MOTION AND POSITION TRACKING SYSTEM USING MPU6050 SENSOR

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AIM:

The aim of this project is to design a motion and position tracking system using the MPU6050 sensor to accurately measure acceleration and angular velocity. It enables real-time monitoring of movement and orientation for applications in robotics, navigation, and wearable devices.

COMPONENTS REQUIRED:

- ESP32 (microcontroller)
- MPU6050 module (GY-521 breakout board commonly used)
- Jumper wires
- Breadboard
- USB cable (for uploading code & powering ESP32)
- OLED Display (SSD1306) for real-time visualization
- Buzzer

ESP32:

- Dual-core MCU – Powerful processor with built-in Wi-Fi and Bluetooth (BLE).
- Connectivity Range – Wi-Fi up to ~100 m indoors and ~300 m outdoors (line of sight).
- Low Power – Supports deep sleep modes for energy-efficient IoT applications.
- Versatile I/O – Multiple GPIOs, ADC, DAC, UART, SPI, I²C, PWM for diverse sensor/actuator interfacing.

MPU6050 MODULE:

- 6-axis Sensor – Combines 3-axis accelerometer and 3-axis gyroscope.
- Range – Accelerometer: ±2g to ±16g, Gyroscope: ±250°/s to ±2000°/s.
- Communication – Uses I²C (and optional SPI) interface for easy microcontroller integration.
- Applications – Motion tracking, gesture recognition, robotics, and wearable devices.

OLED DISPLAY:

- Display Size – Commonly 0.96" with 128×64 pixel resolution.
- Interface – Supports I²C and SPI communication.

- Power Efficient – Consumes less power with high contrast and wide viewing angles.
- Use Case – Ideal for real-time data visualization in compact embedded systems.

BUZZER:

- Types – Available as active (self-driven) and passive (needs external signal).
- Operating Voltage – Typically works between 3V to 12V.
- Sound Output – Produces audible alerts or tones (~1–5 kHz common).
- Applications – Used in alarms, notifications, and real-time alerts in embedded systems.
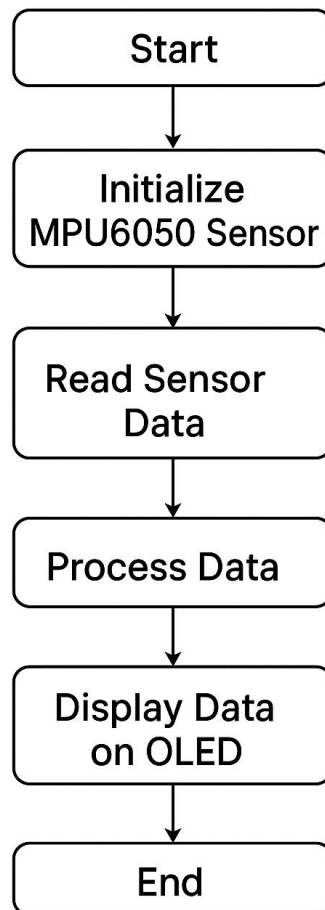
AVAILABLE COMPONENTS:

- ESP32 (Microcontroller)
- OLED Display Module
- Breadboard
- Passive Buzzer module
- Sensor Module
- Jumper wires

PIN CONFIGURATION:

COMPONENTS	ESP32
MPU6050	
VCC	3.3V
GND	GND
SDA	GPIO 21
SCL	GPIO 22
INT	GPIO 19
OLED DISPLAY(SSD1306)	
VCC	3.3V
GND	GND
SDA	GPIO 21
SCL	GPIO 22
PASSIVE BUZZER	
POSITIVE	GPIO 25
NEGATIVE	GND

FLOWCHART:

Motion and Position
Tracking System

```
┌─────────────────┐
│      Start      │
└─────────────────┘
         │
         ▼
┌─────────────────┐
│    Initialize   │
│  MPU6050 Sensor │
└─────────────────┘
         │
         ▼
┌─────────────────┐
│   Read Sensor   │
│      Data       │
└─────────────────┘
         │
         ▼
┌─────────────────┐
│  Process Data   │
└─────────────────┘
         │
         ▼
┌─────────────────┐
│   Display Data  │
│     on OLED     │
└─────────────────┘
         │
         ▼
┌─────────────────┐
│       End       │
└─────────────────┘
```

PROCEDURE:

- Connect the circuit as per the pin configuration table.
- Install Arduino IDE libraries:
  - o Go to Sketch > Include Library > Manage Libraries
  - o Install "MPU6050" by Electronic Cats or "Adafruit MPU6050"
  - o Also install "Adafruit Unified Sensor"
- Upload the code to Arduino.
- Open Serial Monitor (9600 baud) to see motion/orientation data.
- Connect an OLED to display X, Y, Z tilt angles live.
- Use the data for position tracking or real-time motion visualization.

