NORTHROP GRUMMAN
ENGINEERING & SCIENCE STUDENT DESIGN SHOWCASE
FLORIDA TECH

Secure & Remote 3D Printing

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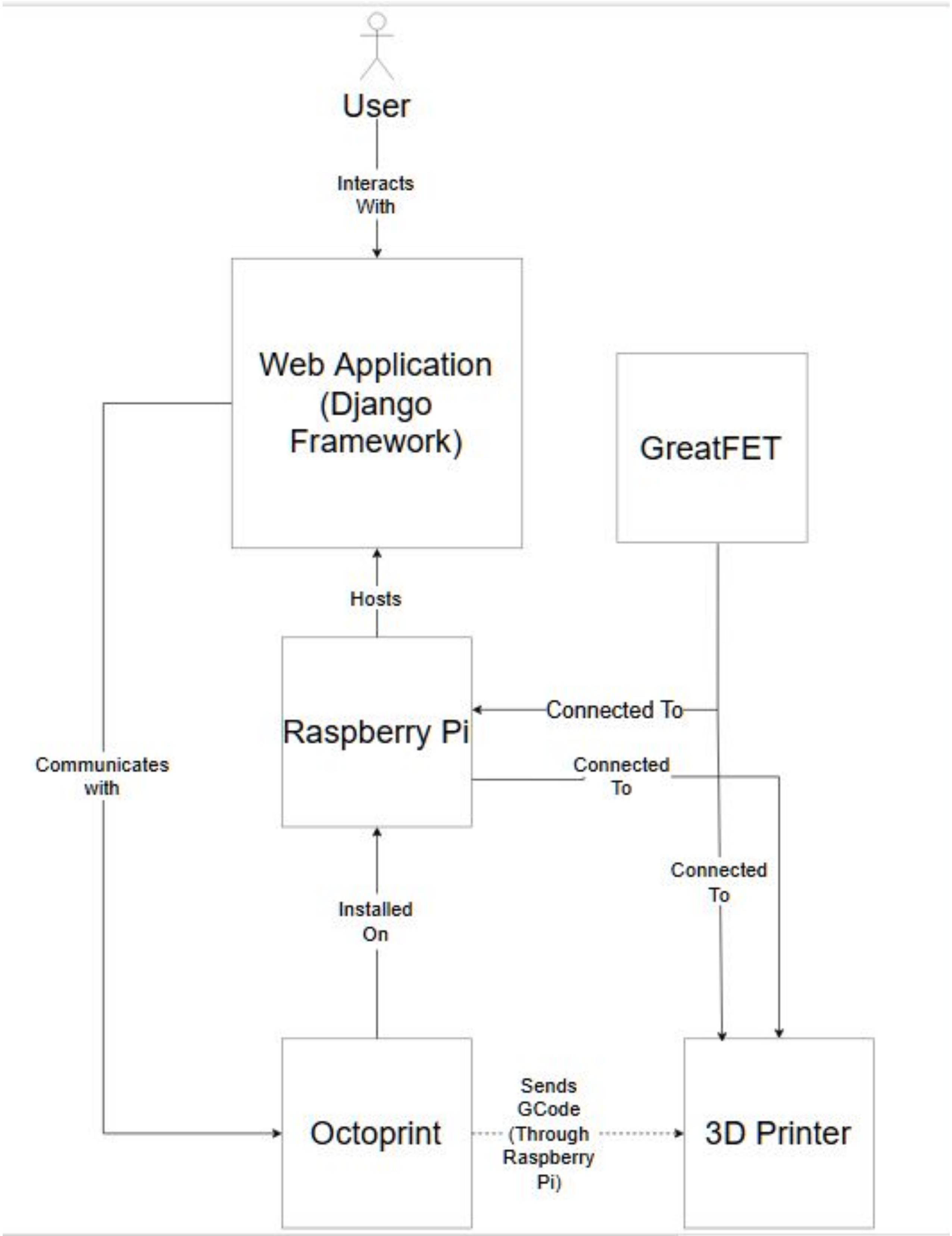
Motivation

