

Study Spot Finder

Group 12 - Senior Design Spring 2020

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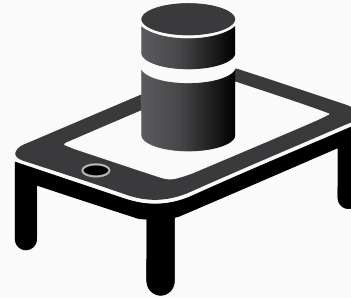
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Darwin Motato, EE

Study Spot Finder

Agenda

1. Introduction
2. Motivation
3. Specifications
4. Block Diagram
5. Hardware
6. Software and Hardware Integration
7. Mobile Application
8. Administrative



Introduction

- Study Spot Finder is a device that helps students locate available spaces on campus to study, either for individuals or groups.
- It implements an online reservation system through a mobile application.
- Users can choose a spot based on number of outlets, capacity, and others.



Motivation

Encourages organization



Reduces wasted time
finding available study
spots



Improves the current
reservation system



Improves students'
experience

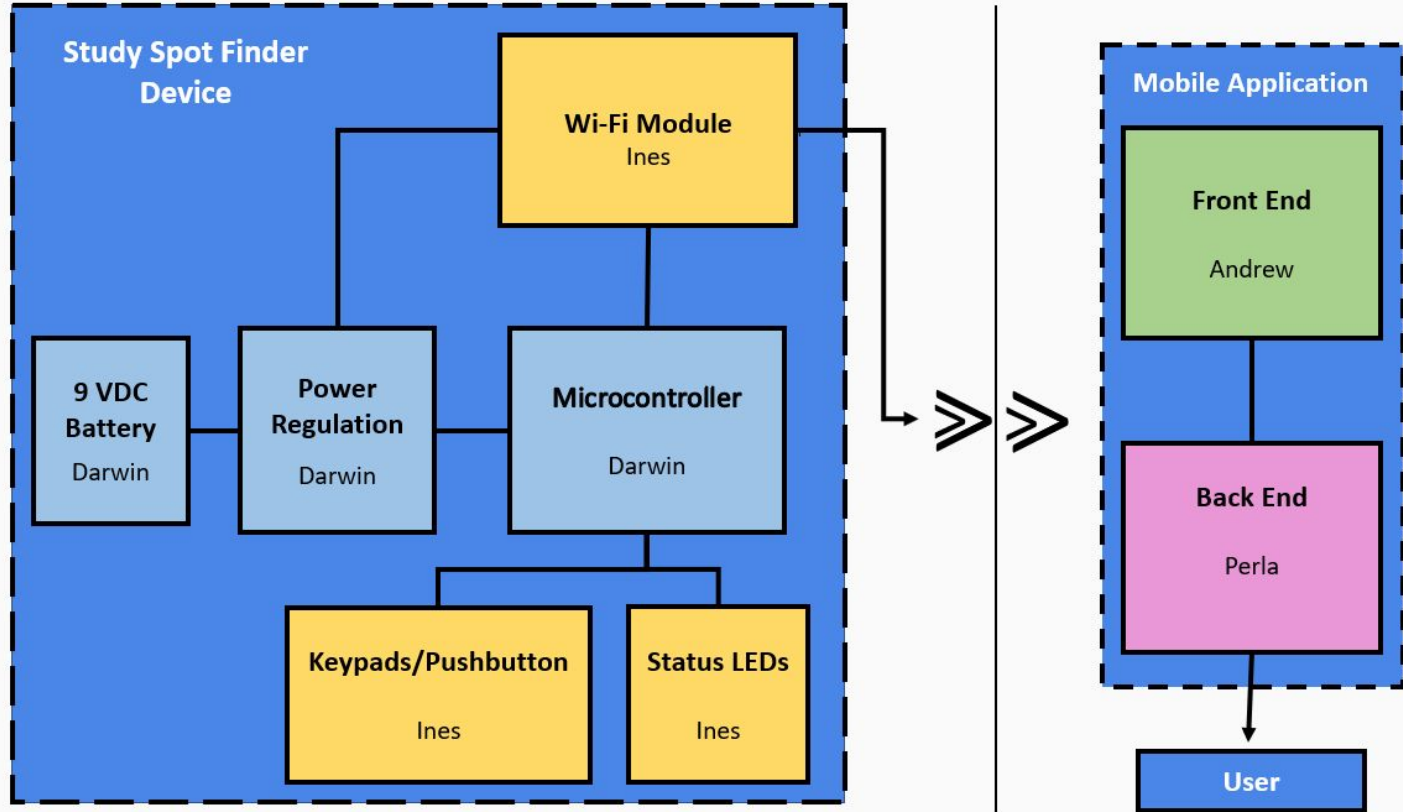


Specifications

1	System Specification	Unit
1.1	The power supply shall provide appropriate voltage to the microprocessor .	5 ± 0.5 Volts
1.2	The device shall consume minimal current when Wi-Fi is not required	< 130 mA
1.3	The device shall boot and begin transmitting data to Wi-Fi within a specified time period	7 seconds
1.4	The device shall change its signal LED color to reflect its status within a specified time after a status change	6 seconds
1.5	The device shall check for status updates at a periodic time interval	5 seconds
1.6	The mobile app shall reflect any changes to available spots within a specified time after an event trigger	5 seconds
1.7	Any changes to device settings by admin must reflect in database within the following time period	5 seconds



