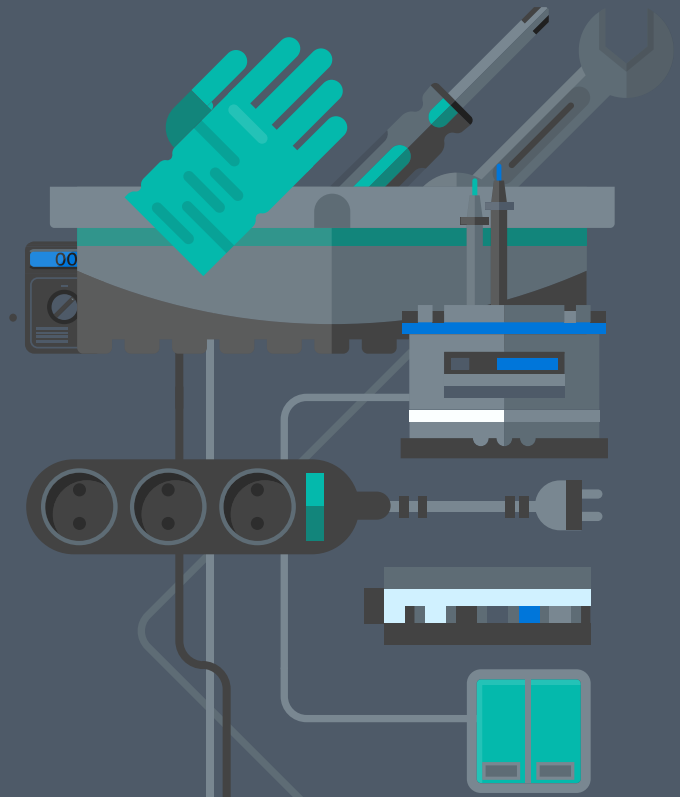
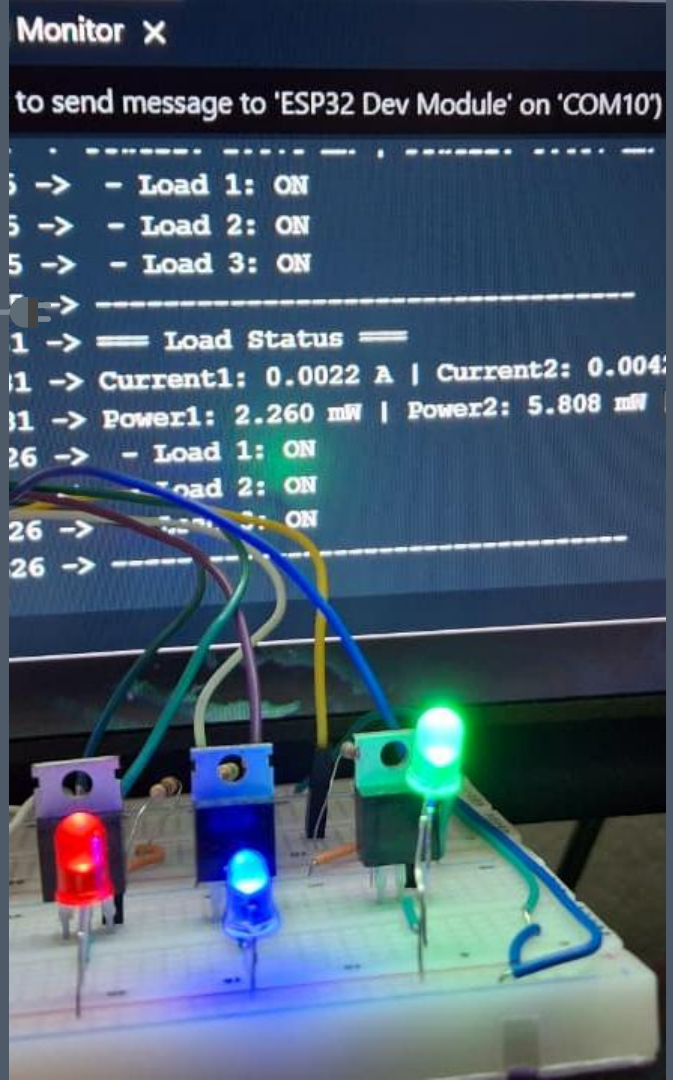


