

UNPLUGGED 2.0 | Round: 2

Team: TerraCharge

Members:

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Project Overview:

The objective of this project is to design and develop a modular PCB using the open-source software **KiCad** within the next 4 hours. The PCB will serve as the backbone of an **advanced central monitoring system** for urban environmental surveillance. This **Smart City Environmental Sentinel** must seamlessly integrate sensor interfacing, power management, and real-time data transmission within a scalable and efficient architecture while adhering to strict power and connectivity constraints.

Key Features:

- Correctly mapped communication protocols for all sensor modules and actuators.
- Robust **power management unit**, including battery monitoring, recharging capabilities, and an **integrated solar panel interface**.
- **Scalability and modularity**, allowing for future enhancements with minimal redesign.
- Use of **standard electronic components** readily available in any electronics lab.

Bill of Material (BOM):

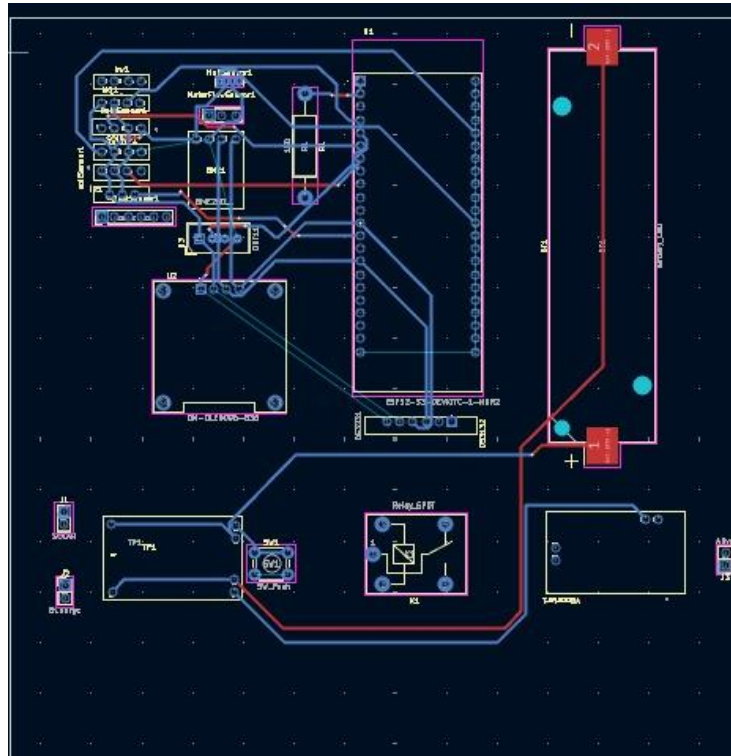
Sr No	Components Name	Specifications	Quantity	Unit Cost	Total Cost	Reference Link
1	ESP32-53 Dev Module	ESP-WROOM-32 WiFi Bluetooth	1	337	337	Link
2	MQ-135 Gas Sensor	Sensitivity to ammonia, sulfide, and benzene steam	1	106	106	Link
3	Sound sensor module	IC chip-LM393	1	48	48	Link
4	OLED Display	SPI/I2C 128*64	1	156	156	Link
5	BME280 EnvironmentalSensor	Temperature, humidity, pressure, I2C, SPI.	1	430	430	Link
6	Solar Panel	20W12v (74*35cm)	1	1762	1762	Link

7	Rechargeable Module (TP4065)	Li-ion battery charging board micro-USB with current protection	1	13	13	Link
8	Battery 3.7v2500mAh18560	3.7V, 2500mAh, Li-ion, 18650, Rechargeable	1	120	120	Link
9	Voltage Booster	can be set to 5v/8v/9v/12v	1	29	29	Link
10	Dust Sensor	Analog output 0 to 1500micro g/m3	1	440	440	Link
11	Hall Effect Sensor	used to detect the both poles of a magnet	1	34	34	Link
12	MAX471 Current and Voltage Sensor	Voltage, current, bidirectional, 3A, 36V, analog output, low resistance, accurate, compact.	1	241	241	Link
13	Water Flow Sensor	4o	1	190	190	Link
14	DHT11 Temperature and Humidity Sensor	0.3mA standby 60µA.	1	56	56	Link
15	Soil Moisture sensor	Having Lm3 comparator chip	1	34	34	Link
16	Relay Module	AC voltage 250v, AC current 10 A max DC voltage 30 v Dc current 10 A	1	83	83	Link
17	Rain Sensor	Providing both digital and analog output	1	53	53	Link
18	RTC DS3231 module	Precise Real time clock I2C AT24C32 without cell	1	149	149	Link
19	IR Flame sensor	Comparator chip LM393	1	25	25	Link

