# Sdmay19-14 Wireless Recharging System

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Advisor: Craig Rupp, Andrew Bolstad

Client : National Carwash Solutions (NCS)

Website : http://sdmay19-14.sd.ece.iastate.edu

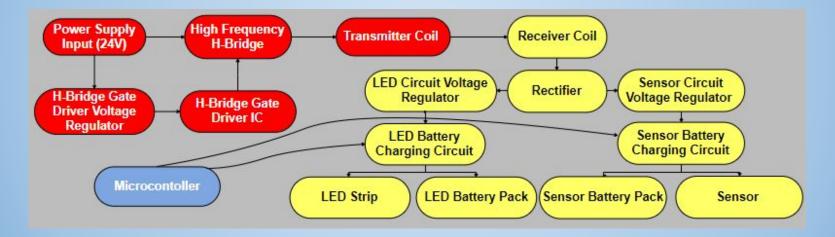


### **Problem Statement**

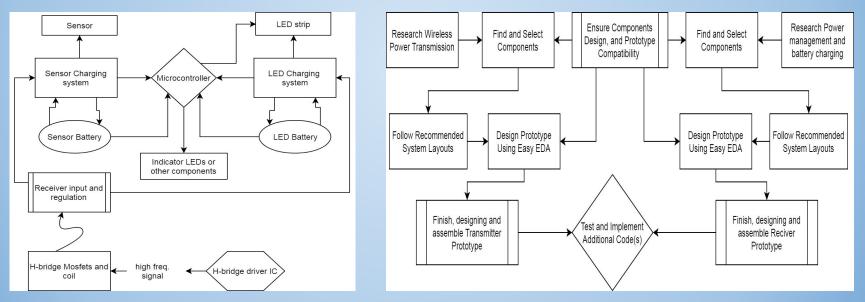
National Carwash Solutions has a sensor on a car wash arm that is powered by a set of batteries . Currently, the batteries are not rechargeable and they have proposed to employ a wireless charging system. The sensor cannot be powered using a wired connection due to the car wash arm being able to rotate completely around a base point. To avoid entangling electrical power cables, a wireless charging system is the most viable option to provide constant power for the sensor.



## **Concept Diagram**



## **System Design Integration**



System's Integration Diagram

System's Development Diagram

## Functional / Non - Functional Requirements

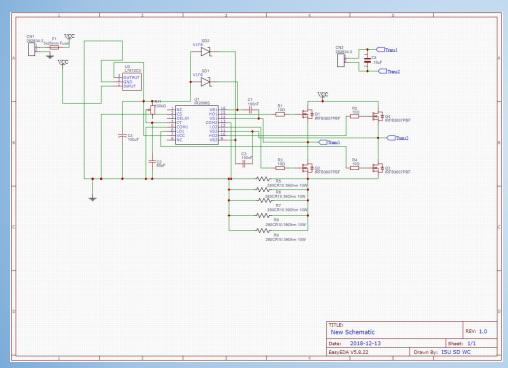
#### **Functional requirements**

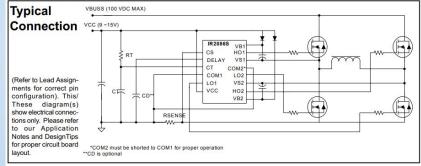
- Transmit power wirelessly through the air
- Provide a stable 3v/100mA supply for sensor load
- Provide a stable 12v/1A supply for an LED strip
- Seperate Battery Charging systems for both LED and sensor loads
- Monitor the system(s) with an onboard microcontroller

#### **Non-functional requirements**

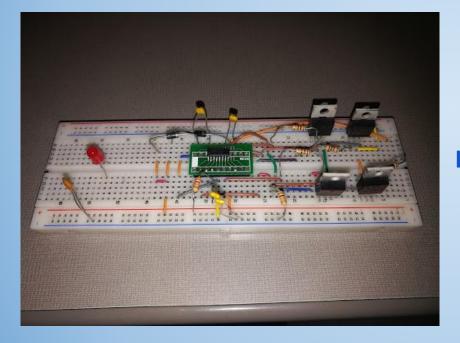
- Environmentally protecting device(s) against water and heat
- Alerting the user in case of critical battery or system state
- Having a long battery back lifespan
- Allowing options in the future for expansion and development

