Smart Home Blackout Shades

Group Number: 2

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Sponsor: Jetsons Living

Description

The Motivation for this project is to enhance living conditions of any homeowner, who wishes to live more comfortable and more connected. These days, many homeowners typically already own smart home devices such as voice assistants (Amazon Echo and Google Home), smart lighting (Phillips Hue), smart switches (GE Z-Wave Wireless switches), video surveillance, smart thermostats (Nest), video door bells (Ring), etc. Our goal is to add integrated smart shades to their list.

The goal of our project is to develop a device that can automate the typical home owner's blackout shades. In other words, our developed device can control how much sun light gets into the house as per user's requests. The shades can be drawn all the way for a full blackout effect, or any distance in between for just the right amount of light, without any solar glare. The device will communicate through Wi-Fi, and will be able to be controlled from the user's smartphone, or by a dedicated IR remote. Also, we plan to integrate our smart shades with Amazon Echo, so, the user can verbally control their shades. Our intention is to integrate the device with the sponsor company's system, which will then be able to tie in the device to other smart home devices such as their all-in-one smart hub, Arden. Users can set a time to automatically have blinds open/close in specified areas. Also, users will be able to set a schedule based on motion in the room. Users can also turn on our installed LEDs, which can glow specific color on their blinds, to set the desired mood. The device will have the option to either run on battery power, or be wired directly to the homes 120V 60Hz AC mains. If running on battery, the batteries will be able to be charged with a solar panel on the inside of the window. Ideally, it will be able to completely sustain its battery for very long periods of time. Currently, smart shades or blinds already exist in the market for consumers individually. However, we intend on making our product much more cost effective than the current products available, and ultimately our product will be integrated with our sponsor company's existing smart home system, as well as security system.

Upon accepting this project, our tasks can be categorized into a multitude of sub tasks. First, we need to do substantial amount of research in the area of battery power, as well as protection and charging, and PV panels, since our device will be powered from the energy collected from sun. Next, we need to research and develop an AC to DC conversion method for the wired power. Then we will need to determine what microcontroller we will use and how it will be connected to the internet. Next, we will research how to control the motor and LEDs, and how we will take in data from the motion sensor. Then we will do research in the area of IR communication, and begin to prototype an IR remote. The next task would then be to begin designing our full schematics and getting an idea of how our PCB(s) will be laid out. Next, we need to figure out how to set up an app/web page for user interface, and also integrate the device with Amazon Echo for voice control. Last, we will explore how we will fully integrate the device in to our sponsor company's system.

Requirement Specifications

Hardware Features:

- The system can operate completely wireless
- The system must operate continuously & autonomously
- The system must be able to respond to user-controls
- The system must also be capable of accepting wired power
- 2.4 GHz wireless Wi-Fi connection
- Motor operation noise must be relatively low
- LEDs operating luminous intensity will be between 200-1500 mcd
- LEDs must be user-controllable
- System housing must be able to fit in most standard window frames

Software Features:

- The customer will be able to control/edit settings with an app
- The system will take commands over voice
- The system will be able to act on a schedule
- The shade will be able to be lowered to different positions (e.g. drawn 50%)

Market Requirements:

- Simple User Interface
- Wireless Connectivity
- Battery Life
- Easy to Install
- Noise
- Cost

