

3D Metal Printing

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Project and Motivation

The purpose of this project is to create a faster, cost-effective alternative to current metal casting processes. The project goal is to create a 3D metal printer that is capable of quickly creating metal components at a lower cost. Our objective is proof-of-concept for future exploration, creating highly precise parts is beyond the scope of this project.

A Metal Inert Gas (MIG) welder is combined with a Computer Numerical Control (CNC) machine more typically used for computer-aided machining of metal parts, as seen in Figure 1. Welding wire is fed through the nozzle of the MIG welder, creating the weld pool. The CNC is programmed to precisely position the MIG for accurate deposition ("printing"). Building upon previous layers of deposition, a 3D object will be printed.

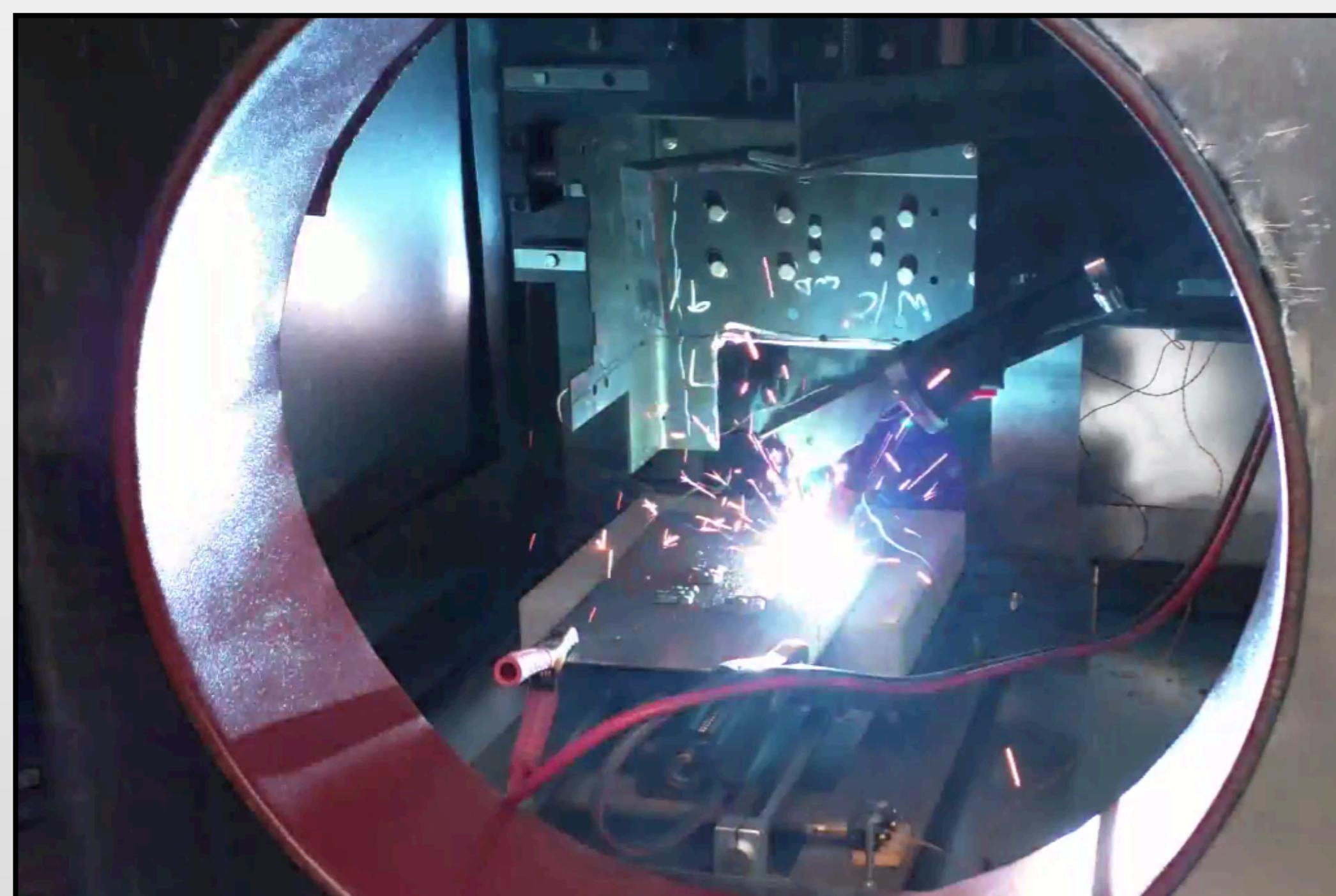


Fig 1. System in Deposition Mode

Goals

- Interface the MIG welder with CNC machine.
- Determine quality of deposition based on temperature and current.
- Control the MIG welder based on quality of deposition.
- Allow for future expandability

Control System

Control of the system is done using a PCI Express DAQ board from Sensoray CO Inc. The controller receives inputs from 4 sensors that monitor the deposition. Based on these inputs, the controller will adjust wire feed speed to ensure a quality deposition. If at any point an error occurs, the system will pause and wait for corrections to be made.

