HKN

Self-Project:

Self-Adjusting Solar Panel v1.0

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Date of Demonstration: March 16, 2018

Objective: We wanted to create a solar panel that adjusted

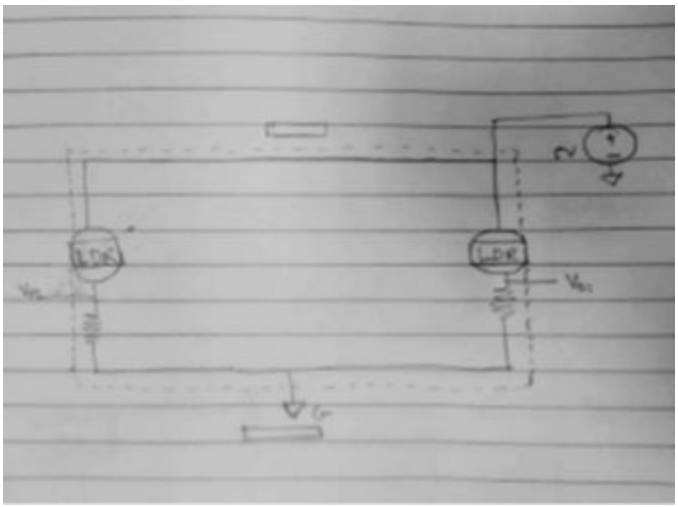
Materials:

Analog Digital Discovery 2

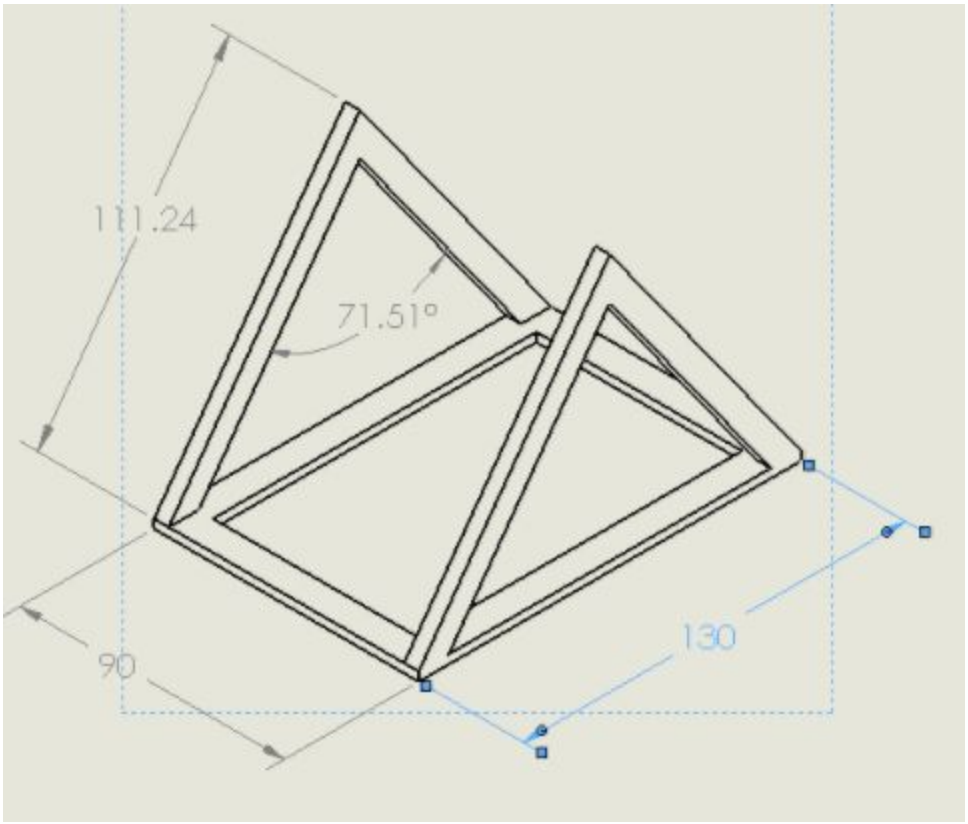
Elegoo EL-KIT-003 UNO Project Super Starter Kit