Block Diagram



Andrew ■ Darwin ■ Ines ■ Perla ■ Hardware Software



HARDWARE

Casing

Shape: Cylinder

Material: ABS plastic

Dimensions: 14cm x 14cm x 16cm



Available

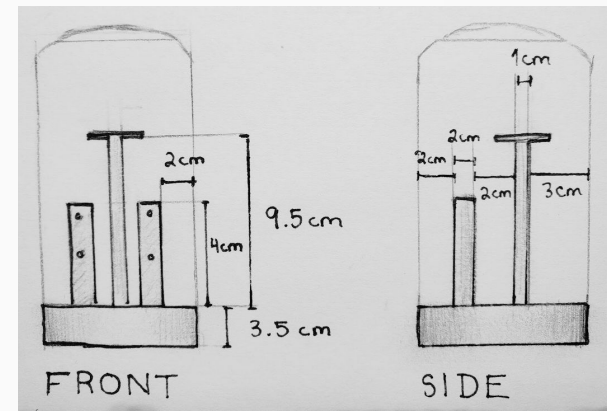
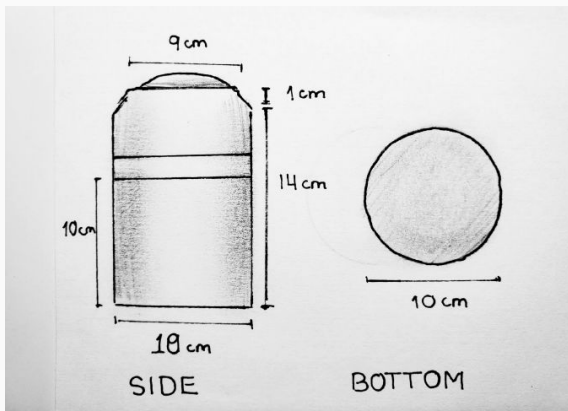


Reserved



In use

Study Spot Finder
Concept design



WI-FI Module | Research Comparison

Decision Matrix	CC3220	ESP-8266	ESP12
Cost	\$59	\$6	\$10
Ease of Use	Too much documentation, Little Forum support	Forum support, some documentation	Forum support, some documentation
Average Current Use	34 mA	10 mA	15 mA
Firebase Communication	No	Yes	Yes
Supply Voltage	2.1-3.6	3.3-3.7	3.3-3.7
Flash Memory	1 MB	1MB	1MB

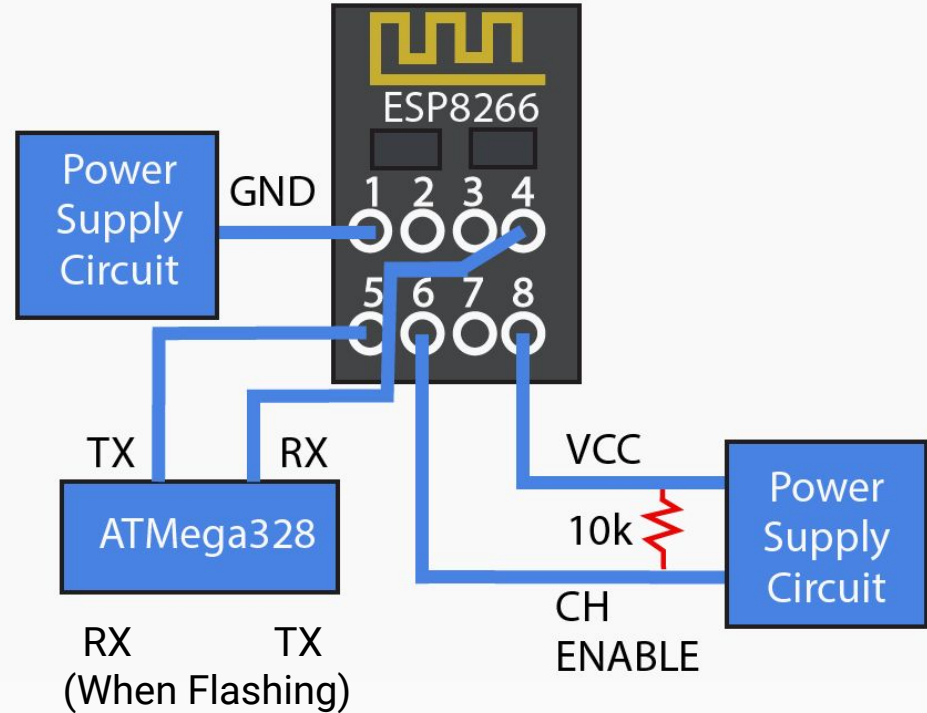
- Final Decision

ESP8266

By Expressif

Cost: \$5.99

- Compact, Low-Cost
- Serial UART Communication
- Support from Arduino Libraries for effective coding
- Better range compared to Bluetooth



Microcontroller | Selection

Decision Matrix	Raspberry Pi Zero W	ATMega328P	MSP430G2553	STM32F103C8T6	NUCLEO-L011K4
Cost	\$10	\$2.08	\$2.09	\$1.69	\$10.32
Ease of Use	Raspberry Forums	Arduino Library	Heavy Documentation	Some forums	Some Forums
Power Use	80 mA	16 mA	0.35 mA	1.19 mA	20 mA
Wi-Fi Enabled	Yes	No	No	No	No
Firestore Communication	No	Yes	No	No	No
Flash Mem	Expandable	48kB	128kB	128kB	16kB
Pins	40	14	47	38	38



