GNG1103

Technical Report

Prototype I and Customer Feedback

Submitted by

Project Group 19

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Abstract

This project is being executed because we want to solve problems regarding the automation of STEM. We have empathized with our clients by becoming users in their space and listening to their needs. We then defined a problem statement in which we highlighted the main problems. We have ideated to assist in brainstorming possible designs and solutions. We created an initial prototype in which it deemed successful based on our criteria to evaluate it.

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1 Introduction

The current system for 3D printing lacks automacy. A lot of time is wasted by users because they must enter Makerspace to check on their print frequently. The process of selecting a printer, signing out a SD card, preparing the STL file, uploading the g-code on to the SD card, and starting the print can take upwards of ten minutes. Not only that, some computers are not compatible with the larger SD cards, meaning that the user will need an adapter to save the g-code onto the SD card. Group 19 seeks to improve the speed of this process by uploading g-code from a single computer in the Makerspace which will eliminate the tedious process users have to currently go through. The basic user requirements will ensure that the solution created will make users work efficiently and productive while using Makerspace. Our designs are associated with anyone using Makerspace. The system created will eliminate the tedious steps to reduce the time taken for users to set up a print in Makerspace. Within this report we will discuss potential materials for designing the prototype of our product and create a plan to create our prototype.

1.1 Problem Statement

We want to design a system and user interface that improves the current problems with automating the use of 3D printers while eliminating the troubles with SD cards to enhance the user and staff experience with 3D printing, organizing, time management, and ease of use.

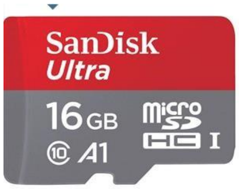
2 Design for Prototype I

The prototype consists of using one raspberry pi, one 3D printer, one computer, one power source, one printer cable and one instance of OctoPrint. An instance of OctoPrint will be accessed by the user in which they upload the g-code that they would like to print. They will then send the g-code to the raspberry pi. The raspberry pi will then upload the g-code to the printer.

Information from the OctoPrint web interface is then displayed in the UI through HTTP Web Requests. This is possible because each instance of OctoPrint has its own API key, which prevents any mix up in which printer is being requested the information. The estimated print time and how much of the print is complete is then displayed in the UI. Web requests are constantly made to update the UI because the estimated completion time of the print is subject to change.

3 Bill of Materials

Table 1 Bill of Materials

Part Name	Picture of Template	Description/ Specification	Quantity	Supplier	Cost (CAD)
Raspberry Pi		N/A	1	https://www.amazon.ca/RS-ComponentsRaspberry-Model-Motherboard/dp/B07BFH96M3/ref=sr_1_4?crid=J5VNE19VQ5WU&keywords=raspberry+pi+3b%2B&qid=1571017689&sprefix=raspberry+%2Caps%2C182&sr=8-4	$55.97
Micro SD		16 GB	1	https://www.amazon.ca/Sandisk-UltraMicro-UHS-IAdapter/dp/B073K14CVB/ref=sr_1_3?keywords=SanDisk+16GB&qid=1571260591&sr=8-3	$9.30
Printer Cable		6ft/1.8m	1	https://www.amazon.ca/gp/product/B00NH11KIK/ref=ox_sc_mini_detail?ie=UTF8&psc=1&smid=A3DWYIK6Y9EEQB	$4.43
3D Printed Case + Stand		ABS/PLA	1	https://www.thingiverse.com/thing:3719217	$0
TOTAL COST(GST=&1.79)					**$71.49**

4 Project Plan and Execution

The prototype will be tested in MakerSpace. This prototype is a physical and comprehensive prototype. Our prototype implements all attributes and components (e.g. raspberry pi, OctoPrint, 3D printer) and combines them to create one whole system. Our prototype is also a physical design allowing us to analyze unmodelled behavior (e.g. printer not extruding filament when print is started). The objective of our tests is to ensure that our prototype is compatible with the 3D printers in MakerSpace. The first prototype will be the raspberry pi only connecting to one printer. Possible results include a fully successful print from start to finish, the print will not start, the 3D printer will start but the print will not complete, and the 3D printer will suddenly pause mid print.

5 Prototyping and Testing, Customer Feedback

A successful test will be when the g-code is sent to the 3D printer wirelessly and the print completes. This data will be tracked with successful prints to attempted prints ratio. The data will be manually tracked. The test will be complete when there are two consecutive short and long prints are made. The short prints will be anywhere from 10 to 15 minutes and the long print will be anywhere from 30 to 60 minutes.

Short and long prints were successfully completed. OctoPrint was successfully able to manage the print settings to produce high quality results.

Our initial prototype consists of a raspberry pi inside a 3D printed case as seen in Figure 1. This is connected to a power supply to power the pi and the pi is connected to the 3D printer via a printer cable as seen in Figure 2. The g-code is uploaded through the OctoPrint web interface as seen in Figure 3.

