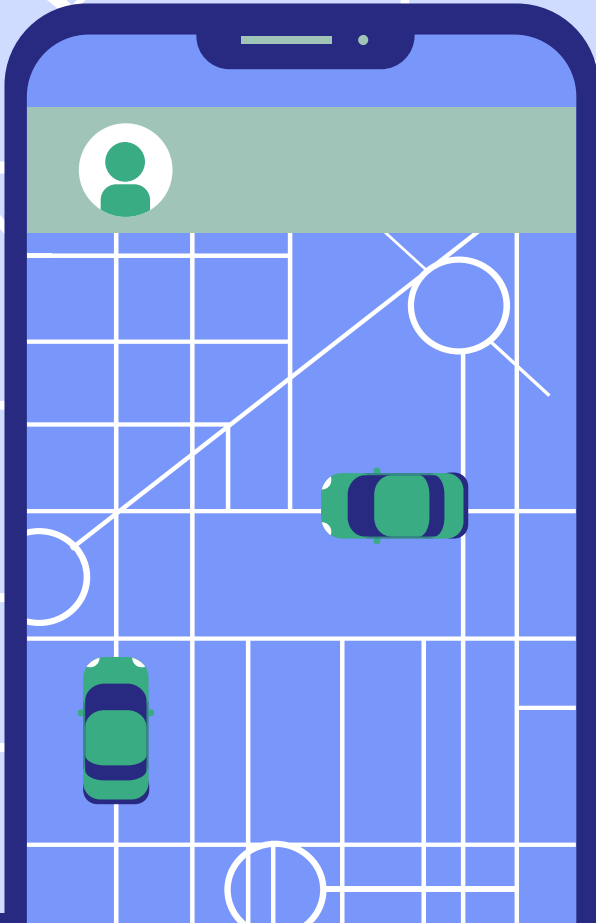


SmartPark

IoT-Driven Automatic Parking Solution

Senior Design Project - Team sddec24-17





About Us

Team Members :

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Client/Advisor : Md Maruf Ahamed

Parking can be problematic!



Project Plan



Problem Statement

Streamline parking experience

Create a detection-based system to monitor parking spots for availability and valid payments

Develop an app for students, teachers, etc. to view and reserve available parking

Eliminate issues such as busy parking lots and time-consuming searches

User Needs

Availability

Quick Parking

Easy Payment

**Parking
Validation**

Requirements

Functional

- **Hardware**
 - Sensors update in real-time
- **Software**
 - Users can reserve spots
 - User is directed to their parking space
 - Payment feature

Non-Functional

- **Hardware**
 - Low-maintenance
- **Software**
 - Secure payments
 - Availability
 - Low-latency

WHAT SETS US APART?



