GSM based Patient Healthcare Monitoring System

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Abstract: **Modern healthcare monitoring system necessitate immediate data acquisition, accurate predictions, and swift medication responses. These systems are equipped with sensors to measure vital parameters like body temperature, heart rate and oxygen levels. The collected data is transmitted to a central control system for remote patient health analysis, effectively reducing the workload of medical professionals and ensuring precise results. Additionally, these systems employ GSM technology to enable parameter monitoring via mobile phones. Data from patients is processed through a microcontroller platform, typically Arduino Uno. Any anomalies reported by the patient trigger the system to send a message to the designated caretaker or physician providing essential data for future health assessments. Further enhancements such as timed medication remainders can transform this system into a real time application focused device, advancing patient care systems. When considering factors such as cost, configuration and efficiency, this system emerges as the most effective and cost-efficient solution compared to alternatives worldwide. Moreover, it offers invaluable assistance to patients residing in remote areas.**

Index terms: **Heartbeat, Arduino Uno, GSM technology, Real time clock**

I. INTRODUCTION

Heart disease is the primary cause of mortality among men and women in many countries. Within this category, heart attack, coronary heart disease, congestive heart failure and congenital heart diseases represent significant health challenges. The elderly, especially those requiring round the clock monitoring, are particularly susceptible to heart related issues. Many of them live alone, often without continuous care and support, further exacerbating their vulnerability.

Furthermore, healthcare services in remote areas of many countries are often undeserved, lacking the necessary infrastructure to provide adequate medical attention. There is a compelling case for the development and implementation of a remote monitoring system by considering all the above factors into account. The primary goal of this system is to transmit a patient's vital symptoms including body temperature and heart rate using the short message service (SMS) in conjunction with cost effective hardware components.

One of the distinctive features of this system is its ability to not only measure heart rate and body temperature but also display the recorded values on LCD screen. This innovative feature empowers patients to independently monitor their heart rate and body temperature. The system achieves this by employing heartbeat sensor circuit for heart rate detection and LM35 temperature sensor for accurate body temperature measurement. Arduino uno serves as the interface between these sensors and the system, collecting the necessary signals and processing them to generate valuable output.

The output data are subsequently transferred through the transmitter utilizing GSM module to send this information from the Arduino uno to the recipient, often medical expert in the form SMS messages. In terms of cost effectiveness, ease of setup and overall efficiency, this system shines as a highly efficient and profitable solution when compared to alternative systems worldwide.

Additionally, the advantages of this system extend to patients living in remote or isolated areas, providing them with essential healthcare support that might otherwise be challenging to access. If not only improves care of patients but also addresses that pressing issue of monitoring elderly individuals, enhancing their quality of life and overall well-being.

A. Objective

The main objective of this proposed system is:

i. Real-time calculation of the heart rate of a patient.
ii. Real-time calculation of the temperature of the human body.
iii. Display the calculated heart rate and temperature on the LCD module and send via SMS.
iv. Set the Alarm using a Real-time clock module for patient pill monitoring on a time-to-time basis.

B. Motivation

In a hospital setting, either a nurse or a doctor is required to physically move from one patient to another to conduct health checks. However, this approach may not enable continuous monitoring of patients and critical situations may go unnoticed until healthcare professional assesses the patient's health during their rounds. This can pose a significant challenge, especially for doctors who are responsible for patients in the hospital.

Our system addresses this issue by providing continuous monitoring of patient's health and ability to detect any abnormalities. The system continually collects and analyzes data from the patients under supervision. When it identifies any irregularities or concerning health parameters, it promptly notifies the designated caretaker or a doctor. This proactive approach ensures that critical situations are detected and acted upon in a timely manner, relieving the burden on healthcare providers and enhancing the level of care provided to patients in the hospital.

