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3D Printer Scheduler

System for maintaining order on a print farm.

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Colophon

Date 15 September 2021
Reference Reference
Version 1.0
Department HBO-ICT

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1 Introduction

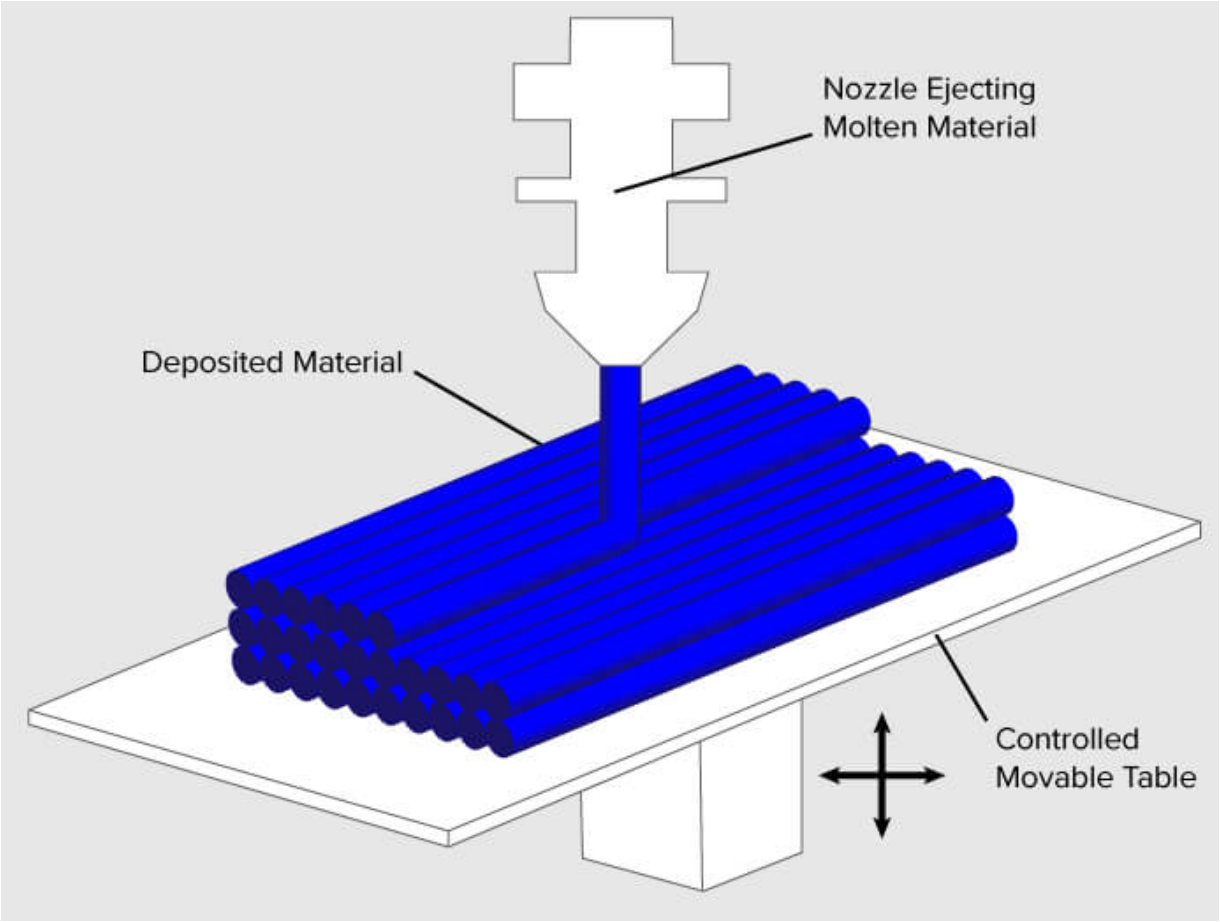
Jack started with a hobby of 3D printing with a single printer. Quickly friends and family started requesting various prints for which they paid, resulting in small profit. This allowed him to buy another printer, and another, and soon he was operating a small print farm. Offering his services online and via folders allowing him to grow the business. As the business grew, he also got different printers and modified some. Allowing him to print multi-color and print in special materials.