RESERVATIONS

Reserve a spot from the comfort of your home

LIVE DATA

Our server will hold **Live Data** to ensure accuracy



NON-APP USERS

Help make parking easier even for those **without our app**



LED DISPLAY

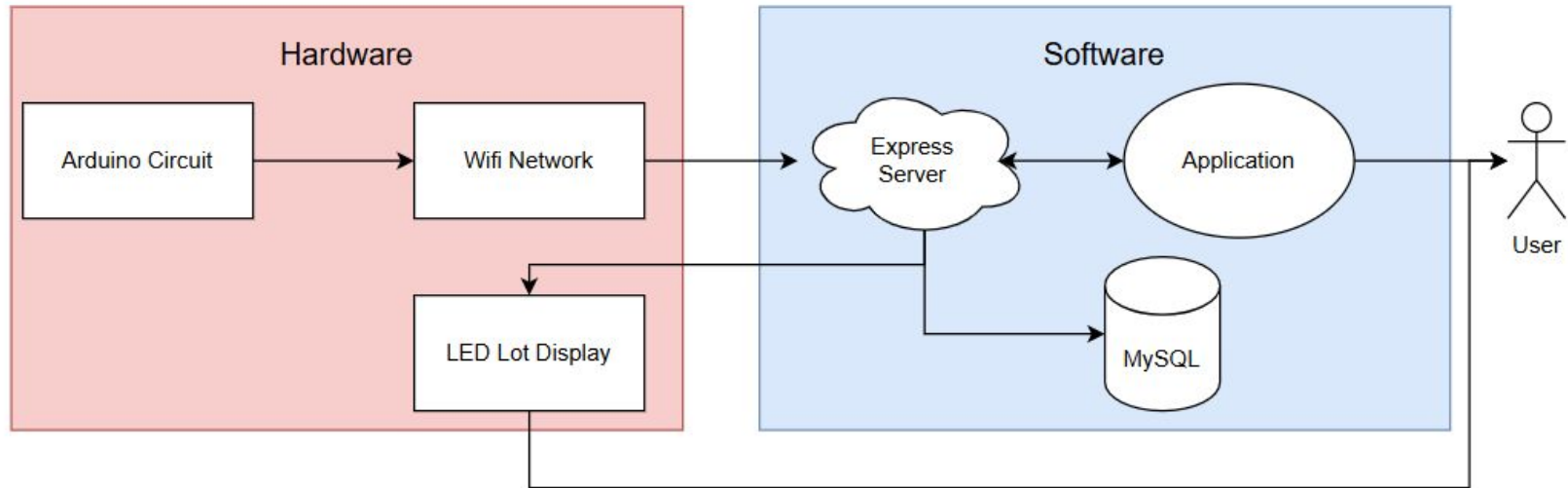
Communicate spot status to users



Our Solution



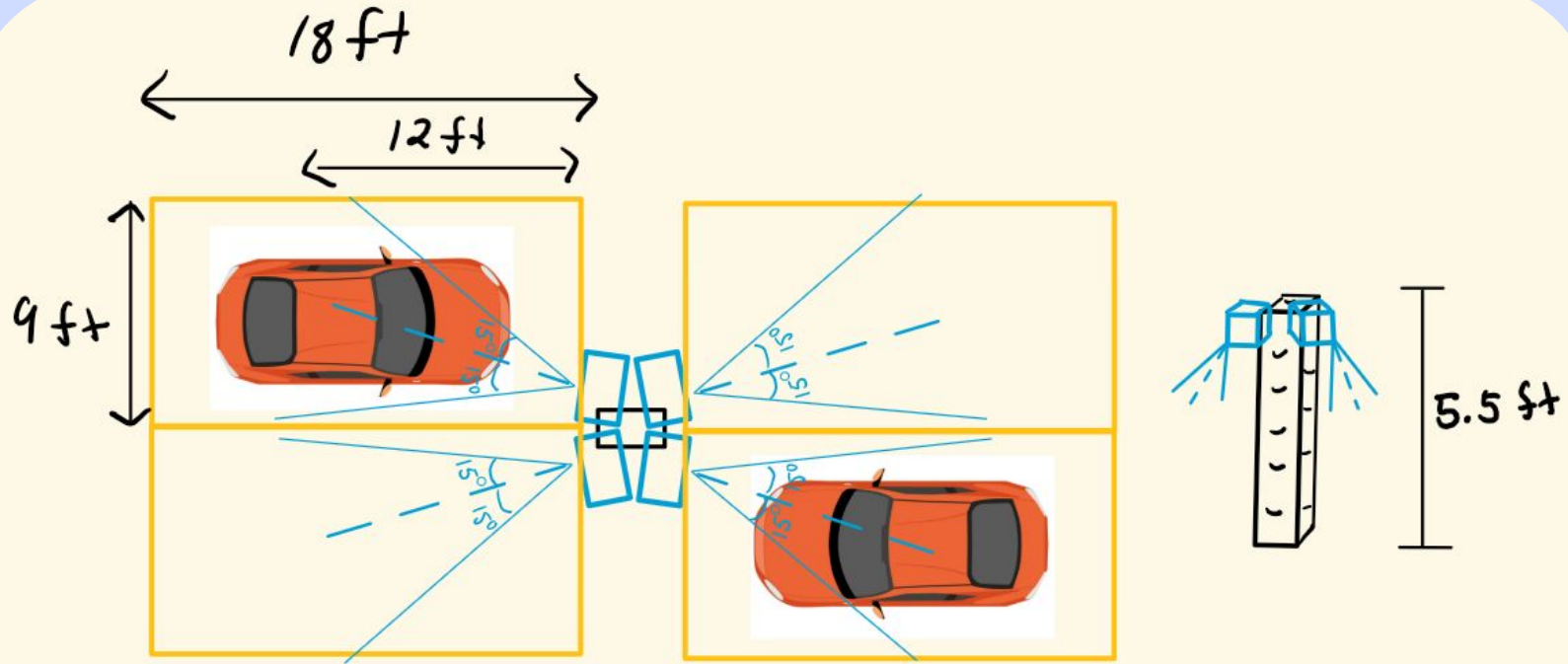
Overall Design



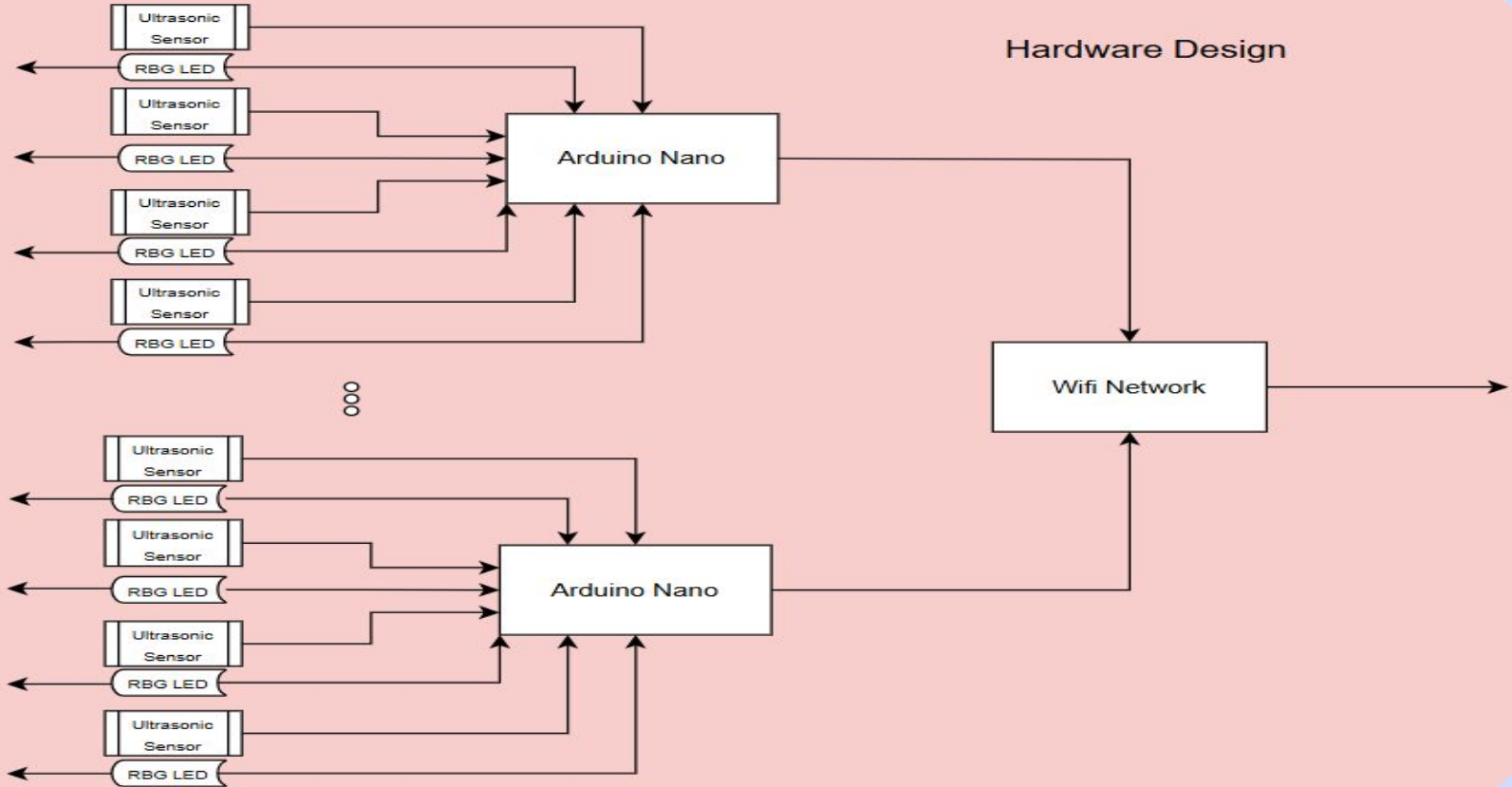
