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GSM Based Elderly Health Monitoring System

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ABSTRACT

The increasing need for continuous health monitoring among elderly people has led to the development of smart healthcare systems. This paper presents a GSM-based elderly health monitoring system designed to track vital parameters such as body temperature, heart rate, and oxygen saturation (SpO_2) in real-time. The system uses biomedical sensors integrated with a microcontroller to collect patient data and transmit it through GSM technology to caregivers or medical professionals. In case of abnormal readings, the system automatically sends alert messages, ensuring immediate attention and reducing health risks. This solution is cost-effective, portable, and easy to use, making it suitable for home-based healthcare monitoring. The proposed system enhances patient safety, supports remote monitoring, and reduces the need for frequent hospital visits.

Keywords: *GSM, Elderly Care, Health Monitoring, Sensors, Remote Monitoring.*

1. INTRODUCTION

In today's modern world, monitoring the health condition of elderly people has become very important. As people age, they are more prone to health issues such as heart problems, fever, and low oxygen levels. Continuous monitoring is not always possible manually, especially when family members are not around.

To solve this problem, this project proposes a **GSM-based elderly health monitoring system**. This system continuously monitors important health parameters such as:

i. Body Temperature
ii. Heart Rate
iii. Blood Oxygen Level (SpO_2)

The collected data is displayed on an LCD screen and, in case of abnormal conditions, an alert message is sent via GSM to caregivers or family members.

2. PROBLEM STATEMENT

i. Lack of continuous health monitoring
ii. Delay in emergency medical response
iii. Difficulty in monitoring elderly people remotely
iv. Need for a low-cost and reliable monitoring system

This project aims to overcome these challenges using an embedded system.

3. OBJECTIVES

i. To design a real-time health monitoring system
ii. To measure temperature, heart rate, and SpO_2 levels
iii. To display the data on an LCD screen
iv. To send SMS alerts using GSM during emergencies
v. To develop a low-cost and portable system

4. LITERATURE REVIEW

Several health monitoring systems already exist, such as:

i. IoT-based health monitoring systems
ii. Bluetooth-based wearable devices
iii. Smart health bands and watches

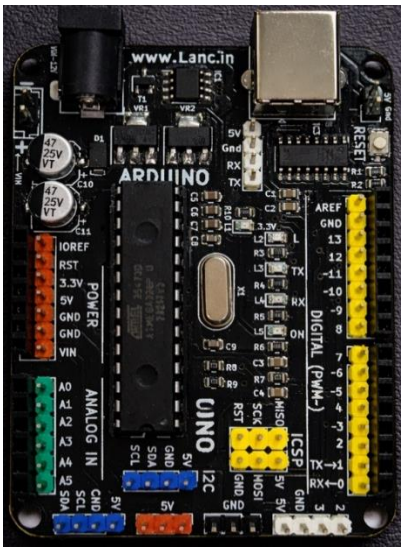
Limitations of Existing Systems:

i. Dependence on internet connectivity
ii. High cost
iii. Limited range (Bluetooth systems)

iv. Lack of real-time alert systems in some cases
v. This project improves upon these systems by using GSM technology, which works without internet and provides long-distance communication.

5. COMPONENTS DESCRIPTION (MAIN PART)

5.1 Arduino Microcontroller



The Arduino Uno is a powerful and reliable microcontroller board based on the ATmega328P, designed for students, beginners, and professionals working on embedded and IoT projects. It provides a simple and flexible platform to build electronics projects, automate systems, and develop innovative prototypes.

Our custom version features **color-coded Berg strip headers** for easy pin identification and **dual I/O ports** for better expansion and organized connectivity. The board is designed for practical product development, offering stable performance and a user-friendly layout.

To begin using it immediately, simply connect the board to your computer using a USB cable, or power it with an external adapter or battery. It contains everything required to support the microcontroller, making it perfect for learning, prototyping, and real-world applications.

