GNG1103

Technical Report

Prototype 2: Test Plan and Results

Submitted by

TEAM 10

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Date: November 7th, 2019

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Introduction

After working on developing our project's first prototype, our team had encountered a few technical difficulties which had led us to design a second, more efficient, prototype. In this report, a critical analysis of our first prototype will be given as well as alternative solutions to enhance the quality of our product. Furthermore, customer and user feedback will be taken under consideration in order to satisfy their needs.

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Test Objectives Descriptions

SPECIFIC TEST OBJECTIVES

Prototype 1

We have set goals to assure our product will become more refined with each prototype. By the time we present our final project, all of the issues raised in the prototyping process will have been addressed. Our first prototype was a low-fidelity model in terms of function, but represented the aesthetics and position of the components in the final product.

Prototype 2

Our second prototype focuses on the circuit component of the project. Our team focused on developing a circuit which will be able to work reliably when the sensor is engaged and disengaged. Since we have not received the shipment of our magnetic reed switches, we used a tact switch and a LED to test the viability of our circuit using the nodeMCU. The Dashboard programming side of our project is currently underway but is not yet functional.

Prototype 3

Our final prototype will incorporate the functional circuit with the proper sensor and send usable data to the Dashboard. We are aiming to have the information displayed accurately and will focus on aesthetics with our extra time.

POSSIBLE TYPE OF RESULTS

This prototype could lead to numerous types of results. After getting feedback on our first prototype, we realized that we would have to face some difficulties posting our users interface to a URL. We switched our sensor from a tact switch to a magnetic reed switch which will allow us to gain more reliable data with a wider margin of error.

For the future prototypes we do need to be aware of any possible interference from the printer. The Ultimaker 3D printers operate at extremely high temperatures so we need to ensure this factor will not have an effect on the data collected by the sensors. We also need to limit interference in the form of magnetic fields. Since our sensor works through magnetism, any strong external magnetic forces would be extremely detrimental to the function of our sensor.

USING RESULTS

Based on the results of our first prototype, some adjustments and modifications are made in order to improve the entire system. We received feedback from RossVideo which let us know that creating a Dashboard custom panel that could be accessed online would be difficult. It is for that reason that we decided to make our final product function only on a specific tablet or laptop. Having a public domain to access this information will be a hypothetical future goal for our product, but will not be realized for the purposes of this class.

This first prototype also raised a few concerns from the coding side of things. The team in charge of programing the custom panel have run into some issues with changing the display colour of a parameter based on the value of the variable. These issues will be studied and addressed by the third prototype.

CRITERIA FOR SUCCESS AND FAILURE

SUCCESS	FAILURE
● Have one fully functional button ○ timer able to start when the magnetic reed switch is disengaged, functional light system indicating which printer is available/used/not functioning	● Opposite of the "SUCCESS" column ○ 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 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

Figure 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

PROTOTYPE TYPE

Although our first prototype was of type comprehensive, our second prototype is more focused. Since our team did not receive the key element of our project, the magnetic reed switch, the main focus of this prototype was on assuring that the circuit was functional and properly connected. Testing was done using a tact switch and an LED, instead of the magnetic sensor.

TESTING PROCESS

In this prototype we could not do as much as we had initially planned since we did not receive the magnetic reed switch. We were unable to connect our sensor with the nodeMCU and connect the nodeMCU to our Dashboard. Even though we have not yet received the magnetic reed switch, we built and tested a circuit using a tact switch. This won't perfectly represent our final prototype, but it allows us to be certain that our circuit is functional when we test it with Dashboard.

To test the circuit, we pressed the tact switch and made sure that the light was illuminated while the button was being pressed. This simple circuit forms a basis for our final prototype. In the final version, the tact switch will be replaced by a magnetic reed switch, and the light will actually be information being sent out to our Dashboard.

