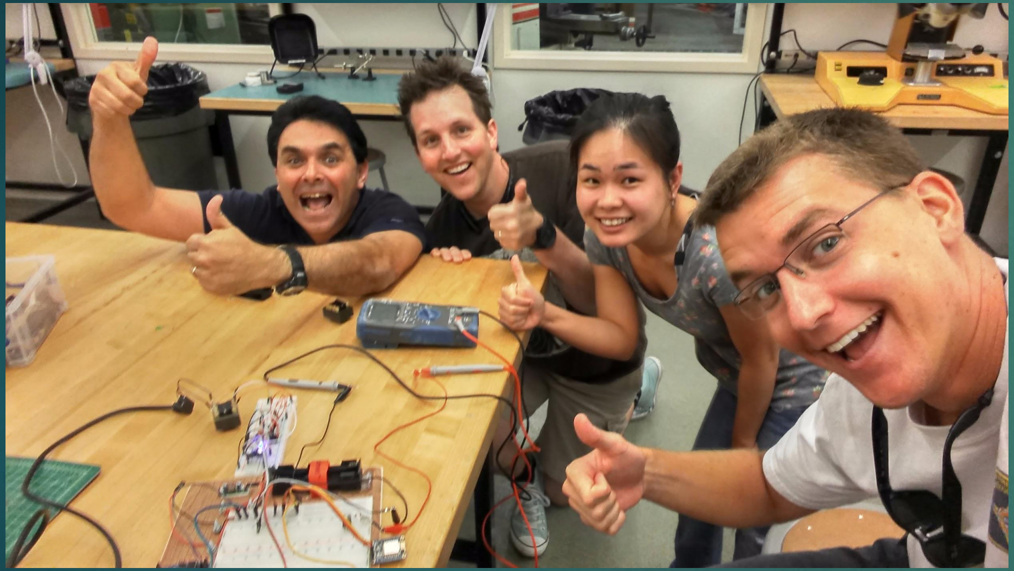
Real-Time Parking Information Solution

Team 9

Them Le	-	EE
Danny Russell	-	CpE
Carlos Pereda	-	CpE
Roddey Smith	-	CpE

Division of Tasks



Them Le (EE)

- Power System, Hardware, Eagle CAD drawings.

Carlos Pereda (CpE)

- Database, Back-end Management, WiFi Communication.

Danny Russell (CpE)

- Front-end UI, Web and Mobile Application.

Roddey Smith (CpE)

- Housing Design, Test Bench, Misc HW & SW help as needed.

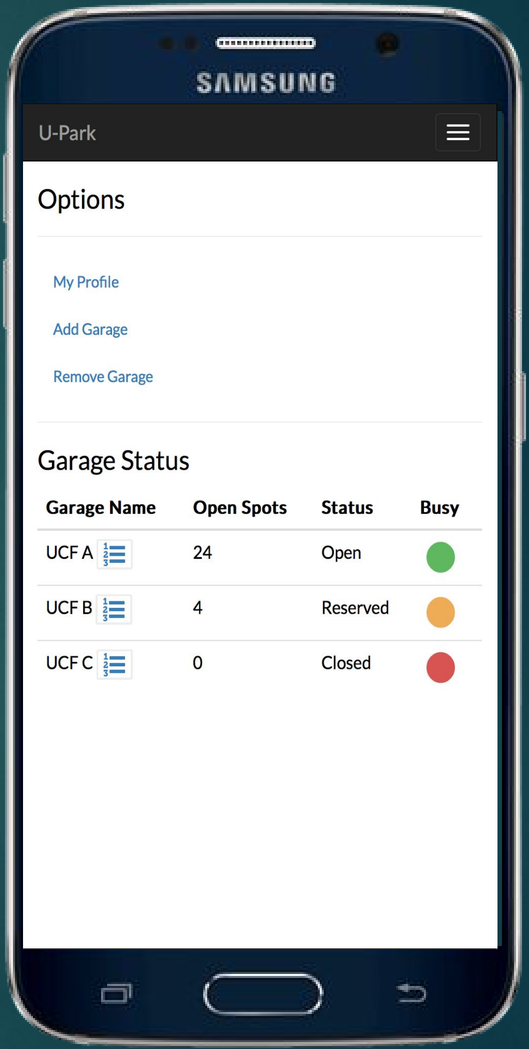
What is U-Park?

The Problem:

- Current system on the signs to know whether a garage has available spots doesn’t work.
- Too much time is wasted searching for parking.

The Solution:

- U-Park provides accurate information accessible from any mobile device.
- U-Park helps visualize parking availability for each level of the garage.
- Allows users to check garage parking availability without having to drive in.



U-Park

Options

My Profile

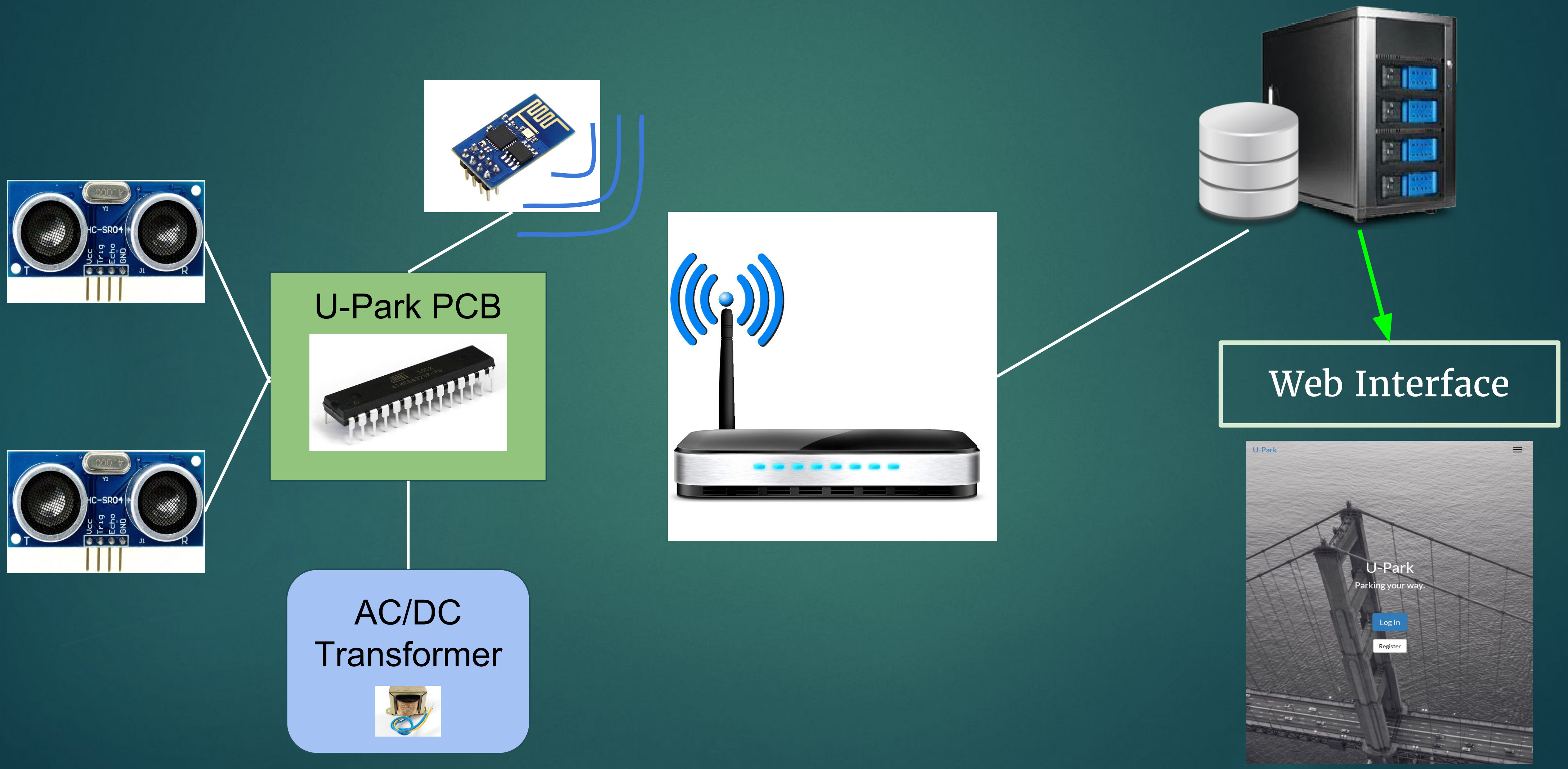
Add Garage

Remove Garage

Garage Status

Garage Name	Open Spots	Status	Busy
UCF A	24	Open	🟢
UCF B	4	Reserved	🟠
UCF C	0	Closed	🔴

System Block Diagram



U-Park

Parking your way.

Log In

Register

Requirement Specification

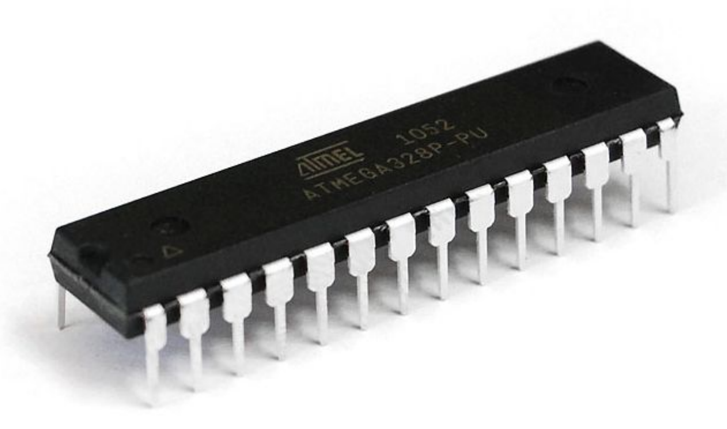
Cost:	No more than $50 per sensor module
# Spots Monitored:	At least two (2)
Communication:	Wireless
Short Update Interval:	< 3 Minutes
Operation Duration:	> 16 Hours per day
Power Consumption:	No more than 500 mA
Power Source:	120V AC
Operating Environment:	Florida Climate
User Interface:	Mobile Friendly

ATMega328P-PU vs. MSP430

- ATMega328P-PU vs. MSP430
- Extremely low power was not a requirement
- ATMega328P-PU has more available online resources
- ATMega328P-PU also has more variety of compatible sensors that are easy to experiment with
- Past experience of team members with using an Arduino UNO board

ATmega328P-PU Specifications

CPU	8-bit AVR RISC based Processor
# Pins	28
Memory	2 kB Flash Memory
# GPIO Pins	23
Operating Voltage	(1.8 - 5.5) V
Price	~ $1.80

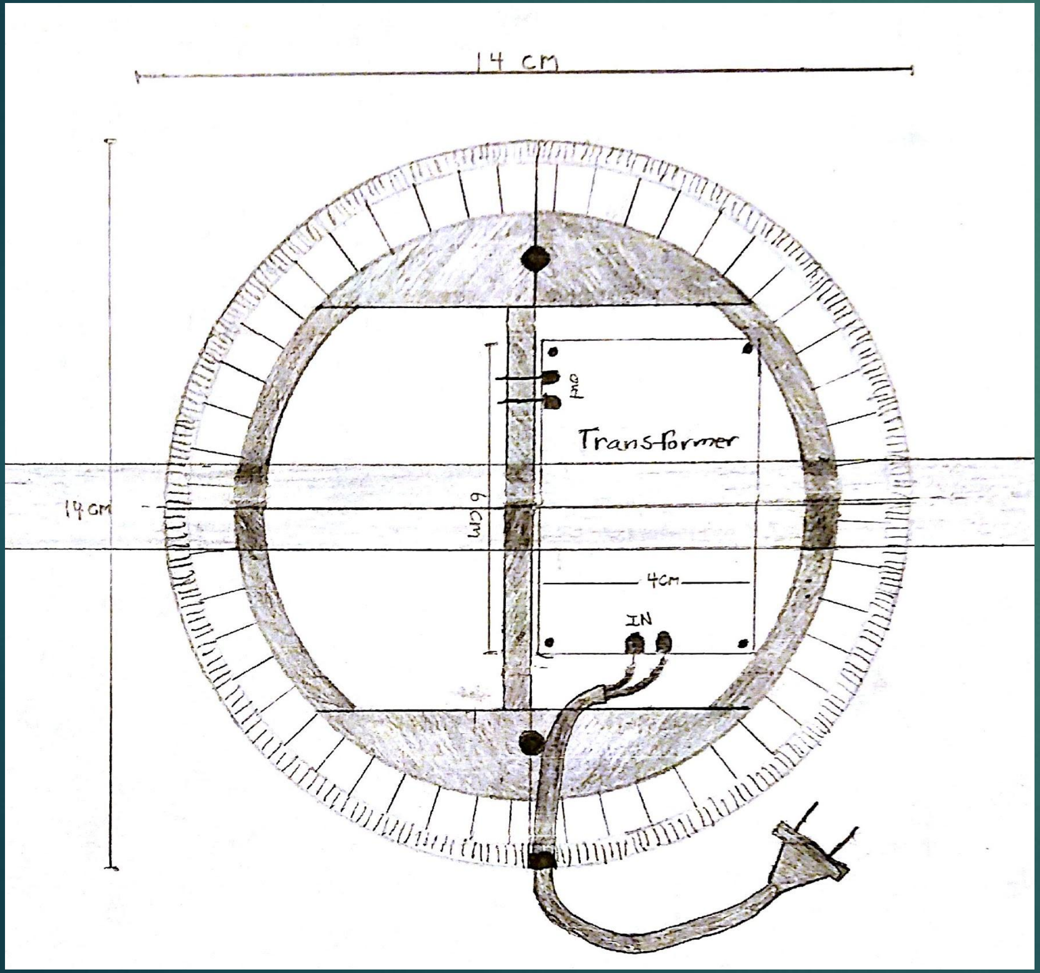


Outer Casing Details

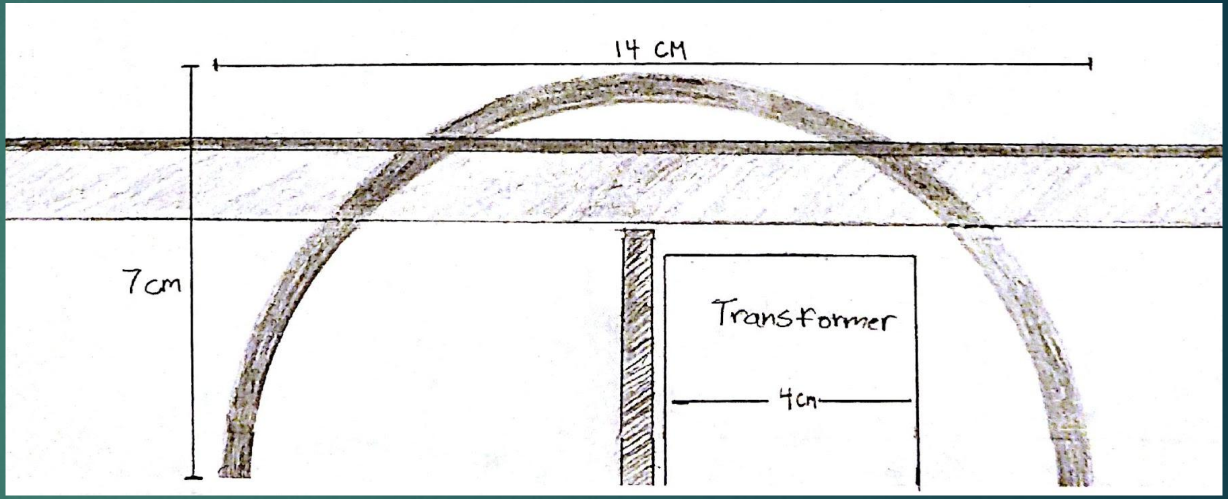
- Designed In Fusion 360
- 3D Printed main housing module
- Issues with FAB-LAB Printer