- 2pcs Photoresistor
- 2 10kohm resistors
- 1 1kohm resistor
- 3D Printer
- 1pcs UNO R3 Controller Board
- 1pcs LCD1602 Module (with pin header)
  1pcs Potentiometer
- 6 V 600mA 80x60mm Micro Mini Power Solar Cell
- Servo

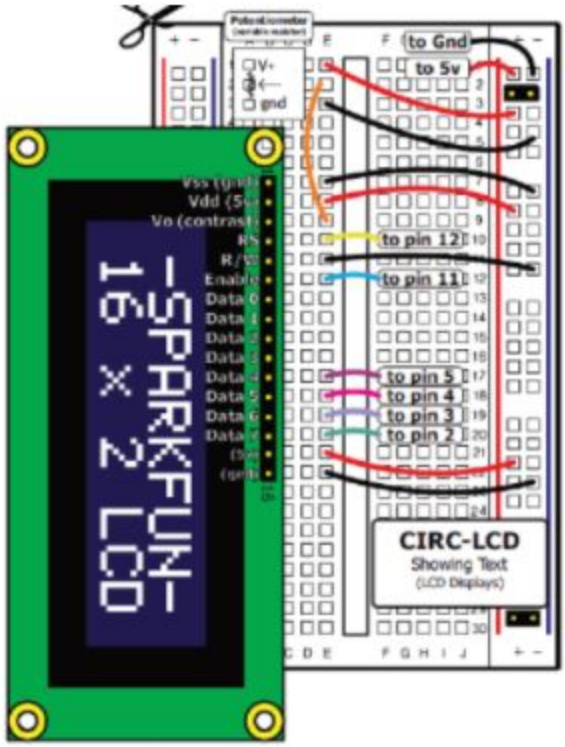
Schematics Diagrams:



Simple LDR arrangement



3D Printed Frame



LCD Wiring Configuration

Principle:

The idea is to use voltage division to create a relation between the intensity of the light and the orientation of the solar panel. The component that is used to create this difference is the LDR circuit. An LDR is a light dependent resistor. A light dependent resistor changes impedance with the change in light intensity. When the amount of light increases then the resistance decreases. When there is a decrease in the amount of light there is an increase the amount of resistance as denoted by this figure.

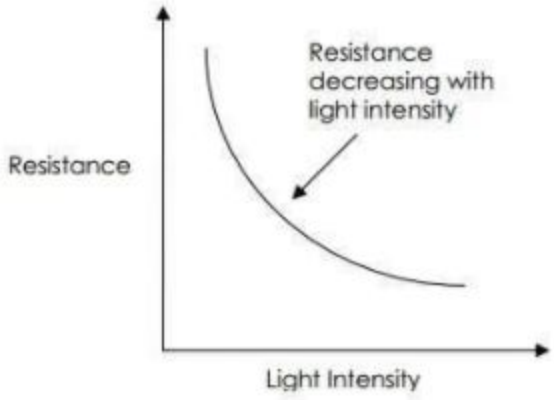


Figure 1

This change in resistance changes the voltage division relationship changing the voltage recorded at either ends of the circuit. Voltage division can be modeled by this equation.

$$V_1 = \frac{R_1}{R_1 + R_2} V_s$$

Figure 2

The voltage measured at the output is interpreted by the code provided to the arduino. The voltage difference between the nodes are measured. The difference determines the state of movement dependending on the threshold preset inside of the code. The sign of the difference determines the angular displacement of the servo. That angular displacement cause the two LDR's at either side of the solar panel to reach a point where the amount of light intensity is equivalent at either ends because the more light that is perpendicular to the surface decreases the resistance of the LDR. Eventually the two voltages produce a difference that has a magnitude below the threshold and the solar panel stops rotating. This ensures that either end of the solar panel is getting the most amount of sunlight. An LCD display was included to monitor the voltage difference and compare it to the amount by which the solar panel moved.

