

FALL DETECTION SYSTEM FOR SENIOR CITIZENS

Mini- Project Report

*Submitted in partial fulfilment for the
Digital Assignment of
Artificial Intelligence (UCSC311L)*

B.C.A

by

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1.INTRODUCTION:

Falls are a major health risk for senior citizens, often leading to serious injuries, loss of independence, and in severe cases, death. With the global increase in the aging population, ensuring the safety of elderly individuals has become more important than ever. A fall detection system is a smart solution designed to automatically detect falls and alert caregivers or emergency services in real time. This project aims to develop such a system using sensor-based data and artificial intelligence techniques to monitor and ensure the well-being of elderly people living alone or in assisted living environments.

2.OBJECTIVE:

The main objectives of this project are:

- To design a reliable and real-time fall detection system using sensors and machine learning.
- To minimize false positives and ensure timely alerts during actual fall incidents.
- To enhance the safety and confidence of senior citizens by offering quick response in emergencies.
- To make the system cost-effective, easily wearable, and user-friendly.

3.PROBLEM STATEMENT

Elderly people often live alone or are left unattended for long periods, making them vulnerable to falls and injuries. Existing fall detection systems either rely heavily on manual alerts or are not sufficiently accurate, leading to delayed response or frequent false alarms.

This project addresses the need for a robust, automatic fall detection system that can:

- Accurately differentiate between normal movements and falls.
- Alert caregivers instantly when a fall is detected.
- Operate effectively with minimal user intervention.

4.PEAS SPECIFICATION

Performance Measure

- Accuracy of fall detection
- Response time of alert mechanism
- Number of false positives/negatives

Environment

- Indoor and outdoor environments (home, assisted living facilities)
- Presence of furniture and obstacles

Actuators

- Alert system (SMS, app notification, buzzer)

Sensors

- Accelerometer
- Gyroscope
- Optional: Heart rate sensor, GPS

5.SYSTEM ARCHITECTURE

The system consists of three major components:

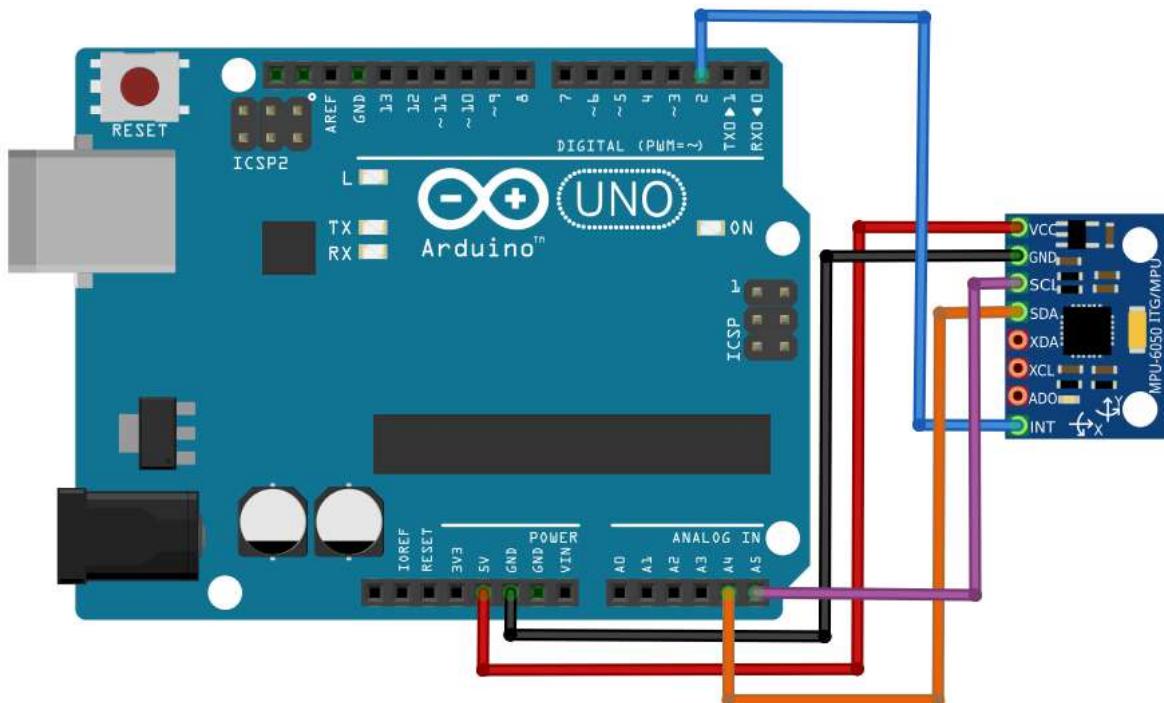
1. Sensor Module: Worn by the user, it continuously collects motion data through accelerometers and gyroscopes.
2. Processing Unit: Data from sensors is processed using a microcontroller that applies machine learning algorithms to detect falls.
3. Alert Module: If a fall is detected, the system immediately sends an alert message.