Outer Casing Design

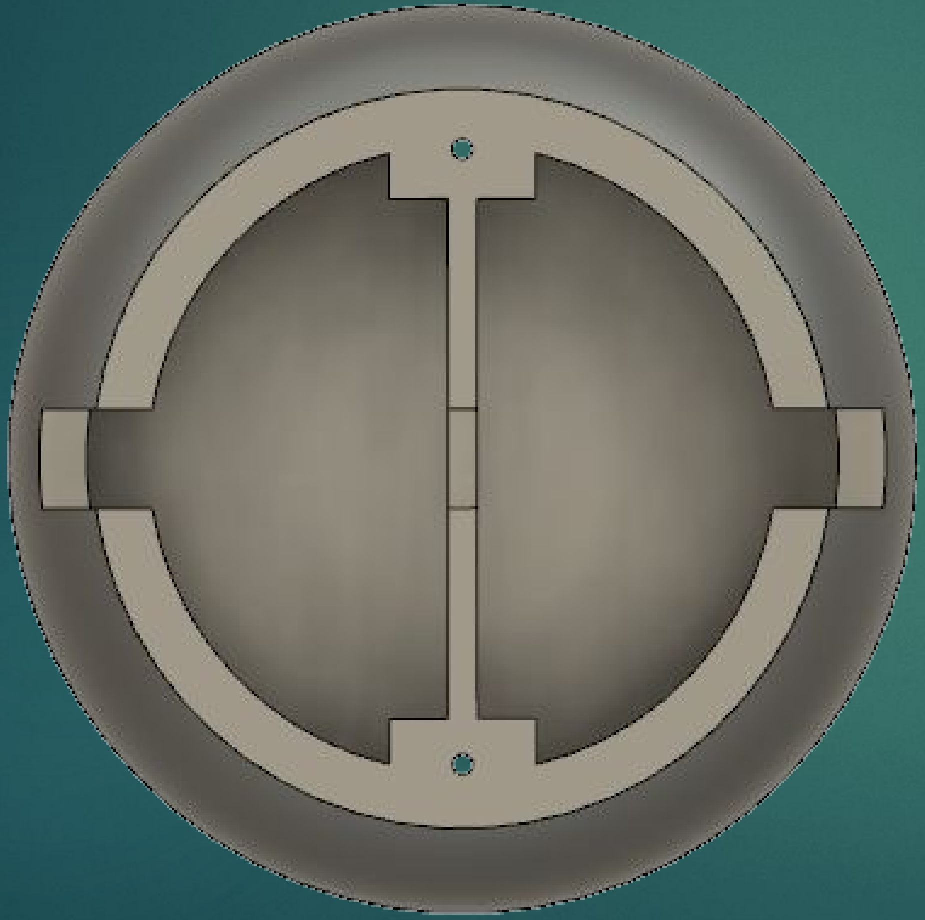
Top-Down View

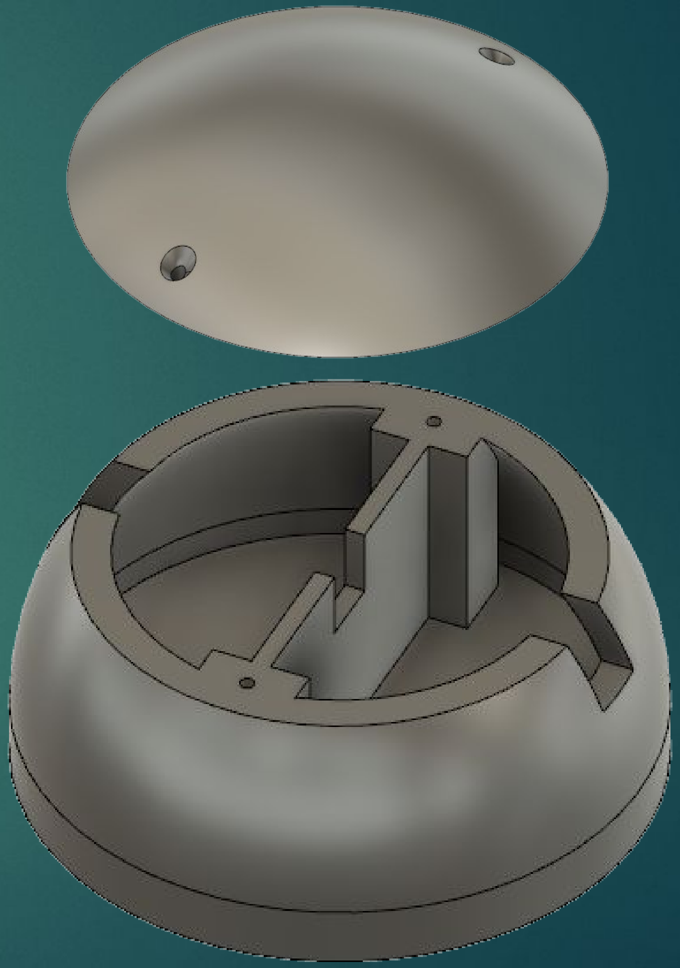


Front View



Outer Casing - Fusion 360 Design





Spot Detection Sensors

Hall Effect Sensor

Infrared Sensor

Ultrasonic sensor

Ultrasonic Sensor

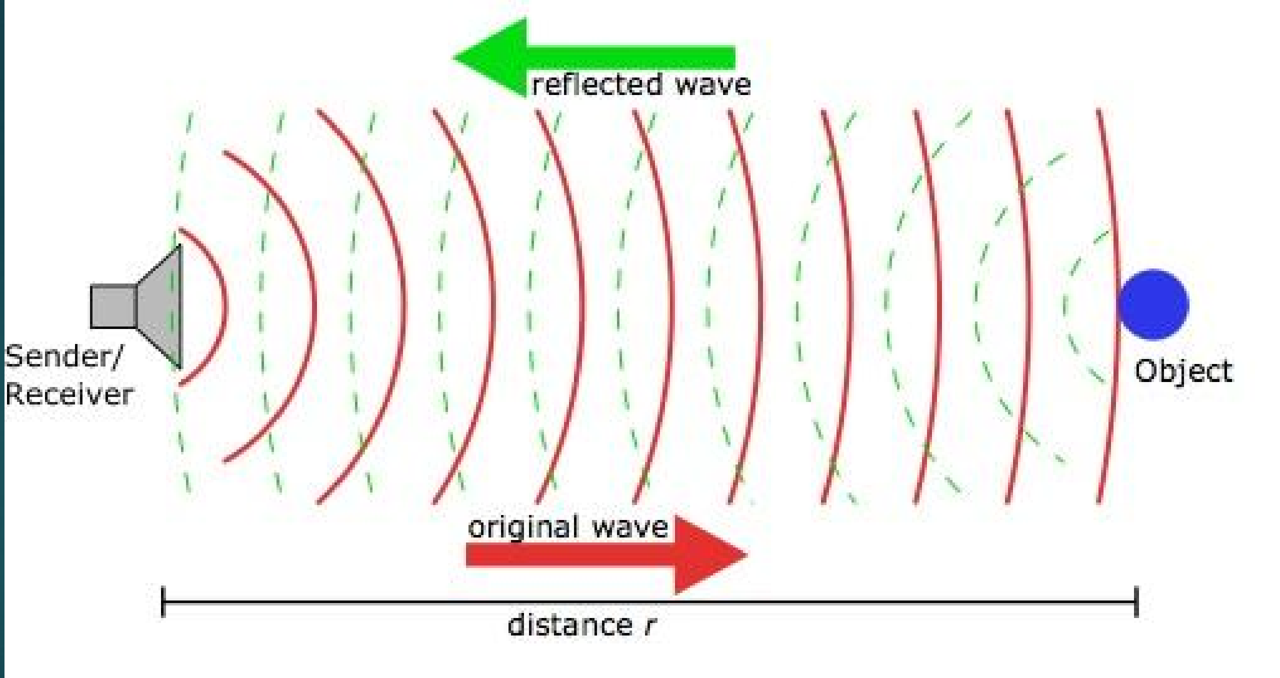
Advantages:

- An ultrasonic sensor’s response is independent of the surface color or optical reflectivity of the object.
- Low power consumption
- Stable performance, accurate distance measurement.

Disadvantages:

- Needs to be mounted in a downward-looking configuration, as perpendicular as possible to the target
- Targets of low density, like foam and cloth, tend to absorb sound energy; these materials may be difficult to sense at long ranges.

Ultrasonic Sensor



Manufacturer	Parallax
I/O Lines	4 (Vcc, Trig, Echo, GND)
Price	$1.42
Detectable Range	2cm-4m
Resolution	0.3 cm
Power Supply	5V DC

Distance **r**= Ultrasonic Spreading velocity (340 m/s) * time

Power Supply

From Battery

Advantages:

- Ease of use
- Testing purposes

Disadvantages:

- Not an efficient method in the long run to implement the U-Park system
- Batteries alone would require much higher maintenance costs as the batteries reached the end of their life

From 120V AC

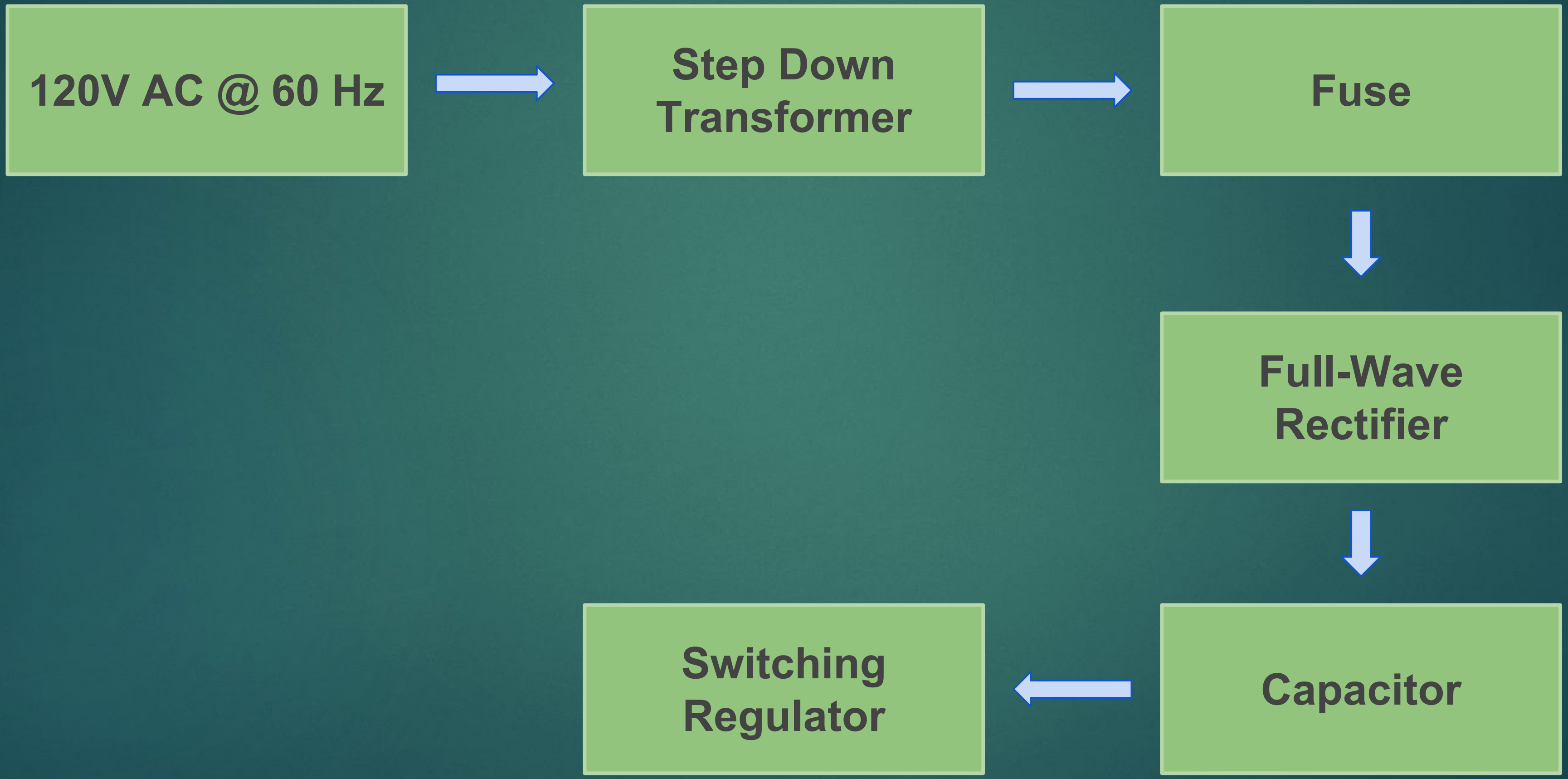
Advantages:

- Stable power supply
- Cheaper than batteries

Disadvantages:

- Whole system goes down if the power is out
- Have to use transformer and other components to step down voltage from AC to DC

