

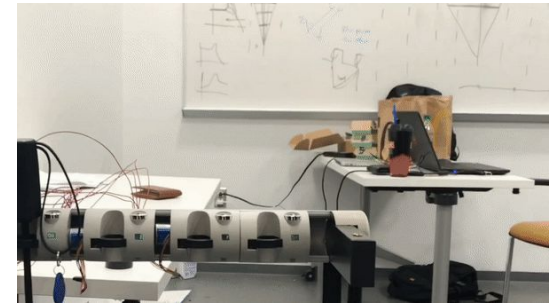
ECE445 Senior Design

Group 72 Umbrella Rental System

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Xu

5.3 2017

Introduction



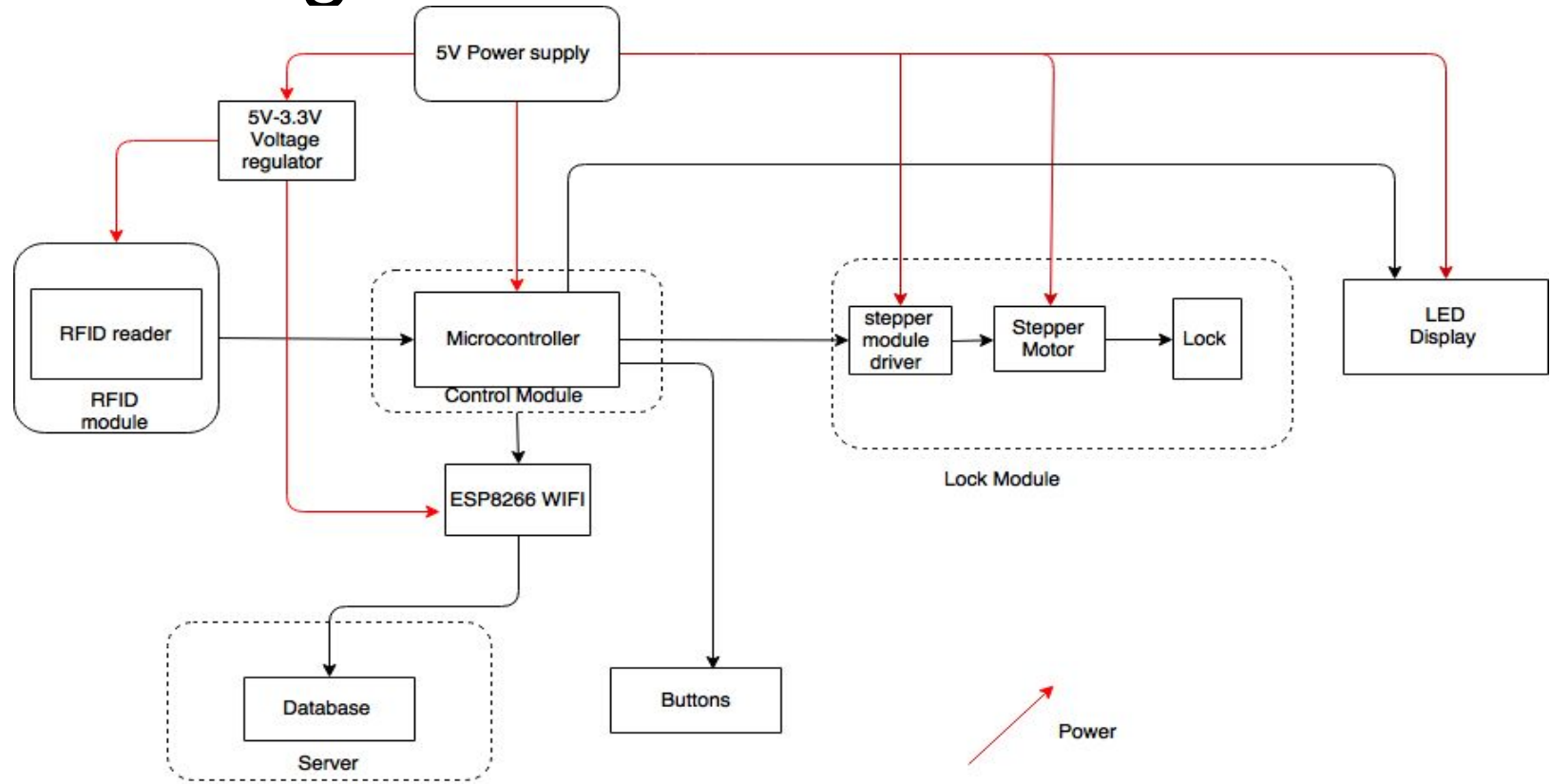
- Problem: Sudden rain or snow when you need to commute between work or class. Purchasing umbrellas for rare uses is wasteful.
- Our solution:
- A smart, self-serve, 24x7 umbrella rack which provides umbrella rental service
- An easy, low cost way for people to rent and return umbrellas

