GNG1103

Technical Report

Prototype 1: Test Plan and Results

Submitted by

TEAM 10

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Introduction

Our final product will be a fully functional, attractive, easy to use system which will help users of the MakerSpace locate available 3D printers, and monitor current 3D printing jobs. In order to reach this goal, our team is tasked with developing a series of prototypes which can be used to learn how to use the given tools to our advantage, identify and fix any problems that we encounter, and get feedback from our customers and users. In this report we will outline our plans and goals to create useful prototypes that we can learn from and build on.

Test Objectives Description

SPECIFIC TEST OBJECTIVES

We have set goals to assure our product will become more refined with each prototype, and that by the time we present our final project, all of the issues raised in the prototyping process will have been addressed. Our first prototype is a low-fidelity model in terms of function, but will represent the aesthetics and position of the components in the final product. For this prototype, we are looking for customer feedback that will help us hone our design to create a final UI and sensor system that pleases the eye and is easy to use and understand.

For the first prototype, we are looking for customer feedback that will help us hone our design to create a final UI and sensor system that pleases the eye and is easy to use and understand.

Future prototypes will have high functionality and will allow us to identify and solve problems with the network connections, sensor wire location, and eventually solve issues posed by beta users.

POSSIBLE TYPES OF RESULTS

The development of our project's prototype could lead to numerous types of results. For instance, after designing and programming our user interface using Dashboard, the customer may suggest some changes or voice some criticisms. Furthermore, the type of

sensor used for our designed mechanism is a magnetic sensor. Although it is extremely efficient and reliable, there could be some technical difficulties connecting the sensor to nodeMCU. If the two components are not properly connected, our entire system would not be functional and it would be difficult to find the error once it is connected to Dashboard.

USING RESULTS

Based on the results of our first prototype, some adjustments and modifications will be made in order to improve the entire system. For example, depending on our findings with the magnetic sensor, we might consider using another type of sensor such as a tact switch or ultrasonic sensor. Also, the exact distance between each magnet will need to be more accurate, and will be determined after examining how the magnets of our first prototype interact together. However, if the magnetic sensor is fully functional while being reliable and easy to operate, then we will keep the sensor and only modify the aesthetics of the setup. Considering that the sensor will have wires connecting to the nodeMCU and that the arm of the printer will be moving around, a risk of interference must be considered. Once we test our prototype, a strategic placement of the wires will need to be determined to minimize interference.

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).	• Technical difficulties connecting the nodeMCU to Dashboard and the sensor
• Efficient sensors (The magnetic sensors are able to interact and to detect whether the printer's arm is at rest or working. Also, they are placed at an appropriate distance from each other).	• Magnetic interference of sensors (Components surrounding the sensors which also have a magnetic field might interact with the sensors lead to false signals).

Figure 1: Table explaining 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

The prototype type our team has selected is a high visual fidelity comprehensive model. The reason being that this selection gives a better overview of our design and would give us the most useful feedback. It incorporates all of the product subsystems and allows us to evaluate all of our different subsystems individually before they are properly integrated together. This way, further testing could be done once all the subsystems are connected.

TESTING PROCESS

This prototype mostly explains how our final product is going to look and how it will function. Magnetic reed switch will be attached to the wall of the 3D printer and with the help of that it will be detected if the printer is in use or not.

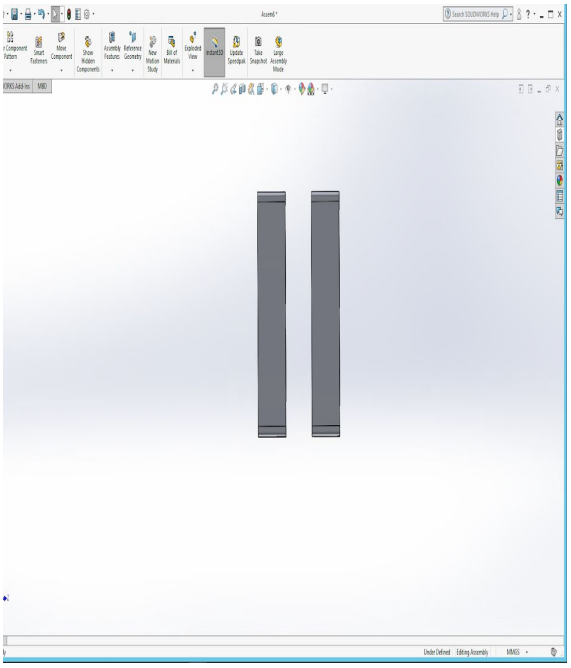


Figure 2: Magnetic reed switch when the magnets are disengaged, indicating the 3D printer is in use.

