ELECOMP CAPSTONE SUMMIT
FRIDAY, MAY 11, 2018

THE UNIVERSITY OF RHODE ISLAND

THINK BIG WE DO℠

Hexagon CMM

3D Printing Retrofit Package for a Coordinate Measuring Machine

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HEXAGON
MANUFACTURING INTELLIGENCE

Project Motivation

A time demanding factor of ensuring that a product is created to exact design specifications is the designing, engineering, and manufacturing of the fixtures that will hold it in place during the measurement process. The motivation for this project is to provide a retrofit package that adds the capability of 3D printing to a Coordinate Measuring Machine (CMM). Adding this capability to a CMM will allow users to leverage the size and precision of a CMM to design and print large format 3D prints. The intent of developing this package is to provide the means to 3D print the fixtures that will secure the product being measured by the CMM. This project will begin as exploratory research and expand into proof of concept design, testing, and demonstration.

Anticipated Best Outcome

The anticipated best outcome for this project is a fully functional proof of concept 3D printing retrofit package for the CMM that provides an interface and a 3D print head assembly. The interface shall have the capability of using a 3D drawing file as a selectable input, slicing the 3D drawing into layers, translates the layers into movement commands for the print head and the CMM, and sends them to their respective devices. The 3D print head assembly shall be mountable to the existing CMM design. When installed the output shall be a usable 3D printed object.

Key Accomplishments

User Interface: [Figure 2] A user interface was developed that allows the user to interact with the respective parts of the retrofit package. This interface also provides the means to connect to and control the CMM.

Hardware Components: [Figures 3 & 4] The hardware components for the 3D printer retrofit package were ordered, assembled, wired, and tested to ensure they met the minimum requirements for the scope of this project.

Machine Mounting: [Figure 1] A mounting assembly was fabricated that allows for the print head assembly to utilize the existing probe head mounting system. This allows for simple installation and removal of the print head, as required by the requirements for this project.

G-Code Translation: A method has been developed that allows the created g-code translator to parse out the required information as it relates to the extrusion process and the movement path and create files designed to be read by the interface during operation.

Communication Methods: A serial connection was configured for communication between the Arduino and the user interface to allow for control of the print head assembly while reading the extrusion file. A TCP/IP connection was configured for communication between the interface and the CMM to allow for control of the CMM while reading the movement file.

Optimization: The Arduino and the interface codes have both gone through an optimization process to help reduce the impact of delay during operation which would cause a loss of synchronization during the print job.

Printing: There have been test prints made to demonstrate the viability of future development of this project. The tests were successful in showing progress, promise, and future development hurdles.

Deliverables: Software documentation, operating instructions, wiring diagrams, testing results and a bill of materials have been created and provided to Hexagon.

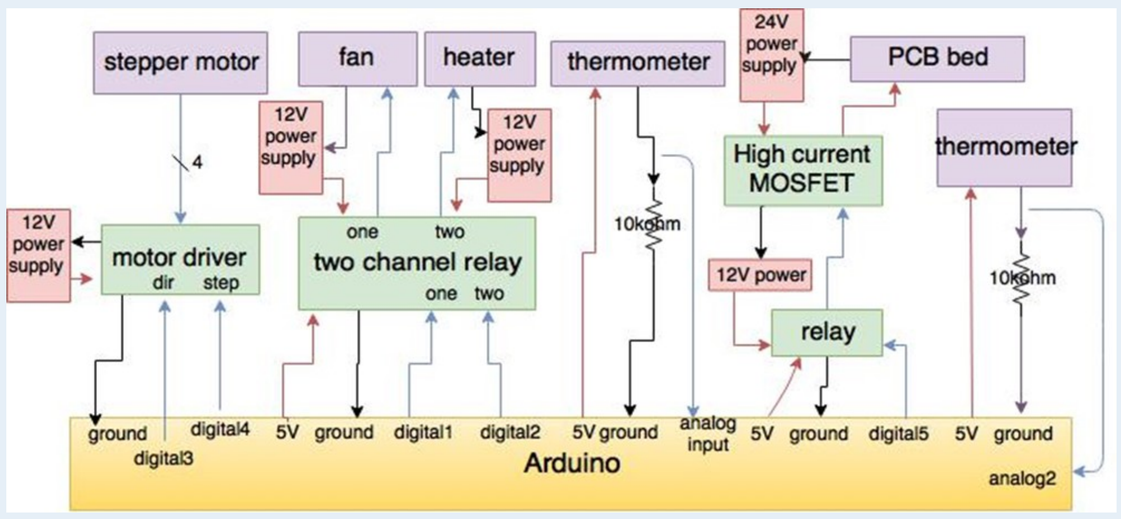

Figure 4: Wiring diagram for the 3D printer retrofit package.

