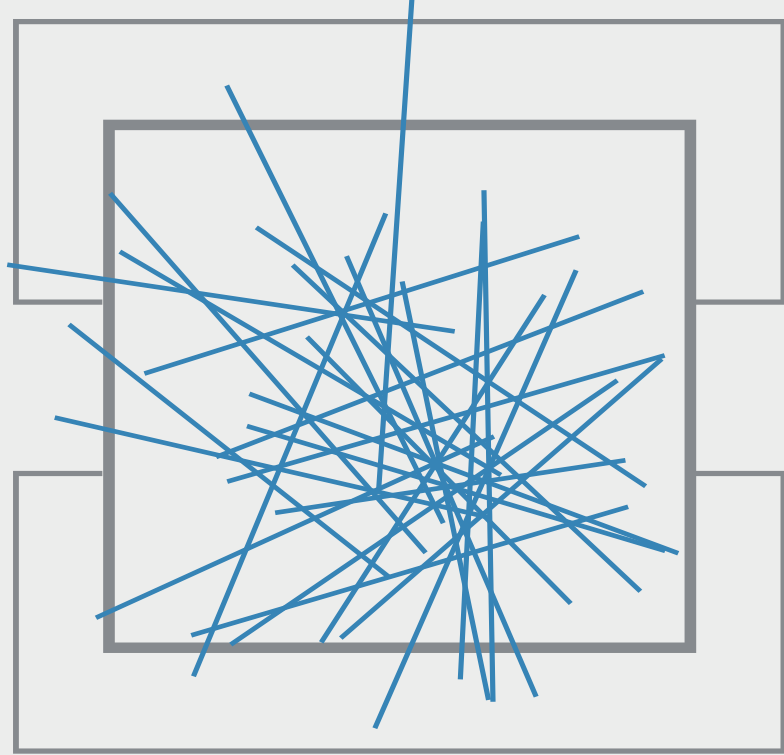


Automating Robotic Construction and Extrusion Systems Through Control System Applications

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Research Motivation

The construction industry is currently tasked with the monumental challenges of rapid urbanization and long term environmental sustainability.

- Worldwide need for infrastructure to accommodate a projected additional 2.3 billion people by 2050. [1]
- Conventional construction techniques are slow and unable to meet demand. [2-5]
- Conventional techniques are wasteful contributing to 1/3rd of all global CO emissions and 1/3rd of all material consumption. [2-5]
- 3D Printing techniques can alleviate some of these issues but the current state of the art is an extremely manual and labor intensive process. [6]