II. LITERATURE REVIEW

[1] studied research on patient's health monitoring system that is both flexible and scalable within the context of a 6LowPAN network. One significant limitation of

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existing approaches is the integration of various technologies and networking solutions. The Internet of Things (IoT) represents an outcome of synergistic collaboration across multiple fields, including telecommunications, computer science and electronics. Additionally developed CDMA- based ubiquitous disease management system tailored chronic illness. This innovative system aims to improving healthcare of patients by utilizing an expanded, simplified electrocardiogram (ECG) mobile phone diagnostic algorithm within the hospital, home or travel settings suggested by [2,3] and developed significant emerging trend is the expansion of Machine-to-Machine (M2M) capabilities into the wireless technology. Vendors are incorporating radio chips or modules that can be easily connected to nearly any device or machine, marking a notable shift in the industry. [4] developed a personal health diagnosis system that has been created based on a patient's symptoms, utilizing a variety of datasets to access both disease and patient's risk and pointed out that the innovations in the latest generation systems revolve around two key aspects. The introduction of continuous monitoring capabilities for patients and enhancement of workflow and productivity for medical staff. [5] also underscored the

significance of various technologies and their advantages in facilitating rapid communication. [6] developed a related development, a wearable sensor system designed for monitoring the movements of the patient. This system has been fine tuned to maintain an error rate below 5% by setting a threshold level. [7] developed IoT based system for monitoring of driver drowsiness and alert message to the driver to avoid accidents.

The proposed system measures human body temperature by placing fingers on a temperature sensor and monitoring the heartbeat by placing a fingertip on heartbeat sensor module. Moreover, the system can perform multiple functions including temperature measurement, real time clock (RTC) and alarm functionalities as well as monitoring heartbeat. It is equipped to send SMS notifications to the predefined mobile numbers stored within the system.

To implement this system, the hardware components are interfaced with an Arduino uno. The block diagram of the proposed system is shown in figure 1 and illustrating the various hardware components and their connections within the system.

