SMART WEARABLE SENSOR FOR HEALTH MONITORING OF ELDERLY PEOPLE

S. Annapoorani
Department of Electrical and Electronics Engineering
Agni College of Technology, Thalambur, Tamil Nadu, India

Radhika Somakumar
Department of Electrical and Electronics Engineering
Agni College of Technology, Thalambur, Tamil Nadu, India

P. Vennila Devi
Department of Electrical and Electronics Engineering
Agni College of Technology, Thalambur, Tamil Nadu, India

L. Emimal
Department of Electrical and Electronics Engineering
Agni College of Technology, Thalambur, Tamil Nadu, India

B. Bharathi Selvan
Department of Electrical and Electronics Engineering
Agni College of Technology, Thalambur, Tamil Nadu, India

Abstract- The health monitoring of elderly people is of utmost importance in the society leading to challenges and research thrust in the Smart Healthcare Monitoring System (SHMS). Also, monitoring the elder person's physiological data can help in the early detection of any disorder, and also, ensures a safe environment. This paper aims at observing the health condition of elderly people remotely via wearable sensors, and the data from wearable sensors to be processed and analyzed using machine learning and IoT concepts, and transmitting the detection of disorder information to the hospital, that is, updated in the webserver or doctor concerned for immediate actions. In addition to health monitoring, airbag mechanism is incorporated to protect the elderly people from falling down.

Keywords – Wearable sensor, health monitoring, IOT, air bag mechanism.

I. INTRODUCTION

Our research motivations came from the interest in enhancing the living facilities and healthcare in particular. While we are doing our day to day jobs, we care about our elderly people and disabled people's health when we leave them home alone for a long period. Therefore, it is becoming essential to engage technologies such as healthcare wearable sensors with our healthcare systems in order to have a safer and convenient environment for everyone to live in [1-3]. The growing elderly population, accompanied by the increasing prevalence of chronic diseases associated with ageing, will have profound implications for the health care system [4, 5]. The remote monitoring of elderly people accumulates patient's physiological data via wearable sensors, and sense pulse, temperature, respiratory rate etc. of elderly people in real-time. The data is transmitted to a data repository, where it will be stored and checked for any abnormality. Thus, any detection of disorder in a patient's vitals will be reported to patient's doctors and/or hospital in real-time to act on quickly and prevent a number of problems, such as, a sudden heart attack. Technologies are efficient in providing patients physiological information from their locations to physicians anywhere in real-time, therefore, enabling remote remediation [6, 7].

For example, data such as blood oxygen saturation, heart rate, and blood pressure can be measured via wearable devices, and transmitted from patient's locations to their doctors in real-time. This enables doctors and patients to communicate remotely. Providing such a system that will efficiently monitor an elder person's physiological activity at regular intervals could detect diseases and other difficulties earlier. Especially, in the case of elder people who are much likely to have a disorder in their physiological data. It is an utmost necessity to develop new methods and technologies so as to enhance health services for the elder community at a reasonable price with simple use while ensuring maximum comfort and independence. The goal was to detect signs of illness before traditional health care assessment.

Other than detecting the vital signs indicating disease condition, if the elder person is falling down, a system is needed to protect them since falling down due to ill condition is very common [8-10]. Hence, this paper presents a framework which utilizes a smart-phone app and wearable sensors along with Aurdino and IoT for Smart Healthcare Monitoring System (SHMS) in addition to air bag mechanism to protect elderly people when falling down. The system proposed in this paper enables continuous monitoring of elder people's health in real-time to prevent chronic diseases thus preventing hospitalization that burdens the healthcare systems and costs.

The organization of paper is as follows. Proposed system is explained in section II. Simulation results are detailed in section III. Hardware implementation and results discussion are described in section IV. The conclusion is presented in section V.

