
PROGRESS REVIEW 11

Astha Prasad

Team F: ADD_IN

ILR #10

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Teammates:

Daniel Berman

Nikhil Baheti,

Ihsane Debbache

Introduction

Over the last two weeks, the team's efforts were largely focused towards printing around COTS items. Since the work on software is largely complete and the GUI is capable of generating G-Code with R angles oriented around COTS items, my tasks were distributed towards helping the rest of the team out on other subsystems. Since getting the firmware to work was on high-priority, I worked closely with Nikhil for the days leading up to the PR. We faced several issues with the RAMBO board that drives the printer, which Nikhil and I worked on as well. Hence, the following tasks were undertaken by me for this PR:

- Set up the MATLAB GUI on Nikhil and Ihsane's computers
- Fix the RAMBO board
- Help Nikhil debug firmware

Set up the MATLAB GUI for the team

The main aim behind the software team developing the GUI was to make it easy for all members of Team F to generate GCode for any parts they wished to print. With the easy-to-use interface, all members would not need to get into details about the working of the code. Since we are in our testing phase, I set up the GUI on Ihsane and Nikhil's computers and ensured that it ran smoothly. This mainly involved saving the settings for invoking Slic3r from command line. This was a straight forward process and all members of the team should now be able to run the GUI without hassles. Dan also set up an excel file for team members to report any bugs/issues faced while using the GUI so that it can be tracked, addressed and dealt with in a timely manner.

Fix the RAMBO board

During testing, we noticed that the print bed, which is usually set to a temperature of 65° Celsius, had stopped heating up. This was causing the print filament to cool down much faster than usual, thus disallowing it to stick to the print bed. In order to continue testing, it was necessary to fix this issue. We traced the error to a blown MOSFET at the heat bed connection. We did not have any spare MOSFETS but we did have an entire spare RAMBO board which we had ordered last semester in case of emergencies. Sadly, one of the motor drivers on the board was not working, due to which we were unable to switch boards. We decided, instead, to de-solder one of the MOSFETs from the spare board and solder it onto the current PCB. This solution worked and the print bed started heating up, thanks to the new working MOSFET.

While changing components, we noticed that the plastic around the connector for the power input to the heated bed had melted into the connector housing on the board. The connection had remained intact but it was impossible to unclip the 2-pin connector from the PCB socket.

Since we had spares for both the housing and the pluggable connector, Nikhil and I decided to remove the melted ones and solder in a brand new socket at the bed input.

Firmware

The main challenge we faced was with the inverse kinematics implementation in the Interrupt Service Routine (ISR) of the firmware.

Nozzle Dance

During testing, we found that the printer would execute the first few lines of GCode accurately and then start producing 'checksum' errors, during which the nozzle would drift away, executing sudden movements and turns, almost like a waltz. While printing a cylinder with a COTS item positioned at the center (Figure), we witnessed the printer print 3/4th of a circle with perfect R-Axis angles, after which the erroneous printing started. This, at the very least, confirmed that the R-Axis angles generated by the software were correct. It also proved that the equations used in the implementation of inverse kinematics are correct. The generated GCode, as plotted by the GUI, is shown in Figure 1. The issue causing the 'dance' however lies elsewhere in ISR.

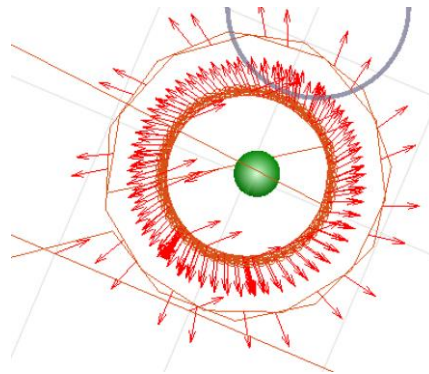


Figure 1 : GCode for a thin cylinder (Indicating R angles)

Nozzle Drift

After many tries, we eliminated the 'checksum' error by making one change to the code. It appeared that while incrementing the x and y steps in the interrupt service routine, the code was running a comparison between a signed variable and an unsigned variable. After changing this, the 'checksum' error was eliminated. On further testing however, we saw that the nozzle would drift gradually in one direction during execution. The drift is exhibited in Figure 2.

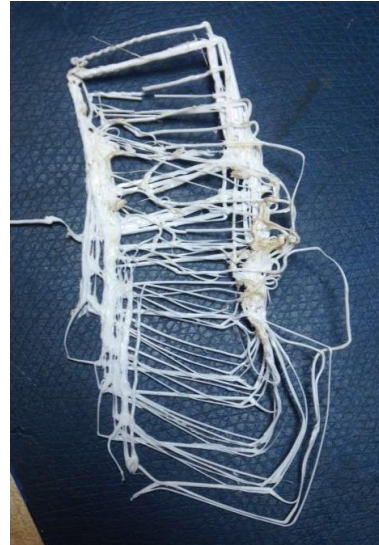
On further investigation, we found that the nozzle would drift only while executing commands that had a small XY movement and a large R movement. For example:

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G1 X50 Y70 R0
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G1 X52 Y70 R180
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(a) No drift without R commands



(b) Drift seen with R commands



(c) Drift seen while printing a thin cylinder

Figure 2 : Nozzle drift

We are still unsure of what is causing the drift. We believe that it may be due to either accumulating error or some sign inconsistency in the interrupt service routine. We plan to debug the code further this week.

Challenges

Along with all the valuable time spent fixing the unforeseen issues with the PCB, a major problem we faced was that of the nozzle clogging. Since testing is the best way to check the behavior of the printer, the clogging issue was causing constant delays with the work on firmware. All team members are now comfortable with the method to unclog the nozzle and Ihsane is working on finding a permanent solution to the issue.

Teamwork

The rest of the team worked in the following manner:

Nikhil Baheti

Nikhil and I worked simultaneously on debugging the firmware. He helped me get familiarized with the changes he had made to the existing RAMBO firmware and together, conducted the tests on the printer. He also set up the edited firmware on the new printer, thus ensuring that the pins and configurations of the new printer were compatible with that of the first one.

Dan Berman

Dan worked on designing a sturdy mount for the new printer and set it up to print with the slimmer nozzle that he designed earlier this semester. He also helped with testing and gave us some ideas for debugging the firmware.

Ihsane Debbache

Ihsane worked on conducting the test for repeatability of locating features, for which he used the Makerbot to print 3 different types of locating features several times. He also worked on the troubleshooting the nozzle clogging issue and will continue work on this until it is fixed.

Future Goals

With the SVE drawing closer and the software subsystem nearly completed, the main tasks for me are outlined quite clearly:

1. Work with Nikhil on fixing the firmware
2. Conduct tests with different settings (temperature/speed/fan) to improve print quality
3. Look into web development