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IoT Based Patient Healthcare Monitoring System

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Abstract: ***The need for a health care monitoring system that provides instant sensing and precise predictions with prompt response is highly required. Recently, health care sensors are playing a key role in hospitals and home care for patients. The patient monitoring systems has become one of the most advanced technologies because of its ability to provide a higher level of information about the patient's condition The prototype model designed for the healthcare monitoring system is based on three main objectives: to monitor various physical parameters of patients, to detect if any emergency has occurred to the patient and to reduce the workload on the hospital staff. Physical parameters of the patients like pulse per minute and body temperature are sensed using biosensors like pulse rate sensor and LM35 sensor respectively. The sensor values are displayed on the LCD for constant monitoring. A buzzer is turned ON and an alert notification is sent to the caretaker, if any of the values crosses the threshold, indicating an emergency. A graphical representation is also displayed on the IoT platform for past analysis. An accelerometer is usedin this system to sense the movements of the patients and detect any fall or injury for senior citizens who prefer to stay at home and live independently, the system can communicate with caretakers to request for help if needed.***
Keywords: Arduino IDE, Healthcare, IoT, Pulse rate sensor, LM35 temperature sensor, ADXL335 Accelerometer

I. INTRODUCTION

The need for a health care monitoring system that provides instant sensing and precise predictions with prompt response is highly required. Recently, sensors based on healthcare are playing a pivotal role in hospitals and home care for patients.[7] The patient monitoring systems has become one of the most advanced technologies because of its ability to provide a higher level of information about the patient's condition. This proposed solution to the problem acts as a simple, effective Arduino-based system that can be used for remote monitoring by the patient's caretaker.[4] By means of a temperature sensor and pulse rate sensor, the patient's health can be continuously monitored. The use of an accelerometer also makes it possible to see if the patient has fallen from their current position to react immediately.[1] Remote monitoring is achieved by making use of the IoT platform that sends information to the caretaker.

II. OVERVIEW OF THE PROPOSED SYSTEM

The system will be based on Arduino Uno microcontroller because of its numerous advantages of Atmega328P and will have an open-source platform with advantage of physical computing. The proposed solution is a system that constitutes different sensors like Pulse Rate sensor and LM35 Temperature sensor along with Accelerometer module. [9][10] The main applications that the system will be able to perform is discussed below. The Pulse Rate sensor and the Temperature sensor will detect the patient's heartbeat per minute (BPM) and body temperature respectively and the values are displayed on the LCD screen. The accelerometer module detects if the patient has fallen off the bed and alerts the caretaker through IoT application ThingSpeak.[3]

III. HARDWARE PLATFORM

The system is developed using ATMEGA328P Arduino UNO, to collect data from pulse sensor, temperature sensor and Accelerometer. The block diagram of the proposed system shows the different components which will be useful to solve the problem.

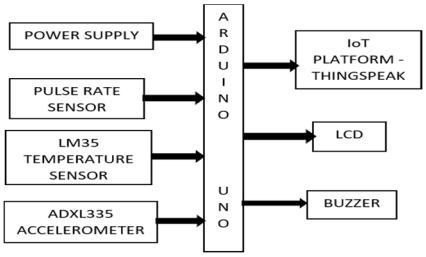

Figure 1: Block diagram

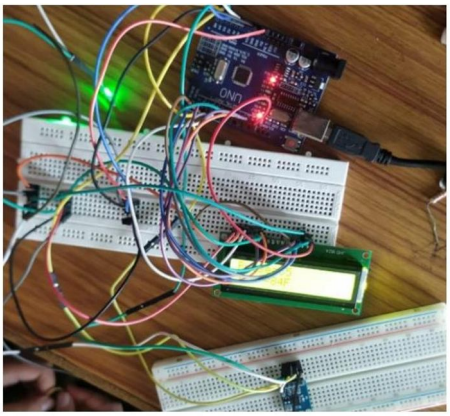

Figure 2: Hardware of Healthcare monitoring system

The Arduino is given a power supply. The data is acquired using the pulse rate sensor, LM35 sensor and an accelerometer. These sensors measure the patient's pulse rate, temperature and movement (if any) respectively. The Arduino logic checks for the specified threshold that can be modified as required alert the caretaker via buzzer and IoT platform. There is a continuous display of the sensor readings on the LCD as well.

A. Pulse Rate Sensor

The heartbeat sensor is based on the principle of photo plethysmography that measures the change in volume of blood through any organ of the body which in turn causes a change in the light intensity through that organ. (a vascular region)

Figure 3: Pulse Rate Sensor

B. LM35 Temperature Sensor

The LM35 temperature sensor is a sensor based on integrated circuit which is used to measure temperature. The output of this sensor is electrical and is proportional to the Celsius temperature.

