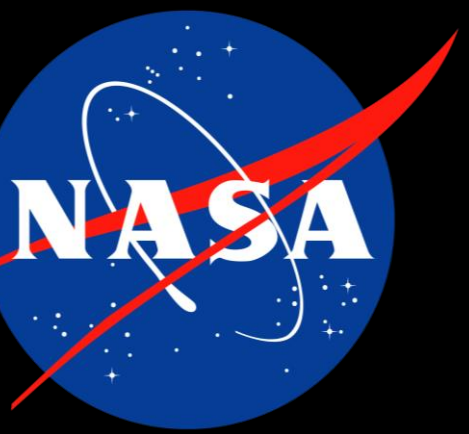
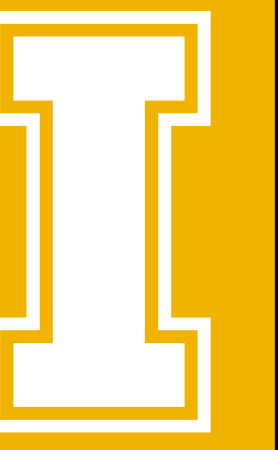


EXPO

engineering ▲ design

ROBOTIC ASSEMBLY OF PHOTOVOLTAIC ARRAYS

JAMES ADAMS, TRISTON HARDCASTLE PECK, CONNER MULLINS, HAOZHOU SU, SPENSER SCRUGGS

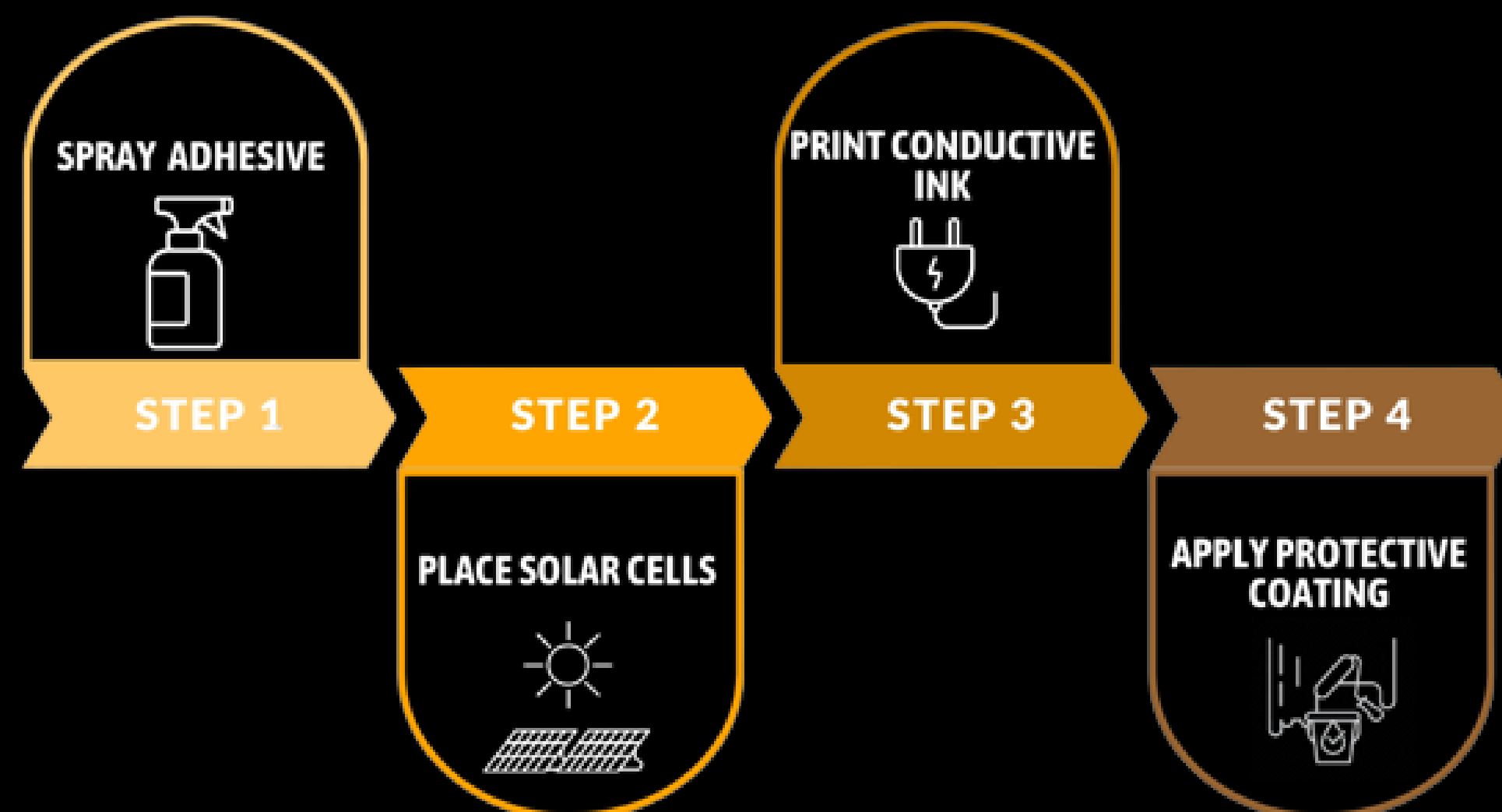


OBJECTIVE

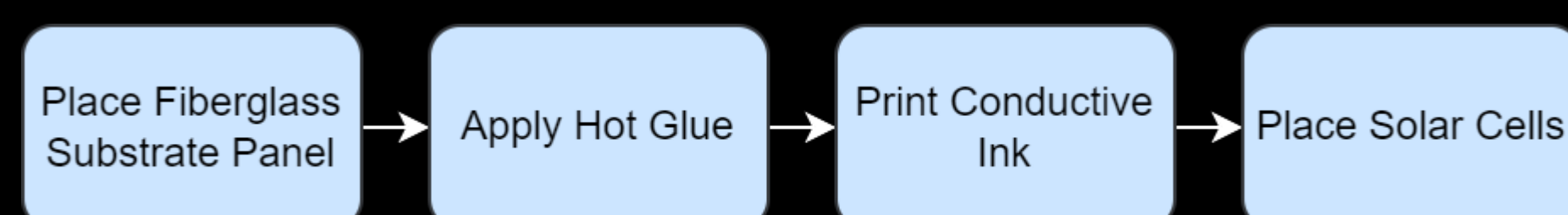
To create a **proof-of-concept prototype** for the NASA Print-Assisted Photovoltaic Array architecture, capable of producing **functional** solar panels **on earth**.

VALUE PROPOSITION

Long-term space missions will need a reliable source of solar panels to replace and expand infrastructure. Our project, based on a NASA patent, demonstrates a **modular, scalable, accurate, and autonomous** method of manufacturing solar panels, utilizing robotics.



NASA's Patented 4-Step Process.



Our Simplified Implementation. Hot Glue Instead of Spray Adhesive, No Protective Coating.

