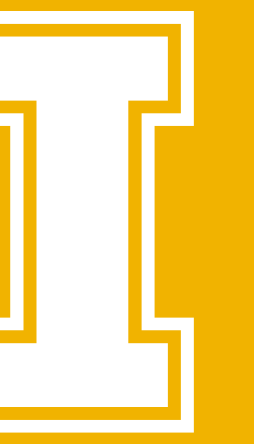


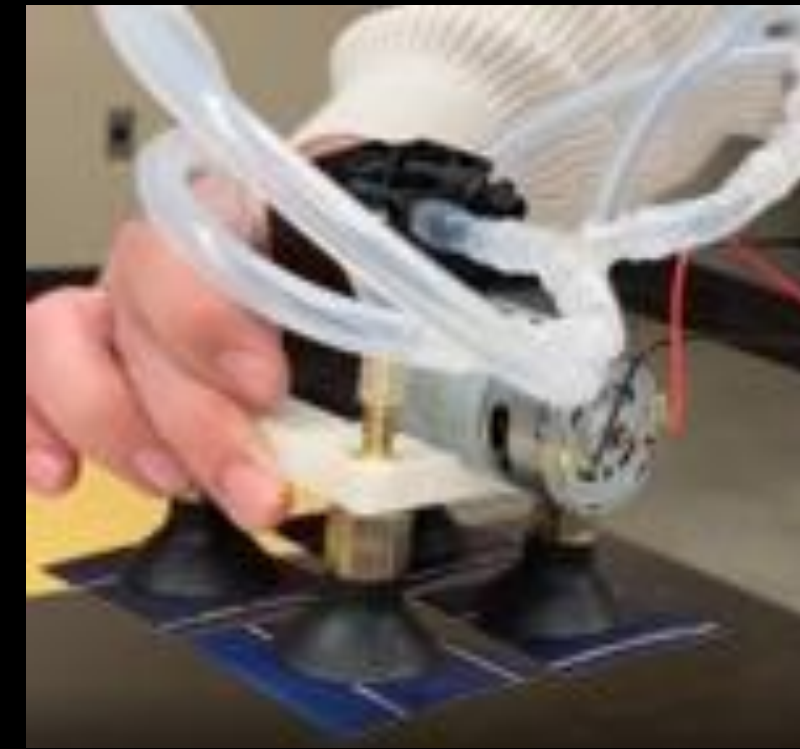


ROBOTIC ASSEMBLY OF PHOTOVOLTAIC ARRAYS

CHANDLER CALKINS, GLEN FINDLEY, TYLER GRONER, HOLLY KEIR, GRANT LUCKE, DAVID VOROUS



CONCEPT DEVELOPMENT



Preliminary Vacuum End Effector



Preliminary Ink End Effector



Preliminary Spray End Effector

- Suction cups without bellows prevented flexibility when lifting fragile cells
- Conductive Ink Pen with holding spring proved too stiff and inconsistent
- Single spray adhesive applicator produced inconsistent spray
- Mini I/O and hand I/O couldn't send signals to end effectors
- Communication through ethernet signals between arms

