Hardware Documentation: Wearable Health Monitoring Device

# 1. Overview

This document outlines the hardware components, pin connections, power supply details, and configuration used in the Wearable Health Monitoring Device based on the ESP32 extension board with built-in peripherals.

# 2. Main Components

|  |  |
| --- | --- |
| Component | Description |
| ESP32 Extension Board | Microcontroller with built-in OLED, LED, and buzzer |
| OLED Display | 128x64 SSD1306-based, connected via internal I2C (0x3C) |
| Built-in LED | Connected to GPIO 2, used for visual alert |
| Built-in Buzzer | Connected to GPIO 4, used for audible alert |
| Edge Impulse TinyML Model | Pre-trained model running on-device for anomaly detection |
| Power Supply | USB power / 3.7V Li-ion battery via TP4056 (for wearable use) |

# 3. Pin Configuration

|  |  |  |
| --- | --- | --- |
| Signal | GPIO Pin | Description |
| SDA (I2C) | GPIO 21 | OLED I2C Data |
| SCL (I2C) | GPIO 22 | OLED I2C Clock |
| Built-in LED | GPIO 2 | Indicator for abnormal vitals |
| Built-in Buzzer | GPIO 4 | Buzzer for abnormal vitals |

# 4. Power Management

- The board can be powered via USB (5V) during development.  
- For wearable application, a 3.7V Li-ion battery can be connected through a TP4056 charging module.  
- Estimated consumption: ~80–100mA (active OLED, MCU processing).  
- ESP32 deep sleep modes can be configured later for low-power mode.

# 5. Sensor Interface (Expandable)

Currently simulated data is used. To expand, you may connect:

|  |  |  |
| --- | --- | --- |
| Sensor | Interface | GPIO Pins |
| MAX30100 | I2C | GPIO 21, 22 |
| MLX90614 | I2C | GPIO 21, 22 |
| AHT20 | I2C | GPIO 21, 22 |

# 6. Circuit Notes

- All components are either soldered to a PCB or connected via jumper wires for testing.  
- Ensure common ground (GND) between all modules.  
- No level shifters required (3.3V logic throughout).  
- Buzzer and LED are controlled digitally (HIGH/LOW).

# 7. Safety & Limitations

- Only one I2C bus is used; avoid address conflicts.  
- Buzzer usage should be short (not continuous).  
- Monitor temperature of ESP32 in long operations.  
- Ensure battery protection circuit is present.

# 8. Conclusion

This hardware design offers a fully integrated solution for real-time health monitoring using ESP32. Its compact footprint, onboard display/alerts, and expandability make it ideal for wearable applications. Power optimization and wireless communication can be future enhancements.