THE HUMAN SAFETY DEVICE

A Project Report submitted in partial fulfillment of the requirements for the degree of

Bachelor of Technology

In

Electronics and (Communication/Instrumentation Engineering)

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Certificate

This is to certify that the Project entitled "***THE HUMAN SAFETY DEVICE***" has been carried out by ***ANAMIKA NAG,ANNAPURNA NAYAK,DEBESEE RATH,M.MANISHA PATRA,NIBEDITA MAHARANA,RISHITA SATAPATHY*** under my guidance and supervision and be accepted in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology** in **Electronics and Communication/Instrumentation Engineering** under Silicon University, Bhubaneswar.

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Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been include. We have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/sources in our submission. We understand that any violation of the above will be cause for disciplinary action by the institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

GROUP 2
ECE-C2

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Place:Bhubaneswar
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Department Vision, Mission and PEOs

Vision…

To be recognized as a beacon of quality education and research in the field of Electronics and Communication Engineering

Mission…

1. Continually improve the standard of our graduates by having high caliber motivated faculty members together with quality educational programs and facilities in-line with the rapid technological advancements in the field of Electronics and Communication Engineering (Knowledge, Skill and Quality).

2. Provide a balanced regime of quality education that incorporates theoretical and practical education, innovation and creativity as well as freedom of thought and research with emphasis on professionalism and ethical behavior (Professionalism & Ethics).

3. Promote and support research activities over a broad range of academic interests among students and staff for growth of individual knowledge and prepares for continuous learning (Research and Life-long Learning).

PEOs of the Program

PEO1. Fundamental Knowledge & Core Competence: To provide knowledge of science and engineering fundamental for an electronics & communication engineer and equip with proficiency of mathematical foundations and inculcate competent problem solving ability.

PEO2. Competency for Real World: To design, optimize and maintain electronics and communication systems in tune with community needs and environmental concerns.

PEO3. Professionalism & Social Responsibility: To exhibit leadership capability, triggering social and economical commitment and inculcate community services and protect environment

PEO4. Life-long Learning: To pursue higher studies or engage in a technical or managerial role in diverse teams, grow professionally in their career through continued education & training of technical and management skills.

Abstract

This project presents the development of a portable, low-cost human safety device designed to provide real-time health monitoring and emergency response, especially for elderly individuals and people with health vulnerabilities. The system integrates embedded sensors, GSM, and GPS modules to detect abnormal health events—such as sudden falls—and instantly alert pre-defined contacts via SMS, without the need for internet connectivity. It features a fall detection algorithm, manual emergency trigger, audible buzzer for local alerts, and accurate real-time location tracking. The device addresses the limitations of existing health monitoring systems that rely heavily on internet access and are often prohibitively expensive. With a focus on standalone operation, minimal false alarms, and reliable performance even in remote areas, the project offers a practical solution for enhancing personal safety. Future enhancements may include AI-based predictions, SpO_2 monitoring, app integration, and solar power support for improved usability and autonomy.

CONTENTS

Chapter 1

INTRODUCTION

Introduction

In today’s fast-paced world, ensuring personal safety—particularly for vulnerable populations such as the elderly or individuals with chronic health conditions—has become a significant concern. With the increasing demand for real-time health monitoring and emergency response systems, wearable safety devices have gained considerable attention. However, many of these existing systems come with limitations such as high cost, reliance on constant internet connectivity, and limited accessibility in remote or low-network regions.

Most commercially available health monitoring solutions, such as smartwatches or fitness bands, are equipped with features like fall detection and vital sign tracking. While these are useful, their effectiveness is often hindered by the need for internet-based platforms and expensive cloud subscriptions. In remote areas, where internet access is unreliable or completely absent, such devices fail to offer dependable protection. Furthermore, in critical moments, any delay in communication or alert delivery can result in serious consequences.

