Project Deliverable F:

Prototype I and Customer Feedback

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Table of contents

List of figures

Introduction

This document is intended to summarize the initial prototypes and describe the steps taken to produce them. It is also meant to describe what each portion of the prototype succeeds in and what needs to improve based on the customer feedback. Based on the portions that need to be improved, the plans for the second prototype will be laid out with their reasoning also explained within the same section.

User Interface

Initial Design

In the initial design, the user interface was constructed with basic elements that essentially place holders for the final prototype. The title, logo and clock are intended to be final, however the images of the printers and the status bar beneath are placeholders which resemble the goal for the final prototype. Furthermore, the interface deals with multiple empty tabs, however if a final version of the project was assembled, then each tab will contain access to several printers.

Additionally, an 'About Makerspace button sends the user to the portion of the CEED website which talks about the makerspace in detail. Plus, a question mark is available at all times for the user to click on have the interface explained to them. Essentially, how each number corresponds to the printer.

Each printer will have a status bar underneath which will indicate to the user whether or not the printer is functional, non-functional, currently doing a print, or not doing a print.

Finally, the initial interface includes only two printers, however in the final prototype this skeleton will be copied for multiple printers. The functional system will most likely be applied to only one or two of the printers.

Customer Feedback

While the customer feedback was largely optimistic, the concern generally pointed to the same portion of the user interface. The customers and target users are concerned about the use of words to describe the state of the printer since the interface could reach a larger community of users than just the CEED staff.

Also, one CEED staff member said that, while the clock is extremely practical, it does not mean anything to users who are unaware of the opening and closing time of the space.

Plans for Prototype II

To address the issues regarding the use of words, the plan for the second prototype is to use words as a contingency to the new format. A coloured border will go around the name, or the video feed of the printer. For times where the printer is on, the colour will be green; off will be indicated by the colour red; and non-functional indicated by orange or yellow, both are colour will connote cautiousness.

In the future, the dashboard will be published as a website using an IP address and sampled HTML code in order to allow staff to access the data from anywhere. Part of this

publication will also include the possible addition of a mobile-friendly site for anyone using a phone or tablet.

Finally, the solution for the clock will be to simply add an opening time and closing time to the interface which will be able to inform any irregular users, or members outside of the uOttawa student community.
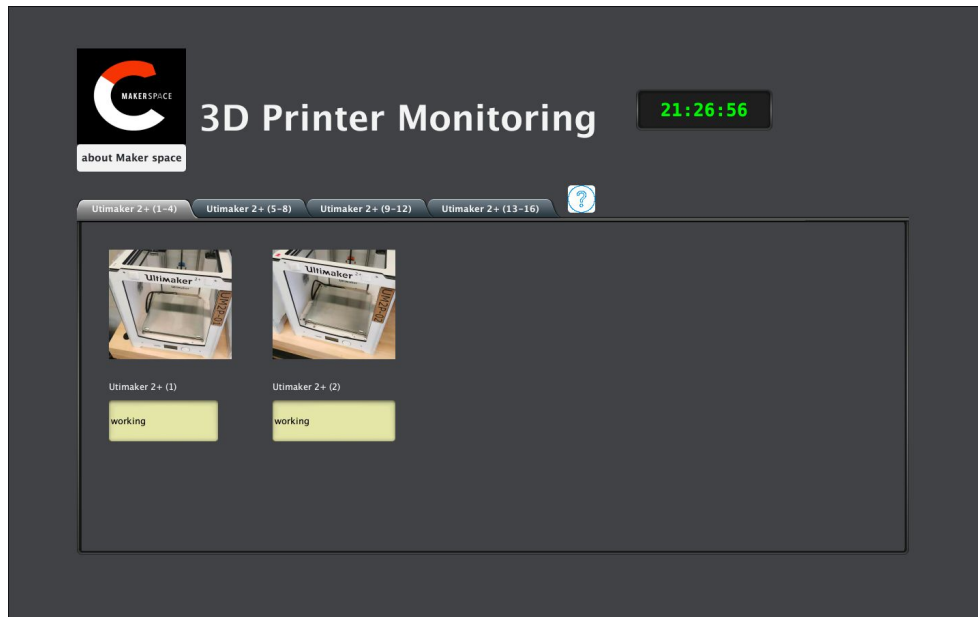

Figure 1: User Interface

Circuit design

Initial Design

The first edition of the physical logic that will be responsible for analog signals was created using the Node MCU, a breadboard, an LED and some additional logical components. In the current stage the motion sensor sends an analog signal to the Node MCU which then converts into a digital signal, which can be computed by a computer. This signal is then processed by a small program (Listed below in 'Source Code'). Finally the computers sends another signal back to the Arduino which turns on an LED attached to a breadboard.