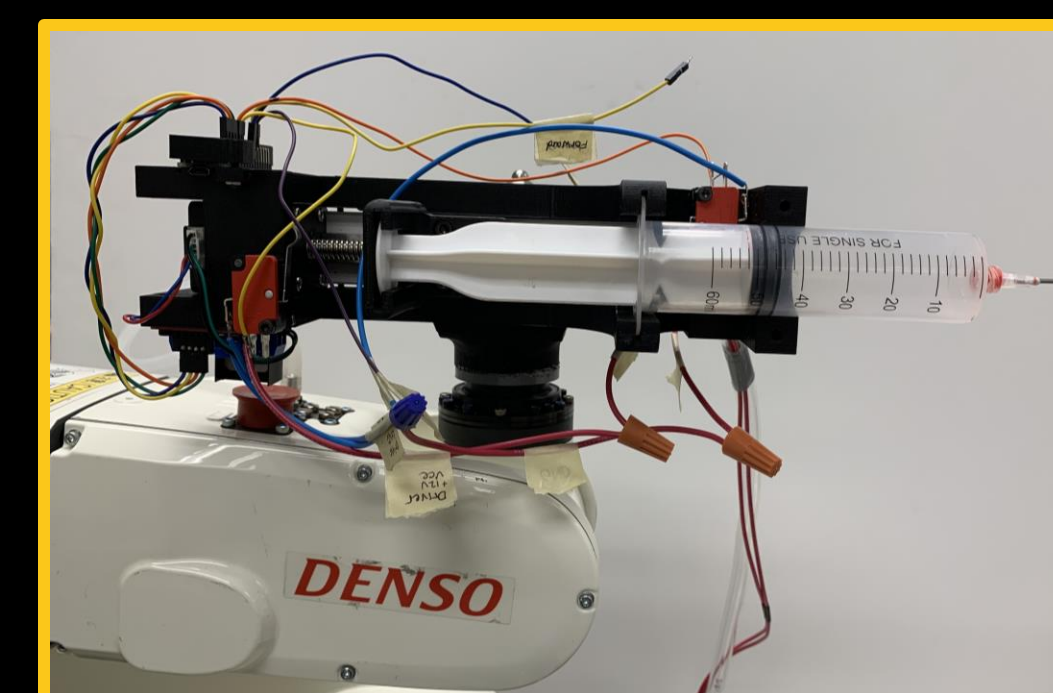
INTEGRATION

- 3-D prints used to hold end effectors on robotic arms:
 - Vacuum end effector uses hosing and vacuum pump for suction
 - Atomizing spray nozzle with pump and compressed air
 - Arduino and stepper motor work together for controlled dispensing of ink
- Coding communication between both arms
- Voltage stepped down from power supply for required electrical components