Objective

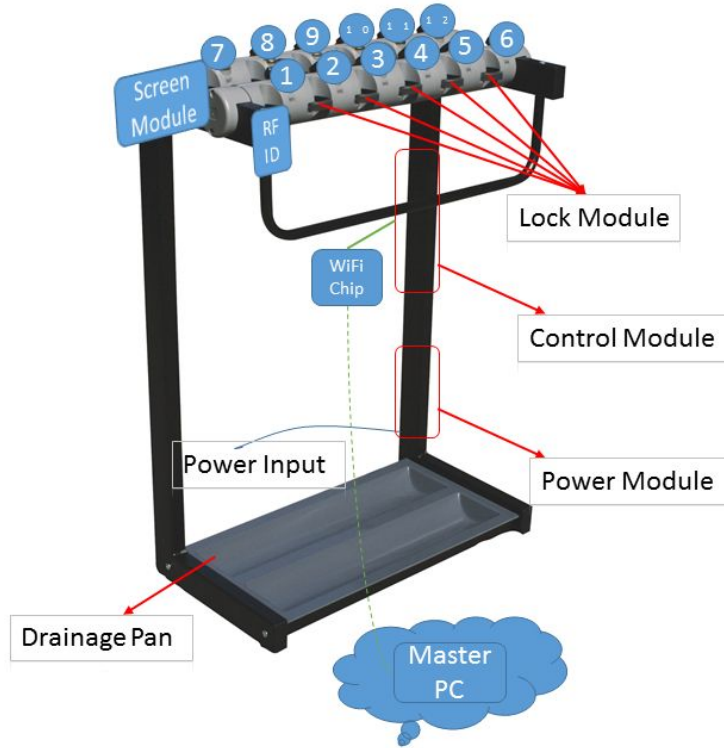
Technical Capabilities:

- Ability to read RFID cards for user identification
- Communicate with backend database through wifi to maintain rental record and to support real time multi-rack distribution/deployment
- Log damage report in case of accidental or malicious damage

Block Diagram



Physical Design & Project Picture



LOCK11-1 —
LOCK33-02
LOCK33-02
LOCK33-02
332-02
LOCK21-1 —
LOCK33-02
LOCK33-02
LOCK33-02
332-02
LOCK31-1 —
LOCK33-02
LOCK33-02
LOCK33-02
332-02
LOCK41-1 —
LOCK33-02
LOCK33-02
LOCK33-02
332-02

LCD Display

LCD Display Unit

1. 1602 Lcd Display with adjustable backlight
2. Use 5V Power Supply
3. Shows 16 characters x 2 lines
4. Reads ASCII code