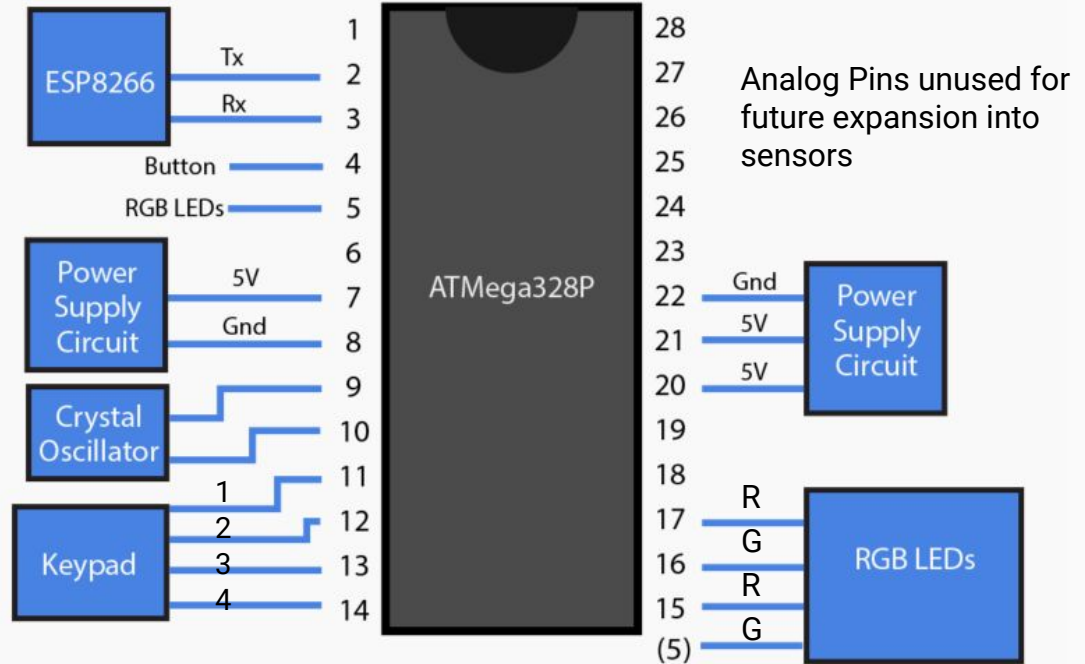
- Final Decision

ATmega328P

By Atmel

Cost: \$2.08

- Cheap and Energy Effective
- Easy communication with firebase library
- Simple flashing & debugging with development board



- Final Decision

5mm RGB LED

By Jameco

Cost: \$0.39

- Multiple colors on one component minimize complexity
- Compatible with current capacity of microcontroller
- Very bright for students to easily know status



PCB Design Overview

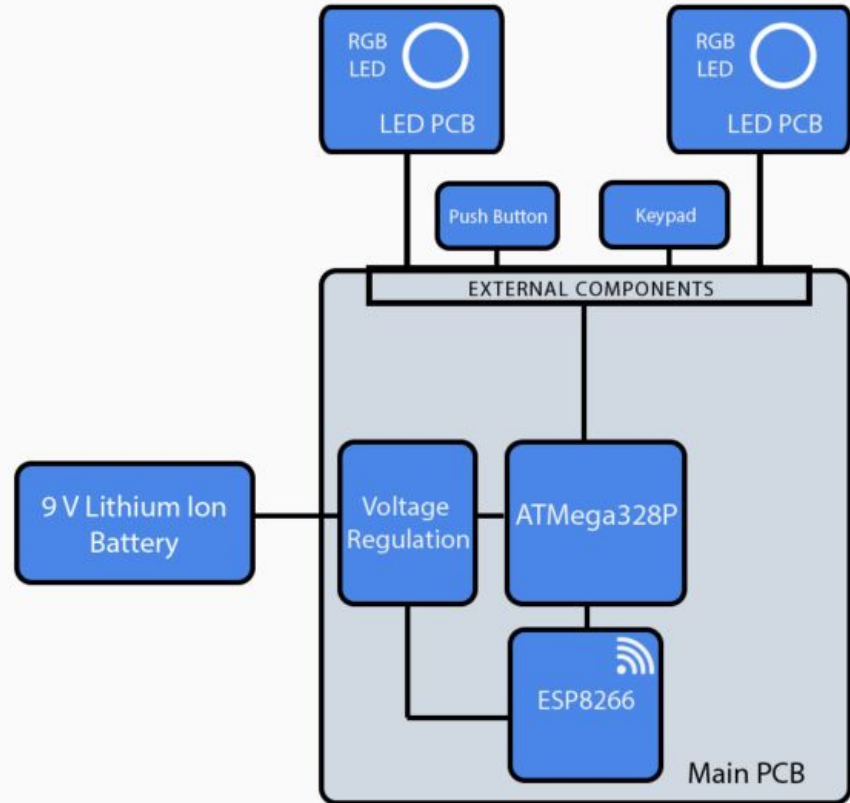
2 different PCB Boards:

Main PCB

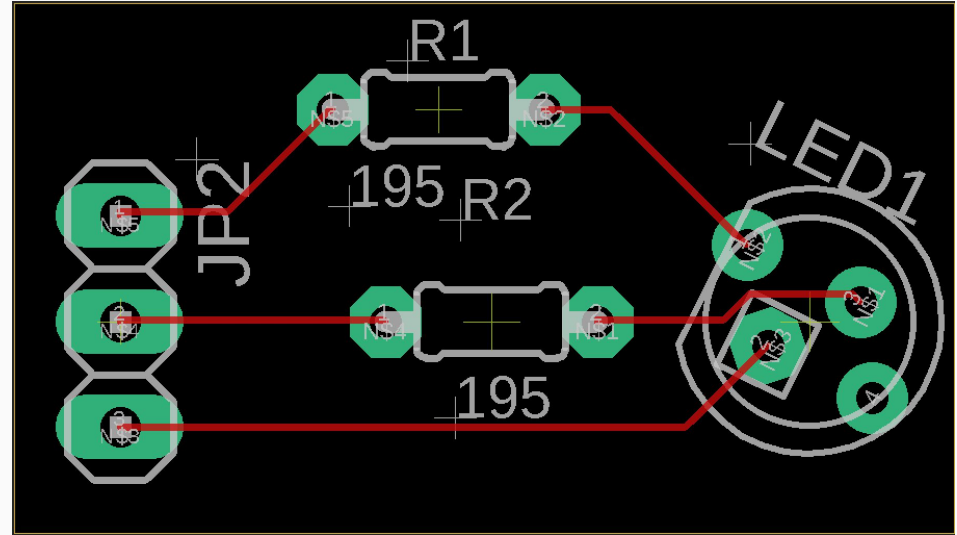
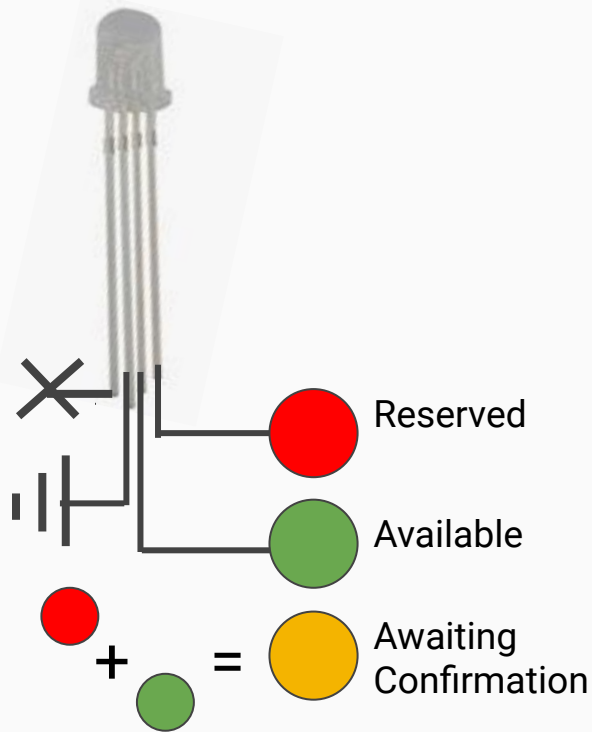
- Processing
- power regulation
- Wiring to external components

LED PCB

- Holds an RGB LED
- Separate for convenient placement



LED PCB schematic



- RGB LED
- Forward Current required => 20mA
- Blue pin will not be used, only Red and Green.



Voltage Regulation

9 V rechargeable Battery

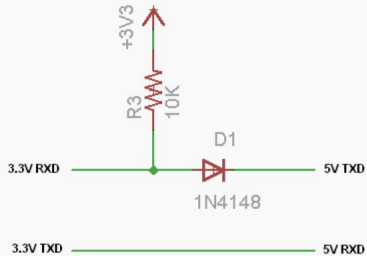
2 Voltage Regulators

- 3.3V (ESP8266)
- 5V (ATMega & Buttons)

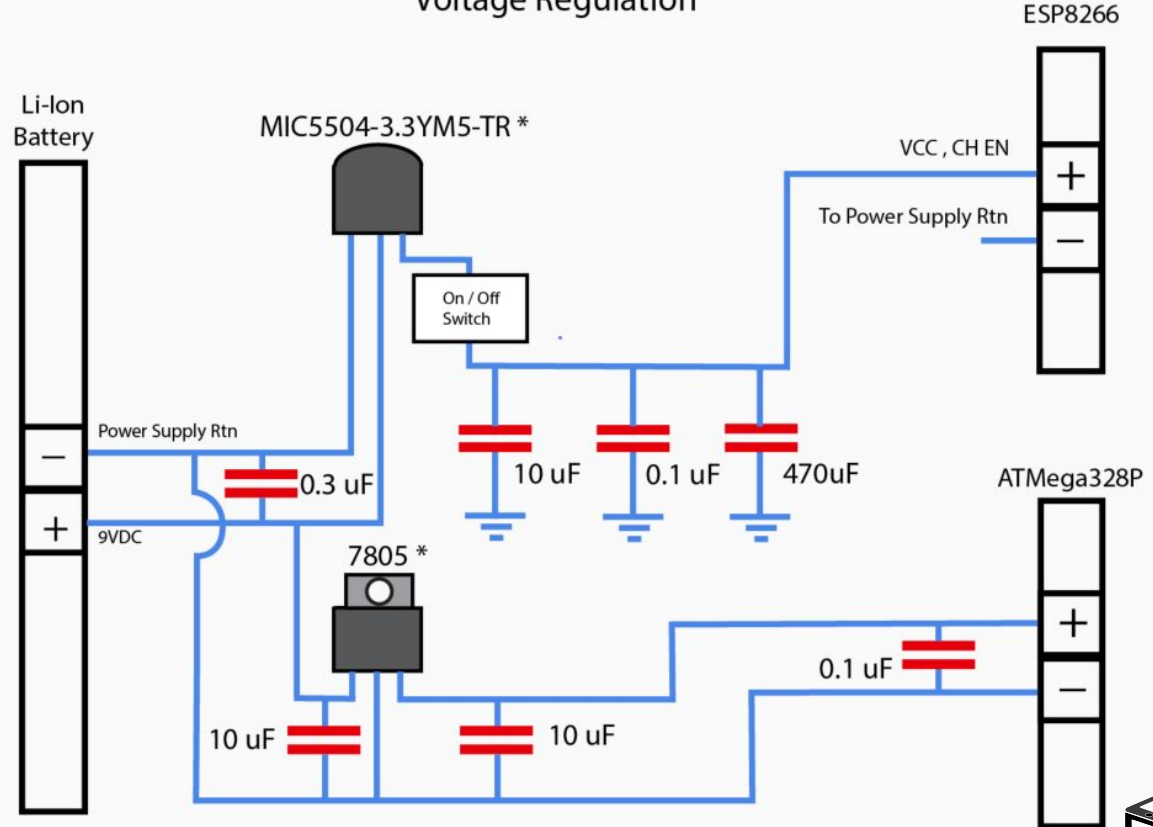
Decoupling Capacitors based on Datasheets