Hardware Design



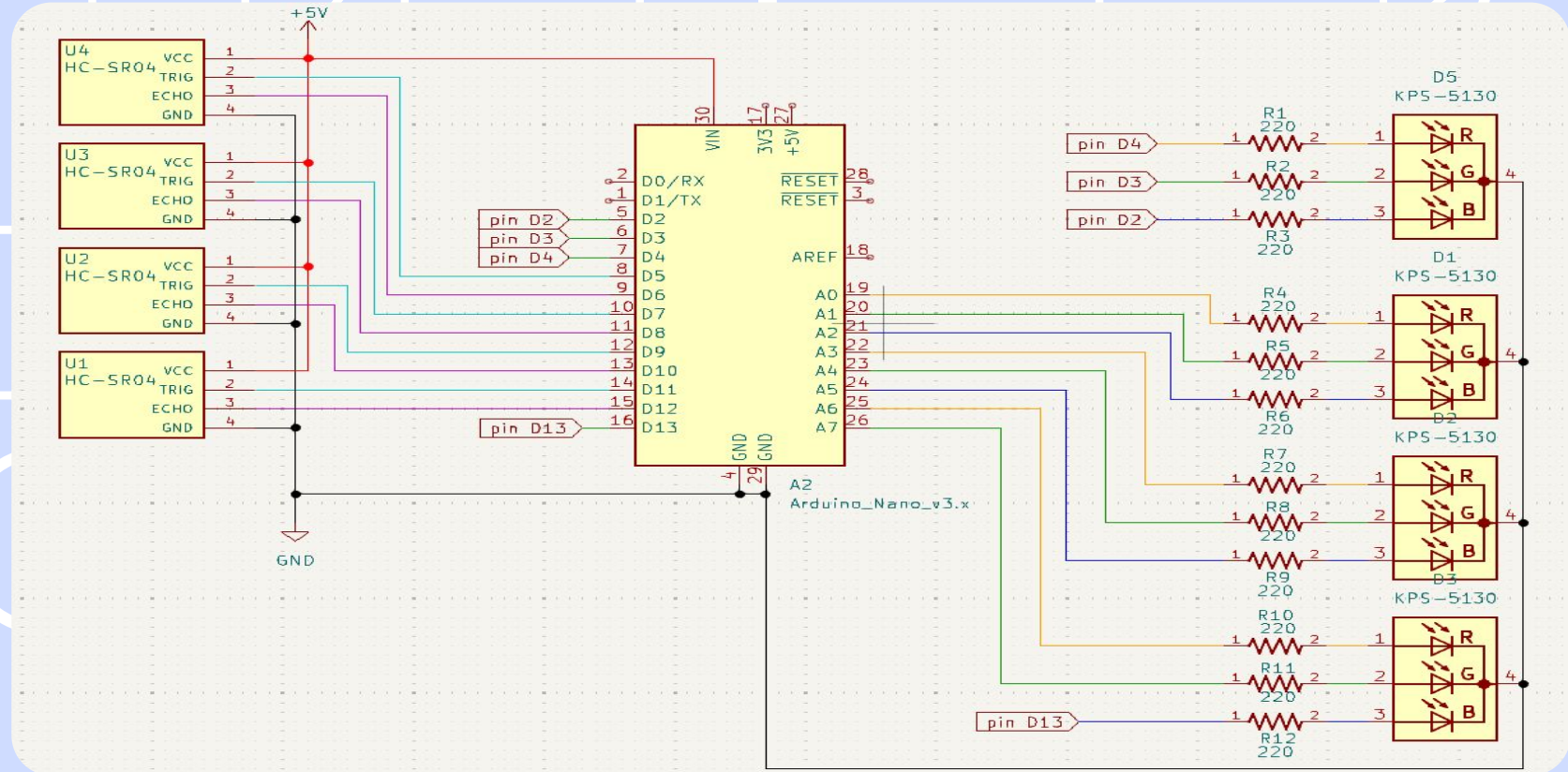
Conceptual Sketch of Parking Lot



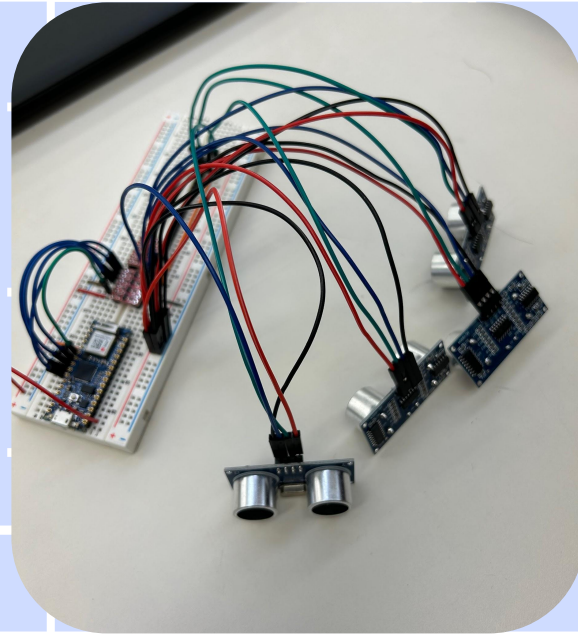
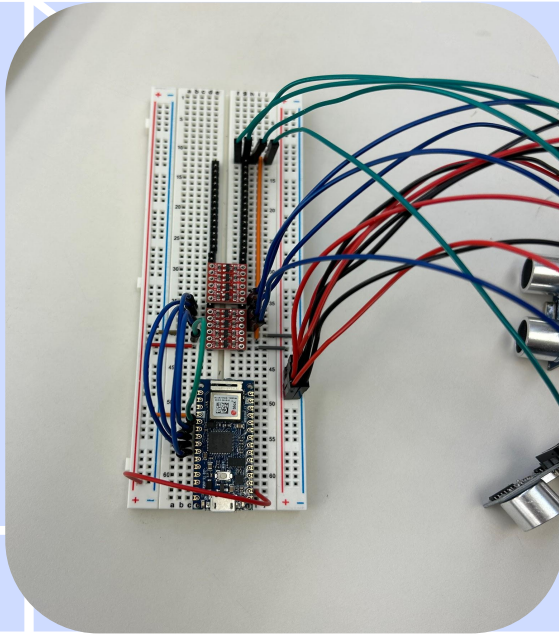
Design FlowChart