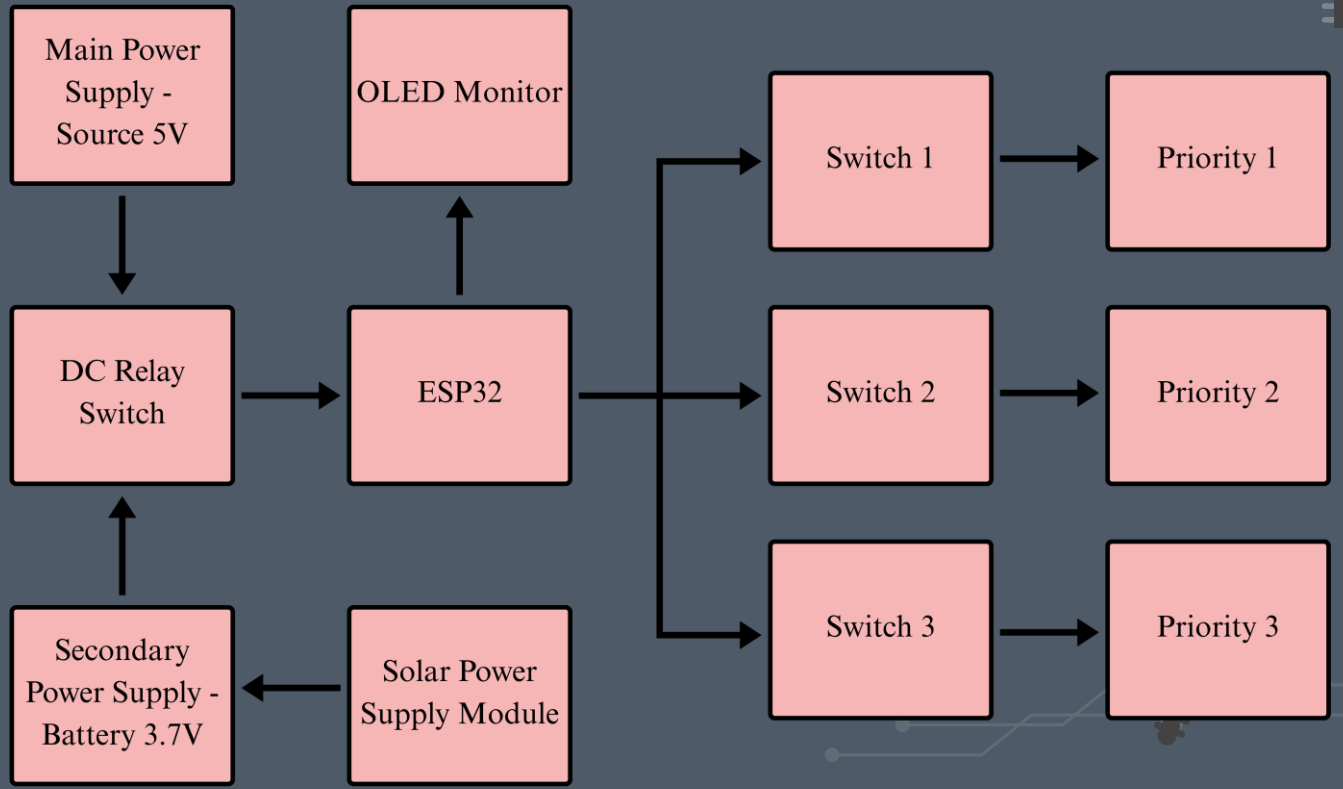
Smart Backup Power Management and Real-time Monitoring System

For Junior Design Project

Hardware Implementation



Block Diagram:



04 Key Ingredients for the Projects

ESP32 Dev Module

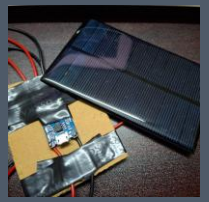
Acts as the main controller, handling Wi-Fi communication, sensor data processing, and load control via Blynk.

Shunt Resistors

Measure current flow for monitoring load consumption.

Relay SRD-05VDC-SL-C

Switch between different loads and power sources according to set priorities.

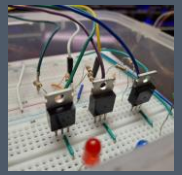


Solar Panel with Charging Module

Provides renewable energy to charge the battery.

