safety and reliability.

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