



Item-Tracking Backpack

Team 66

Abdullah Alfaraj, Raef Almuallem

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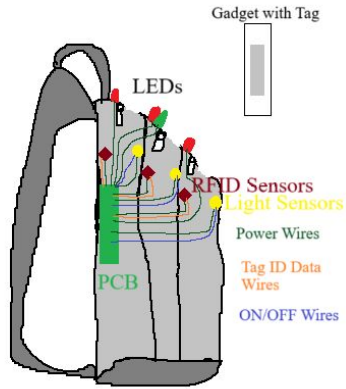
- 1. Objective**
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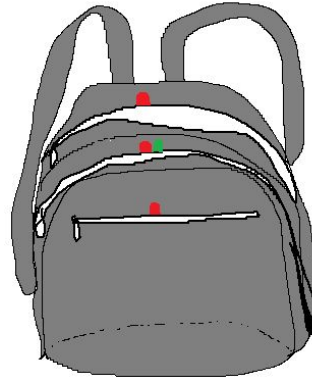
Introduction

- 80% of Students Lose Belongings
- Students Forget Items At Home
- Backpacks Can Store Many Items

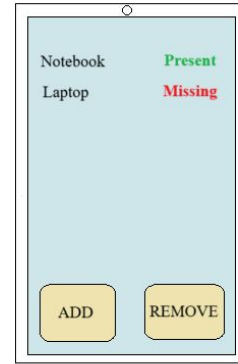




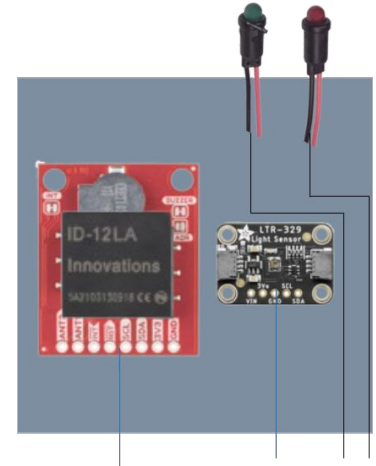
**Cross-Section
View**



**Front
View**

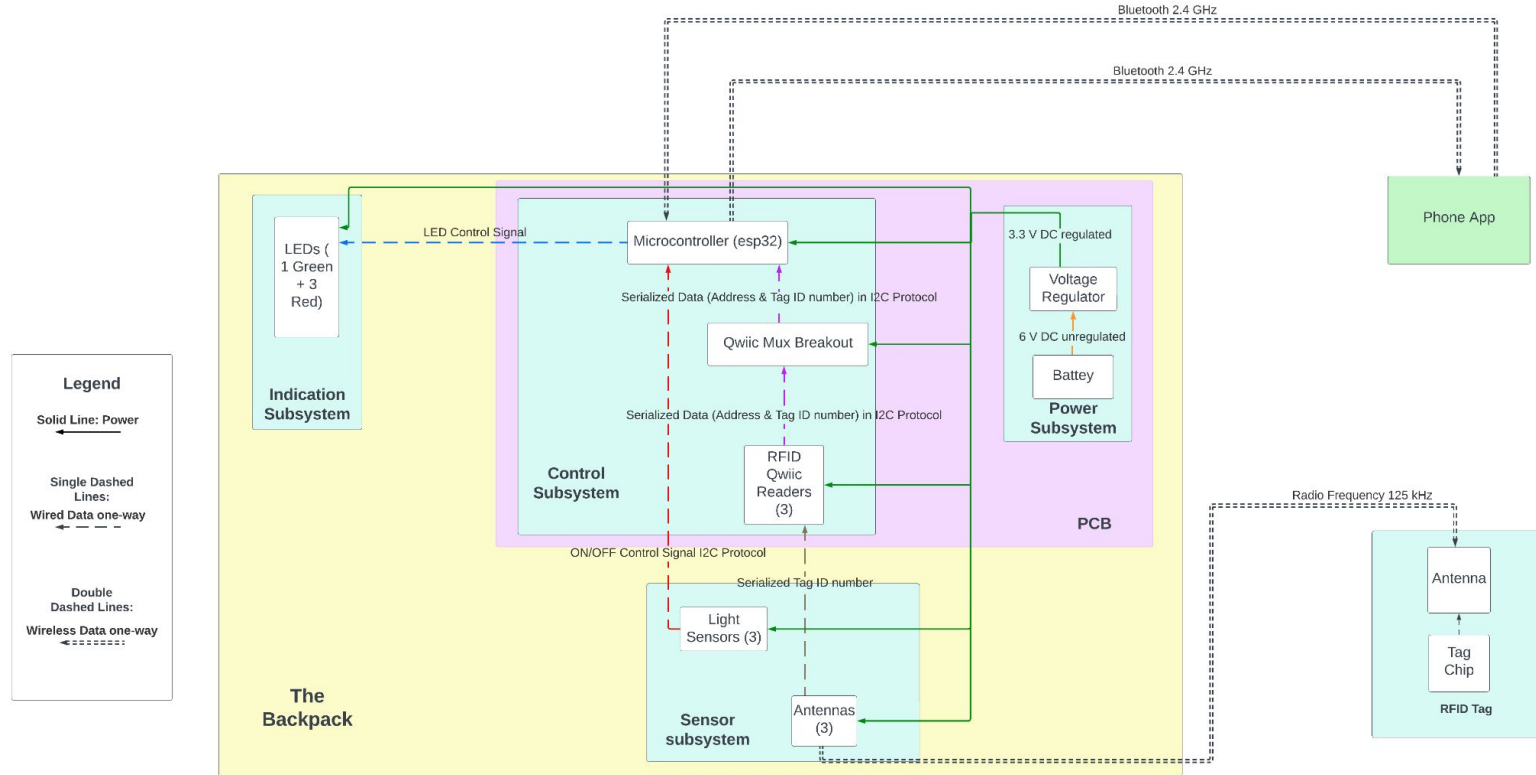


App Interface



- Tracking in 3 Compartments
 - Maximum of 5 items/compartment
- Status monitored using application
- LEDs will allow for status-monitoring
 - LEDs turn off to conserve power

Block Diagram





Subsystems



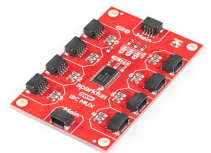
- **This subsystem consists of:**
 - ESP32-S3-WROOM-1
 - Qwiic RFID Reader
 - Qwiic Mux Breakout
- **This subsystem interfaces with the other subsystems:**
 - Uses I2C protocol
 - Uses 2.4 GHz Bluetooth to communicate with the phone app
- **It keeps track of the registered items**
 - Tag ID Number
 - Location