- Currently there are exploits for the 3D printer which causes the printer to stray from the original design to create injected modifications
- 3D printers require hands on activity which many users would like to mitigate
- Adding a remote way to monitor the printer would allow administrators to multitask

Goal

- Develop a web application to remotely print an uploaded 3D model
- Have a secure line of communication form user to webserver to printer
- Allow administrators to control a queue of print requests and provide them with the tools necessary to moderate which files should be printed

Design



Features

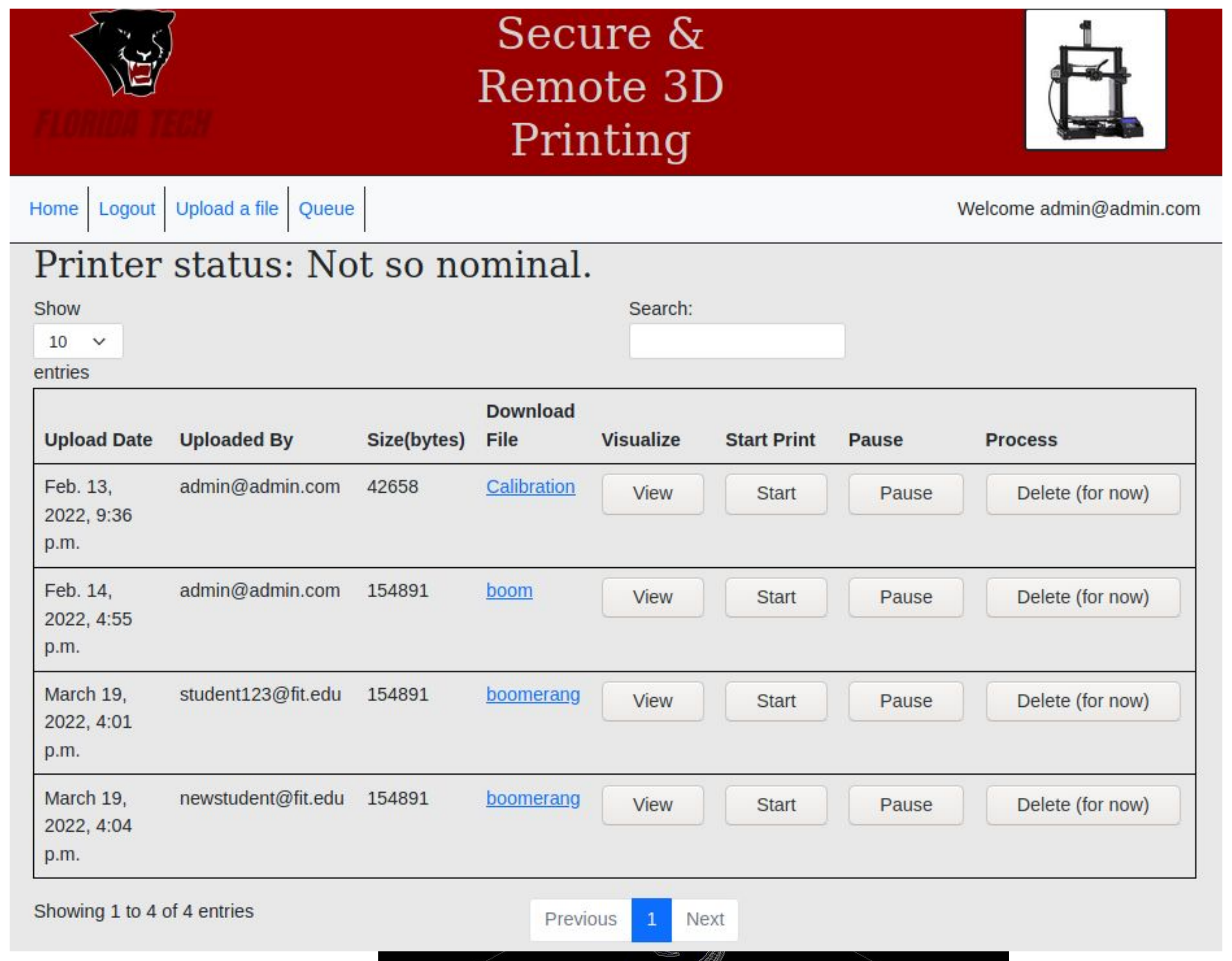
- Website features
  - Users may create an account, login, logout, and upload files to be screened by an administrator
  - Queue view for administrators to monitor, view, and print models
  - Interfaces with Octoprint via REST API calls to pull relevant data and control printer operations