N-CHANNEL Mosfet

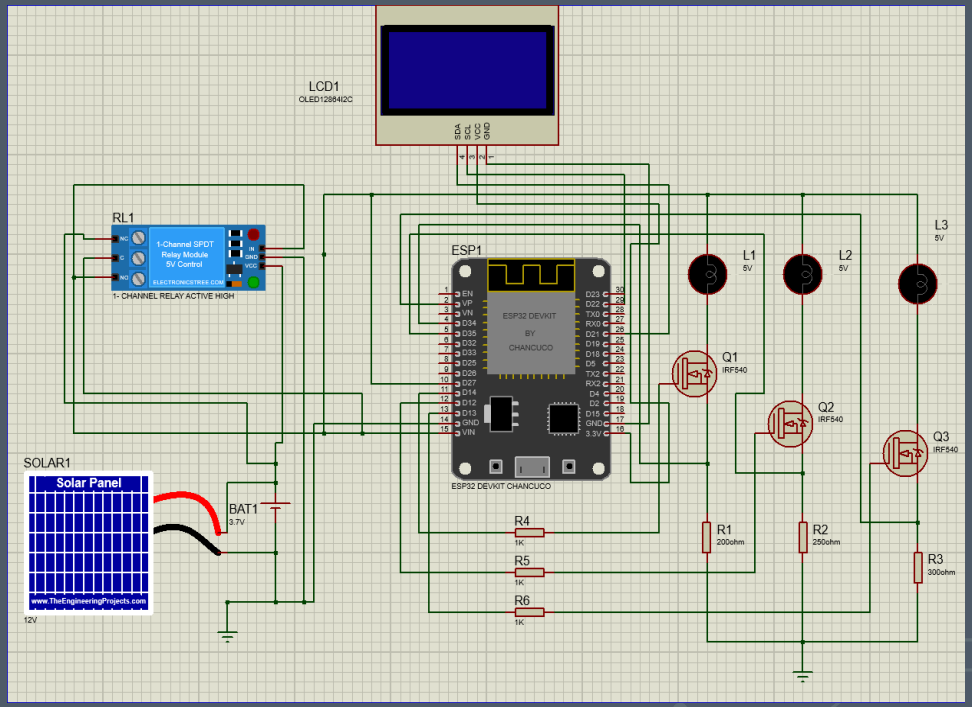
Used for efficient load switching and current control.



Lithium Rechargeable Battery

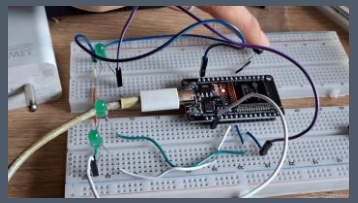
Stores energy from the solar panel for backup operation

Circuit Schematic:

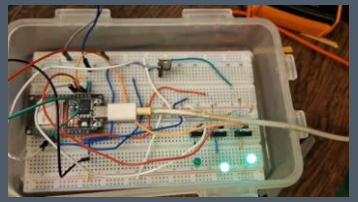


Proxy Experiment to achieve our Vision:

- First we made a circuit, to determine and understand the concept of switching in ESP32.