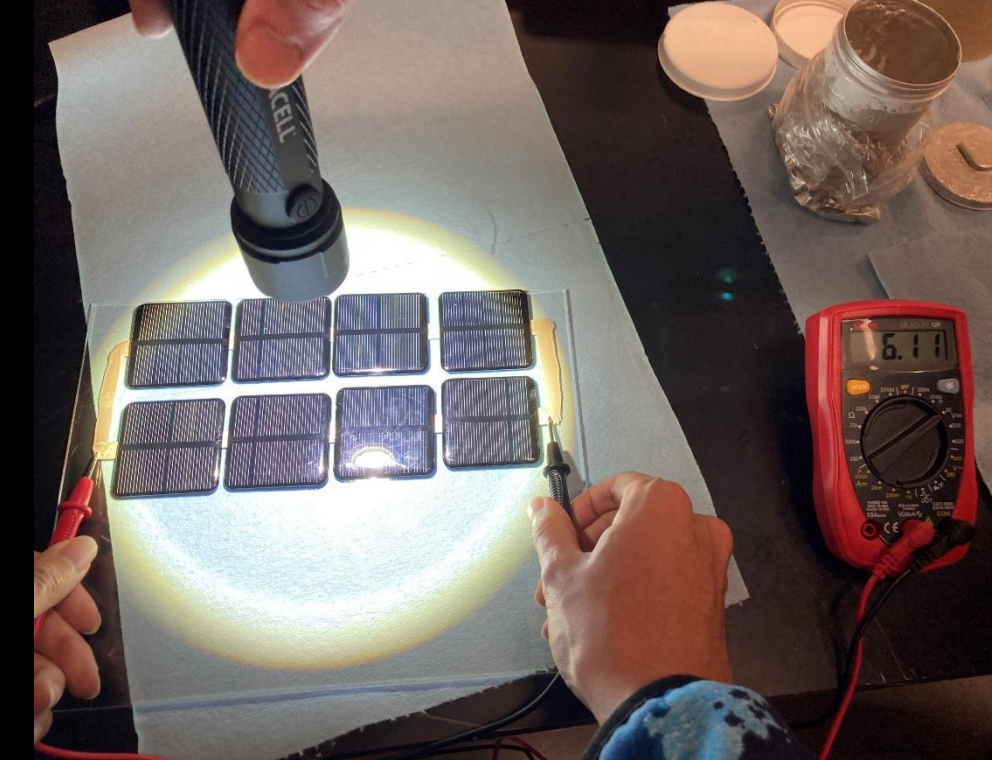
KEY REQUIREMENTS

- Functional solar panels (power an LED)
- Panel assembly time:
 - <30 min (marginal)
 - <10 min (ideal)
- 2 functional panels without intervention

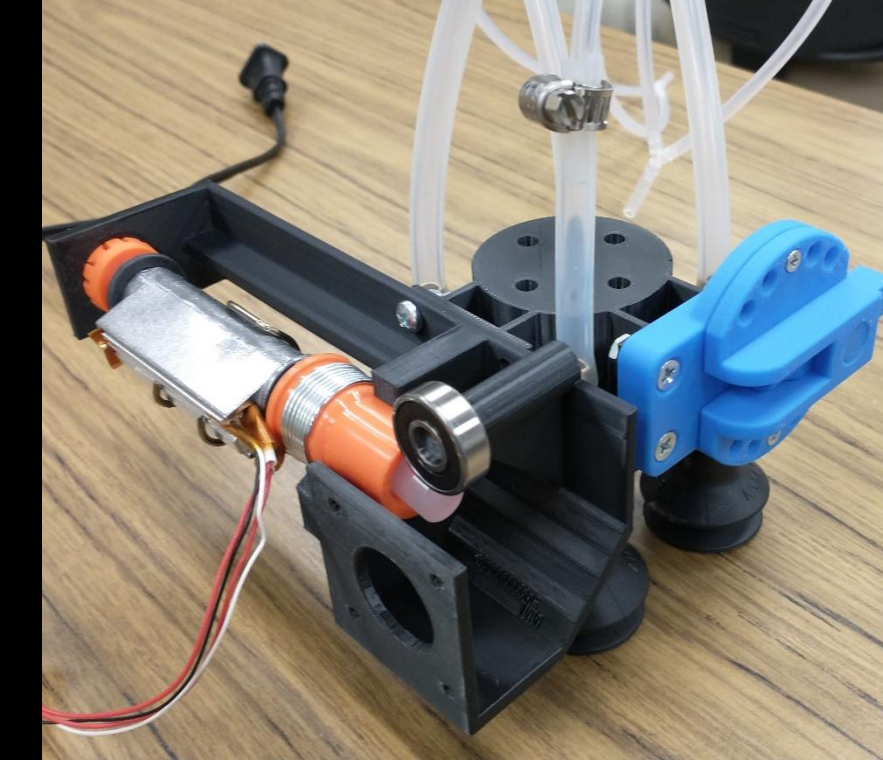
CONCEPT DEVELOPMENT



Prototype 1. Fragile Panels, Warping Substrate.