ESP-32-S3-WROOM-1

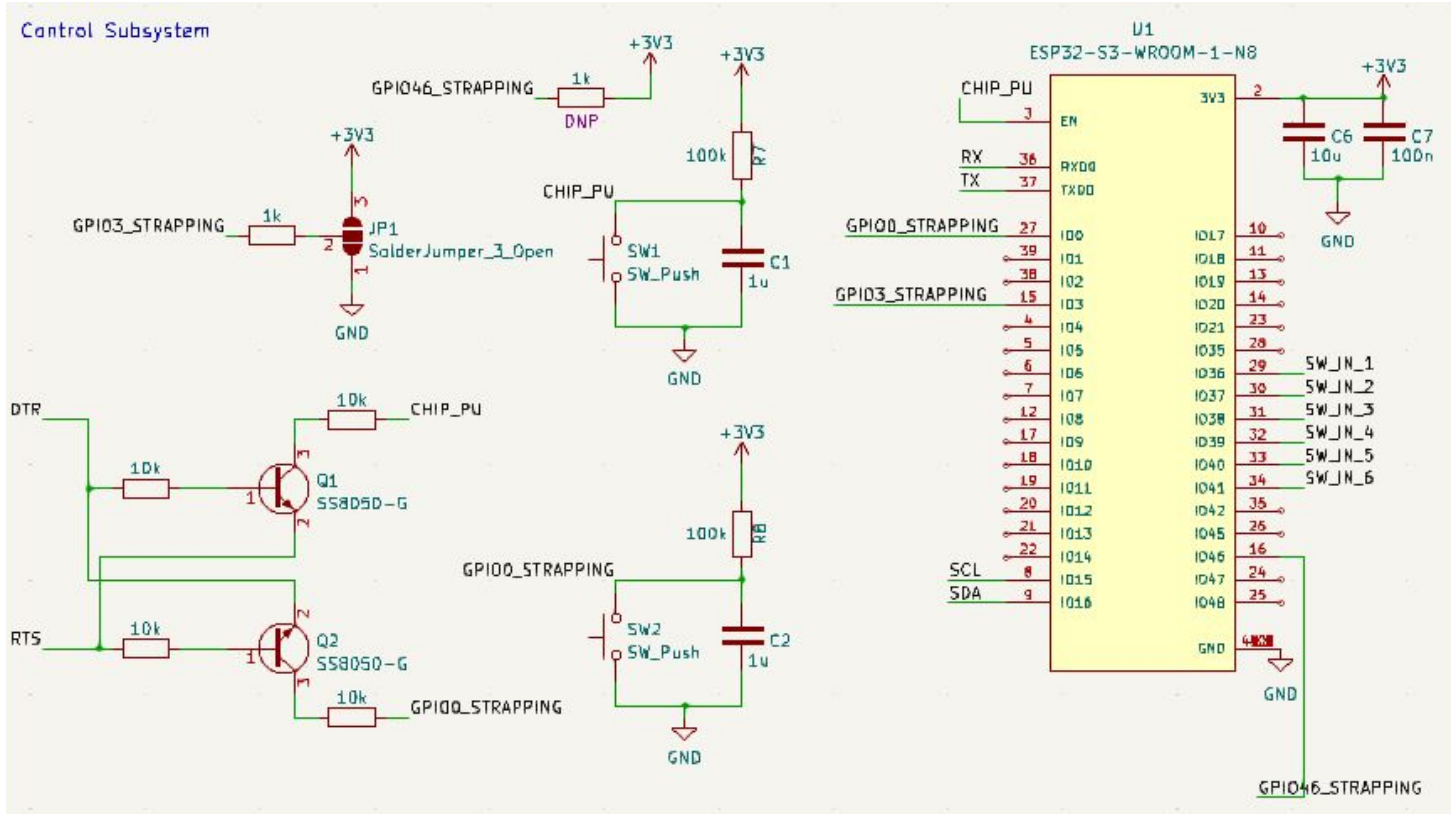


Qwiic RFID Reader



Qwiic Mux Breakout

Control Subsystem Schematic

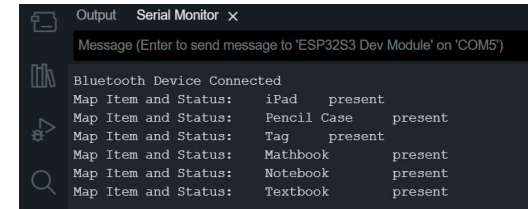


- **Requirements:**

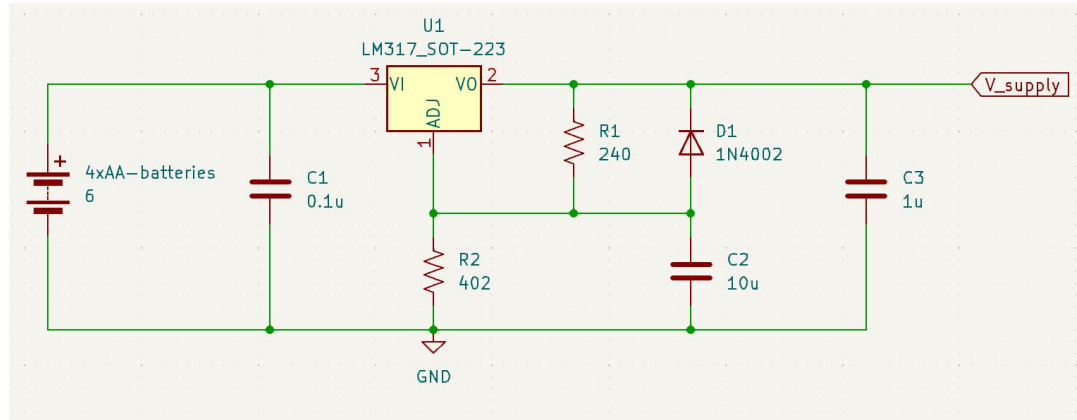
- Sends Bluetooth 2.4 GHz signals
- Receives data from the sensors using the I2C protocol
- Tracks all item locations
- Switches the LED of the correct compartment ON/OFF

- **Results:**

- Bluetooth Works (Verified using nRF Connect testing app)
- Serial data received (Verified using Serial Monitor in Arduino IDE)
- Used maps for tracking (Verified using nRF Connect & Serial Monitor)
- Signals to switches (Verified using a digital multimeter)

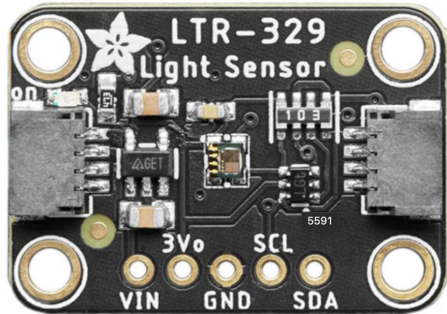


- Delivers power to the rest of the subsystems in 3.3 V DC
 - Uses LM317 voltage regulator