Security Features

- By design
  - Website, octoprint, and file server are all hosted on a raspberry pi with docker
    - Containers prevent an attacker from listening to any internal communications
- Additional measures
  - Encrypted communication channels include HTTPS between the user and the website as well as a direct USB to serial connection between the pi and the printer
  - A Django CSRF Token is used by the server to provide a user with a unique connection specific value to be included in the HTTP requests
  - Extensive file checks prevent users from uploading malicious code and files are stored outside of the projects scope
  - Users are required to create an account in order to upload files

Evaluation

- Recommended features
  - preview 3D projects (implemented)
  - Improve upon the websites appearance
  - Provide users with more feedback relating to their requested prints
- Issues
  - Cannot establish a MiTM connection to the 3D printer reliably, limiting our ability to fuzz traffic



Secure & Remote 3D Printing

Home | Logout | Upload a file | Queue

Welcome admin@admin.com

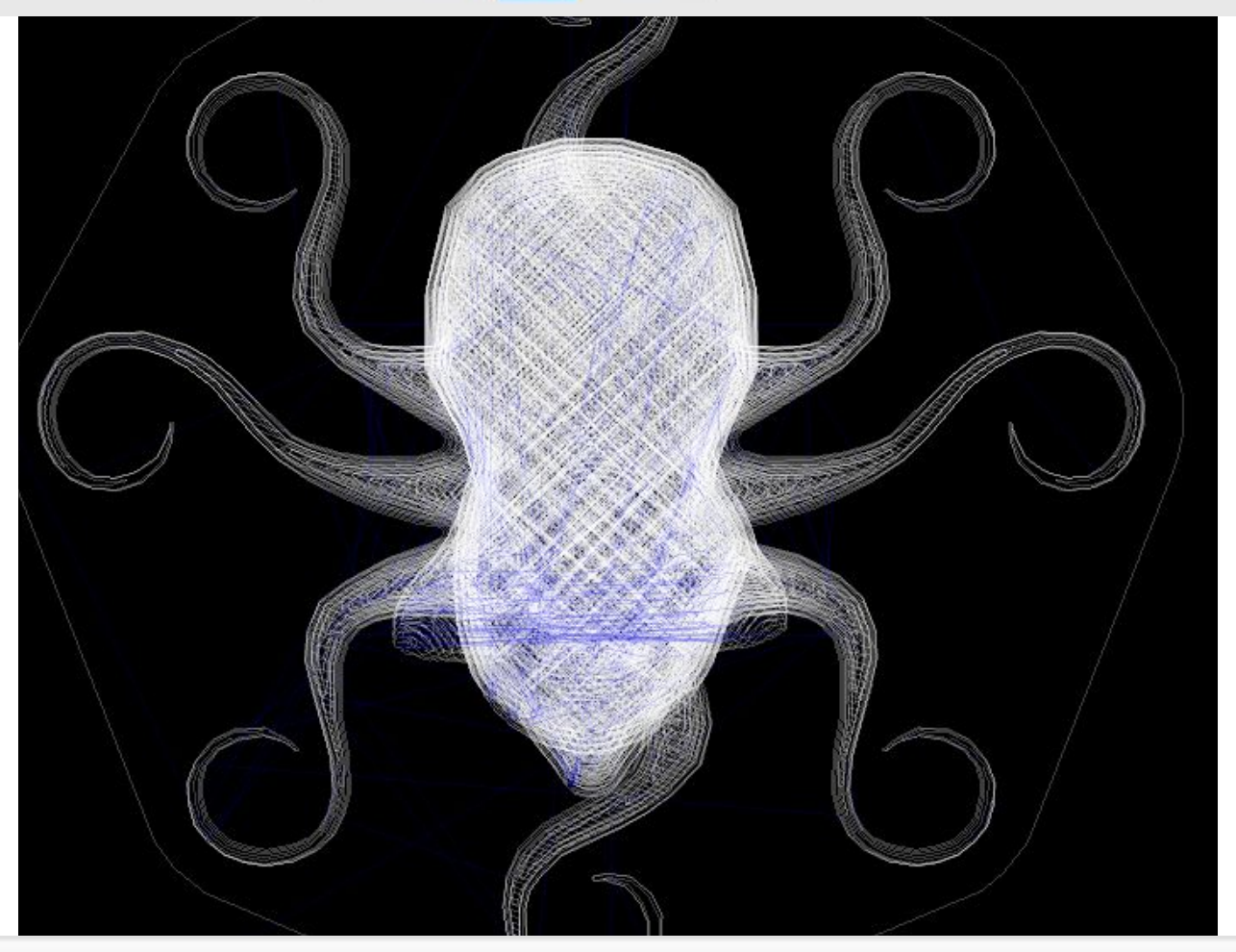
Printer status: Not so nominal.