To address these challenges, our project proposes a low-cost, portable, and standalone human safety device that combines the capabilities of GSM and GPS modules with embedded sensors for real-time health monitoring. The device functions without any dependence on the internet, making it ideal for use in both urban and rural settings. It is specifically designed to detect emergency situations—such as falls or abnormal temperature changes—and respond instantly by sending SMS alerts with real-time GPS location to predefined emergency contacts. Additionally, it features a buzzer for audible alerts and a manual emergency button for immediate assistance.

The project is driven by the objective of creating a reliable, accessible, and easy-to-use safety system that empowers users with timely help during emergencies. By leveraging commonly available technologies in an innovative and cost-effective design, this device aims to bridge the gap between advanced health monitoring systems and the practical needs of people in underserved areas. This initiative not only enhances individual safety but also contributes to the broader goal of inclusive and technology-driven Healthcare system

Chapter 2

LITERATURE SURVEY

In recent years, the development of wearable health and safety devices has gained momentum due to growing interest in personal health monitoring, especially for the elderly and individuals with chronic health conditions. Numerous studies and commercial solutions have been introduced, focusing on real-time health tracking, fall detection, and emergency alert systems. However, several limitations continue to persist, which this project aims to address.

Previous research, such as the study by Wu et al. (2015), highlights the development of wearable fall detection systems using triaxial accelerometers integrated with GSM/GPS modules. Their system was designed to detect sudden body movements and transmit alert messages in emergency situations. However, issues related to battery efficiency and integration of multiple sensors remained partially unresolved.

Similarly, Degen and Jäckel (2013) introduced "SPEEDY", a wristwatch-based fall detector utilizing GSM, GPS, and ZigBee technologies. While the compact design and wireless communication features were notable, the system still depended heavily on reliable network infrastructure and faced challenges with sensor accuracy and false alarms.

Existing commercial products, such as smartwatches with health tracking features, provide fall detection and heartbeat monitoring. However, most of these devices depend on continuous internet connectivity for data synchronization and alert notifications. This reliance limits their use in areas with poor internet coverage, rendering them less effective in remote or rural settings. Moreover, the high cost of these devices and their subscriptions often restricts access for economically disadvantaged populations.

Studies have also identified gaps in integration and functionality. While GSM-based communication solutions do exist, many lack synchronization with real-time sensor data or are unable to send alerts promptly due to network delays. Power management remains a critical concern as well—continuous monitoring leads to battery drain, which can render devices inoperative during emergencies.

These gaps underline the need for a more robust, internet-independent safety device that is affordable, easy to operate, and capable of performing essential health monitoring tasks. Our project builds upon these insights by integrating accelerometer and temperature sensors with GSM and GPS modules into a compact, standalone device that ensures real-time emergency alerts, minimal power consumption, and reliable operation regardless of internet availability