ESP8266 Has strict voltage fluctuation tolerances

Serial Communication also requires 5V to 3.3V Logic Conversion



Voltage Regulation



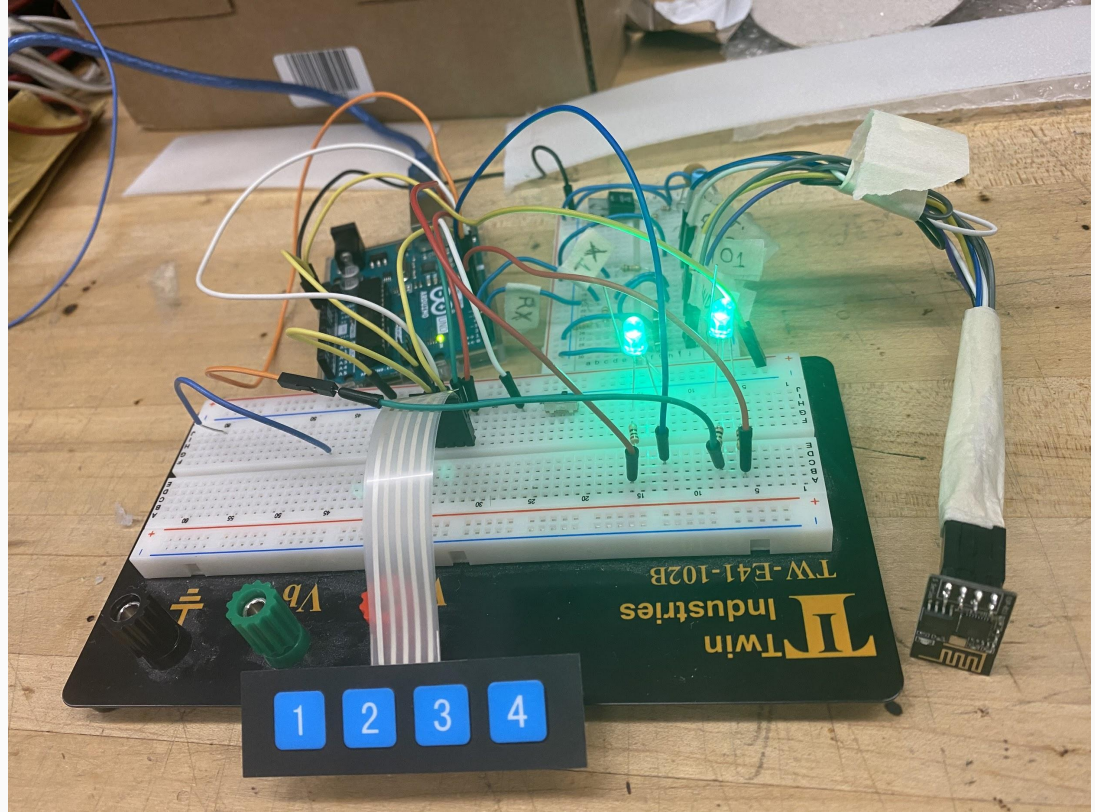
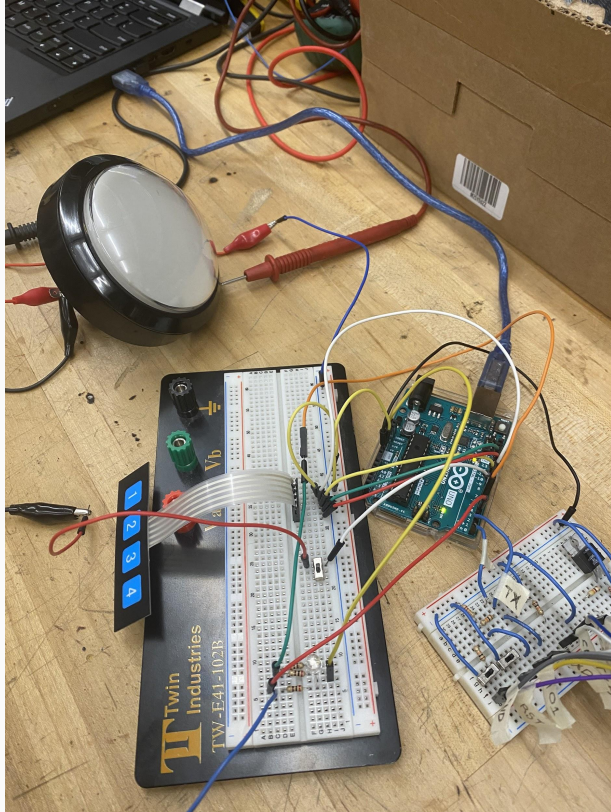
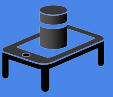
* Planning to upgrade to TPS7A24 Adjustable Voltage Regulator