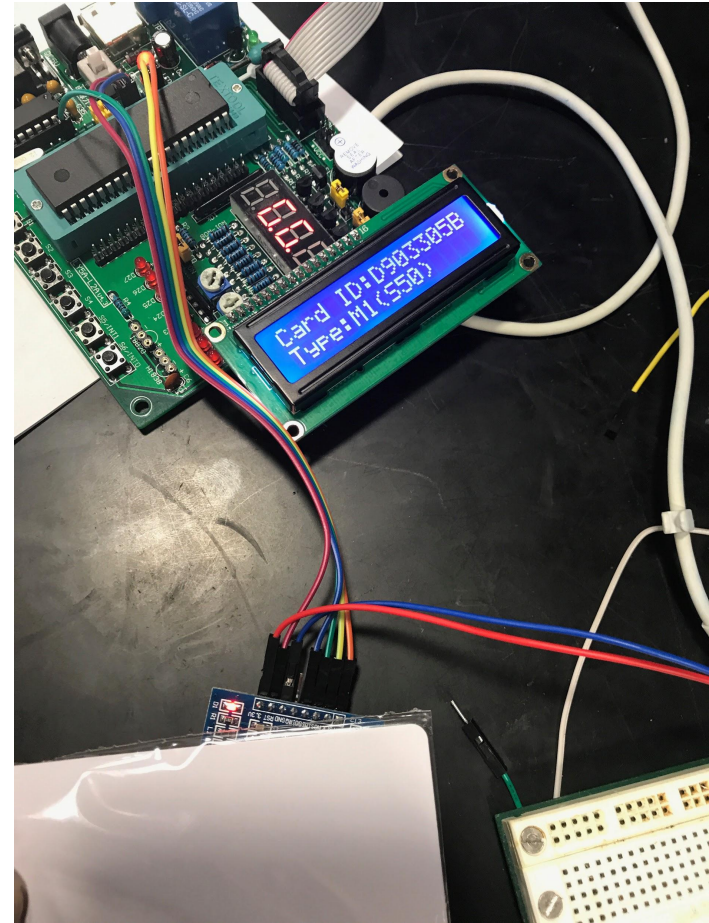
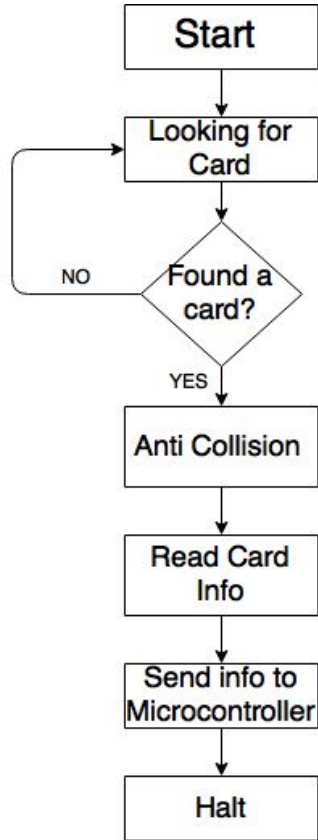
RFID Module

RFID Module

- Use RC522 Sensor 13.56MHz
- Only supports 3.3V
- Read information from RFID tag/card
- Send the card information to Microcontroller
- No delay for the read process



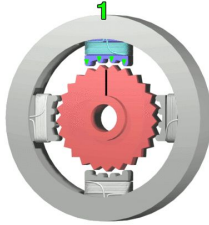
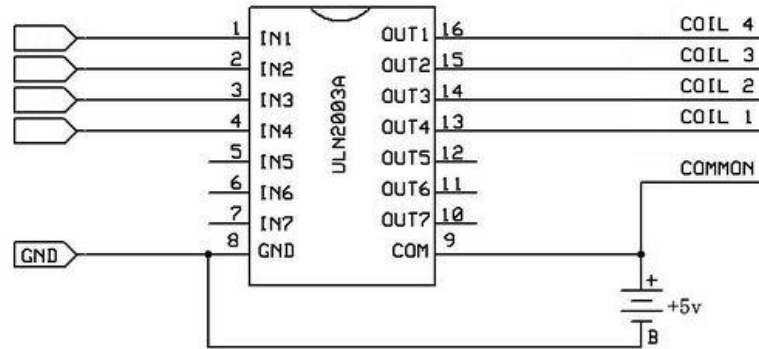
RFID work flowchart



