



Small Equipment Checkout System

Team: SDMAY19-13

Website: <http://sdmay19-13.sd.ece.iastate.edu/>

Advisor & Client: Leland Harker

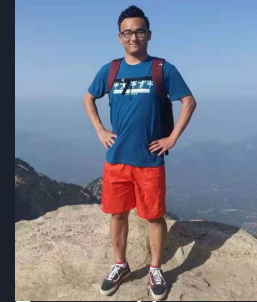
Team Members



Yimin Wang
Major: Electrical Engineering
Team Role: Project Manager
Technical Role: Hardware Team



Jiaxin Li
Major: Electrical Engineering
Team Role: Treasurer
Technical Role: Hardware Team



Fengnan Yang
Major: Electrical Engineering
Team Role: Reporter & Meeting manager
Technical Role: Hardware Team



Caining Wang
Major: Computer Engineering
Team Role: Software developer
Technical Role: Software Team



Bei Zhao
Major: Computer Engineering
Team Role: Secretary
Technical Role: Software Team



System Design



Problem Statement

- Continuing sdmay18-01 Group's work
- ETG's limited working time
- Low efficiency
- Waste of human resource




Functional Requirements (For students)

- Users can check the availability of each item on the front page.
- After Selecting an item to check out, the LED in the corresponding unit will be turned on for checking purpose.
- The system will ask users to sweep the ID card to open the lock.
- Users can review the currently checked out equipment (personal).
- Users can return equipment and close checkout record.
- Report any damaged item to ETG.



Functional Requirements (For Administrators)

- Log in and out
- Create, read, update and delete available equipment.
- Determine max checkout durations for items.
- Create, read, update and delete student users, records, and user privileges.
- Create update, remove locker units
- Add new Administrators



Non-functional Requirements

- The PCB should be designed smaller enough so it can fit into the plastic cover.
- The hardware should be able to work stably for 24/7.
- All the control PCBs in lockers should be connected through a single bus line, so the number of units can be extended easily.
- Administrators can add more units by connecting more PCBs and updating the database, without modifying the circuit design.



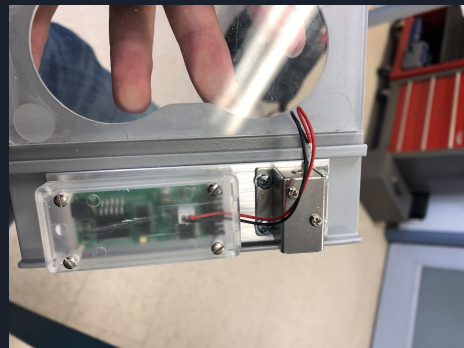
Appearance of the whole project



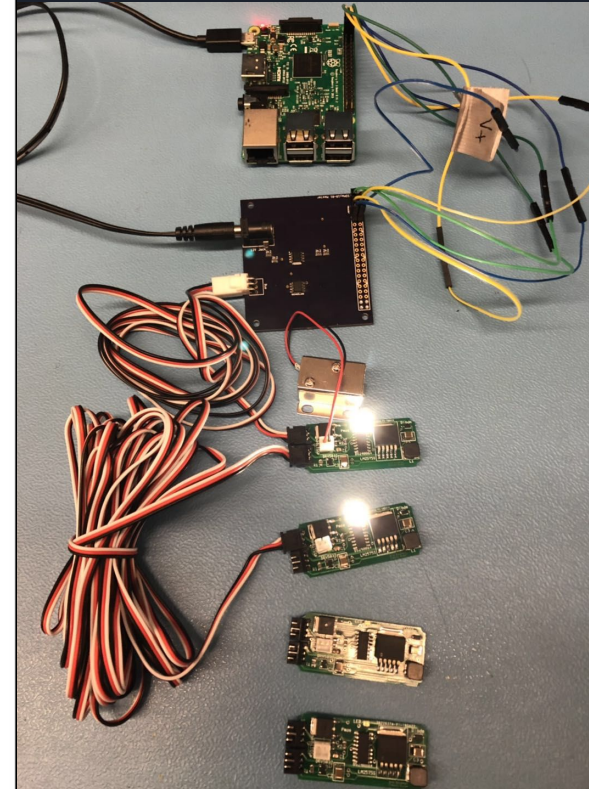
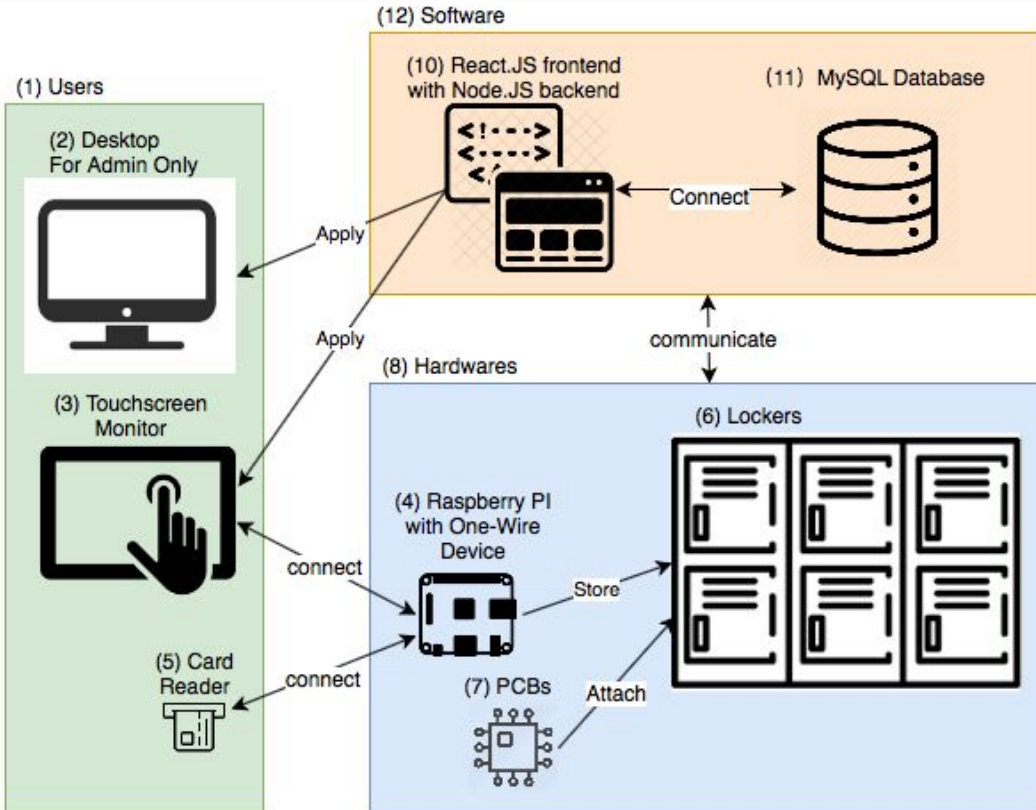
Locker unit for Raspberry Pi and master PCB