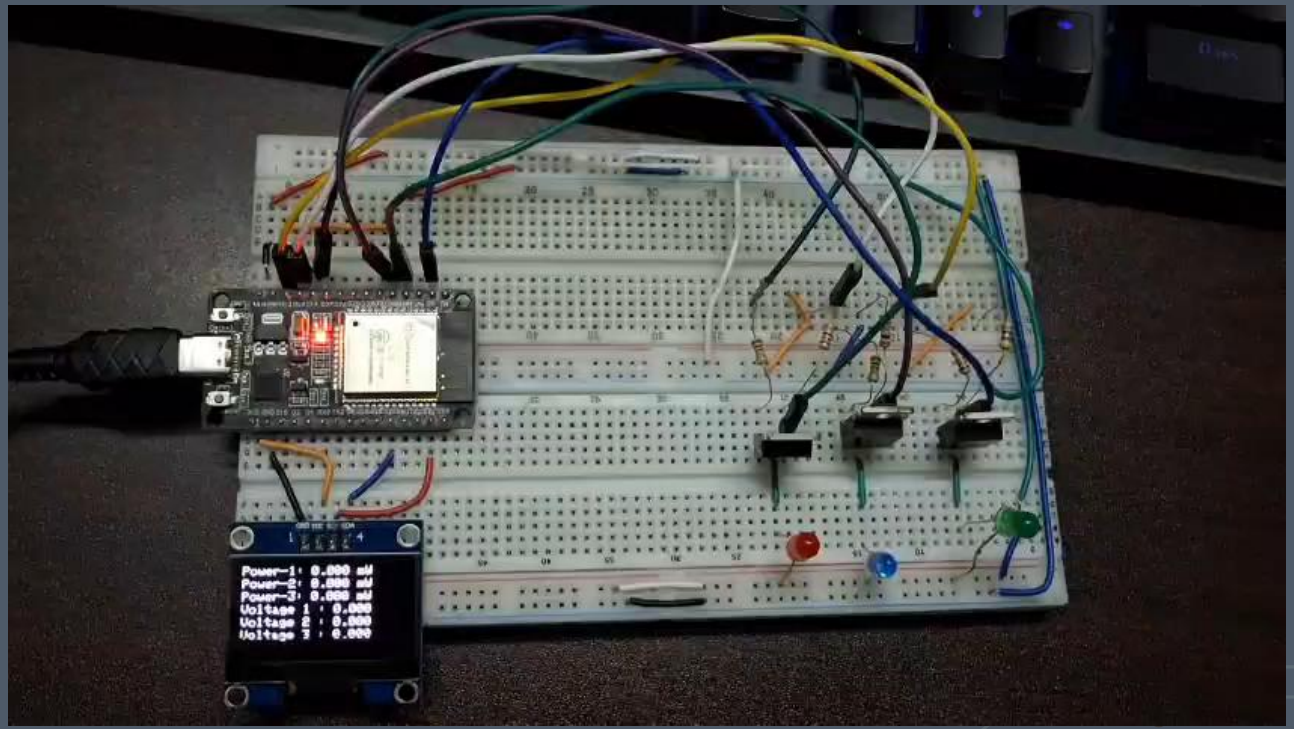


- Then we implemented the circuit by following the Diagrams. But avoided the manual Switching.

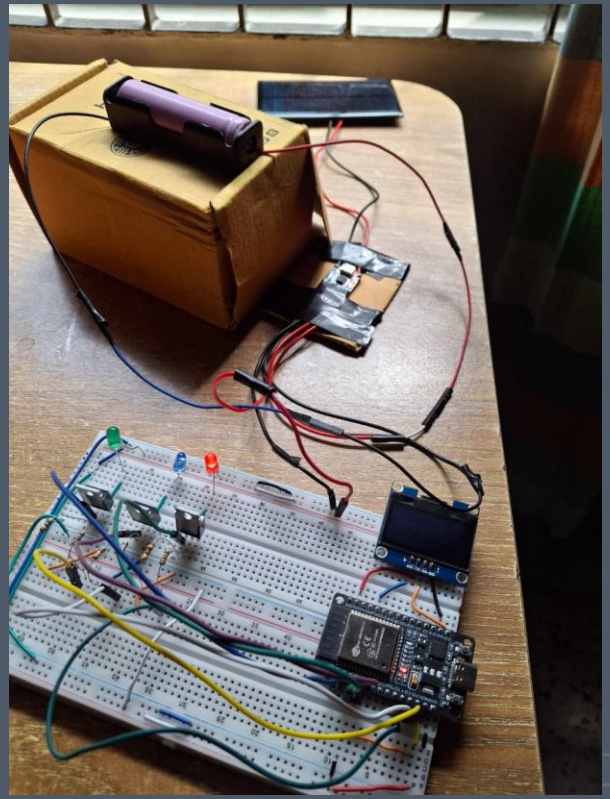


- After that we implemented to build the full circuit including the Solar Panel and the 1.3’ OLED.

