GNG1103

Technical Report

Prototype III customer feedback

Submitted by

TEAM 10

[Ella Fossum, 300076269]

[Sandra Michael, 0300142873]

[Het Patel, 300143987]

[Bassam Mahdi, 0300041252]

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University of Ottawa

Introduction

During development of our two prototypes of the project, our group had experienced a couple of specialized troubles which had driven us to structure a third, increasingly proficient, model. In this report we examine our second prototype and focus on solutions to improve the quality of our final product. We discuss client and user feedback that will be taken in to consideration to improve the design and fulfill their needs.

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Test Objectives Descriptions

SPECIFIC TEST OBJECTIVES

Prototype 1

We have defined objectives to guarantee our final product will turn out to be increasingly refined with every prototype. All of the issues raised in the prototyping process will have been addressed. Our first prototype was a low-fidelity model regarding function. It did however model a primary idea of our user interface. From this prototype we showed the display to our peers and users at MakerSpace to receive feedback on the aesthetics.

We were told that the interface was too crowded and that the text was too small. These were two factors that we modified and improved upon for our second prototype of the UI.

Prototype 2

Our second prototype focused on the circuit of the product. Our group concentrated on building a circuit which can run reliably so we could accurately test our Dashboard and arduino codes. The magnetic reed switches that were ordered had not yet arrived, so we implemented a tact switch and a LED to test the feasibility of our circuit utilizing the nodeMCU.

At this point, we connected our Dashboard UI to the nodeMCU and programmed one fully functional text display box. This box displayed the text “IDLE” when the tact switch was being pressed, and “PRINTER IN USE” when the button was not pressed. Our goals for the next prototype were to incorporate a colour changing feature to these buttons, and add two more sensors and two more text display boxes to test the ability of our product to handle input from multiple sensors at once.

Prototype 3

Our final prototype incorporates the functional circuit with the proper sensor and used it to send usable data to the Dashboard via the nodeMCU. At this point, all the data can be accurately read and transmitted to Dashboard so the current focus is to improve the aesthetics of our product.

We need to test our sensor support structure by mounting it on a printer and observing the results. In particular, we will look for how stable the structure is, if there is any heat interference that may melt the glue, and if the current positions of the sensors allow for them to accurately read the status of the printer.

POSSIBLE TYPE OF RESULTS

This prototype could lead to numerous types of results. After getting feedback on our second prototype, we found out that the Ultimaker 3D printers operate at really high temperatures, so we have to guarantee this factor won't affect the information gathered by sensors. We likewise need to observe any possible effects from magnetic fields. Since our sensor works through magnetism, any solid outside magnetic forces could possibly be unfavorable to the capacity of our sensor.

CRITERIA FOR SUCCESS AND FAILURE

SUCCESS	**FAILURE**
● Have three fully functional button ○ timer able to start when the magnetic reed switch is disengaged, functional light system indicating which printer is available/used/not	● Errors in Dashboard code ○ If the button on the user interface does not function properly → timer doesn't start and/or the light system does not accurately represent the state of the printer, wires

functioning	interfere with the movement of the printer's arm, magnetic sensors placed either too close/far from each other which might affect their ability to detect each other
• Non-interfering wires ○ The wires wouldn't interfere with the movement of the 3D printer's arm, preventing it from moving around its entire surface	• The wires impede the function of the 3D printer

• Efficient sensors
  ○ The magnetic sensors are able to interact and to detect whether the printer's arm is at rest or working
	• External interference
	  ○ Any magnetic fields surrounding the 3D printer cause the magnetic reed switches to malfunction
	  ○ The heat coming from the 3D printer interferes with the sensors

• Stable support structures
  ○ The magnetic reed sensors are securely attached to the sensor support structure and the
	• Unstable support structures
	  ○ The sensors slip off their support structure because they are not attached properly. The

nodeMCU fits properly in its box support structure. Both structures must also be properly mounted onto the side of the printer and gripped on it through a hook support system concept.	hooked part of the supports do not fit the side of the printer.

Table 1: Table outlining which criteria of our product's prototype is considered as successful or a failure depending on the goals set for the design.

Project Plan and Execution

The third prototype of our design is of type comprehensive. At this step of our design process, we are combining all of our subsystems together; our Dashboard UI, the circuit and nodeMCU, and the support structures. All three of the major subsystems have been tested together to see if the signals are sent properly through the sensors, the circuit, the nodeMCU and the arduino board. The reason for the selection of a comprehensive type of prototype was to ensure that our product works as one unit allowing us to readjust our design, if needed.