AC to DC Block Diagram



120V AC @ 60 Hz

Step Down Transformer

Fuse

Full-Wave Rectifier

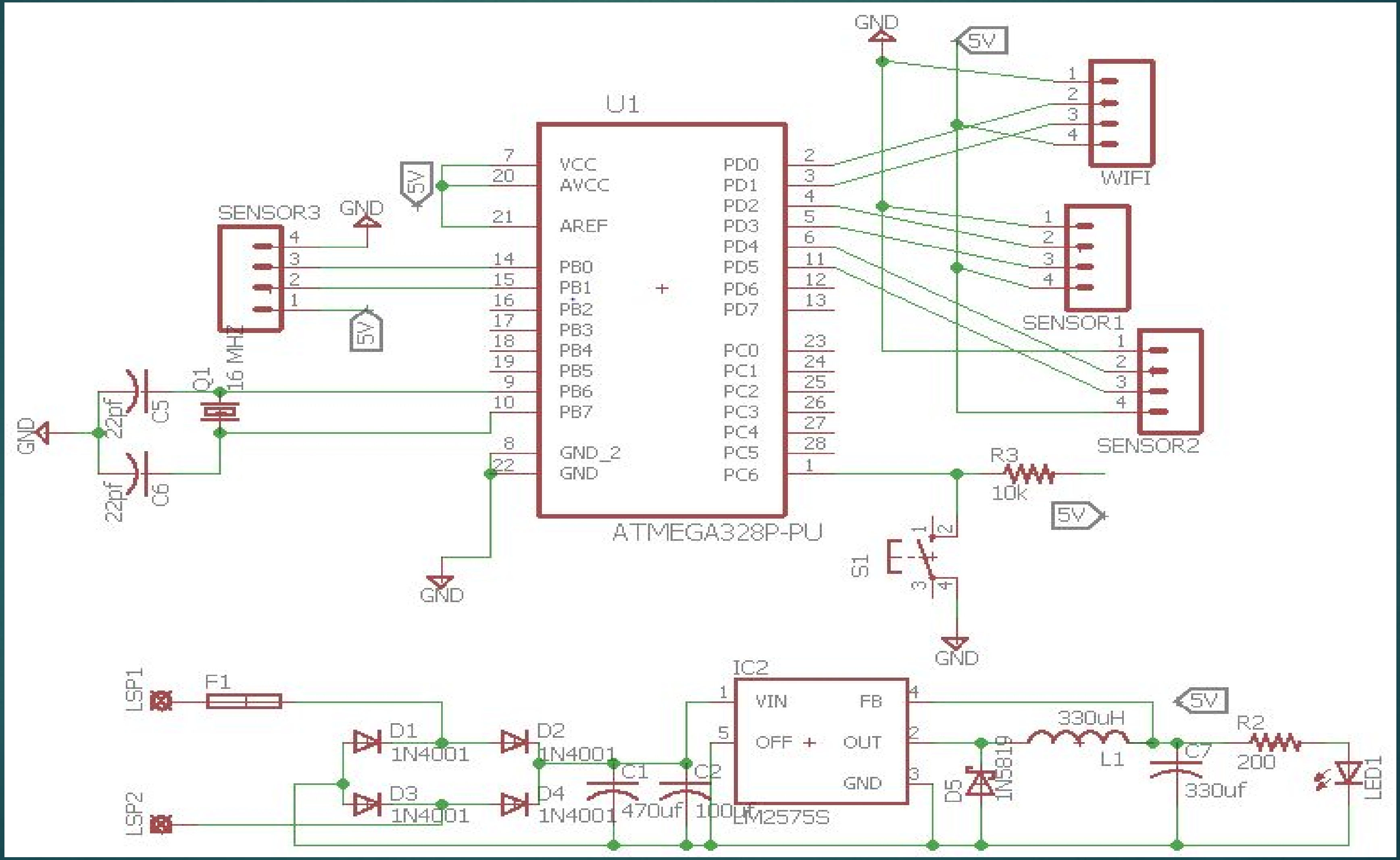
Capacitor

Switching Regulator

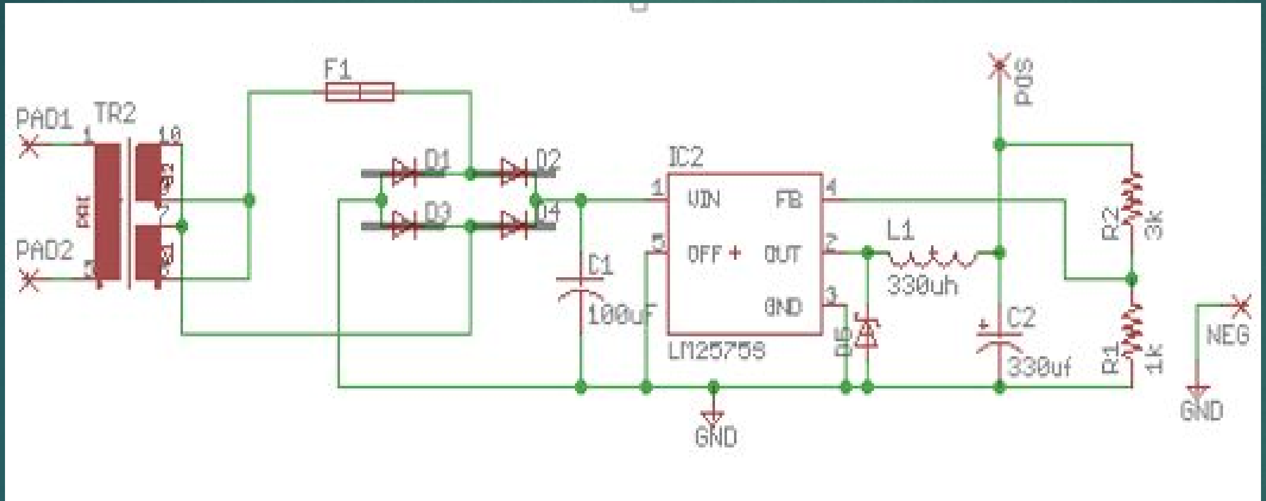
Voltage Regulator

	Linear	Switching
Function	Step down	Step up, step down, invert
Efficiency	Low to medium high if the different between input and output voltage is small	High
Waste Heat	High	Low
Complexity	Low, usually requiring only the regulator and low-value bypass capacitors	Medium to high, usually requiring inductor, diode, capacitor
Size	Small to medium in portable designs, but may be larger if heatsinking is needed	Larger than linear at low power, but smaller at power levels for which linear requires a heat sink
Total cost	Low	Medium
Ripple/Noise	Low; no ripple, low noise, better noise rejection	Medium to high, due to ripple at switching rate

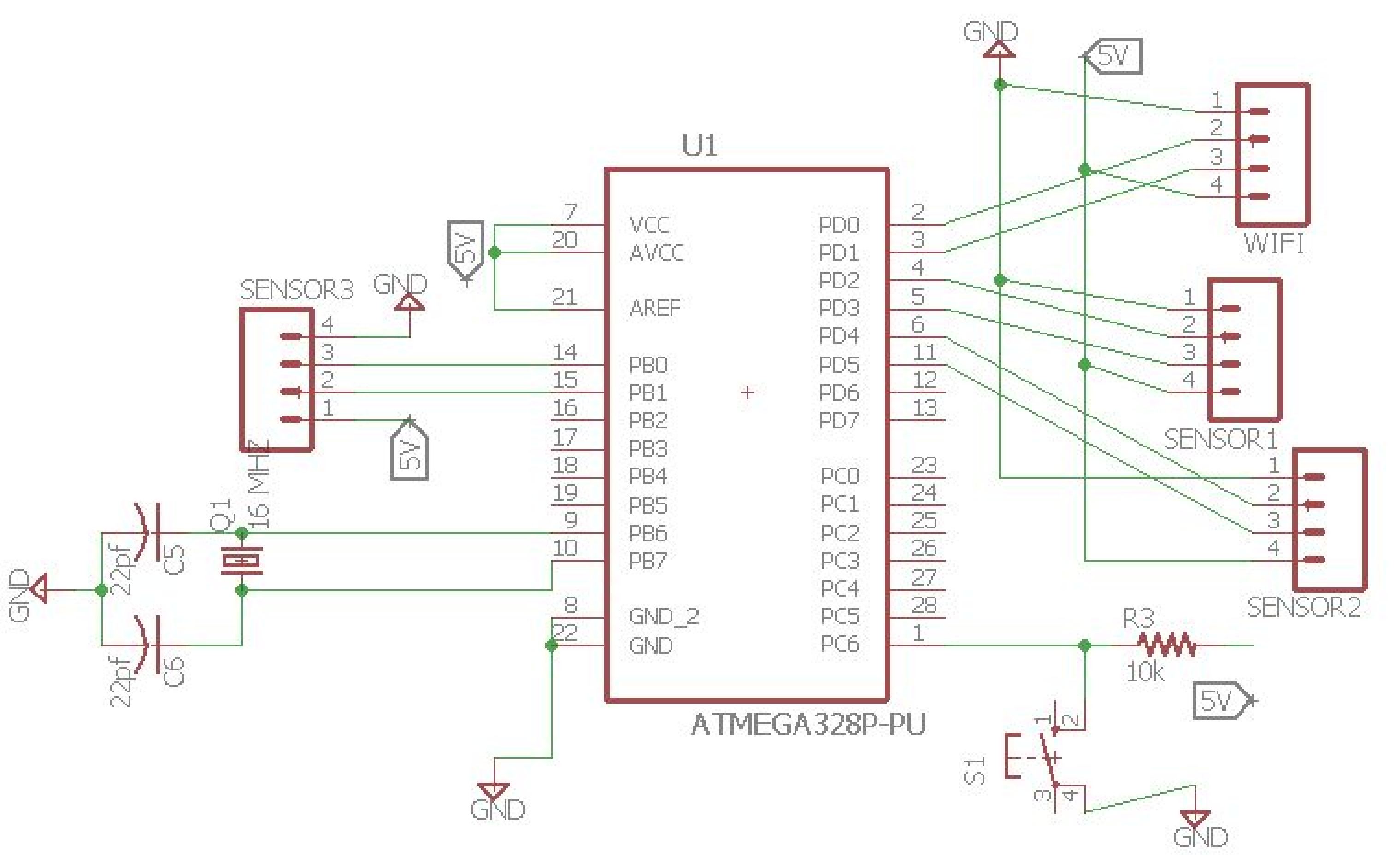
PCB Schematic



AC to DC Schematic



MCU Schematic



ESP8266 - WiFi Transceiver

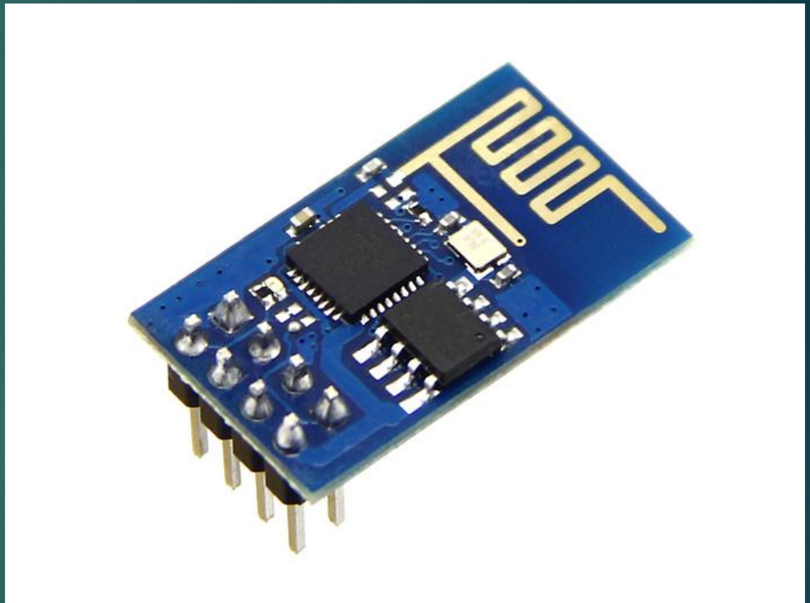
- WiFi Technology.
  - Adheres to IEEE standard 802.11 b/g/n.

- Inexpensive.
  - +/- $4.00 street price.

- Long range to connect.
  - Up to 366 meters (+/- 1,100 feet) using the PCB antenna.

- Easy to program.
  - Hayes Communications' AT Command set.

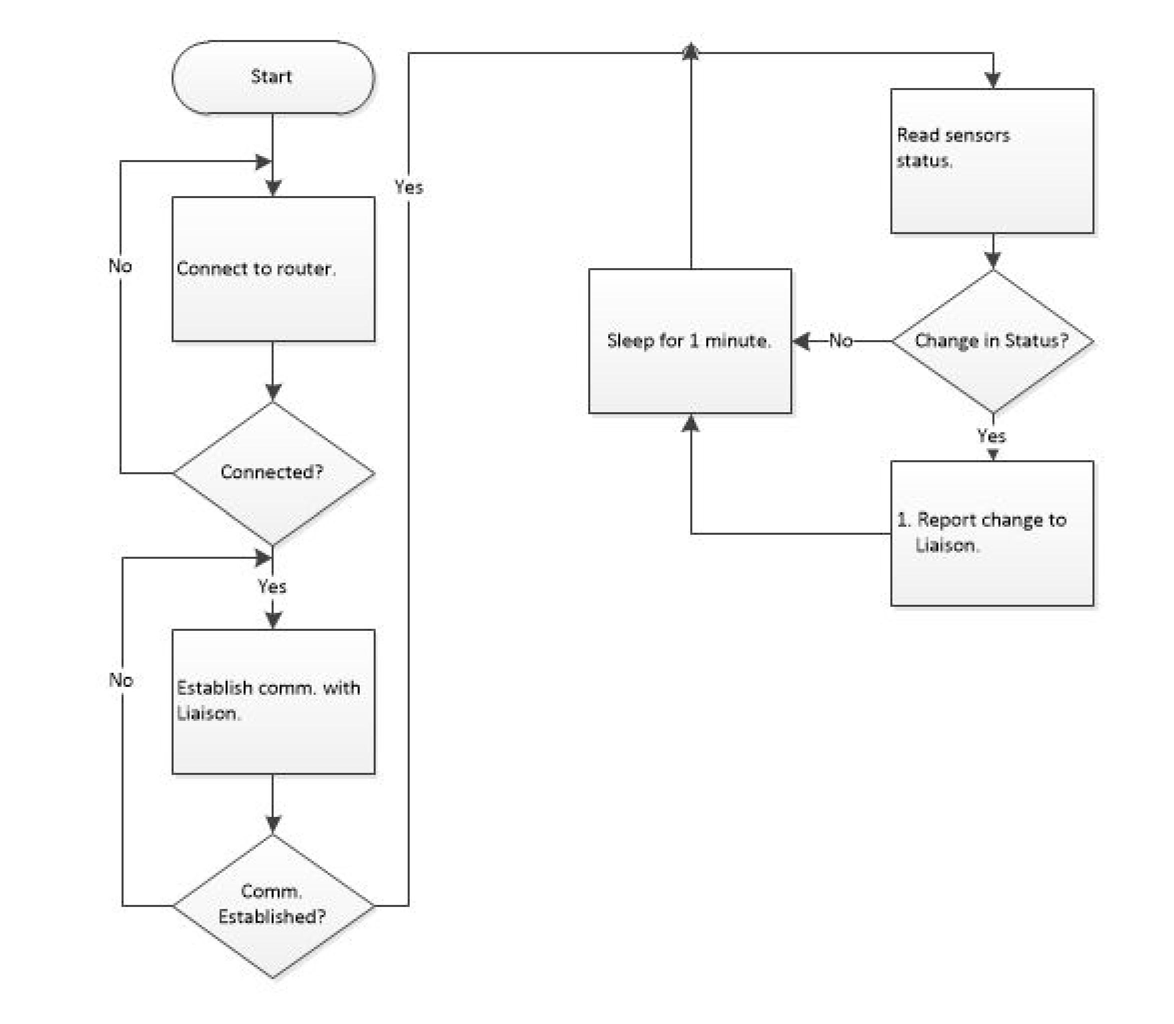
- Other features makes it the ideal communication module to incorporate in the U-Park board.
  - Reduced size.
  - No heat producing components.