II. PROPOSED SYSTEM

In existing, till now, elder people require manual assistance for doing their daily activities. There were many technological developments implemented for adult healthcare. But, most of them are high cost and more weight [11, 12]. In this paper, a remote monitoring system for adult healthcare with low cost and efficiency is proposed. It is implemented using sensors to continuously monitor the health status of the elderly people and update them on the webserver using the IoT system. A pulse sensor is used to measure heart rate. Temperature sensor senses the temperature, and the respiratory sensor senses the respiration activity. Using MEMS sensor, the position of a person is identified. If an elder person is about to fall, the MEMS sensor senses the positional angle of that person, and before that person falls down, air bag mechanism operates and protects the elderly people. The block diagram of health monitoring of elderly people is shown in Figure 1.

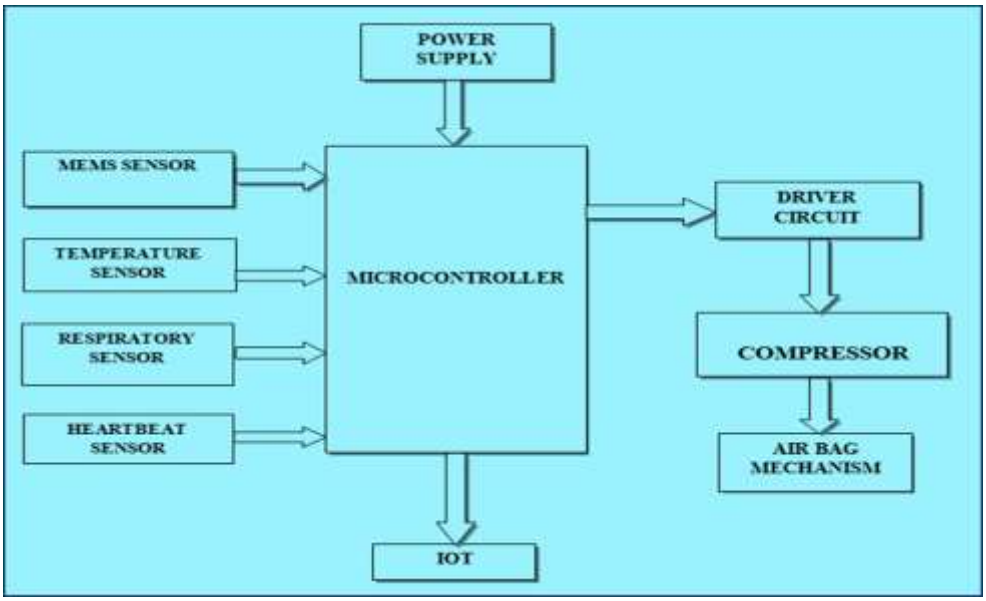

Figure 1. Block diagram of health monitoring of elderly people

All the sensors are connected to Arduino, and all measurements are sent to the patient's smart-phone application through a Bluetooth device. The mobile app will act as a gateway to transmit all patients' data to the cloud for data processing. The data is going to be available to access through multi-platform software like doctor's platforms, that is, website, to watch and interact with patient's data and everyone in real-time. This section highlights the variable components for developing the SHMS and implementing a prototype for the proposed system, which aims at

monitoring elder people's vital signs at their home. SHMS monitor the patient's physiological data using temperature sensor, pulse sensor, respiratory sensor, and MEMS sensor. All collected data will be transferred from sensors to gateway and cloud, which is to be processed to check any disorder or abnormality that is present with the collected data using machine learning concepts. Reports will be generated and sent to the patient's doctor and other parties that provide healthcare.

III. Simulation Results

The simulation is carried out using Proteus software. The simulation diagram of health monitoring of elder people under abnormal condition is shown in Figure 2. From the figure, it is clear that the MEMS sensor value is 47 degrees, and if it is greater than 45 degrees, which is set for this work, then the air bag mechanism will work and protect the elder people. Normally, the relay in the simulation diagram will be in open condition. Once the value in the MEMS sensor exceeds the set value of 45, the relay will close, and it is displayed as "FALLING" condition in the LCD display, closing the relay and running the motor to operate the airbag in front of the elder people to protect them.