 - Output voltage ripple should be less than 3 mV peak-to-peak.



- **Requirements:**
 - The DC component is 3.3 ± 0.1 V
 - The voltage ripple is less than 3 mV peak-to-peak
- **Results (Verified using a digital multimeter):**
 - The DC component is 3.336 V
 - The ripple is less than 1 mV peak-to-peak

- RFID ID-12LA Sensors
 - 125 kHz Frequency
- Light Sensors



LTR-329 Light Sensors



ID-12LA RFID Sensor



RFID Tag

- **Requirements:**
 - No interference between readers
 - RFID scanning must occur within two seconds
 - Light sensors detect when backpack closed
- **Results:**
 - Small actual read range
 - Around 5 cm (verified using ruler)
 - Immediate reads obtained
 - Light sensors successful
 - Closed: <10 lux

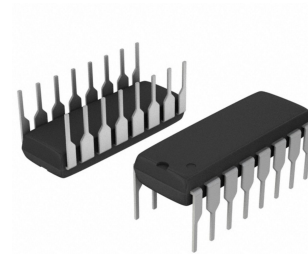
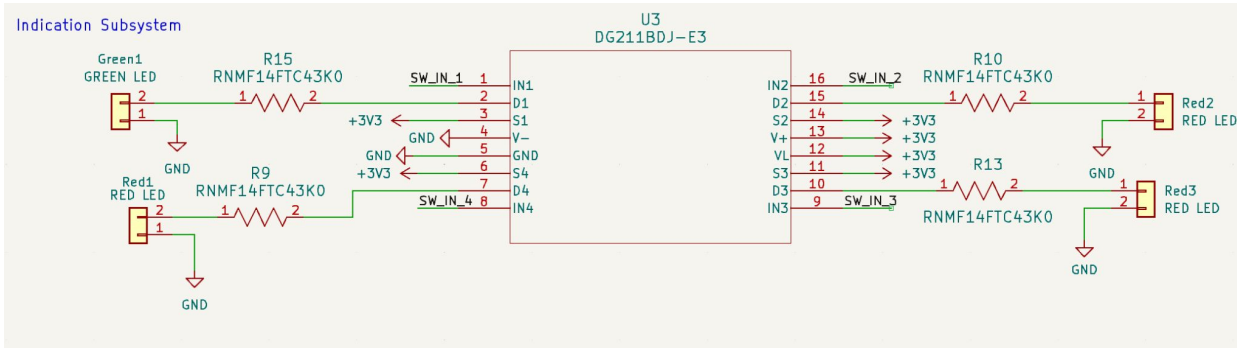
CH0 Visible + IR: 9

