Final Report

ECE 110 Honors
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Introduction

Problem Description

We wanted to create a device that will open and close window blinds based on the light inside and outside the room. We purpose is to eliminate the need to open or close the blinds throughout the day. By sensing the light, the device will open or close the blinds accordingly.

Design Concept

We used a voltage divider circuit to get the voltage values from the photoresistors. Based on the voltage values, the Arduino sent a signal to the servo. The servo was connected to a digital PWM pin of the arduino. The signal turns the servo either clockwise or counterclockwise to a set location. This stops the servo from continuously turning since it stops once it reaches the set location. We used two photoresistors to sense the light inside and outside the room. Based on how bright it is outside and inside the room, the servo either opens or closes the blinds.

Analysis of Components

Characterization of the Sensor

We used two photoresistors in our circuit. Both photoresistors were a part of a voltage divider circuit and the voltage drop across them changed with the changing resistance of the photoresistor. We used an Arduino to measure this voltage drop, and based on what the value was, we turned the motor to a specific position.

We tested the variable resistance of the photoresistor using an ohmmeter and flashlight. We measured the resistance of the photoresistor in the ambient light of the lab, when we covered it with our finger and when we shined a flashlight on it.

	Covered	Uncovered	Flashlight
Resistance	29000 Ω	2000 Ω	370 Ω

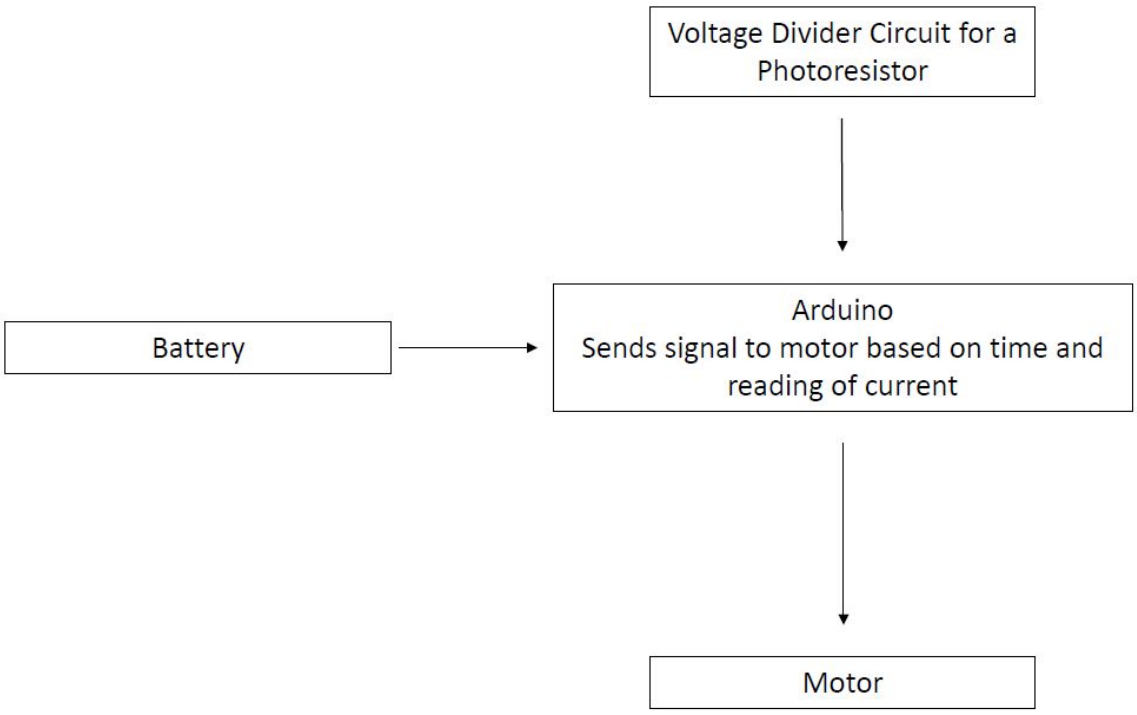
We found the resistance of the photoresistor was inversely proportional to the light intensity, meaning as the amount of light increased, the resistance of the photoresistor decreased.

