**Project Title**

**Smart Pulse Rate Monitoring System Using ESP32 and OLED Display**

**Project Description**

The **Smart Pulse Rate Monitoring System** is a microcontroller-based project designed to detect and monitor a person’s heart rate in real time. It utilizes a **Pulse Sensor** to measure the heartbeat via changes in blood volume, an **ESP32 microcontroller** to process the data, and an **OLED display** to visualize the heart rate in beats per minute (BPM). The system also includes a red LED that acts as an alert or activity indicator—blinking in response to elevated heart rate levels.

This compact and low-cost system is ideal for continuous monitoring of heart rate in both clinical and personal health tracking environments. The project simulates real-time biofeedback by reading analog signals from the pulse sensor and converting them into meaningful data (BPM) displayed clearly on the screen.

**🛠️ Functions and Applications**

**✔️ Functions:**

* **Heart Rate Detection**: Accurately detects pulse rate from fingertip or earlobe using an analog pulse sensor.
* **Signal Processing**: Converts analog pulses into readable BPM values using ESP32.
* **Visual Display**: Shows BPM and signal values on a 128x64 OLED display in real time.
* **Alert System**: Activates an LED when pulse rate exceeds a preset threshold.

**🌍 Applications:**

* **Remote Patient Monitoring**: Especially for the elderly or chronically ill patients.
* **Fitness and Wellness Devices**: Can be integrated into wearable devices or fitness bands.
* **Health Research**: Useful in labs or student projects for understanding biosignals.
* **Educational Tool**: Excellent project for learning about sensors, microcontrollers, and health technology integration.

**🔩 List of Components and Their Functions**

1. **ESP32 Dev Board**
   * Acts as the brain of the project. It reads analog data from the pulse sensor, processes the signal, and controls both the OLED display and LED. It also provides 3.3V regulated power to the sensor and display.
   * **Why ESP32?** It’s affordable, Wi-Fi capable, and has multiple ADC pins for sensor input.
2. **Pulse Sensor (Heart Rate Sensor)**
   * Detects heart rate by measuring changes in blood volume through photoplethysmography (light absorption method). It outputs an analog signal corresponding to the pulse.
3. **OLED Display (SSD1306, 128x64, I2C)**
   * Visually presents heart rate and pulse signal strength. Communicates with ESP32 via I2C protocol (SDA, SCL). Compact and power-efficient.
4. **Red LED**
   * Acts as an alert or activity signal. It turns on when the detected BPM is higher than a defined threshold (e.g., 100 BPM).
   * A simple way to give visual feedback on abnormal readings.
5. **220Ω Resistor**
   * Used in series with the LED to limit current flow and prevent damage to the LED or microcontroller.
6. **Jumper Wires**
   * Connect all components electrically on the breadboard or directly to ESP32 pins.
7. **Breadboard (optional)**
   * Allows for temporary and flexible connections between components without soldering. Useful during prototyping.