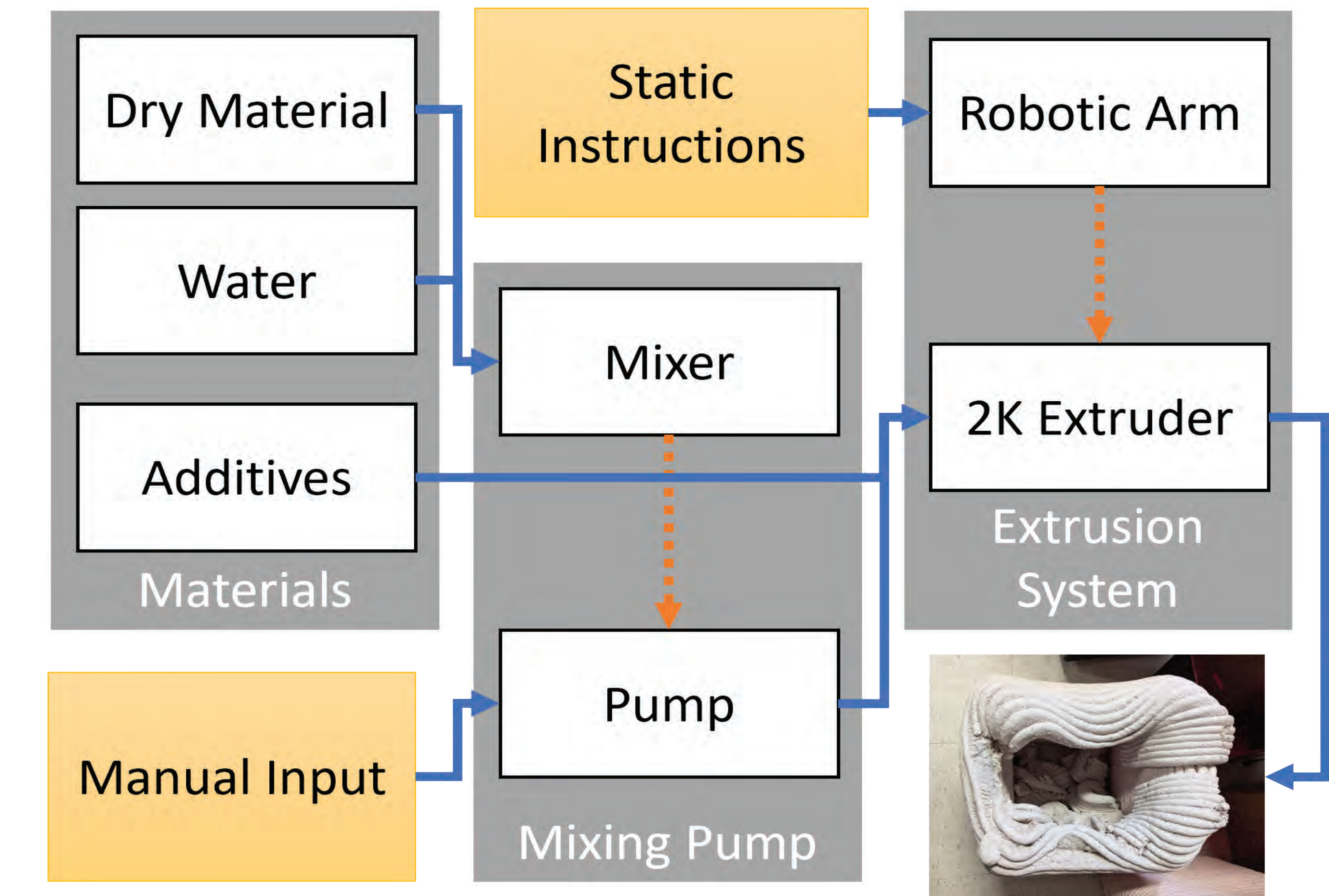


Figure 01: Basic 3DCP System Diagram

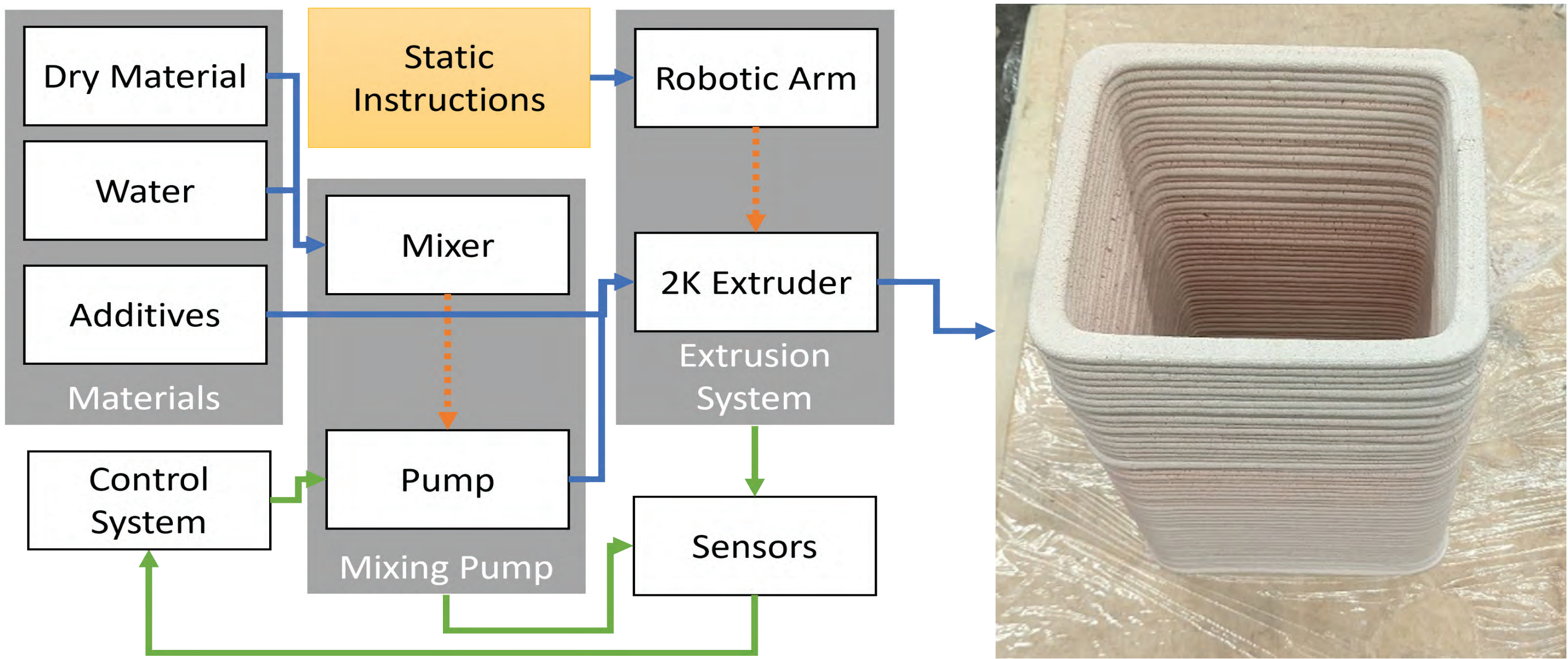
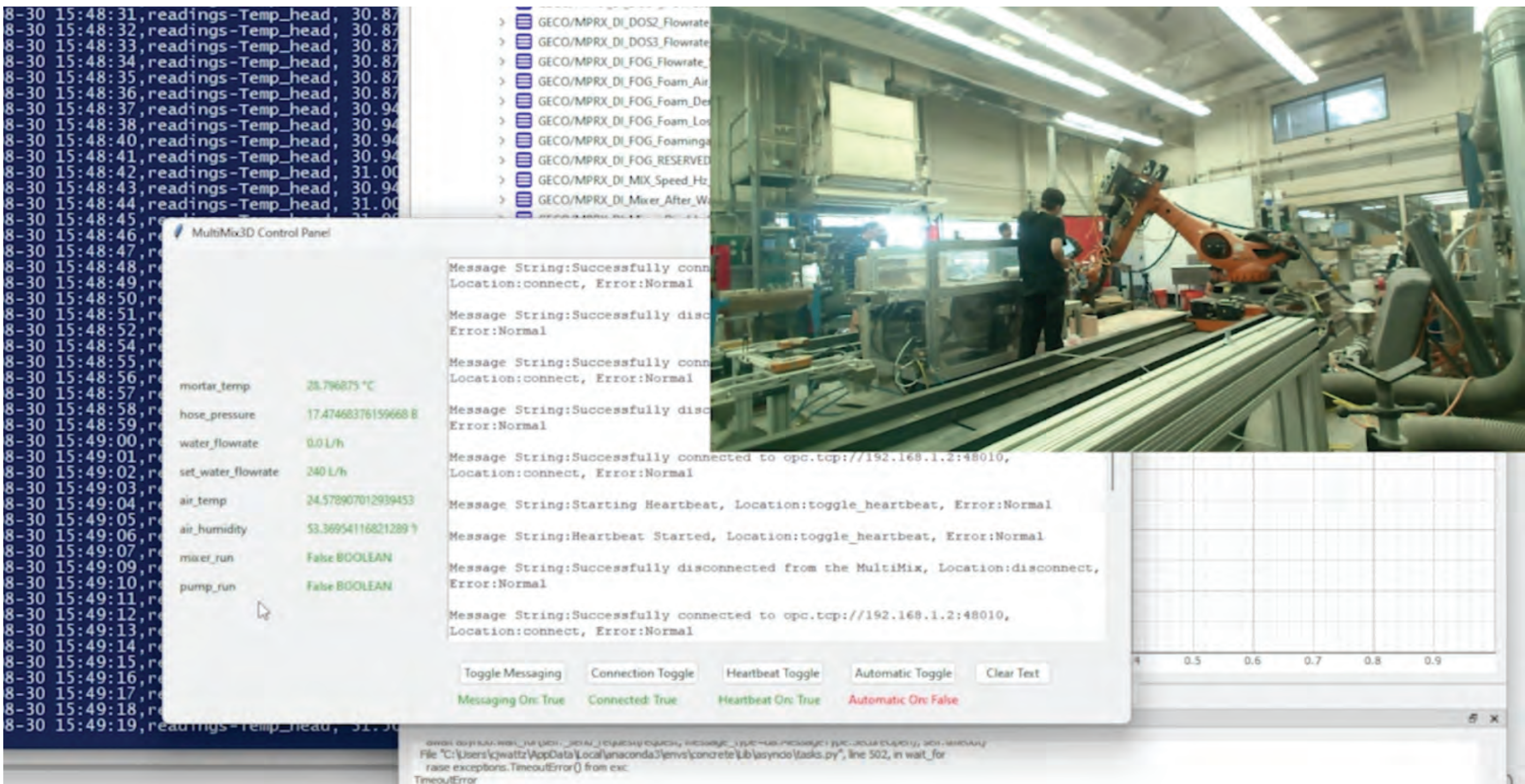


Figure 02: 3DCP System with Pump Controller

Current Research Progress

In the summer of 2024, our collaborative team created a cutting edge test environment to run experiments on the processes of concrete printing with emphasis on data collection and process visability.

- We have run a number of experiments to isolate input parameters and their effects on the resultant output of the printed structure and material homogeneity.
- We have begun data analysis and model creation from our experiments.
- We have centralized most of the data collection



Research Objectives and Future Direction

With the completion of the setup, most of the current work will be focused on analyzing the data and setting up for larger and more involved experiments.

- The data that has already been collected will be used to verify models and controller designs.
- These models will have two broad categories, one category will involve controls for safe and stable operation. The other will be models for design and process control.
- The next milestone goal is to be printing optimized formwork and non-planar structures with complex geometries.
- Further design enhancements for the 2K printing system as well as centralized control/monitoring are already being worked on.
- This research is dedicated to increasing the availability of adequate housing and infrastructure for the general populace.

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