Design Analysis

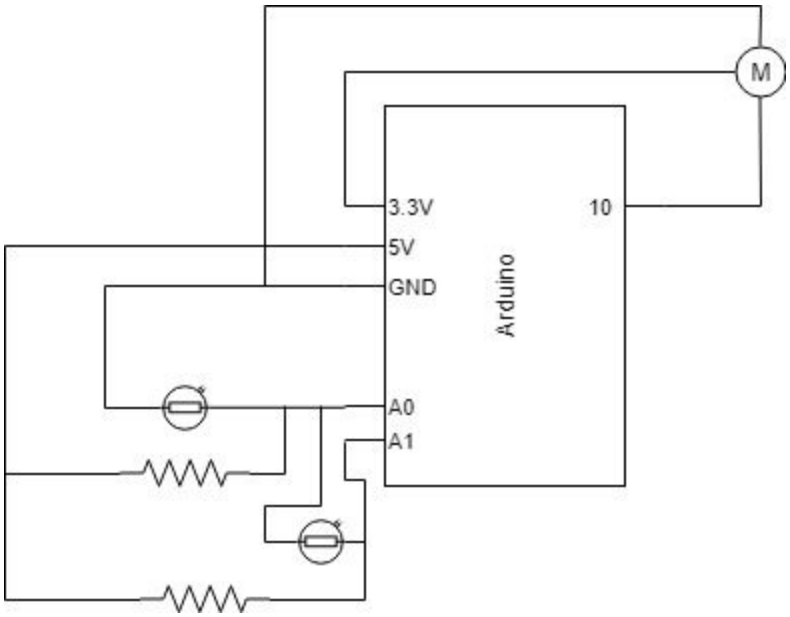
After characterizing the photoresistors, we formed the logic we used in the Arduino to open and close the blinds when we wanted. Since we measured the voltage over the photoresistor with the Arduino, whenever the voltage was low, this meant the resistance of the photoresistor was also low and it was bright around the component. We also were able to monitor exactly how much the voltage was changing over the photoresistor through the serial monitor window in the Arduino coding program. Using these values and the conclusions from the characterization of the photoresistors, we able to set voltage thresholds for when we wanted the servo to move and open or close the window blinds.

Design Description

Block Diagram



Circuit Schematics




```
// Servo - Version: Latest
#include <Servo.h>;
Servo servo_motor;
int position = 0;

void setup() {
  servo_motor.attach(10);
  pinMode(A0, INPUT);
  pinMode(A1, INPUT);
}

void loop() {
  float Vinside = analogRead(A0);
  float Voutside = analogRead(A1);
  if (Vinside < 2.0) {}
  else {if (Voutside > 3.7) {
    servo_motor.write(180);
    delay(1000);}
    else if (Voutside < 2.0) {
      servo_motor.write(0);
      delay(1000);
    }}}
```

Physical/mechanical Construction

We 3D printed a part to attach the window blind wand to the motor. It has four prongs which clip on to the motor. It also has a hole for the wand to go. By rotating the servo, the wand will rotate opening or closing the blinds.

Conclusion

Lessons Learned

We faced a few unforeseen challenges in the development of our design. When we were first ordering parts, we couldn't find photoresistors in the supply center catalog, so we ordered phototransistors instead and thought we would be able to make them work. However, after receiving the phototransistors and setting up a test circuit, using an ammeter, we were unable to detect any of the expected change in current when changing the light intensity. Afterwords, we checked the datasheet and realized the phototransistors were matched for specific infrared emitters and didn't change in response to visible light. We learned to check the datasheet and figure out the basics of how a device works before trying to put it in a circuit.

We also ran into a problem using the servo motor. When we had initially researched servo motors, a website said a PWM signal controlled the servo, so we tried to control it using a simple PWM signal from the Arduino. Our motor started smoking, and we had to go back to the drawing board. After reading some more into the servos, we discovered that the frequency of the PWM signal produced by analogWrite of the Arduino does not match with the frequency the servo is expecting to see. We found the servo library in the Arduino IDE and were able to operate the motor using that.

Self-assessment

Our design mostly completed the task we wanted it to. The photoresistors and servo motor ended up working how wanted them to, however, our design isn't completely functional yet. The 3D printed pieces we got were either too big or too small to fit on the servo motor, so we have no way to attach the servo motor to the tilt wand of the window blinds. Also, currently our two photoresistors are next to each other on the breadboard, so the input for the two is basically the same. If we had more time, we would use longer wires and separate the two sensors so one is much farther inside the room while the other sits near the window. This way the photoresistor will receive different inputs and lead to our desired result. Overall, we were able to accomplish the basis of opening and closing a window with circuitry, but the necessary mechanical components to put our design into use were missing.