

Problem Statement:

In the house I am renting with 3 roommates. Because we are all college students we do what we can to save money around the house, this includes trying to develop habits that limit our utility usage. One of the areas we can do this is by not keeping the fridge door open while we think about what we would like to cook or eat as this causes the fridge to use up more energy than usual as it tries to maintain its temperature with an open fridge door. For this reason I designed and programmed a circuit that would sit in the fridge and detect when the light in the fridge is turned on-- this happens when the fridge is open. It would then wait for 10 seconds before alerting a person that the fridge has been open for a significant period of time. Seeing this light would remind my roommates and I to not keep the fridge door open any longer than is absolutely necessary.

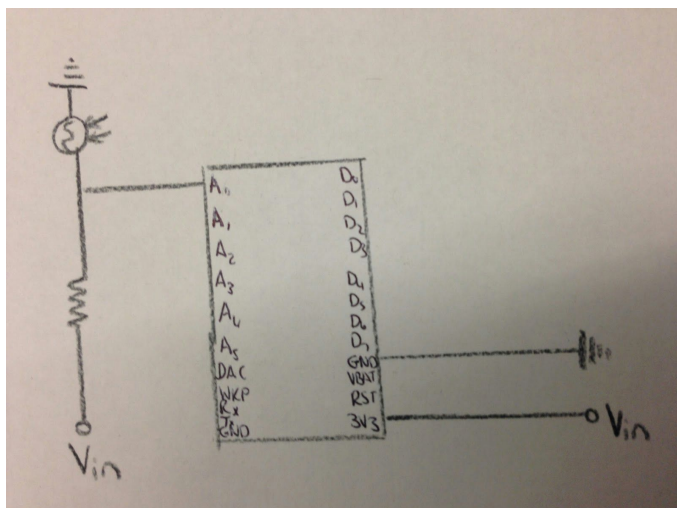
Goal:

I am going to create a product that senses when the fridge is open and notifies the user that they are causing the fridge to work harder because of with one colored LED. When the fridge is open for longer than 10 seconds the color of the LED will change prompting the observer to take action by closing the door. The intensity of this color light will increase the longer the door is left open thus providing a stronger urge as time goes on. There will be a second LED that will blink green when data is being collected while the other LED is not on to show that the unit is working.

Process: Show a record of your work as it progressed. This should include: components used, photos and videos of the circuits assembled, code (and versions of your code), reflections and challenges encountered, how you solved problems, iterated etc. Be able to tell the story of your work.

I started out by creating a circuit that provided the most central feature: alerting someone when the fridge had been open for a significant amount of time (over 10 seconds). I then coded the circuit to provide this functionality. Coding can be found in program 1 in appendix.

Picture of circuit with photoresistor and 1K-ohm resistor



I then decided that it may be useful to the users to other user to be able to review how long the fridge has been open when it is open for more than 10 seconds so they could look to changing their behavior or in the early stages at least improving. In the moment of engaging the fridge I programmed the LED to increase brightness as the length of time the fridge has been open increased over the 10 second threshold so that they would have a sense of this information. I did this by adding a println feature to my if statement for the fridge being open and an analogWrite function to my LED with an increasing intensity as time increased. Coding can be found in program 2 in appendix.

Picture showing output for program 2 on serial monitor display

```
Fridge has been open for:  
11 Seconds  
Fridge has been open for:  
12 Seconds  
Fridge has been open for:  
13 Seconds  
Fridge has been open for:  
14 Seconds  
Fridge has been open for:  
15 Seconds
```

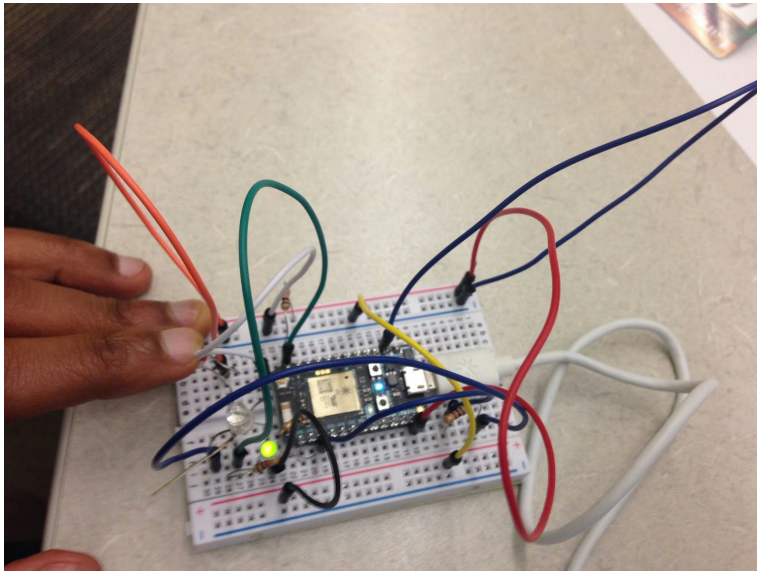
The last features I wanted to add was an LED to show that the device was working even when the fridge was closed. This will likely only have relevance for installation and if the person wishes to check that it is interacting with the cloud due to its usual placement in a closed fridge. Lastly I added a second color LED (using another color of the RGB LED) that would light when the fridge is open. This would remind the observer that they are currently increasing the fridge's power demand. Coding can be found in program 3 in appendix.



