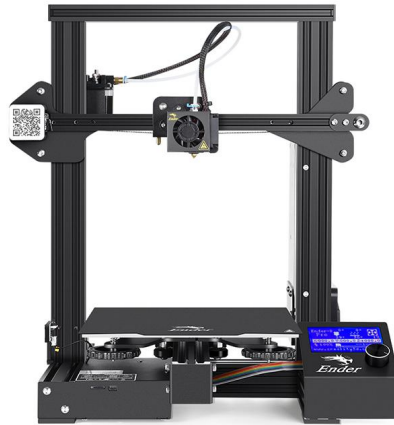


Secure and Remote 3D Printing Milestone Progression



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Sponsored by

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Client

Mike C Newton

Progress of current Milestone (progress matrix)

Task	Completion %	Tiffanie	Carl	Isaiah	Nick	To do
1. Implement, test & demo use of the raspberry pie to print	100%	75%	0%	25%	0%	
2. Implement, test & demo the website interfacing with octoprint's api	100%	0%	40%	60%	0%	
3. Utilize the GreatFET to intercept and inject traffic	10%	0%	10%	0%	0%	Setup the GreatFET as a proxy to the printer and observe traffic.
4. Improve and expand on features of web application (gcode viewer and printer control)	80%	0%	50%	30%	0%	Add more user functionality and allow the users to see their own print jobs.
5. Update the Dockerfile to include Octoprint & Web application	100%	0%	0%	0%	100%	
6. Fix the 3D printer from the last group	100%	100%	0%	0%	0%	

1. Discussion (at least a few sentences, ie a paragraph) of each accomplished task (and obstacles) for the current Milestone:
 - Task 1: Remote printing process has started, but the filament is not being pulled through the feeder fast enough. Fixed an issue which caused Octoprint to not connect to the serial port of the raspberry pi to allow for file transfers. Five calibration tests were used to test the 3D printer as to not waste filament on a large print that would fail.
 - Task 2: In order for the website to communicate with octoprint and subsequently the 3D printer itself, calls to the OctoREST API were integrated into various functions. When a user approved upload is saved to the website it is also uploaded to Octoprint's "/api/files/" directory. This file which is now displayed on the queue is linked to both the website and printer. If a user chooses to delete a file from the queue it is also deleted from Octoprint. Two buttons were added to the queue page. The first button may be used to select a file off of the queue and begin printing if the printer is operational and indicates it is ready. The second button acts as a toggle for pausing or resuming operation. Currently the website also queries Octoprint for estimates on print times which will soon be added to the information associated with each file when viewing the queue.
 - Task 3: Began investigation into using the tool. Due to less documentation here than expected, development of attack vectors will need to be produced more tentatively.
 - Task 4: After suggestion by classmates, added a 3D model visualizer for administrators to see what model a GCODE file translates to. The GCODE viewer, an open-source project, was integrated into the website for use alongside the queue for print jobs. Currently, when an administrator views the queue and is selecting jobs to be printed they may click the view button in order to redirect to the GCODE viewer. Additionally, incorporated OctoREST API to execute printer commands via buttons on the queue page. Still need to improve front-end styling and usability.
 - Task 5: We had an issue with version handling in our requirements file in the repo. Because of this, the image wouldnt build properly because it would keep getting errors. This was because we used Django 3 while our requirements file wanted Django 4, which broke our code. We were able to fix this by making our code compliant with Django 4, then adding library versions to our requirements file. We have a compose file that will make our website container with the octoprint container in the same network.
 - Task 6: 3D printer was not level in both the extruder arm and the printer bed. The bed was level in the Assit Lab, then we had to recalibrate once it was in the IoT Lab. We moved the 3D printer to the IoT Lab to have a controlled environment when pentesting.