Chapter 3

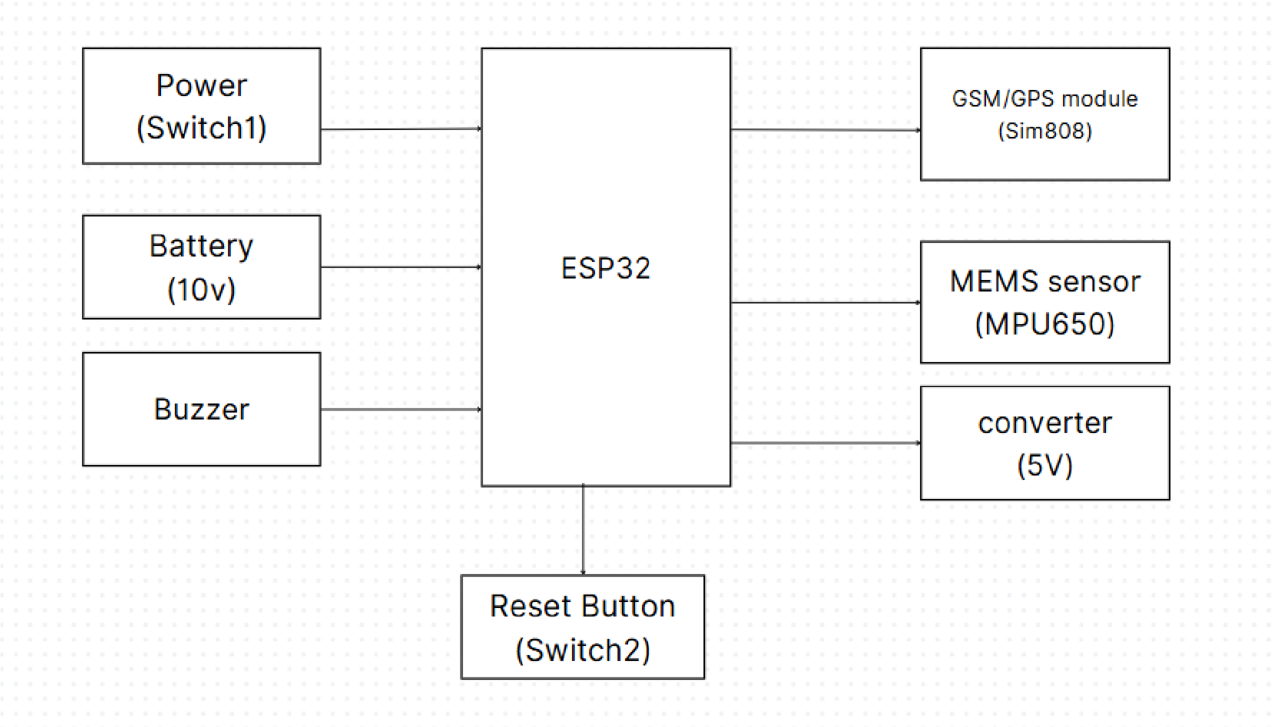
PROPOSED TECHNIQUE NAME

GSM-GPS Enabled Standalone Emergency Alert and Monitoring System (GE-SEAMS)