Power Consumption

Power Modes	Total Current Consumption	Rechargeable 9V 1200 mAh Time
Sleep Mode	35.03 mA	34 Hours
Regular	100 mA	12 Hours
Transferring Data	460 mA	2.6 Hours

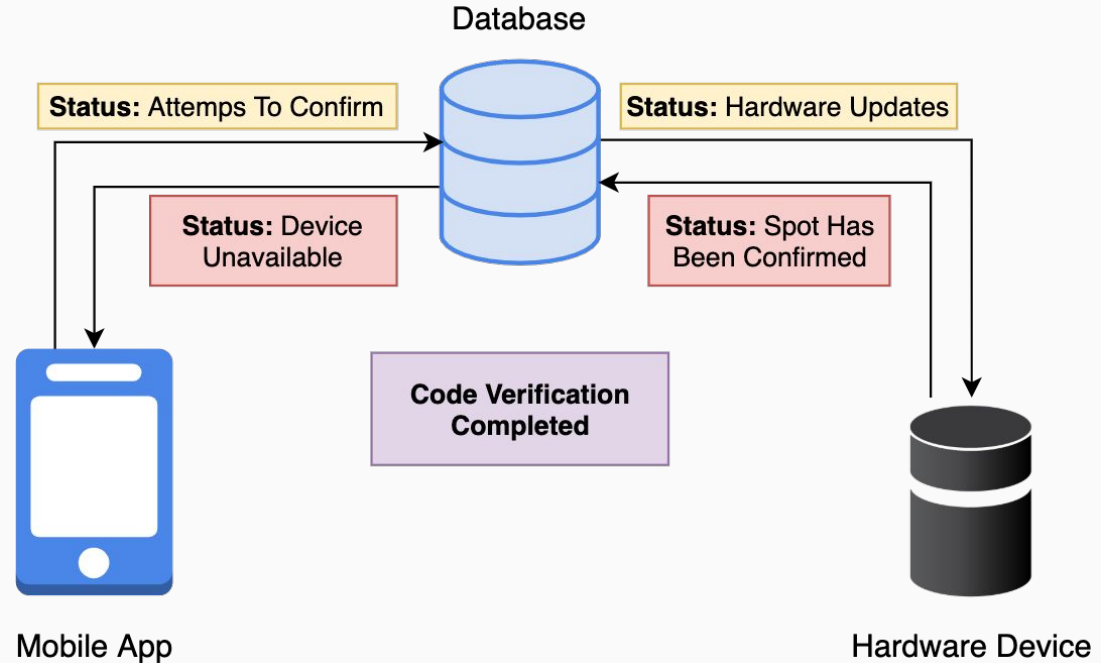




INTEGRATION

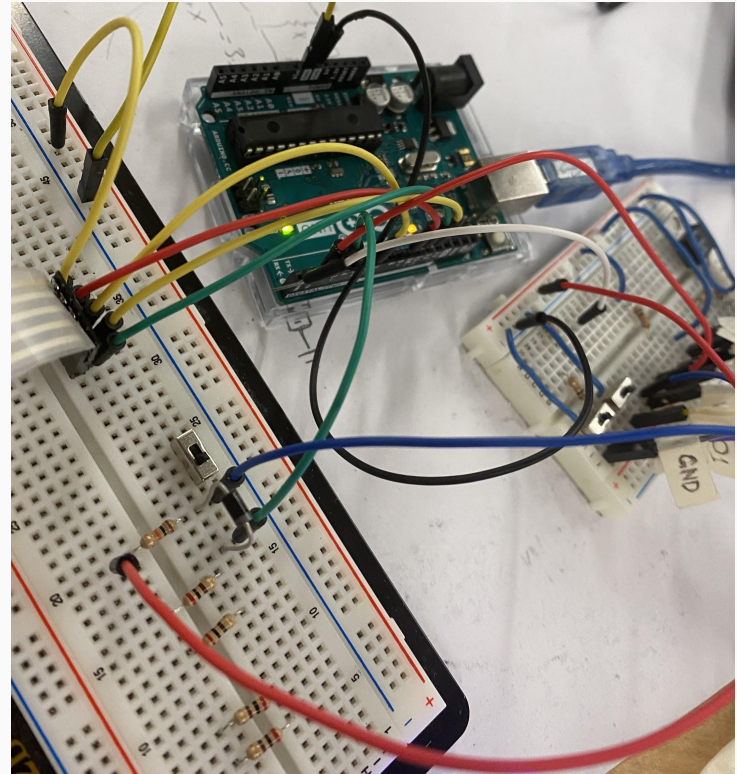
Software and Hardware Integration

- Every hardware device has a unique ID that will allow the software to interact with multiple devices simultaneously
- Hardware device will be periodically checking for new information as well as pushing status updates
- Software will be able to bring back information from this real time database to the user



Arduino-Firebase

- ESP8266 requires a flashing software & Arduino IDE in order to set up and flash the Wi-Fi module before running.
- ATmega talks to the ESP8266 through UART Serial Communication at 9600 Baud using SoftwareSerial.h library.
- Firebase-Arduino library is used to send and manipulate data in a realtime Firebase database through Wi-Fi.