The LCD display shows the health status of the elder people like temperature value as 99 degrees, heartbeat as 74 beats per minute and breathing rate as 19 breaths per minute. In this, Arduino is used for processing the measured physiological data. Aurdino has input and output pins. The sensors like temperature, heartbeat, respiratory and MEMS sensors are connected to the input pins of Arduino module. The output pins of Arduino are connected to the LCD display and relay. The Figure 3 shows the physiological data of elder people under normal condition where temperature is 99 degrees, breathing rate is 19 breaths per minute, heart rate is 74 beats per minute, and MEMS sensor value is 17 degrees.

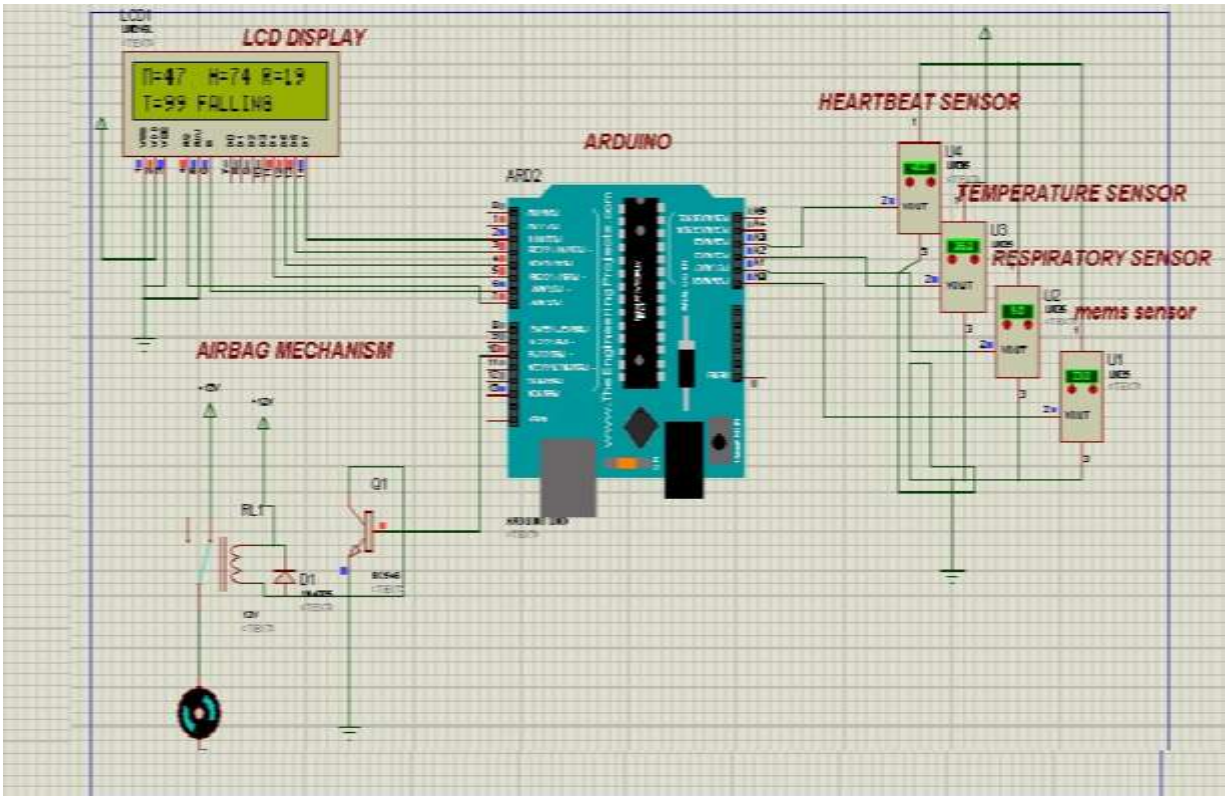

Figure 2. Simulation diagram of health monitoring of elder people under abnormal condition of MEMS sensor