Locker unit for item and slave PCB



Conceptual Sketch



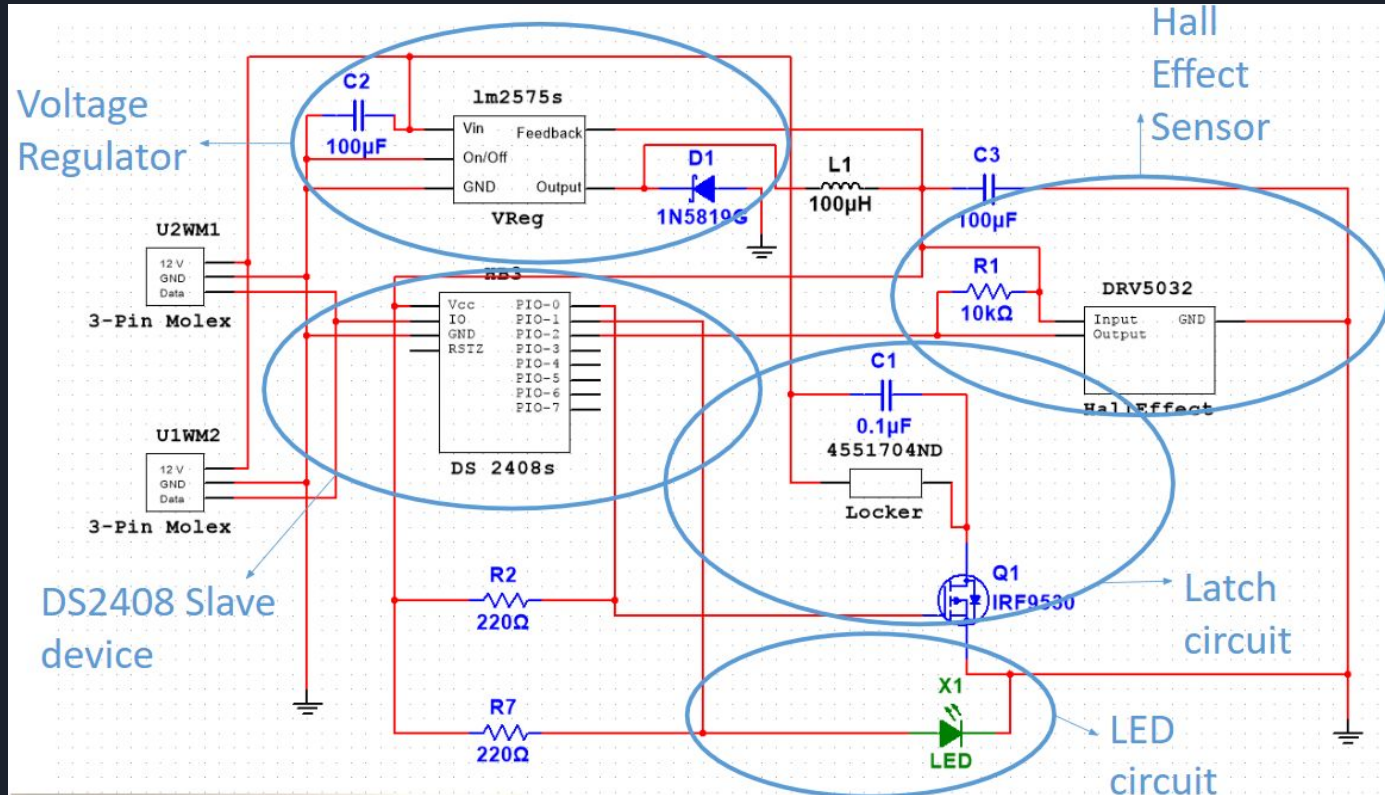


Design Detail

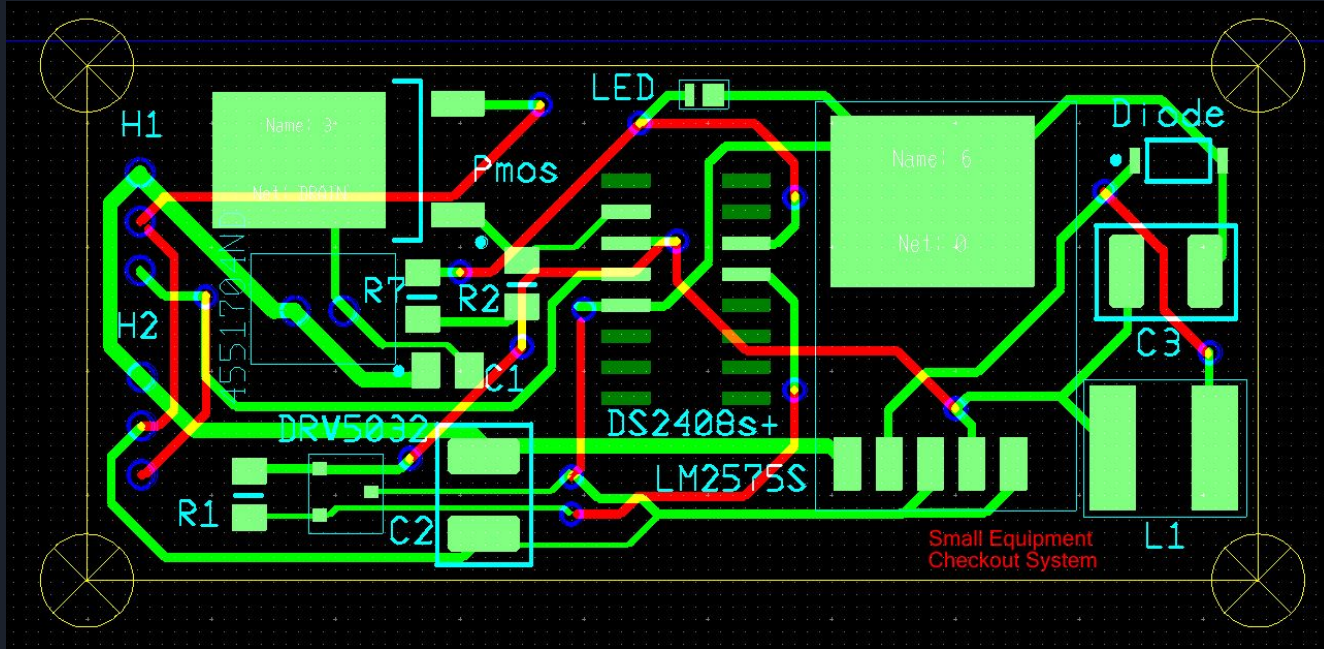


Hardware

Whole Circuit

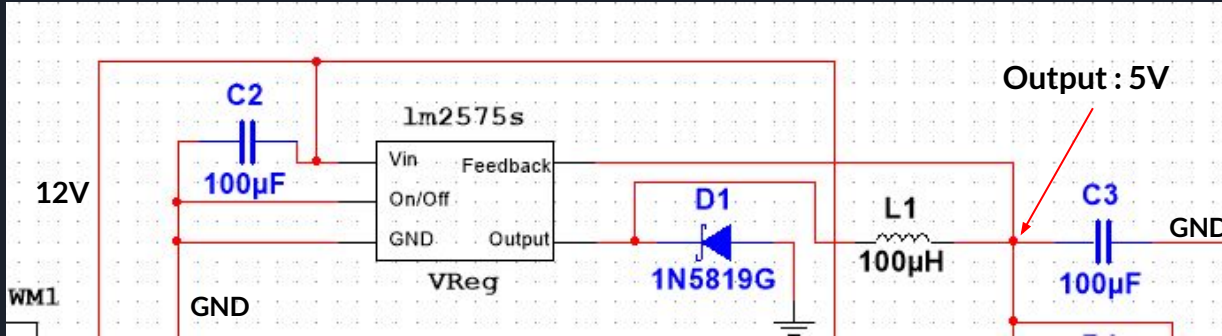


Slave Device PCB Design



Size : 48mm * 21mm * 5mm

Voltage Regulator

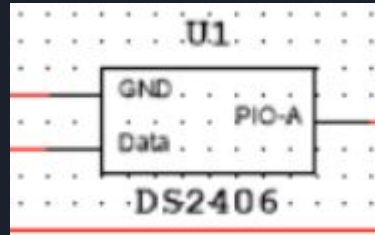
