

# PULSE OXIMETER

**Project Overview** The **LF Alpha Pulse Oximeter** is a microcontroller-based health monitoring project designed to measure a user's blood oxygen saturation (SpO<sub>2</sub>) and heart rate (BPM). It provides real-time feedback by outputting the readings to a Serial monitor and an OLED display, complete with a visual waveform.

**Hardware Components** The system primarily relies on the **MAX30102 sensor** for optical readings and an **OLED screen** for the display. The code also initializes peripherals for an MPU6050 accelerometer/gyroscope and hardware buttons.

## How It Works

- **Finger Detection:** The user places their finger on the MAX30102 sensor. The system uses an infrared (IR) threshold to automatically detect the presence of the finger. If no finger is detected, the OLED prompts the user with a "no-finger" screen.
- **Signal Processing & Warmup:** Once the finger is placed, the system analyzes the IR and Red light signals using Digital Signal Processing (DSP) to calculate true SpO<sub>2</sub> and Heart Rate. To ensure the data is accurate, the system enforces a **20-beat warmup period**. It uses a trailing Exponential Moving Average (EMA) to filter the data, and displays '--' on the screen until the readings stabilize.
- **Dynamic ECG-Like Display:** After the warmup completes, the accurate SpO<sub>2</sub> (normally 95-100%) and Pulse Rate (normally 60-100 bpm) are shown at the top of the OLED display. At the bottom of the screen, the system generates a **synthetic, high-fidelity ECG waveform** (an ideal PQRST wave).
- **BPM Synchronization:** The scrolling speed of the ECG waveform is dynamically updated and synchronized to match the user's actual measured heart rate.