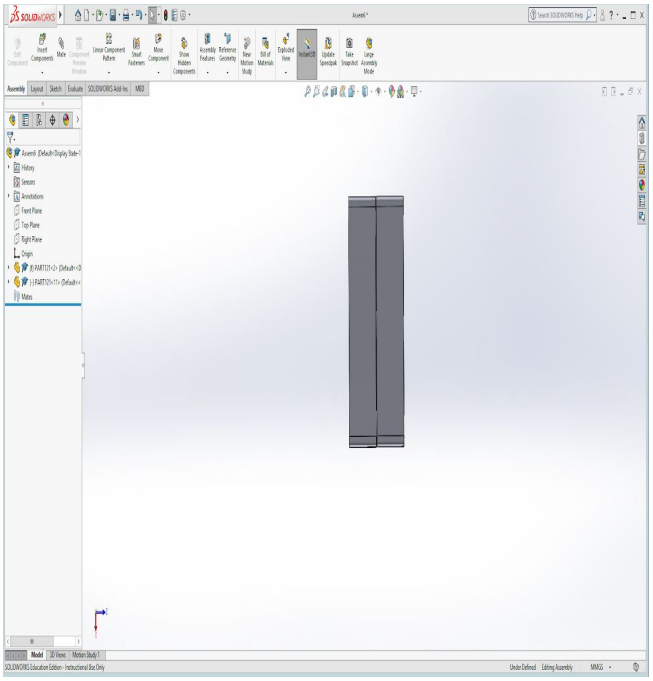
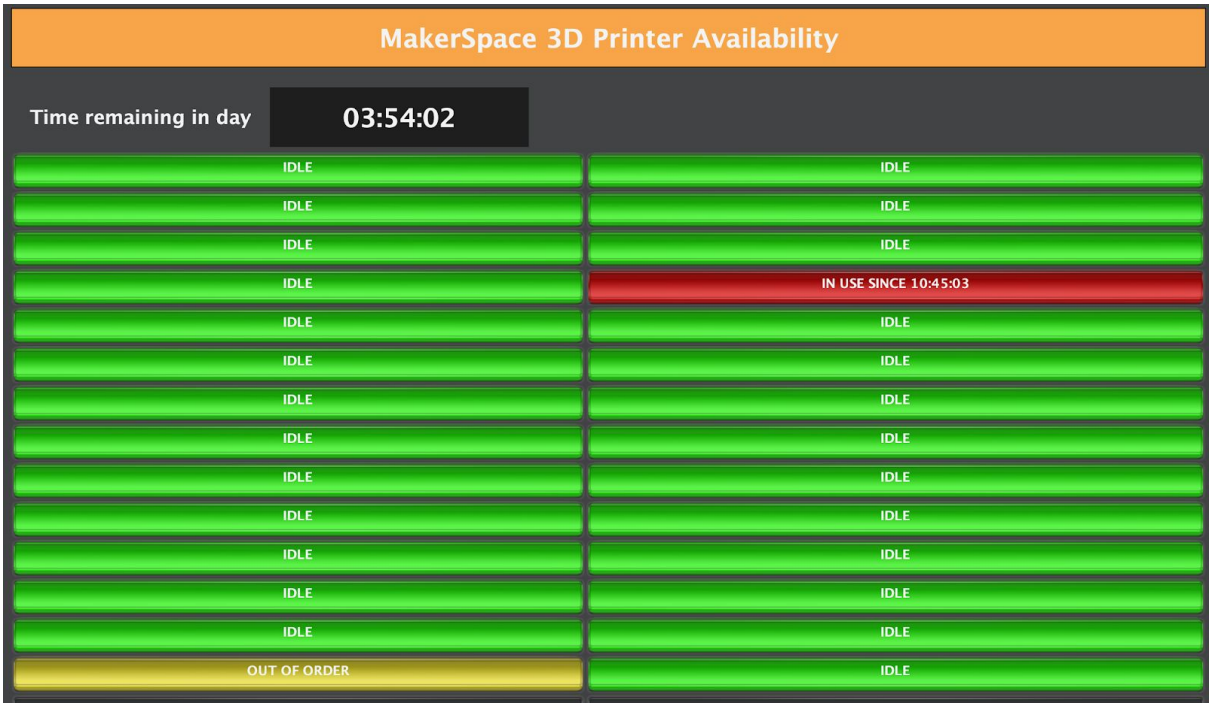


Figure 3: Magnetic reed switches are engaged, indicating that the 3D printer arm is at rest and hence, not in use.