PROGRAM:

```
#include <Wire.h>

#include <Adafruit_GFX.h>

#include <Adafruit_SSD1306.h>

#include <MPU6050.h>

#define SCREEN_WIDTH 128

#define SCREEN_HEIGHT 64

#define OLED_RESET -1

Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, OLED_RESET);

MPU6050 mpu;

#define BUZZER 23   // Buzzer pin (can change)

void setup() {
  Serial.begin(115200);
  // OLED init
  if (!display.begin(SSD1306_SWITCHCAPVCC, 0x3C)) {
    Serial.println("SSD1306 allocation failed");
    for (;;);
  }
  display.clearDisplay();
  display.setTextSize(1);
  display.setTextColor(SSD1306_WHITE);
  // MPU6050 init
  Wire.begin();
  mpu.initialize();
  if (!mpu.testConnection()) {
    Serial.println("MPU6050 connection failed");
    while (1);
```

```
  }
  pinMode(BUZZER, OUTPUT);
}

void loop() {
  int16_t ax, ay, az;
  int16_t gx, gy, gz;
  mpu.getMotion6(&ax, &ay, &az, &gx, &gy, &gz);
  // Display on OLED
  display.clearDisplay();
  display.setCursor(0, 0);
  display.print("AX: "); display.println(ax);
  display.print("AY: "); display.println(ay);
  display.print("AZ: "); display.println(az);
  display.print("GX: "); display.println(gx);
  display.print("GY: "); display.println(gy);
  display.print("GZ: "); display.println(gz);
  display.display();
  // Trigger buzzer if motion exceeds threshold
  if (abs(ax) > 20000 || abs(ay) > 20000 || abs(az) > 20000) {
    digitalWrite(BUZZER, HIGH);
  } else {
    digitalWrite(BUZZER, LOW);
  }
  delay(500);
}
```

EXECUTION:
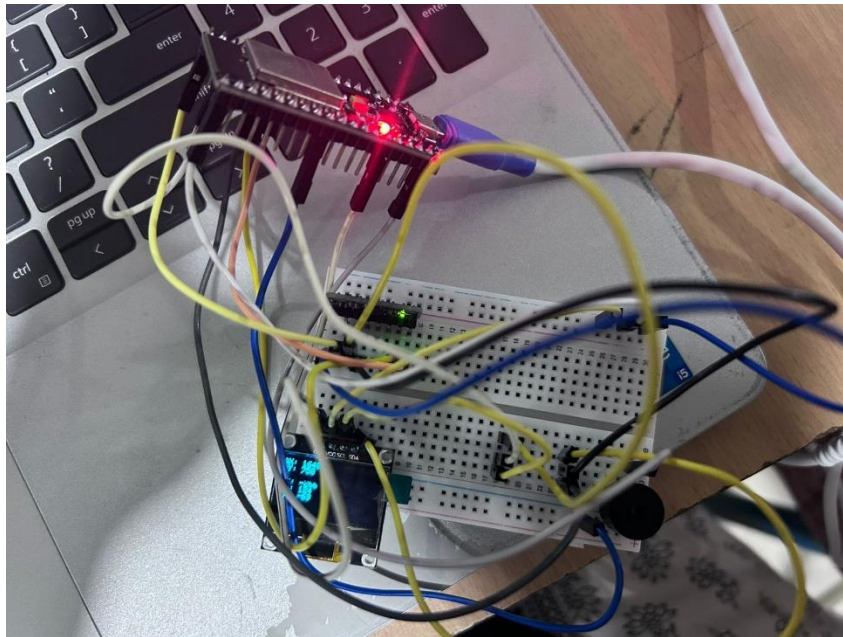
RESULT:

The MPU6050-based motion and position tracking system successfully detected real-time acceleration and angular velocity of the object.

It provided accurate orientation and movement data using the built-in accelerometer and gyroscope.

The results confirmed reliable tracking for applications in robotics, wearables, and navigation systems.