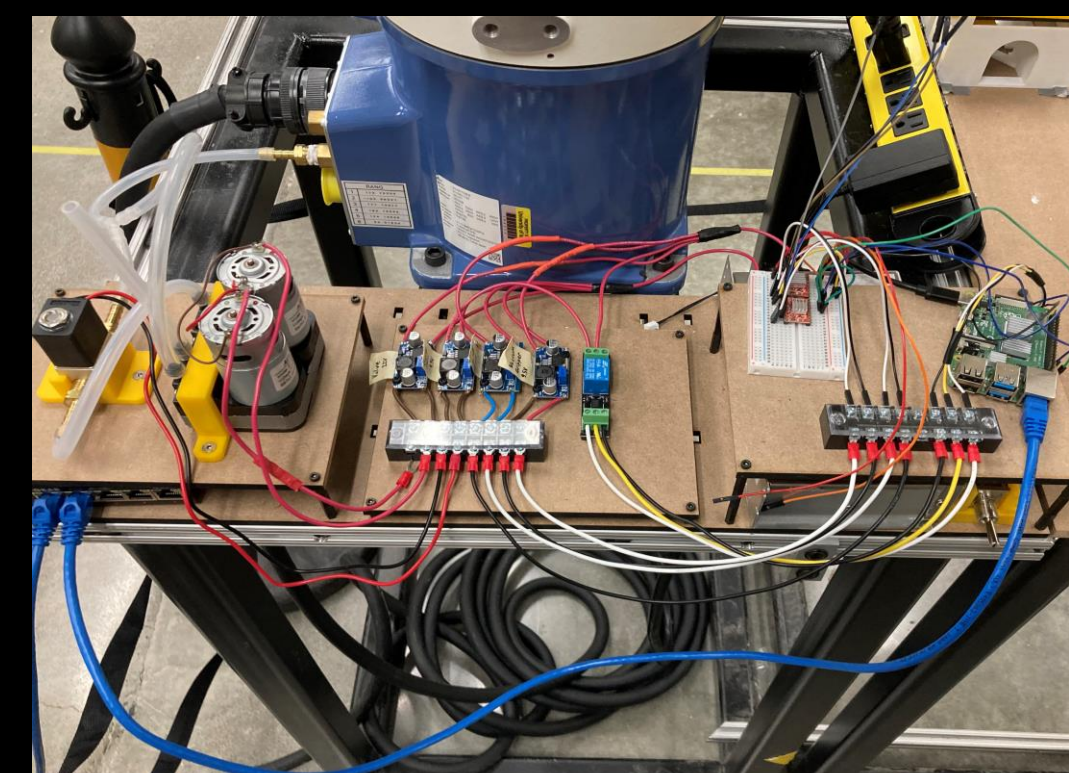


Prototype 2. Thicker Substrate, Stronger Cells, 6 Volts Obtained.



Early End-Effector Prototype. Heat-Warping and Nozzle Permeability.

