Group 7 & Their Solar Powered Wi-Fi Umbrella

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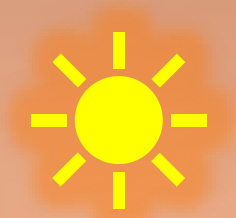

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What is the Solar Powered Wi-Fi Umbrella?

- As the name suggest the product is solar powered and has Wi-Fi capabilities.
- The apparatus is an umbrella that has all the features mentioned in the name alongside some other features like lights and a charging station to charge electronics devices.

Motivation for the Umbrella

1) With the world going more environmental friendly a Senior Design project using some form of renewable energy was highly considered such as solar, wind, hydro, nuclear, etc.
2) July 2016 Pokémon Go! craze and limited mobile data.

Goals & Objectives

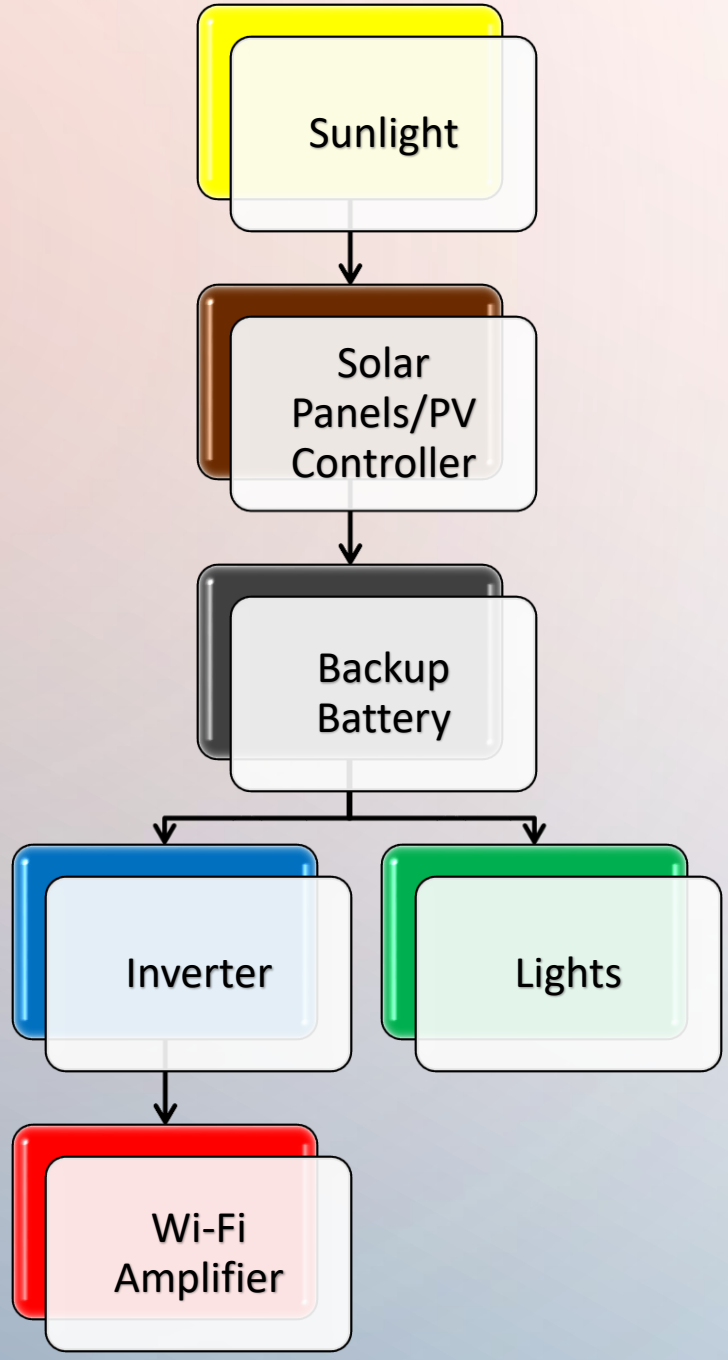
1. Produce an effective and clean solution to the problem presented that will be loved by potential users and the judges.
2. Each individual part/section has their own goals and objectives that will be explained in better details later on.