Function:

i. Reads data from all sensors
ii. Processes the data
iii. Controls output devices like LCD and GSM

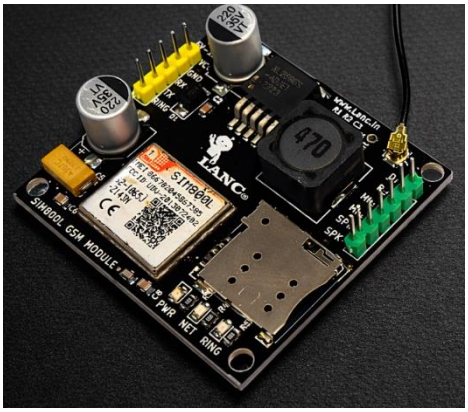
Working:

i. Sensors send analog /digital signals
ii. Arduino processes the signals using programmed logic
iii. Outputs are generated accordingly

Advantages:

i. Easy to program
ii. Low cost
iii. Highly flexible

5.2 GSM Module (SIM800L)



The SIM800L GSM Module is a compact quad-band GSM/GPRS communication module that enables embedded systems and microcontrollers to connect to cellular networks. It allows devices to send and receive SMS messages, make voice calls, and transmit data over GPRS, making it ideal for IoT, remote monitoring, automation, and wireless communication projects.

The module communicates with microcontrollers such as Arduino, ESP32, STM32, Raspberry Pi, and other development boards through a UART serial interface using AT commands. With its small size and low power consumption, the SIM800L is widely used in portable and battery-powered applications.

The SIM800L supports quad-band GSM frequencies (850 / 900 / 1800 / 1900 MHz), allowing it to operate on most GSM networks worldwide.

Function:

i. Sends SMS alerts to users

Working:

ii. A SIM card is inserted into the module
iii. Arduino sends AT commands to GSM
iv. When abnormal conditions are detected, SMS is sent

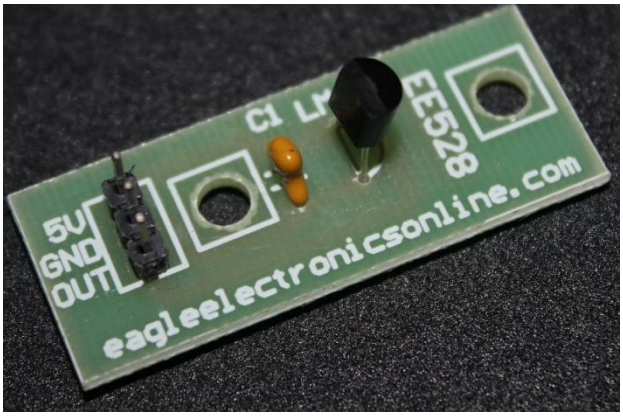
Example Message:

"ALERT! Heart Rate is High"

Advantages:

i. No internet required
ii. Works over long distances

5.3 Temperature Sensor (LM 35)



The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1/4°C at room temperature and ±3/4°C over a full -55 to +150°C temperature range

Function:

i. Detects temperature from the human body

Working:

i. Converts heat into electrical signals
ii. Arduino reads and converts it into temperature value

Normal Range: 36°C to 37°C

5.4 HW-827 Pulse Heart Rate Sensor

Pulse rates are measured via this module. The most important is that it be worn on a finger or on the earlobe. The XD-58C pulse sensor is commonly used to assess heart rate in medical equipment. Pulse Sensor Amped improves the hardware by including amplification and noise cancellation electronics. Getting accurate pulse measurements is much faster and easier. The Pulse Sensor can be used with a 3V or 5V Arduino.