III. IMPLEMENTATION
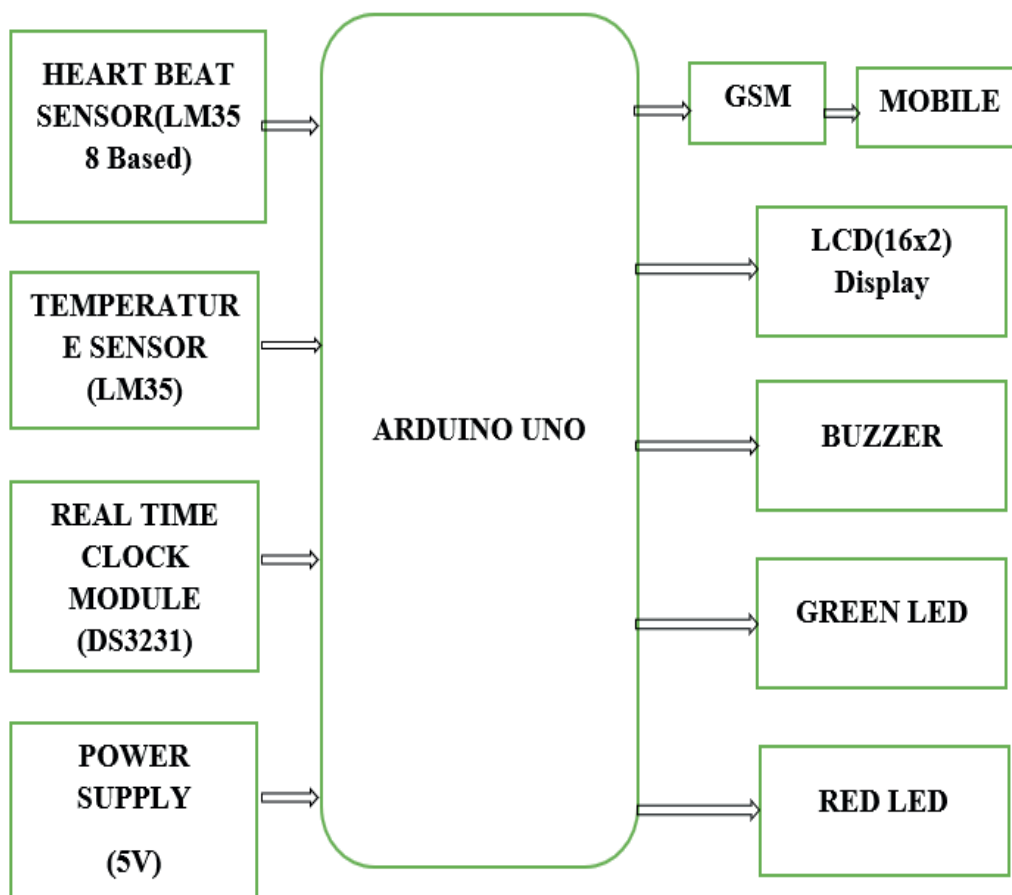
A. Block Diagram

Figure 1. Block diagram of the Proposed System

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Initially the Arduino Uno is interfaced with the heartbeat sensor which is based on the LM358 IC. Similarly, the Temperature Sensor (LM35) and Real Time Clock Module (DS321) are interfaced with Arduino in the appropriate way. These act as input sensors to the Arduino. The GSM, LCD Display, Buzzer, and LED (red, green) interface with Arduino. These sensors act as output Devices in the module. Here, the Arduino is the microcontroller-based controller that controls the whole process. Like Reading the inputs initializing the devices or sensors and turning off the sensors. Further, The GSM Module is responsible for sending the SMS to the concerned phone Number. The required code is dumped in the Arduino using Arduino IDE software.

The complete methodology of the system is explained by seeing the above block diagram. The system commences operation by establishing the connection between the power supply and the central control unit, Arduino. The input configuration includes the integration of a set of sensors comprising the heartbeat sensor, SPO2 sensor, temperature sensor, and real-time clock sensor. To enable data capture,

an initial step involves placing a finger on the heartbeat sensor and the temperature sensor. Subsequently, the gathered data undergoes tailored processing before being simultaneously relayed to both the LCD display and the GSM module for the purposes of display and communication. In case of any abnormalities, the system sends an alert message to the doctor or caretaker's mobile device. To ensure timely medication, the RTC module (DS3231) monitors the schedule and sets alarms when the patient needs to take prescribed medicines. When the patient's temperature exceeds 35°C, the RED LED activates and sends an alert message to the respective doctor for immediate attention. If the patient's heart rate falls below 60 or exceeds 100, the system triggers the buzzer and illuminates the RED LED. Furthermore, when the patient takes medication at the specified times, the GREEN LED lights up. Figure 2 illustrates the flowchart of the proposed system.
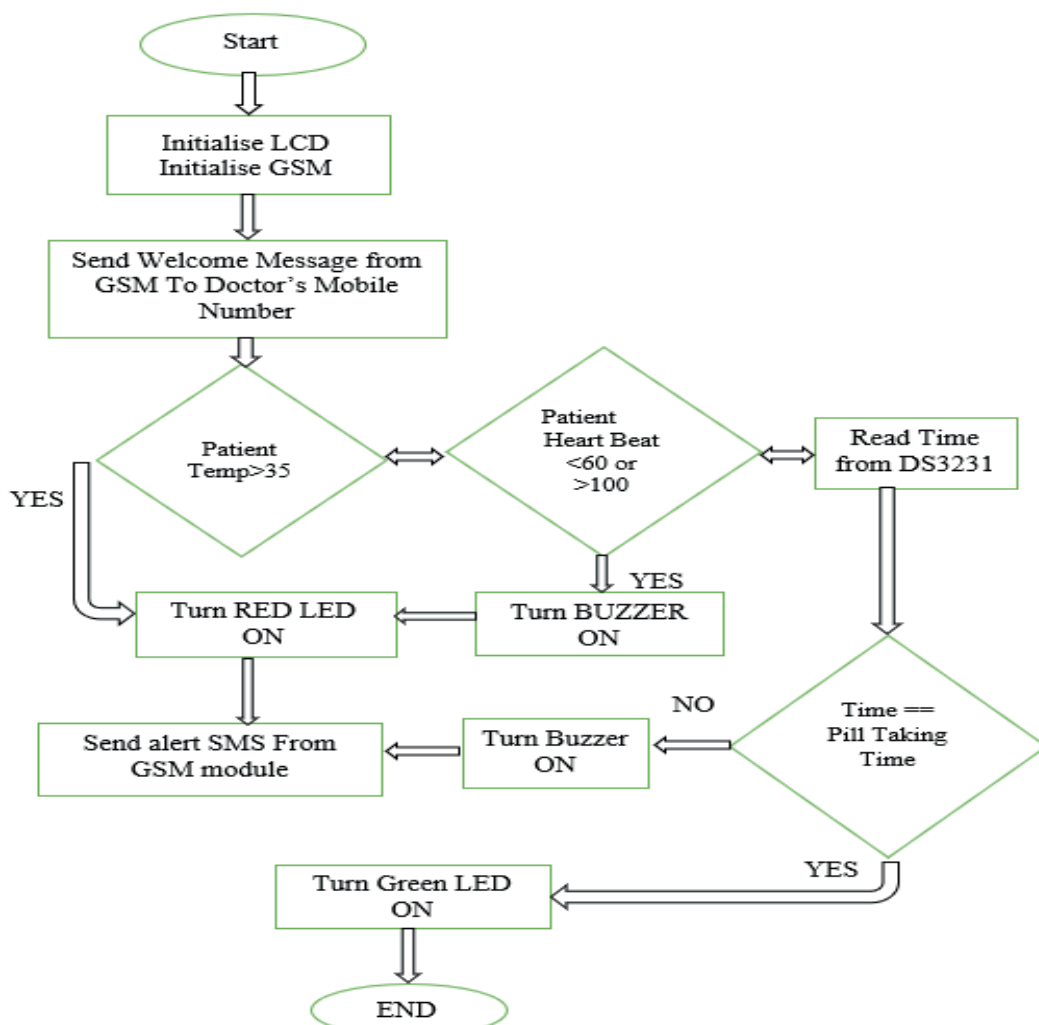
B. Flow Chart

