TEAM #9

Industry Design Processes - Fall 2023
ECE 411

PARKX

Parking Counting System

Portland State University

Agenda

1 Background

2 Our Approach

3 Design Overview

4 Implementation

5 Testing

6 Results

7 Contributions

8 Lessons Learned

Background Research

- Traditional parking systems causes congestion and frustration
- Monitoring systems often give general information
- Most parking systems do not take advantage of renewable energy
- Lack of user user-friendliness

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Problem Statement

There is a crucial need for a cost-effective alternative, incorporating solar panels, to ensure accessible and user-friendly parking space management

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Motivation

1

Create a cost-effective and user-friendly solution

2

Enhance the efficiency of parking space management

3

Provide real-time convenience for drivers

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Our customer

1st stage of production

On-Campus Parking

Expansion

Apartment Buildings

Long term targe

Parking lot owners

Research

Universities

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Schedule: Gantt Chart

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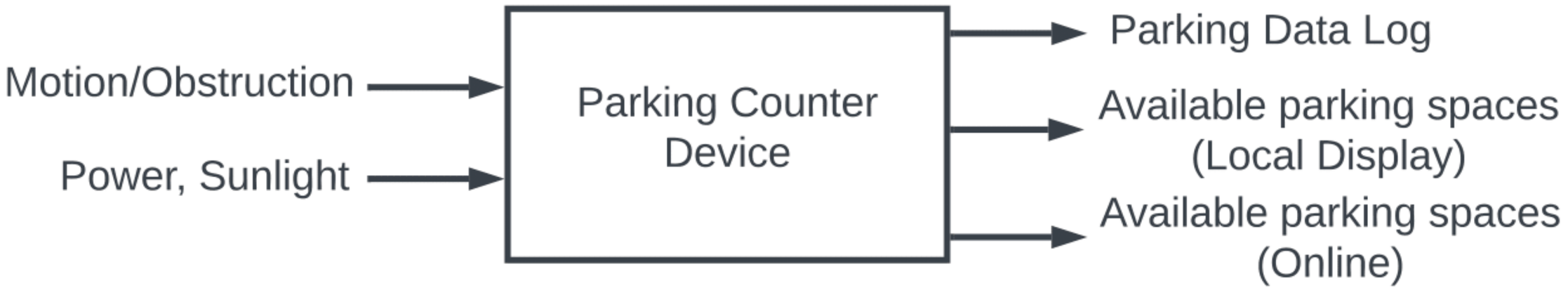
Block diagram: L0



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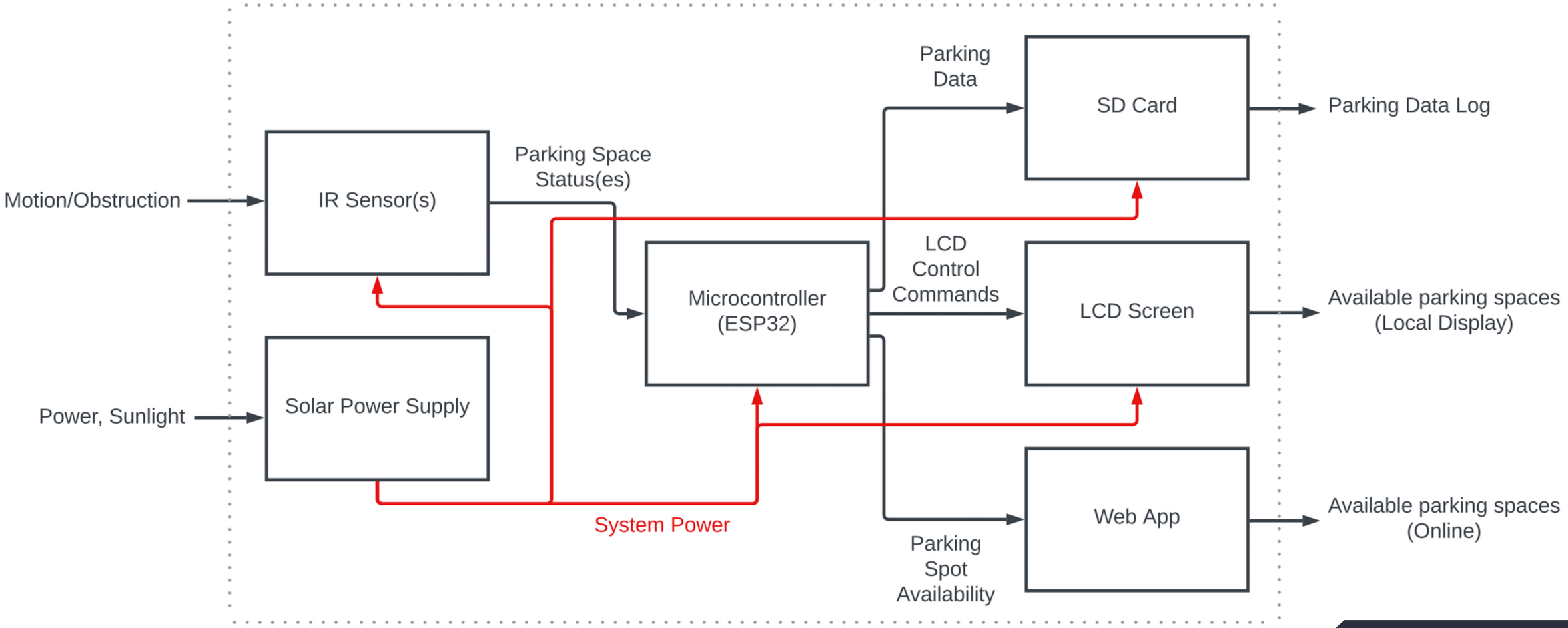
Block diagram: L1



