

Metamorphic Manufacturing v2

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Abstract

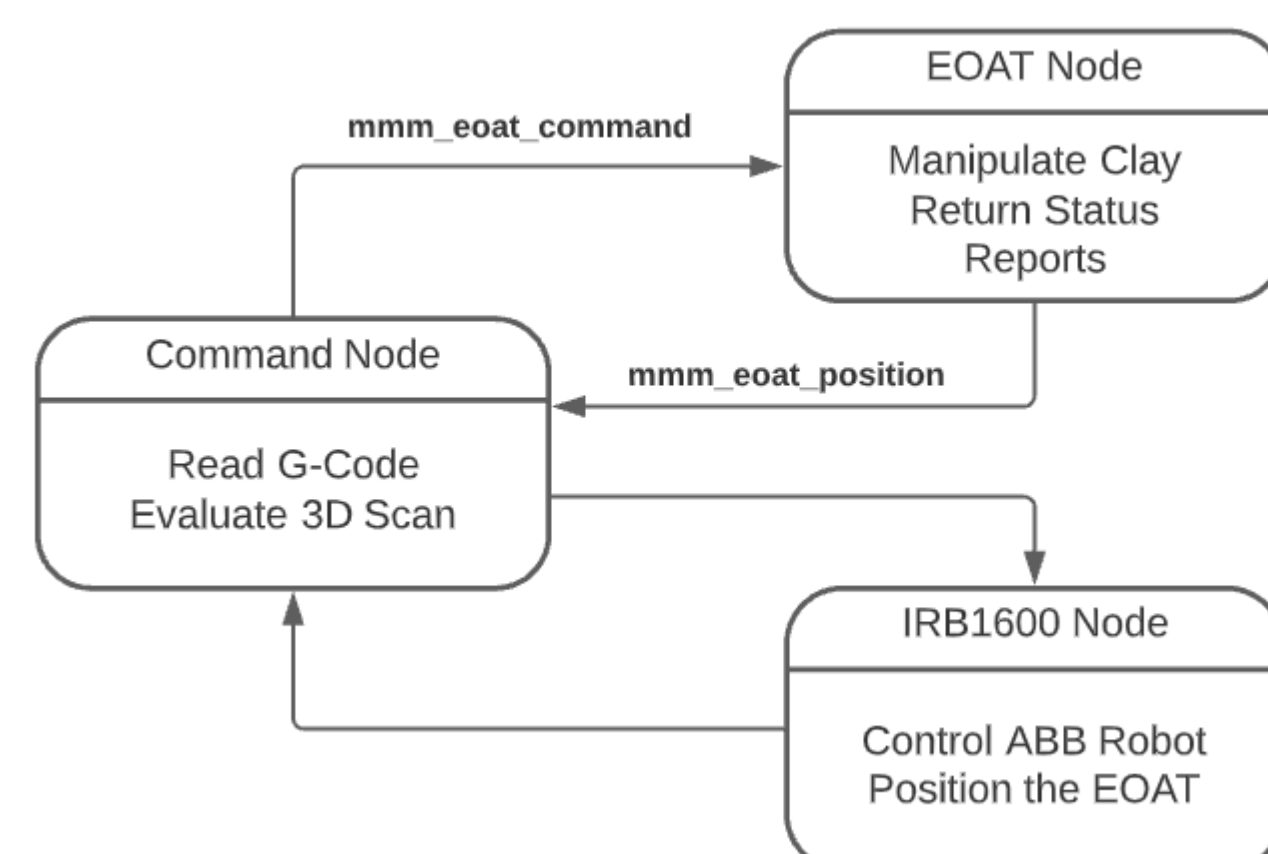
This project focuses on continuing the development of a Metamorphic Manufacturing robot at WPI. Metamorphic Manufacturing is a type of fabrication where material is incrementally deformed to create a desired shape or part. Picking up from the mechanical designs of the previous team, this project developed the control systems for each independent subsystem and integrated all subcomponents into a functional robot capable of molding plasticine clay following instructions from an open loop G-Code style program.