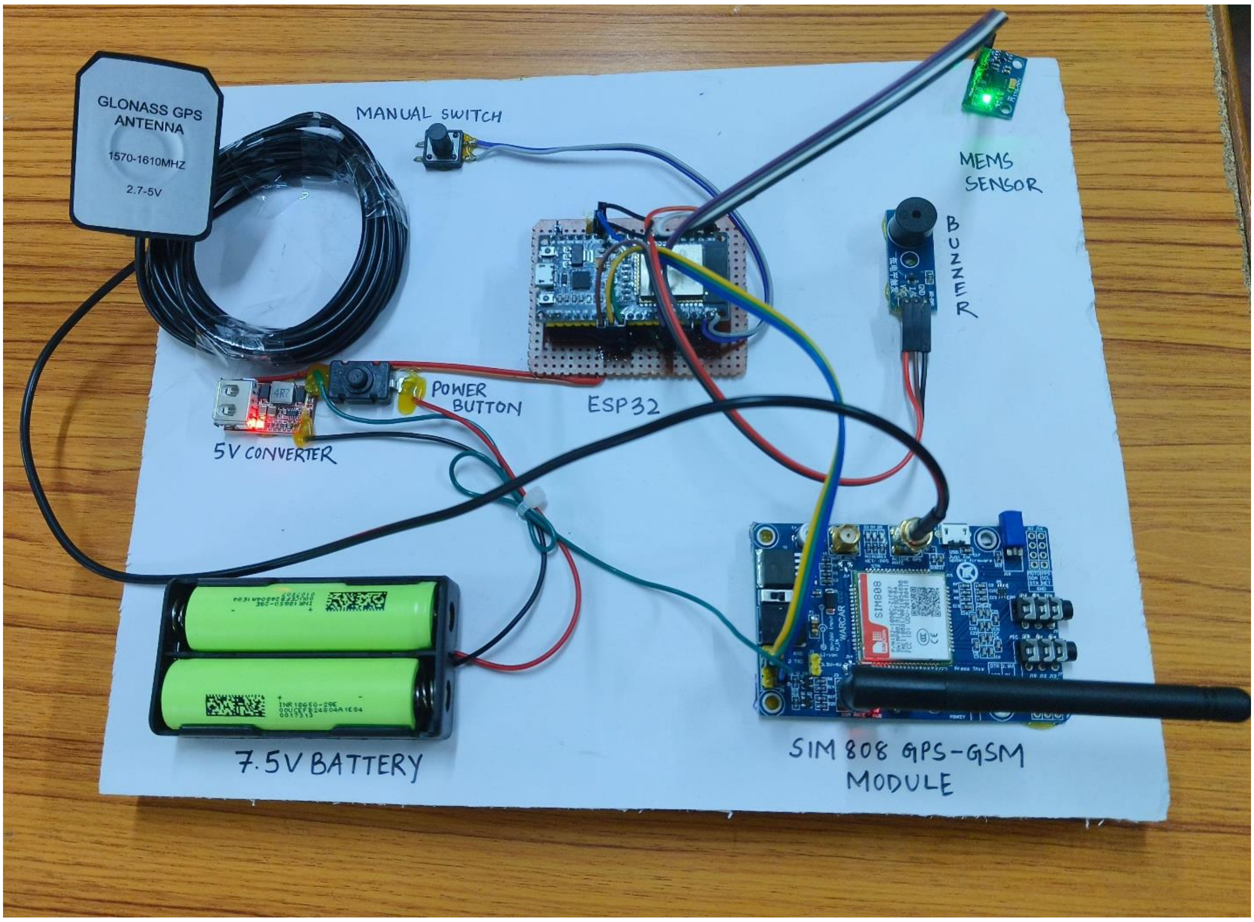
The proposed technique, titled GSM-GPS Enabled Standalone Emergency Alert and Monitoring System (GE-SEAMS), represents a compact, portable solution aimed at enhancing personal safety through real-time health monitoring and emergency response. This technique leverages a combination of embedded sensors (accelerometer and temperature sensor), GSM communication, and GPS tracking to detect health emergencies—such as sudden falls or abnormal temperature variations—and automatically notify emergency contacts via SMS with location details.

GE-SEAMS is engineered to function without internet connectivity, making it highly effective in both urban and remote environments. It also incorporates features such as a manual emergency trigger, an audible buzzer alert, and power-efficient hardware to ensure longer battery life and reliable operation. This integrated technique is not only low-cost and user-friendly but also highly effective in overcoming the limitations of traditional internet-dependent safety system

3.1 BLOCK DIAGRAM



3.2 CIRCUIT DIAGRAM



3.3 COMPONENTS AND ITS SPECIFICATION

The development of the Human Safety Device necessitates a selection of electronic components that collectively enable real-time health monitoring and emergency alert functionalities. Below is a comprehensive list of the essential equipment, along with brief descriptions of their roles within the system:

1. Microcontroller Unit (Arduino Nano or Arduino UNO)

Function: Serves as the central processing unit, orchestrating the operations of all connected modules and sensors.

Description: The Arduino Nano is a compact, breadboard-friendly microcontroller board based on the ATmega328P. It offers sufficient I/O pins and processing power for handling sensor data and controlling communication modules

.

2. GSM Module (SIM800L)

Function: Facilitates the sending of SMS alerts to predefined emergency contacts.

Description: The SIM800L is a quad-band GSM/GPRS module that enables cellular communication. It operates on frequencies 850/900/1800/1900MHz and supports SMS, voice, and data transmission. Its compact size and low power consumption make it suitable for portable applications.

3. GPS Module (NEO-6M)

Function: Provides real-time geographic location data.

Description: The NEO-6M is a GPS module capable of tracking multiple satellites simultaneously to provide accurate positioning information. It communicates with the microcontroller via serial communication and is essential for location tracking during emergencies.