Prototyping, Testing and Customer Validation

The following is a screenshot of our first UI prototype on dashboard. The custom panel does not work but clearly models all current proposed features as well as colours and layouts to be used. This will allow us to analyze and improve on the aesthetics before creating our final prototype. As it was mentioned in the RossVideo lab tutorial, it is best to do a “napkin sketch” of your panel before creating it, as the features are difficult to edit once the panel has been made and the software has been set up.

This prototype is mostly about testing if the circuit is working, the nodemcu connected to dashboard.



MakerSpace 3D Printer Availability

Time remaining in day 03:54:02

IDLE	IDLE
IDLE	IDLE
IDLE	IDLE
IDLE	IN USE SINCE 10:45:03
IDLE	IDLE
IDLE	IDLE
IDLE	IDLE
IDLE	IDLE
IDLE	IDLE
IDLE	IDLE
IDLE	IDLE
IDLE	IDLE
IDLE	IDLE
OUT OF ORDER	IDLE

Figure 4: An ideal representation of Dashboard user interface. The timer hypothetically indicating the amount of time remaining in the day and the light system to indicate when a 3D printer is available (green button), unavailable (red button) or out of order (yellow button).

INFORMATION BEING MEASURED

The first prototype mostly represents the aesthetics and position of the components in our final product; it is not fully functional. Thus, during our testing for our prototype we measured the distance between 3D printer wall and its extruder so the tack switch can fit in between perfectly.

RECORDED INFORMATION

Our progress throughout the development of prototype 1 is being observed with pictures and solid work modeling. We had to modify specific parts of the prototype by problem solving the obstacles we encountered. Finding the most efficient source of glue to attach the tack switch between the printer wall and its extruder. Making the prototype interface(model and diagrams) as reliable and understandable as possible.

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	1	$8.00	$8.00
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	1		
total cost					$21.24

DEPENDENCIES

The biggest dependency in our project is that we need a functioning sensor system before finishing the Dashboard custom panel. The coding used in Dashboard is new to all members in the group so it is crucial to have something to reliably test our program to ensure

it works. We also need to have an input to build our panel around, and this cannot happen until we have some sort of sensor system up and running.

To create our sensor system with the magnetic reed switch, we need to do a lot of research into circuits and contact sensor setups to be able to create a high functioning system. This system needs to work reliably to ensure that any errors come from Dashboard rather than the sensor when the two systems are linked.

GANTT CHART

Prototype 1

Task	Estimated Task Duration	Projected Due Date	Responsibility
Decide on the premise of the prototype	1 Hour	October 22	Team discussion
Create sample non-functional Arduino board displaying the information flow from	1 Day	October 29	Bassam
Design and build mock-up rig to attach reed switch to Ultimaker	2 Days	October 29	Sandra, Het
Construct Dashboard user interface with basic functions	2 Days	October 29	Ella
Compile components and work through any errors	3 Days	November 4/5	Team collaboration

Prototype 2

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	5 Days	November 7	To be determined

and begin work on each element of subsystem			
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

Prototype 3

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
Present the prototype to our client	**Milestone**	November 21	Team collaboration

REQUIRED RESULTS

Our final prototype needs to be a high fidelity model that works in all technical fronts. The Dashboard must be able to display accurate real time data from the sensor system, which must reliably record the status of the Ultimaker 3D printers in the MakerSpace. The final website should be able to be accessed from anywhere on campus. The real results come after we've tested our product with beta users to troubleshoot any unforeseen issues with the user experience.

Conclusions and Recommendations for Future Work

Our goal is to help users of the MakerSpace locate available 3D printers, and monitor current 3D printing jobs. This deliverable provides information about starting and building the first prototype. Our first prototype is mostly represents the user interface and also where and how the component of the final project will be placed. In addition, information about the materials that are required to construct the first prototype and the detailed test procedure are included.

Bibliography

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