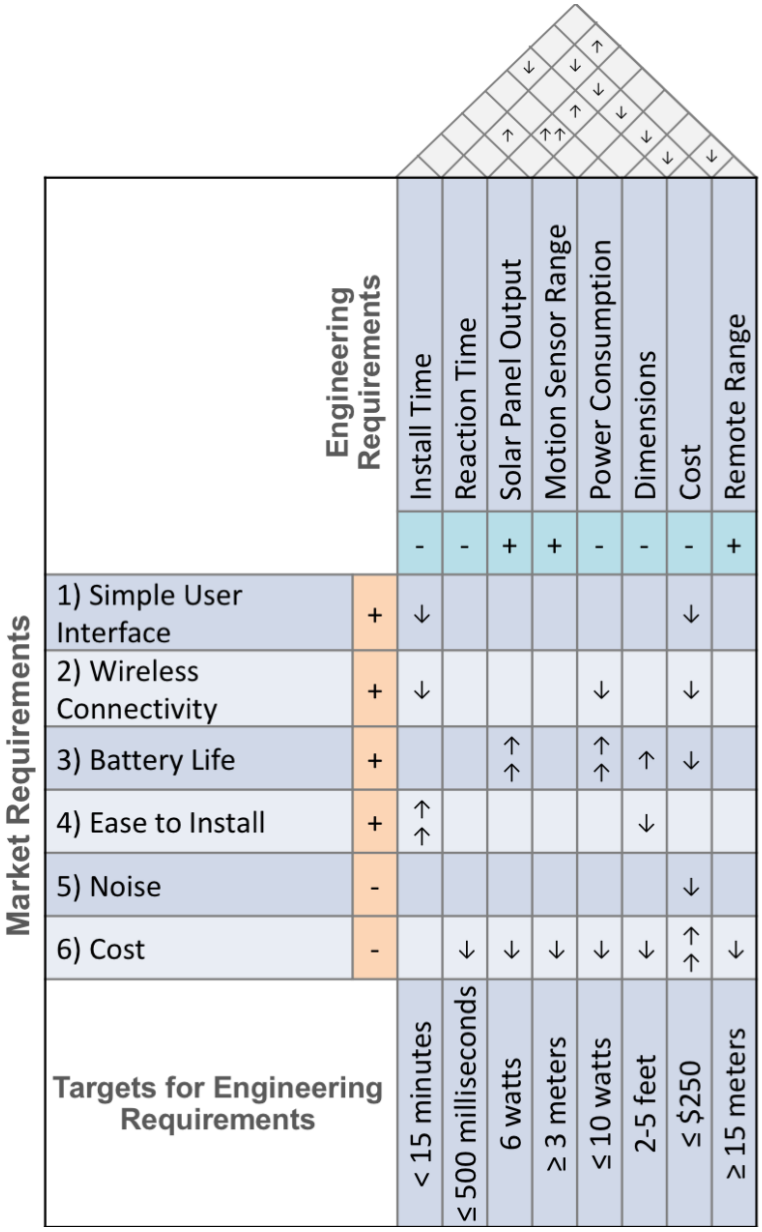
Engineering Requirements:

- Install Time (15 Minutes)
- Reaction Time (500milliseconds or less)
- Average Solar Panel Output Power (~6 Watts)
- Motion Detection Range (> 3 meters)
- Power Consumption (<10 Watts)
- Dimensions (Window width between 2ft-5ft)
- Cost (<$250)
- IR receiver distance (>15m)

Stretch Goals:

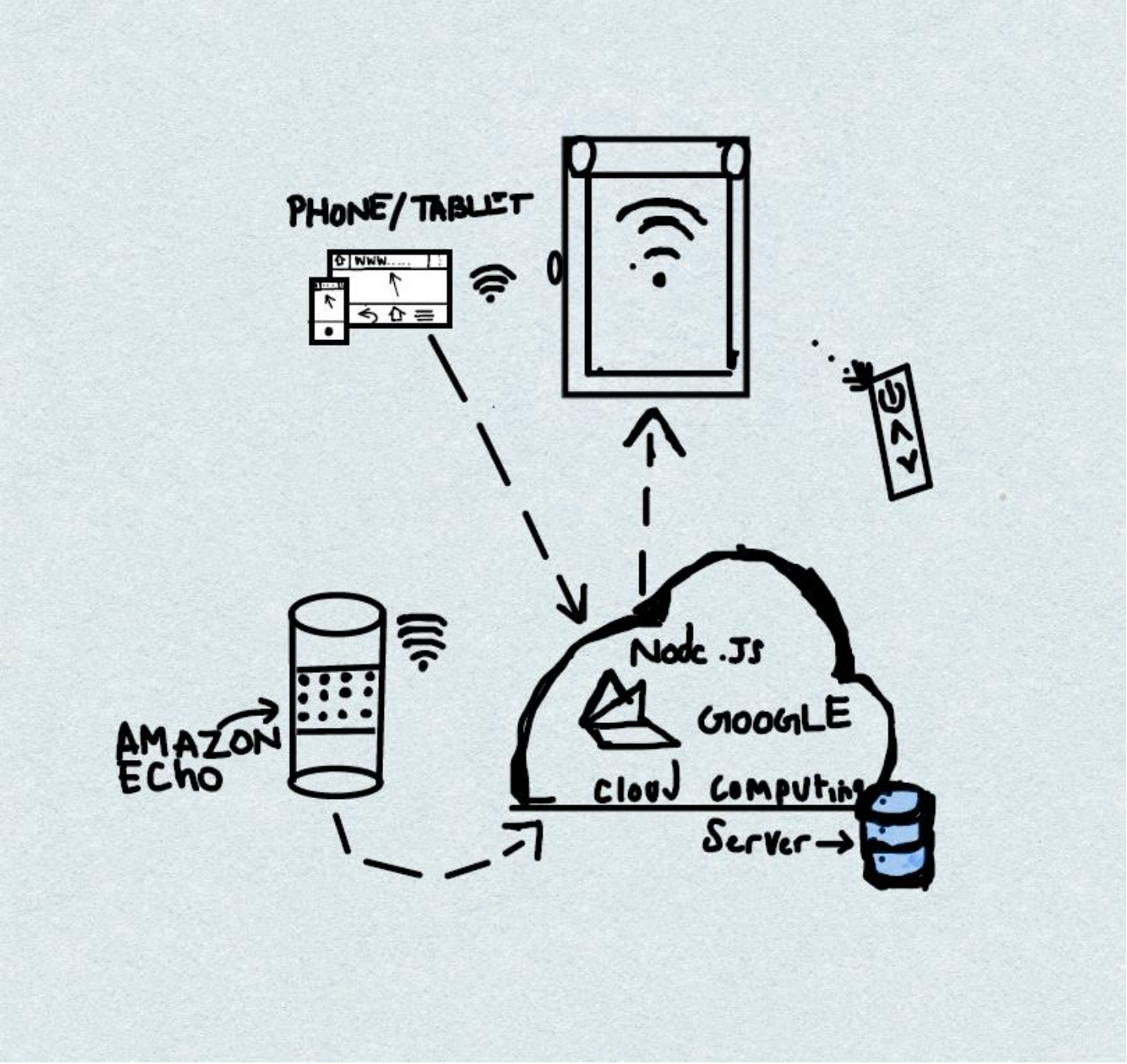
- Shade Transparency
- Wired Charging of Batteries
- Length Programmability
- The system can be set to open/close based on light