FINAL DESIGN



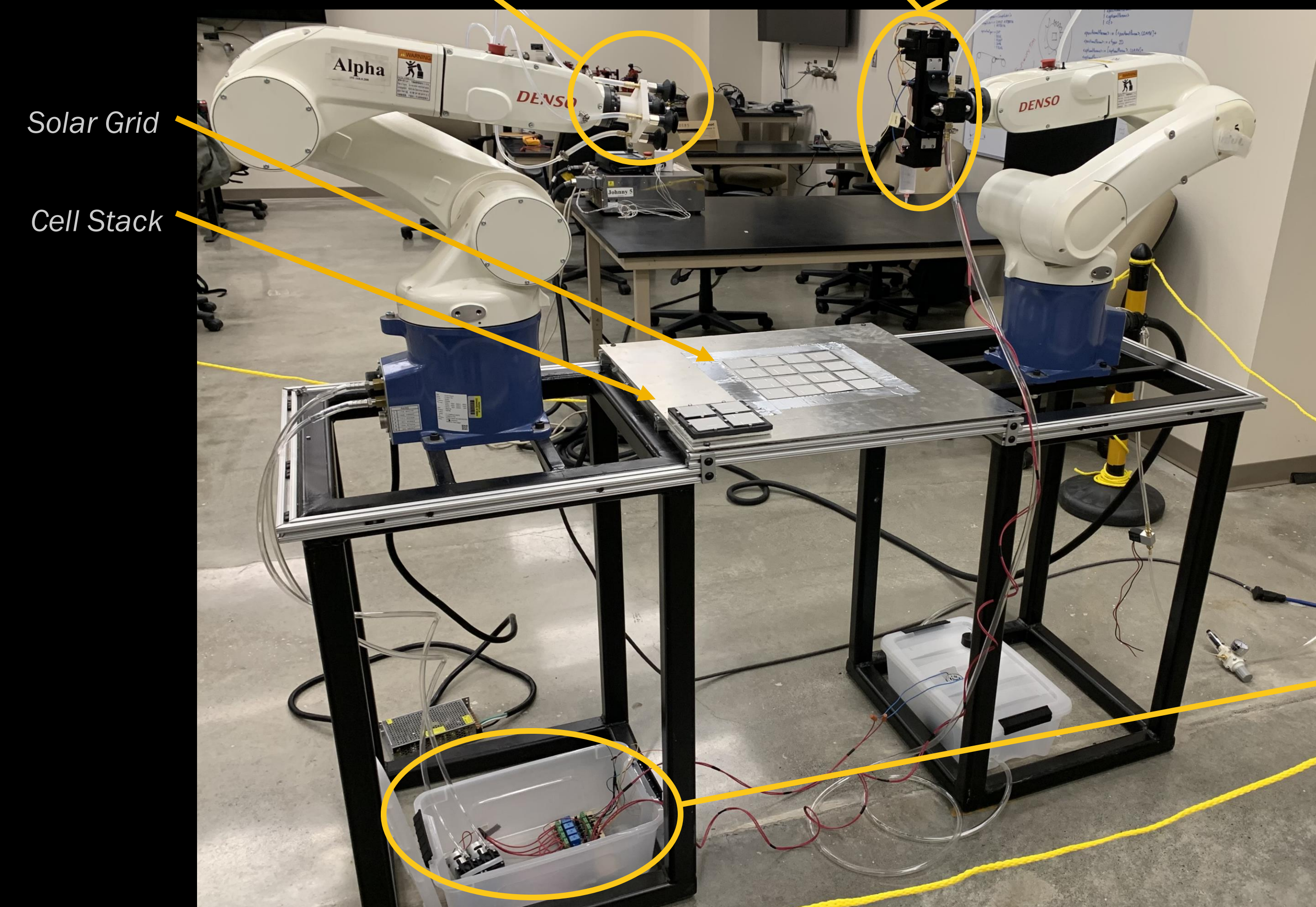
Vacuum End Effector



Ink End Effect

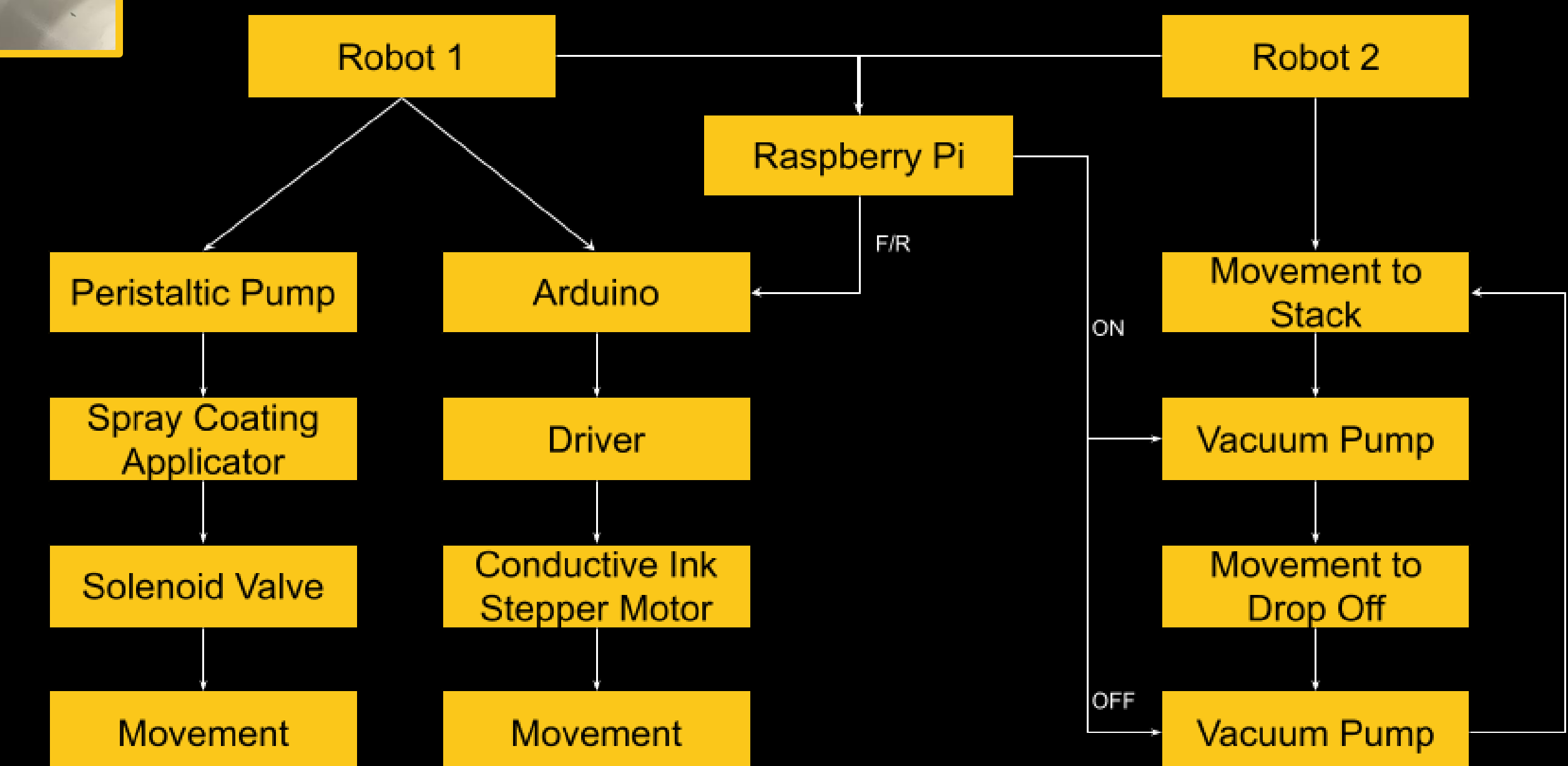


Spray End Effector

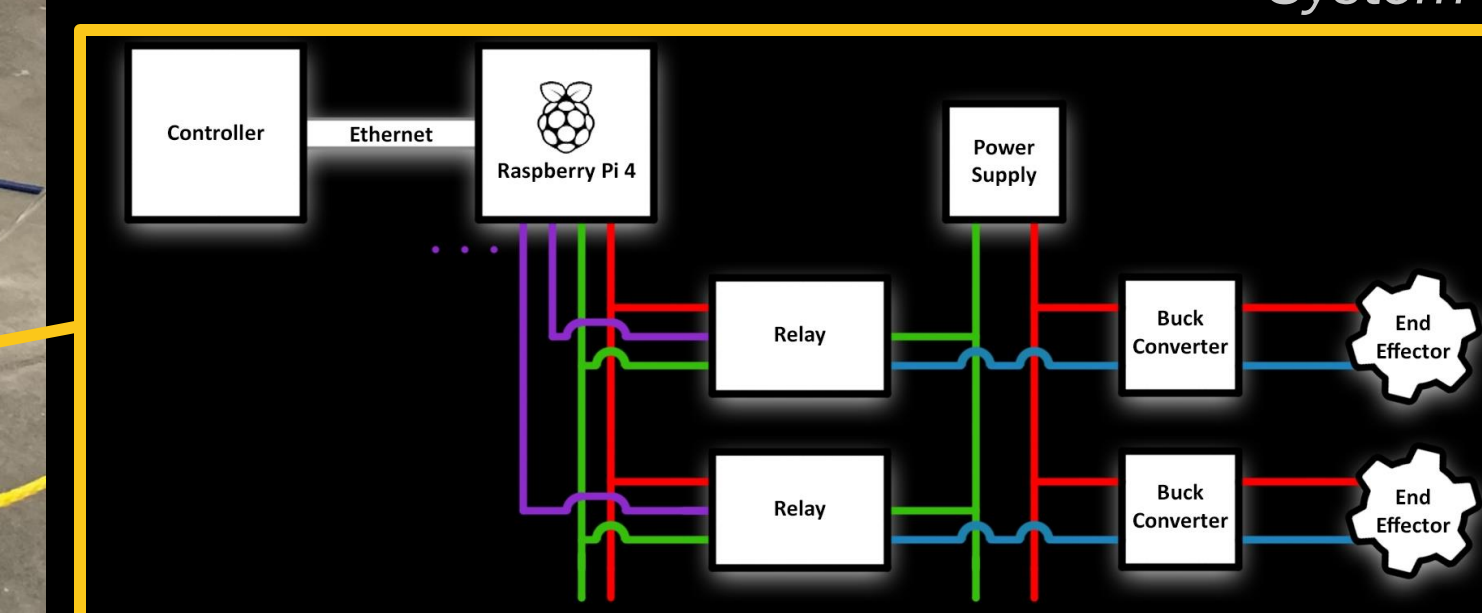


RESULTS

- Each sub-assembly operates properly
- Robotic arms can send signals to end effectors for power
- Full surrogate solar array created with minor human interaction