Lock Module

BYJ - 48 Stepper Motor & ULN2003 Driver Module

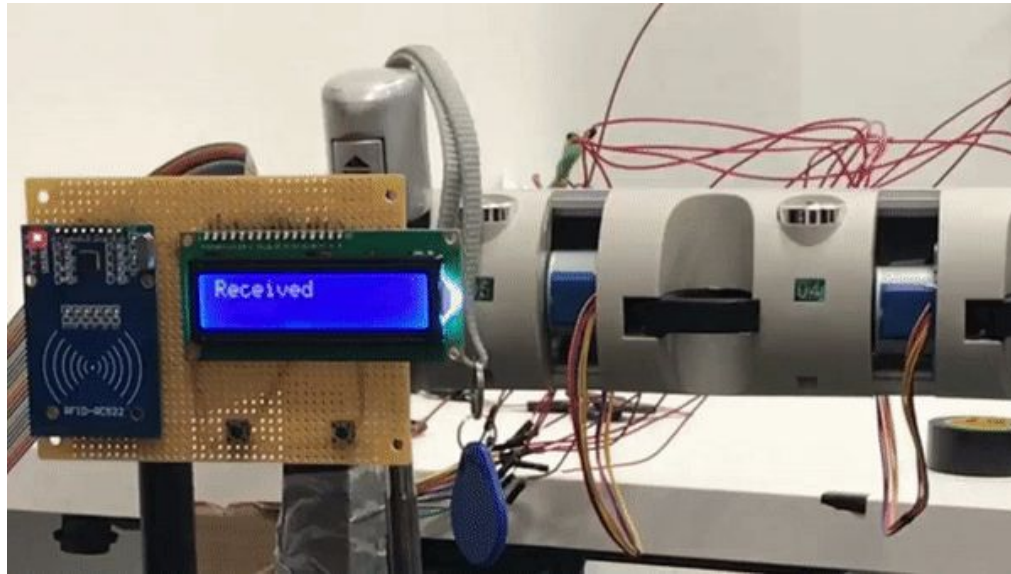
- 4 Phase 5V DC Stepper Motor
- Rotation of 5.625° per set of 4 input pulse
- Execute step 1 to 4 for clockwise rotation
- Reverse steps for counterclockwise turn
- Speed control through frequency of input pulse



Step	Port Data	Pin 3	Pin 2	Pin 1	Pin 0
1	0x03	0	0	1	1
2	0x06	0	1	1	0
3	0x0C	1	1	0	0
4	0x09	1	0	0	1

Motor - Lock Mechanical Design

- Motor rotation through tension wire triggers spring loaded lock arm on a second axle to eject the lock arm, releasing the umbrella



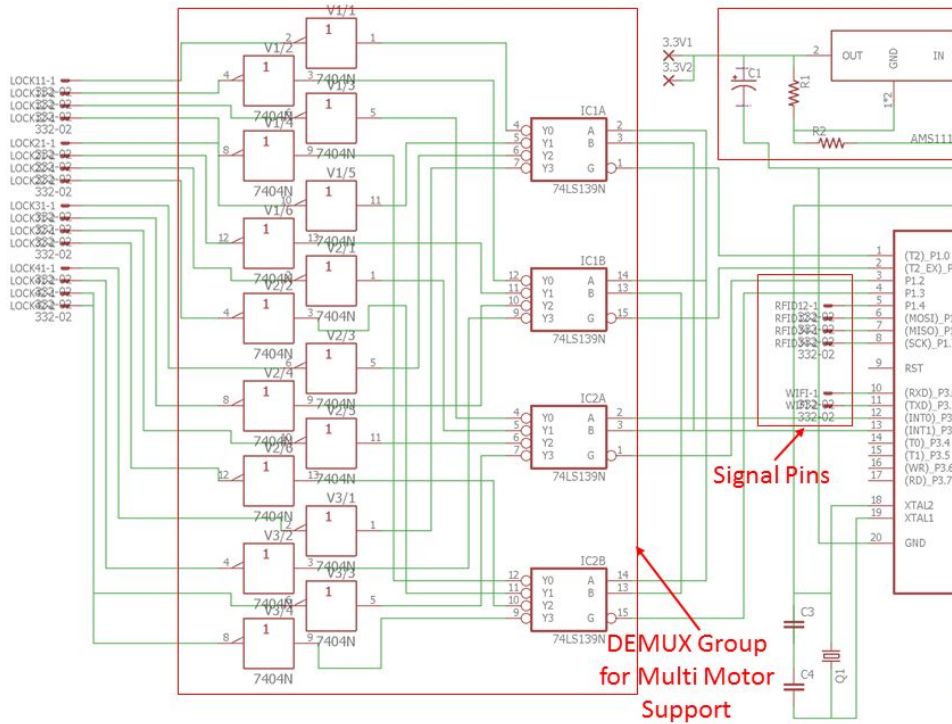
DEMUX Group for Optimized Motor Signal Pin Usage