Quickly it got to a point where he felt printers were not running at the most optimal rate. This was mainly because he just did them in order of arrival which sometimes meant swapping the spools multiple times in a day. While completing prints and handling printers still required manual activity, he figured he could optimize printing activity by writing a piece of software that allowed him to properly schedule the printers.

In creating this program and assignment certain liberties were taken to have an assignment that is both close to reality and still workable as a school assignment. Please keep this in mind when examining the working of this program.

2 Background information

FDM printers operate using large spools of filament which is fed through a tube to a hot end. The hot end will melt the filament and then using X, Y and Z coordinate instructions move along a set path. This results in an object being printed layer by layer.



A spool of a kilogram tends to have about 330 meters. A small print takes up about 2-3 meters of filament. Though this can vary from print to print.

PLA and PETG are the most common filaments. Where PETG requires the printer to run at higher temperatures. ABS requires a printer that is housed to prevent warping, ABS is resistant to higher temperatures. Though a printer can easily be placed in housing without much trouble. Similarly, printers can also be upgraded to carry more colors.

Replacing a spool can easily take a few minutes to do as the printer has to heat up separately, the old spool has to be removed and then a new spool has to be prepared and added. The less this needs to happen the better.

3 Basic program operation

The printers are not connected to any other computer. They each have a micro-SD card containing all the prints. Jack has to manually start each printer and clear the print from the printer.

The program is designed to tell Jack what to print next when a print is done. This saves him the time to find out what would be more optimal. For instance if there are multiple prints using blue PLA in the queue, then the program will favor those so that he doesn't have to change spools constantly.

When the printer tells Jack what to print is assumes that print will happen. When a print is done, he tells the program a print is done. On completion the computer immediately tells him which print to start next on that printer. It will also tell him if he needs to swap out a filament spool for the next print.

Currently, if a print task fails, Jack still marks the printer as done and it will follow the usual process. He will then manually add the print to the queue again. This is not an ideal situation and something that needs to be fixed in the future.

For convenience all possible prints and printers are managed in JSON files. The reason for this is that while adding printers to the system is not that exciting and doesn't happen a lot. The JSON contains the name of the print, GCODE filename, and printing time. This estimated printing time is generated by the slicing software (software that generates the Gcode file).

When adding a printing task to the system the print is chosen and the filament is chosen for that print. This will add it to the queue. The system should choose prints that are viable to do and ideally don't require a filament change, unless there is no other choice.

Controlling the program is done almost exclusively with the numberpad for convenience. This is an important requirement for Jack to make using the program easier.

In the future Jack would like to introduce an alternative method of scheduling where small remaining spools can be used up efficiently.

4 Requirements

To assist himself in writing the software he created the following requirements for himself. Since he is the only one using this system he has kept it simple and not too complicated. Favoring a program that can run on a single computer and runs a simple text interface so it can be run on a small computer in the shed dedicated to the print farm. Additionally, all requirements are must as the focus was on what was specifically needed.

4.1 Business requirements

Code	Description
B1	Spend less time figuring which print to start next.
B2	Maintain an overview of all active printers.
B3	Maintain an overview of all print tasks.
B4	Get an overview of which spools need to be ordered.
B5	Have a central list of all available prints.
B6	Be able to get the most out of leftover printing spools

4.2 User requirements

Code	Description	Source
U1	Add new printer to the system	B2
U2	Add new print to the system	B2
U3	Add a print task to the system	B3
U4	Register a print completion	B1
U5	Be informed on which printer to start a print task.	B1
U6	Operation should be done using menu numbers for quick operation.	B1
U7	Get information all printers and current spools and prints	B3
U8	Get a list of all spools and their current length.	B4
U9	Have a central list of all available prints.	B5
U10	Be able to select a printing strategy related to spool usage.	B6

4.3 System Requirements

Code	Description	Source
NF1	Runs on one computer.	
NF2	Does not need to interact with the printers directly.	
NF3	Data is stored locally in simple files.	
NF4	Interface is entirely text based.	