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Design Alternatives

What have we decide to change? Mostly power supplies

Power source

Switched to solar

Voltage booster

Implement voltage step-up

Backup power

Adding battery

Room for testing

Aimed for test points

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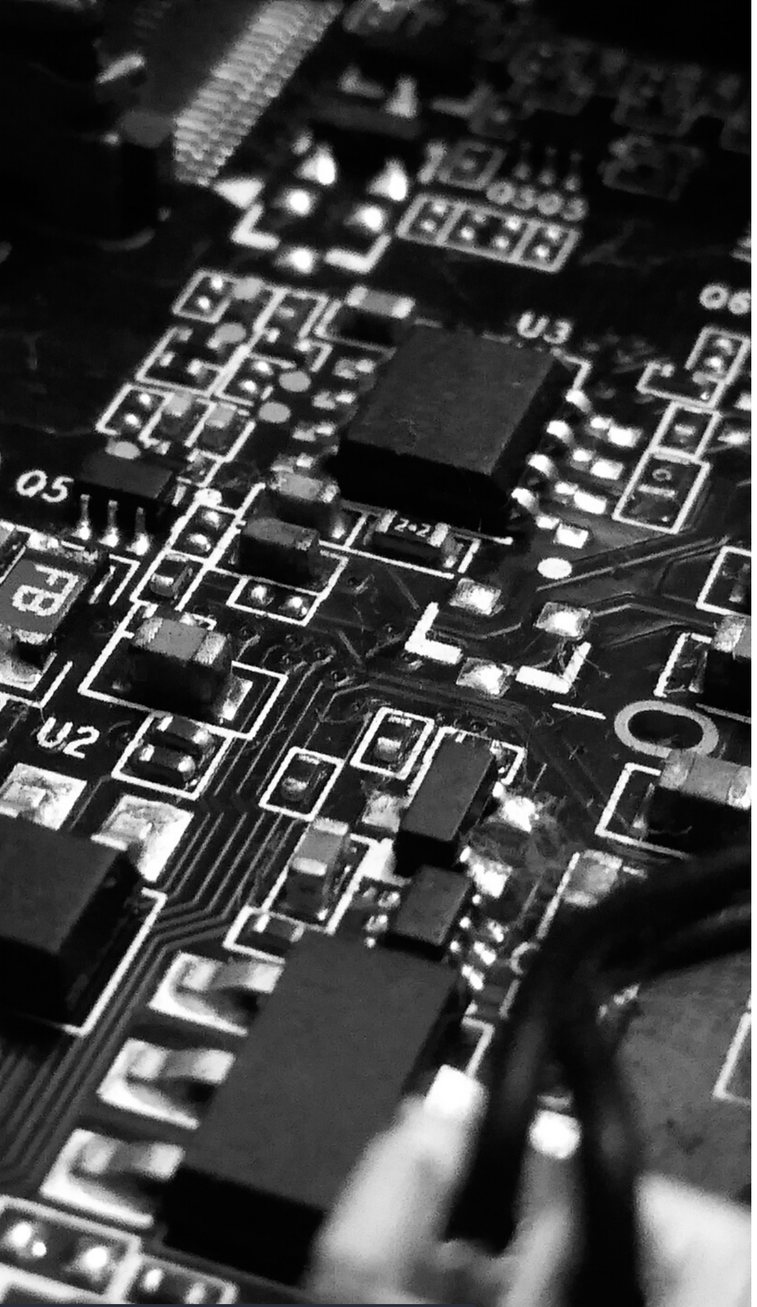

Requirements

Must accurately detect the presence or absence of vehicles in parking spaces

Must provide real-time updates of available slots

Motion sensors must reliably detect vehicles within specified range

Information displayed must be intuitive and user friendly

Should be customizable based on user preferences

Must not pose any safety risks to users or vehicles in the parking area

Must adhere to relevant local regulations and standards

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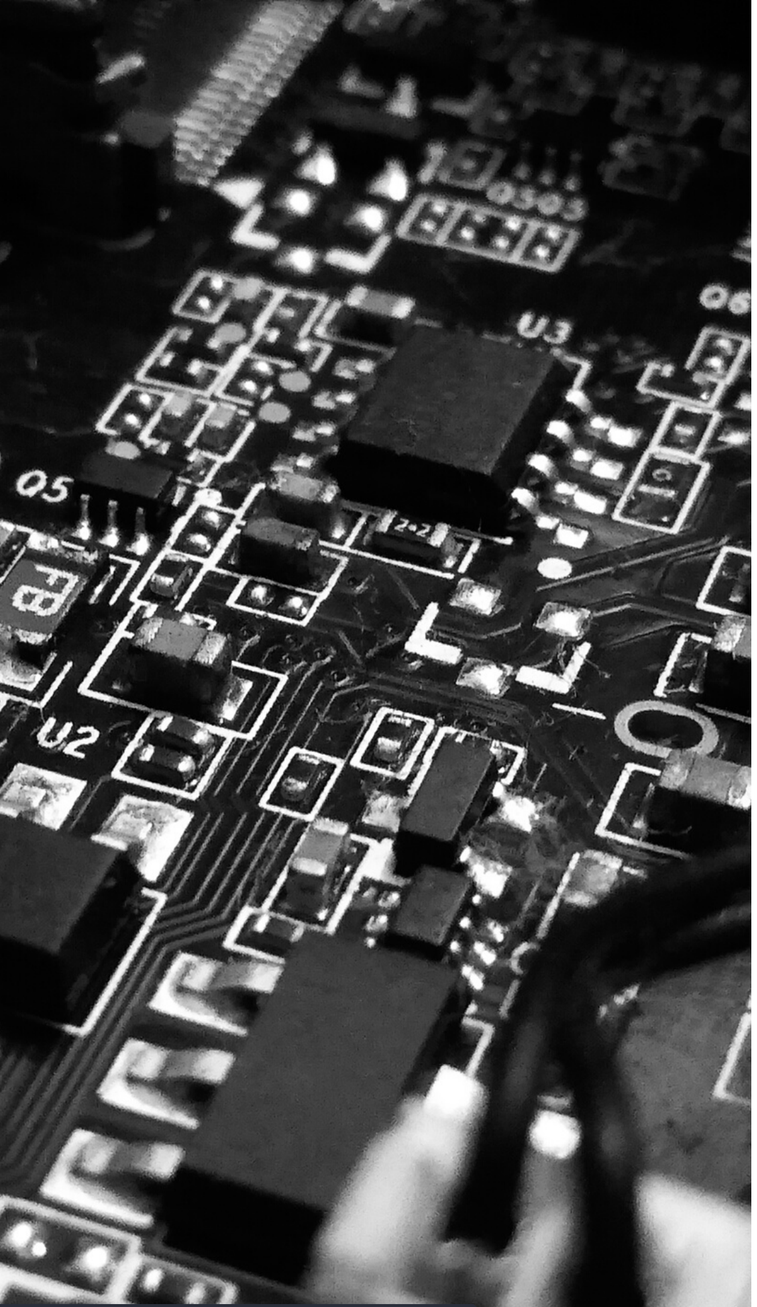

Requirements

Should be designed to be economically viable, with low production and maintenance cost