- Microcontroller has limited pins accessible, but each microcontroller need to control many motors

	4 Signal Pin per Motor V.S. 4 Signal Pin with DEMUX Select	
Pins Needed	$4*n$	$4 + x$
Controllable Motor	n	2^x

- Current prototype used four 74AC139 DUAL 2 to 4 Demultiplexer, one per motor signal

DEMUX Group for Optimized Motor Signal Pin Usage



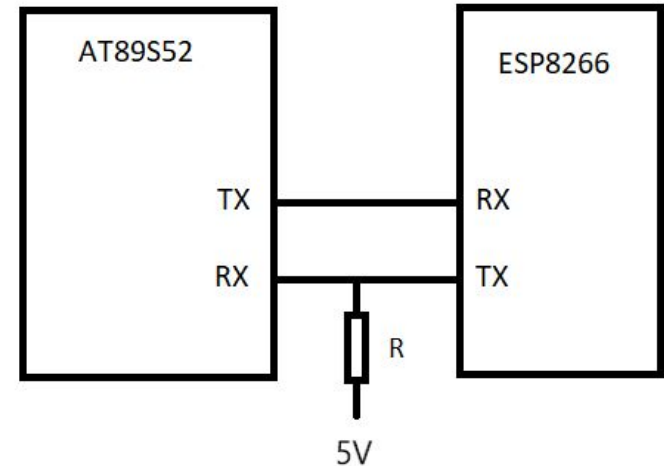
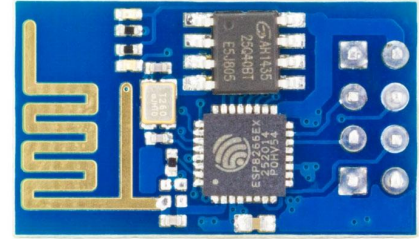
FUNCTION TABLE
(each decoder/demultiplexer)

INPUTS			OUTPUTS			
\overline{G}	SELECT					
	B	A	Y0	Y1	Y2	Y3
H	X	X	H	H	H	H
L	L	L	L	H	H	H
L	L	H	H	L	H	H
L	H	L	H	H	L	H
L	H	H	H	H	H	L