Objectives

- Develop control and communications protocols for independent subsystems
- Develop UI and Integrated system interface
- Develop new tools for shaping plasticine
- Develop open loop control program
- Explore closed loop control program

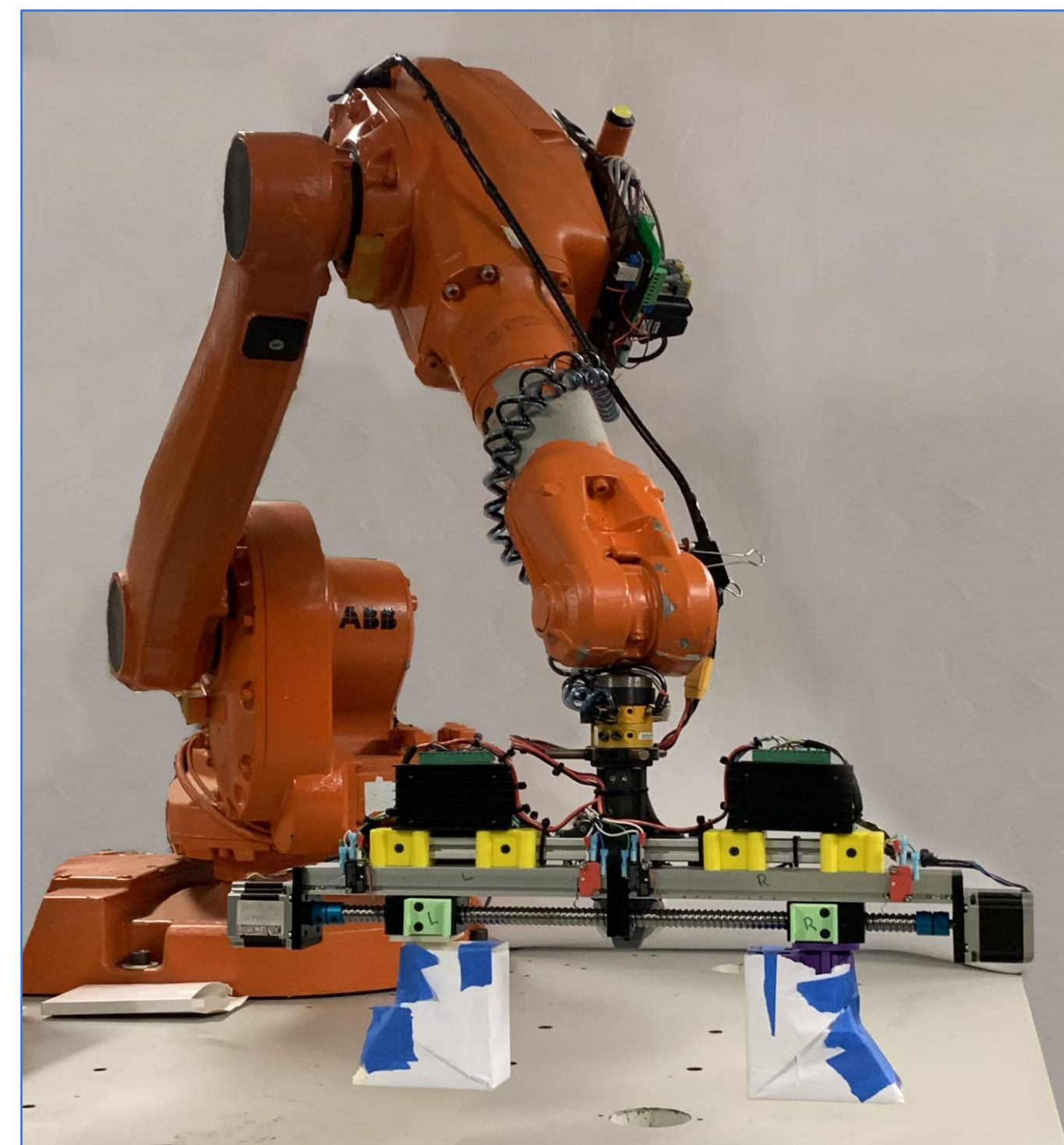
Code Overview

- Open-loop system using a pre-written file similar to G-Code
- Robot Position and Tool Positions extracted
- Commands transmitted via Robot Operating System to Robot and Tooling
- Scan Procedure produces 3D Scan of work object