Figure 4: LM35 Temperature sensor

C. ADXL335 Accelerometer Module

An accelerometer is a device module based on electromechanics, that is used for the measurement of force of acceleration. The output of this module is the acceleration force, only due to gravitational force.

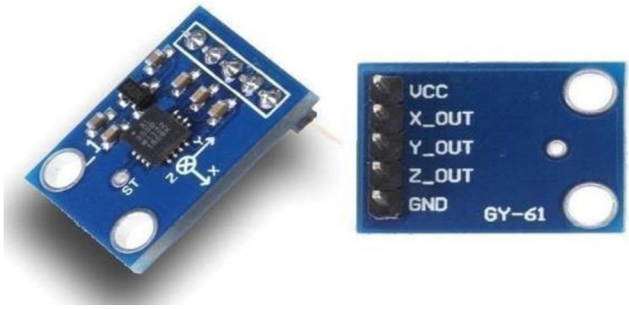

Figure 5: ADXL335 Accelerometer module

IV. RESULTS AND DISCUSSIONS

The LCD interfaced to Arduino UNO displays the measured sensor readings of temperature and pulse rate. The Wi-Fi module connected to Arduino UNO is programmed to send alert notifications to the respective mobile in case the temperature, pulse rate and accelerometer readings cross a threshold value is set to less than 100 F, sends alert notification "The temperature of the patient is high."

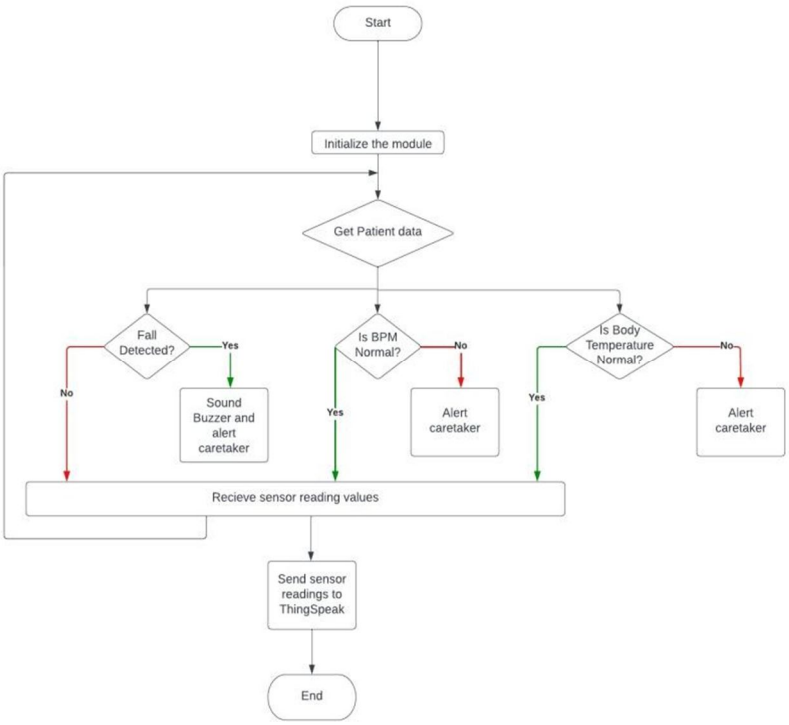

Figure 6: Data flow diagram of proposed solution

A. Algorithm

1) Step-1: Start
2) Step-2: Initialize variables to acquire patient data
3) Step-3: Continuously send data to ThingSpeak for monitoring.
4) Step-4: Based on stored values, current values are checked.
5) Step-5: If the threshold of the values is crossed, the caretaker is alerted.
6) Step-6: Stop

From the above flow diagram, it has been observed that the required modules are initialized and required variables are declared. Then, using the sensors interfaced with the Arduino, the patient's data is collected.The temperature and BPM readings are sent to the ThingSpeak application. The collected data is then analyzed based on the program logic. In case of any discrepancies in the patient data, the caretaker isnotified. The patient data is continuously collected from the sensors and made convenient for the caretakerfor monitoring using the real-time graph on ThingSpeak.

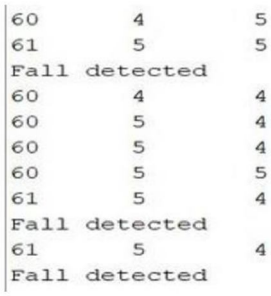

Figure 7: Readings of Accelerometer

V. CONCLUSION

The patient healthcare system serves people by acquiring a patient's health conditions andmovement which have been analyzed based on a working algorithm using Arduino microcontroller. The Patient Healthcare Monitoring System thus developed, efficiently tracks body temperature andpulse rate of a person and detects any movement which will lead to the fall of the patient. It successfully provides reliable service of constant remote monitoring.