Figure 2. Flow chart of the proposed system

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First, initialize the LCD monitor, enable the GSM module, and send the welcome message to the doctor's mobile number. The temperature sensor continuously monitors the patient's body temperature, and the heartbeat sensor continuously measures the heartbeat of the patient which is attached to the fingertip of the patient. If the patient's temperature is above the specified temperature i.e., 35°C or their heartbeat is above the normal heart rate i.e., below 60 or above 100, RED LED will glow and simultaneously get the sound from the buzzer which alerts the abnormal condition of the patient. The GSM module sent an alert message to the doctor and set a time for the patient to take proper medicine in order the maintain the body temperature and normal heartbeat.

IV. RESULTS

The proposed system demonstrates significant potential for applications within the healthcare industry, given its utilization of a compact controller and a diverse array of biosensors for remote data transmission. This system serves as a valuable tool for healthcare professionals to closely monitor the well-being of their patients. Harnessing data collected through comprehensive patient health assessments enables continuous monitoring of the overall health of individuals in need of ongoing care. Additionally, the system can be configured to set alarms for medication

adherence, and it measures vital signs such as temperature and heart rate through various biosensors. Table 1 provides a record of the patient's heart rate and temperature readings. Hardware setup is shown in figure 3 and figure 4 displays the patient's body temperature and heart rate on an LCD screen.