System Process Flowchart



Circuit Diagram



University of Idaho
College of Engineering

2023 Capstone Project

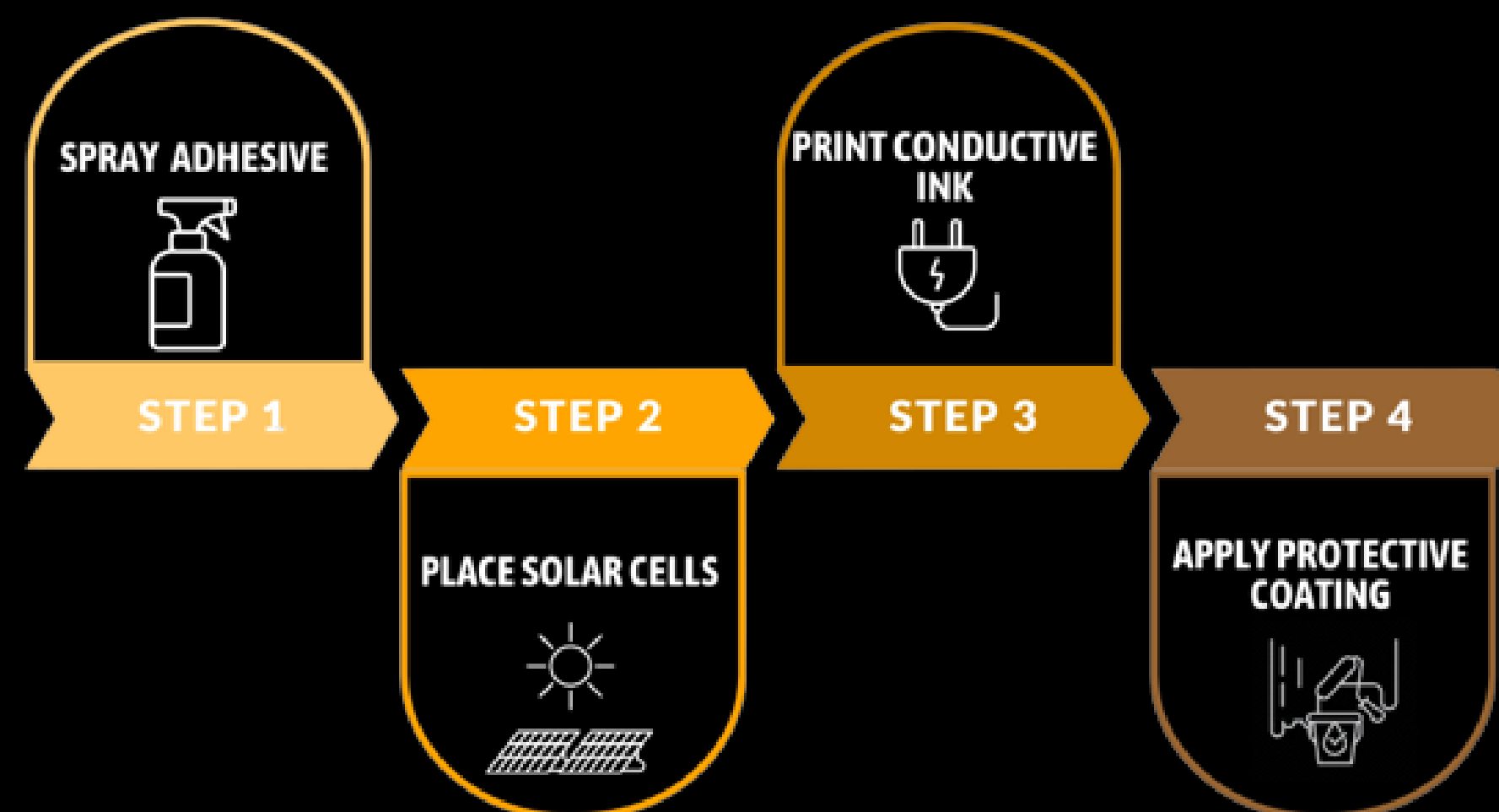
OBJECTIVE

Design, build, and demonstrate a repeatable and automated assembly process for compiling thin-film cells into larger photovoltaic arrays using two robotic arms.

BACKGROUND AND VALUE PROPOSITION

Current solar array assembly methods are expensive, time-consuming, and error-prone. We aim to develop NASA's more efficient patented process of assembling solar arrays.

- Estimated reduction from \$450/Watt to \$25/Watt
- Large scale production
- Solar array manufacturing in space



NASA's Patented 4-Step Process

KEY REQUIREMENTS

- Robotic arms completes 4 step process without operator interaction
- Robotic arms complete the 4-step process within 35 minutes
- Use 2-inch square solar cells to create a 4 x 4 array
- Complete the assembly process twice to demonstrate repeatability

Sponsors and Mentors: Brian Boogaard, Austin Bumbalough, John Carr, Jacob Friedberg, Senami Hodonu, Dr. Michael Maughan, Dr. Matthew Swenson, Nagendra Tanikella