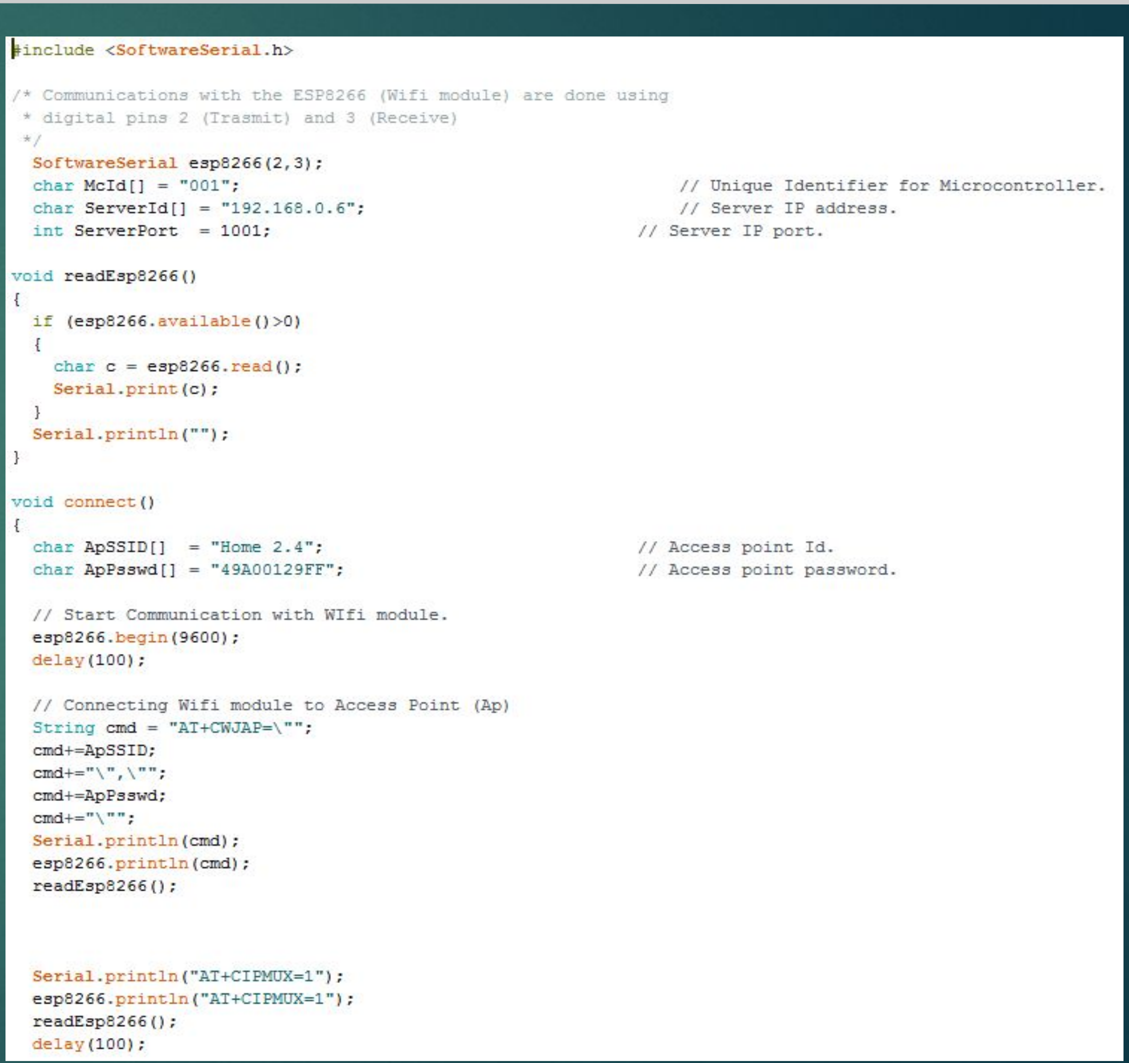


Software Details

- Module 1 (AVR-C) program running on the MCU's
  - TCP Client.
  - Check parking spots every 30 seconds.
  - Reports information to Liaison.
- SPOT (Visual Basic) running on the server
  - Updates MySQL DB Structure.
  - Monitors activities.
- Liaison (Visual Basic) running on the server
  - TCP Server.
  - Multi Thread.
  - Updates MySQL DB (Transactions).
- DB Triggers (MySQL script) running on server
  - Updates DB (Parking Availability).
- Mobile app (Website & Mobile App)
  - Provides updated information on UCF available parking spots.
  - How to get there.

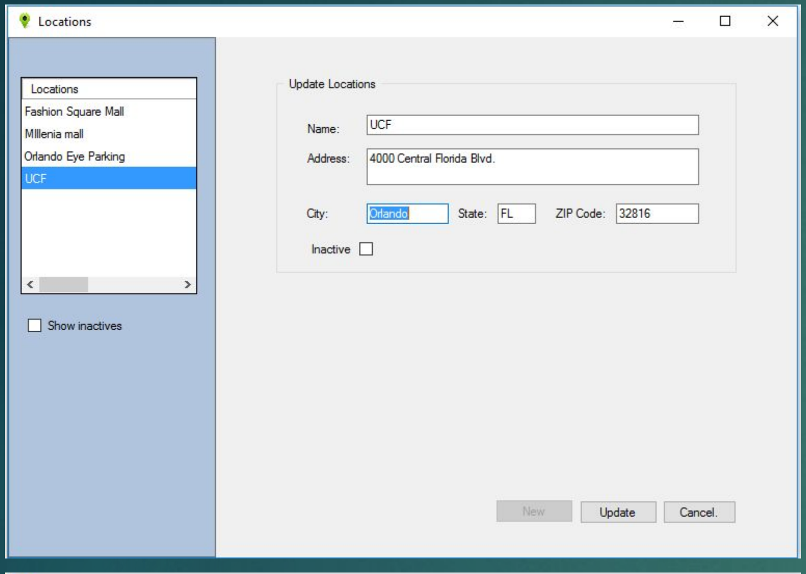
Software Details (Module 1)





```
#include <SoftwareSerial.h>

/* Communications with the ESP8266 (Wifi module) are done using
 * digital pins 2 (Trasmit) and 3 (Receive)
 */
  SoftwareSerial esp8266(2,3);
  char McId[] = "001";                                                 // Unique Identifier for Microcontroller.
  char ServerId[] = "192.168.0.6";                                     // Server IP address.
  int ServerPort  = 1001;                                            // Server IP port.

void readEsp8266()
{
  if (esp8266.available()>0)
  {
    char c = esp8266.read();
    Serial.print(c);
  }
  Serial.println("");
}

void connect()
{
  char ApSSID[]  = "Home 2.4";                                       // Access point Id.
  char ApPsswd[] = "49A00129FF";                                     // Access point password.

  // Start Communication with WIfi module.
  esp8266.begin(9600);
  delay(100);

  // Connecting Wifi module to Access Point (Ap)
  String cmd = "AT+CWJAP=\"";
  cmd+=ApSSID;
  cmd+="\",\"";
  cmd+=ApPsswd;
  cmd+="\"";
  Serial.println(cmd);
  esp8266.println(cmd);
  readEsp8266();



  Serial.println("AT+CIPMUX=1");
  esp8266.println("AT+CIPMUX=1");
  readEsp8266();
  delay(100);
```

Software Details (Spot)

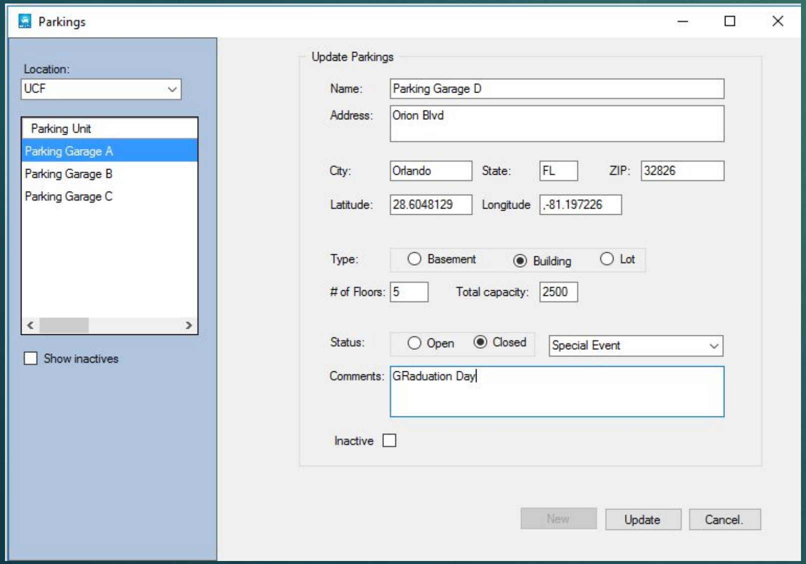


Locations
- Fashion Square Mall
- Mllenia mall
- Orlando Eye Parking
- UCF

□ Show inactives

Update Locations

Name: UCF
Address: 4000 Central Florida Blvd.
City: Orlando State: FL ZIP Code: 32816
Inactive □



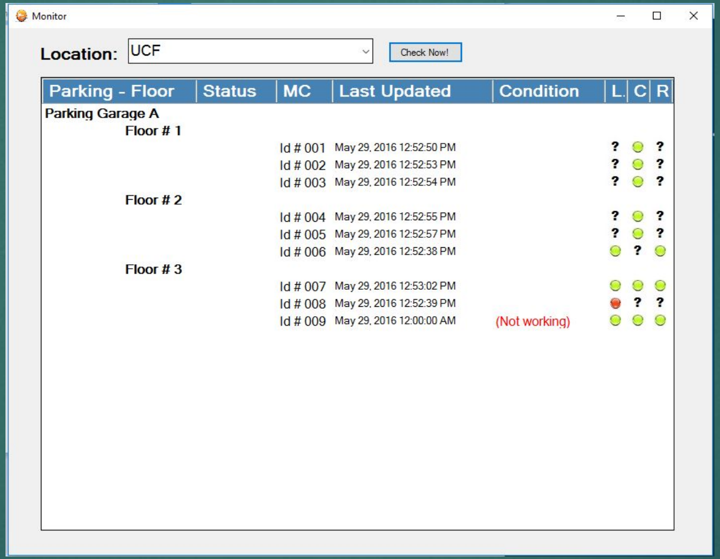
Location: UCF

Parking Unit
- Parking Garage A
- Parking Garage B
- Parking Garage C

□ Show inactives

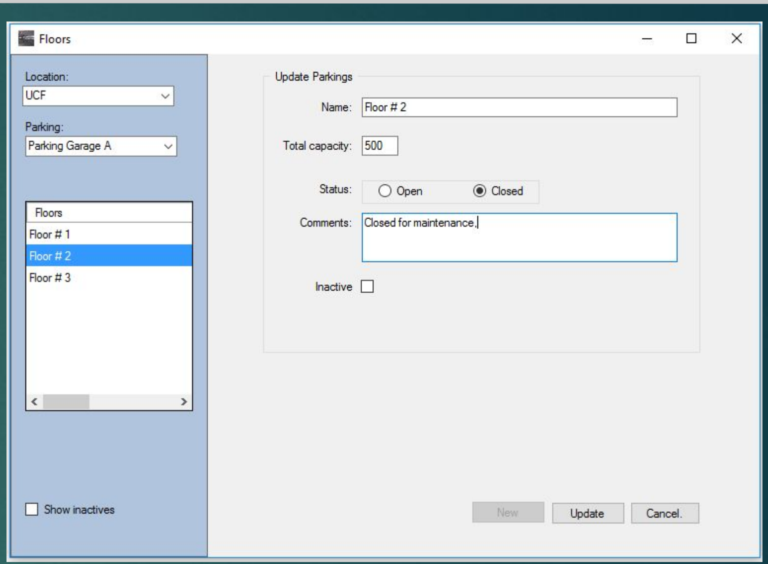
Update Parkings

Name: Parking Garage D
Address: Orion Blvd
City: Orlando State: FL ZIP: 32826
Latitude: 28.6048129 Longitude -81.197226
Type: ○ Basement ● Building ○ Lot
# of Floors: 5 Total capacity: 2500
Status: ○ Open ● Closed Special Event
Comments: GRaduation Day
Inactive □



Location: UCF

Parking - Floor	Status	MC	Last Updated	Condition	L.	C	R
Parking Garage A							
Floor # 1							
		Id # 001	May 29, 2016 12:52:50 PM		?	●	?
		Id # 002	May 29, 2016 12:52:53 PM		?	●	?
		Id # 003	May 29, 2016 12:52:54 PM		?	●	?
Floor # 2							
		Id # 004	May 29, 2016 12:52:55 PM		?	●	?
		Id # 005	May 29, 2016 12:52:57 PM		?	●	?
		Id # 006	May 29, 2016 12:52:38 PM		●	?	●
Floor # 3							
		Id # 007	May 29, 2016 12:53:02 PM		●	●	●
		Id # 008	May 29, 2016 12:52:39 PM		🔴	?	?
		Id # 009	May 29, 2016 12:00:00 AM	(Not working)	●	●	●