Data:

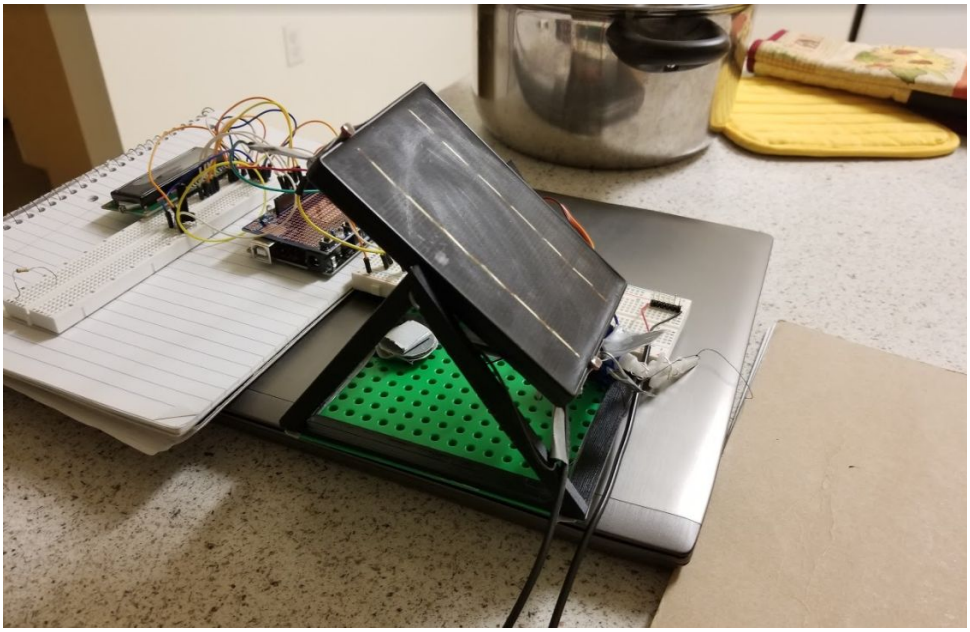


Figure A: Side Profile of Panel

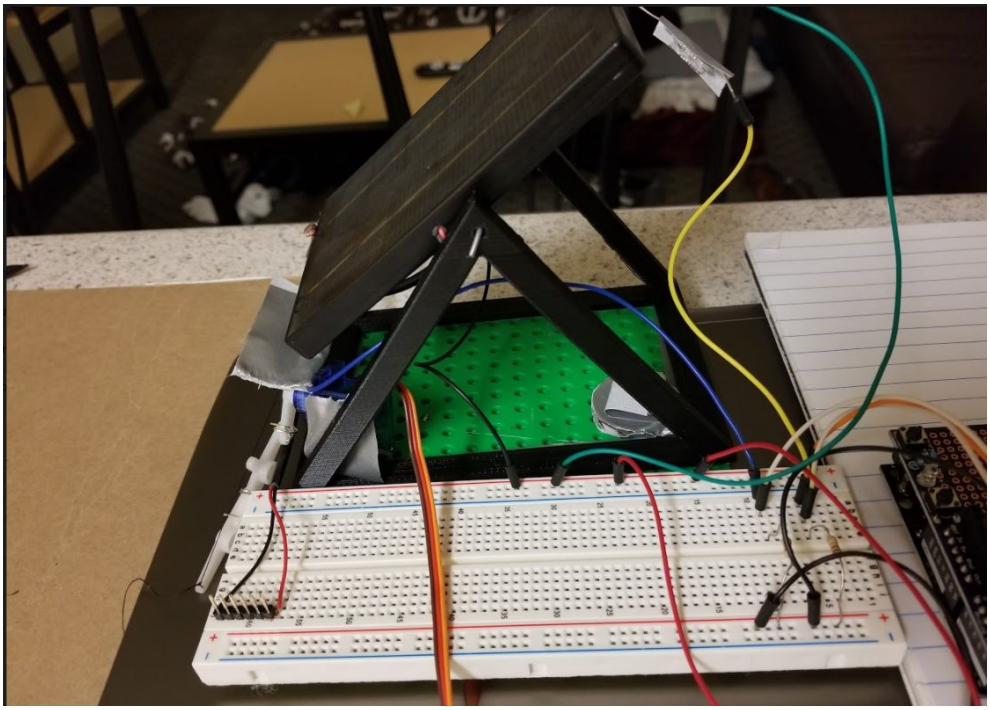


Figure B: Side Profile of Panel

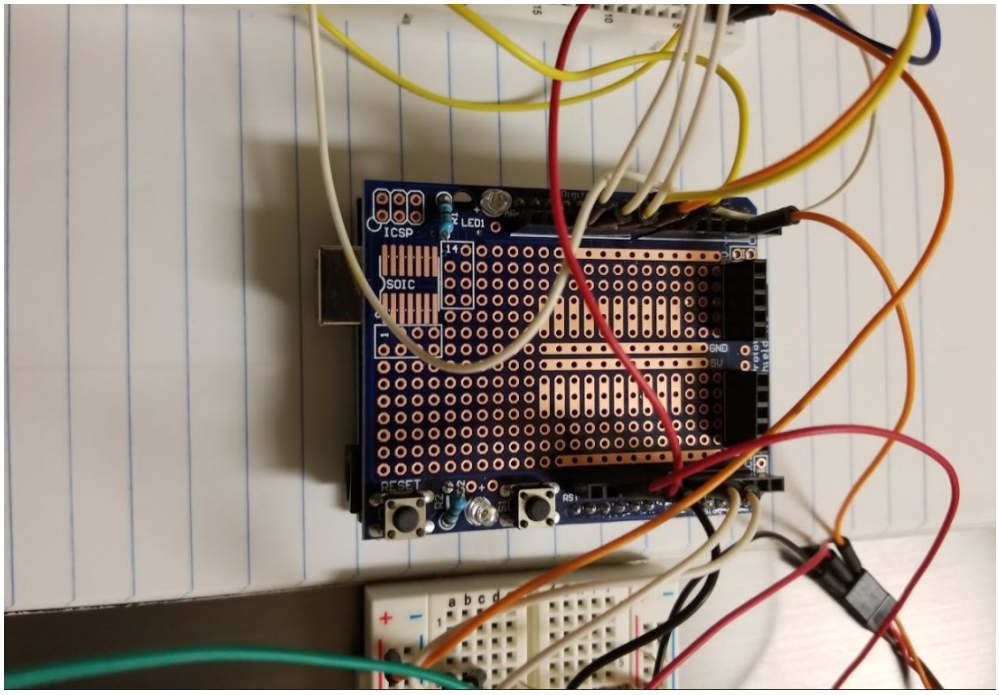


Figure C: Profile of Arduino w/ shield

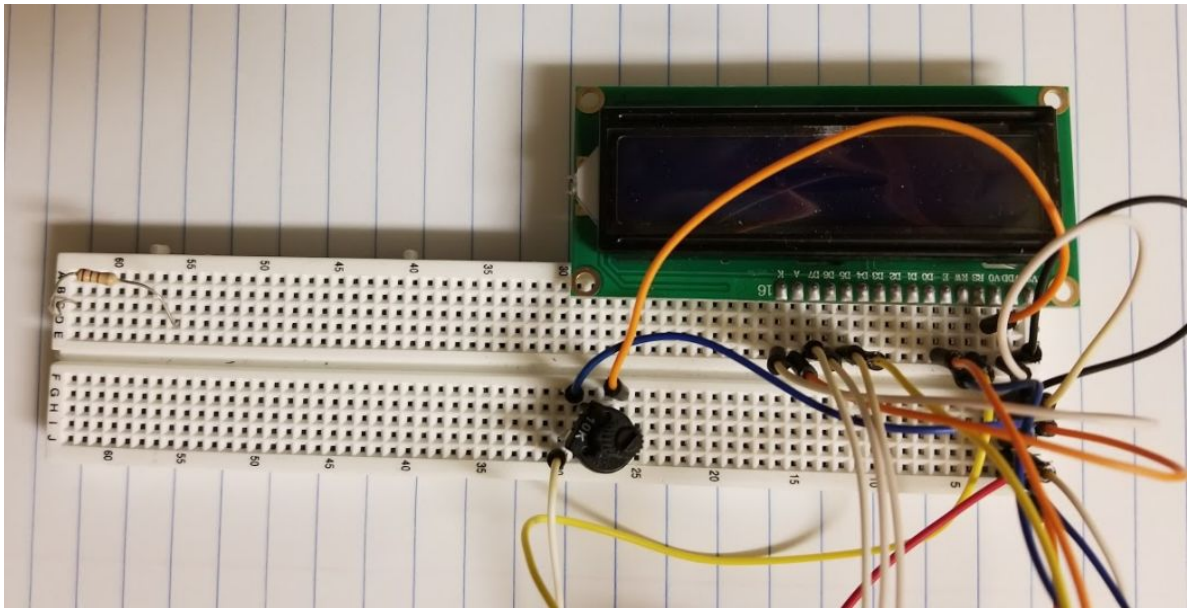


Figure D: Profile of LCD screen

Link to VIDEOS

Movement of Solar Panel w/ Error
https://drive.google.com/file/d/16XuP7e2sQrWVGd7EEyl-cTajaLZL9bJe/view?usp=sharing

LCD Display Showing Voltage Differences Multiplied
https://drive.google.com/file/d/1b4cQvo5OwiVgotcY9ajbttSRZOa8U4Vl/view?usp=sharing

Skills:

- The skills obtained in this project was working with an arduino microcontroller, solidworks, and 3d printing. These were three things in which I had no experience working with. I had missed out on the opportunity during freshman year ENGR 7A, and decided to advance my skills in this so I could become familiar with the tools in my field.
- I had joined the 3D printing club over Winter Break, and I used this as an opportunity to use the hours that I had subscribed to. I had learned how to properly level a 3D printer as well as check for imperfections in the initial stages of printing. I learned how to use a dremel. I asked a student that I had never talked to before If they could help me with using the equipment, and they were very open to help me. The dremel was used to drill a hole in the 3D print so that there was place where the axis could be placed. I learned how to create an object in solidworks using extrusions and cuts. I learned how to use the arduino microcontroller, servo, and LCD display.