Function: Measures beats per minute (BPM)

Working:

i. A finger is placed on the sensor
ii. Light is emitted and reflected by blood flow
iii. Pulse signal is detected and calculated

Output: BPM (Beats Per Minute)

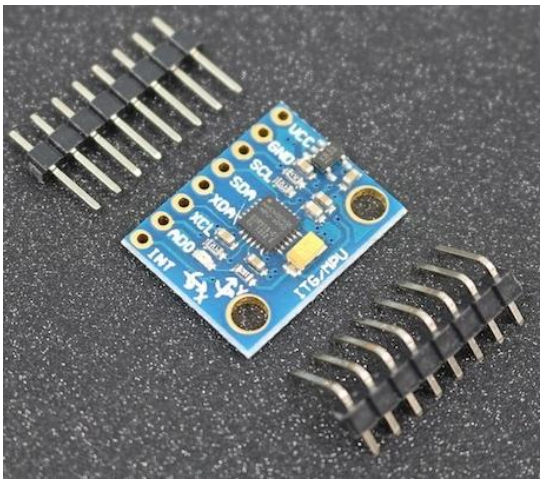
Advantages:

i. Accurate readings
ii. Easy to use

5.5 Motion Sensor (MPU-6050**)**

The MPU-6050 is a serious little piece of motion processing tech! By combining a MEMS 3-axis gyroscope and a 3-axis accelerometer on the same silicon die together with an on board Digital Motion Processor™ (DMP™) capable of processing

complex 9-axis Motion Fusion algorithms, the MPU-6050 does away with the cross-axis alignment problems that can creep up on discrete parts



5.5.1. Accelerometer (3-axis)

Measures **linear motion**

Detects:

- Forward / backward
- Left / right
- Up / down

Output: X, Y, Z acceleration values

5.5.2. Gyroscope (3-axis)

Measures **angular rotation**

Detects:

- Tilt
- Rotation speed
- Orientation

Output: X, Y, Z rotation values

5.5.3 Working Principle

Uses **MEMS (Micro Electro Mechanical System)** technology

Inside tiny structures sense:

- Motion → change in capacitance
- Rotation → Coriolis effect

Data is processed and sent digitally via **I2C communication**

5.5.4. Features

6-axis (3 accel + 3 gyro)

Built-in **Digital Motion Processor (DMP)**

I2C communication (easy with Arduino)

Low power consumption

Compact size

Includes temperature sensor

5.6 16x2 LCD Display

This 16X2 LCD Display Module is useful to interface with any kind of microcontroller target boards like 8051, AVR, aurduio and any other processors. The module comes with 4 bit data and 3 bit control pins. The LCD Contrast can be varied with the potentiometer provided on board.

Function:

Displays temperature, heart rate, and SpO_2

Example Display:

Temp: 36°C

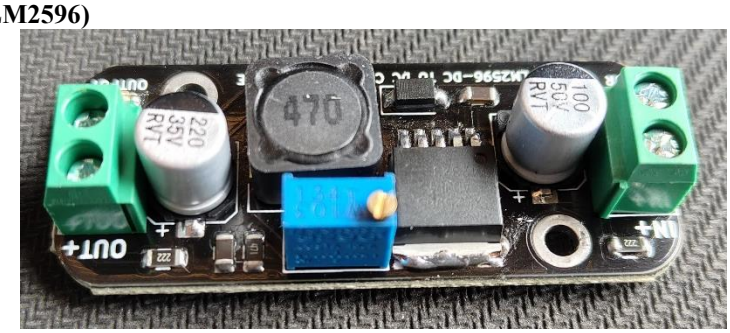
HR: 72 BPM

SpO_2: 98%

Advantages:

Easy to read
Real-time monitoring

5.7 Power Supply Module (LM2596)



DC-DC Buck Converter Step Down Module LM2596 Power Supply is a step-down(buck) switching regulator, capable of driving a 3-A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, and an adjustable output version.

The LM2596 series operates at a switching frequency of 150kHz, thus allowing smaller sized filter components than what would be required with lower frequency switching regulators.