Outcome:

In the end I did not go further than the breadboard for the prototype and the serial display to show output. I have basic knowledge of programming and thus did not have the necessary skillset to take this further in the given time frame. If possible I would store the time information collected on the cloud and sum it so the users could see how many times the fridge had been open for extended periods of time and how long the fridge had been open over the course of the day. If we could see this it would spur us to improve continuously.

Picture showing circuits response to collecting data



Picture showing circuits response to fridge being open longer than 10 seconds



Reflection:

I had extremely low expectations as to how far my limited knowledge in creating a connected device would take me during this assignment. I was pleasantly surprised that I figured out how to build a product that had more features than my original product design had. I believe that having this trepidation had a positive effect on my process as I began by seeing if I could build the most bare bone version of the product first and continually adding to it as I progressed. This ensure that every feature was connected and programmed correctly as opposed to having a huge program and circuit that had mistakes that I would take longer to find.

If I did this in the future I would try to go even further by encasing the circuit and placing it in the fridge for a period of time to see how it behaved in real life scenarios. The only reason I did not do this is because I ran out of time. I would have liked to have added a speaker however after hours of trying I was unable to figure out how to make it sound when desired. Lastly I would want to be able to view the data on my phone and to give my roommates the same capability. I would need to know a little more about what tools are available to do this and how to use them.

Project summary:

I created a fridge notification system that alerts people when the fridge is open longer than 10 seconds in order to reduce the time the fridge stays open unnecessarily.

Appendix

Program 1

```
int ledPin= D0;
int photoCellPin = A0;
int i1=0 ;
int i2=0;

int photoCellReading=0;
int threshold= 1800;

void setup() {

  pinMode(ledPin, OUTPUT);
  Particle.variable("light",&photoCellReading, INT);
  Serial.begin(9600);
}
void loop() {
  int pirValState;
  photoCellReading = analogRead(photoCellPin);
  if (photoCellReading <= threshold){
    for (i1=0; i1<20; i1++ ) {
      photoCellReading = analogRead(photoCellPin);
      if (photoCellReading > threshold) {
        i2=i2+1;
      }
      delay(500);
    }
    if (i2=20){
      analogWrite(ledPin, HIGH );
    }

    photoCellReading= analogRead(photoCellPin);
    if (photoCellReading>=threshold){
      digitalWrite(ledPin,LOW);
      i2=0;
    }

    delay(1000);
```

```
}
```

Program 2:

```
int ledPin= D0;
int photoCellPin = A0;
int i1=0 ;
int i2=0;
int i3=0;

int photoCellReading=0;
int threshold= 1800;

void setup() {

  pinMode(ledPin, OUTPUT);
  Particle.variable("light",&photoCellReading, INT);
  Serial.begin(9600);
}
void loop() {
  int pirValState;
  photoCellReading = analogRead(photoCellPin);
  if (photoCellReading <= threshold){

    for (i1=0; i1<20; i1++ ) {
      photoCellReading = analogRead(photoCellPin);
      if (photoCellReading > threshold) {
        i2=i2+1;
      }
      delay(500);
    }
    if (i2=20){
      while (photoCellReading<threshold){
        i3=i3+1;
        analogWrite(ledPin, 100+ i3 );

        Serial.println("Fridge has been open for: ");
        Serial.print(10+i3);
        Serial.print(" Seconds");
        Serial.println();
        photoCellReading= analogRead(photoCellPin);
      }
    }
  }
}
```

```

    }
    Serial.println("Fridge has been closed");
    }
    photoCellReading= analogRead(photoCellPin);
    if (photoCellReading>=threshold){
    digitalWrite(ledPin,LOW);
    //noTone();
    i2=0;
    i3=0;
    }

    delay(1000);

}

```

Program 3:

```

int ledPin= D0;
int photoCellPin = A0;
int i1=0 ;
int i2=0;
int i3=0;
int SenseOn= D1;
int FridgeOpen = D2;

int photoCellReading=0;
int threshold= 1800;

void setup() {

    pinMode(ledPin, OUTPUT);
    pinMode(SenseOn, OUTPUT);
    pinMode(FridgeOpen, OUTPUT);
    Particle.variable("light",&photoCellReading, INT);
    pinMode(SpeakerPin, OUTPUT);
    Serial.begin(9600);
}

void loop() {
    int pirValState;
    photoCellReading = analogRead(photoCellPin);
    digitalWrite(SenseOn, HIGH);
    delay(1000);
}

```

```

digitalWrite(SenseOn, LOW);
if (photoCellReading <= threshold){
    digitalWrite(FridgeOpen, HIGH);
    for (i1=0; i1<10; i1++ ) {
        digitalWrite(SenseOn, HIGH);
        photoCellReading = analogRead(photoCellPin);
        if (photoCellReading > threshold) {
            i2=i2+1;
        }
        delay(1000);
        digitalWrite(SenseOn, LOW);
    }
    if (i2=10){
        while (photoCellReading<threshold){
            digitalWrite(SenseOn, HIGH);
            i3=i3+1;
            analogWrite(ledPin, 100+ i3 );
            delay(1000);
            Serial.println("Fridge has been open for: ");
            Serial.print(10+i3);
            Serial.print(" Seconds");
            Serial.println();
            photoCellReading= analogRead(photoCellPin);
            digitalWrite(SenseOn, HIGH);
        }
    }
    Serial.println("Fridge has been closed");
}
photoCellReading= analogRead(photoCellPin);
if (photoCellReading>=threshold){
    digitalWrite(ledPin,LOW);
    i2=0;
    i3=0;
}

delay(1000);

}

```