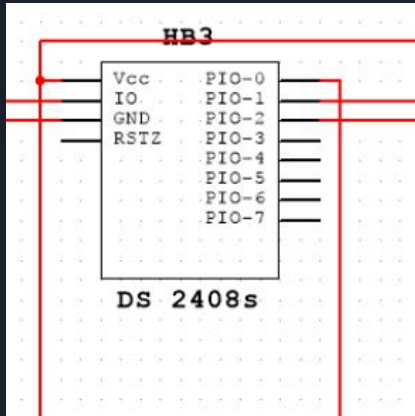


Components

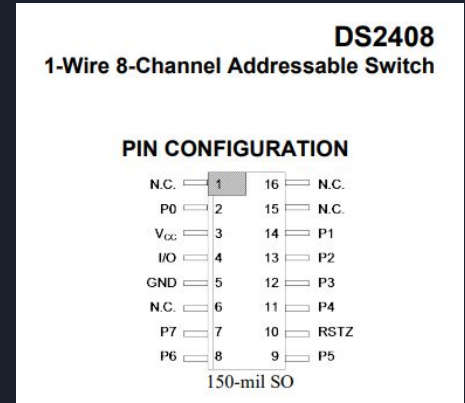
- Capacitors : 100uf
- Diode : 1N5819G
- Inductor : 100uH
- Voltage Regulator : LM2575S



DS2408 Slave Device



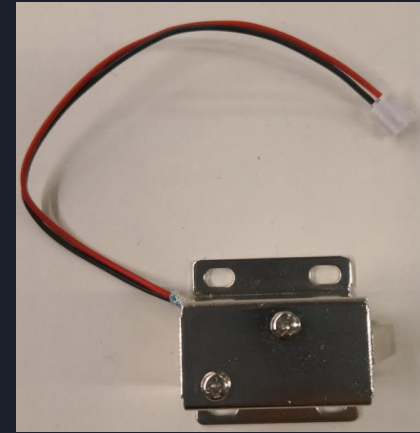
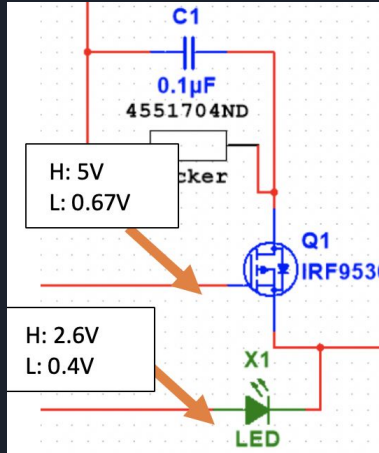
Single Channel
Addressable
Switch



8-Channel Addressable
Switch
(DataSheet)

