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Supervising Real Time Vital Signs of a Patient Using Fuzzy Logic

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Abstract: ***Over the last few decades healthcare monitoring systems have become a major concern thereby drawing attention of researchers worldwide. Due to increasing technology, the online telemedicine has proved to be cost-effective and useful in delivering timely and efficient healthcare services. These healthcare systems are mainly based on wireless technology integrated with sensor devices. The developing technological services, has led to revolutionary change in remote healthcare monitoring system by replacing the conventional bedside monitors with portable devices. Our proposed work mainly aims in providing timely medical assistance to elderly people who are suffering from heart ailment and to those who cannot visit hospital on regular basis. Our proposed system is designed to measure vital parameters like temperature and heart rate using sensor devices. With the help of Wi-Fi module, the system will continuously transmit the primary vital data of the patient to the server were fuzzy logic is applied to determine whether the patient is critical or not. If the patient is found to be critical then immediately an SMS and email will be sent to the patient's relative to notify them about the patient's condition.***
Keywords— healthcare services, Wi-Fi, sensor devices, medical assistance, fuzzy, primary vital data.

I. INTRODUCTION

The population is drastically increasing these days. Elderly people are more fragile to health problems and need a comprehensive health care system. Technological advancements have helped the healthcare applications to improve. As different machines are involved in the health care system to track patient's health there is always scope for improvement. Health care involves human life which cannot be endangered due to lack of advanced health care devices.

Continuous health care monitoring is necessary for the patients in hospitals or homes as well, so as to track the patient's body parameters and provide a consistent and reliable data to the doctors or the medical staff for diagnosis. Such an approach is particularly beneficial to old, physically challenged and those people who live alone and not be able to seek help in case of medical emergencies. Ever increasing population and rise in the number of patients has led to the shortage of staff resources in developing countries like India in the health care sector. Thus, healthcare sector requires new models for information handling and communication in order to guarantee quality-oriented health care of the elderly [4]. Frequent visits to the doctor or waiting in long queues is not possible for elderly people. This problem can be resolved by integrating various advanced technologies and data analytics in the healthcare monitoring system.

II. LITERATURE SURVEY

Karandeep Malhi et al [5] develop Zigbee smart non-invasive wearable physiological parameters monitoring device has been developed and reported in this paper. The system can be used to monitor physiological parameters, such as temperature and heart rate, of a human subject. The system consists of an electronic device which is worn on the wrist and finger, by an at risk person. Using several sensors to measure different vital signs, the person is wirelessly monitored within his own home. An impact sensor has been used to detect falls. 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 [6].

Otto, Jovanov and Milenkovic [7] in their paper describe a prototype system for continual health monitoring at home. The system consists of a modest wireless body area network (WBAN) and a home health server. The sensors of the WBAN monitor user's heart rate, mobile and locomotive activity and upload the information with time-stamp to the home server at regular intervals of time. The home server may integrate this information into the local database for the user's inspection or it may forward the information further to medical-server [8].

In the work "Heartbeat monitoring alert via SMS" [9], the heart beat rate is detected using photoplethysmograph (PPG) technique. This signal is processed using PIC16F87 microcontroller to determine the heart beat rate per minute. Then, it sends SMS alert to the mobile phone of medical experts or patient's family members, or their relatives via SMS. Thus, doctors can monitor and diagnose

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the patient's condition continuously and could suggest earlier precaution for the patients themselves. This will also alert the family members to quickly attend the patient. PPG is a simple and low-cost optical technique that can be used to detect blood volume changes in the micro vascular bed of tissue. Frequently, it is used non-invasively to make measurements at the skin surface. A PPG is often obtained by using a pulse oximeter which illuminates the skin and measures changes in light absorption. Typically, a PPG tools uses an emitter-receiver pair to determine blood flow. It consists of a matched infrared emitter and photodiode, which transmits changes in infrared reflectance resulting from varying blood flow. A heartbeat sensor circuit which adopted PPG technique is designed using MPLAB software [10].