Specifications Number

- Battery must last throughout the night.
- Wi-Fi signal must be strong enough and extend 100 feet
- Lights will illuminate without blinding users.
- Charging station will power multiple devices.
- Emergency button will alert users via text message in case the need arises.

Visual Representation of the Process

How will things be divided?



1. Solar Panels
2. PV Controller
3. Back-up Battery

Solar Panels

	***Mono*crystalline**	***Poly*crystalline**
Production	Each cell is made of one silicon piece	Each cell is made with more than one piece of silicon
Operation	Solar radiation	
Efficiency	135-170 W/m^2 (14-21%)	120-150 W/m^2 (12-18%)
Warranty	25 Years	
Compatibility	Works well with typical charge controller	
Weight	Light	Heavy
Maintenance	Low	

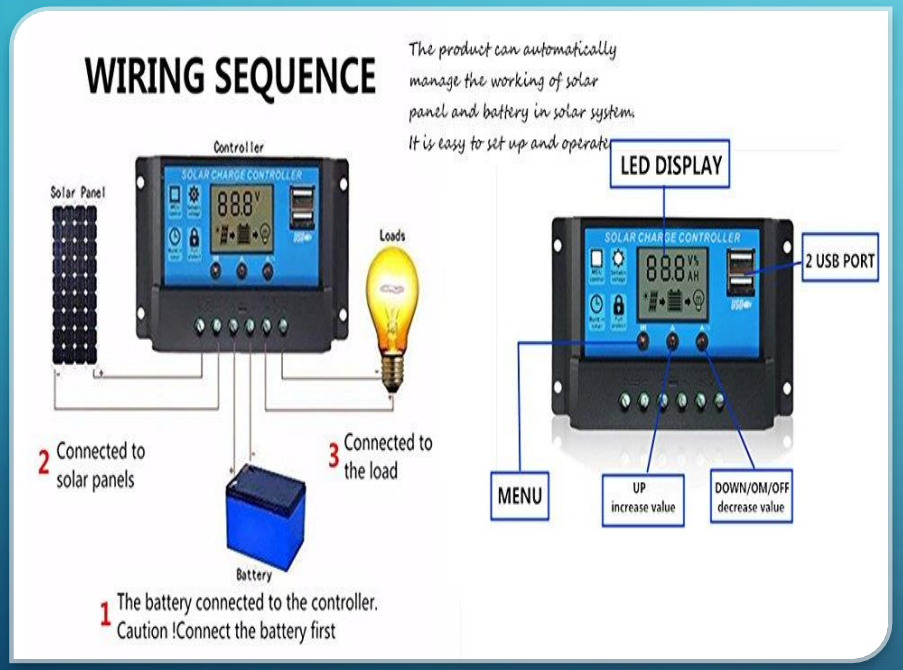
Monocrystalline
‘Bendable Sun Power Solar Panel’

- Water resistant, lightweight, semi-flexible, and durable.
- Can curved to a maximum 30 degree.
- Has a conversion rate between 22%-25% (can capture more sunlight than conventional solar panels.)
- Produces 100 watts of power 18v at 5.4 amps.
- Weighs 4.5lbs, making it easier to transport, hang and install.

PV Controller

Pulse Width Modulation (PWM)	***Maximum Power Point Tracker (MPPT)***
1. Affordable to buy and to replace. 2. Lower voltage means lower safety risk. 3. Can last up to 10 years.	1. Easier connections in the strings allow for easier installation. 2. Less regulators are required. 3. Charging efficiency up to 25%.

MOHOO 20A Solar Charge Controller Regulator (PWM)