TABLE I.
BODY TEMPERATURE AND HEARTBEAT OF THE PATIENT

BODY TEMPERATURE (°C)	HEART-RATE (BPM)
35	73
34	74
36	69
35	79
36	73
31	73
34	73

Figure 3. Hardware Setup of the system

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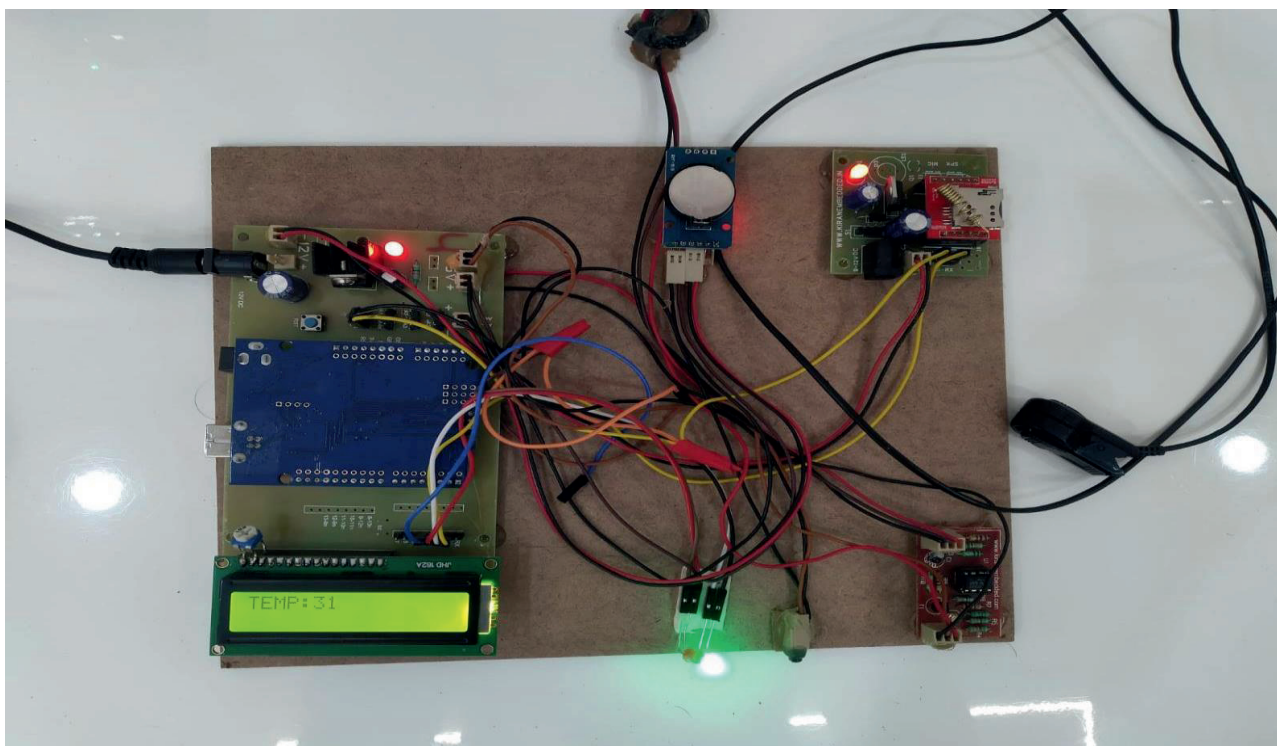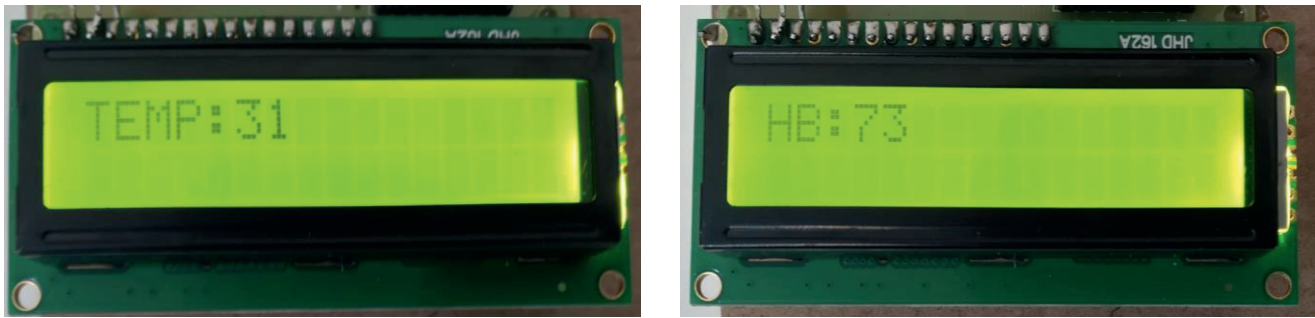
Figure 4. Display of body temperature and heartbeat of the patient

V. CONCLUSIONS

The proposed system not only allows for the evaluation of doctor's performance within hospital but also ensures that patients receive accurate and potentially life-saving treatments. Future enhancements to the system could involve the integration of blood pressure sensors and dental care monitoring systems, thus advancing its capabilities in monitoring of health. With precise experimentation, the system could transition into a real-time hospital environment, potentially saving numerous lives. Implementing quick, accurate, and real-time methodologies can further enhance the efficiency of the proposed system. An additional focus is on cost reduction, making it feasible for patients at all levels of disease severity to benefit from this system. The system measures body temperature by placing a finger on a temperature sensor and records the heartbeat by placing the fingertip on the Heartbeat sensor module. It then calculates both the temperature and heartbeat data, sending SMS messages to pre-stored mobile numbers in the system. Additionally, SMS is the optimal method for data transmission in critical situations, especially in rural areas where broadband communication is scarce.

The incorporation of both a blood pressure sensor and dental care monitoring systems represents a significant advancement in the ongoing development of the health monitoring system. This methodology can be extended to encompass various healthcare services and applications, including disease management and eldercare.

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