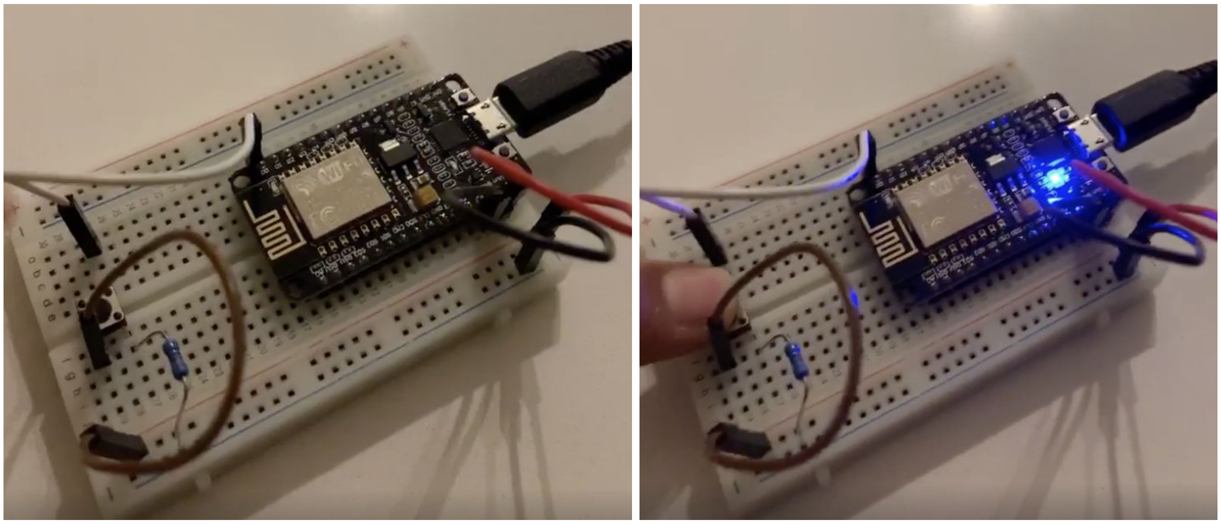

Figure 1: Prototype circuit with LED using nodeMCU and tact switch

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 + shipping	$13.24
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 end	3		
total cost					$37.24

Table 1: Cost Approximation

DEPENDENCIES

For this prototype, the main dependency our team is facing is receiving the magnetic reed switch. Once we receive this crucial piece for our product, we will be able to complete our programming on

Arduino, properly connect the wires to the right pins on the Arduino board, and find a strategic placement for it on the 3D printer. Furthermore, once we receive the magnetic sensor, we could test our product and see if each subcomponent is connected correctly to each other and if the system itself is functional or not.

Another dependency we are currently facing regards the coding. One team member is responsible for connecting Dashboard to the nodeMCU in the presence of wifi while another team member is responsible for creating a code on Arduino which intake data from the sensor and sends it to the nodeMCU. Hence, the design of each member relies on each other. For instance, both need to use the same variable names and if one person designed a code that inputs data, the other's program must output the data accordingly.

GANTT CHART

Task	**Estimated Task Duration**	**Projected Due Date**	**Responsibility**
Discuss any changes to the design that need to be implemented, choose subsystem to prototype	1 Hour	November 6/7	Team discussion
Determine materials needed for prototype	1 Hour	November 6/7	Team discussion
Divide team into subsections and begin work on each element of subsystem	5 Days	November 7	To be determined
Combine elements and address errors	1 Day	November 12	To be determined
Test the prototype			Team discussion
Observe and note changes to be made			Team discussion

Table 2 : Gantt Chart of the process of development for the second prototype.

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.

REQUIRED RESULTS

After further analysis of the first prototype, some modifications and decisions were made by our team. The ideal goal of this project was initially to be able to display a Dashboard which could be accessed through a website. However, after receiving feedback from a RossVideo professional, we were informed that our hypothetical goal might not be realistic. Hence, the alternative solution is to have access to the availability and condition of three different Ultimaker 3D printers in MakerSpace.

Furthermore, once the magnetic reed switch is installed and functions properly, the data that it receives, if it detects the other sensor or not, should be sent and processed by the Arduino board. The data output by the Arduino board is sent to the nodeMCU, which then is delivered to the Dashboard via wifi. When the two magnets are engaging (very short distance from each other), this should indicate that the printer is available and should display a green idle on Dashboard. In contrast, when the magnets are not engaging, the printer is in use and the idle displayed in Dashboard should be red.

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 second prototype after getting feedback on our first prototype. In addition, information about the materials that are required to construct the second prototype and the detailed test procedure are included.

Bibliography

MakerStore. “Electronics, Materials, and Merch.” *MakerStore*, makerstore.ca/shop?olsPage=t%2Felectronics&page=2.