- Pins Function
 - Vcc : 5V Power Supply
 - IO : Data Signal from Master Device
 - PIO-0 : 12V Electric latch
 - PIO-1 : 3.2V LED
 - PIO-2 : Hall-Effect Sensor

Latch Circuit

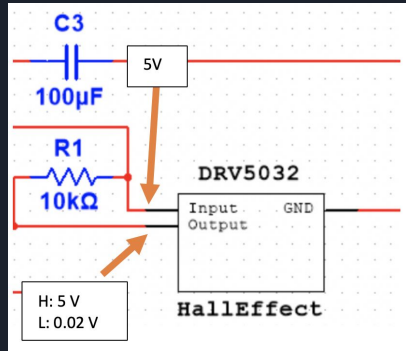


12V Electric Lock

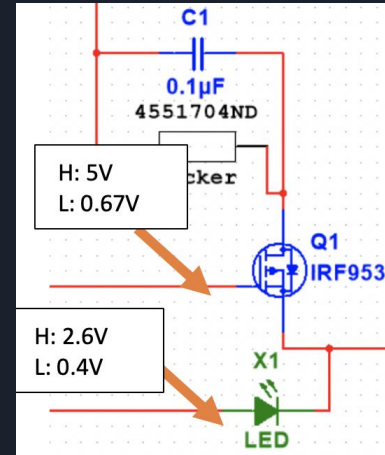
- Components
 - Capacitors : 0.1uf
 - Nmos : AOD454A
 - Locker : 12V Electric Latch