The LED is simply used to ensure that the circuit is processing the signal properly and is not intended to be part of the final version. Also, a resistor is used to protect the circuit from electrical overflow.
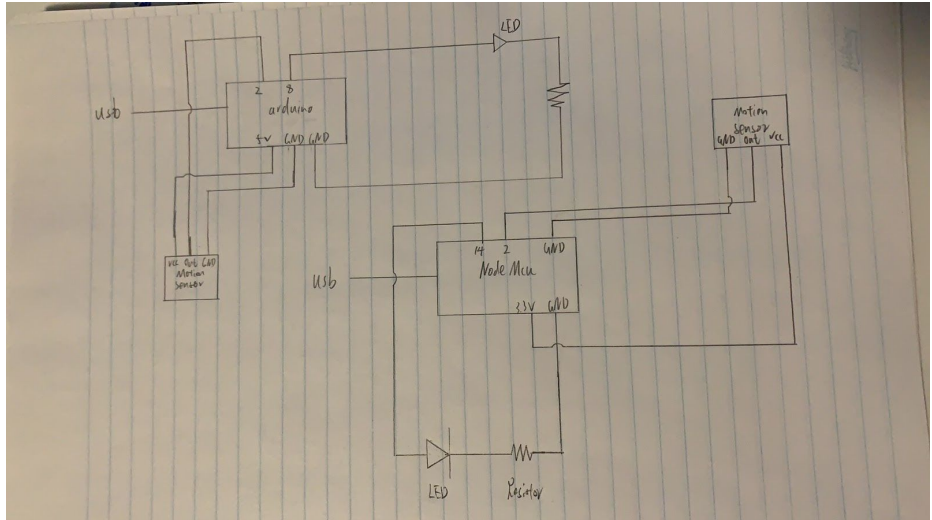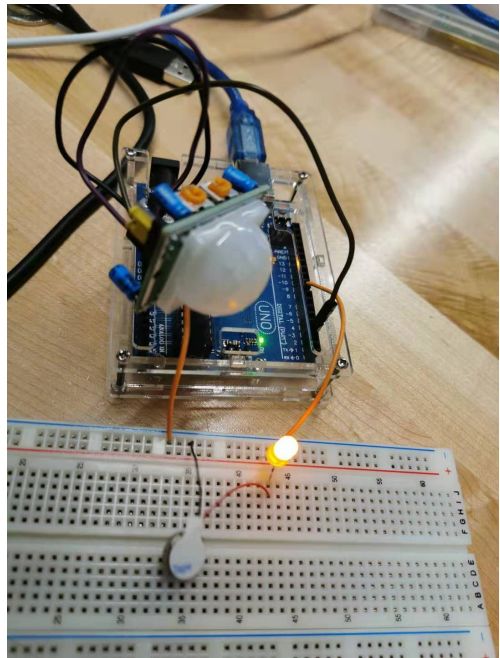
Figure 2: Sample Sketch of Circuit
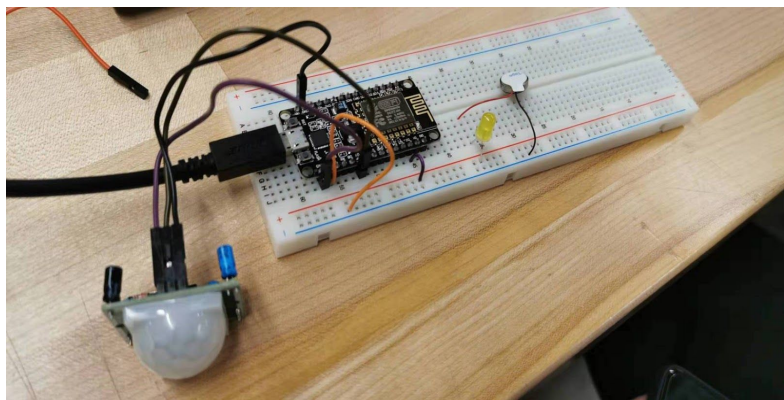

Figure 3: Prototype of Circuit

Plans for Prototype II

The subteam working on this portion of the project plans to begin sending signals to the dashboard which will trigger changes to the interface available to the users (Described in 'User Interface'). Additionally, the team will work on condensing the the circuit and preparing it for the cases which the components will go into for the final version.

The plans for the final version includes feed from a camera which will send video of the printer while it completes a print. However, this is more of a pipe dream for the team. If this addition to the circuit hinders the overall functionality it will most likely be scrapped in favour of a more stable and consistent system.

Soldering all components to a proto board will be reserved for the final edition of the project since this will be a mostly permanent process.

Case Design

As it stands currently, the circuit, the boards and the motion sensor are all exposed and are quite obtrusive. In order to protect these components from their surroundings the subteam leading the physical components will be designing a case to hold all components and will be attached to anything used to mount these components rather than directly attaching components to the printers.

