

SDDEC21-11: 3D Metal Printer

Client and Faculty Advisor: Dr. Timothy Bigelow

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Introduction and Motivation

Problem Statement:

We require the ability to 3D print metal objects with simulated defect for Non-Destructive Evaluation (NDE) research. The current software is not fully functional and difficult to maintain.

Solution:

Design and implement the software/hardware system necessary in order to enable the printing of 3D metal objects using the provided powder bed metal printer setup such that Prof. Bigelow and his lab can use it fluently.

Design Requirements

Functional Requirements:

- Rewrite object oriented C# source code to procedural programmed Matlab
- Adjustable voxel count per layer
- Adjustable laser scan line spacing
- Create defects at specific locations

Non-Functional Requirements:

- The printer will print at appropriate speed
- The printer will be located in a secure lab
- The laser will operate under safe conditions
- The printer will function reliable

Constraints:

- Matlab, VXM System, Arduino, and lab computer

Technical Details

The team used a variety of tools to accomplish the tasks laid out in the requirements section. One concern presented was the use of Matlab to implement a real time software system. This is mitigated insofar as there are a number of failsafes available including a physical stop button.

Languages used:

- Matlab 2020b: To control printer
- Arduino: To control sensors

Development Tools:

- Wireshark: To communicate with laser
- LabView: Initially used to test motors

Environments:

- Matlab IDE
- Arduino IDE

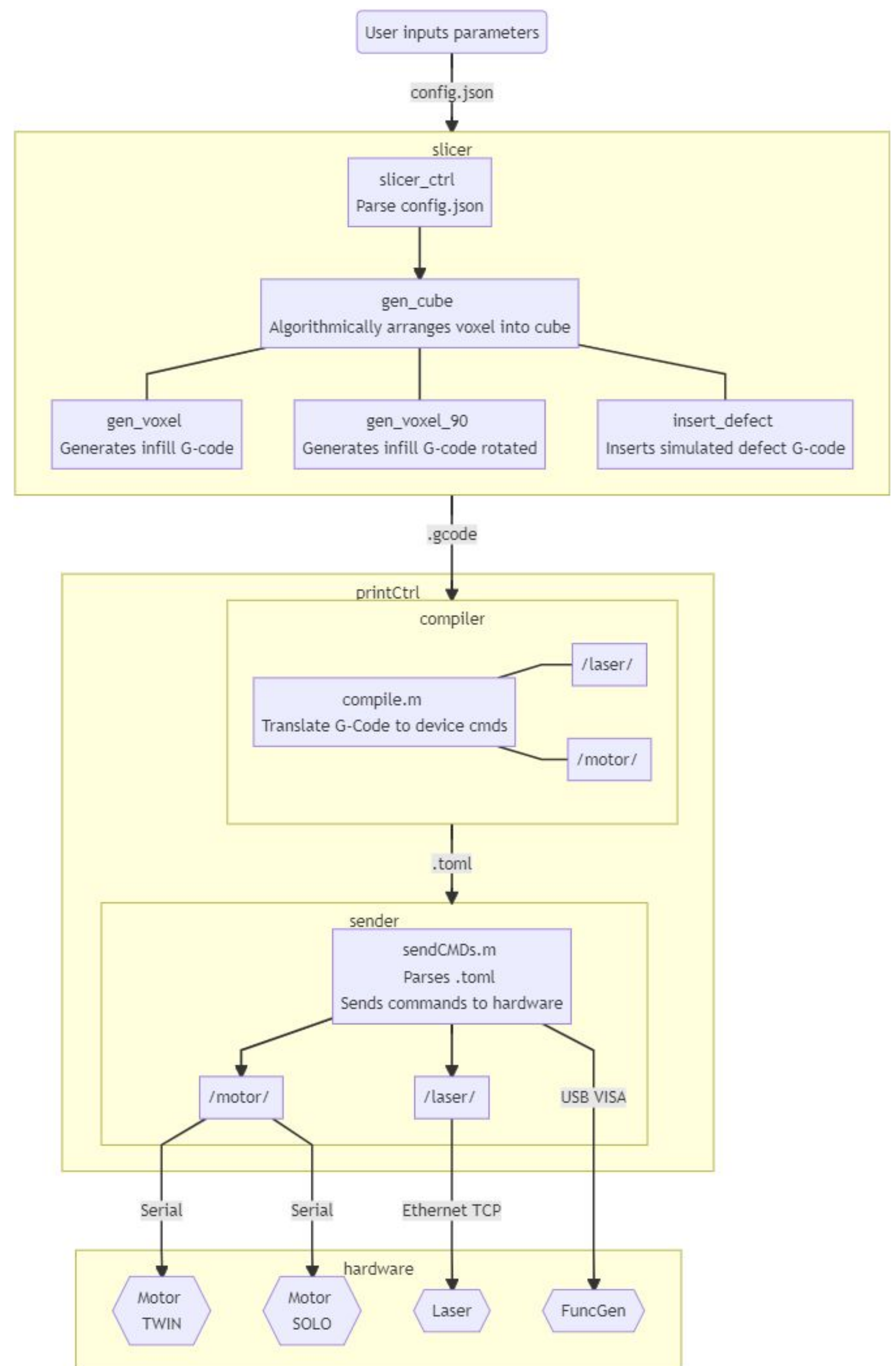
Libraries:

- Instrument Control Toolbox
- matlab-toml-forked

Standards:

- ISO 6983 (G-code)

Design Approach



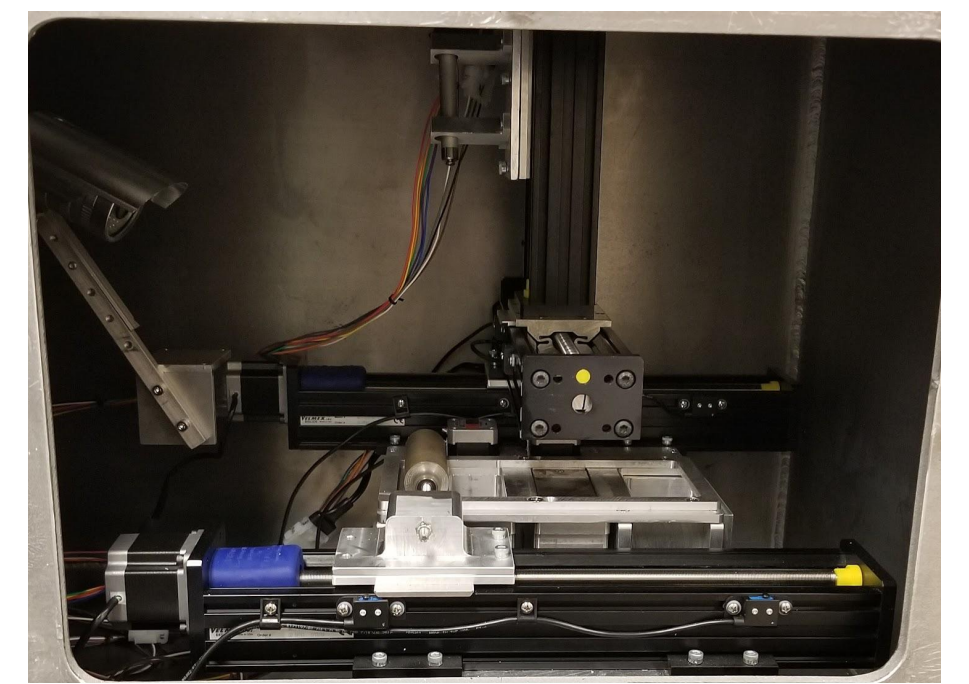
Intended Use

Users:

- Professor Bigelow
- Students researchers

Uses:

- Rapid prototyping for Non-Destructive Evaluation Research



Testing

Testing Environment:

- Matlab Debugger
- Professor Bigelow's Lab

Testing Strategies:

- Unit Testing for testing functions
- Integration Testing for software and hardware together

Test Results:

- Successfully communicated with printer motors
- Successfully communicated with printer laser
- Laser is able to trace a cube with a pilot laser
- Voxel count per layer can be adjusted
- Defects can be inserted into a cube