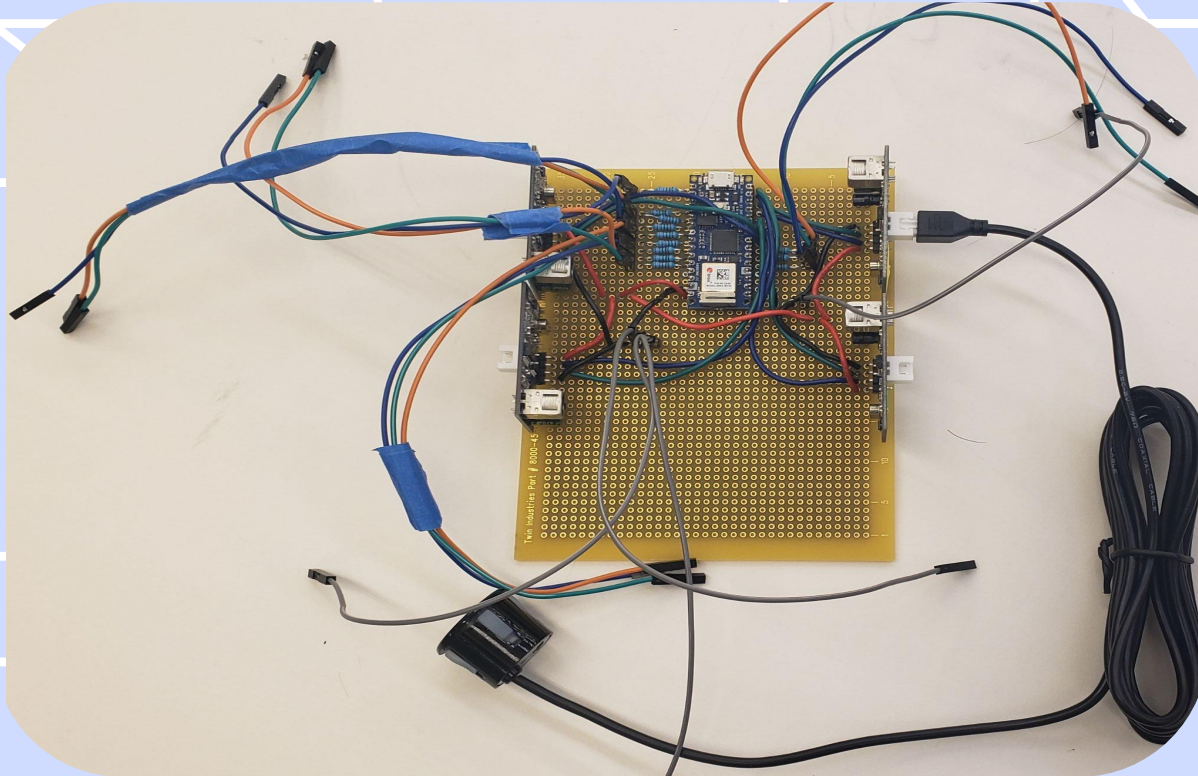
Schematic PCB Design



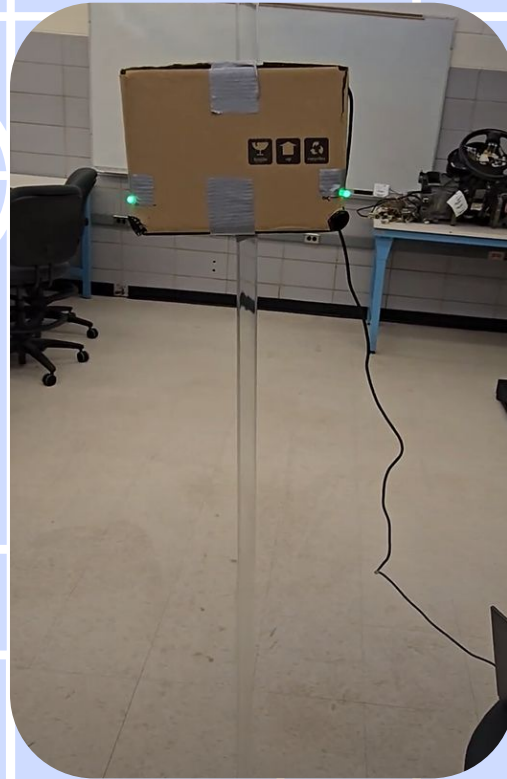
Arduino Circuit



Circuit Prototype



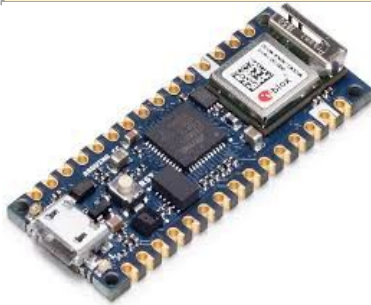
Final Prototype



Hardware Components



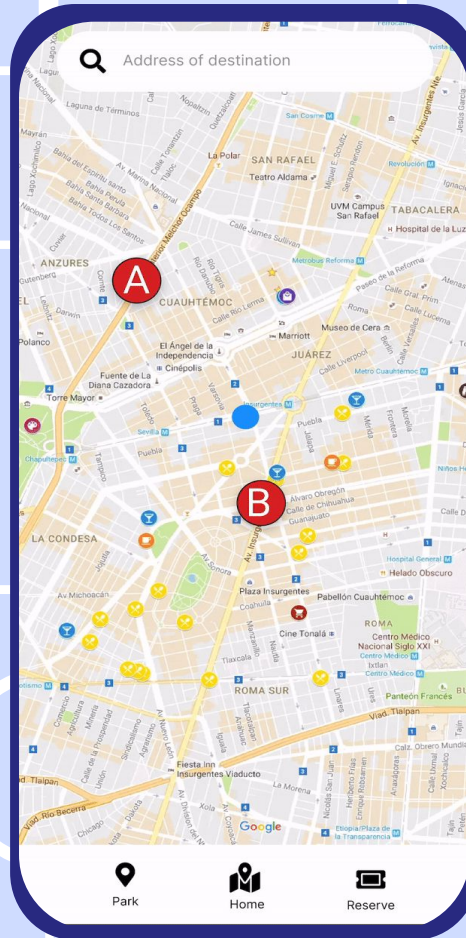
Arduino Nano 33 IoT	WiFi (NINA)	Ultrasonic Sensor
• WiFi capability • Low cost	• Board communication to server	• Accurate • Team familiarity