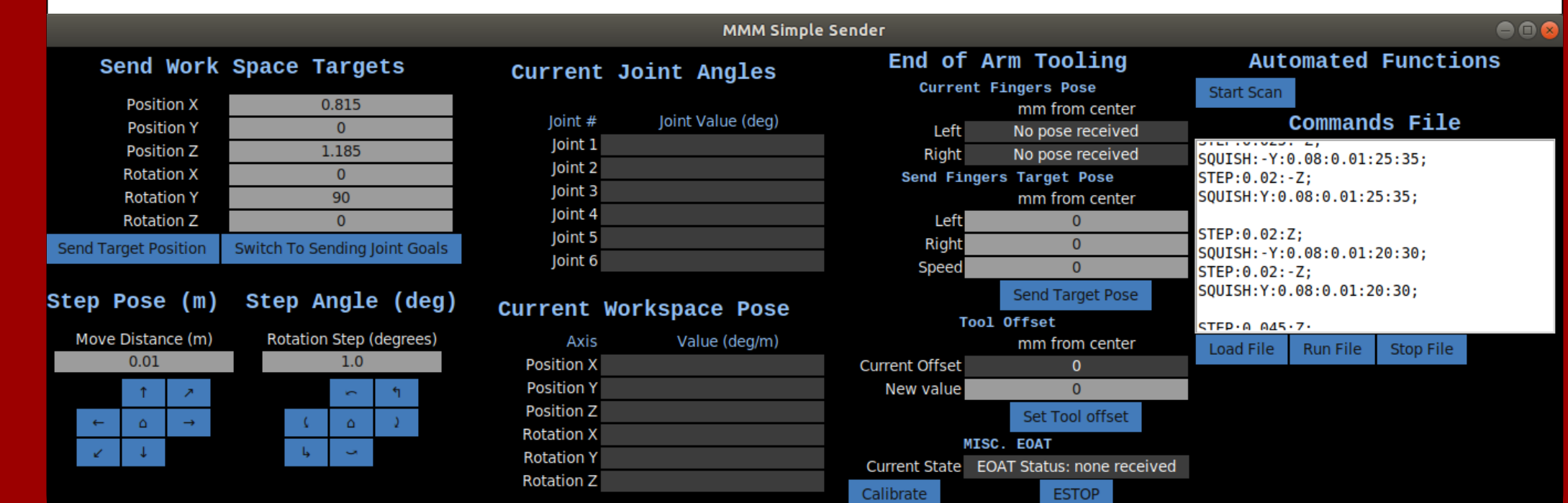
Manipulator

- Independent pair of lead screws
- Positioned by the IRB1600 6-DOF Arm
- Controlled by a ROS Node on a Raspberry Pi
- Automatic Calibration and Safety Sensors