Project Outcome

The Anticipated Best Outcome was achieved: a proof of concept was successfully designed and tested.

Figures

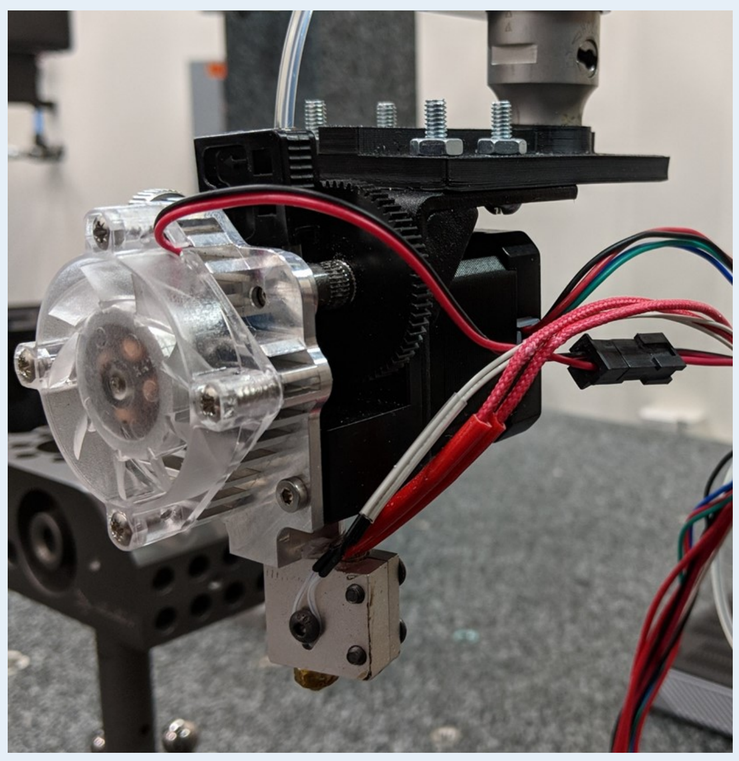

Figure 1: 3D printer head for the retrofit package

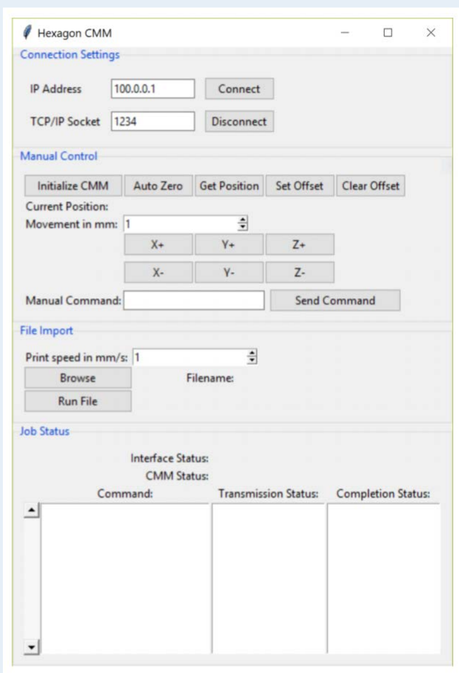

Figure 2 : Graphical User Interface (GUI).

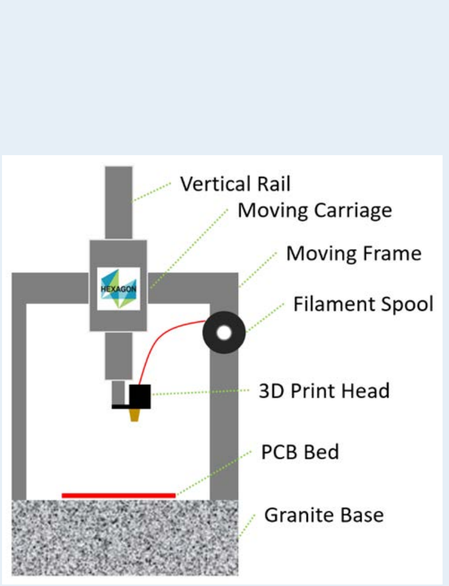

Figure 3: The CMM with the 3D printing retrofit package.