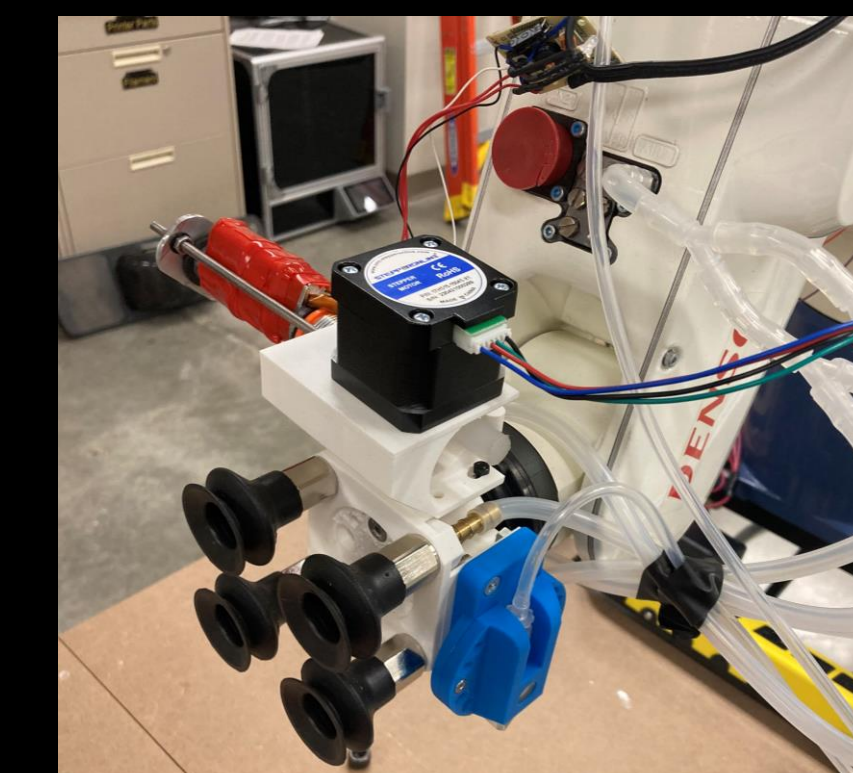
FINAL DESIGN



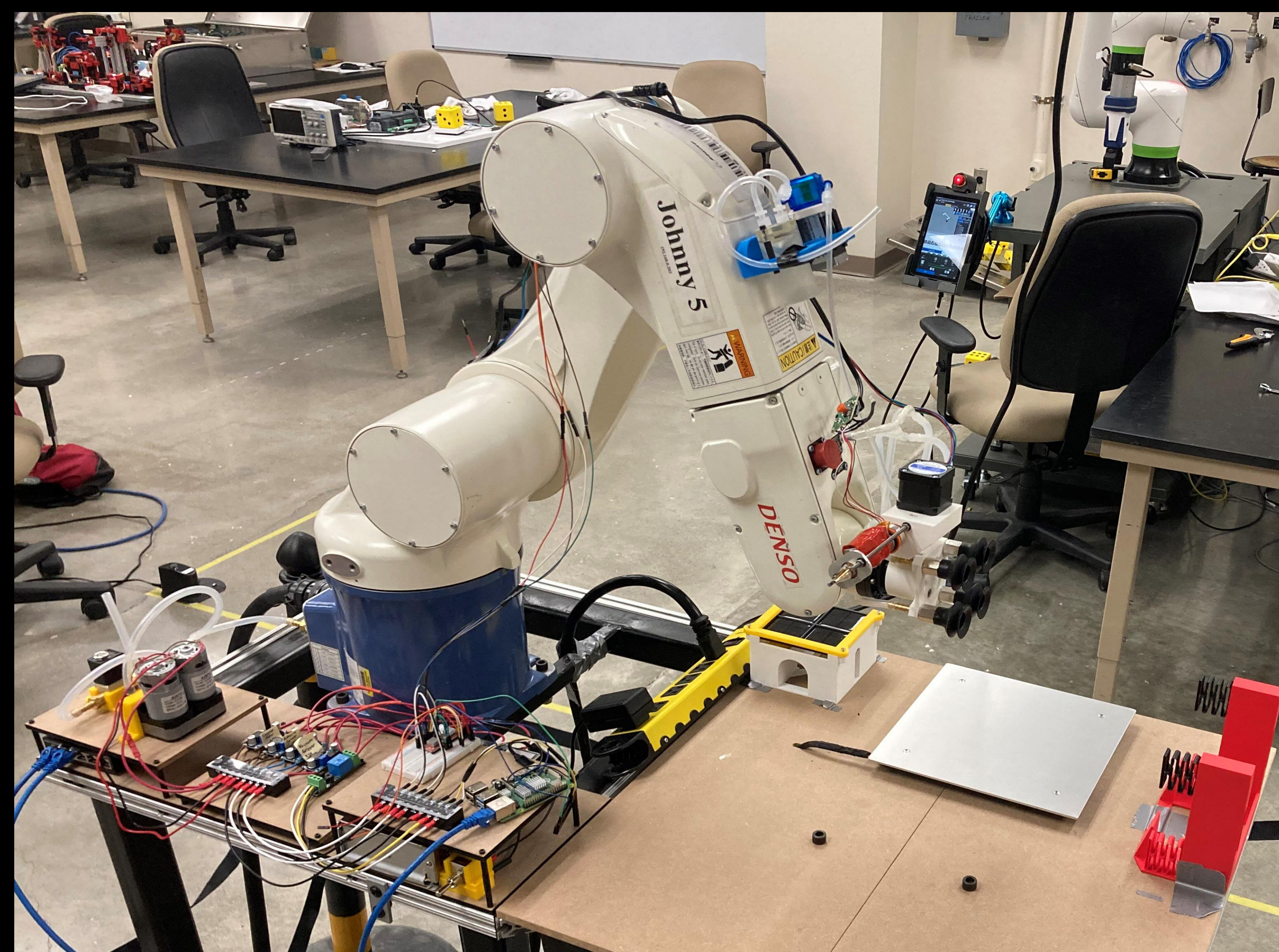
Circuitry Organized With Mounting Plates, Terminal Blocks.