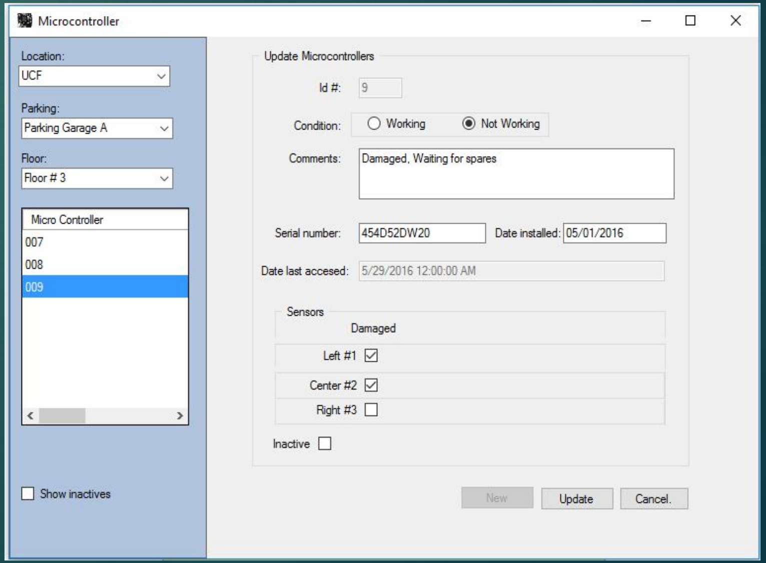
Location: UCF
Parking: Parking Garage A

Floors
- Floor # 1
- Floor # 2
- Floor # 3

□ Show inactives

Update Parkings

Name: Floor # 2
Total capacity: 500
Status: ○ Open ● Closed
Comments: Closed for maintenance.
Inactive □



Location: UCF
Parking: Parking Garage A
Floor: Floor # 3

Micro Controller
- 007
- 008
- 009

□ Show inactives

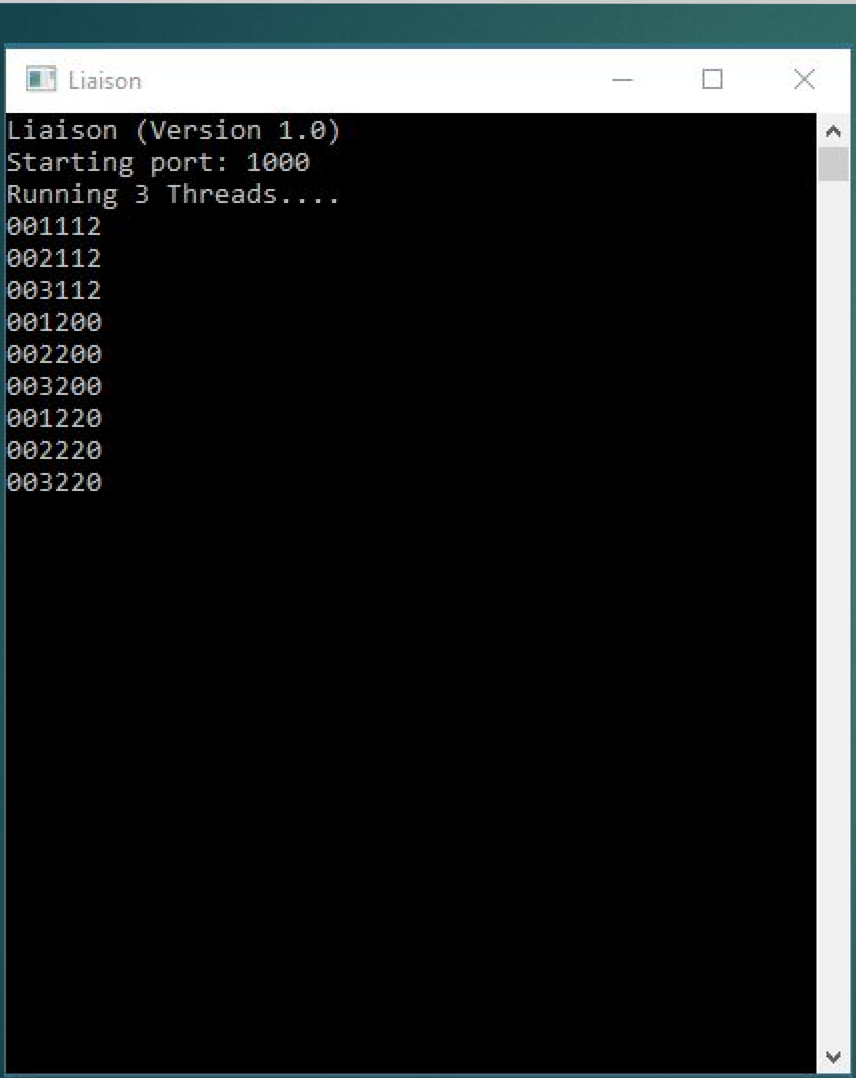
Update Microcontrollers

Id #: 9
Condition: ○ Working ● Not Working
Comments: Damaged, Waiting for spares
Serial number: 454D52DW20 Date installed: 05/01/2016
Date last accesed: 5/29/2016 12:00:00 AM

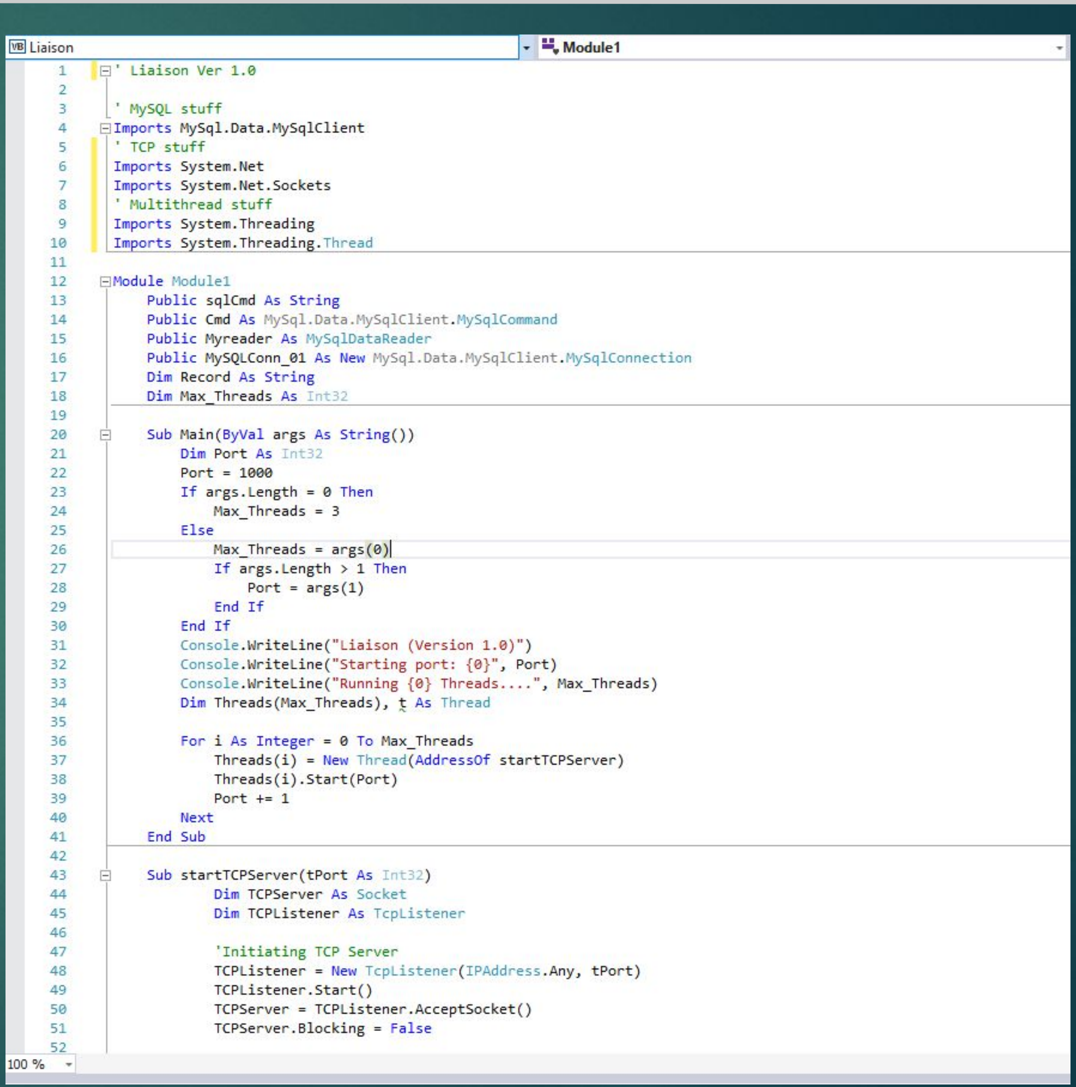
Sensors
Damaged
Left #1 ☑
Center #2 ☑
Right #3 □

Inactive □

Software Details (Liaison)

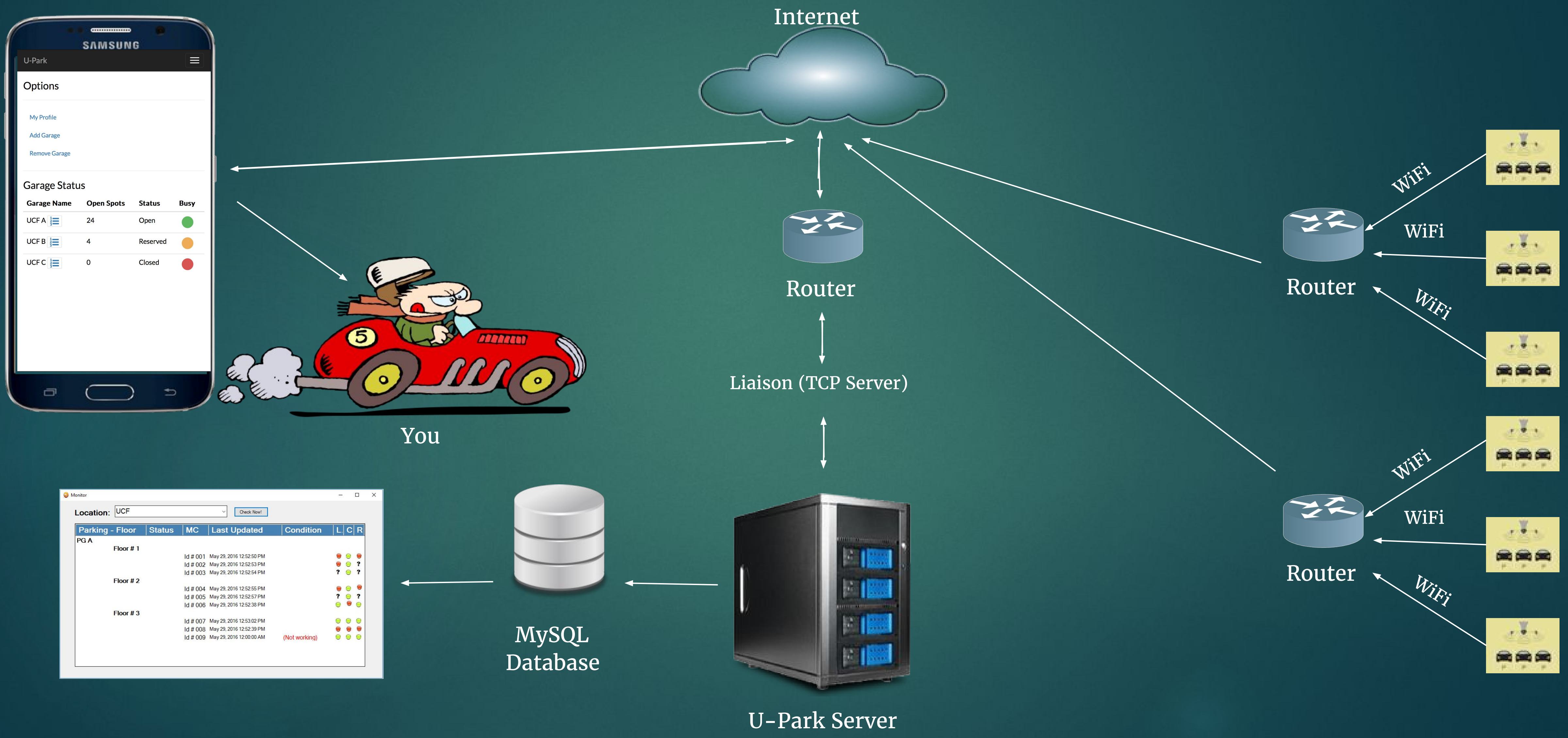


```
Liaison (Version 1.0)
Starting port: 1000
Running 3 Threads....
001112
002112
003112
001200
002200
003200
001220
002220
003220
```



```
' Liaison Ver 1.0

' MySQL stuff
Imports MySql.Data.MySqlClient
' TCP stuff
Imports System.Net
Imports System.Net.Sockets
' Multithread stuff
Imports System.Threading
Imports System.Threading.Thread

Module Module1
    Public sqlCmd As String
    Public Cmd As MySql.Data.MySqlClient.MySqlCommand
    Public Myreader As MySqlDataReader
    Public MySQLConn_01 As New MySql.Data.MySqlClient.MySqlConnection
    Dim Record As String
    Dim Max_Threads As Int32

    Sub Main(ByVal args As String())
        Dim Port As Int32
        Port = 1000
        If args.Length = 0 Then
            Max_Threads = 3
        Else
            Max_Threads = args(0)
            If args.Length > 1 Then
                Port = args(1)
            End If
        End If
        Console.WriteLine("Liaison (Version 1.0)")
        Console.WriteLine("Starting port: {0}", Port)
        Console.WriteLine("Running {0} Threads....", Max_Threads)
        Dim Threads(Max_Threads), t As Thread

        For i As Integer = 0 To Max_Threads
            Threads(i) = New Thread(AddressOf startTCPServer)
            Threads(i).Start(Port)
            Port += 1
        Next
    End Sub

    Sub startTCPServer(tPort As Int32)
            Dim TCPServer As Socket
            Dim TCPListener As TcpListener

            'Initiating TCP Server
            TCPListener = New TcpListener(IPAddress.Any, tPort)
            TCPListener.Start()
            TCPServer = TCPListener.AcceptSocket()
            TCPServer.Blocking = False

```

System Diagram



U-Park

Options

My Profile

Add Garage

Remove Garage

Garage Status

Garage Name	Open Spots	Status	Busy
UCF A	24	Open	●
UCF B	4	Reserved	●
UCF C	0	Closed	●