05 Demonstration with 5V:

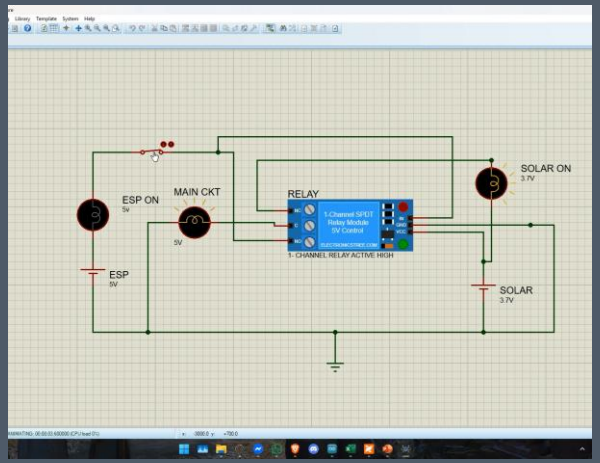


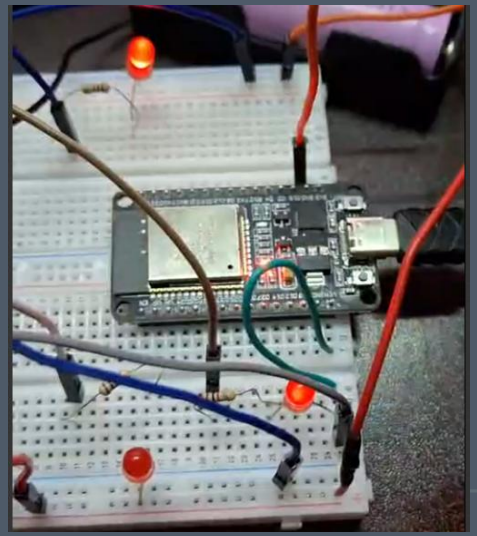
Demonstration with Solar Charged 3.7 V Battery:

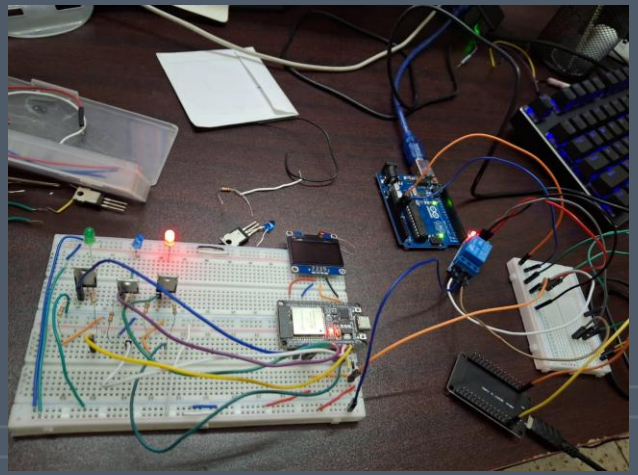


Challenges in implementing Relay:

- The Relay module takes 5v to switch from NC (Normally Closed) to NO (Normally Open). Under 4.5 V the switching doesn't occur.
- Even when Switching did happening, the voltage was fluctuating. It ended up damaging the ESP32.
- Another Circuit and simulation was created to understand the concept.
- They were separately connected.



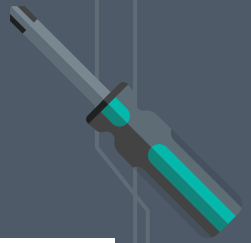


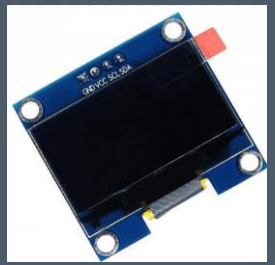


Software Functionality

Coding Implementation

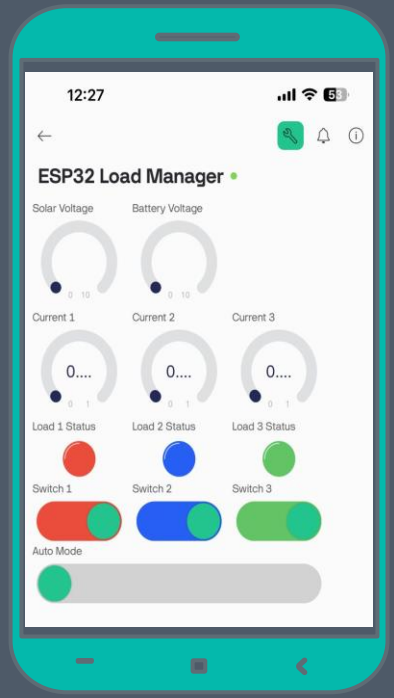
- ESP32 programmed in Arduino IDE
- Defined pins for loads, relay, and shunt sensors
- Functions to read current and calculate power
- Local monitoring via OLED
- Remote monitoring via Blynk
- Synchronization between hardware and software