Each container will have a hole for the jump wire to connect the components and the boards together. Then, the container containing the protoboard will have a slot for an LED which will serve as a physical contingency. Essentially, if the circuit is doing anything the LED will turn on. The case for the motion sensor and the camera will have a hole big enough so that each component will still be capable of collecting their necessary data without being impeded.

During testing, the motion sensor tended be extremely sensitive meaning that an acrylic cover will be needed to protect from anything that could cause inaccurate readings.

Since the Node MCU has internet capabilities, a case will be needed to protect its data from being corrupted by surrounding noise from nearby phones and computers.
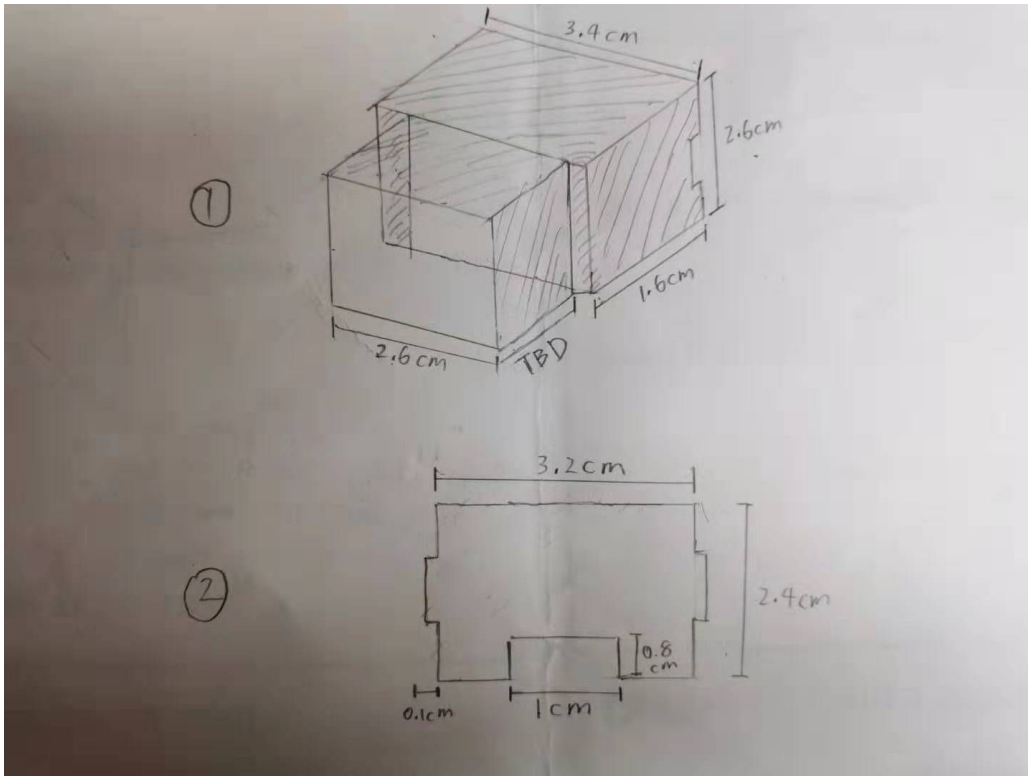
Figure 5: Motion Sensor Case

IDE code

In its present state, the code is not simply seeing if the motion sensor detects any motion. This is because the printer will briefly stop moving when it changes layers, or perhaps the arm could be blocked by a speck of dust. For instance, the code must account for this, meaning that it cannot take a signal every fraction of a second. Detecting after longer periods of time lends to a far more consistent and reliable program for detecting actual change in the printer.

In the future, the program will be tweaked to provide the most optimal solution for the time interval.

```
int record[15]={0,0,0,0,0,0,0,0,0,0,0,0,0,0,0};
int flag=0;
int i;

void setup() {
  Serial.begin(9600);
  pinMode(13,INPUT);
  pinMode(4,OUTPUT);
}

void loop() {
  int motion=digitalRead(13);
  int sum=0;
  for(i=0; i<14; i++){
    record[i]=record[i+1];
    sum=sum+record[i];
  }
  record[14]=motion;
  sum=sum+motion;
  if(sum>=10){
    flag=1;
  }else{
    flag=0;
  }
    if (flag==1){
    Serial.println("working");
    digitalWrite(4,HIGH);
  }else{
    Serial.println("free");
    digitalWrite(4,LOW);}
  delay(500);
 }
```

Conclusion

In summary, the first prototype is a bare bones and stripped down version of the final goal. The current state of the physical components is a breadboard and sketches for their cases. For the software and user interface, currently there is only a basic display which has no real life connection.

For the next prototype, the team will clean up the circuit work and finish the models for the cases for each component. Additionally, regarding the circuit, the subteam will work on adding camera capabilities that will allow users to view what is being printed in real time. The software team will work on improving the user interface to include the camera feed; a clock that will tell users how long until the Makerspace closes; and a more user friendly, colour coded system that will indicate whether a printer is currently printing or not.