Software Design



App Interface Prototype



App Interface Prototype



App Interface Prototype

←

Payment

Spot #

License Plate #

License Plate State

Pay

Full Name

Country

Address

Card

Card number

Expiration Date

Security Code

Submit Order

Park

Home

←

Reserve

Spot #

25

License Plate #

XYZ 123

License Plate State

Iowa

Pay

Full Name

John Doe

Country

United States

Address

123 Oak Street

Card

Card number

0123456789

Expiration Date

01/01/2025

Security Code

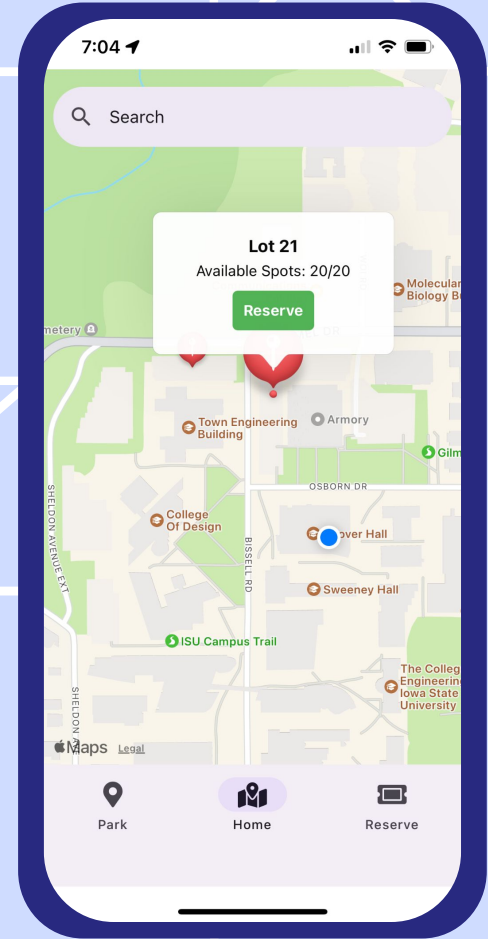
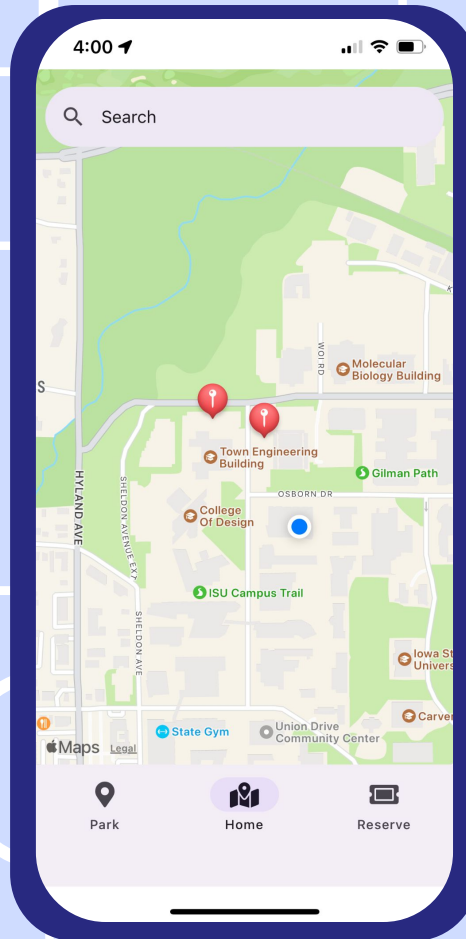
012

Submit Order

Park

Home

Final App Interface



Final App Interface

Payment

Spot Number

Spot Number13

License Plate Number

Number

License Plate State

State

Full Name

Full Name

Country

Address

Checkout

Park

Home

Reserve

Payment

Spot Number

Spot Number13

License Plate Number

Number

License Plate State

State

TEST MODE

Pay with link

Or pay with a card

Card information

Card number

MM / YY

CVC

Billing address

Country or region

United States

ZIP

☐ Save your info for secure 1-click checkout with Link

Pay faster at Example, Inc. and thousands of businesses.