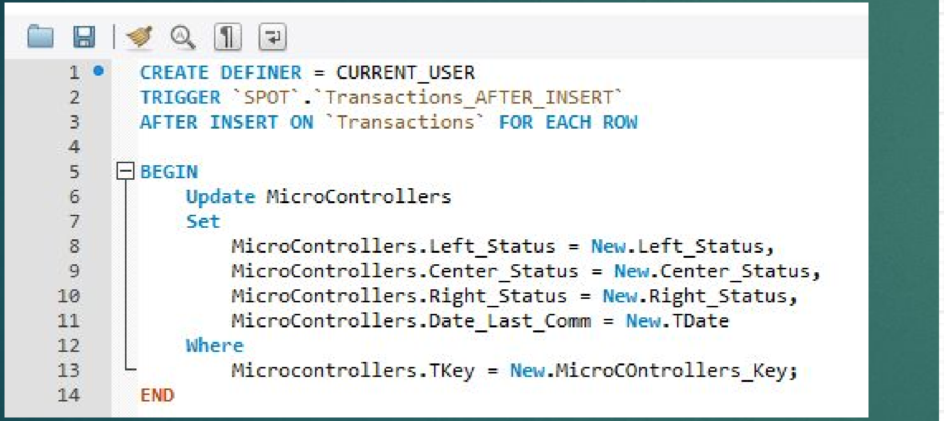
Monitor

Location: UCF

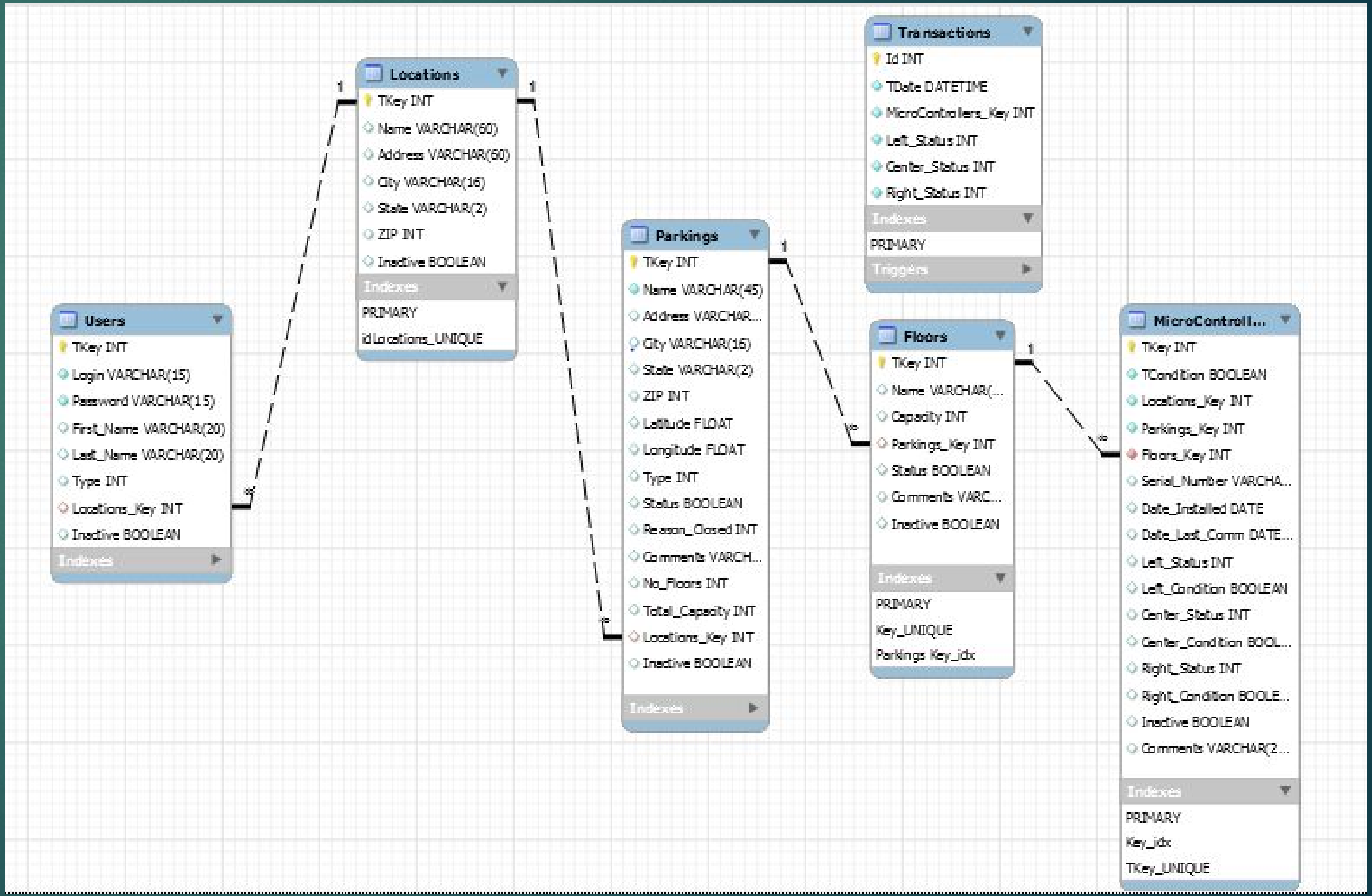
Check Now!

Parking - Floor	Status	MC	Last Updated	Condition	L	C	R
PG A							
Floor # 1							
		Id # 001	May 29, 2016 12:52:50 PM		●	●	●
		Id # 002	May 29, 2016 12:52:53 PM		●	●	?
		Id # 003	May 29, 2016 12:52:54 PM		?	●	?
Floor # 2							
		Id # 004	May 29, 2016 12:52:55 PM		●	●	●
		Id # 005	May 29, 2016 12:52:57 PM		?	●	?
		Id # 006	May 29, 2016 12:52:38 PM		●	●	●
Floor # 3							
		Id # 007	May 29, 2016 12:53:02 PM		●	●	●
		Id # 008	May 29, 2016 12:52:39 PM		●	●	●
		Id # 009	May 29, 2016 12:00:00 AM	(Not working)	●	●	●

Software Details (MySQL Script)



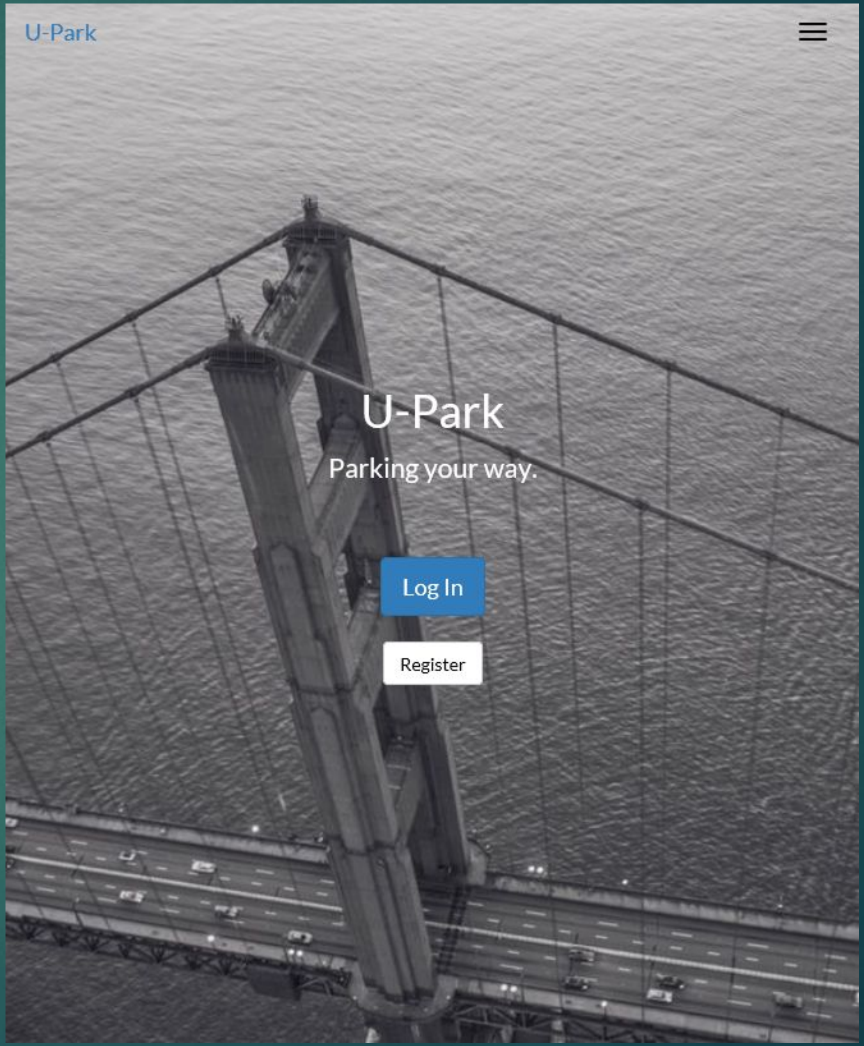
```sql
CREATE DEFINER = CURRENT_USER
TRIGGER `SPOT`.`Transactions_AFTER_INSERT`
AFTER INSERT ON `Transactions` FOR EACH ROW

BEGIN
    Update MicroControllers
    Set
        MicroControllers.Left_Status = New.Left_Status,
        MicroControllers.Center_Status = New.Center_Status,
        MicroControllers.Right_Status = New.Right_Status,
        MicroControllers.Date_Last_Comm = New.TDate
    Where
        Microcontrollers.TKey = New.MicroCOntrollers_Key;
END
```



User Interface

- Overview
  - Where users will interface with the system
  - Register and log in
  - Quick access to parking information
    - Safety
    - Convenience

- Interface Types
  - Administrator
  - Standard User

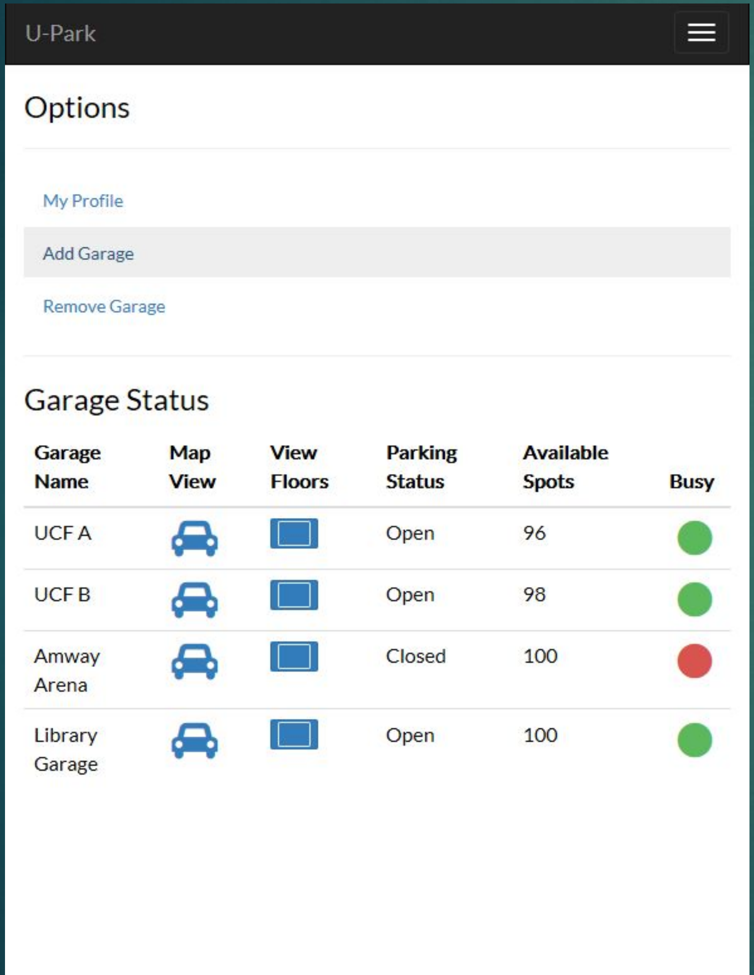


User Interface

- Software Details
  - HTML and Bootstrap CSS
    - Built front facing web application
    - Scalable to any size screen
  - PHP
    - Scripting for database access
  - Javascript
    - Table refresh
    - Event Messages

- Development Tools
  - NetBeans
    - HTML and Bootstrap
  - Eclipse
    - PHP and Javascript
  - XAMMP
    - Website and database test environment

User Interface



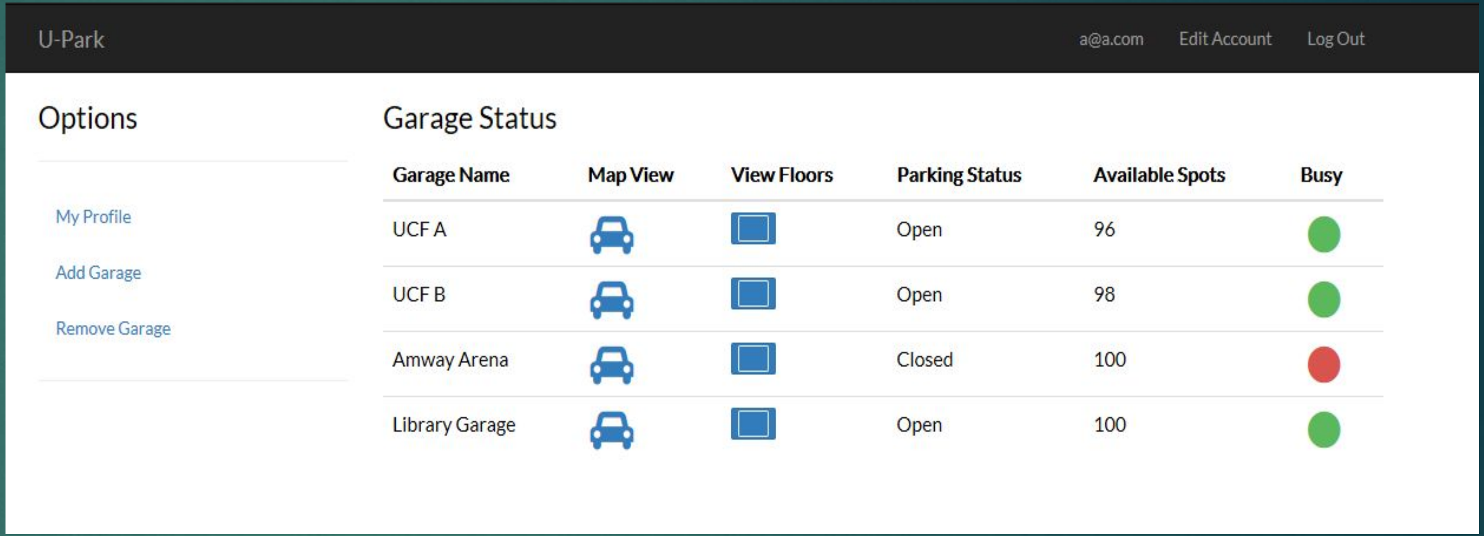
U-Park

Options

- My Profile
- Add Garage
- Remove Garage

Garage Status

Garage Name	Map View	View Floors	Parking Status	Available Spots	Busy
UCF A	🚗	🟦	Open	96	🟢
UCF B	🚗	🟦	Open	98	🟢
Amway Arena	🚗	🟦	Closed	100	🔴
Library Garage	🚗	🟦	Open	100	🟢