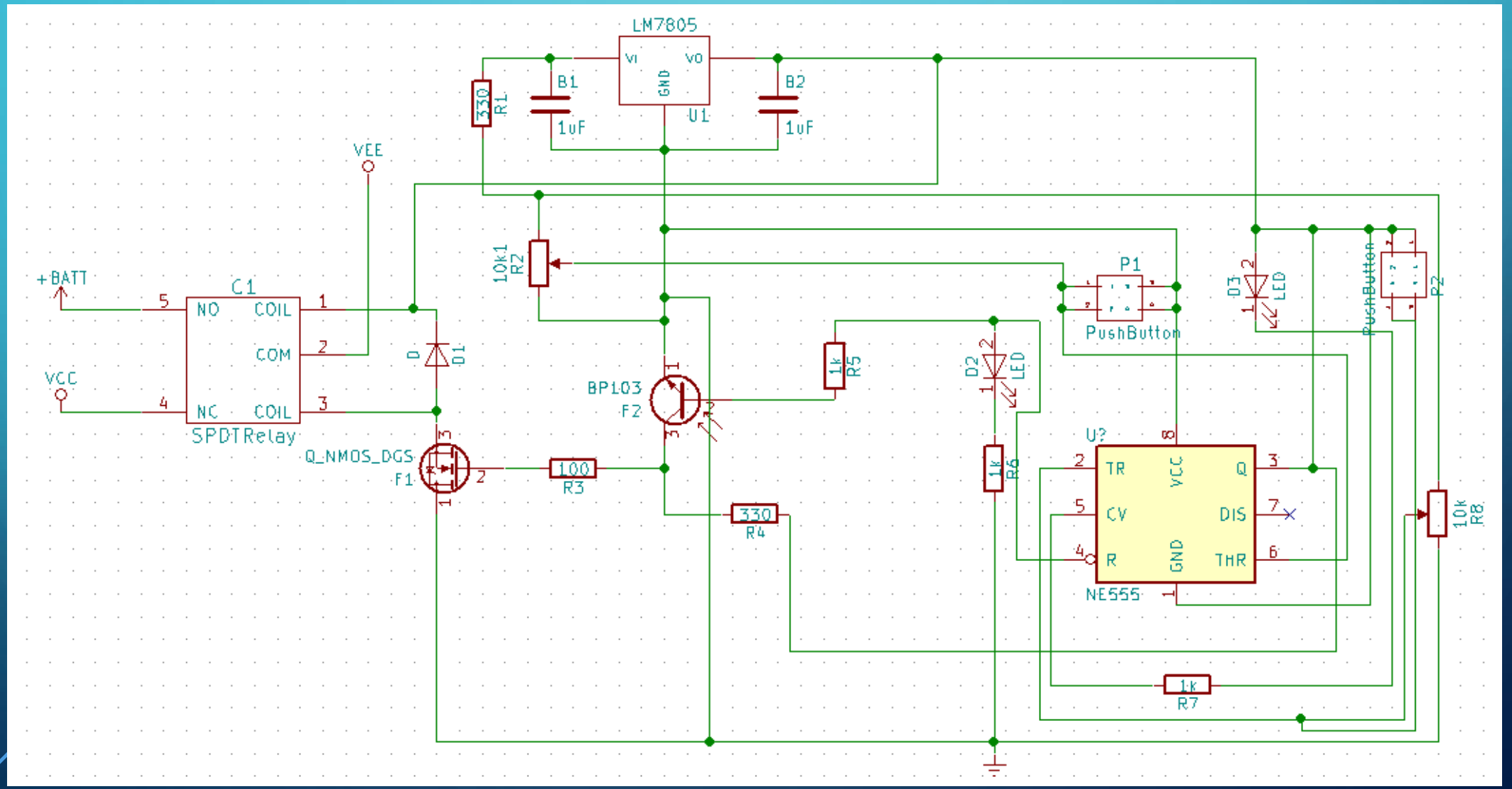


- Has a passive heat cooling system.
- Working Temperature: -31°F to +140°C
- Self consume: ≤10mA
- Float Charge: 13V
- Discharge stop:10.7V and Discharge reconnect:12.6V

PV Controller

- Was decided to be our design once the inverter of the project resulted in being more complex than anticipated.
- No display was included because we thought it was best to use what little programming resources we had into other features.
- Will be used to compare the previously mentioned PV Controller to see what is the difference between the two and how good this homemade controller works out.

PV Controller Circuit Schematic



PV Controller

- Most important feature is the SPDT Relay.
- This relay will ultimately help determine whether the controller is charging the battery or not.
- The LEDs will tell whether or not the controller is charging. One LED will be green while the other will be red. These colors are to show that green means charging while red means not charging.

