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Team 15

Product Design Specification

Short Descriptive Name
Proximity Light Indicator – A visual distance indicator that changes LED color based on how close an object is to the sensor.

Executive Summary with Concept of Operations
Our product indicates when something is in proximity, and detects the distance using 3 LEDs(Blue, Yellow, Red) to signify if something is close or further away. Blue being further, yellow being midway, and red being close.

This device can be used in environments with frequent movement, such as workshops, factories, or parking areas, to alert users when objects or people approach within a set range.

The system operates automatically when powered on. The onboard microcontroller continuously reads distance data from the sensor and updates the LEDs accordingly. It requires no manual control and is designed to be simple, low-cost, and low-power.

Brief "Market" Analysis
Intended users/customers

- Commercial or industrial facilities
- Parking garages or lots (with a steady power source)
- Smart home device
- Workshop/Factory requiring proximity alerts

Our competition includes parking sensors, ultrasonic alarms, and motion-activated lights. Unlike these, our product focuses on simplicity and visual clarity. It provides LED-based feedback without sound or complex installation. This makes it ideal for quieter work environments or small spaces.

The total component cost (sensor, microcontroller, LEDs, and power supply) is approximately $15–20. Accounting for labor and overhead, the product could retail for around $30–40, offering an affordable alternative to more complex commercial systems.

Requirements
Must:
The system must detect the distance of an object using an ultrasonic sensor. The system must change the color of the RGB LED based on the measured distance. The system must provide a visual indication of proximity using the colored LEDs. The system must continuously update in

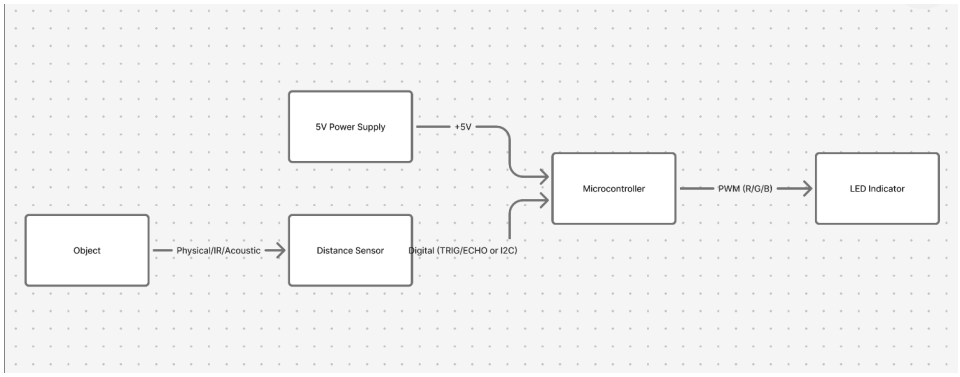
real time. The system must include at least one ultrasonic sensor for distance measurement. The system must include at least one LED for visual output. The PCB must be a minimum 2-layer design with at least 10% surface mount components. THe system must be safe to operate. The system must not overheat or short circuit under normal operation.

Should:
The system should smoothly transition between colors to show distance. The system should operate reliably in normal indoor conditions.

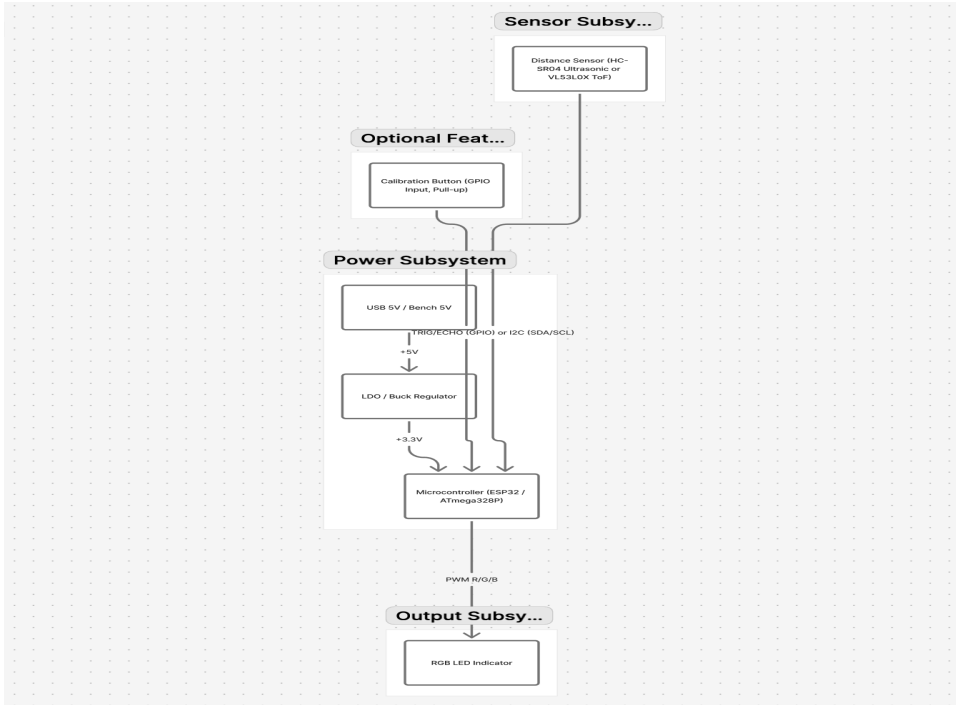
May:
The system may include a calibration feature to adjust detection range or color thresholds. The system may include a mounting feature.

System Architecture

Level 0



Level 1



Design Specification

- **Sensor:** HC-SR04 Ultrasonic Distance Sensor
- **Processor / Microcontroller:** ESP32 Feather
- **Actuator / Output:** LED(Red, Yellow, Blue)
- **Power:** 5V DC via USB or bench power supply
- **Mechanical Design:** Compact, with 2 layer PCB design with sensor and microcontroller, connected to LEDs in front. Also holes for mounting applications.
- **Firmware:** Language: C/C++, Development Environment: Arduino IDE
- **Arduino:** Yes
- **Development Environment:** Arduino IDE, KiCad