Code	Description	Source
F1	Display a menu of options with number input.	U6
F2	List all printers with their current spools and jobs.	U7
F3	List all available prints	U9
F4	List all available Spools and their current length	U8
F5	Add task to queue using numberpad. Selecting print, filament type and color.	U3, U6

F6	Start print queue which will try to assign a print to each printer.	U5
F7	Register print completion which reduces spool length and selects a new print.	U4, U5
F8	Register print failure which returns the print to the queue, reduces spool length, and selects a new print.	U5
F9*	Select different printing strategy.	U10

5 Testing

Jack never wrote any tests for his program, mainly because he couldn't figure out how to with the current code structure. There is a markdown file in the project explaining what tests should exist and succeed. There is also a table showing which print fits on which printer. This can be used to ensure tests are successful.

6 Diagrams

In figure 1 we see a general overview of how the program is used. Once the program is started and things are added to the queue, it waits for Jack to register a completion of a print.

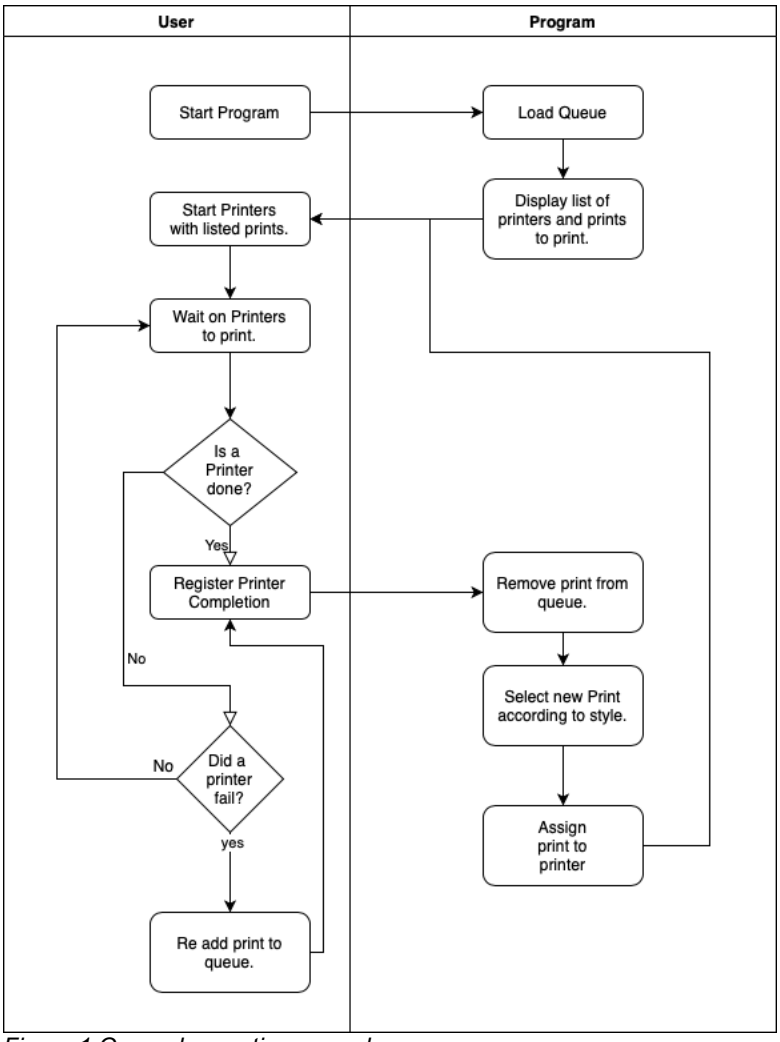


Figure 1 General operating procedure