Conductive Ink Reservoir (Resin Printed) and Pump.

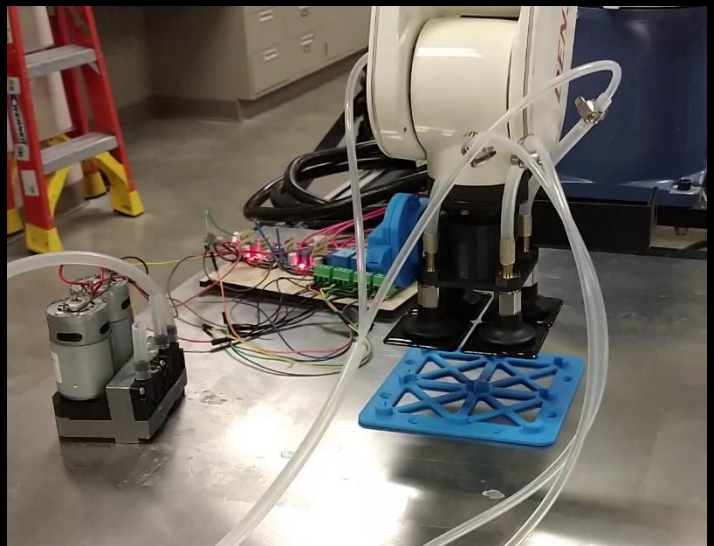


Revised End-Effector. No Heat Warp. Resin Nozzle.