U-Park

a@a.com Edit Account Log Out

Options

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Garage Status

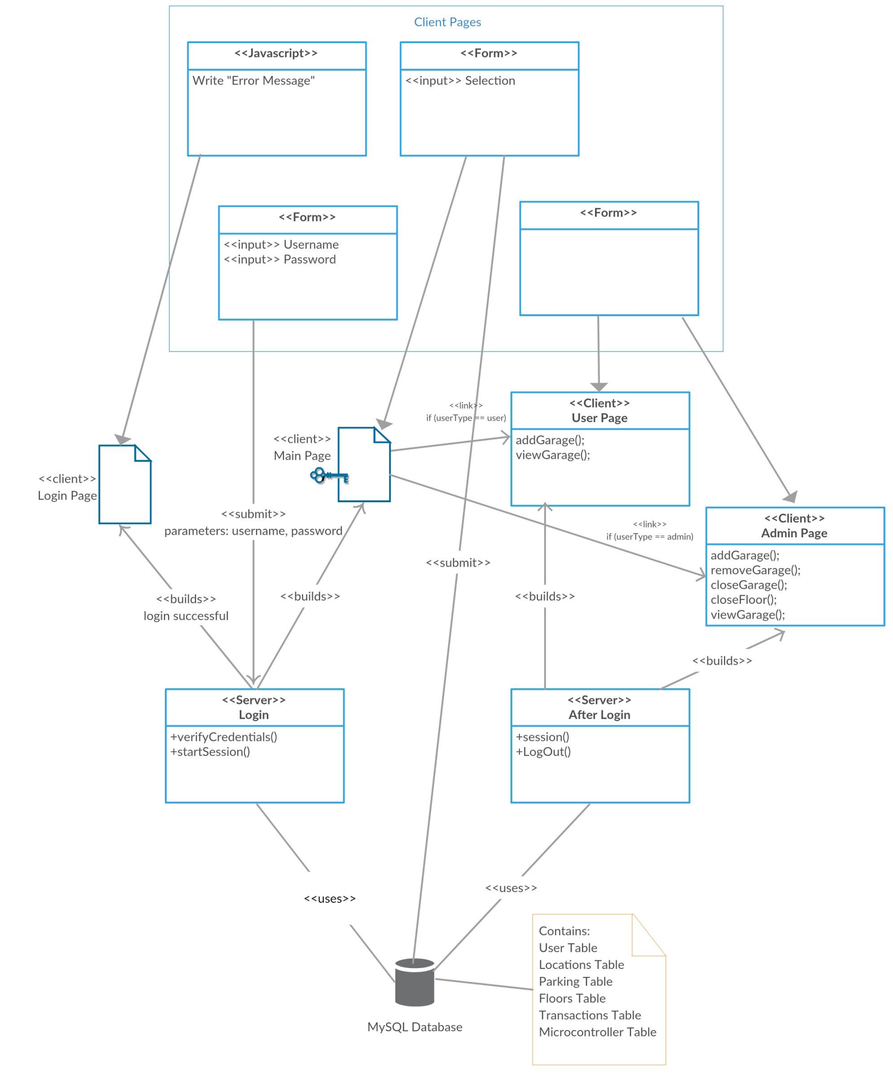
Garage Name	Map View	View Floors	Parking Status	Available Spots	Busy
UCF A	🚗	🟦	Open	96	🟢
UCF B	🚗	🟦	Open	98	🟢
Amway Arena	🚗	🟦	Closed	100	🔴
Library Garage	🚗	🟦	Open	100	🟢

- Bootstrap allows for scalability and Clean-looking UI elements

User Interface

- Registration Process
    - Create username and password
    - Check for validity
    - Input to user database with password encrypted using Sha256

- Login Process
    - Enter username and password
    - Send encrypted values to database to confirm validity



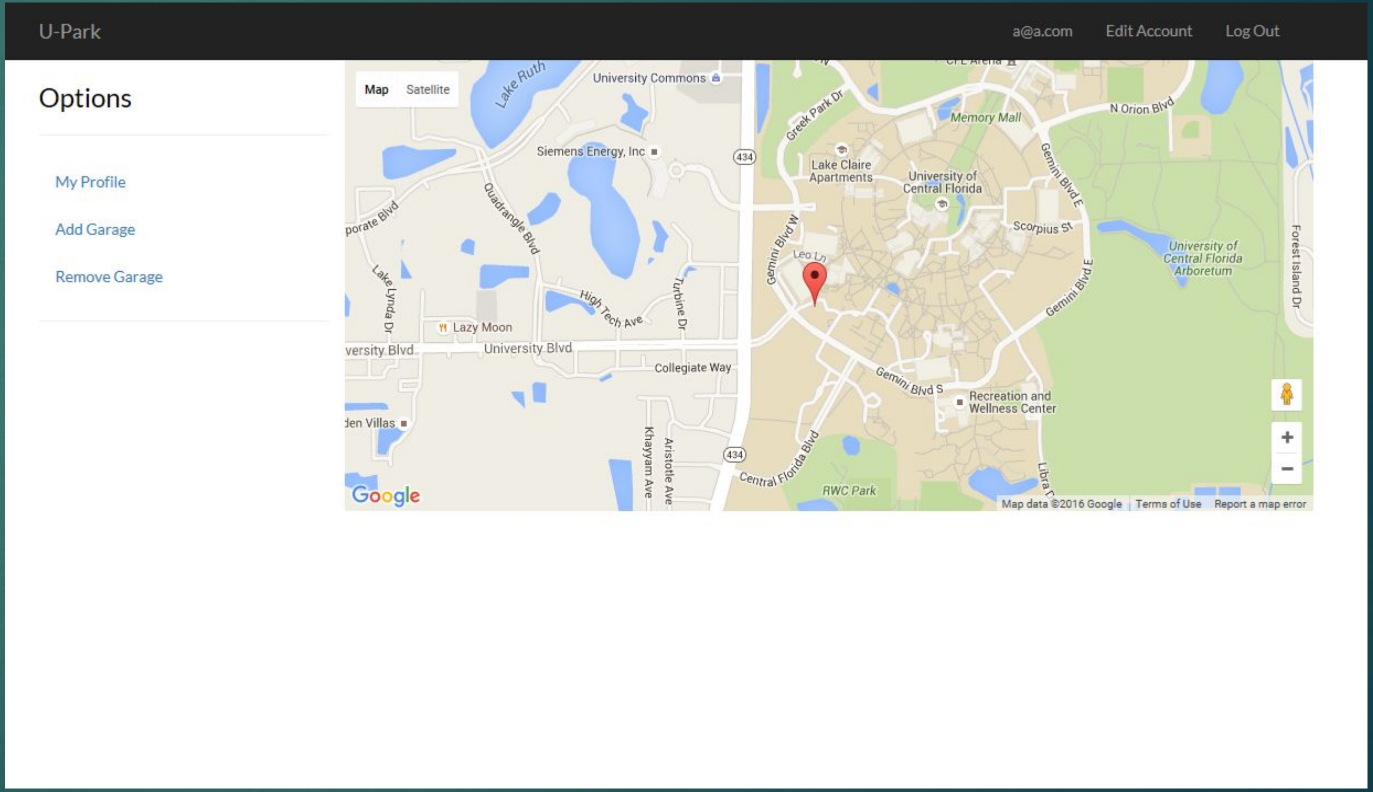
User Interface

- Standard User Interface
  - User selects garages to monitor
  - Table is built with parking levels from database
  - User can click on specific garage to see levels on each floor

- Administrator Interface
  - Used by garage owners or custodians
  - Have ability to mark garage as closed or reserved
  - Can do this for individual floors

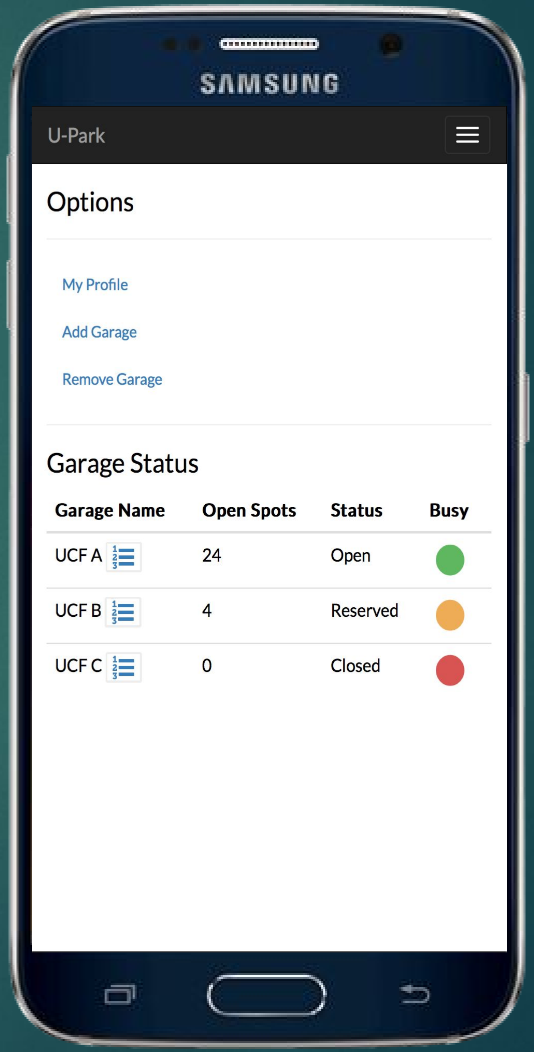
Map View

- Users can view garage location on Google Maps
  - Admins input latitude and longitude
  - Uses Google API to show garage location
- Once user has chosen a garage, they can identify the location on Google Maps



Mobile Application

- Quick access to all functions of web application
- Scaled to be viewed on smaller screen
- Built with speed and safety in mind



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Garage Status

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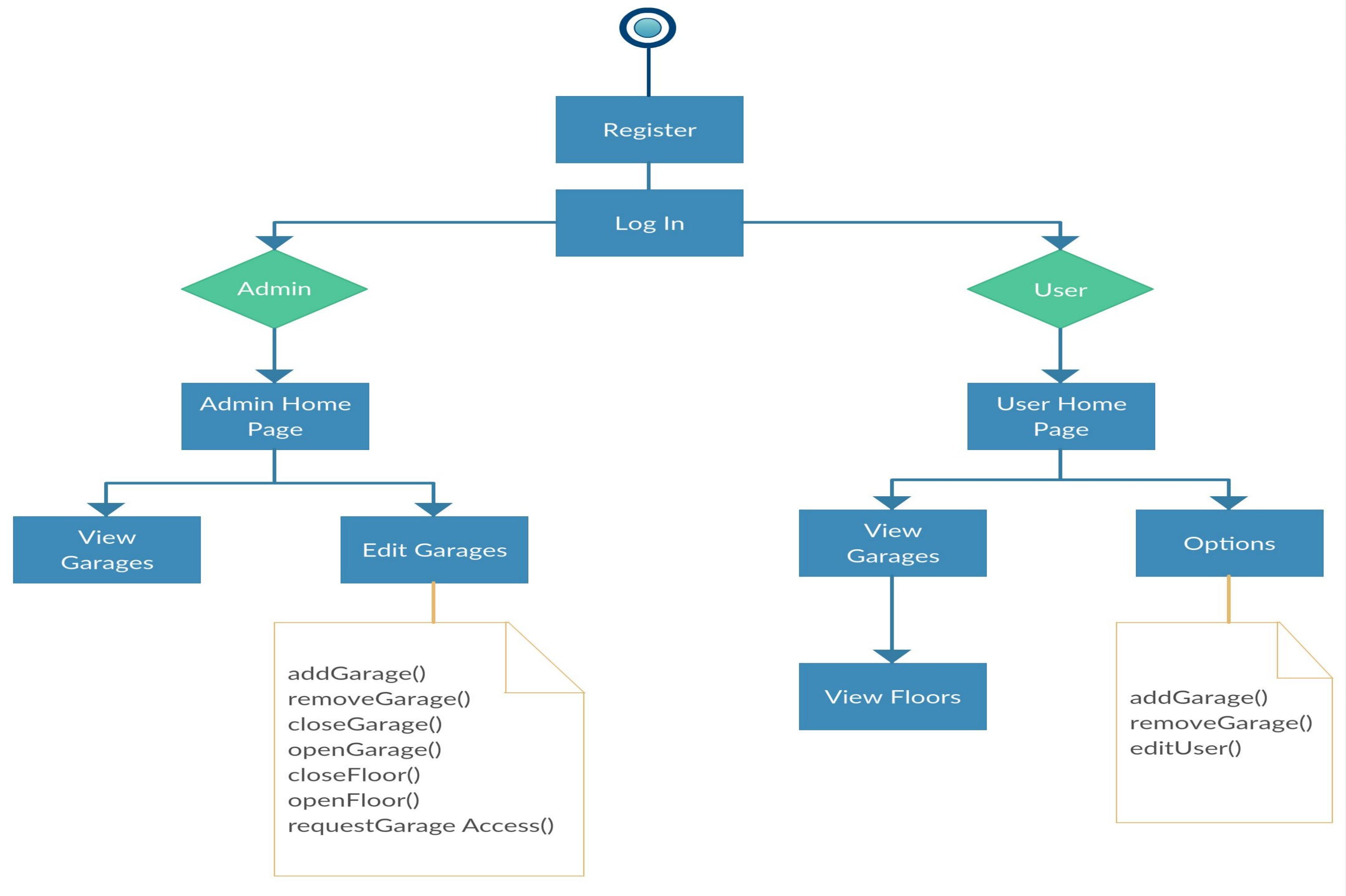
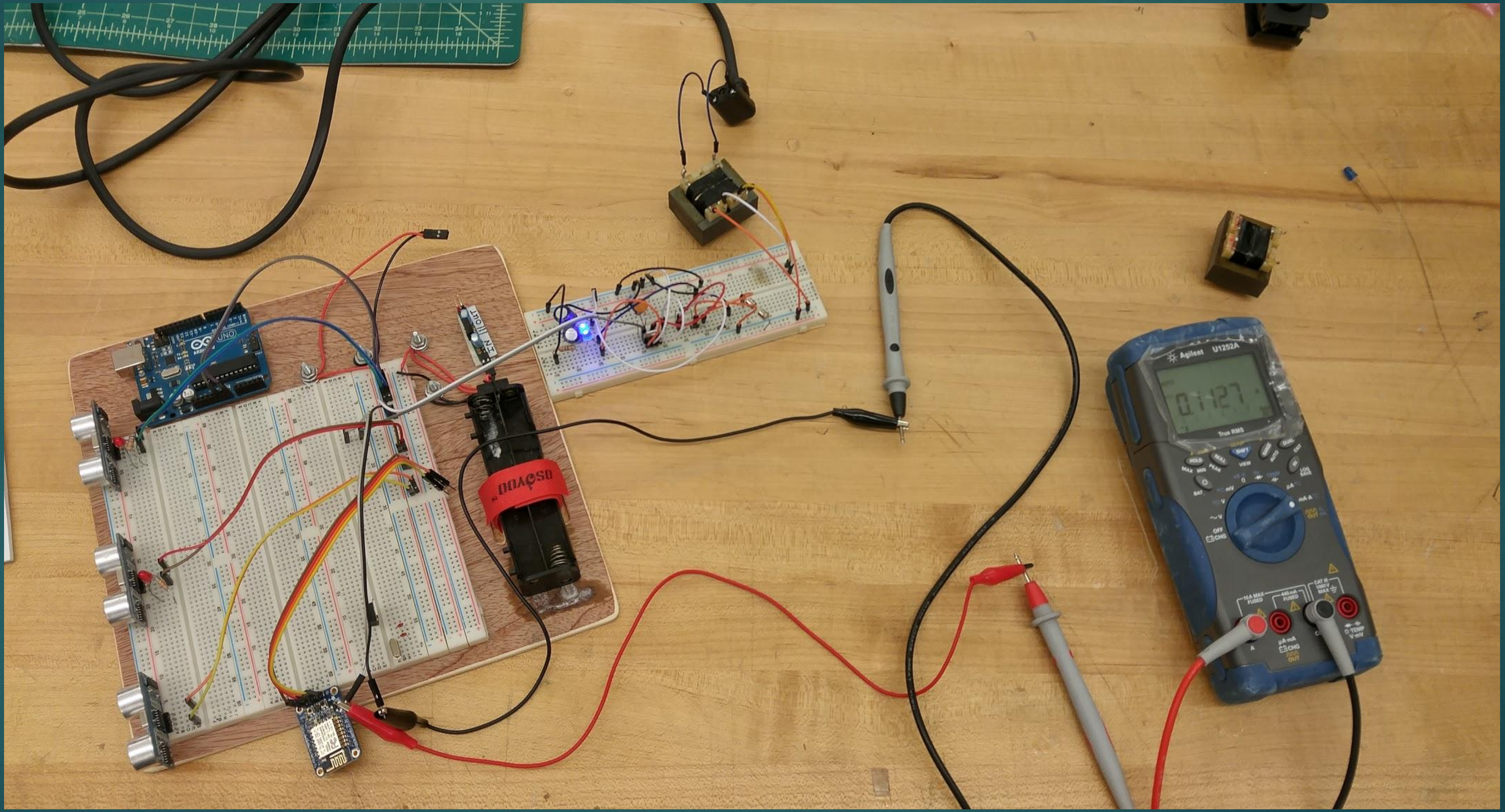
UCF B	4	Reserved	🟠
UCF C	0	Closed	🔴