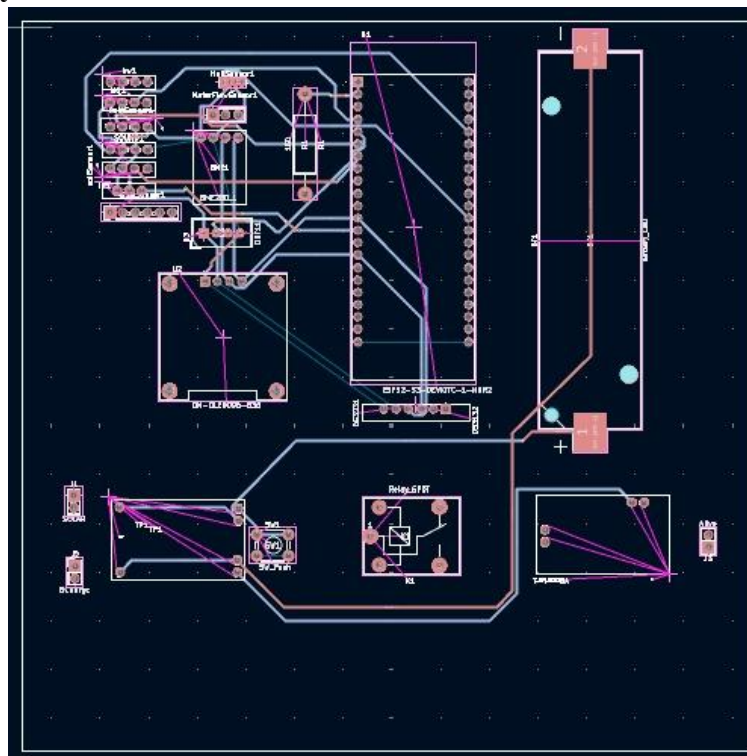
PCB Design:

Deliverables:

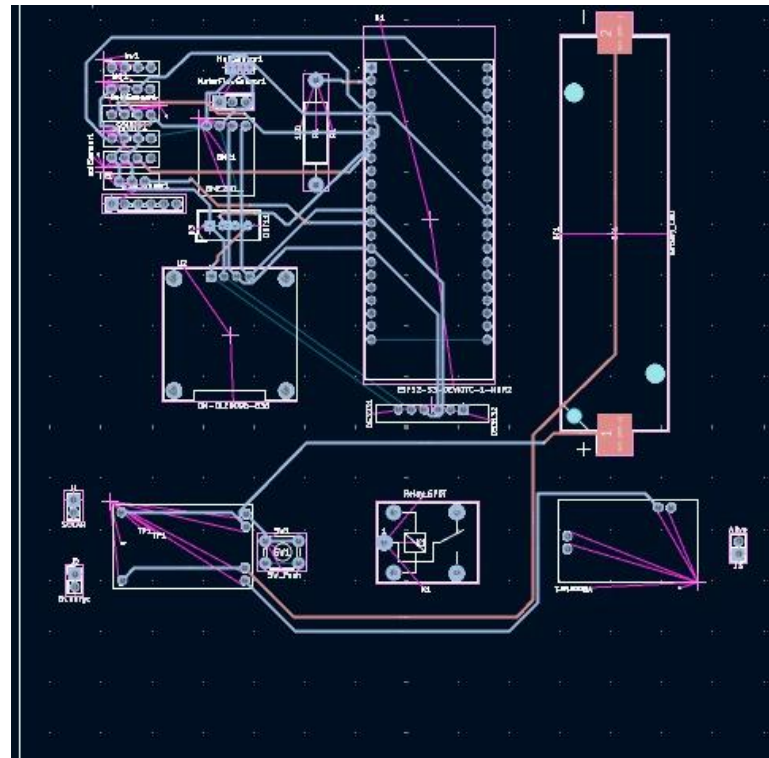
- Complete PCB Layout:



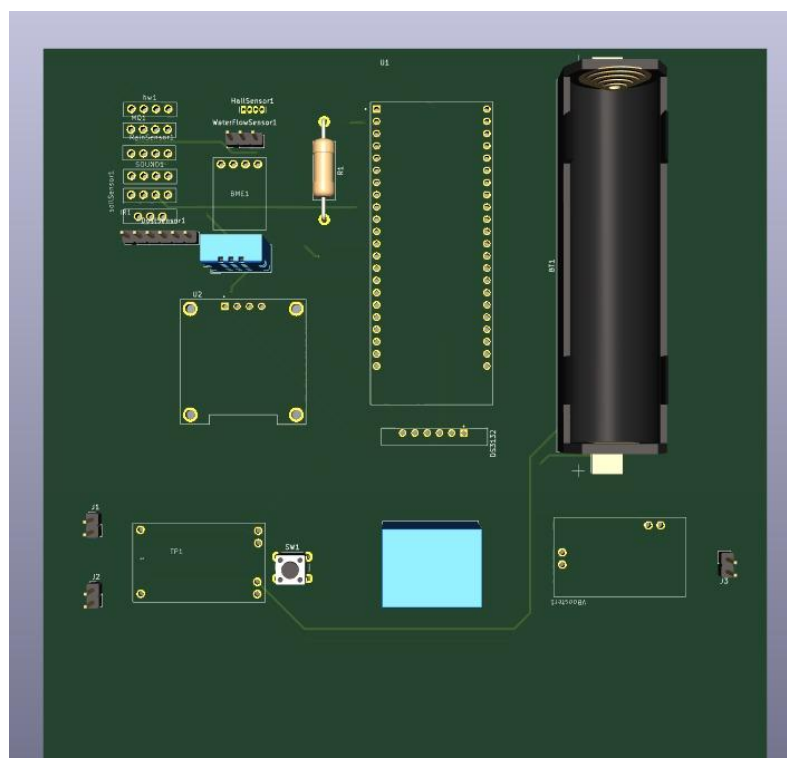
- Front Copper Layout



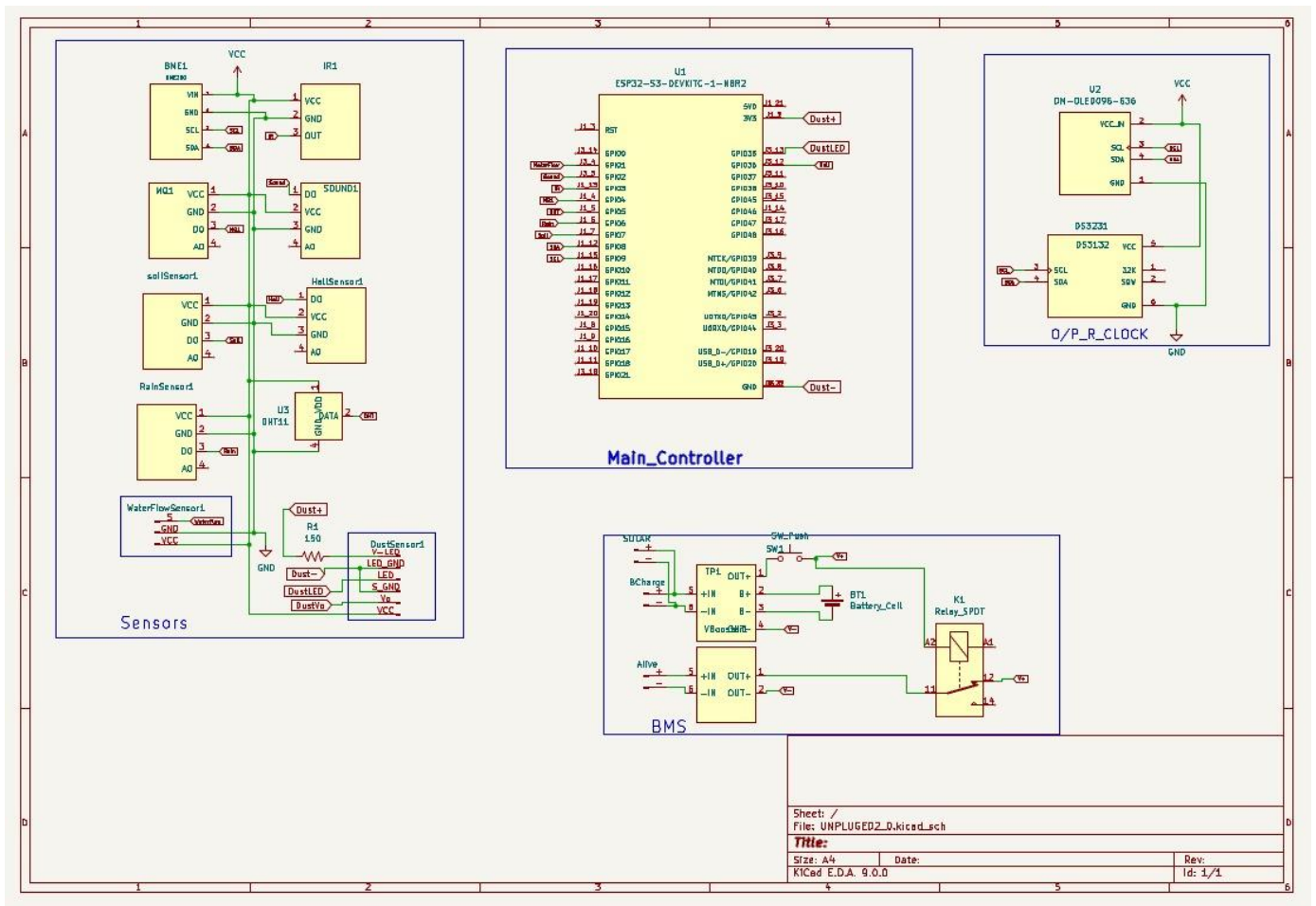
- **Back Copper Layout**



- **3D rendered image of the PCB**

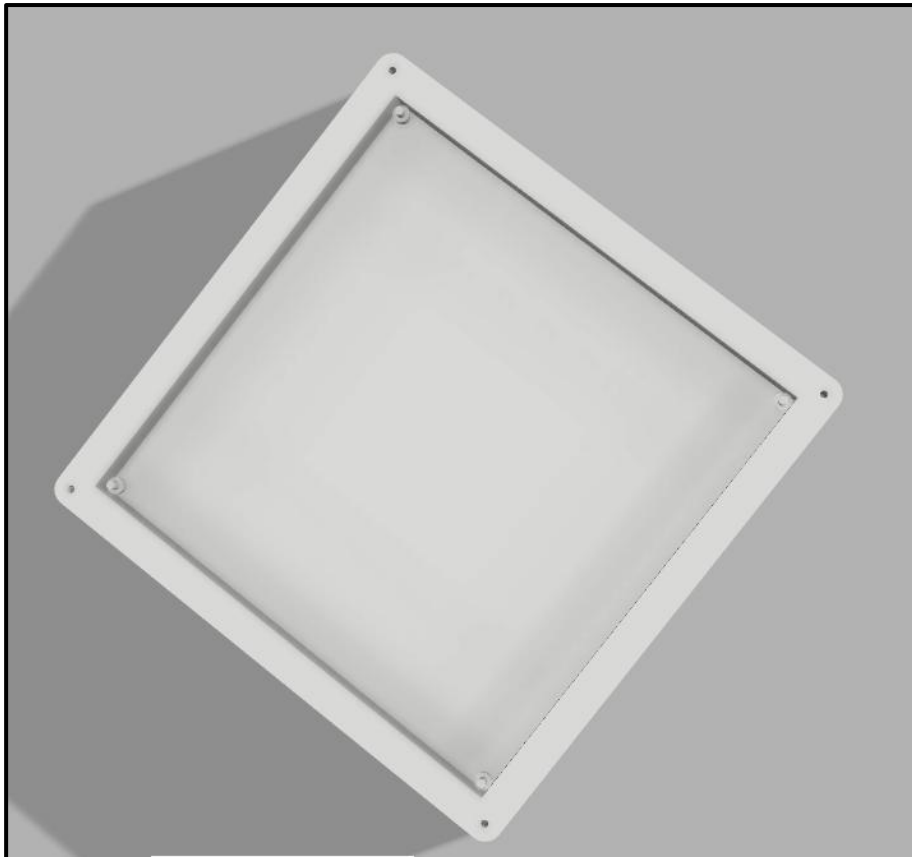
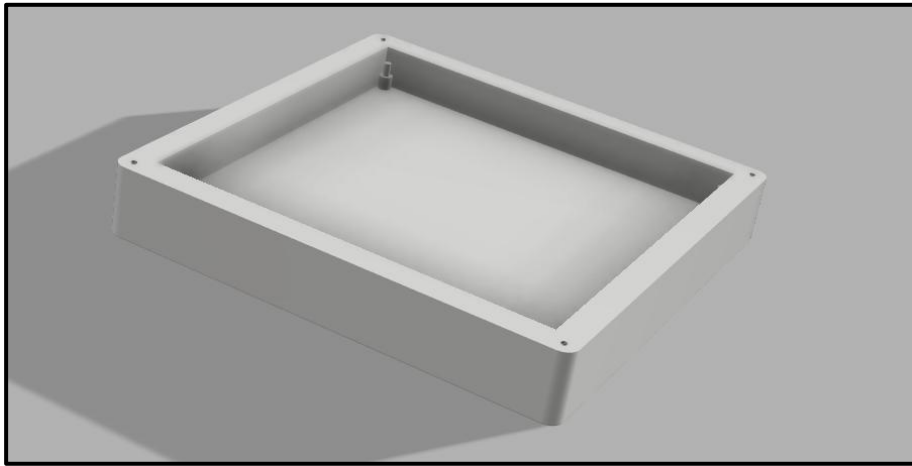
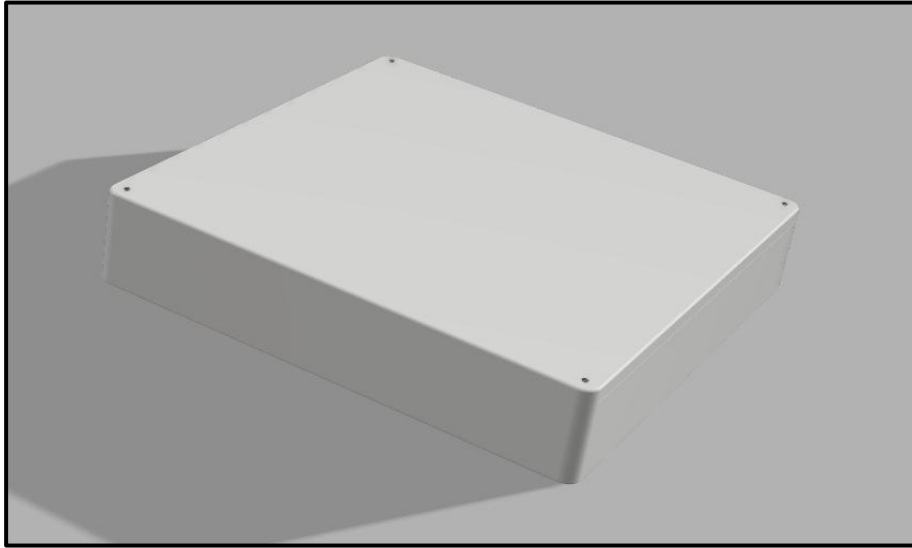


- Schematic Diagram Screenshot



CAD 3D Rendered Screenshot

A high-resolution 3D model of the entire system has been created to assist in design validation and implementation.



Verification Checks

To ensure the reliability and efficiency of our project, we have conducted multiple verification tests, including:

- **Circuit Validation:** Ensuring all connections function as expected.
- **Software Testing:** Debugging and optimizing firmware for ESP32.
- **Power Management Tests:** Verifying the efficiency of solar power charging and voltage regulation.
- **Sensor Accuracy Tests:** Comparing collected data with reference values.

GitHub Repository

For complete project files and documentation, visit: [GitHub Repository](#)