May be modular and customizable based on user preferences

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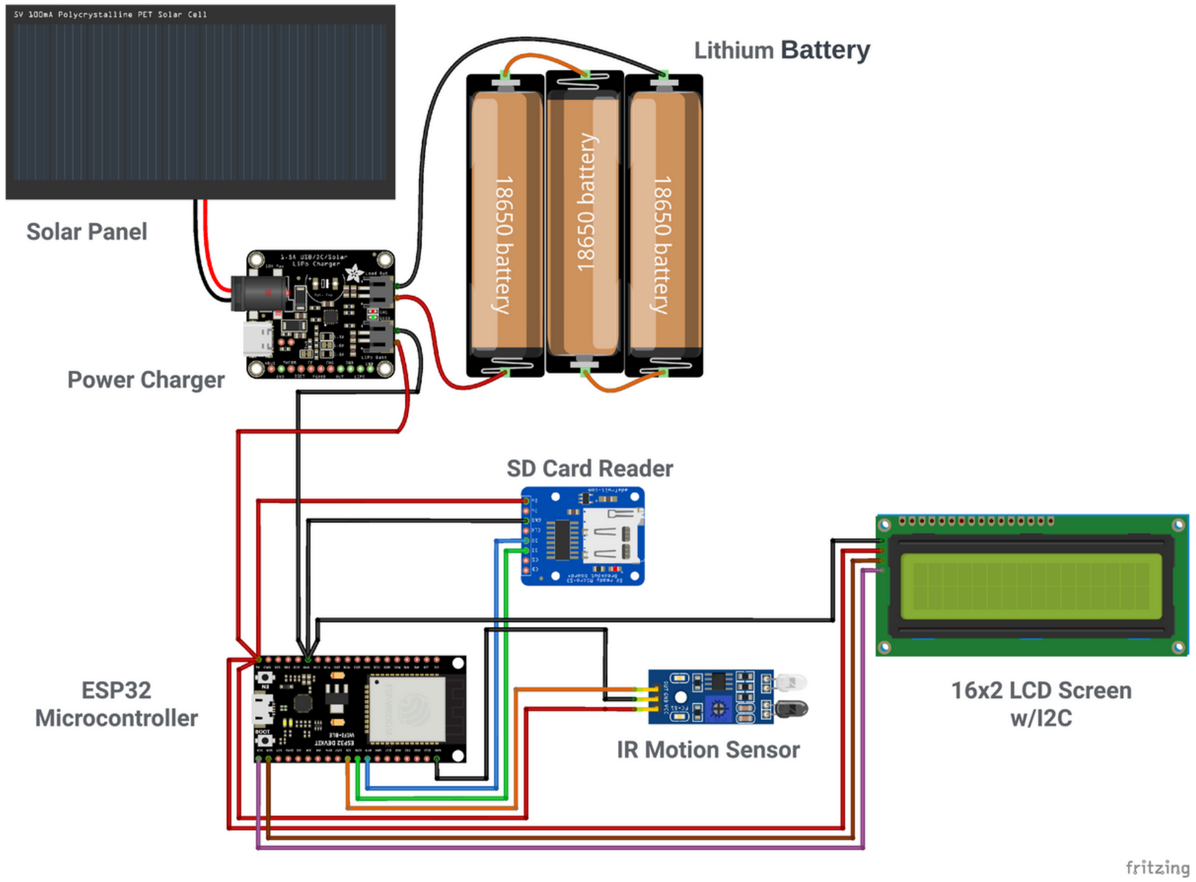
Simulation Circuit

- Used Fritzing for circuit visualization
- Breadboard layout
- Contributed to prototype project



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Breadboard Prototype

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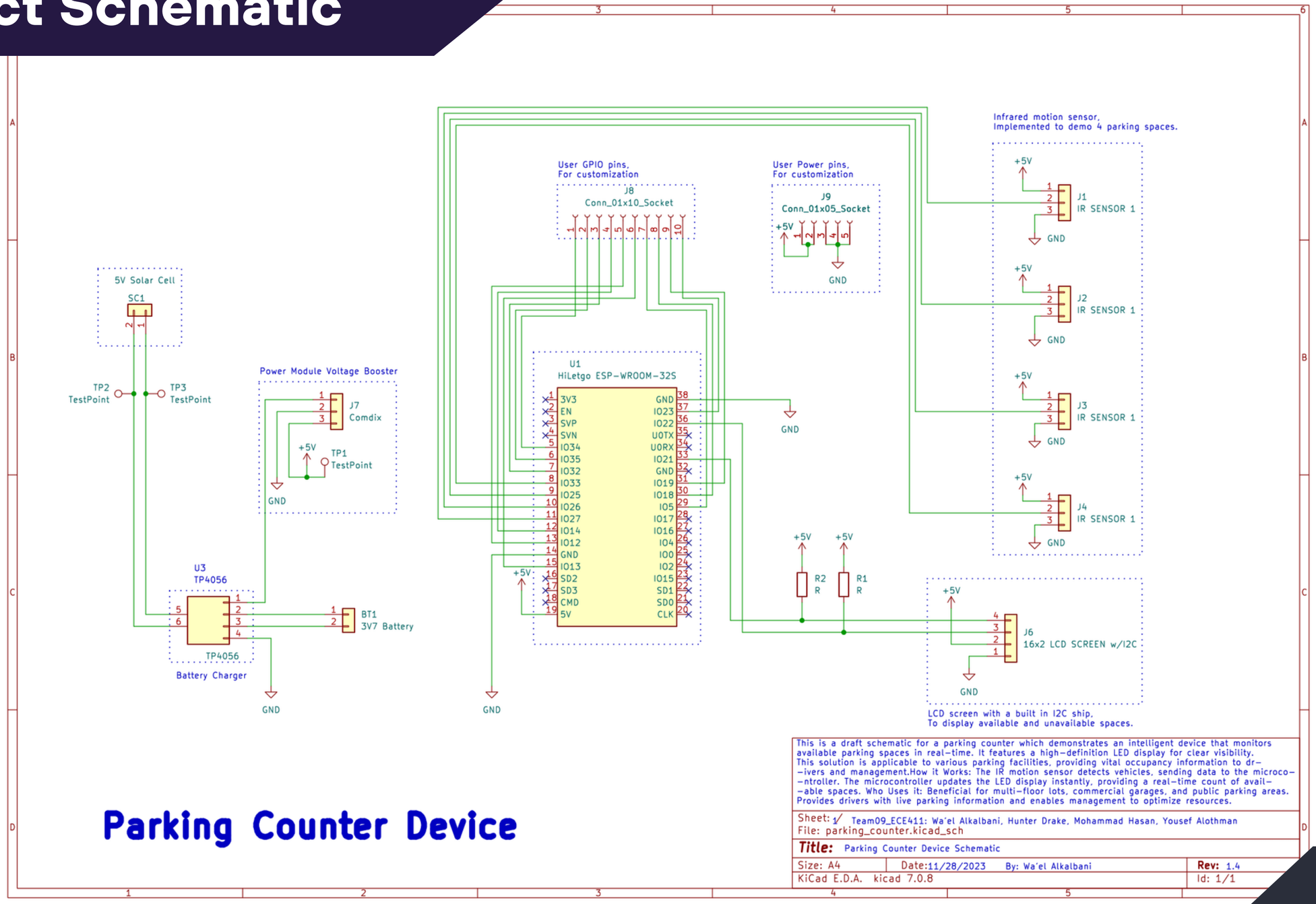
Product Schematic