TESTING PROCESS

1. User Interface

1.1. Arduino and Dashboard code

As it stood, the sensors passed a 1 or a 0 to the nodeMCU, which then relayed that information with respect to the pin it came from to Dashboard. During the test, we found out that while the system did work, we had incorrectly assigned the 1s and 0s in our Dashboard code, meaning they represented the opposite of what we wanted them to; when the sensors detected a printer in use, our Dashboard said that printer was idle. This was a quick fix– we simply

swapped the 1s and 0s in our switch function in dashboard, which got the program up and running as intended.

```
while (1) {
  // This will send the request to the server

  // Read pin for printer 1
  printerState = digitalRead(printer1);
  if ( printerState == 0 ) {     // Send the button value to Dashboard
     client.println("1,0");
  } else {
     client.println("1,1");
  }

  // Read pin for printer 2
  printerState = digitalRead(printer2);
  if ( printerState == 0 ) {     // Send the button value to Dashboard
     client.println("2,0");
  } else {
     client.println("2,1");
  }

  // Read pin for printer 3
  printerState = digitalRead(printer3);
  if ( printerState == 0 ) {     // Send the button value to Dashboard
     client.println("3,0");
  } else {
     client.println("3,1");
  }

  delay(500);
}
```

Figure 1.1.1: Sample segment of arduino code which is receiving information from the sensors

```
if (event.getEventType()==1) {
   var rawData = event.getBytesAsString();
   ogscript.debug(rawData);

   var inputArray = rawData.split(",");

   switch (inputArray[0]) {
      case "1":
         switch (inputArray[1]) {
            case "0":
               params.setValue('printer1status',0,"IDLE"); //change text to "idle"
               ogscript.setStyle('printer1','bg#288A2C'); //change colour to green
             break;

            case "1":
               params.setValue('printer1status',0,"PRINTER IN USE"); //change text to "printer in use"
               ogscript.setStyle('printer1','bg#A90B0B'); //change colour to red
               break;

            default:
               params.setValue('printer1status',0,inputArray[1]); //display raw data input
               ogscript.setStyle('printer1','bg#FFF748'); //change colour to yellow
               ogscript.setStyle('printer1','fg#000000'); //change text colour to black
         }
         break;
      case "2":
         switch (inputArray[1]) {
            case "0":
               params.setValue('printer2status',0,"IDLE"); //change text to "idle"
               ogscript.setStyle('printer2','bg#288A2C'); //change colour to green
             break;
```

Figure 1.1.2: Sample segment of Dashboard listener function which converts data into readable information

1.2. Dashboard User Interface

The Dashboard testing involved showing our functional display to peers and MakerSpace users to gather feedback and gauge their reactions. The feedback we received told us that our visual display still needed work. The colour yellow was overwhelming to people and the grid-like structure made it hard on the eyes, This feedback will be incorporated and tested again before Design Day.

Figure 1.2.1: Prototype 3 of our Dashboard UI

2. Circuit

For this prototype, we added an additional two magnetic reed switch sensors into our circuit, in order to show that our system can handle more than one input at a time. Since we are going to place our circuit inside a box that will be hooked on the side of the printer, we decided to use a 9V battery to power the nodeMCU instead of connecting it to a computer.

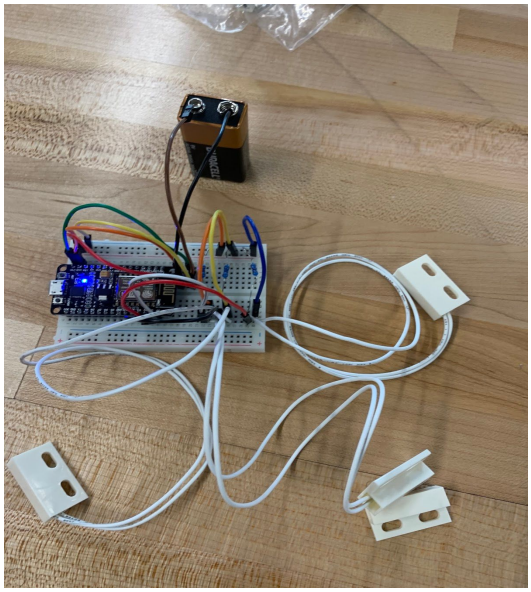

Figure 2.1.1: Prototype 3 including the three sensors, the nodeMCU, and an external battery.

3. Support Structures

In order to design and build the sensor's support structure, our team had to measure the dimensions of the region where it will be located on the printer as well as the distance between the two thumb screws of the printer's arm. The structure was then designed using Solidworks and 3D printed using an UltiMaker 3D printer, in MakerSpace. The length dimension of the first prototype, shown in *Figure 3.1.1*, was too large for the printer and could have interfered with the movement of the arm, once the sensor would have been placed above it. Furthermore, the gap of Part A which consists of the simple hook system of the structure was too narrow and did not fit on the printer, as demonstrated in *Figure 3.1.1.* According to these defaults, the second prototype was designed with a smaller length (4.7 cm instead of 5.2 cm) and a wider gap (0.9 cm instead of 0.6cm). Once the adjustments were made, Part A of the second prototype, shown in *Figure 3.1.2* , successfully fit onto the printer. The next step to finalize this subsystem is to glue an elastic onto Part B which will then be wrapped around the thumb screws for stability. The sensors will also need to be glued to both Parts and tested, once they are placed, to ensure they are engaging appropriately with each other.

