**Wearable Emergency Auto-Responder for High-Risk Workers with Gesture, Motion & Camera Alert System**

**Core Idea**

A **wearable emergency responder system** that:

* Detects **unusual gestures (e.g., waving, sudden motion/fall)** via **MPU6050 + APDS-9930**.
* Captures image/video using **ESP32-CAM** when a fall or fire is detected.
* Sends **SMS with GPS location and image** using **SIM800L + GPS**.
* Can be **manually triggered by a custom gesture** or through a **hidden button**.
* Has a **vibration motor** for haptic feedback to user confirming action sent.
* Sends alerts **even in remote areas without internet** via GSM.
* Designed for use in **construction, mining, night security, elderly care, or lone field workers**.

**Component Utilization**

| **Module** | **Purpose** |
| --- | --- |
| **MPU6050** | Detect fall or sudden impact |
| **APDS-9930** | Detect waving/gesture and ambient light |
| **ESP32-CAM** | Capture photo on trigger |
| **SIM800L** | Send SMS with photo and/or location |
| **NEO-6M GPS** | Get current location |
| **Vibration Motor** | Haptic feedback after alert is sent |
| **Button** | Manual emergency trigger |
| **Relay (optional)** | Can be used to turn on a powerful buzzer or emergency LED |
| **Battery Modules** | TP4056 + 9V batteries for portable power |

**Implementation Phases**

**Phase 1 – Core Sensing**

* Setup MPU6050 with ESP32, detect motion/fall patterns.
* Integrate APDS-9930 for gesture.

**Phase 2 – GSM + GPS Communication**

* Setup SIM800L to send SMS with GPS link.
* Connect GPS module to get live location.

**Phase 3 – Camera Integration**

* Integrate ESP32-CAM to capture and store/send images.

**Phase 4 – Haptic Feedback**

* Add vibration motors to confirm alert sent.

**Phase 5 – Compact & Power**

* Design wearable form (strap, vest, etc.).
* Power with TP4056 and 9V batteries.

**ESP32-CAM**

| **ESP32-CAM Pin** | **Function** |
| --- | --- |
| GND | Ground |
| 5V | Power Input (use 5V regulated) |
| 3V3 | 3.3V Output (low current) |
| U0R / GPIO3 | UART RX (Programming) |
| U0T / GPIO1 | UART TX (Programming) |
| GPIO0 | Used for programming (LOW to flash) |
| GPIO2, GPIO12, GPIO13, etc. | Usable GPIOs (but limited) |

We’ll use **I2C multiplexing and smart pin reuse** where needed.

**MPU6050 – Fall Detection**

**🔬 Working**

* Combines a **3-axis accelerometer + gyroscope**
* Outputs data via **I2C** (SDA/SCL)

**🔧 Connections**

| **MPU6050 Pin** | **Connect To (ESP32-CAM)** |
| --- | --- |
| VCC | 3.3V (from ESP32-CAM) |
| GND | GND |
| SCL | GPIO14 (or GPIO12) |
| SDA | GPIO15 (or GPIO13) |

We’ll use I2C protocol — simple, supports multiple devices on same pins.

**APDS-9930 – Gesture & Ambient Light**

**🔬 Working**

* I2C sensor for **gesture, proximity, light sensing**
* Low power, ideal for wearables

**🔧 Connections (Shares I2C with MPU6050)**

| **APDS-9930 Pin** | **Connect To (ESP32-CAM)** |
| --- | --- |
| VCC | 3.3V |
| GND | GND |
| SDA | GPIO15 (shared I2C) |
| SCL | GPIO14 (shared I2C) |

NEO-6M GPS – Real-time Location

🔬 Working

* Communicates via UART
* Sends GPS coordinates at 9600 baud

🔧 Connections

| **GPS Pin** | **Connect To (ESP32-CAM)** |
| --- | --- |
| VCC | 5V |
| GND | GND |
| TX | GPIO16 |
| RX | GPIO17 |

📌 Use SoftwareSerial (UART) via GPIO16 and GPIO17 or other unused pins.

**SIM800L – GSM/SMS Module**

**🔬 Working**

* Sends SMS, uses **UART**
* Needs **strong 3.7–4.2V power**, not directly from ESP32
* TX/RX: UART communication

**⚡ Power Warning**

* Do NOT power SIM800L directly from ESP32 — use **XL6009 step-up** to boost 3.7V (from 9V battery via TP4056) to ~4.0V

**🔧 Connections**

| **SIM800L Pin** | **Connect To** |
| --- | --- |
| VCC | XL6009 Output (4V) |
| GND | Common Ground |
| TXD | GPIO4 (ESP32-CAM RX for SIM) |
| RXD | GPIO5 (ESP32-CAM TX for SIM) |

SIM800L is **3.3V logic**, so you may need a **resistor divider** on TX → RXD line (ESP32 TX to SIM800L RX).

**Push Button – Emergency Trigger**

**🔧 Connections**

| **Button Pin** | **Connect To** |
| --- | --- |
| One leg | GPIO33 (any input pin) |
| Other leg | GND (via 10k pull-down resistor) |

* Detect HIGH when pressed
* Debounce in code

**Relay Module – Control Buzzer or LED**

Use only if you want to activate:

* Buzzer (already in your kit)
* High-brightness emergency LED

**🔧 Connections**

| **Relay Pin** | **Connect To** |
| --- | --- |
| VCC | 5V |
| GND | GND |
| IN | GPIO32 (Output control) |

Relay will toggle when GPIO32 is HIGH

**Power Management**

**🔋 Battery Setup**

* Use **9V battery** → to **TP4056**
* TP4056 Output (3.7V) → to **XL6009**
* XL6009 Output:
  + **4.0V** → SIM800L
  + **5.0V** → ESP32-CAM

Ensure **shared ground** between all power rails.

**Possible Extensions**

* Add **RFID** to identify the person sending the alert (e.g., ID tag scan).
* Store previous alerts with timestamps on SD card.
* Use **RF module** to notify another nearby worker directly.
* Use **relays** to sound sirens or activate safety lights if used in a facility.