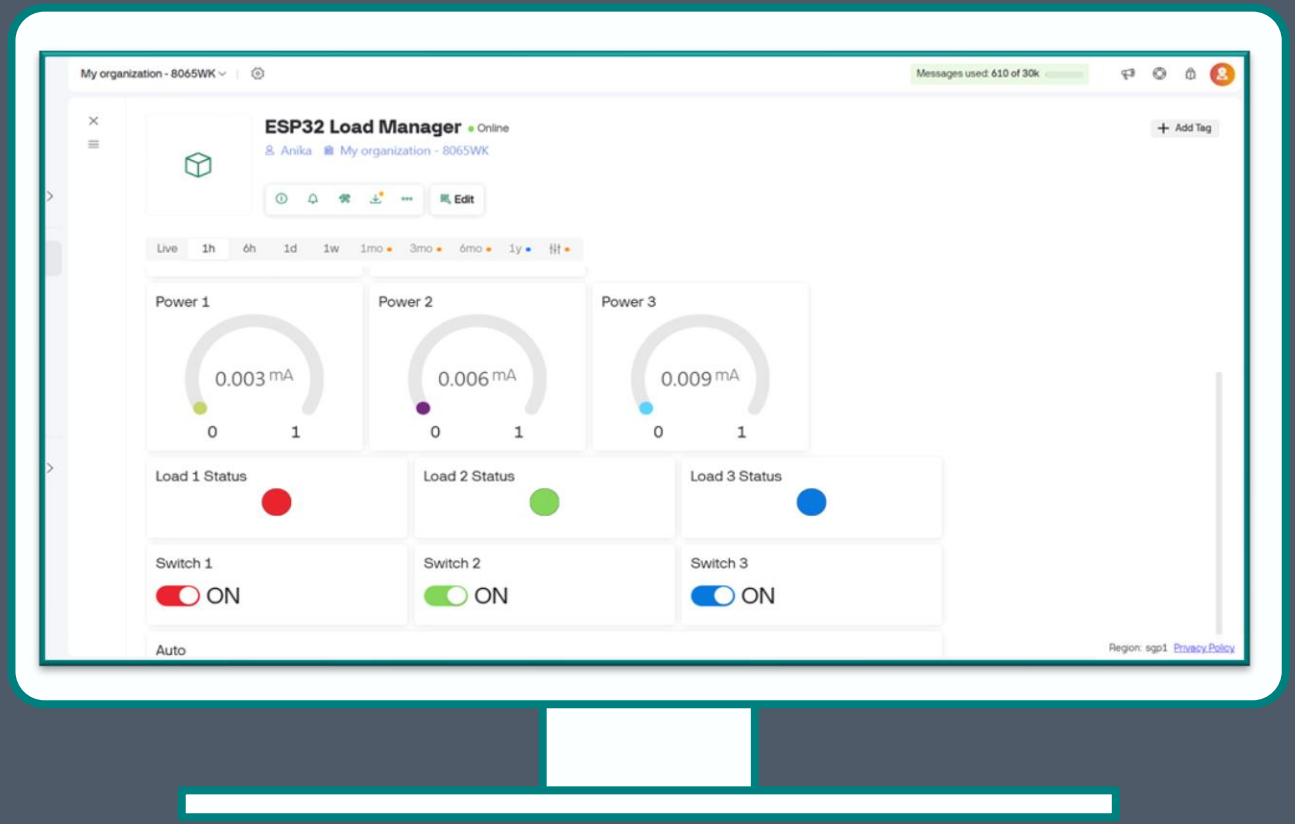


Blynk Dashboard

- Virtual pins control and monitor loads
- Power values displayed in Watts
- LED indicators show real-time load status
- Dashboard updated every 2 seconds