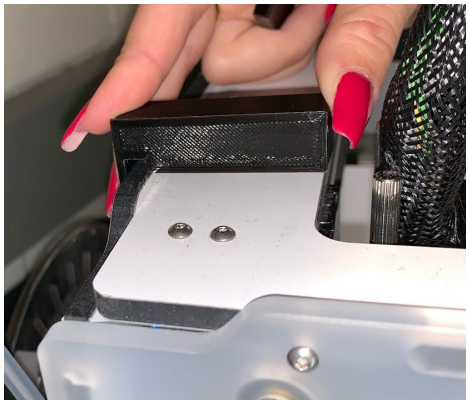

Figure 3.1.1 : Part A of the first prototype of the sensor support structure subsystem.

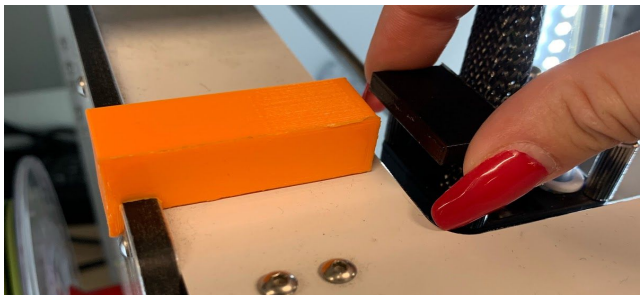

Figure 3.1.2 : Part A (in orange) and B (black) of the second prototype of the sensor support structure subsystem.

REQUIRED MATERIALS/ COST APPROXIMATION

Item number	Part name	Description	Quantity	Unit cost	Total cost
1.	Magnetic reed switch	an electrical switch that switches when a magnetic field affects it	3	$8.00	$24.00
2.	nodeMCU	Microcontroller featuring Wifi chip	1	$11.99	$11.99
3.	Dashboard	an open platform that enables users to use custom panels that makes complex operations simple.	1	Free	Free
4.	Breadboard	solderless device for temporary prototype with electronics and test circuit designs.	1	Free (borrowed from MakerSpace)	Free
5.	Wires	Electrical wire with pin at each	3		

		end			
total cost					$35.99

Table 2: Cost Approximation of our product's production.

DEPENDENCIES

1. Sensors

The sensors, which will be placed on three different UltiMaker printers, could only be tested once the proper sensors came in. This specific testing consists of one of the last steps of the design process. Also, the sensors could not be permanently glued onto their support structure nor could their wires be soldered to the perboard until we are assured that the entire system is functional.

2. Arduino and Dashboard Code

The programming aspect of this prototype took a long time to develop, but once we sorted through the syntax errors, it was time to test to make sure the program did what we wanted it to do. To properly test the code, we needed to have our functional circuit with the three sensors attached. It was essential that we knew the circuit was functional so that we could isolate any errors to the Dashboard or arduino code.

3. Sensor System

To finalize the sensor supports, we needed the full information relay system to be functioning reliably. This way, if the sensors malfunctioned while attached to the printers, we would know that the error came from the placement of the sensors rather than the code or the circuit.

In addition, we needed the circuit to be soldered before creating the box that would hold the nodeMCU. For this part to be made, we need to know the exact dimensions of the perboard and nodeMCU to ensure the box can hold the product.

GANTT CHART

Task	Estimated Task Duration	Projected Due Date	Responsibility
Discuss issues with previous prototypes, create solutions	1 Hour	November 12	Team discussion
Determine materials needed for prototype	30 Minutes	November 12	Team discussion
Create final sensor section and attachment device	4 Days	November 13	Het
Create final microcontroller setup	6 Days	November 17/18	Ella, Bassam
Establish functional Dashboard user interface	5 Days	November 17/18	Ella
Install sensor to sample 3D printer	1 Hour	November 17 18	Sandra, Het
Compile components and work through any errors	1 Day	November 17/18	Team collaboration
Test the prototype	1 Day	November 19	Team collaboration
Make changes if needed	3 Hours	November 20	Team

			collaboration
Refine design and create last minute features, time permitting	2 Hours	November 20	Team collaboration

Table 3 : Gantt Chart of the process of development for the third prototype.

Conclusions and Recommendation for Future Work

The goal of our final product is to help users of the MakerSpace locate available 3D printers, and monitor current 3D printing jobs. This deliverable provides information about building and the changes that were made to our third prototype after getting feedback on our second prototype. In addition, information about the materials that are required to construct the third prototype and the detailed test procedure are included.