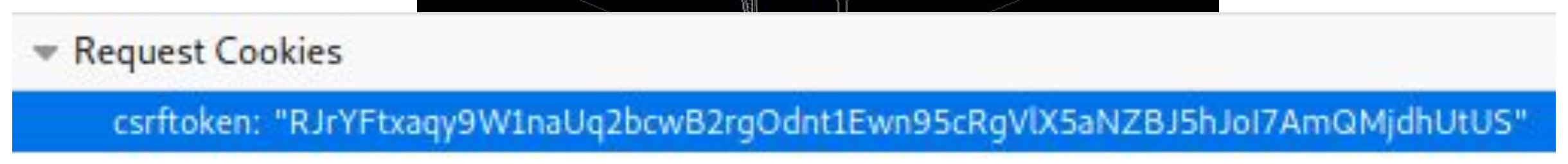
Show 10 entries

Search:

Upload Date	Uploaded By	Size(bytes)	Download File	Visualize	Start Print	Pause	Process
Feb. 13, 2022, 9:36 p.m.	admin@admin.com	42658	Calibration	View	Start	Pause	Delete (for now)
Feb. 14, 2022, 4:55 p.m.	admin@admin.com	154891	boom	View	Start	Pause	Delete (for now)
March 19, 2022, 4:01 p.m.	student123@fit.edu	154891	boomerang	View	Start	Pause	Delete (for now)
March 19, 2022, 4:04 p.m.	newstudent@fit.edu	154891	boomerang	View	Start	Pause	Delete (for now)

Showing 1 to 4 of 4 entries





Request Cookies

csrftoken: "RJrYFtxaqy9W1naUq2bcwB2rgOdnt1Ewn95cRgVlX5aNZBJ5hJol7AmQMjdhUtUS"

Conclusion

- Users can print remotely while knowing that their projects will come out as expected
- Administrators may view and approve files that have been scanned to ensure they are not malicious
- The web application tracks each of the user uploads and places them in a queue

Future Work

- Provide users feedback when their project has started printing
- Establish a connection to the printer and fuzz gcode input in order to ensure files passed in do not exploit unforseen edge cases
- Add a contact page to reach out to an admin
- Setup an email server to notify users of print job progress

Acknowledgements

- Dr. Chan and peers for provided feedback