House of Quality

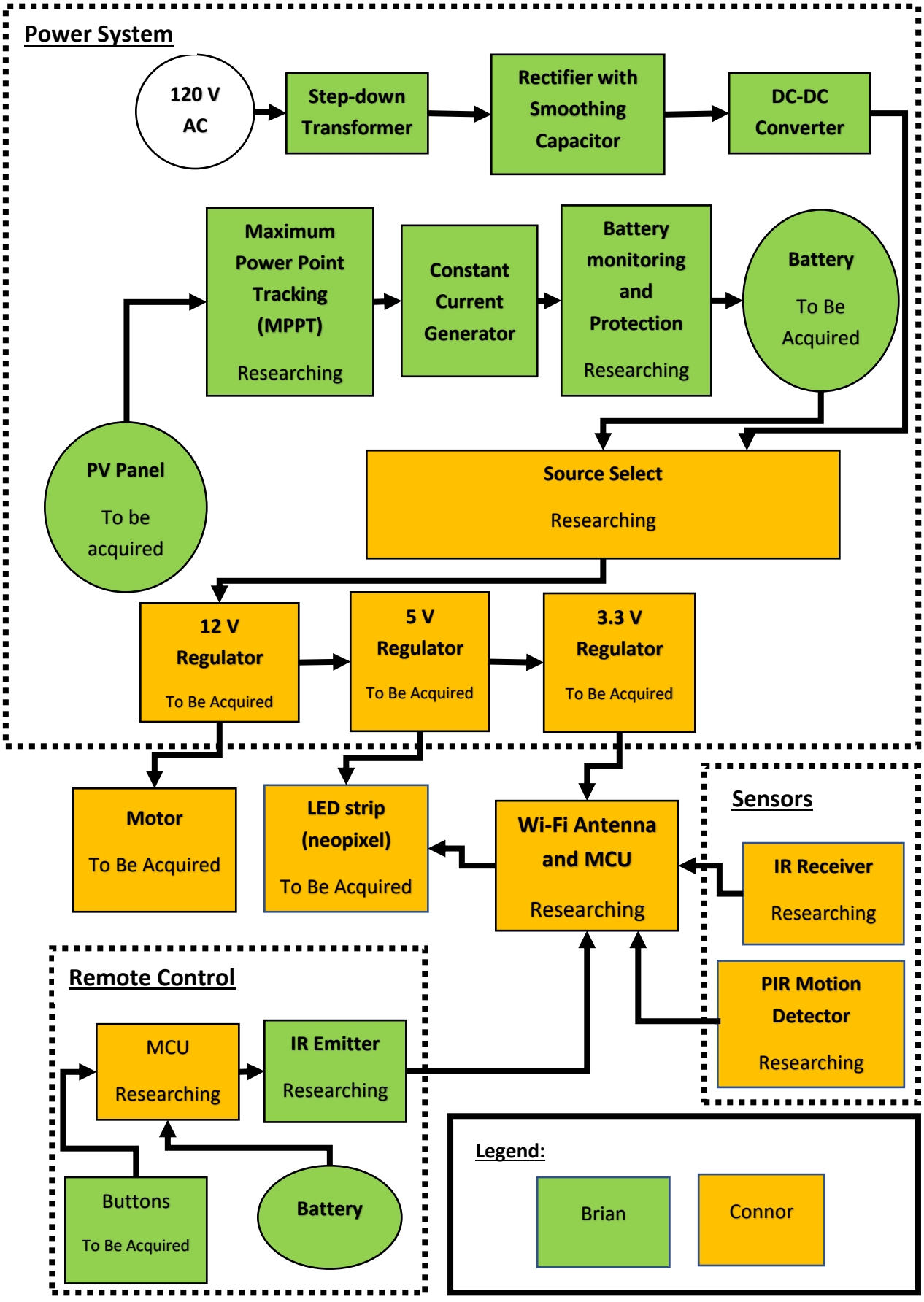


Legend	
Positive Polarity	+
Negative Polarity	-
Strong Positive Correlation	↑↑
Positive Correlation	↑
Negative Correlation	↓
Strong Negative Correlation	↓↓