Parking Counter Device

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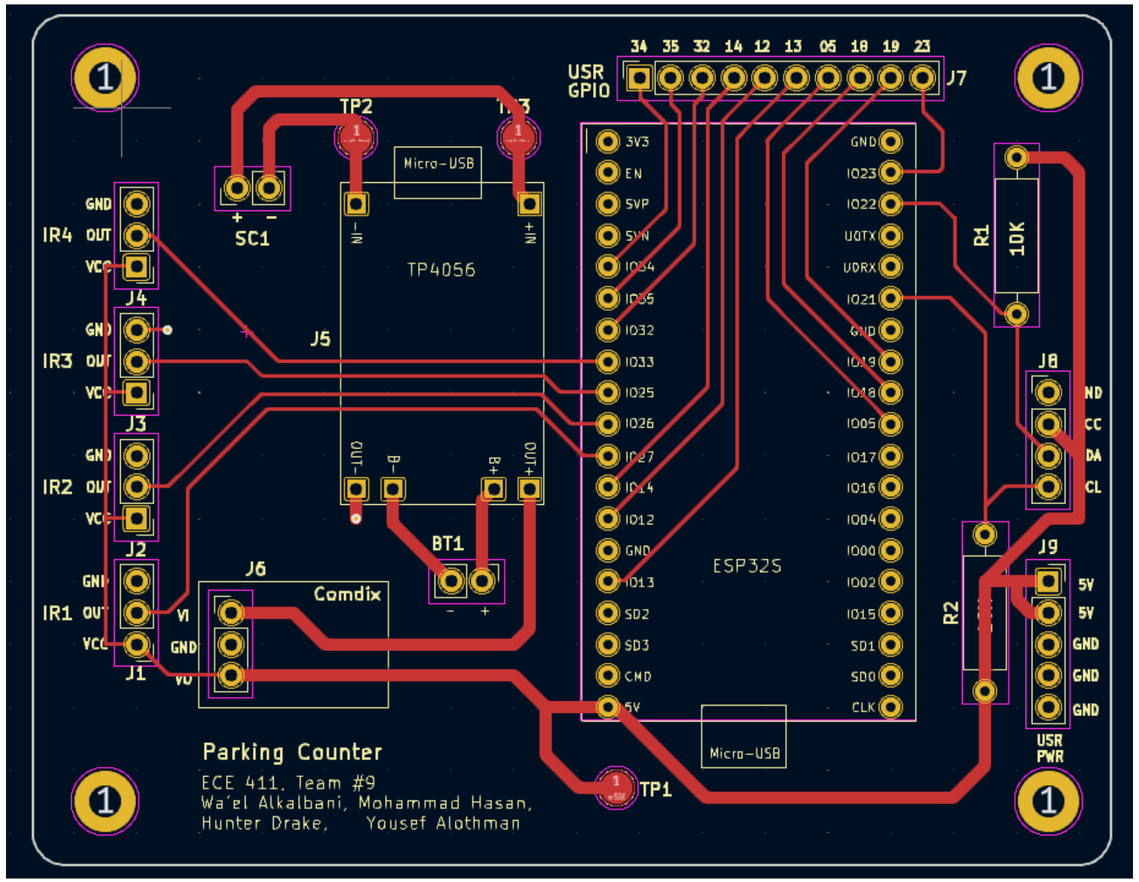
PCB Layout

- **Encounters modularity requirement**
- **2.6x3.4 in**
- **Double layers**
- **Connects to GND**
  - *Ground Plane*
  - *Via Pins*
- **Designed for user peripheral functionalities**
  - *USR GPIO*
  - *USR PWR*
- **1mm 5V traces**
- **Labeled**
- **Cost: $49.35 (3)**



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EST Cost

Description	Cost Ea.	Cost Total
IR SENSOR	$0.88	$3.52
BATTERY CHARGER	$0.78	$0.78
Step up voltage regualtor to control battery voltage to get 5v	$0.80	$0.80
5-6V solar panel	$0.60	$0.60
lcd screen with I2C interface	$0.00	$0.00
esp32s microcontroller - with Wifi module	$0.00	$0.00
SD card reader	$1.80	$1.80
SD card	NA	NA
3D print of parking lot for the simulation	NA	NA
PCB	NA	NA
7.4V battery - 2600 mAh Lithium Ion	$15.82	$15.82
	PCB	$49.30
	Total	**$72.62**

PCB Layout

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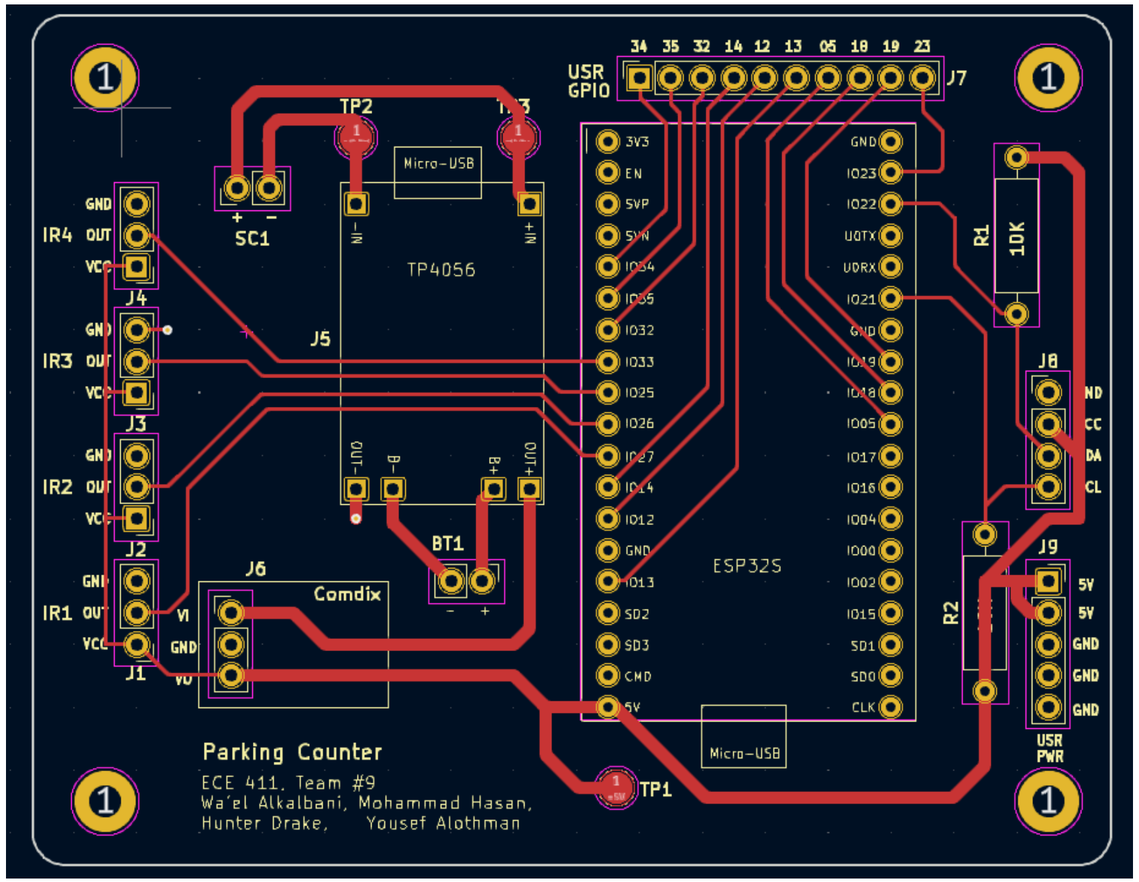