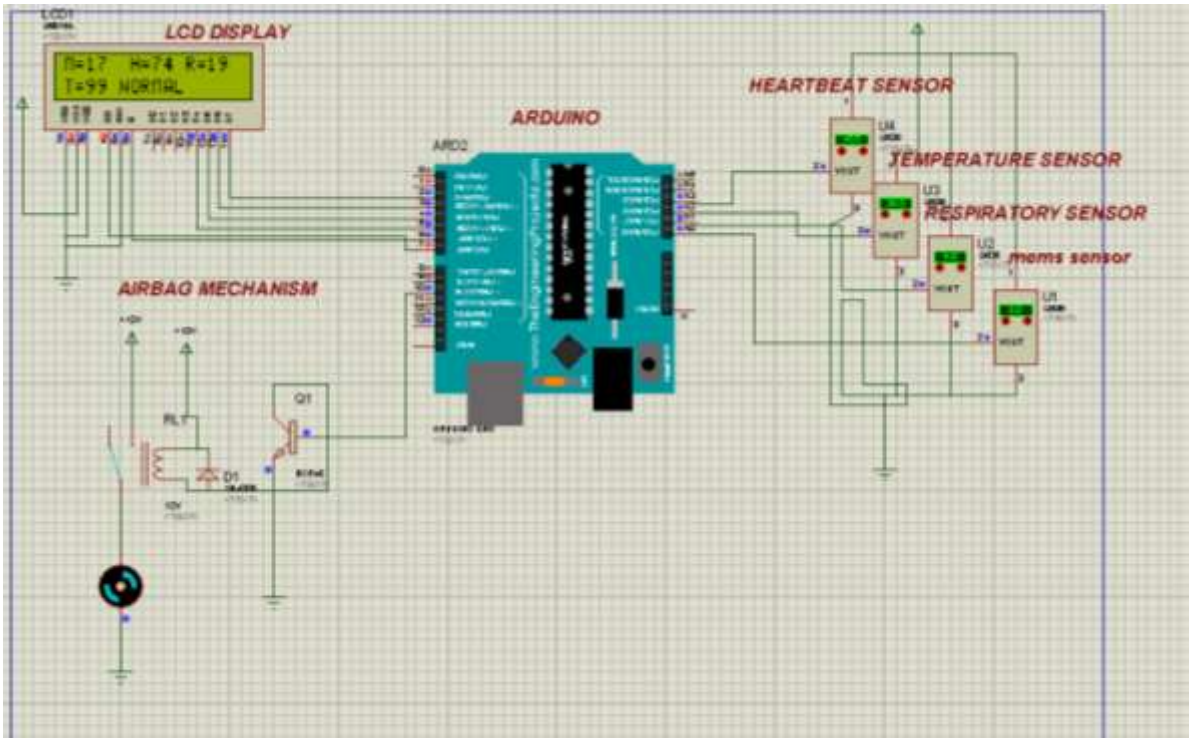

Figure 3. Simulation diagram of health monitoring of elder people under normal condition

IV. HARDWARE IMPLEMENTATION AND DISCUSSION OF RESULTS

The prototype of remote monitoring of elderly people is developed and tested under normal and abnormal conditions. The Figure 4 shows the hardware implementation picture. The various components used for hardware implementation are Aurdino UNO, temperature sensor, respiratory sensor, heart beat sensor, and MEMS sensor, LCD display and DC motor along with mobile app to see physiological data and messages. All the sensors are connected to the input side of the Arduino module, and DC motor and LCD display are connected to the output side of the module. Figure 5 shows the measurement of heart beat. The heart beat value is displayed in the LCD display and its value is 75 beats per minute.