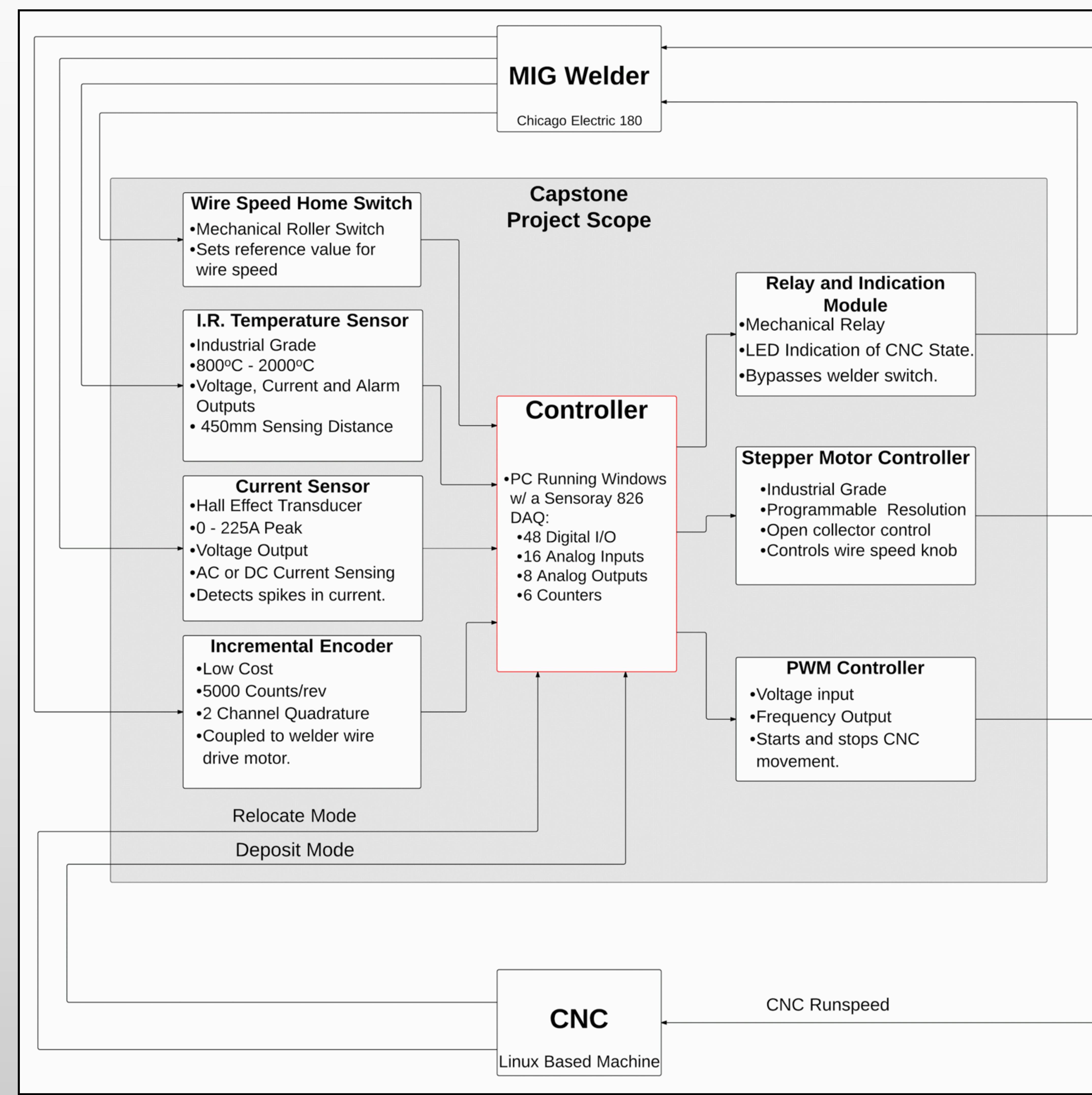


Fig 2. Block Diagram of System

Project Outcomes



Fig 3. Z-axis Deposition Testing

The following outcomes were successfully completed:

- Selected a controller that minimized limitations of future expansion.
- Accurately measured speed of wire leaving the welder.
- Created a system that dynamically calculates and controls the wire feed rate.
- Determined welder settings in correlation with CNC settings to achieve a quality weld.
- Created a homing and calibration procedure for the welder settings.
- Controlled the temperature of the plate being welded to via feedback from the temperature sensor.



Fig 4. Shape Deposition Testing

A special thanks to Jim Lamberson at Sensoray