III.SYSTEM OVERVIEW

The overview of the system is as shown in a figure 1. The hardware and software together create an integrated automated environment to detect the priority of the patient's body condition [1]. The system basically consists of two sensors which are used to collect the vital signs of a patient like body temperature and heart rate. These physiological parameters collected by sensors are sent to central server by Wi-Fi module. All the real-time data is stored at server side. Now, fuzzy logic is applied at server side on the gathered data of a patient to check the health status of patient whether he/she is critical or not. Therefore, on the basis of predefined condition, fuzzy logic will decide the status of a patient. In case of an emergency, a SMS and an email will be sent to his/her relatives.

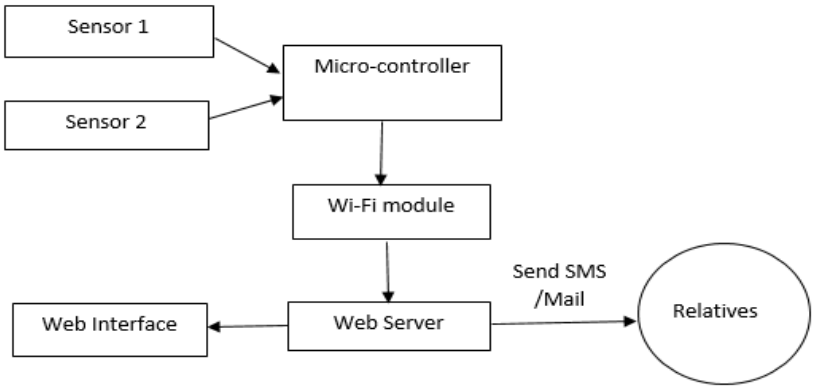

Fig. 1 Overview of the system

The overall system has been developed in two phase [1]. The first phase is designing and development of hardware sensor nodes [1]. The second phase is the development of software part where fuzzy rules are applied on gathered data to get the status of a patient. Both the phases are described below:

A. Hardware Development

In hardware development, we have used two sensors viz., temperature and heartbeat sensor. ATmega 16 development board is used to embed the sensors and Wi-Fi module as a transmitter [1]. LM35 temperature sensor is used for measuring body temperature which gives the output in analog form. Microcontroller uses analog to digital converter to measure the voltage and gives the output in degree Celsius.

Heartbeat sensor measures the heartbeat of a patient's body per minute which is also called as beats per minute(bpm). Pulse sensor works on the principle of near-infrared spectroscopy (NIR) [1]. NIR involves using light in wavelength of 700-900nm to measure blood volume [2]. Hemoglobin absorbs light emitted by infrared LED at the wavelength of 700-900nm which measures rate of flow of blood in patient's body. It gives the output in digital form. The hardware unit has 2 nodes viz., sensor node and Wi-Fi node. The system is developed on ATmega16/32(microcontroller) development board [1]. Sensor node is connected at port A of the controller and Wi-Fi node is connected at port D of the controller.Wi-Fi module is connected to data server using UART. Sensors are continuously sending the data through wifi module to central server using UART.

B. Software Development

The sensor node data is sent to the server where fuzzy rules are applied to determine whether the patient is critical or not. If the

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patient is critical then emergency message is sent through SMS and email to the patient's relatives.

Web interface enables several physicians, doctors, and medical centers to view and diagnose patient's medical status simultaneously [3]. Here the end user will set the range for heartbeat as well as temperature for checking the status of a patient. This range will help the system to decide whether the patient is critical or not with the help of pre-defined fuzzy rules. Now the system will check if the heartrate and temperature value of a patient is within the range or not which is specified by the experts. Based on this fuzzy rules will decide whether to send an emergency alert to the patient's relative or not depending upon the results of fuzzy rule set.

However, to ensure data visibility only to authorized doctor/physician, web portal requires user ID and password [3]. The data from the listening port is presented to the doctor on web portal in order to check medical status of the patient [3]. Web interface is developed with the help of asp.net framework. This web interface becomes the platform for the interaction between patient and the doctor as shown in Figure 2.