Pay \$10.99

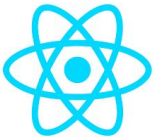
24

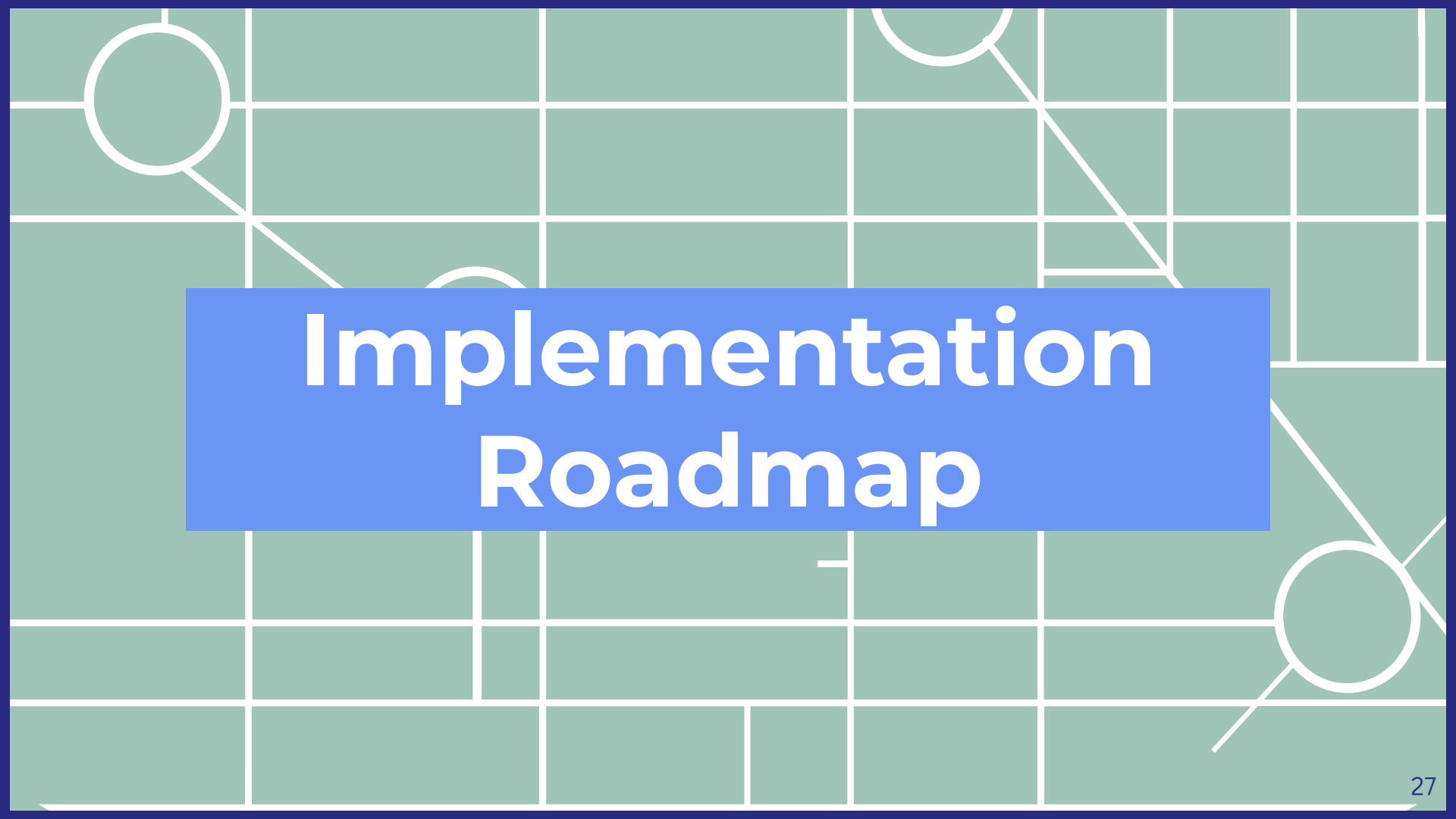
Backend Requests

Request Name	Inputs	Outputs	Description
Initialize	Str mac_address	Int[] spot_ids	Gets the spots for a specific board from server
Update Spot	Int[] spot_id Bool[] is_occupied	Int[] is_reserved	Updates the server if a spot is occupied and updates the LED on the sensor
Get Locations	N/A	Location[] locations	returns a list of all the location in our database
Get Available Spots	Int location_id	Int totalSpots Int availableSpots	Returns the count of spots and available spots of a give location
Get One Open	Int location_id	Spot openSpot	Returns one spot that is open to be reserved
Post Reserve	In to_reserve_id	status success	1) Check if the spot is still available 2) Process payment 3) Create reservation in database

Software Components

React Native	Stripe	Node.js / Express	MySQL
• Javascript • Large community	• Easy to use API • No setup or monthly fees • Customizable	• Javascript • Lightweight • MySQL compatible	• Insures ACID properties • Materialized Views





Implementation Roadmap

Implementation Challenges

Irresponsible Parking

Account for people using the system incorrectly.

Connectivity

Internet connectivity in parking lots can be unreliable.

Weatherproofing

Hardware systems will be exposed to the elements.

Server Overload

Potential data overload during data communication.

Mitigation Techniques

**Irresponsible
Parking**



Notify Parking Division

Connectivity



Used NANO's as WiFi access points

Weatherproofing



Waterproofed Sensors

Server Overload



Tested different servers

Testing

Hardware

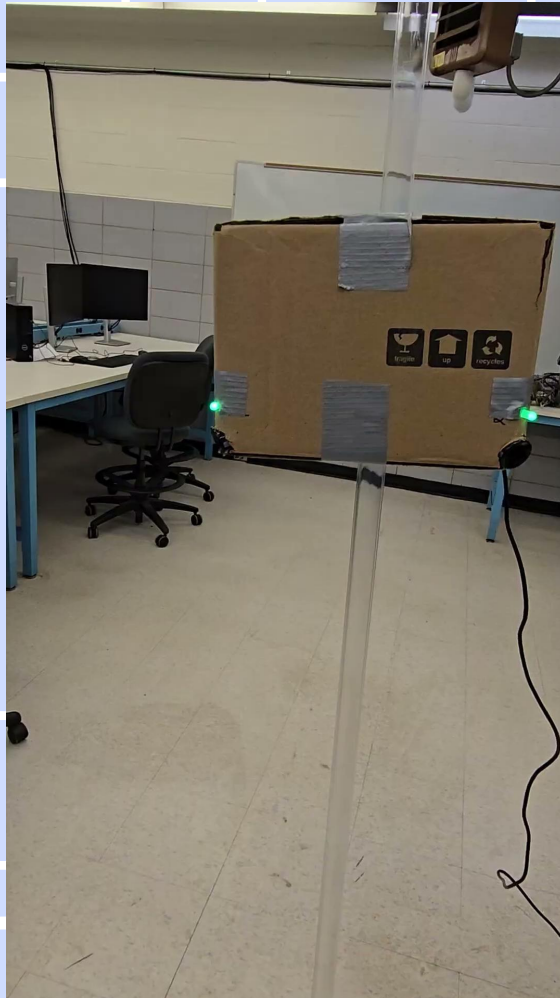
- Sensor Tests
- WiFi connection and management
 - Connectivity testing
- LED Color Validation
- Server Communication
 - Mock Server
 - Software Server