6.TOOLS, FRAMEWORK & SENSORS USED

- Microcontroller: Arduino UNO
- Sensors: ADXL345
- Programming Languages: C++
- Libraries: Wire.h, Adafruit_Sensor.h, Adafruit_ADXL345_U.h

7.IMPLEMENTATION DETAILS

Diagram:



Code:

```
#include <Wire.h>
#include <Adafruit_Sensor.h>
#include <Adafruit_ADXL345_U.h>

Adafruit_ADXL345_Unified accel(123);

bool fall = false, trigger1 = false, trigger2 = false;

void setup() {
    Serial.begin(9600);
    if (!accel.begin()) {
        Serial.println("✖ No ADXL345 detected!");
        while (1);
    }
    accel.setRange(ADXL345_RANGE_16_G);
    Serial.println("✓ ADXL345 Initialized!");
}

void loop() {
    sensors_event_t e;
    accel.getEvent(&e);

    float ax = e.acceleration.x, ay = e.acceleration.y, az = e.acceleration.z;
```

```

float AM = sqrt(ax * ax + ay * ay + az * az) * 10;

Serial.print("AM: "); Serial.println(AM);

if (AM <= 15) trigger1 = true;

if (trigger1 && AM >= 15.5) {

    trigger2 = true;

    trigger1 = false;

}

if (trigger2) {

    float angleChange = sqrt(ax * ax + ay * ay);

    Serial.print("Angle Change: "); Serial.println(angleChange);

    if (angleChange >= 1.5) {

        Serial.println("⚠ SMALL FALL DETECTED! ⚠");

        fall = true;

        trigger2 = false;

    }

}

if (fall) {

    Serial.println("🔴 FALL CONFIRMED!");

    fall = false;

}

```

```
delay(20);
```

```
}
```

8.Sample Input And Output

Sample input:

From Serial Monitor:

AM: 12.34

AM: 15.12

AM: 16.47

Angle Change: 2.01

Sample Output:

```
AM: 101.69
AM: 98.67
AM: 91.34
AM: 99.23
AM: 111.18
AM: 104.62
AM: 90.66
AM: 98.17
AM: 105.50
AM: 90.35
AM: 95.40
AM: 107.77
AM: 100.43
AM: 93.78
AM: 96.96
AM: 96.82
AM: 93.29
AM: 99.84
AM: 103.27
AM: 103.48
AM: 97.50
AM: 102.92
AM: 102.13
AM: 95.08
AM: 100.35
AM: 98.61
```

```
AM: 97.10
AM: 104.47
AM: 101.60
AM: 98.10
AM: 103.44
AM: 103.92
AM: 96.43
AM: 100.57
AM: 100.22
AM: 94.53
AM: 90.43
AM: 93.53
AM: 87.32
AM: 85.29
AM: 77.47
AM: 73.97
AM: 65.99
AM: 63.68
AM: 7.17
AM: 58.00
Angle Change: 5.78
⚠ SMALL FALL DETECTED! ⚠
🔴 FALL CONFIRMED!
AM: 21.32
```

Video Link:

https://drive.google.com/file/d/1BGil7rU6kG9zvDj2kHZfcnYN5bl2nt5p/view?usp=drive_link

9. Challenges Faced

- Distinguishing falls from other rapid movements such as sitting or bending.
- Sensor calibration and noise reduction for accurate data.
- Developing a lightweight model for real-time performance on microcontrollers.

10.CONCLUSION & FUTURE SCOPE

The Fall Detection System successfully meets its goal of identifying fall incidents in real time and alerting caregivers. By utilizing wearable sensors and smart algorithms, the system provides a low-cost yet effective solution for elderly safety.

Future Enhancements:

- Integration with health monitoring (heart rate, oxygen levels)
- Voice-activated emergency response
- AI-based learning model to adapt to user behavior
- Full mobile app with GPS tracking and health dashboard