Function: Regulates voltage
Working: Converts higher voltage to required level
Advantages:

i. Protects components
ii. Ensures stable operation

Coding:

```
#include <Wire.h>
#include <LiquidCrystal.h>
#include <SoftwareSerial.h>
#include <MPU6050.h>
#include <PulseSensorPlayground.h>

// LCD
LiquidCrystal lcd(7, 6, 5, 4, 3, 2);

// SIM800L
SoftwareSerial sim800(10, 11);

// MPU6050
MPU6050 mpu;

// Sensors
const int PulseWire = A0;
int lm35Pin = A1;

PulseSensorPlayground pulseSensor;
int Threshold = 500;

// MPU values
int16_t ax, ay, az;
int16_t prev_ax = 0, prev_ay = 0, prev_az = 0;

bool alertSent = false;

void setup() {
  Serial.begin(9600);
  sim800.begin(9600);

  lcd.begin(16, 2);
  lcd.print("Patient Monitor");
  delay(2000);
  lcd.clear();

  // MPU
  Wire.begin();
  mpu.initialize();

  // Pulse
  pulseSensor.analogInput(PulseWire);
```

```
  pulseSensor.setThreshold(Threshold);

  if (pulseSensor.begin()) {
    Serial.println("Pulse OK");
  } else {
    Serial.println("Pulse ERROR");
  }
}

void loop() {

  // 🌡️ Temperature
  int tempVal = analogRead(lm35Pin);
  float voltage = tempVal * (5.0 / 1023.0);
  float temperature = voltage * 100;

  // ❤️ BPM
  int myBPM = pulseSensor.getBeatsPerMinute();

  // 🦾 MPU
  mpu.getAcceleration(&ax, &ay, &az);
  int diff = abs(ax - prev_ax) + abs(ay - prev_ay) + abs(az - prev_az);

  prev_ax = ax;
  prev_ay = ay;
  prev_az = az;

  // 📺 LCD Display
  lcd.setCursor(0, 0);
  lcd.print("T:");
  lcd.print(temperature, 1);
  lcd.print("C   ");

  lcd.setCursor(0, 1);
  lcd.print("BPM:");

  if (pulseSensor.sawStartOfBeat()) {
    lcd.print(myBPM);
    lcd.print("   ");
  } else {
    lcd.print("--- ");
  }

  // 🚨 MOVEMENT ALERT ONLY
  if (diff > 18000 && !alertSent) {

    sendSMS("ALERT: Patient Movement Detected!");

    lcd.clear();
    lcd.print("Movement Alert!");
    delay(2000);
    lcd.clear();

    alertSent = true;
  }

  if (diff < 2000) {
    alertSent = false;
  }

  delay(1000);
}

// SMS
void sendSMS(String msg) {
  sim800.println("AT+CMGF=1");
```

```
  delay(1000);

  sim800.println("AT+CMGS=\"+91XXXXXXXXXX\"");
  delay(1000);

  sim800.println(msg);
  delay(100);

  sim800.write(26);
  delay(3000);
}
```

6. METHODOLOGY

Working Process:

Sensors collect health data
Arduino reads and processes the data
Values are displayed on LCD
System checks for abnormal values
If abnormal → GSM sends SMS alert

7. BLOCK DIAGRAM EXPLANATION

Sensors → Arduino → LCD Display
Arduino → GSM Module → Mobile
Power Supply → All components

8. RESULTS AND DISCUSSION

Results:

i. Temperature measured accurately
ii. Heart rate detected correctly
iii. SpO_2 values displayed properly
iv. SMS alerts received successfully

Performance:

i. System is reliable
ii. Low power consumption
iii. Fast response

Advantages:

i. Low cost
ii. Easy to use
iii. Portable
iv. Real-time monitoring

9. CONCLUSION

This project successfully demonstrates a GSM-based elderly health monitoring system. It continuously monitors vital health parameters and sends alerts during emergency situations.
The system is cost-effective, easy to implement, and highly useful for elderly care.

10. FUTURE SCOPE

i. Integration with mobile applications
ii. Cloud data storage
iii. AI-based health prediction
iv. Wearable device integration
v. GPS tracking for location

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