- Discussion (at least a few sentences, ie a paragraph) of contribution of each team member to the current Milestone:
 - Tiffanie Petersen: Tiffanie focused on working with the 3D printer this milestone. When preliminary testing (without the pi) she found that the printer was not level causing issues, so the bed has been realigned. Then the arm that holds the extruder is off by 1 degree causing the filament to lift off of the bed. Also the magnetic plate for the bed was set up incorrectly, which was fixed using the peel on the underside of the panel. She also worked on the document needed for the milestone as well as helped with the octoprint problem. She also printed all the test calibrations to ensure that the printer was working as intended.
 - Carl Mann: Moved the 3D printer and worked on interfacing with octoprint and the api. Also took the lead for using a gcode imager for the website to allow for an image of what is to be printed. He located a once functional open source visualizer and refactored the module to make it operational and integrated into the web app.
 - Isaiah Thomas: Integrated OctoREST API functionality into pre-existing operations. The website now effectively communicates with Octoprint and the printer to produce 3D models. Added all necessary processes for a user to upload a file to the printer, delete a file from the printer, start a print job, pause a print job, and observe the status of the printer and latest job. Operations such as upload and deletion leverage pre-existing functions to communicate with Octoprint. Control of the printer required adding buttons which query for relevant information from Octoprint and also send commands.
 - Nick Contrell: Updated the code to be compliant with the latest version of the libraries used in the project. Also made the requirements.txt file use strict versioning when installing libraries on the deployed pi/container. Also made a compose file to have the website and octoprint able to directly communicate with each other.

2. Plan for the next Milestone (task matrix) or [skip if this is for Milestone 6]

Task	Tiffanie	Carl	Isaiah	Nick
1. Enhance website appearance	50%	0%	0%	50%
2. Final website functionality	25%	25%	25%	25%

3. Deploy website (open facing IP)	25%	25%	25%	25%
4. Begin MitM of 3D printer	25%	25%	25%	25%
5. Create the poster for the project	75%	0%	25%	0%

3. Discussion (at least a few sentences, ie a paragraph) of each planned task for the next Milestone or "Lessons Learned" if this is for Milestone 6
 - Task 1: We plan to update the web application based on user feedback to make it more user friendly. Some ideas for upgrades to make the website more user friendly include a pop-out ui to display information regarding accepted print jobs and We also want to ensure that the web application is up to the standards that the client expects.
 - Task 2: We want to make sure that the web application is fully functional. A majority of edge cases should be properly handled by the website. The next step is to allow normal users to view their personnel jobs in the queue and their status. Estimated print times and the gcode viewer should be accessible to non-administrative users. Information regarding other user's prints and administrative functions should be inaccessible.
 - Task 3: The website should be deployed so that more users can access it. This will require the pi to handle inbound connections from users outside of the local network. Once this has been securely implemented vigorous testing may be conducted by students to test the effectiveness of our implementation.
 - Task 4: In order to effectively fuzz the printer the GreatFET must be set up to act as a MITM proxy. Research has been conducted to understand how this may be implemented. For milestone 5 we should have the GreatFET operational and ready to perform penetration testing on the printer itself.
 - Task 5: As part of senior design we need to create a poster to talk about the project and how successful it was. Relevant information will be

included to convey the importance of the project. This poster will be used in the senior showcase.

4. Date(s) of meeting(s) with Client during the current milestone:
 - None (Dr. Siddhartha Bhattacharyya acts as an intermediary between our team and the client until further notice)
5. Client feedback on the current milestone
 - The client will be met once the project proceeds further. Depends on when Dr. Siddhartha Bhattacharyya decides the product is ready.
6. Date(s) of meeting(s) with Faculty Advisor during the current milestone:
 - 2/1/22
 - 2/14/22
7. Faculty Advisor feedback on each task for the current Milestone
 - Task 1:
 - Task 2: Work on preventative measures for MitM and ensure authentication measures or tokenization. Relay to the users ways in which the website is working to ensure the security of operations and communication. Capture traffic between user and website as well as internal communication to display security measures.
 - Task 3: When deploying the server, do not allow inbound connections from sources outside of the local network. The application should be accessible only through a designated access point.
 - Task 4: Investigate more ways in which the printer/website/octoprint may be attacked. Utilize resources such as wireshark to view traffic and document vulnerabilities.
 - Task 5:
 - Task 6:

Faculty Advisor Signature: _____ Date: _____

Evaluation by Faculty Advisor

- **Faculty Advisor: detach and return this page to Dr. Chan (HC 214) or email the scores to pkc@cs.fit.edu**

- Score (0-10) for each member: circle a score (or circle two adjacent scores for .25 or write down a real number between 0 and 10)

Tiffanie Petersen	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
Carl Mann	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
Isaiah Thomas	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
Nick Contrell	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10

Faculty Advisor Signature: _____ Date: _____