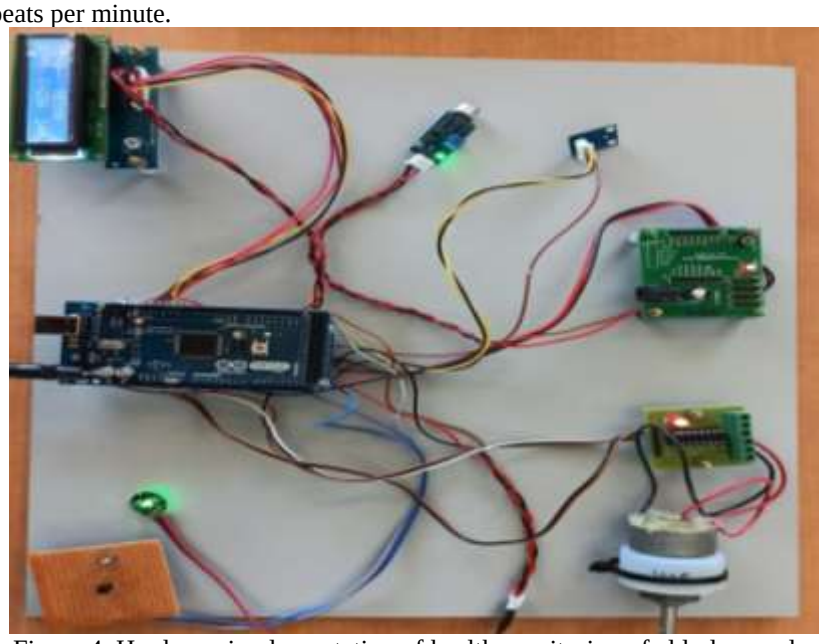

Figure 4. Hardware implementation of health monitoring of elderly people.

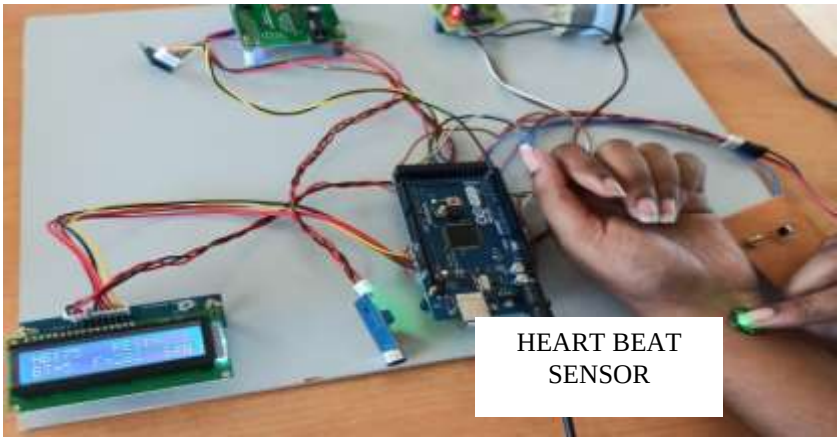

Figure 5. Heartbeat sensor measuring heart beat

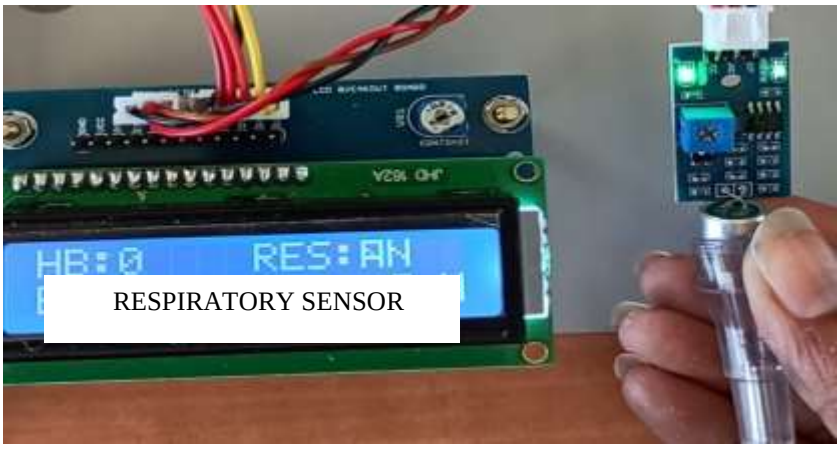

Figure 6. Respiratory sensor measuring respiratory rate

Figure 6 shows measurement of respiratory rate of elder people using respiratory sensor. If the breaths per minute or respiratory rate is more than 20 breaths per minute, the information will be send to the patient's mobile and the doctor's mobile using the app developed in the mobile. In the figure 6, since respiratory rate is greater than 20, it is marked as abnormal (AN).