WiFi Module

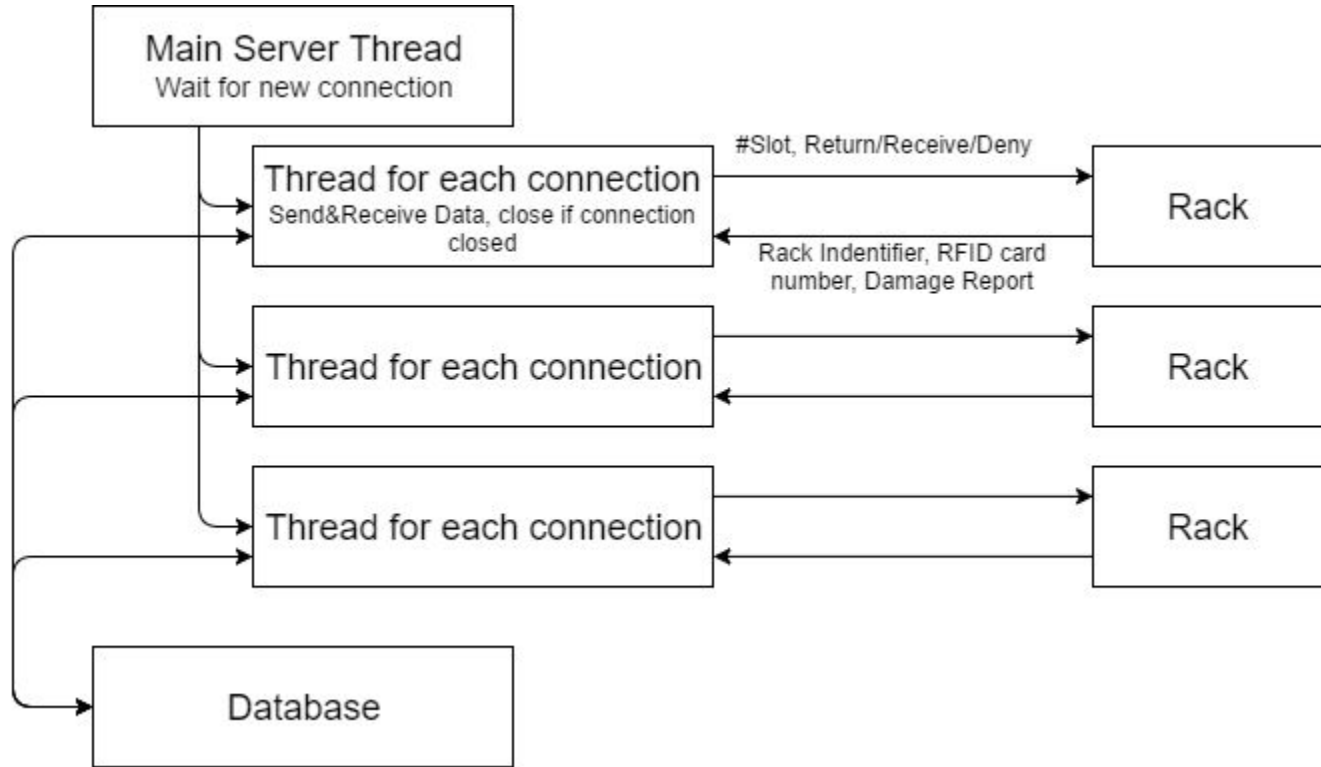
Chip: ESP-8266

- 3.3V supply voltage
- AT Command Set
- Example:
AT+CIPSTART=<Protocol>,<IP>
,<PORT> //Connect to PORT on
target IP via Protocol, e.g. TCP
- I/O pin voltage, however...