Blynk Dashboard



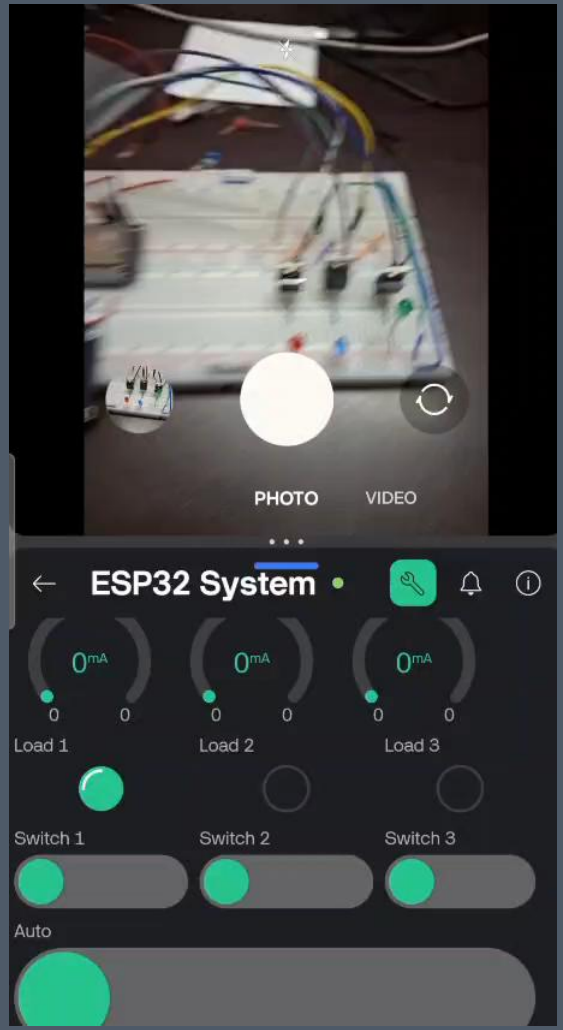
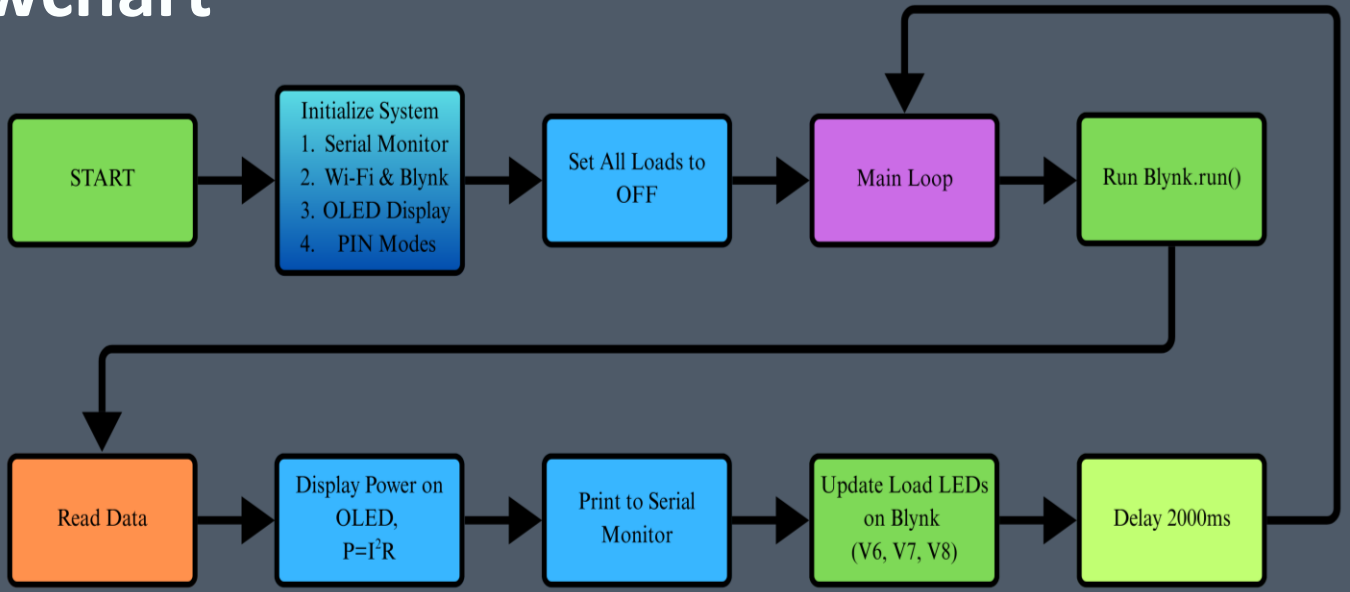


PHOTO
VIDEO
ESP32 System
0mA
0mA
0mA
0
0
0
0
0
0
Load 1
Load 2
Load 3
Switch 1
Switch 2
Switch 3
Auto

Flowchart



Blynk Button Handlers

- V10 → Toggle Load1 → LED V6
- V11 → Toggle Load2 → LED V7
- V12 → Toggle Load3 → LED V8