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Code Overview

Interfacing with a screen

Using I2C

Logging time stamps

SD card reader to store data

GPOIO pins to toggle

parking sensors

Wifi module from the esp32

Webapp that shows live data

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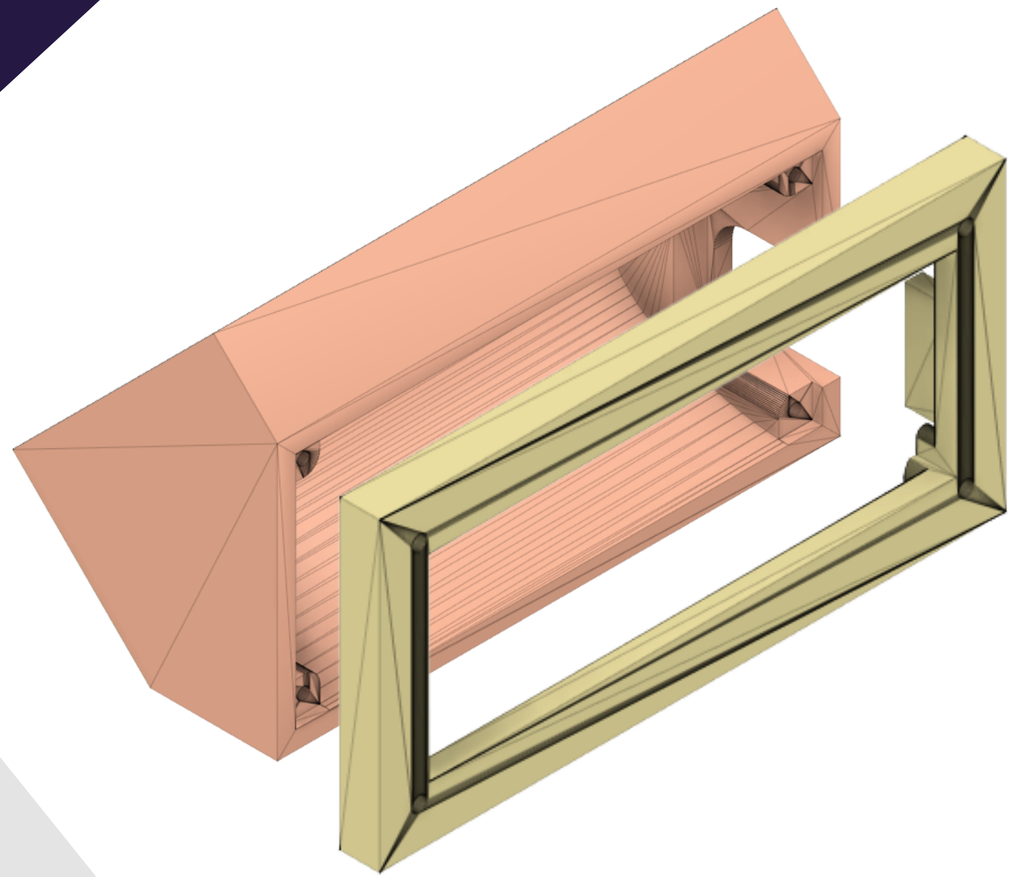
3D printing & Enclosure

- **Brainstormed options between laser cutting and 3D printing**
  - Team members expertise
  - Easier to visualize and plan
  - Modular design
- **Fusion 3D design**
  - Solar panel housing
  - PCB enclosure
  - LCD screen mount
  - Parking structure prototype