CH1 Infrared: 0

CH0 Visible + IR: 178

CH1 Infrared: 116

- **Requirements**
 - LEDs on for 30 seconds
 - LEDs turn off when backpack closed
- **Results:**
 - LED timing successful (verified using timer)
 - Switches



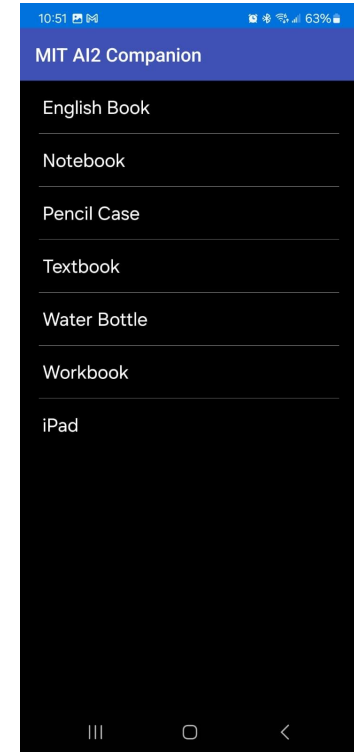
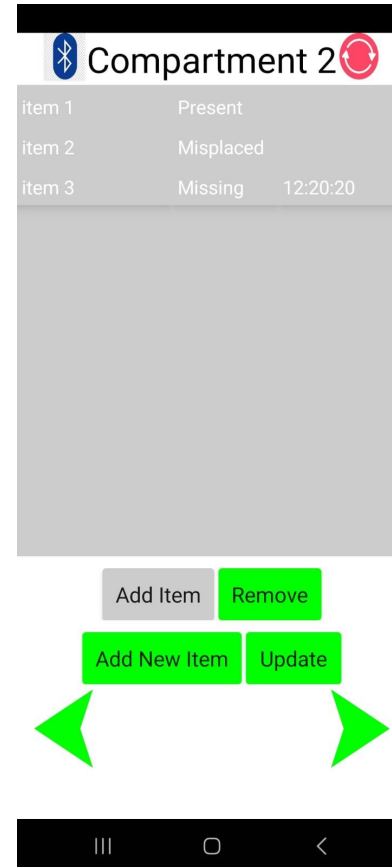
DG211BDJ DIP Switches

- Item-Tracking in 3 different compartments
 - Maximum of 5 items/compartment
 - Lists for each compartment
- Status displayed
 - **Present:** in correct compartment
 - **Missing:** outside of backpack
 - **Misplaced:** in incorrect compartment