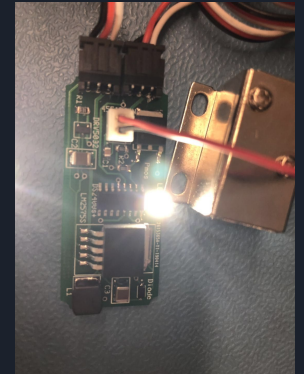
Door Detecting Circuit & LED



- Power supply: 5 V from voltage regulator
- Pull-Up resistance: 10K-ohm
- Output connected to the PIO 2 of DS2408
- Output: 5V/0.02V



- Power supply: PIO 1 of DS2408
- Pull-Up resistance: 220 ohm
- Output: 2.6V/0.4V



Cost

Manufacturer Part Number	Description	Unit Cost	#	Total
DF3A-3P-2DS	CONN HEADER R/A 3POS 2MM	\$0.19	68	12.92
DS2408S+T&R	IC SWITCH 8-CHAN ADDRESS 16SOIC	\$5.89	34	200.26
DRV5032FCDBZT	SENSOR MAG SWTCH OMNI SOT-23-3(open drain)	\$0.89	34	30.26
LM2575S-5.0	IC REG BUCK 5V 1A TO263-5	\$4.69	34	159.46
B2B-PH-K-S(LF)(SN)	CONN HEADER VERT 2POS 2MM	\$0.17	34	5.78
RR1220P-103-D	RES SMD 10K OHM 0.5% 1/10W 0805	\$0.11	34	3.74
C0805X104K5RACTU	CAP CER 0.1UF 50V X7R 0805	\$0.40	34	13.6
SME2014UWDN05	LED Lighting SM2014 White, Warm 3985K 3.2V 150mA 110° 0805 (2015 Metric)	\$2.91	34	98.94
CC1210MKX5R7BB107	CAP CER 100UF 16V X5R 1210	\$4.41	34	149.94
VLS6045AF-101M	FIXED IND 100UH 1A 527MOHM SMD	\$0.58	34	19.72
1N5819HW-7-F	DIODE SCHOTTKY 40V 1A SOD123	\$0.50	34	17
CRGP0805F220R	CRGP 0805 220R 1%	\$0.22	68	14.96
DF3-3S-2C	CONN RECEPT HOUSING 3POS 2MM	\$0.11	68	7.48
AOD454A	MOSFET N-CH 40V 20A TO252	\$0.64	34	21.76
795891442205	Mini Electromagnetic Electric Control Door Cabinet Drawer Lockers Lock	\$2.69	34	91.46
1528-2233-ND	Jumper Wires	\$1.95	34	66.3
RASPBERRY PI B	Resberry Pi	\$29.95	1	29.95
2197	HDMI FLAT CABLE - 1 FOOT / 30CM	\$3.95	1	3.95
U050-003	USB 2.0 A TO MICRO-USB B CABL 3'	\$4.65	1	4.65
	PCB	\$0.40	34	13.6
Total				\$965.73