After demonstrating our prototype to a CEED staff member, they were impressed. In fact, they assisted us in improving the prototype. They assisted with trouble shooting the device in problems we were facing such as printing in the center and connecting the raspberry pi in the center. They suggested getting a static ip address in the future, so the raspberry pi’s ip address is constant.

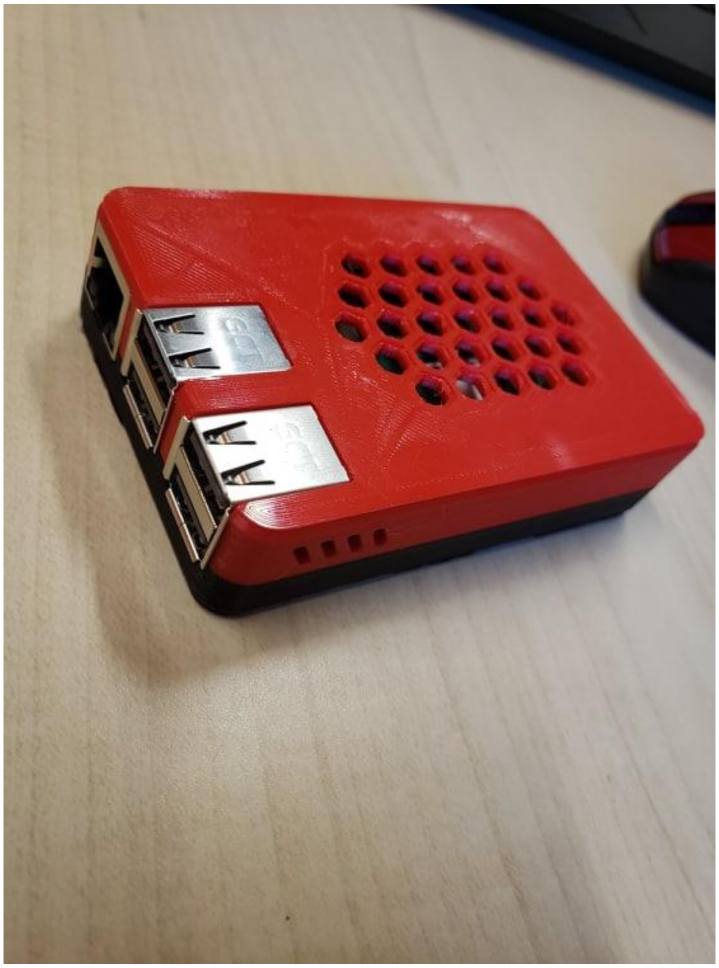


Figure 1 Raspberry Pi and 3D Printed Case

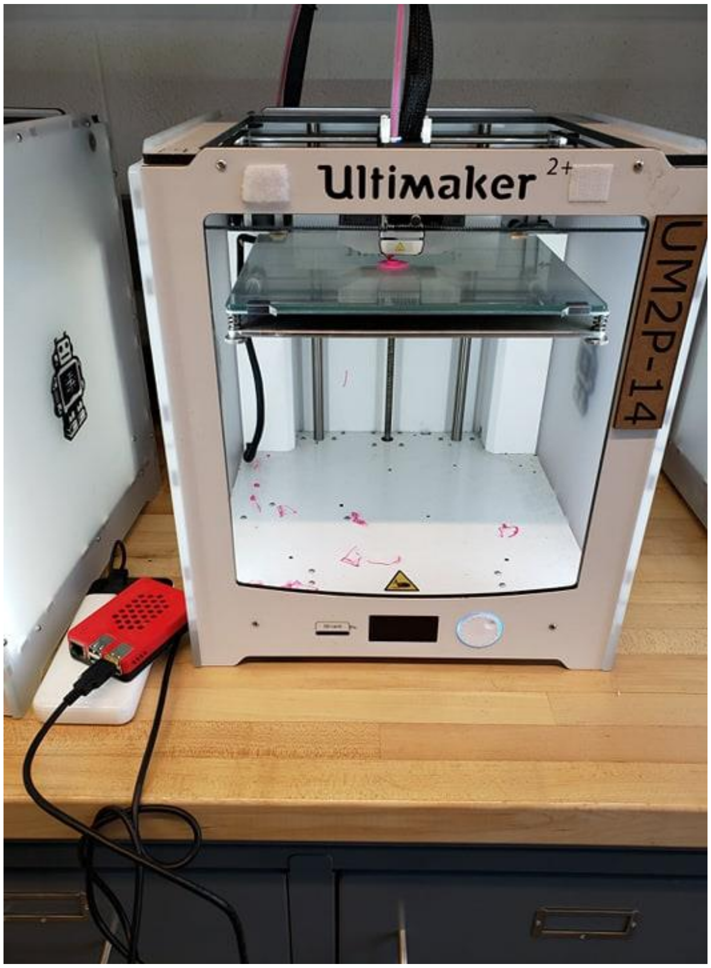
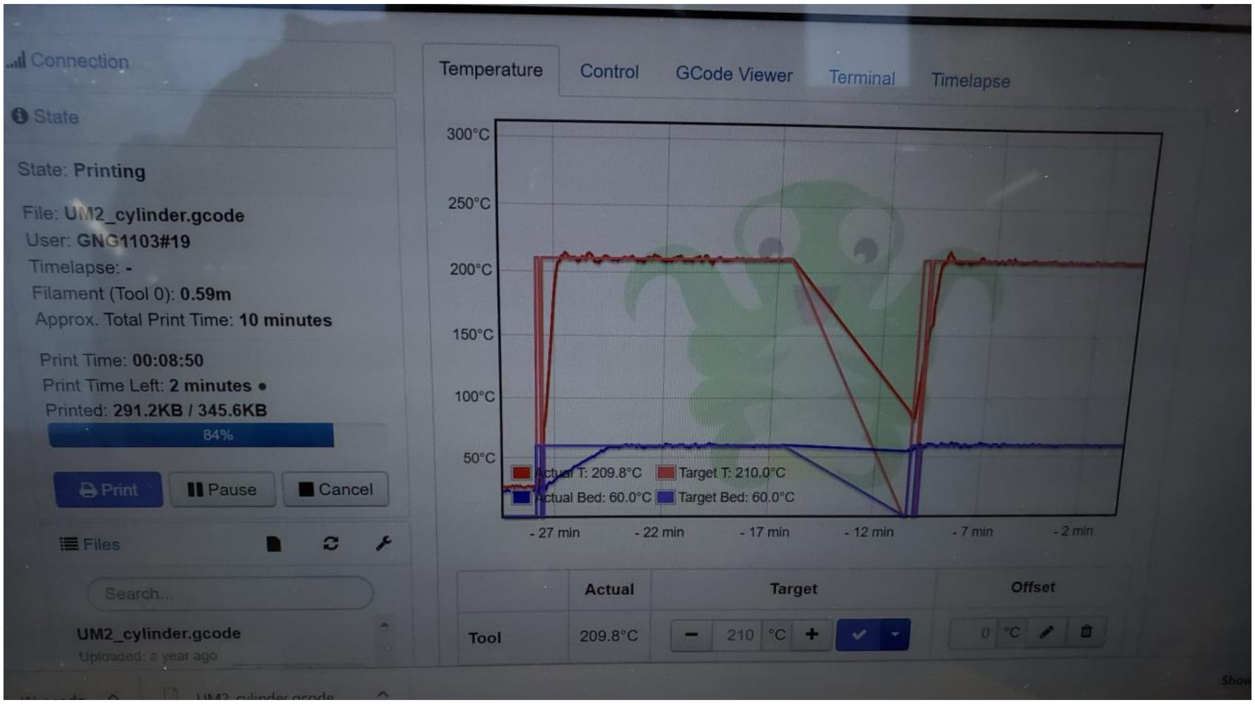


Figure 2 Raspberry Pi Connection With Printer



State: Printing

File: UM2_cylinder.gcode

User: GNG1103#19

Timelapse: -

Filament (Tool 0): 0.59m

Approx. Total Print Time: 10 minutes

Print Time: 00:08:50

Print Time Left: 2 minutes

Printed: 291.2KB / 345.6KB

	Actual	Target	Offset
Tool	209.8°C	210 °C	0 °C

Figure 3 OctoPrint Web Interface

6 Analysis:

After performing various tests, we came across several errors. One of which being the print head was starting the print in the corner of the print bed as opposed to the print center. This was due to a missing g-code script specific to the printer. After consulting OctoPrint forums, we realized we were missing a block of code. After implementing the g-code script, we were able to start printing in the center of the print bed. A second error we encountered was that the print was pausing midway. This was caused by the raspberry pi's power source being too weak, causing it to shut down. This was resolved by acquiring a better power supply. An initial problem that we encountered was connecting the raspberry pi to the university's network. We found out that there were restrictions preventing this. This was solved by hosting a hotspot on a computer in which the raspberry pi could connect to.

Print Success % = successful prints / attempted prints x 100%

This formula will be used for calculating the success rate of our prototype. The other data that will be used is obtained from OctoPrint. This data will include temperature of the print bed and nozzle, print time, and the location of the print head in the XYZ axis.

After resolving our problems, our print success percentage was 100%. This formula concludes the end of the first prototype signifying that it was a success.

7 Conclusions and Recommendations for Future Work

We deem our original prototype as successful because it went as according to plan. Many of the recurring problems we encountered were solved and so far, we were able to connect the pi to two printer and have two successful prints. Using Trello, helped us stay on track to complete prototype one and assisted in distributing the workload amongst the team. We plan on sticking to the created schedule to stay on track and execute our project accordingly.