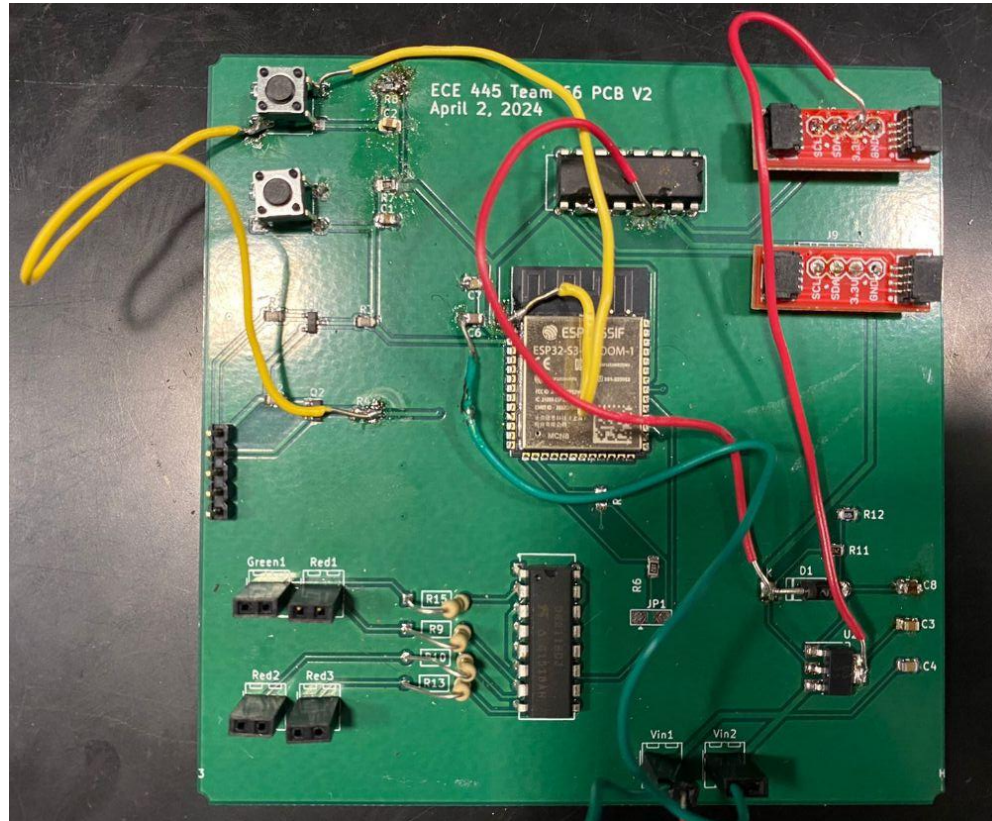
- Addition of new items
 - Update item names
- Addition and removal of registered items
- Status updates within ten seconds

- Number of tracked items successful
- Item addition using scanning
- Registered items accessed using list
- Status updates in less than 10 seconds (verified using stopwatch)

Number of Items	1	2	3	4	5
Update Time (s)	< 1	1.12	1.57	2.30	2.83

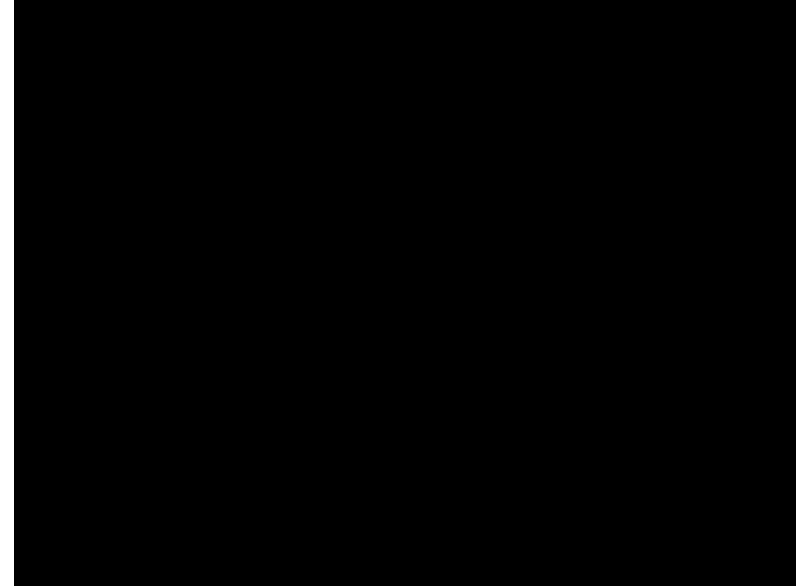
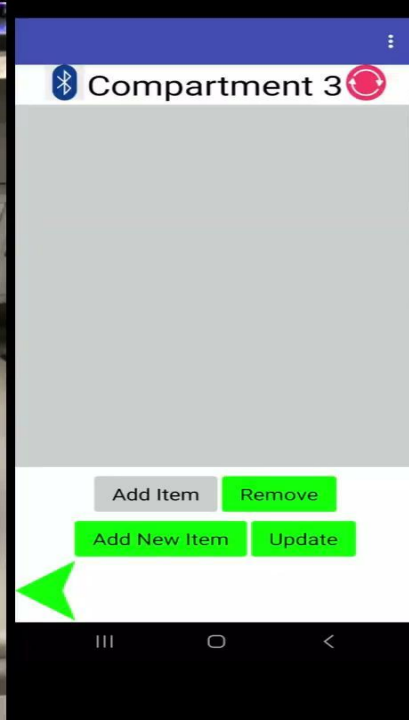