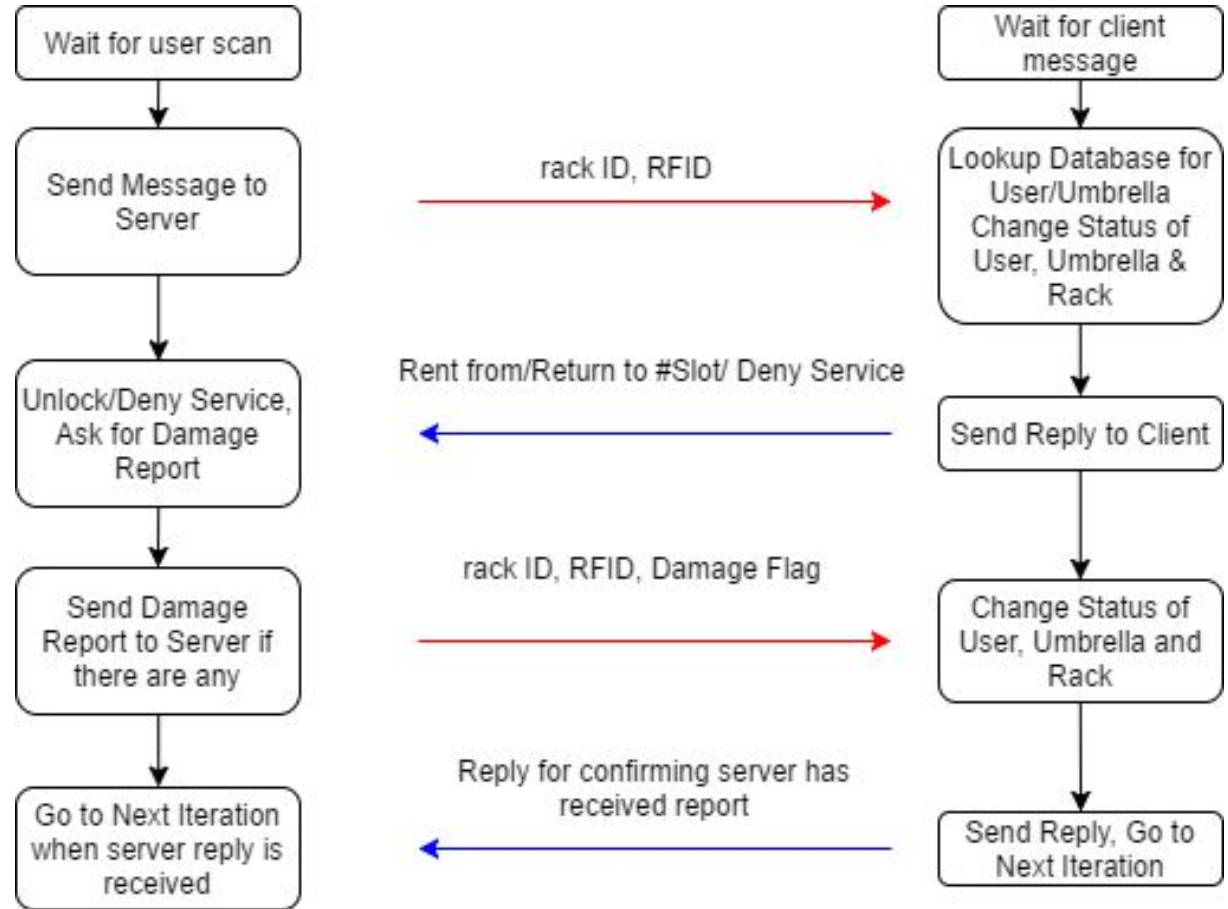


Control&Server

Software System Overview



Microcontroller & Server



Conclusion

Positives:

- Project works as designed with full functionality
- Every module satisfies the Requirement and had been Verified
- Easy to use with fluent user experience
- Full support for flexible multi rack deployment
- Low Manufacturing Cost and low operation cost

Part	Manufacturer	Retail Cost (\$)	Bulk Purchase Cost (\$)
AT89S52	Atmel	\$3 each	\$1.16 each
PCB	PCB Way	\$3.80 each	\$0.559 each
Motor & Driver	Generic	\$20 per 10 pair	\$8.50 per 10 pair
RC522 RFID	Generic	\$25	\$4.6 per Reader + 10 Card
ESP 8266 WiFi	Generic	\$4 each	\$2.20 each
1602 LCD	Generic	\$3 each	\$1.31 each
Rack	Generic	\$15 each	\$10 each
Power Supply	Generic	\$6	\$3
DEMUX IC	Texas Instrument	\$8 per 4 pair	\$1.152 per 4 pair
Other IC (Inverter, etc)	Texas Instrument	\$4	\$1.768
Total		\$91.80	\$34.24

Conclusion

Negatives and Future Work:

- Exposed wiring and circuitry on current prototype
- Better protection and waterproof for circuitry
- Improve corner cases in rental database algorithm
 - Reporting damage will cause current user to be banned temporarily, even if the user is not responsible
- User registration interface - Website, Mobile Apps
- Setup payment system for commercial applications

Questions?

Thank you!