Software

Website homepage & OWFS address page

admin | return item

IOWA STATE UNIVERSITY

E - CHECK SMALL EQUIPMENT CHECKOUT

Click on a locker to open

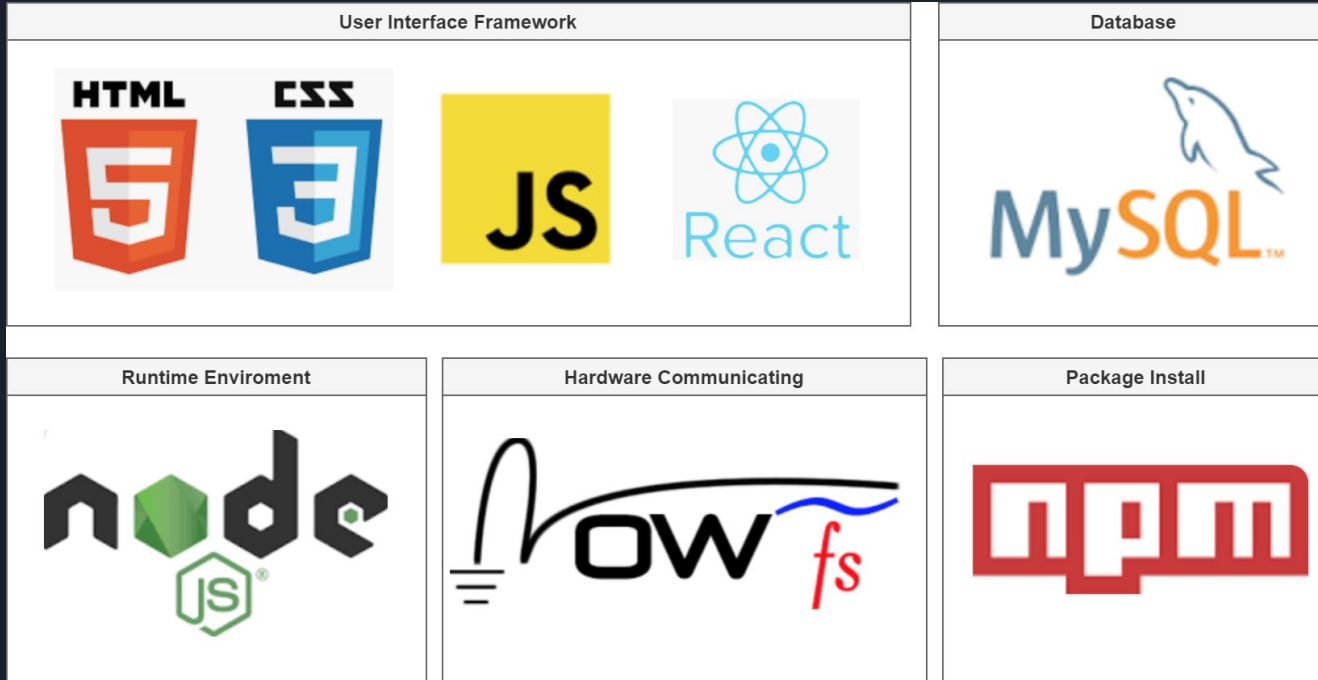
Raspberry Pi 3 Model B	item is borrowed	item is not available	item is borrowed	Arduino MKR GSM 1400
item is not available	item is borrowed	Soldering Iron	item is not available	item is borrowed
Screws	Wires	item is borrowed	12 Volt Cables	Micro USB Cords
Pencils	Pizza			

29.2BDC25000000

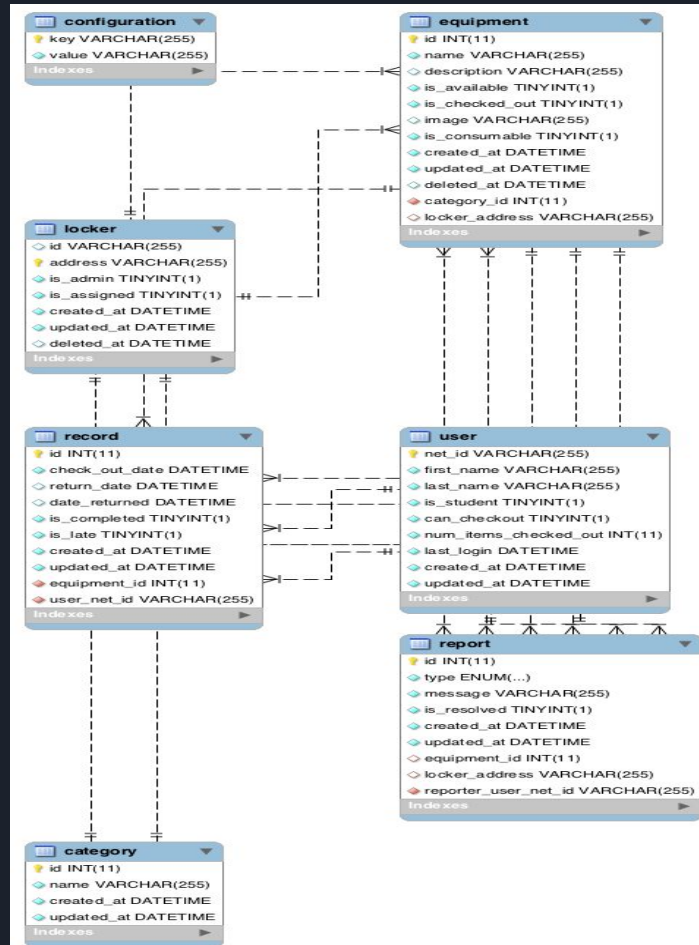
attached system

UP	directory
LCD_H	LCD_H
LCD_M	LCD_M
PIO.BYTE	0 CHANGE
PIO.ALL	0.0.0.0.0.0.0 CHANGE
PIO.0	CHANGE
PIO.1	CHANGE
PIO.2	CHANGE
PIO.3	CHANGE
PIO.4	CHANGE
PIO.5	CHANGE
PIO.6	CHANGE
PIO.7	CHANGE
address	292BDC25000000E3
alias	CHANGE
crc8	E3
family	29
id	2BDC25000000
latch.BYTE	0 CHANGE
latch.ALL	0.0.0.0.0.0.0 CHANGE
latch.0	CHANGE
latch.1	CHANGE
latch.2	CHANGE
latch.3	CHANGE