Battery Backup

Lead-acid

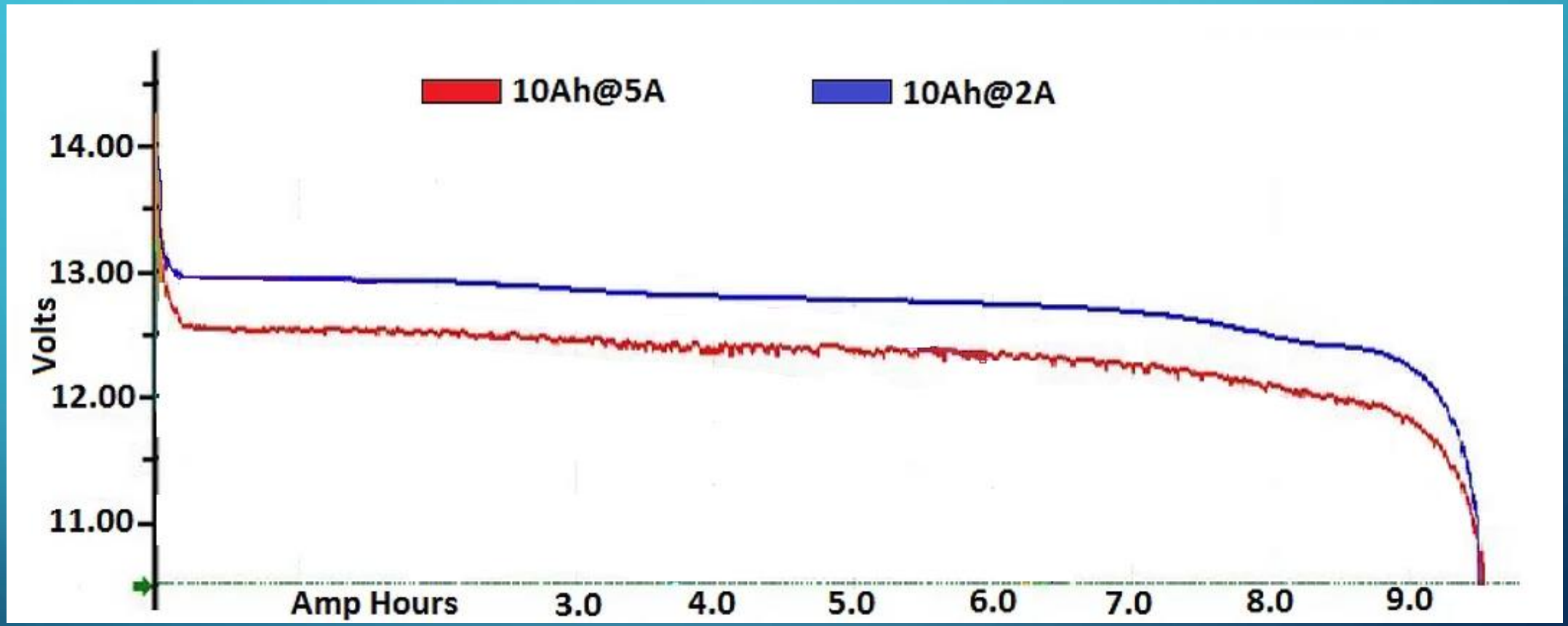
- Cheaper.
- Heavy and bulky.
- Potentially toxic discharge.
- Shorter life cycle.
- Quick powerful discharge.

Lithium-ion

- Continuously constant discharge.
- Longer lasting life cycle.
- Potential to explode.
- More expensive.

Lithium Ion Comparison

	DAKOTA	Rujjshop
Capacity	10Ah at 12 Volts	8 Ah at 12 Volts
Dimensions	5.94"x 2.55"x 3.74"	6.1"x 2.95"x 1.57"
Weight	2lbs 14oz	2lbs 5oz
Max Operating Temperature	120 F max	115 F max
Cost	$120	$60


10Ah@5A
10Ah@2A
14.00
13.00
12.00
11.00
Volts
Amp Hours
3.0
4.0
5.0
6.0
7.0
8.0
9.0

1. Inverter
2. Wi-Fi Extender
3. Emergency Call Button

Why a DC-AC Inverter?

- Was included in order to charge devices that require AC power such as laptops and will also power the Wi-Fi Extender.
- Needs to be a 12v to 120v inverter because 12v is the voltage of the battery while the 120v is the standard voltage for AC devices.
- Idea was merged with the charging station that was originally in the project in order to kill 2 birds with 1 stone.