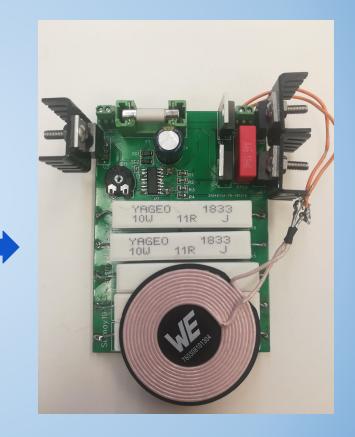
### **Transmitter Design**



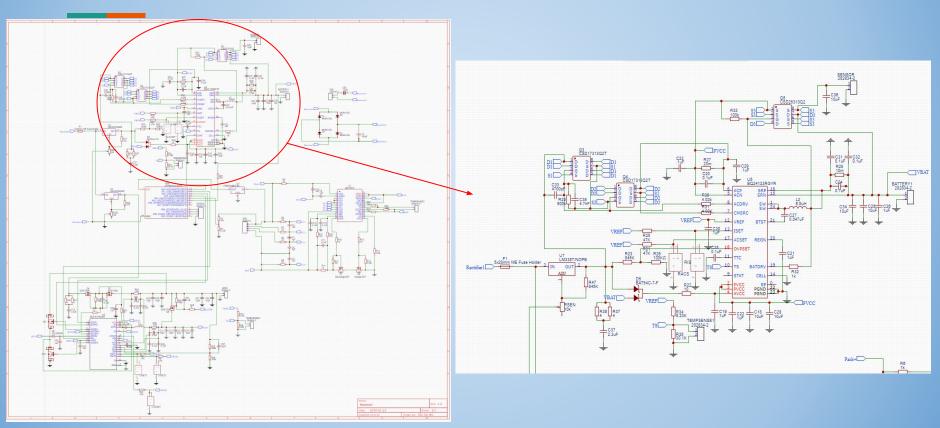


## **Transmitter Design**

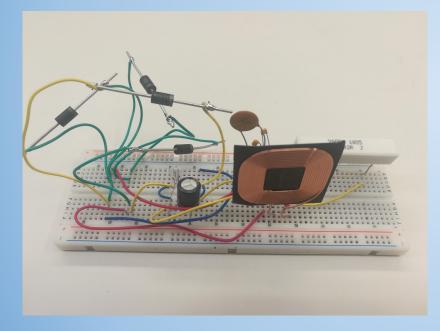




## **Receiver Design**



## **Receiver Design**





## Microcontroller

Monitors the power systems of the receiver battery packs so that:

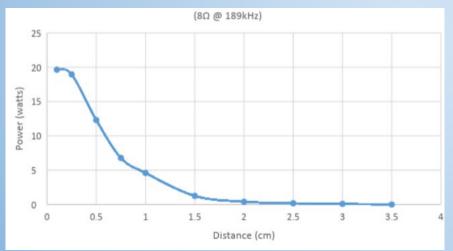
- Outputs given to operator about state of power systems
- Control of LEDs to both functional and entertainment purposes
- Be easily programmable and updateable to accommodate changes in the future

PowManSysV0_1a§			
boolean flip=false;			
double maxCapacity=.550*3600;			1
double currentCapacity=maxCapacity	¥7		
<pre>double maxVoltageSensor=4.2;</pre>			
<pre>double currentVoltage=0;</pre>			
void setup() {			
<pre>// initialize serial communicat:</pre>	ion at 9600 bits per second:		
<pre>// Serial.begin(9600);</pre>			
<pre>pinMode(10,OUTPUT);</pre>			
<pre>pinMode(9,OUTPUT);</pre>			
<pre>pinMode(5, INPUT);</pre>			
<pre>pinMode(8,OUTPUT);</pre>			
3			
<pre>// the loop routine runs over and</pre>	over again forever:		
void loop() {			
//10 is red 9 is blue			
if(currentVoltage/maxVoltageSer	nsor<0.79){		
digitalWrite(8,LOW);			
<pre>for(int i=0;i&lt;5;i++){</pre>			
digitalWrite (10, HIGH);			
<pre>digitalWrite(9,LOW);</pre>			
delay(500);			
<pre>digitalWrite(10,LOW);</pre>			
<		>	