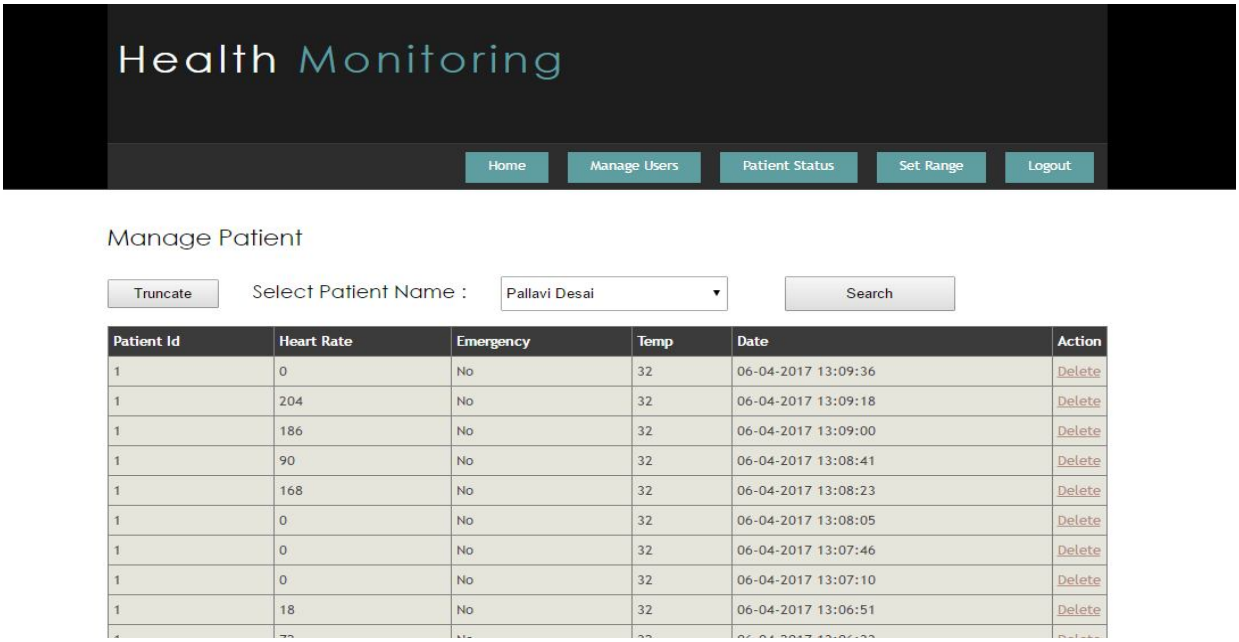

Fig. 2 Web interface for doctor-patient interaction

In case of emergency, an alert will be sent to the relatives of patient as shown in figure 3.

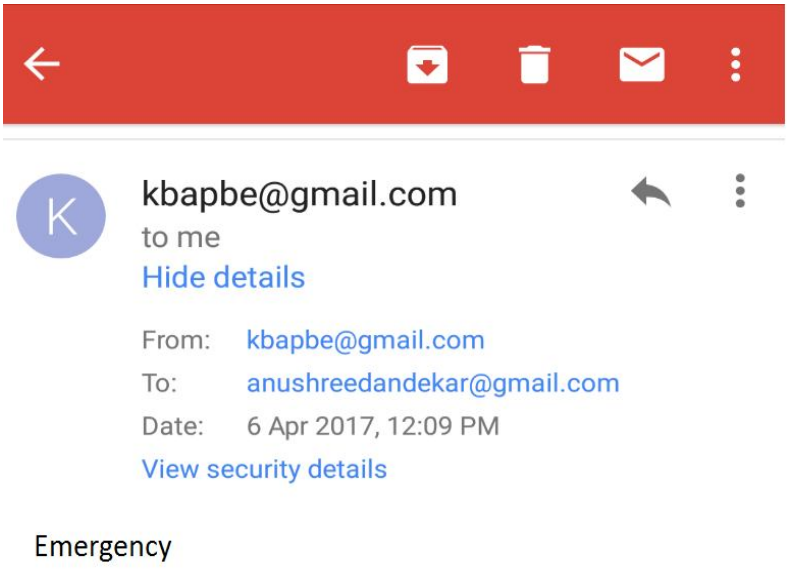

Fig. 3 Emergency Alert

IV. CONCLUSIONS AND FUTURE SCOPE

This paper indicates a real time patient monitoring system which can be deployed at home for elderly people who are suffering from heart ailment and for those who cannot visit hospital on regular basis. The proposed model can be enhanced by developing wearable sensor device which enhances the portability of the system and also accuracy can be added by integrating GPS module in the system. This GPS module will help to trace the location of patient in case of accident. The vision of the system in the future is to provide the patient with the real time prescription which can reduce the consultation time between the doctor and patient with the help of Artificial Intelligence system.