Final Design and Conclusions

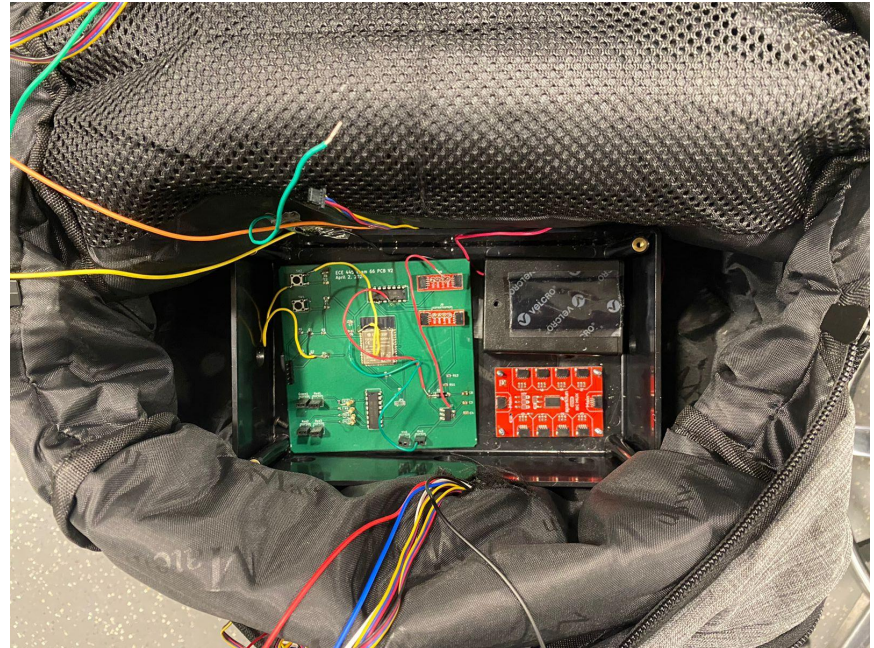


- LEDs Inside Backpack
- RFIDs Always Active
- LEDs blink





- AA batteries
- PCB and sensors in containers
- Data stored locally



Successes:

- Application tracking was successful
- LED tracking was successful
- Microcontroller signal speed was as desired
- PCB functional

Failures:

- Multiplexers (MUX) failed (we connected the batteries in the reverse direction)
- Imperfect PCB connections
- Packaging not ideal

What we learned:

- Bluetooth development skills
- PCB design and debugging skills
- Project scheduling

What we would change:

- Better power source connector
- Better component prototyping
- Better packaging

- Improve the range of the RFID
- Make the phone application more responsive
 - Auto Refresh
 - Add colors to the status
- Encryption of bluetooth data

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<https://www.ziprecruiter.com/Salaries/Graduate-Electrical-Engineer-Salary--in-Illinois#:~:text=How%20much%20does%20a%20Graduate.be%20approximately%20%2449.36%20an%20hour>.
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<https://www.prnewswire.com/news-releases/parents-spend-267-billion-in-back-to-school-80-of-children-will-lose-pricey-supplies-lunch-boxes-and-clothing-219434601.html> (accessed Feb. 15, 2024).
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Thank You For Listening