LCD screen mount

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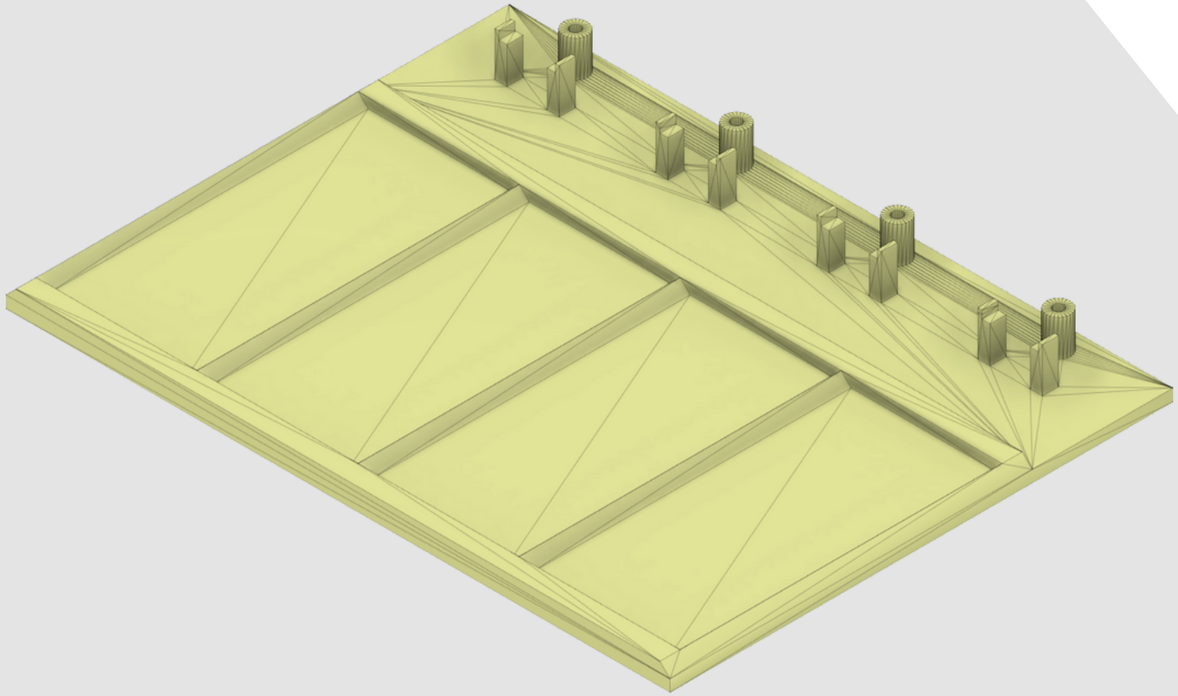
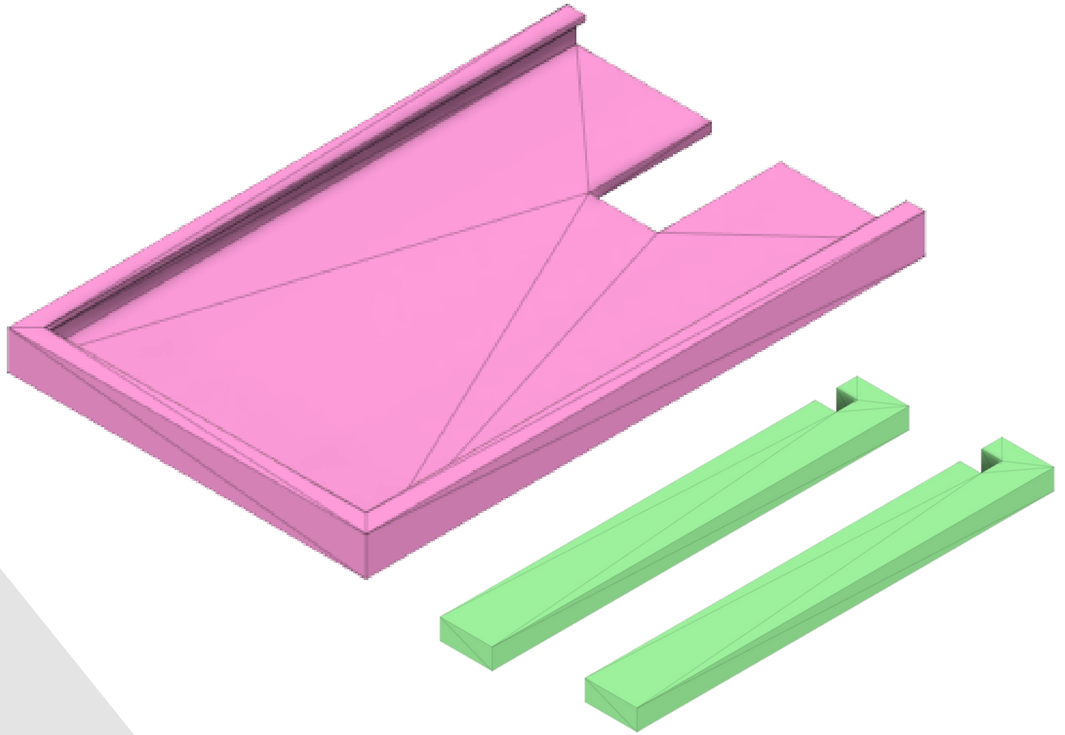
3D printing & Enclosure

Parking Structure





Solar panel housing

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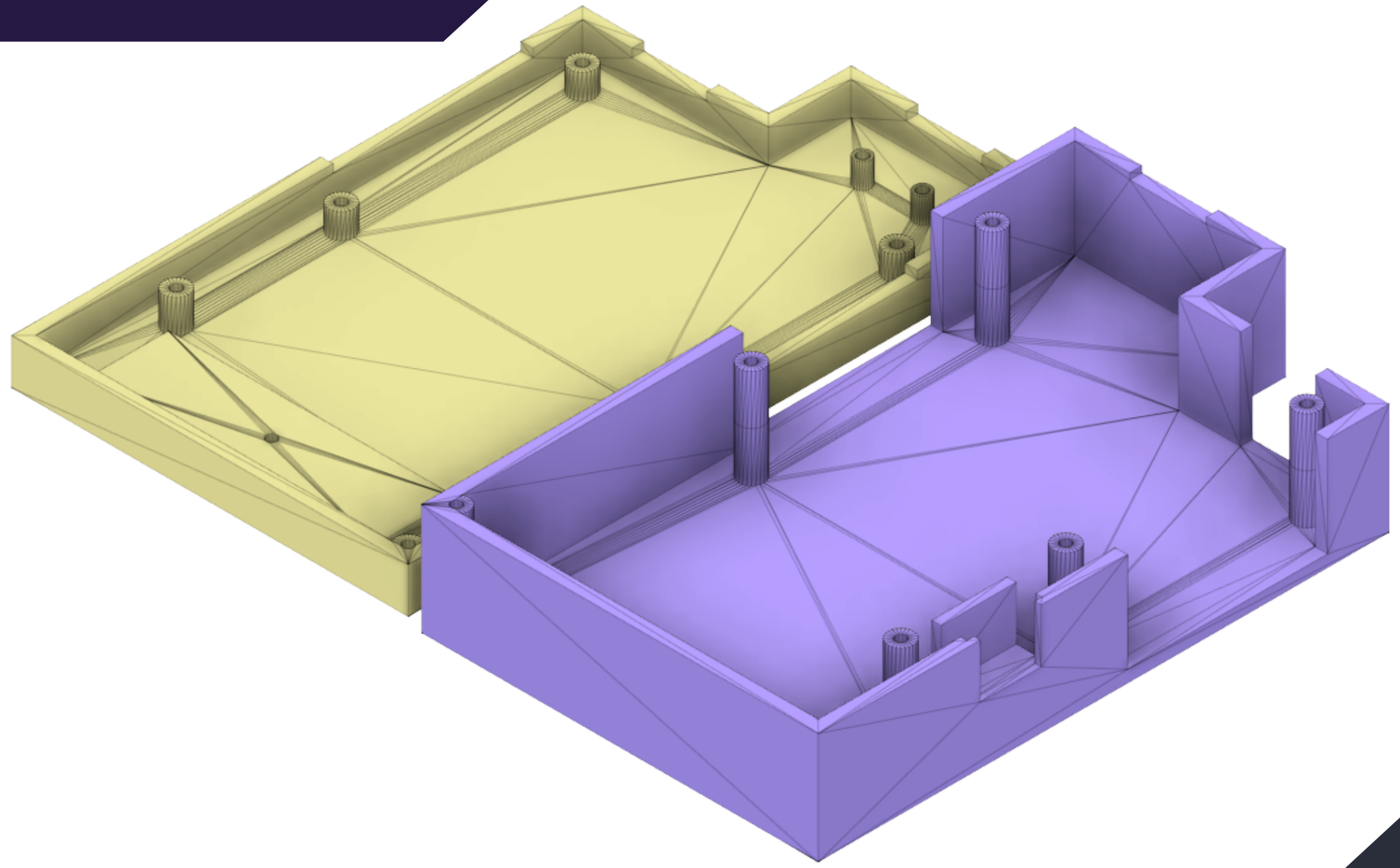
3D printing & Enclosure