VI. FUTURE SCOPE

Patient health monitoring system can be further developed to include vital body parameters like Respiration Rate and Blood Pressure using appropriate sensors. Some more measures which are very significant to determine a patient's condition like the level of diabetes can be addressed in future work. This would ensure complete remote monitoring of the patient. A graphical user interface canbe developed and provided with an authentication system to allow multiple patient monitoring by the same caretaker. Although the system looks somewhat bulky, it will be a tiny device with proper manufacturing in the near future.

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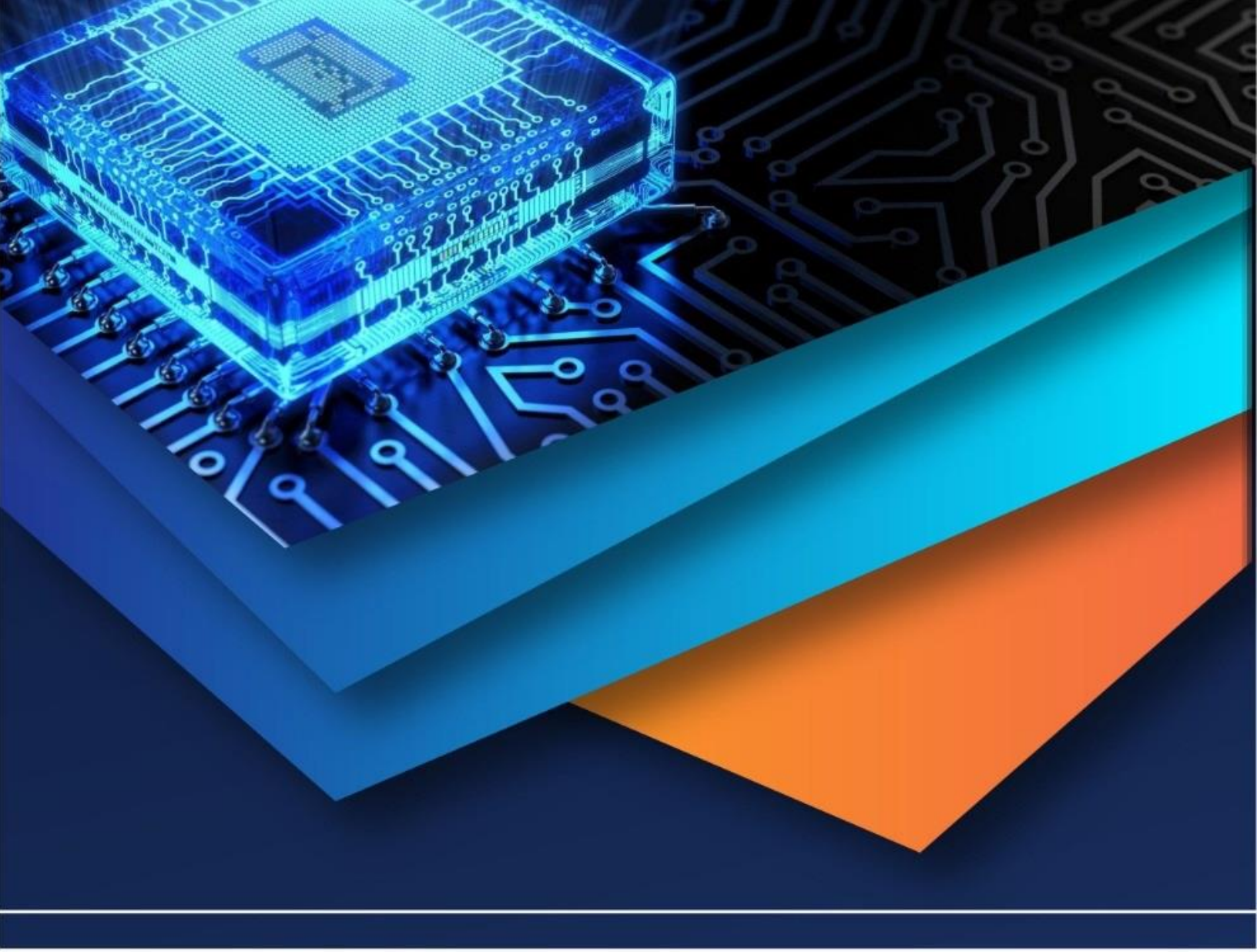

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