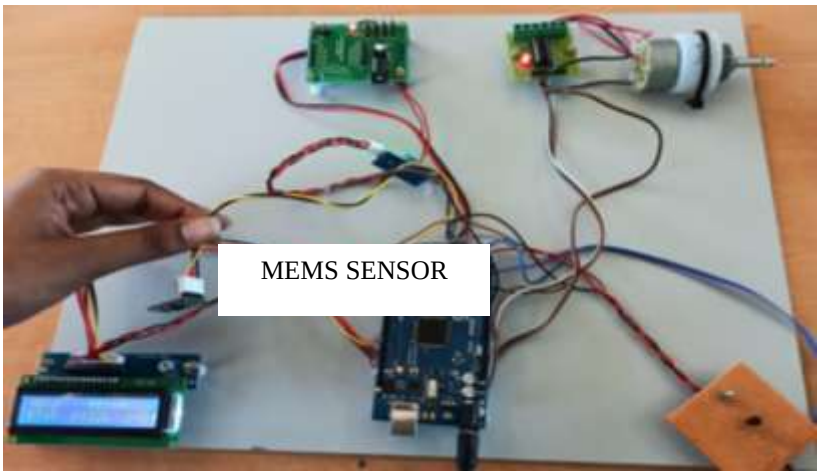

Figure 7. MEMS sensor measuring angle of elder people

Figure 7 measures the angle position of the elder people using MEMS sensor. When the value exceed the predetermined value of 45 degrees, it is indicated in the LCD display as abnormal (AN), and the motor will run which in turn will operate the air bag to protect the elder people before they fall. Figure 8 shows the measurement of temperature using temperature sensor which is displayed in the LCD display. Any abnormality in the vital signs of elder people such as temperature, heart rate, respiratory rate, and angle of the elder people will be informed to the elder people's relative and doctor for immediate treatment.

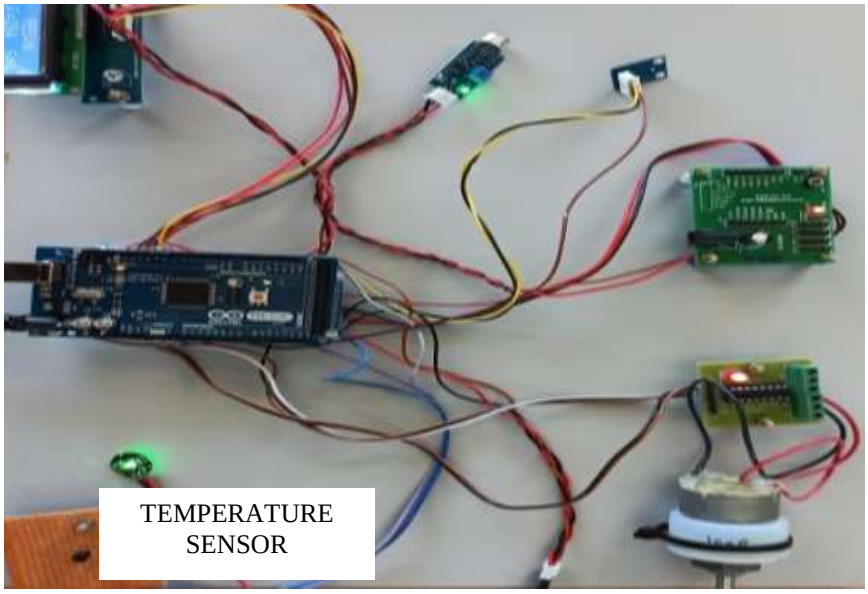

Figure 8. Temperature sensor measuring temperature

V. CONCLUSION

A remote monitoring of elderly people using Aurdino, IOT, mobile app, and sensors like temperature sensor, heartbeat sensor, respiratory sensor and MEMS sensor is developed to reduce the cost and burden of health monitoring system. The proposed health monitoring system prevents hospitalization and ensures safe and comfortable environment for elderly people. The physiological data of elderly people is sensed using the respective sensors and the physiological data is transformed to cloud for further processing of data. If any abnormality is found, the same is conveyed to the doctor and the relative of elderly people via mobile application. Airbag is operated before the elderly people fall by the detection of angle of the person, and it ensures good protection of elderly people from fall. Addition of few more sensors to enhance the monitoring of elderly people could be considered for future work

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