PCB Enclosure



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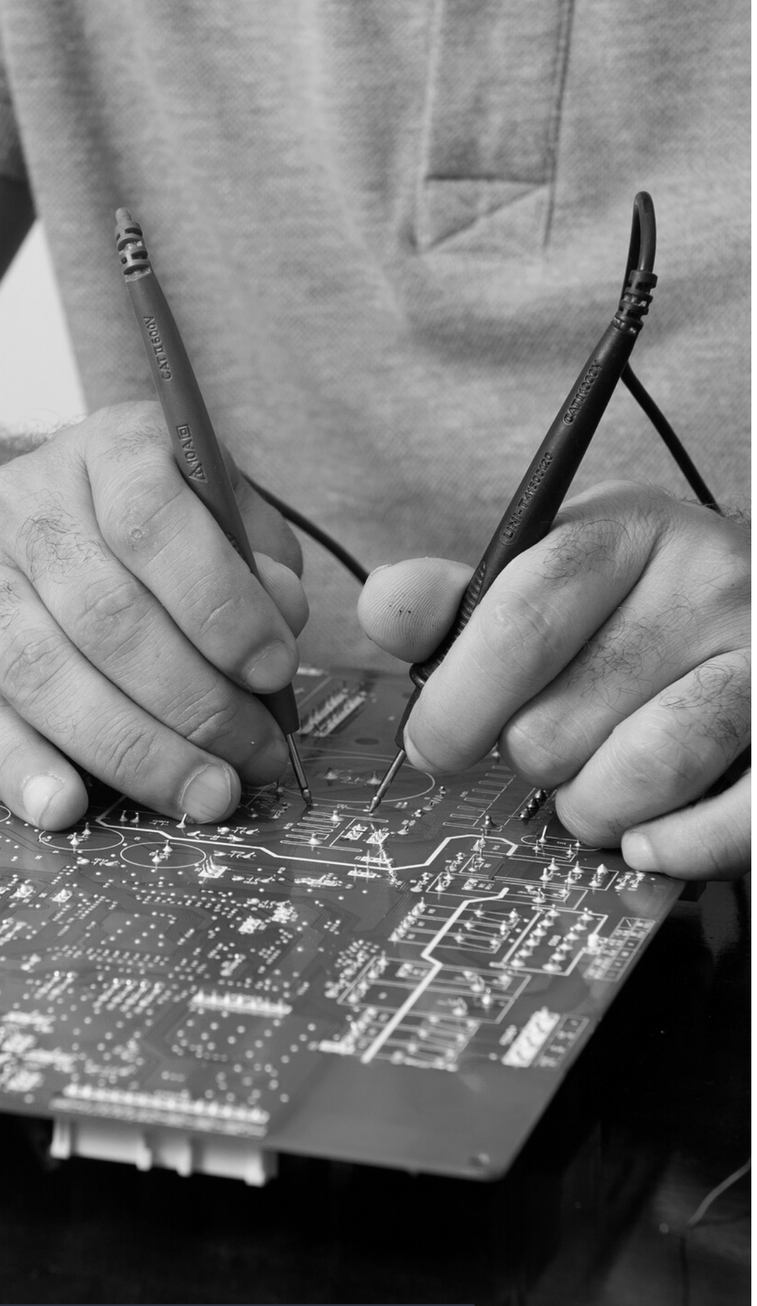

Units Testing

- **IR Sensors**
  - Test sensor output voltage changes with object proximity
  - Verify sensors work within specified range
- **Solar Power Supply**
  - Ensure solar panel charges the battery.
  - Confirm 3.7V power module and 5V boost converter output
- **Microcontroller**
  - Check uC's IR Sensor inputs.
  - Validate uC's display and uSD Card writing
- **microSD Card**
  - Ensure uC data stays on the uSD Card.
  - Confirm other devices can read uSD Card data
- **LCD Screen**
  - Validate uC data displays accurately on the LCD

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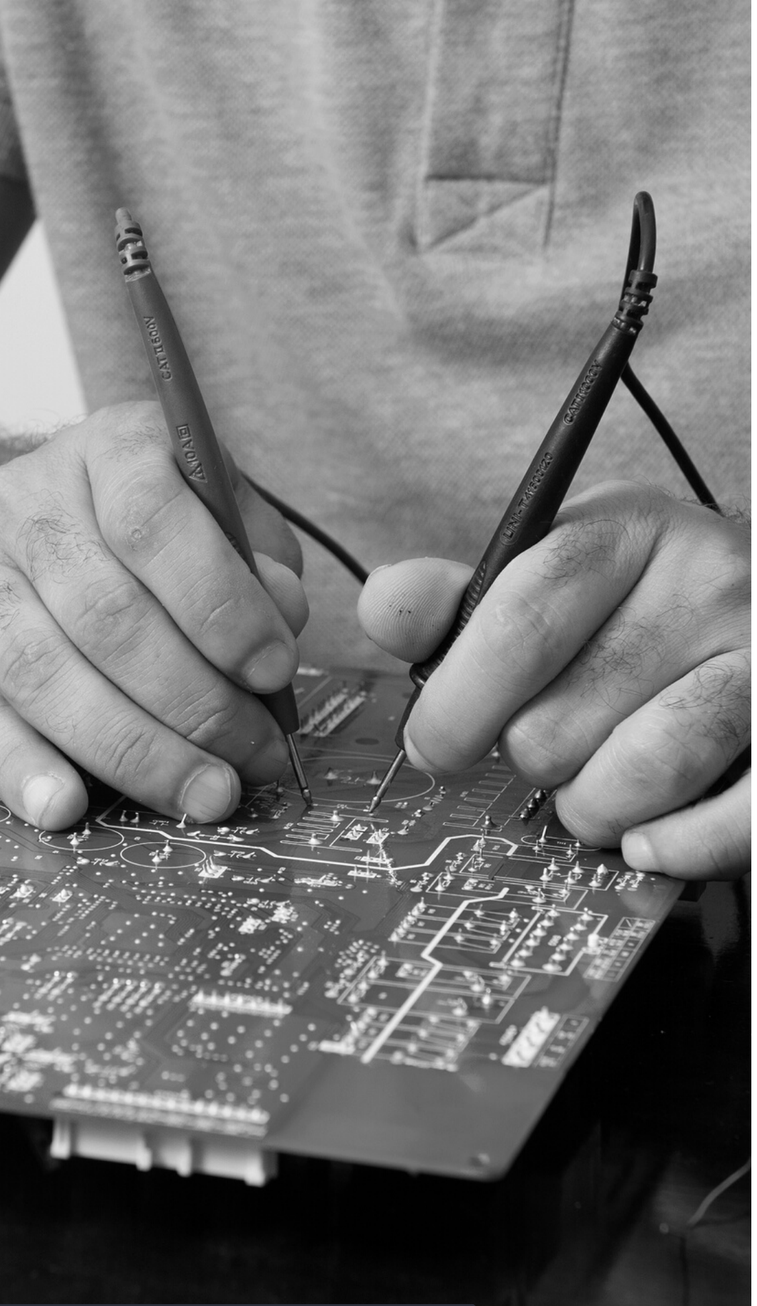