**Example Code** 

### **Transmitter Test Results**

#### **Power vs Distance**

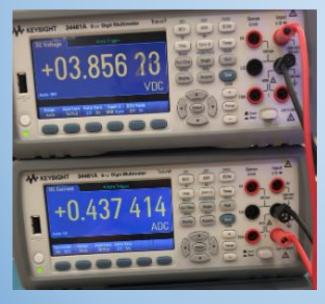


#### **Rectified Delivered Power**



### **Receiver Test Results**

#### **Sensor Battery Pack Charging**



Power levels are what we would expect to see when charging the sensor battery

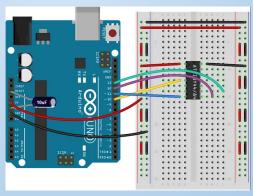
Top: Battery charging voltage

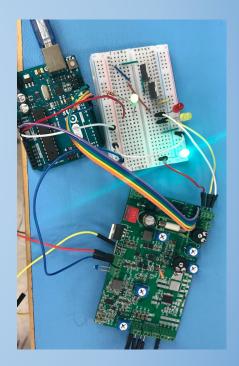
Bot: Battery charging current

# **Programming and Testing (attiny44)**

Using an arduino and the arduino programming software, code can be uploaded to the attiny with the arduino acting as a programmer for the onboard controller

Using an arduino makes code creation, uploading, and testing, easier and simpler





# **Use-Case Scenarios and Applicability**

- Coding options leave room to change use of project
- Wireless charging of higher power devices such as Quadcopters, Hoverboards, or RC cars possible
- Making longer range transmitter based off design

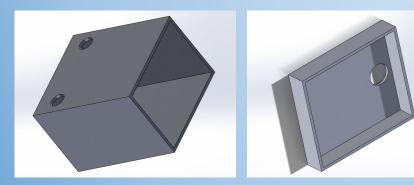


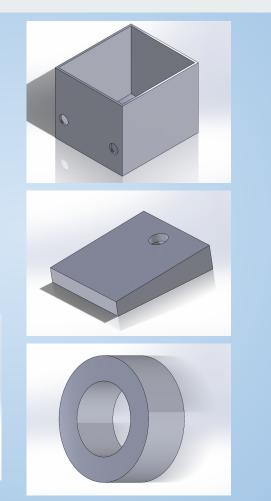




## **System Containment**

- Use of epoxy layer
- Minimal entry points
- Inclined lid for liquid direction
- Designed for specific use



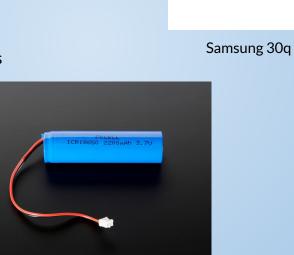






## **Battery Choice**

- Safety Standards
- Voltage/Current rates
- Mono vs Duo Pack decision effects





INR18650-300 SAMSUNG SDI



Great Power Battery Co. Ltd.

Shenzhen PKCELL Co. Ltd.

Samsung 25r

# **Constraints/Trade-offs**







Functionality vs Efficiency

Some aspects of the project, such as power loss, were not made a main focus, as overall functionality was needed most to prove viability and do-ability of project.

#### Versatility vs Optimization

We aimed to design our project in a way that modifications could be more easily made, while allowing potential for more versatile device(s). Future work can expand upon and get refined as needed, instead of being limited to a unique path of development.

## **Project Planning and timelines**

SDmay19-14 Timeline	January			Febuary				March					Ар	Мау			
Week of month :	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15	Week 16	Week 17
Find a new advisor																	Finals
Communicate with Client																	
Find and order parts																	
Design PCB (redesign if needed)																	
Get components on PCB																	
Design and build isolation cover																	
Modify battery unit design																	
Build battery unit and test																	
Make thorough test plans to follow																	
Program Micro Controller / interfac	e																
Follow test plans and ensure funct	i																
Create poster																	
Prep for final presentation																	

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Follow test plans and ensure funct																	
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## **Project Status Evaluation**

What is our project's state (what works what doesn't)?

- The project functions and can transmit and receive power wirelessly, and charge sensor battery
- On board microcontroller can sense battery voltages and alert user about the state of the system
- Room for improvement and expansion of the design
- Client satisfied with our work and progress

### **Future Works**



- Making design more optimized and efficient
- Adding extra features to the system (extra coding options, extra sensors....)
- Adding an additional isolating layer for the cables that goes into the boxes at the entry points
- Improving versatility and useability of components

# **Thank You**

Questions.....?