Software Block Diagram



Hardware Block Diagram


Power System
120 V AC
Step-down Transformer
Rectifier with Smoothing Capacitor
DC-DC Converter
Maximum Power Point Tracking (MPPT)
Researching
Constant Current Generator
Battery monitoring and Protection
Researching
Battery
To Be Acquired
PV Panel
To be acquired
Source Select
Researching
12 V Regulator
To Be Acquired
5 V Regulator
To Be Acquired
3.3 V Regulator
To Be Acquired
Motor
To Be Acquired
LED strip (neopixel)
To Be Acquired
Wi-Fi Antenna and MCU
Researching
Sensors
IR Receiver
Researching
PIR Motion Detector
Researching
Remote Control
MCU
Researching
IR Emitter
Researching
Buttons
To Be Acquired
Battery
Legend:
Brian
Connor

Budget

The budget, approved by our sponsor, is a maximum of $500 for all research and development, as well as production costs. Our group will keep a record of their spending and the sponsor will reimburse the group when the full working prototype is delivered. The sponsor has also added that they would like the product to be able to be reproduced for $250 or less. A tentative budget is listed below.

Item	**Cost**
Shades & Housing	$100
Motor	$60
Main Unit PCB & Parts	$60
Remote PCB & Parts	$30
Motion Sensor	$15
LED Strips	$30
Solar Panel	$80
Batteries	$25
Total	**$400**

Initial Project Milestones

August 21st, 2017 – April 25th, 2018

Fall Semester (August 21st – December 8th):

Week 1 (Aug 21st – Aug 25th)

- Formation of project teams.
- Creation of initial project idea.

Week 2 (Aug 28th – Sep 1st)

- 1st Group meeting to discuss project and assign roles for the Initial Project Document – Divide and Conquer.

Week 3 (Sep 4th – Sep 8th)

- 2nd Group meeting to put together each part of the Initial Project Document.
- Completion of the Initial Project Document – Divide and Conquer.

Week 4 (Sep 11th – Sep 15th)

- Attend Half Hour Meeting to discuss the Initial Project Document.

Week 5 (Sep 18th – Sep 22nd)

- Update the Divide and Conquer Project Document based on what was discussed at the previous meeting.

Weeks 6 – 8 (Sep 25th – Oct 13th)

- Initial project research
    - Becoming more familiar with the Arduino
    - Researching the expected parts that will be used
    - Researching the development of mobile apps
- Beginning of documentation towards the final document.
    - Recording information for the Senior Design 1 Document Draft.
    - Assignment of roles and parts for the Draft as well.

Weeks 9 – 10 (Oct 16th – Oct 27th)

- Completion of research and beginning of creating an in-depth design.
- Putting together each part of the Senior Design 1 Document Draft.

Week 11 (Oct 29th – Nov 3rd)

- Completion of the Senior Design 1 Document Draft.

Week 12 (Nov 6th – Nov 10th)

- Finalize the design of the project.

- Begin working on 100-page submission.

Week 13 (Nov 13th – Nov 17th)

- Completion of 100-page document.
- Order parts.

Weeks 14 – 15 (Nov 20th – Dec 1st)

- Begin working on initial prototype.
- Prepare the Final Documentation.

Week 16 (Dec 4th – Dec 8th)

- Complete the Final Documentation and initial prototype.

Spring Semester (January 8th – April 21st):

Week 1 (Jan 8th – Jan 12th)

- Regroup with project team.
- Review and revise plans for Spring Semester.

Weeks 2 – 4 (Jan 15th – Feb 9th)

- Completion of functional prototype.
- Initial planning on improving the design and prototype.
- Work on CDR Presentation.

Weeks 5 – 8 (Feb 12th – Mar 9th)

- Order new parts if necessary.
- Work on Conference Paper.
- Continuation of testing and improving the prototype.

Weeks 9 – 11 (Mar 19th – Apr 6th)

- Beginning of Final Documents for Senior Design 2.
- Completion of the prototype

Week 12+ (Apr 9th – April 21st)

- Completion of Final Documents for Senior Design 2.
- Completion of Final Presentation and Evaluation.