VALIDATION

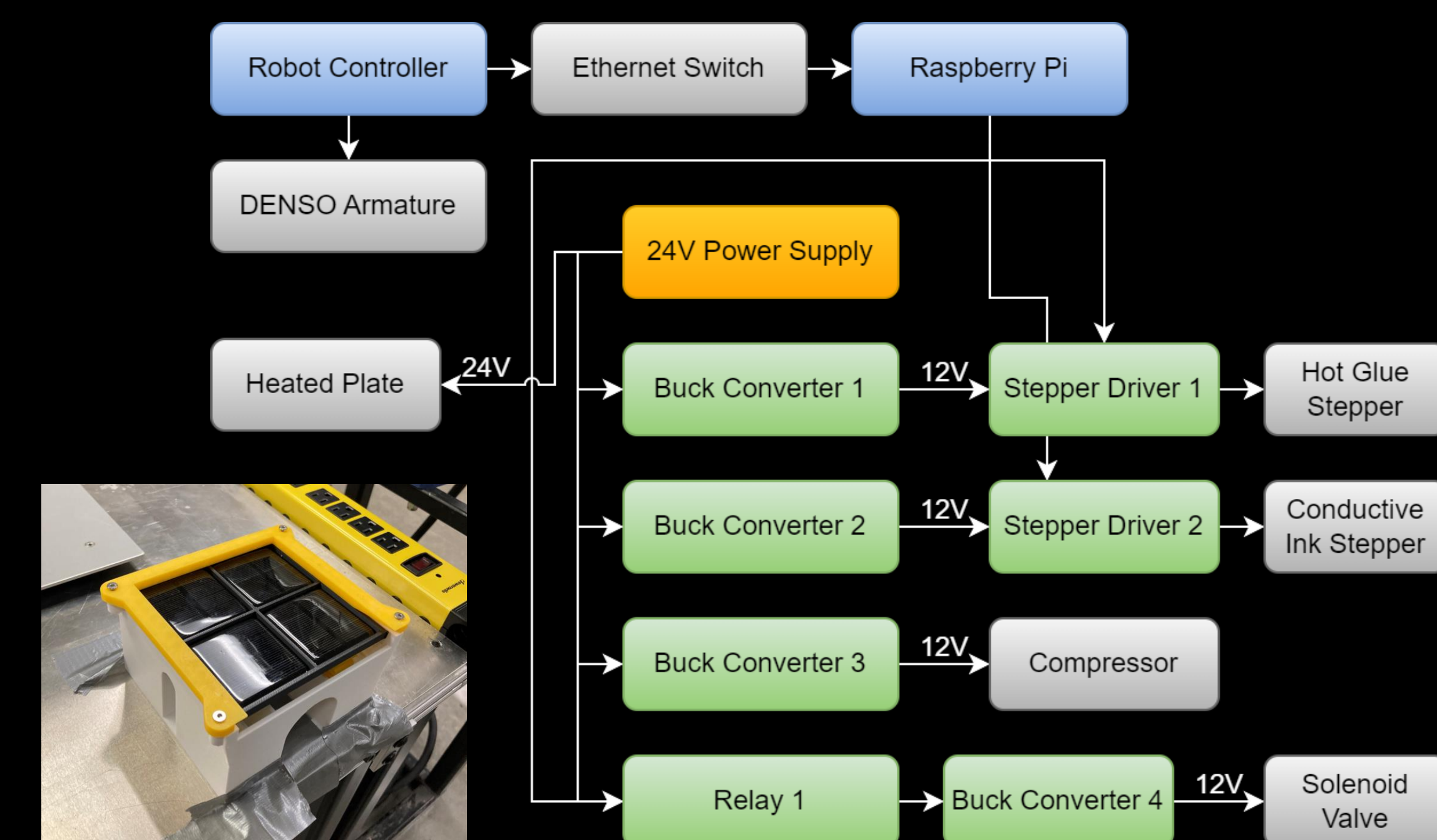
- Full-system test to verify all 3 key requirements
- Individual sub-system tests for robot end-effector
- Testing documented in DVP&R spreadsheet



Still Frame From Early Validation Test.

RESULTS

- The system places all solar panel components accurately and autonomously.
- Successful communication between robot controller and Raspberry Pi
- Panel assembly completed within specified timeframe



Cell Dispenser. Trays Are Reusable. Final Version Holds 32 Cells.

System Component Diagram



Substrate Dispenser. Uses 3D-Printed Springs. Pictured With Alignment Plate.



2024 Capstone Project

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Dr. Michael Maughan, Dr. Matthew Swenson, Nagendra Tanikella, Senami Hodonu, Kris Olds