Project

Study Spots

000001

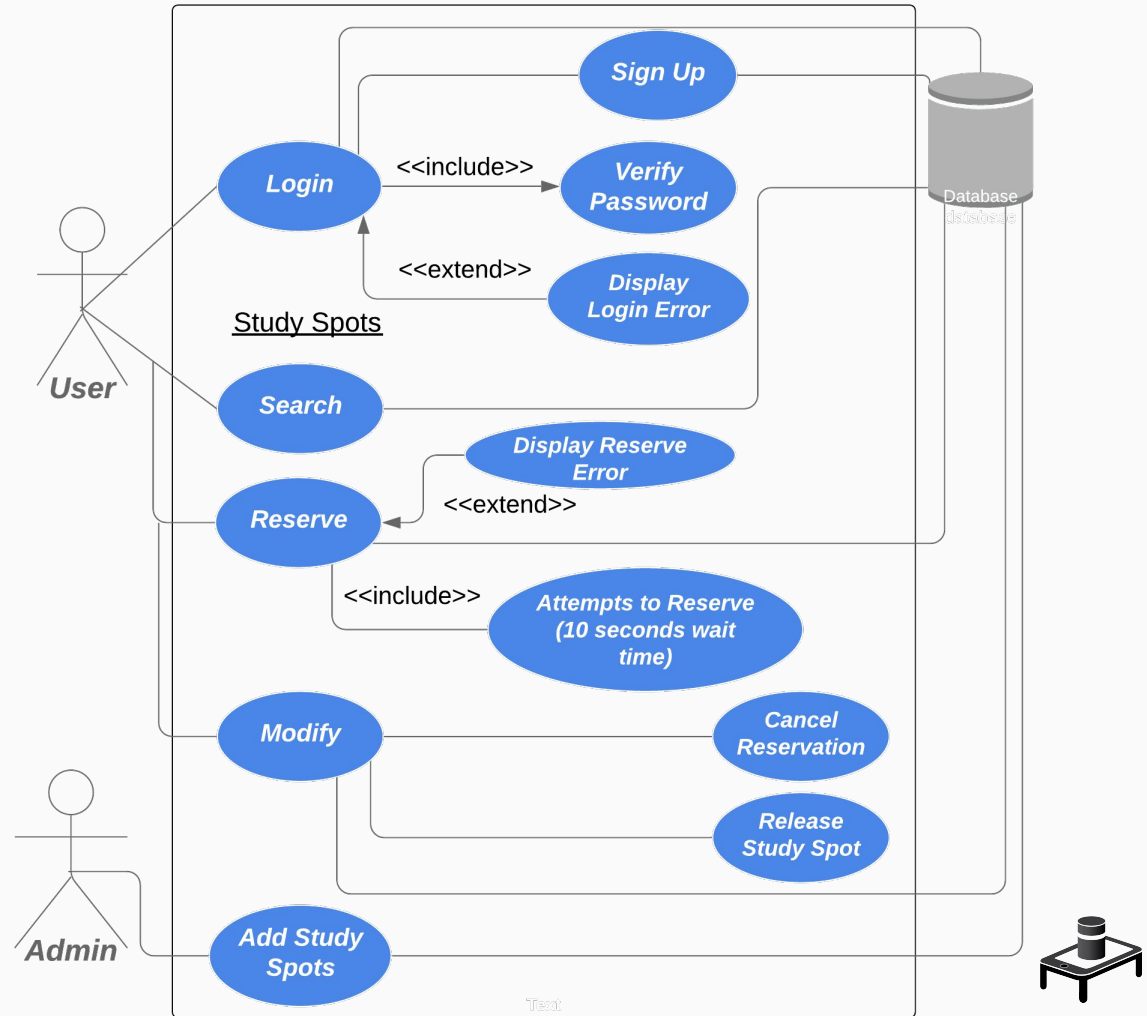
```
name: " "  
buildingName: " "  
floorNumber: " "  
spotType: " "  
capacity: " "  
outlets: " "  
desktopComputer: " "  
status: " "  
validToUse: " "
```

- Firebase will be handling the data with a real time database
- Hardware device sends the data about itself into the database with the required fields
- findDevice() by unique ID and update() functions will be used in order to change the predetermined values of every hardware device



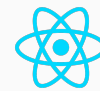
MOBILE APP

Use Case Diagram



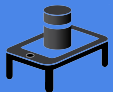
Mobile App | Development Selection

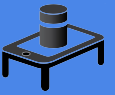
Decision Matrix	iOS (Native)	Android (Native)	React Native (Cross-Platform)
Programming Language	Swift	Java	JavaScript
Performance	Fast	Medium	Fast
Cost	99\$/year	\$25	Depends
Development	Fast	Slow	Fast
Flexibility	Limited	Open-Source	Open-Source
Testing	Limited	Extensive	Moderate



UX/UI Design User

Link: bit.ly/sdgroup12





Study Spot Finder Admin

Admin Login

Admin Password

Sign In

[Forgot your password?](#)



Register a New Device

Name of Device

Serial Number

Building Name

Floor Number

Spot Type

Individual

Group

Capacity of Study Spot if Group

Outlets Available?

Yes

No

Number of Outlets

Desktop Computer Available?