4. Accelerometer Sensor (ADXL335 or ADXL345)

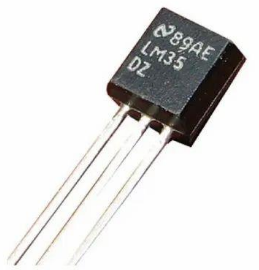
Function: Detects sudden movements or falls by measuring acceleration along multiple axes.

Description: These are low-power, 3-axis MEMS accelerometers that provide analog (ADXL335) or digital (ADXL345) outputs corresponding to acceleration forces. They are instrumental in implementing fall detection algorithms.

5. Temperature Sensor (LM35)

Function: Monitors the user's body temperature.

Description: The LM35 is a precision analog temperature sensor with an output voltage linearly proportional to the Celsius temperature. It is used to detect abnormal temperature variations indicative of potential health issues.



6. Push Button Switch

Function: Allows manual triggering of emergency alerts.

Description: A simple tactile switch that, when pressed, signals the microcontroller to initiate an emergency alert sequence.

7. Buzzer

Function: Emits an audible alert to notify nearby individuals during emergencies.

Description: An electronic sounder that produces a buzzing sound when activated, serving as an immediate local alert mechanism.

8. Power Supply Module (e.g., LM2596 Step-Down Converter)

Function: Regulates voltage levels to ensure stable operation of components.

Description: A DC-DC buck converter that steps down higher voltage inputs to levels suitable for the microcontroller and other modules, ensuring consistent performance and protecting components from voltage fluctuations.

9. Rechargeable Battery Pack (e.g., 18650 Li-ion Batteries)

Function: Provides portable power to the device.

Description: High-capacity lithium-ion batteries that offer rechargeable power sources, enabling the device's portability and extended operation without reliance on external power.

10. Miscellaneous Components

Includes: Resistors, capacitors, diodes, LEDs, voltage regulators (e.g., 7805), and connecting wires.

Function: These components support various functions such as signal conditioning, voltage regulation, status indication, and establishing electrical connections between modules.

Each of these components plays a vital role in the functionality of the Human Safety Device, contributing to its ability to monitor health parameters, detect emergencies, and communicate alerts effectively. The careful selection and integration of these components ensure that the device operates reliably, efficiently, and is suitable for use in diverse environments, including areas with limited internet connectivity.