Inverter

- Has 2 USB ports and 2 standard US wall outlets.
- Has an On/Off switch if needed.
- Aluminum casing to protect from overheating.

Power	**300W**
Amps	**2.1A**
Voltage	**120V-AC**
Dimensions	**6.7 x 2.4 x 6 inches**

Wireless Solution Requirements

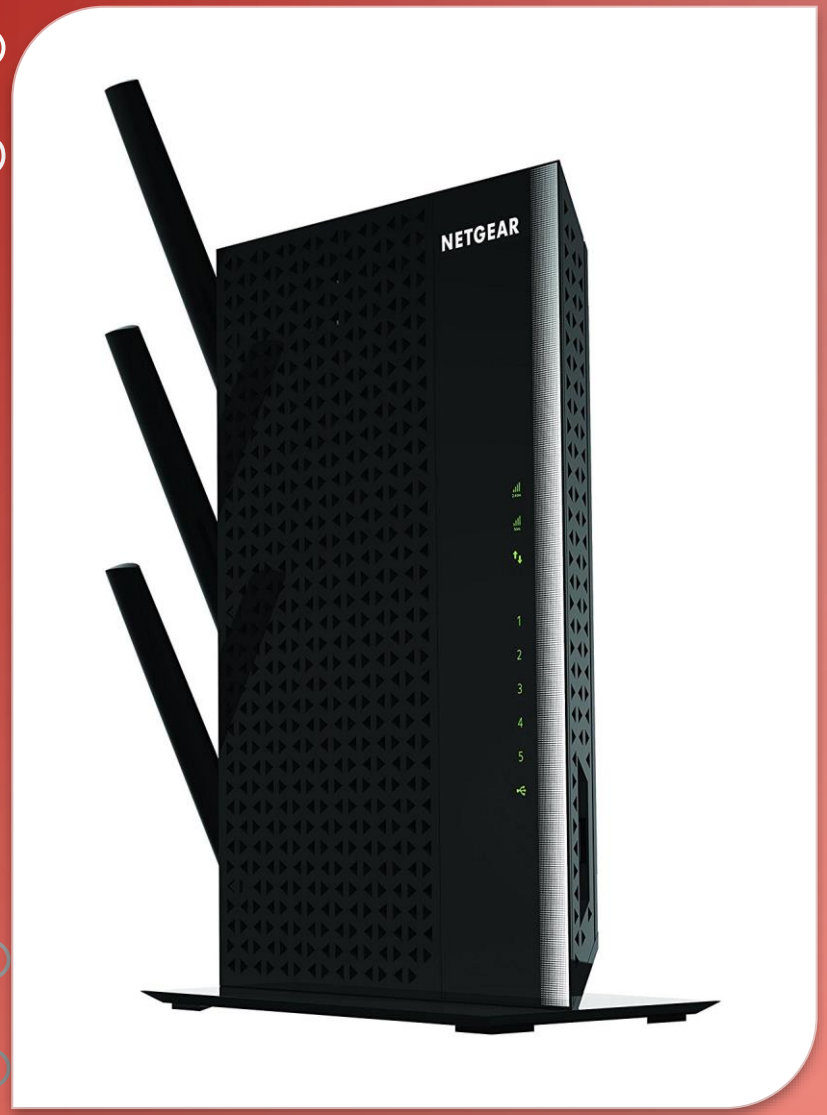
- Ability to provide high data transmission speeds.
- Reliability of data delivery services.
- High efficiency and low power consumption.
- Network security.
- Ease of deployment in new locations.
- Cost.
- Volume of traffic (users) supported.

Potential Wireless Solutions

	Wi-Fi Amplifier	Cellular Hotspot	Satellite Hotspot
Acceptable speeds	Best	Good	Better
Reliability	Good	Better	Best
Efficiency	Best	Better	Good
Security	Best	Good	Better
Ease of deployment	Good	Better	Best
Cost	Best	Better	Good
Traffic supported	Best	Better	Good