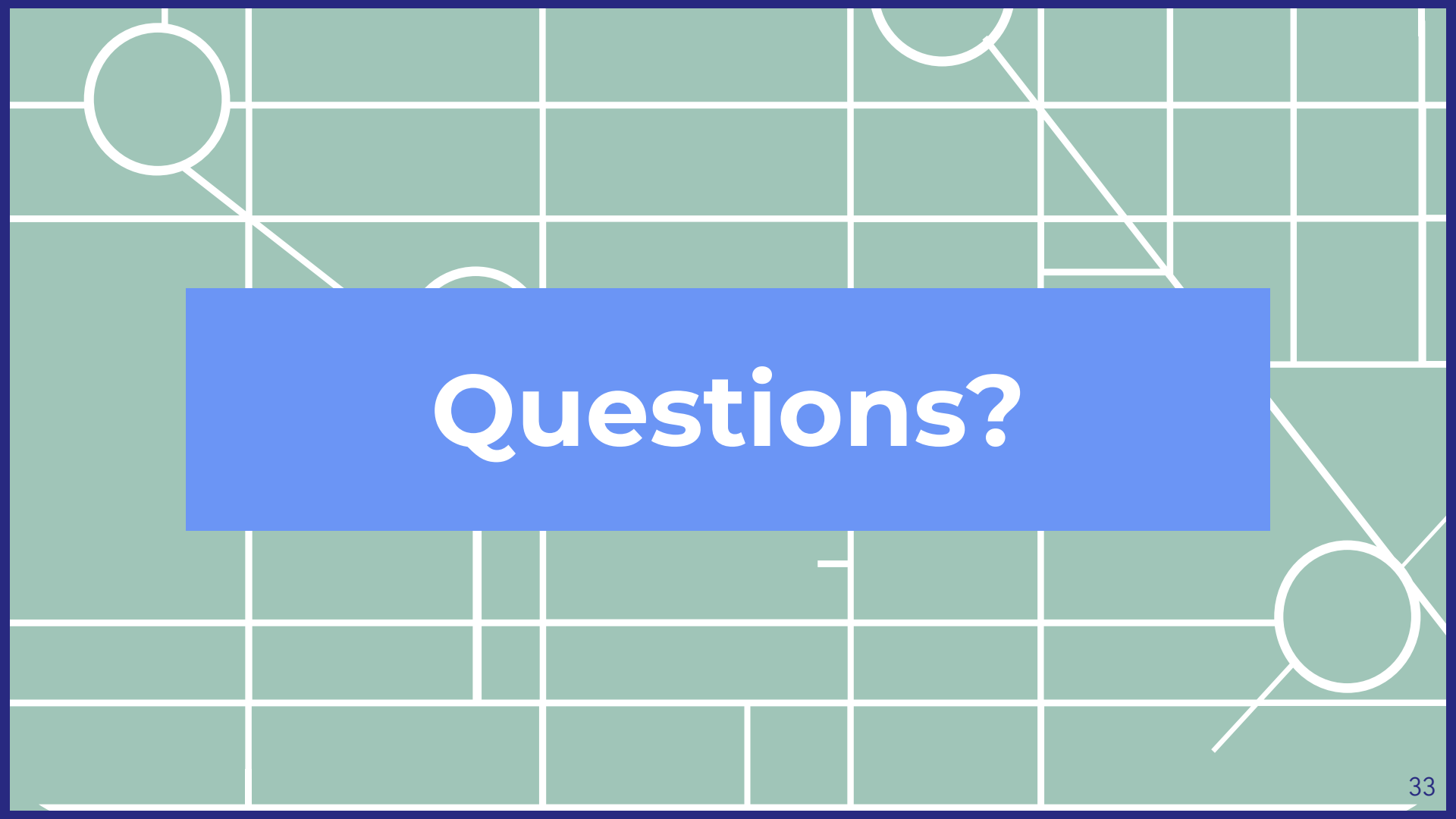
Software

- Application Testing
 - Expo Go
- Server Testing
 - Postman
- Application to server requests
 - Mock server
 - Final server



Demonstration Video





Questions?

Edge Case

QUESTIONS

- User parks in invalid parking spot.
- User parks in an invalid spot temporarily.
- User parks poorly (takes up multiple spots).
- User parks in a correct spot but does not pay.
- Someone takes a user's reserved spot.

SOLUTIONS

- We will contact the parking division.
- We will notify the parking division after a set amount of time.
- Have a user report it.
- Contact parking division.
- If a spot is reserved, only the user who reserved it can pay for it.

Future Considerations

- Use mobile network for when wifi is not working.
- Interface to allow users to view a select specific spots.
- Use camera's to identify license plates.
- Implement interrupts to send messages at more consistently intervals.
- Convert the prototype into a printed circuit board.
- Find a better solution to mount the sensor to the pole.
- Purchase more expensive sensors to improve accuracy.
- Run hardware using battery power.