3.4 Code (Integrated with GSM/GPS sensor along with sensor)

```
#include <Wire.h>
#include <DFRobot_SIM808.h>
#include <MPU6050.h>
#include "BluetoothSerial.h"

HardwareSerial sim808(2);  // UART2 -> RX=16, TX=17
DFRobot_SIM808 Sim808(&sim808);
MPU6050 mpu;
BluetoothSerial SerialBT;

char phone[] = "7325859474";
String latitude, longitude;
char c;
int buzzerPin = 4;
int buttonPin = 23;  // NEW: Button connected to GPIO5

unsigned long fallStartTime = 0;
bool fallOngoing = false;
bool alertSent = false;

void setup() {
  Serial.begin(115200);
  SerialBT.begin("Fall_Detector");
  sim808.begin(9600, SERIAL_8N1, 16, 17);  // UART2: RX=16, TX=17
  SerialBT.println("Bluetooth Serial started");
  Wire.begin();  // I2C for MPU6050
 mpu.initialize();

  pinMode(buzzerPin, OUTPUT);
  pinMode(buttonPin, INPUT_PULLUP);  // NEW: Button as input with pull-up resistor
  digitalWrite(buzzerPin, HIGH);  // Buzzer off (assuming LOW = ON)

  sim808.println("AT+CGNSPWR=1");
  delay(2000);
  sim808.println("AT+CGNSSEQ=\"RMC\"");
  delay(2000);

  Serial.println("Setup Complete");
}

void loop() {
  if (fallDetected()) {
    if (!fallOngoing) {
      fallStartTime = millis();
      fallOngoing = true;
    }

    if ((millis() - fallStartTime > 10000) && !alertSent) { // 10 seconds fall
      digitalWrite(buzzerPin, LOW);  // Turn buzzer ON
      gps_location();
```

```
      sms_send();
      delay(2000);
      digitalWrite(buzzerPin, HIGH);
      make_call();
      alertSent = true;
    }
  } else {
    fallOngoing = false;
    alertSent = false;
  }

  // NEW: Check if the button is pressed
  if (digitalRead(buttonPin) == LOW) {  // Button pressed (LOW because of INPUT_PULLUP)
    Serial.println("Emergency Button Pressed!");
    SerialBT.println("Emergency Button Pressed!");
    digitalWrite(buzzerPin, LOW);  // Optional: Turn buzzer ON when button pressed
    gps_location();
    sms_send();  // Send emergency SMS
  Serial.print("MPU6050 Temperature: ");
  Serial.print(temperature);
  Serial.println(" °C");
  SerialBT.print("MPU6050 Temperature: ");
  SerialBT.print(temperature);
  SerialBT.println(" °C");

  // Threshold for fall detection
  return (a < 0.7 || a > 1);
}

void sms_send() {
  String url = "http://maps.google.com/maps?q=" + latitude + "," + longitude;

  sim808.println("AT+CMGF=1");
  delay(100);
  sim808.print("AT+CMGS=\"");
  sim808.print(phone);
  sim808.println("\"");
  delay(1000);
  sim808.println("Person in danger! Location:");
  sim808.println(url);
  sim808.println((char)26);
  delay(2000);

  Serial.println("Message sent with GPS location.");
}

void gps_location() {
  latitude = "";
  longitude = "";

  sim808.flush();
  sim808.println("AT+CGNSINF");

  String response = "";
  long timeout = millis();
```

```
  while (millis() - timeout < 3000) {
    if (sim808.available()) {
      response += char(sim808.read());
    }
  }
  Serial.println("Raw GPS response:");
  Serial.println(response);

  int index = response.indexOf("+CGNSINF:");
  if (index != -1) {
    String gpsData = response.substring(index);
    int commaCount = 0;
    int start = 0;
    int end = 0;

    for (int i = 0; i < gpsData.length(); i++) {
      if (gpsData.charAt(i) == ',') {
        commaCount++;
        if (commaCount == 3) start = i + 1;
        if (commaCount == 4) {
          end = i;
          latitude = gpsData.substring(start, end);
        }
        if (commaCount == 4) start = i + 1;
        if (commaCount == 5) {
          end = i;
          longitude = gpsData.substring(start, end);
          break;
        }
      }
    }
    Serial.print("Latitude: ");
    Serial.println(latitude);
    Serial.print("Longitude: ");
    Serial.println(longitude);
    SerialBT.print("Latitude: ");
    SerialBT.println(latitude);
    SerialBT.print("Longitude: ");
    SerialBT.println(longitude);
  } else {
    Serial.println("GPS data not found.");
    digitalWrite(buzzerPin, HIGH);
  }
}

void make_call() {
  sim808.println("ATD" + String(phone) + ";"); // Dial the number
  delay(10000); // Wait for 10 seconds while the call is ongoing
  sim808.println("ATH"); // Hang up the call
  Serial.println("Call initiated and ended.");
}
```

3.5 Result and Analysis

- The device successfully detects sudden falls and abnormal body temperatures.
- Upon detection, it sends SMS alerts with GPS coordinates to predefined emergency contacts.
- The buzzer alerts nearby individuals instantly.
- The system functions effectively without internet, relying on GSM signals.
- Alerts include real-time data such as:
    - Fall at location: [latitude, longitude]
    - Emergency triggered manually
    - Abnormal temperature readings

3.5.1 Challenges During Making:

During the development of the Human Bio-Safety Device, we faced several challenges:

I. Microcontroller Selection:
Initially, we used ESP32, but due to some hardware and communication issues, it did not work as expected. We then switched to Arduino UNO, which worked initially but later faced stability problems. Finally, we changed back to ESP32 integrated with the SIM808A module, which provided stable GSM and GPS communication.