Wi-Fi Amplifier Choices

	Netgear Nighthawk AC1900 Wi-Fi Range Extender	Netgear AC1200 Wi-Fi Range Extender
External Antennas	3	2
Security	WES, WPA, WPA2, WPS (Wi-Fi Protected Setup)	WES, WPA, WPA2, WPS (Wi-Fi Protected Setup)
Networking Options	802.11b, 802.11g, 802.11a/b, 802.11a/g, 802.11a, 802.11n, (2.4+5 GHz Dual-band), 802.11ac, 802.11ac(2.4+5 GHz Dual-band)	802.11n, (2.4+5 GHz Dual-band), 802.11ac
Processor	Dual Core 1GHz processor	Quad Core processor
Wired LAN Ports	5	5
Price	$108.90	$82.52



Wi-Fi Amplifier Choice: Netgear Nighthawk AC1900 Wi-Fi Range Extender

- Extreme dual band Wi-Fi speed- up to 1.9Gbps.
- 700 mW high-power amplifiers & high-gain 5dBi antennas for maximum Wi-Fi coverage.
- Dual core 1GHz processor for max Wi-Fi performance.
- Fastlane technology- Use both Wi-Fi bands to establish one super high speed connection.

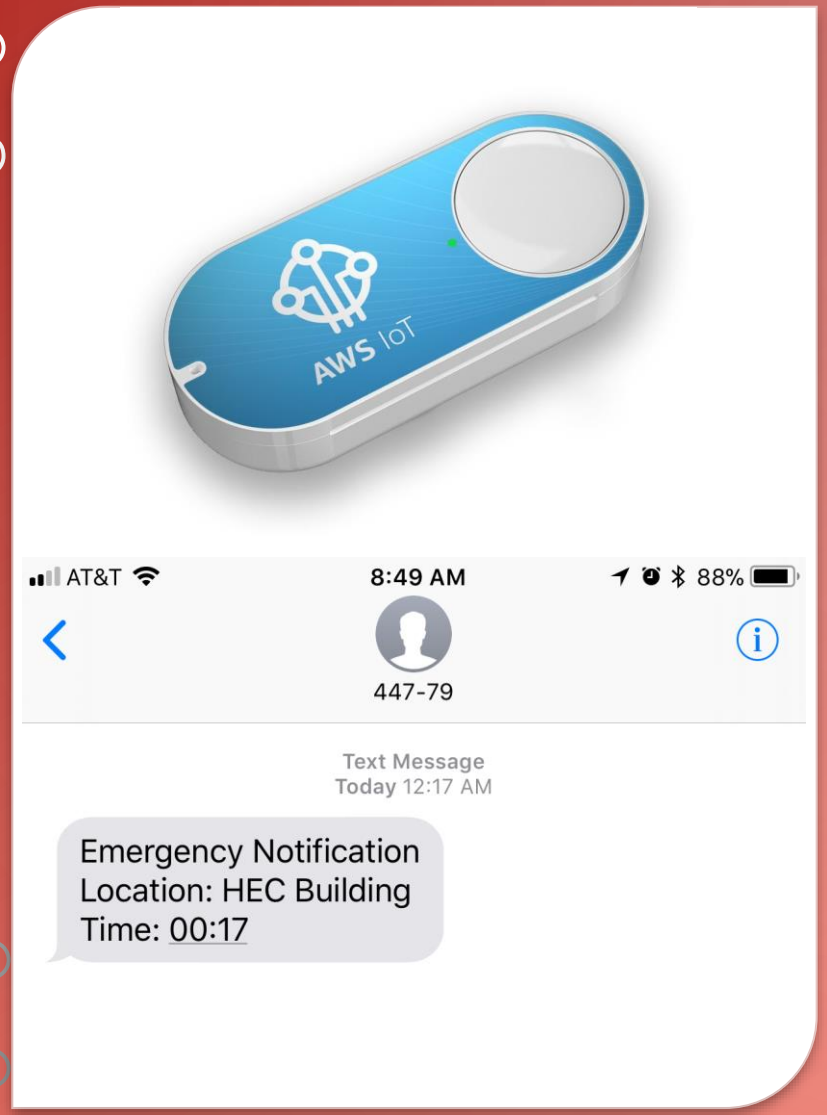
Wi-Fi Amplifier Configuration and Installation

Configuration

- Via browser or mobile app.
- Locally or remotely.
- Username and password protected.
- Configured per application.

Installation

- Powered by the solar energy system.
- Located in the base of the device.
- Antennas to be pointed in varying directions.
- Not to be surrounded by metal as to not interrupt the signal.