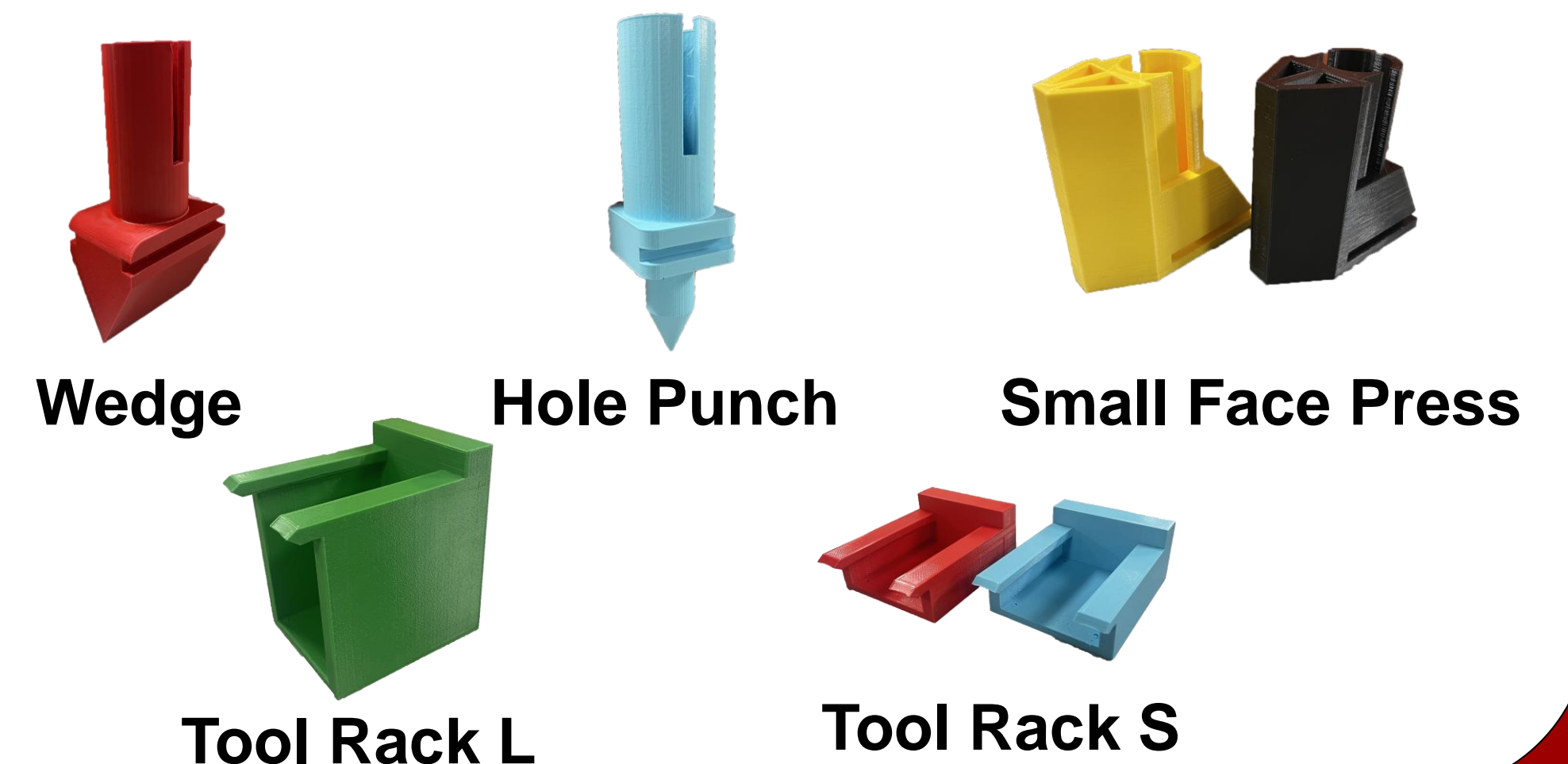
Software Results

- Developed controls for each subsystem
 - ABB Robot
 - Independent EOAT
- Integrated each system through ROS
- Developed User Interface
- Developed G-Code style command file



Hardware Results

- Created specialized tools and tool racks for various plasticine molding techniques
- Experimented in the manufacturing of a horseshoe



Tooling

- The Universal Tool Changer (UTC) interfaces with the lead screws and tools using magnets for easy tool changing.
- Slots in tools allow for operator-less tool changes
- The Press handles the deformation of plasticine, pushing both laterally and longitudinally to shape the plasticine.



The Press

The UTC

Why Plasticine?

Plasticine behaves similarly to metals heated to blacksmithing temperatures and is both safer and easier to reset after testing deformations during development.