Conclusion:

I will continue to use all of the new skills I have learned because I would like to further my understanding. With this project I only received surface level knowledge, but I gained a foot in the right direction. It gave me the encouragement to continue working with the tools. I will begin to expand further on continuing projects and upcoming senior design projects. There were some difficulties leading up to the build of the solar panel which included using the 3D printers at the 3D printing lab. The machines did not properly print is the first, or second, or third time, and hours were spent leveling and debugging the machine. We also consulted different designs with Professor Lee. which was helpful but ultimately did not end being complicated because of the 2D axial movement. Because of a limited time constraint, as of right now the solar panel can easily bugged.

In order to connect two wires provided by the arduino kit, without the aid of a breadboard I needed a work around. I used a combination of aluminum foil and duct tape to create a point of contact. What I discovered is aluminum foil is very good at conducting at low voltages. The problem is that connections were not securely made. When the whole device was moved or when the solar panel moved the wires would loosen themselves and the incorrect voltages were read as a result. This lead to the solar panel incorrectly going in the wrong direction. With more time I will implement this using soldering techniques. This will make sure that all connections stay intact with movement.

There is also a limit to what the arduino can see at the time. The light intensity that an LDR sensor can see is around +/-70 degrees from the perpendicular axis of the LDR plane. This means if the source of light is not within the viewing range of the LDR there will be no difference voltages and the solar panel will not adjust. This is not problematic because the sun sets and rises in almost the same positions. Some simple hard coding of positions would fix that problem. But if there were some obstruction that made the sun appear to the LDR circuit at an irregular angle than the solar panel would not adjust properly. A way to possibly fix this is to add more LDR circuits and increase the complexity of the circuit. This would give more accurate information on where the source of light is coming from.

References:

- ❖
- ❖ Professor, Henry P. Lee of University of California Irvine
- ❖ LCD BreadBoard LayOut -- https://learn.adafruit.com/adafruit-arduino-lesson-11-lcd-displays-1/breadboard-layout
- ❖ LDR Circuit Test-- https://www.electronics-tutorials.ws/io/io_4.html