Yes

No

Submit



Modify Devices

Search

+ Filters

Table 3

Library
2nd Floor



Table 4

Student Union
1st Floor



Spot 2

Library
3rd Floor



Table 6

Eng 2 Atrium
1st Floor



Table 34

Library
2nd Floor



Spot 1

CSB 1
1st Floor



Spot 2

Eng 2 Atrium

Study 1

Tech Commons



Modify Devices

Search

+ Filters

Table 6



Summary

Location

Eng 2 Atrium
1st Floor

Type

Group

Capacity

Up to 4

Outlets

2

Modify



Spot 2

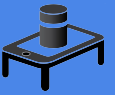
Eng 2 Atrium

Study 1

Tech Commons

ADMINISTRATIVE

Cost



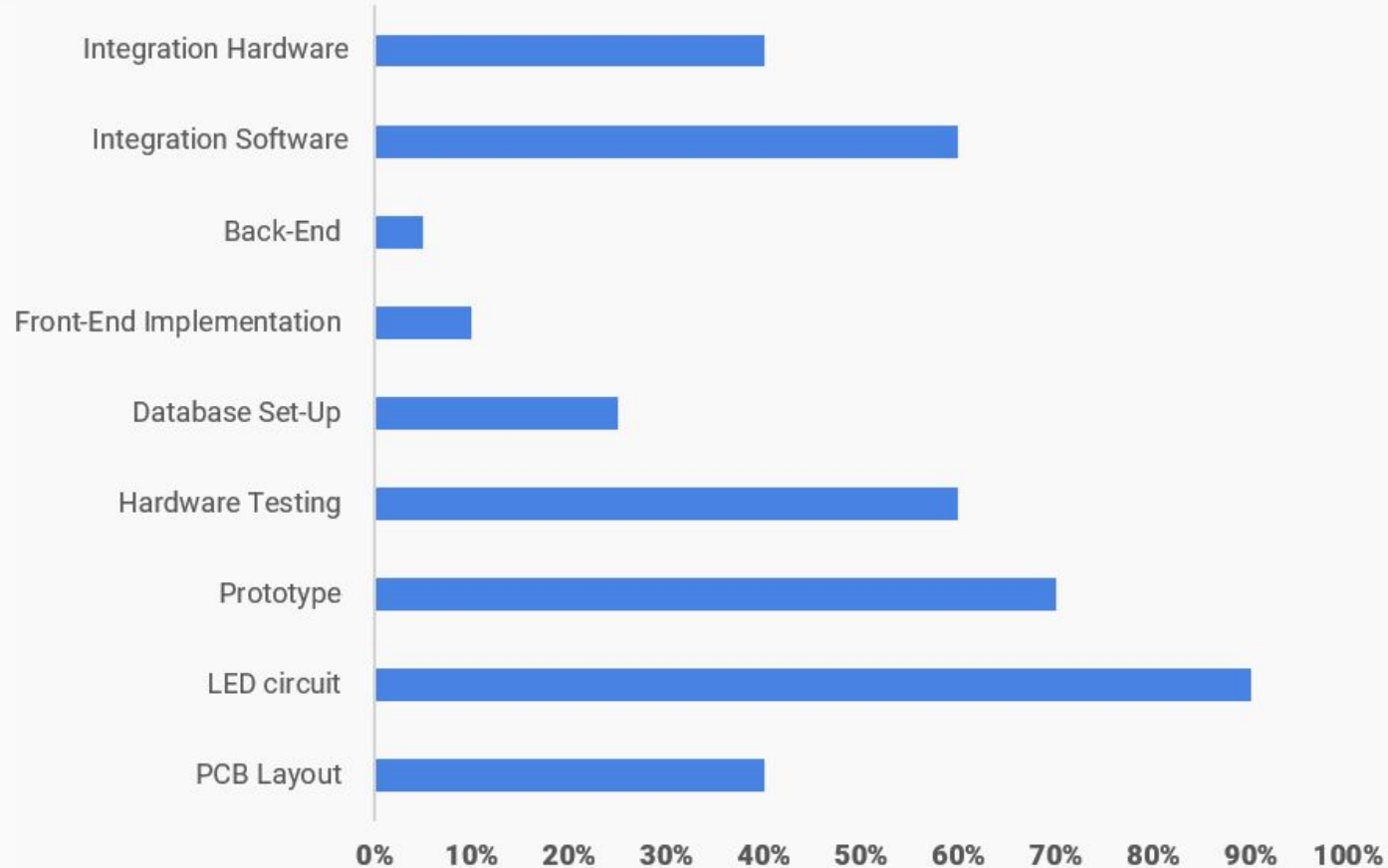
Level	Description	Manufacturer	Part No.	Quantity	Unit Cost	Total Cost
1	Microcontroller	Arduino	Arduino UNO	1	\$2.50	\$2.50
1	Wifi Module	Espressif	WRL-13678	1	\$6.95	\$6.95
1	Voltage Regulator	Sipex	AS2850	1	\$3.04	\$3.04
1	Keypad	Adafruit	4861332	1	\$2.95	\$2.95
2	LED	Jameco Value Pro	2228957	2	\$0.39	\$0.78
2	Plastic Material	MH Build Series	MMUULTCG	1	\$19.99	\$19.99
1	Connectors	JST PH 2 pin	VUPN924	2	\$2.9	\$5.8
1	Button	Jiu Man		1	\$9.99	\$9.99
1	Switch	Judco	J-188A-1	1	\$1.85	\$1.85
1	Battery	Life Partner	B07RT322DY	1	\$5.75	\$15.75
Total						\$69.60

Work Distribution

Team Member	Front-End	Back-End	Software Integration	PCB	LED	Hardware Integration	Wi-Fi Communication
Andrew	Primary	Secondary	Primary				
Perla	Secondary	Primary	Primary				
Darwin				Primary	Secondary	Primary	Secondary
Ines				Secondary	Primary	Secondary	Primary



Project Milestone & Completion



Thank You!

Questions?