Verification Testing

- Test object presence adjusts LCD parking spots by 1
- Check power supply for entire system functionality
- Validate uSD Card formatting for parking data log

Validation Testing

- Validation Tests:
- Verify accurate uSD Card parking data at different times
- Test multiple IR sensors change LCD spots

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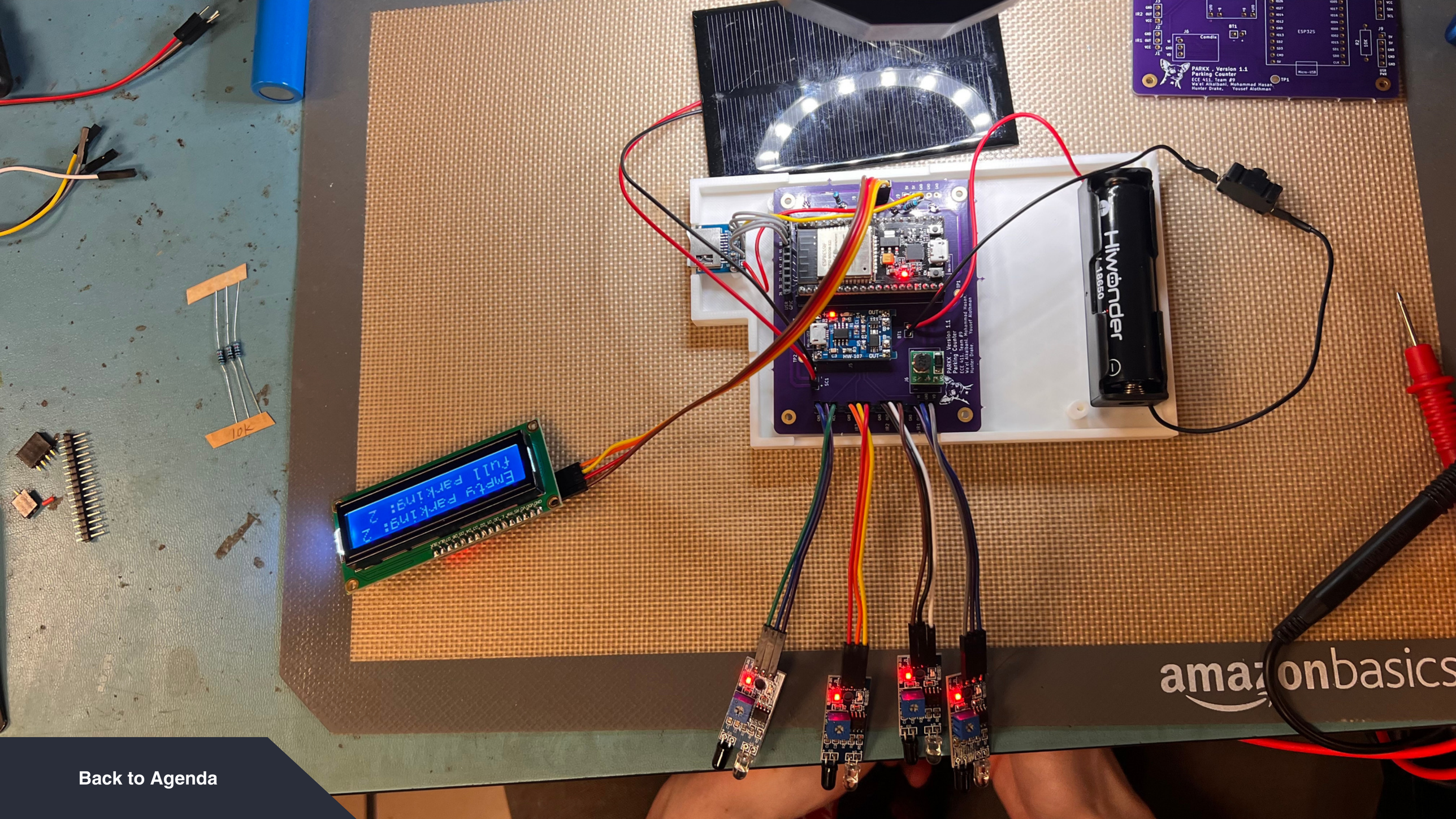

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Results

- **What worked**
  - IR Sensors detect obstacles
  - LCD screen displays serial data
  - Sd card stores data and sends to the webapp
- **What needs more oversight**
  - Battery and power
  - Measurement on the temperature of the esp32 and battery life percentages

Lessons learned

Project millstone

Patience is key

learning from our mistakes

Reviewing each step

Maybe digikey instead of amazon

Components documentations

In small steps

Celebrated progresses

Understandable functionalities

Add labels where possible

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Contribution

Research and Background
All team

Prototyping
Mohammad Hasan

Project Scheduling
Hunter Drake

Schematic & PCB
Wa’el Al Kalbani, Hunter Drake

Software
Mohammad Hasan, Yousef Alothman

Documentation
All team

3D Design & Enclosure
Hunter Drake

Presentation
Wa’el Al Kalbani

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Questions?

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THANKS!

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