Software Implementation



Database schema of Web application





Iowa State University's Attendance Tracking System - ATRACK

```
const fetch = require('node-fetch');
const moment = require('moment');

// TODO change this event registered under an etg account
const eventId = '8345'; // https://atrack.its.iastate.edu/event/8345/view
const eventKey = 'KYZG';
const apiKey = 'CsbxvMZV14un8K7JkgHlp0wA63UPQGxe'; // https://atrack.its.iastate.edu/api/check-in
```

An API provided by university to get basic student information through University ID(ISU card)

- Net-ID
- Name



Potential & Actual Risks

Potential Risk

- Because the system needs to collect student ID information, it is possible that this information will be leaked under cyber attack.
- The Raspberry Pi is placed in a box without a cooling system and will work for 24/7. It is possible to become overheated.

Actual Risk

- Used jumper wire to connect master PCB and slave PCB during the test, which short and burn the master device (12V output and 5 v input in wrong order).
- Solution: using 2 mm 3 pin connect header and cable.



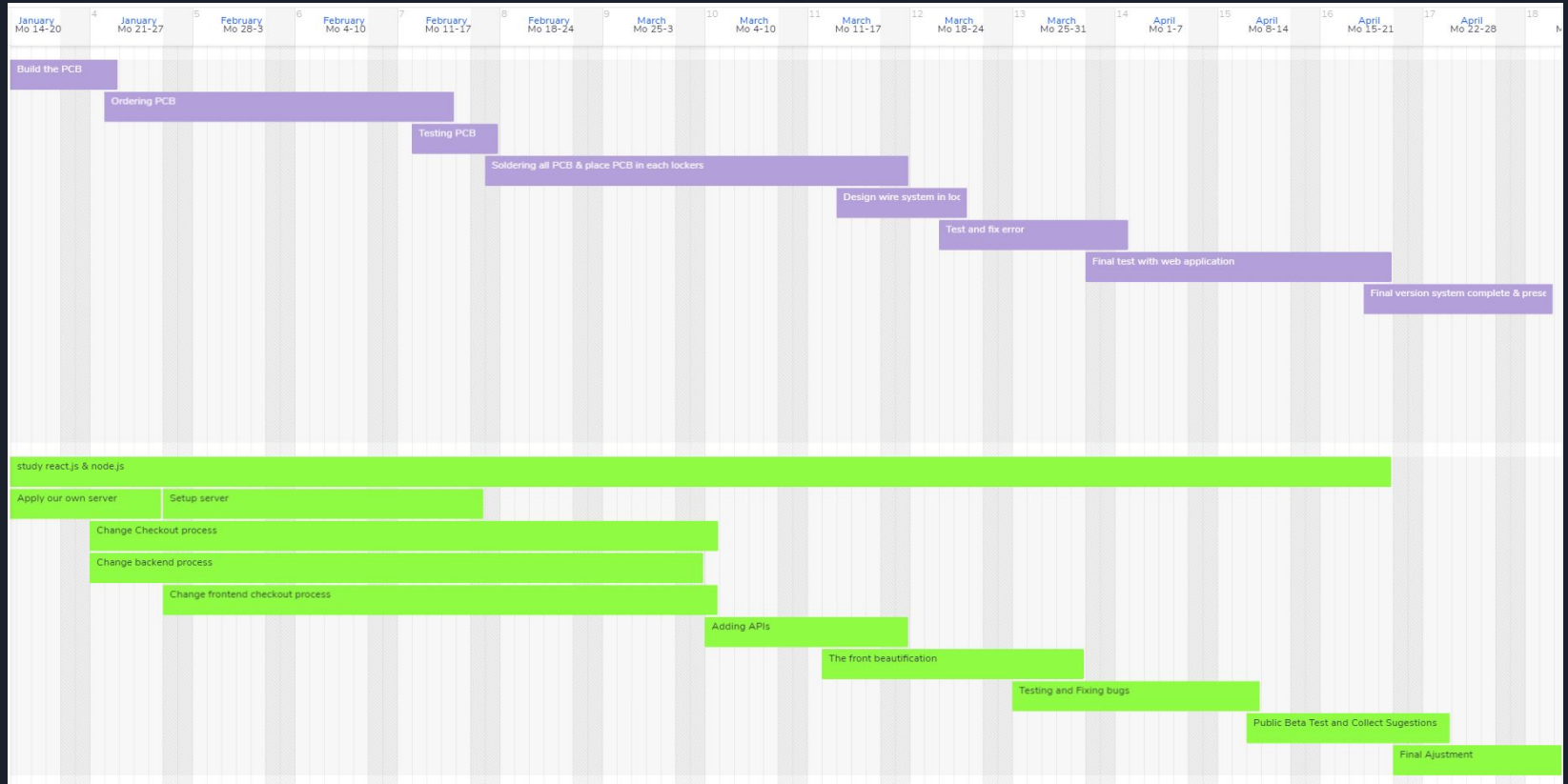
Conclusion



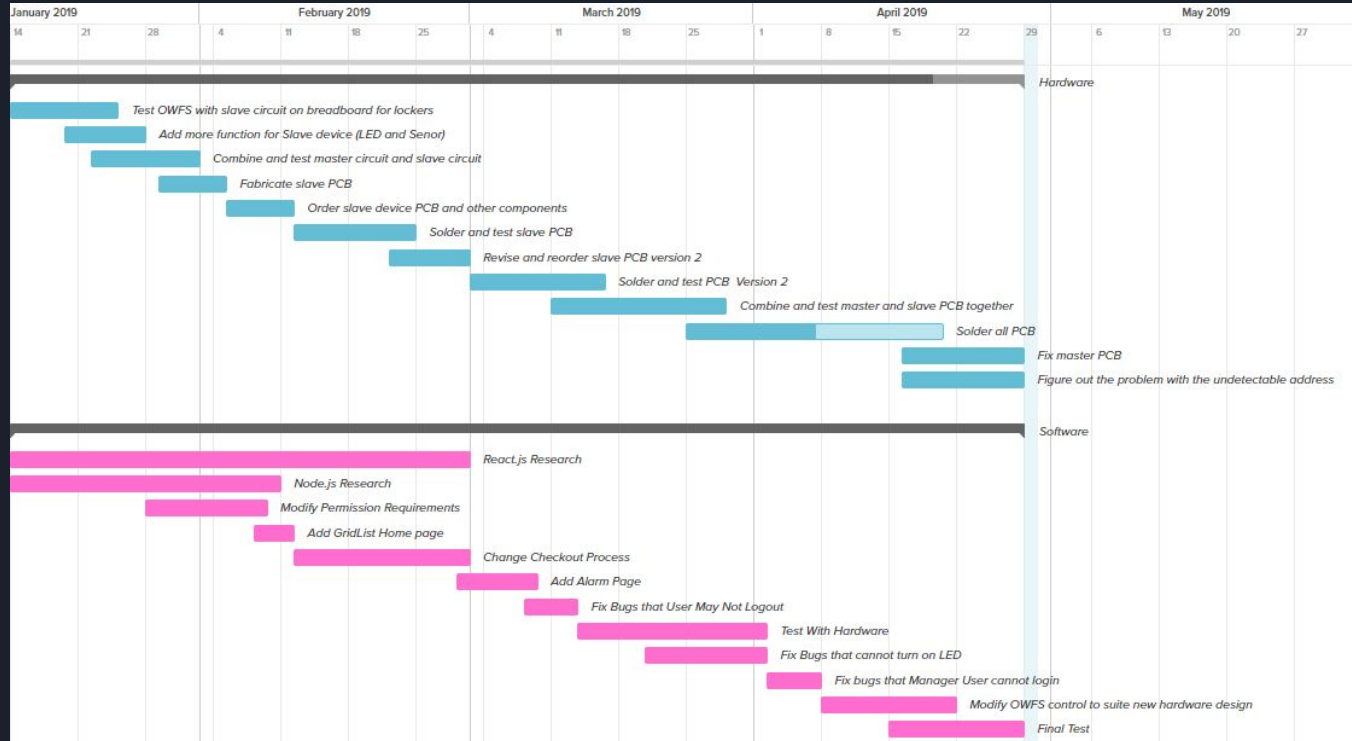
Potential Improvements

- Complete the door detecting system.
- Add more locker units to the whole checkout system.
- Design and implement the cooling solution for the unit that stores the Raspberry Pi and master PCB.

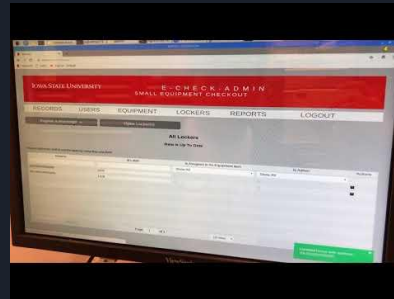
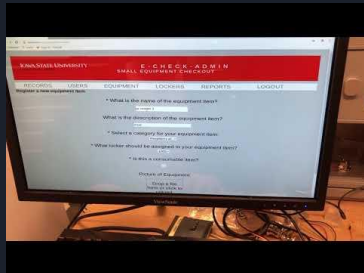
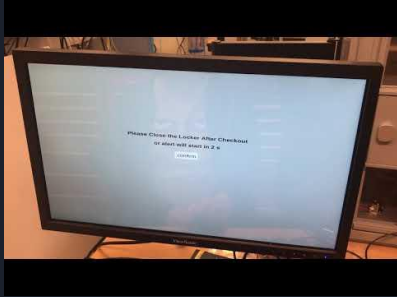
Proposed plan for this semester



Current project status



Demo Video





Thanks

Q&A