Emergency Call Button

- Implemented by using an Amazon AWS IoT Button.
- Automatically connects to the Wi-Fi amplifier.
- When the button is pressed it will send a distress call to local law enforcement displaying the location and time of the press.
- Battery life of the button is about 1000 presses.
- When the button is pressed a Lambda function is invoked which produces and sends SMS message.
- IoT Button --> Lambda Function --> Simple Notification Service (SMS Message).

1

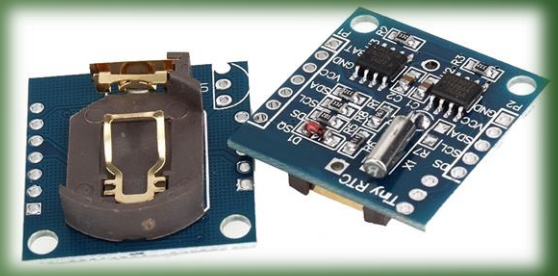
- Arduino Light Controller

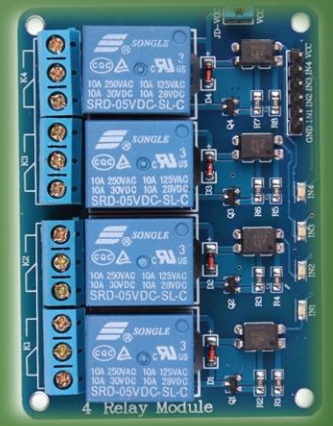
2

- Lights

LED Lights Microcontroller

- LED lights are going to be controlled using an Arduino UNO Microcontroller.
- The microcontroller will have a Real Time Clock board as and a 4 channel relay board in order to implement this functionality, mounted on a prototyping shield.
- In addition, a maintenance mode will exist in order to change the stored sunrise and sunset times referred to by the Arduino.





EMERGENCY LIGHT FUNCTION

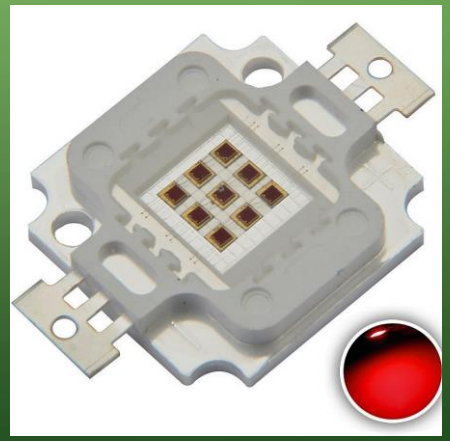
- In addition, an emergency button function has been implemented here as well.
- In case of emergency the button is pressed and the lights will flash in an alternating pattern for 5 minutes.
- This will call attention to the umbrella to ward off someone causing trouble as well as to be easily visible by law enforcement.

LED Lights

	LED Light Option 1	LED Light Option 2	Regular Household LED
Price	$11 for 10	$6 for 1	$18 for 4
Voltage to Operate	6-7v-DC	9-11v-DC	120v-AC
Power Consumption	5 Watts	10 Watts	8.5 Watts
Size	8 x 8 mm	20.2 x 20.2 mm	107 x 60
Lumens	500-600	900-1000	800

Option 1

Option 2



LED Lights

- With the ribs having a small width and cylindrical the LEDs needed to be small enough to fit in the ribs.
- Ideally they would be inside the ribs but for this project they are in the outside of the ribs.
- Added a heatsink (black gear looking mount) in order to reduce the heat that the LEDs will emit.
- For this project they will be mounted by adhesive tape however the ideal location would be inside the ribs themselves with a proper casing that will protect from overheating.

Administration Content

Divide & Conquer

	Aaron	Alan	Freddy	Kevin
Umbrella	1			2
Solar Panels	2		1	
PV Controller			2	1
Lights		2		1
Wi-Fi Extender		1		
Emergency Button		1		
Backup Power/Battery	1			

Budget	$1000
Solar Panel	$180
PV Controller	$110
Battery	$120
Wi-Fi Amplifier	$105
Arduino Microcontroller	$40
Lights	$25
Microcontroller	$52
Inverter	$30
Umbrella/Housing	$80
Etc.	$15
Total	$757

Closing Statements
&
Questions?