II.MEMS Sensor Configuration:
Setting up the MEMS (accelerometer) sensor was tricky. We struggled with defining the correct gestures to detect falls and determining an appropriate time window for the detection.
After several trials, we decided that if a fall or abnormal movement was detected within 10 seconds, the buzzer would ring. Otherwise, no alert would be triggered. This approach helped us accurately differentiate between normal movements and emergencies.
III. Ongoing Challenges:
Fine-tuning sensor sensitivity, handling module compatibility, and managing power consumption were continuous tasks during development.

3.5.2. Real-Time Challenges

- **Network Dependency:** Although GSM works without internet, poor signal areas still pose a challenge for SMS delivery.
- **Sensor Accuracy:** Ensuring that fall detection and abnormal temperature readings are accurate without false alarms required careful sensor calibration.
- **Power Management:** Maintaining low power consumption for longer device operation was a critical design challenge.
- **Integration of Modules:** Synchronizing GSM, GPS, and sensor modules smoothly without communication delays was complex.
- **Cost Efficiency:** Balancing between adding more features and keeping the device affordable was a constant consideration.

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Chapter 4

CONCLUSIONS

4.1 Conclusion

The Human Safety Device project successfully demonstrates the practical application of embedded systems and communication technologies in enhancing personal health and safety, particularly for vulnerable individuals such as the elderly and people with medical conditions. This project addresses significant limitations found in conventional health monitoring devices—namely high cost, dependence on continuous internet connectivity, and ineffectiveness in remote areas.

By integrating core components such as GSM and GPS modules with sensors like accelerometers and temperature detectors, the device offers real-time health monitoring and emergency response capabilities. One of the key strengths of the device is its ability to function independently of the internet. The GSM module ensures prompt delivery of SMS alerts containing the user's live GPS location, enabling swift action from caregivers or emergency responders. The accelerometer-based fall detection mechanism, coupled with a manual emergency trigger and an audible buzzer, adds multiple layers of safety for the user.

Although the project achieved its primary objectives, some challenges and limitations were observed, such as occasional delays in SMS delivery under extremely weak GSM signals and the need for further optimization in power management. Nonetheless, these challenges open avenues for future enhancements, such as incorporating AI for smarter detection, SpO_2 and heart rate monitoring, and solar-powered operation for uninterrupted functionality.

In conclusion, the Human Safety Device stands as a promising, affordable, and accessible solution for real-time health emergency response. It not only bridges the gap left by existing systems but also lays the groundwork for future innovations in the field of health tech and personal safety.

- Developed a low-cost, portable, and efficient human safety device.
- Successfully achieved real-time health monitoring and emergency alerting.
- GSM and GPS integration enabled communication without internet dependency.
- Ensured quick fall detection and emergency response.
- Device proved highly reliable in both urban and remote environments.
- Manual emergency triggering enhanced user safety further.
- Overall, the project fulfilled its objective of providing a standalone safety solution.

4.2 Scope for future investigation

- Integration of blood oxygen level monitoring.
- A mobile app to monitor alerts and sensor data in real time.
- Making the device more compact and wearable.
- Adding AI-based data analysis for predictive health warnings.
- Solar-powered version for remote locations.

4.3 References

- 1.Wu, F., et al. (2015). Development of a Wearable-Sensor-Based Fall Detection System.This study presents a wearable device utilizing a triaxial accelerometer and GSM/GPS modules to detect falls and send emergency alerts, emphasizing low power consumption and outdoor applicability.
- 2. Degen, T., & Jäckel, H. (2013). SPEEDY: A Fall Detector in a Wrist Watch.Introduces a wristwatch-based fall detection system integrating GSM, GPS, and ZigBee technologies, highlighting the feasibility of compact wearable safety devices.
- https://youtu.be/dXcF-Uqa-gw?si=e6TZWC28JU5qru7_ MPU-6050 interfacing
- https://github.com/DFRobot/DFRobot_SIM808 SIM808 interfacing