V. ACKNOWLEDGMENT

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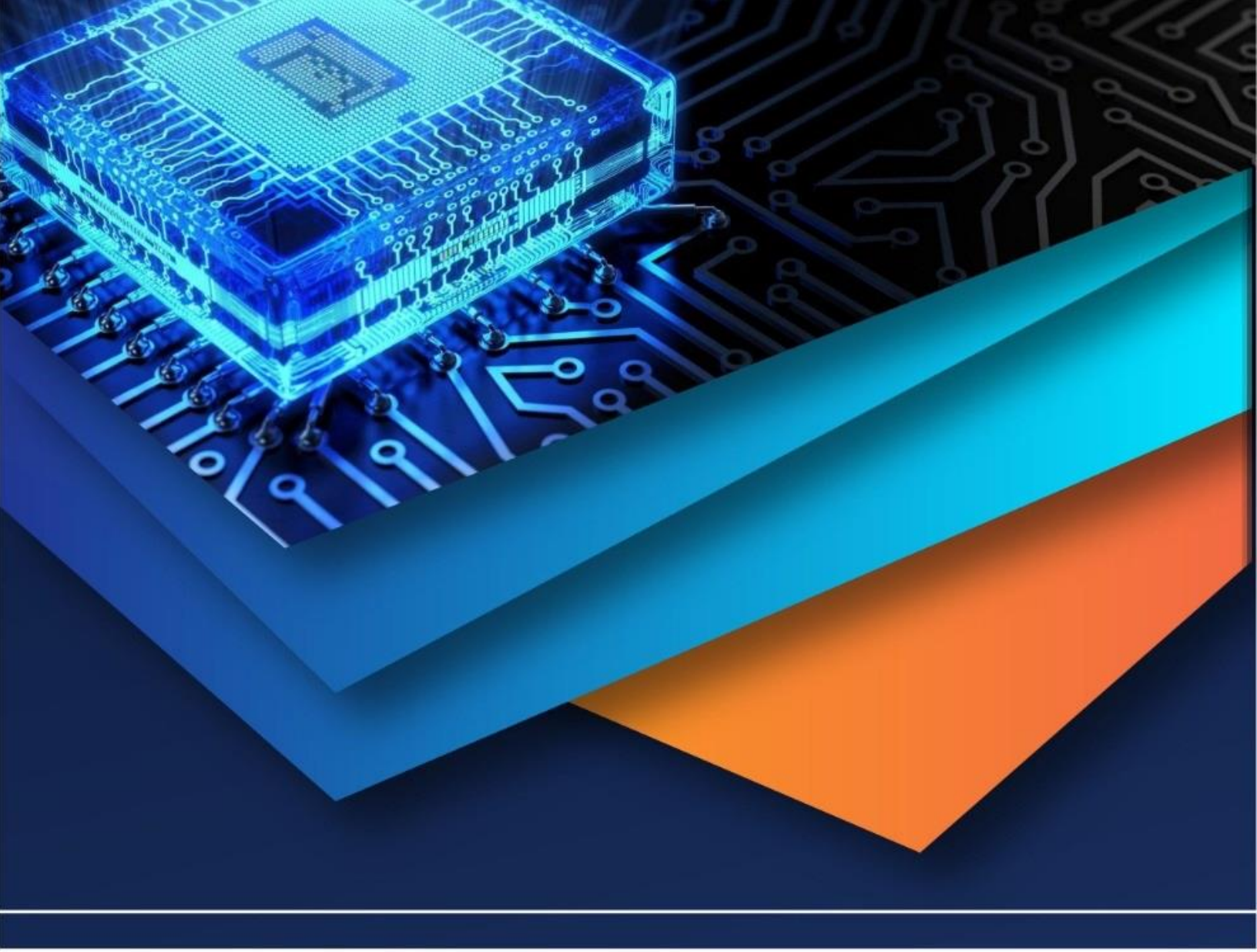

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