User Interface



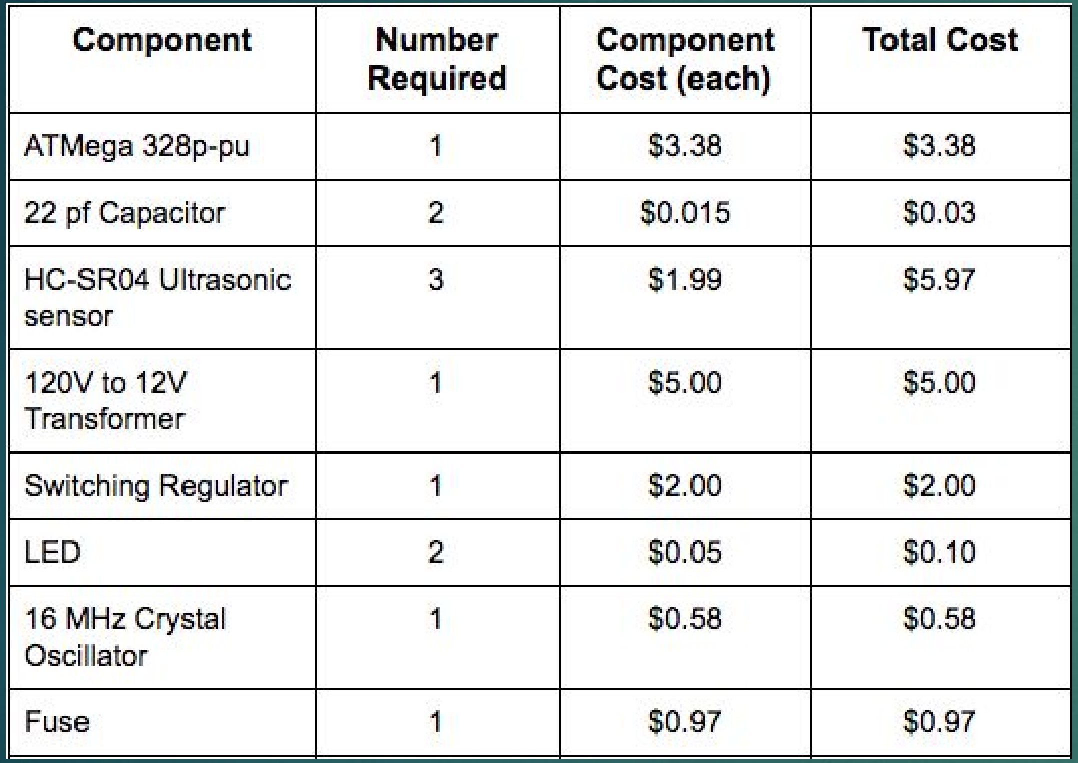
Prototype



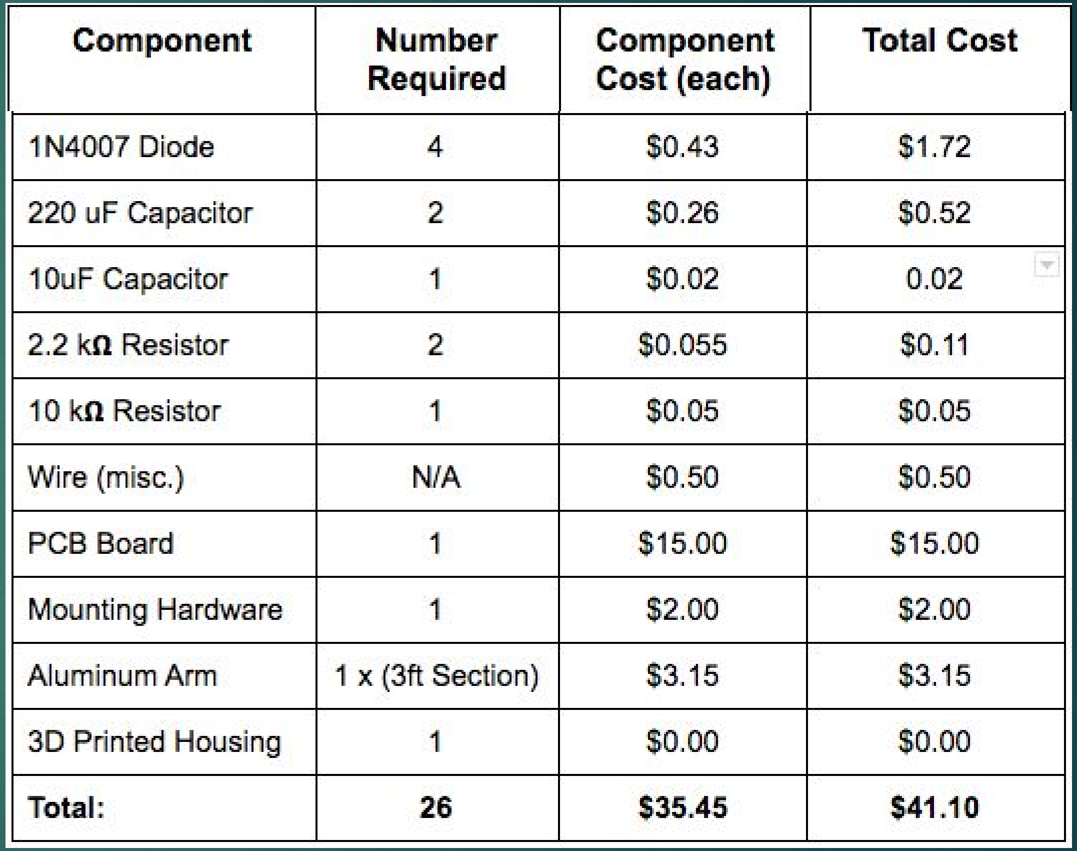
Budget and Financing

- The project is being self-funded by the team
- Specification was to come in under $50.00 per module
- Competitors products are no less than $100

Budget and Financing (cont’d)

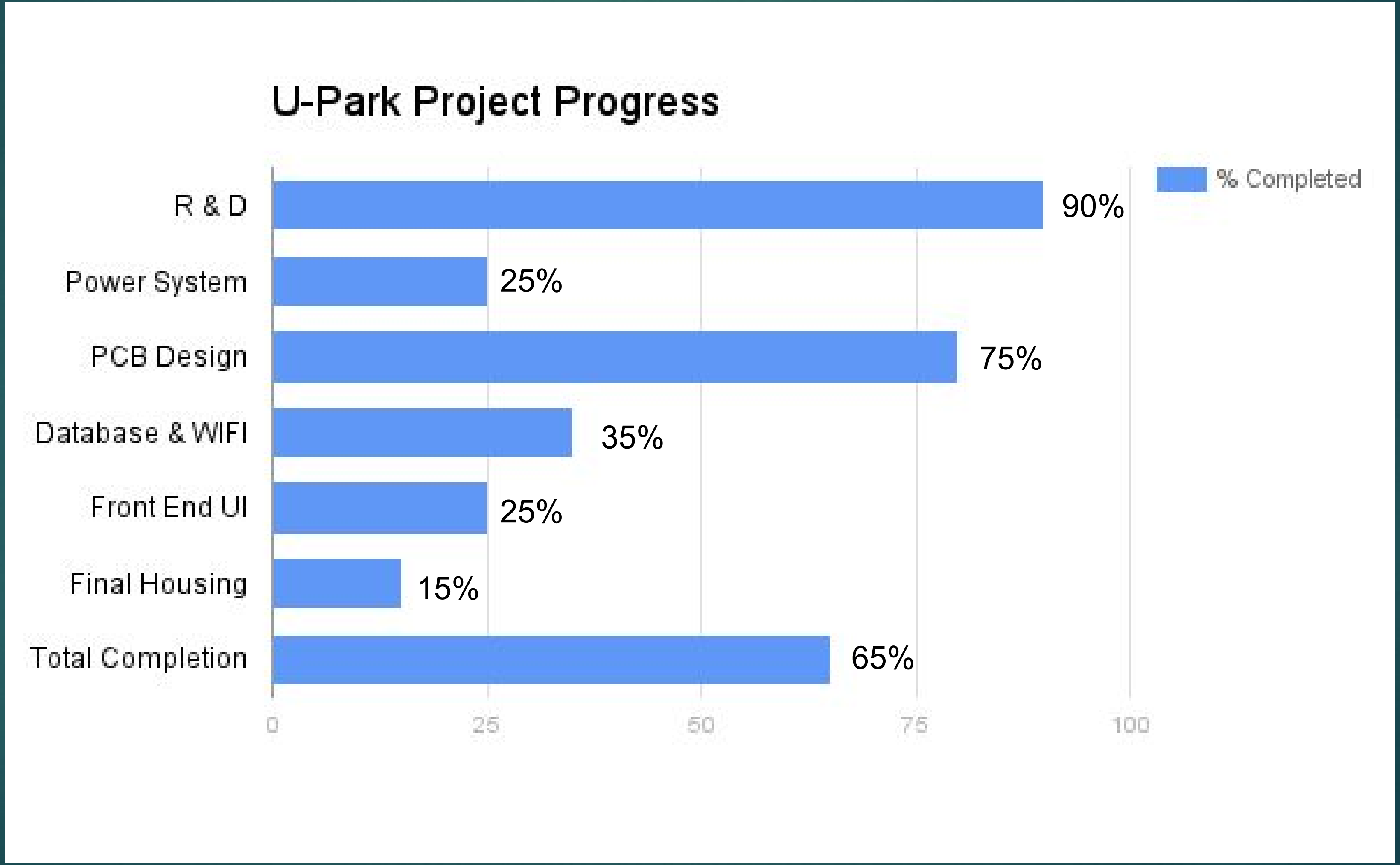


Component	Number Required	Component Cost (each)	Total Cost
ATMega 328p-pu	1	$3.38	$3.38
22 pf Capacitor	2	$0.015	$0.03
HC-SR04 Ultrasonic sensor	3	$1.99	$5.97
120V to 12V Transformer	1	$5.00	$5.00
Switching Regulator	1	$2.00	$2.00
LED	2	$0.05	$0.10
16 MHz Crystal Oscillator	1	$0.58	$0.58
Fuse	1	$0.97	$0.97



Component	Number Required	Component Cost (each)	Total Cost
1N4007 Diode	4	$0.43	$1.72
220 uF Capacitor	2	$0.26	$0.52
10uF Capacitor	1	$0.02	0.02
2.2 kΩ Resistor	2	$0.055	$0.11
10 kΩ Resistor	1	$0.05	$0.05
Wire (misc.)	N/A	$0.50	$0.50
PCB Board	1	$15.00	$15.00
Mounting Hardware	1	$2.00	$2.00
Aluminum Arm	1 x (3ft Section)	$3.15	$3.15
3D Printed Housing	1	$0.00	$0.00
Total:	**26**	**$35.45**	**$41.10**

Project Progress



Questions ?