

## PURPOSE

Portable diagnostic devices can be used to monitor and control the spread of infectious disease. Small, portable, and inexpensive diagnostic devices allow detection of disease biomarkers outside traditional lab settings.

## BACKGROUND

Early and accurate diagnosis of infectious diseases is essential for effective treatment and disease control. Traditional diagnostic platforms require large, expensive equipment to perform sample purification and nucleic acid amplification. This project focuses on the hardware design of a palm-sized processor to enable these operations in a compact, user-friendly form. The processor supports the LIAMT (Lab-in-a-Magnetofluidic Tube) system and can analyze the contents of the tube outside the traditional lab setting.

## REFERENCES

Li, Z., et al. (2024). *Palm-Sized Lab-In-A-Magnetofluidic Tube Platform for Rapid and Sensitive Virus Detection*. *Advanced Science*, 11(23), 2310066.

<https://doi.org/10.1002/advs.202310066>

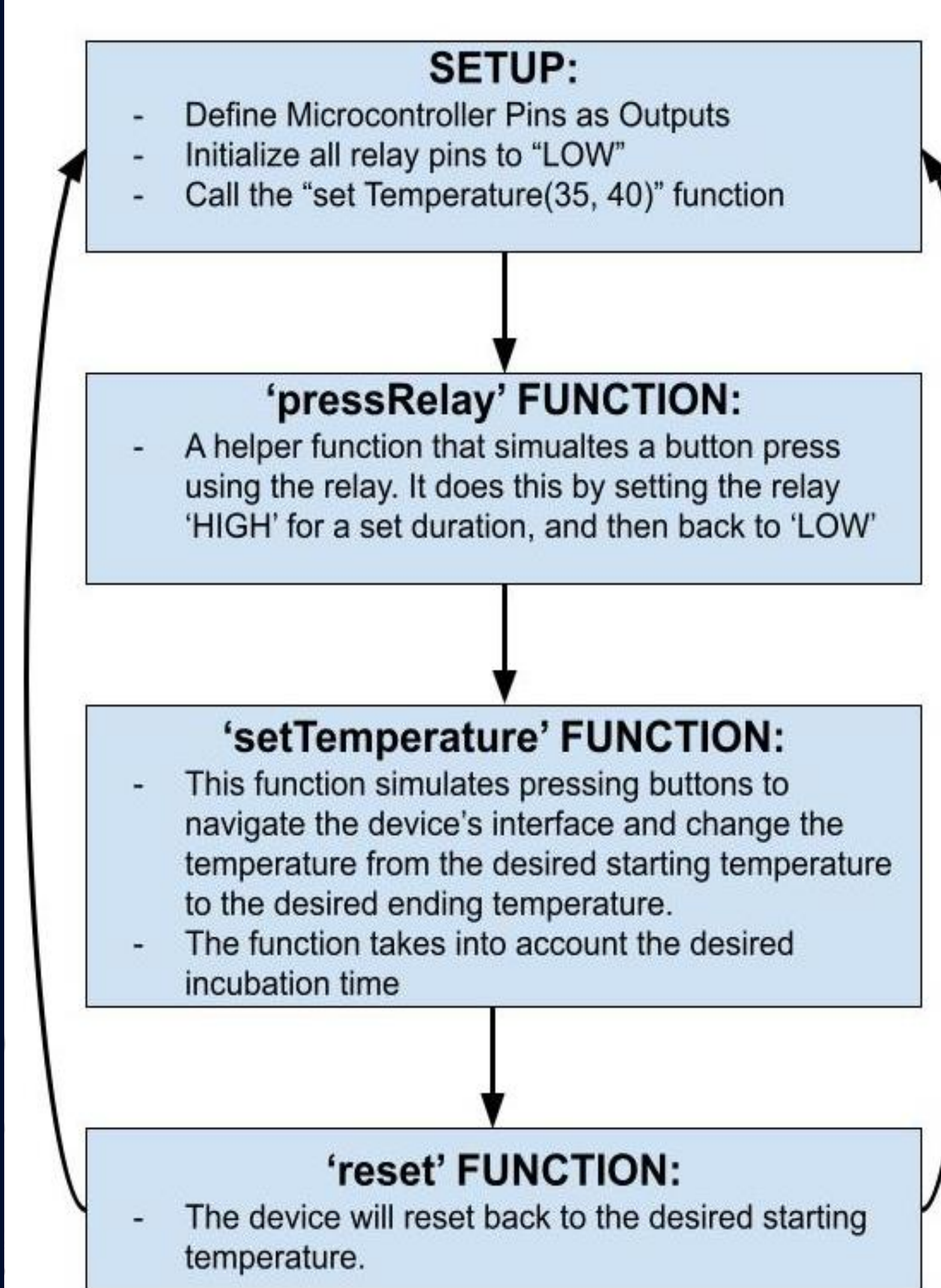
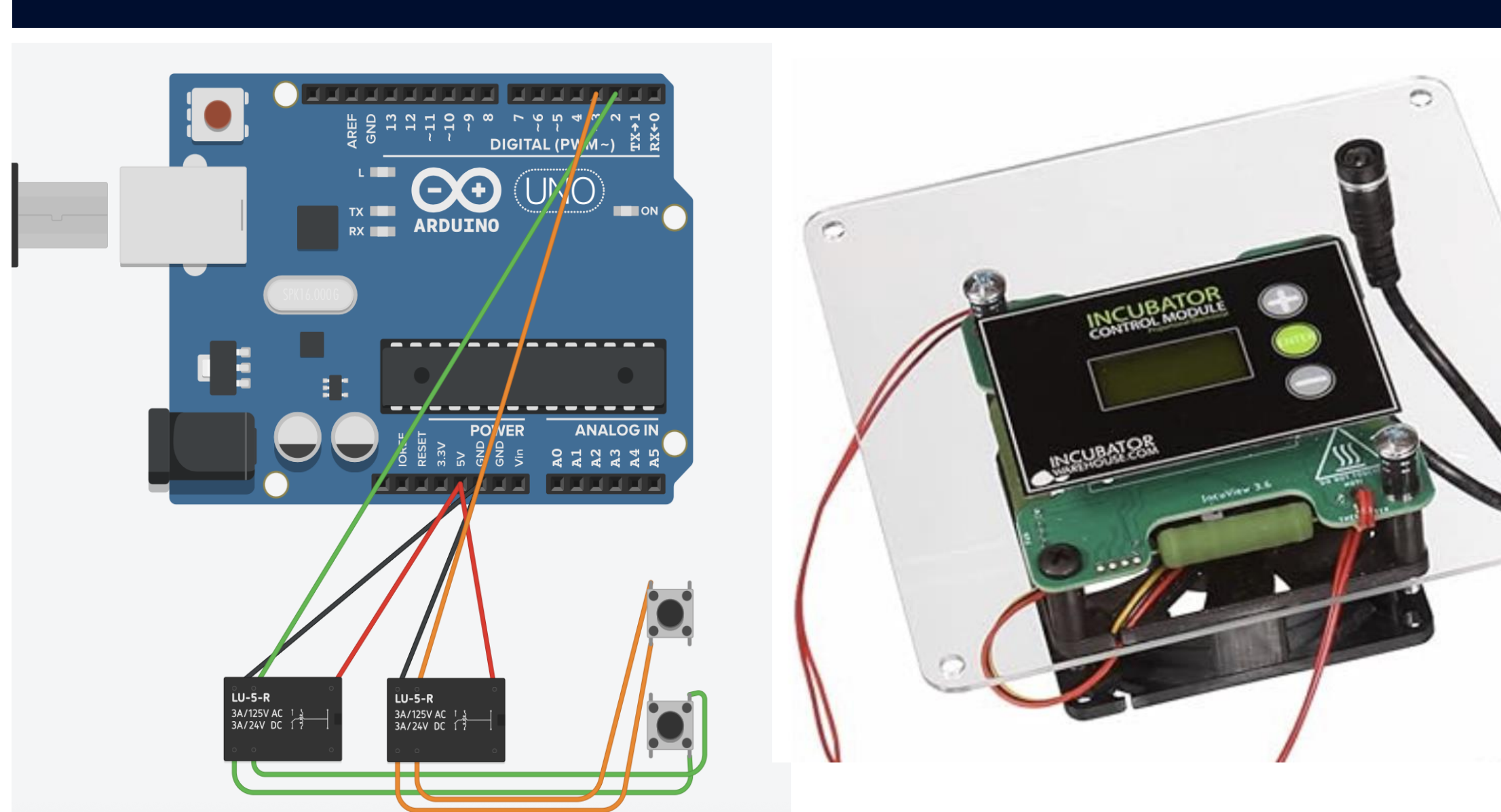
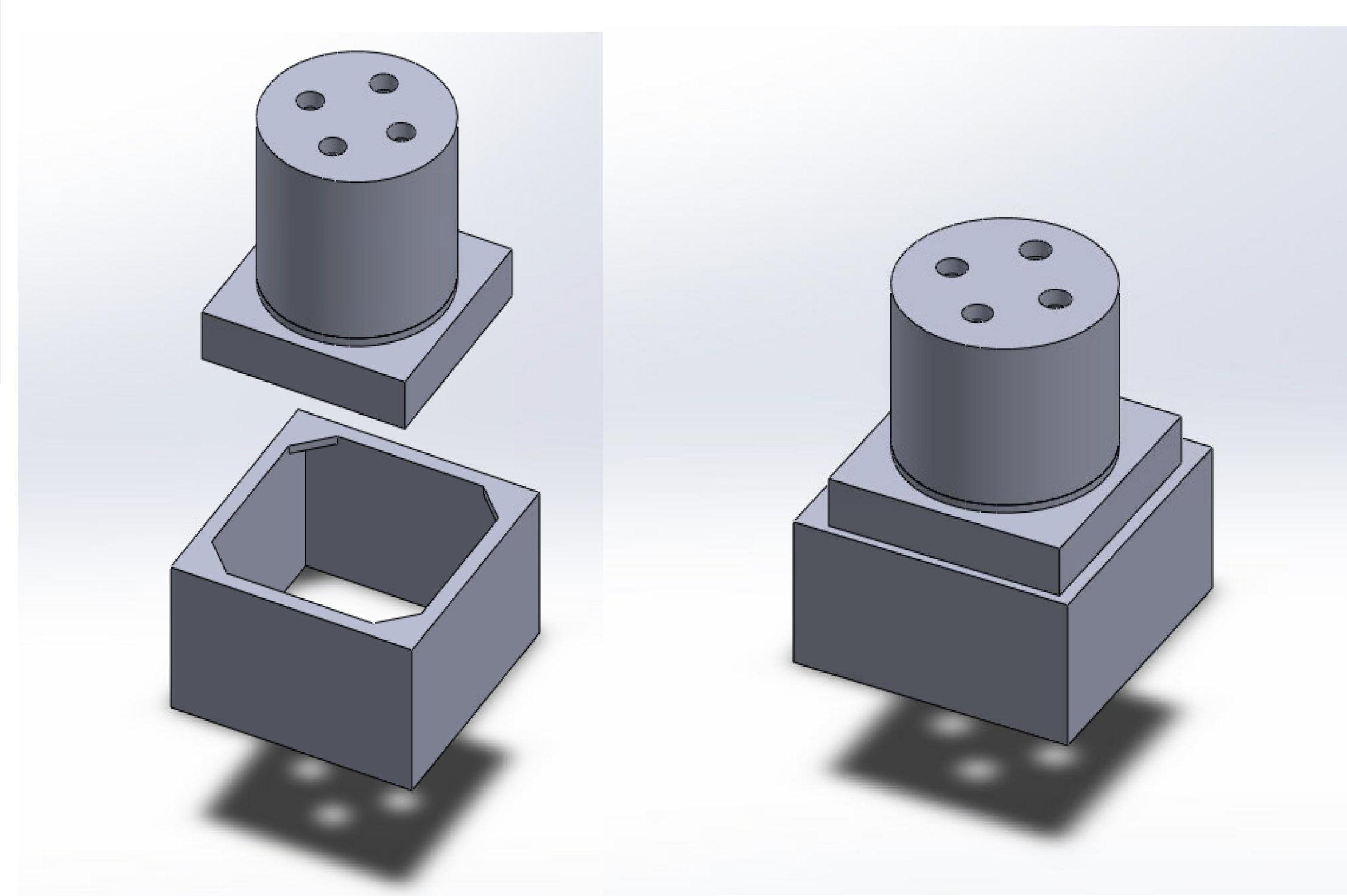
## RESULTS & DISCUSSION

**Thermal Control:** The Arduino-based control code successfully simulates precise temperature adjustments on the IncuKit Mini interface. Relay timing and button press sequences were tuned to achieve stable thermal control within  $\pm 0.1^\circ\text{C}$  of the target value.

**Size:** The control system uses a compact Arduino and minimal components, allowing integration into small enclosures. Final size will depend on the enclosure design and power source components.

**Power:** Power consumption is minimal, as the system only activates relays for short durations. Further testing will measure current draw during idle and active states to assess battery viability for portable use.

**Manufacturability:** The design uses off-the-shelf components (Arduino, relays) and simple wiring, making it easy to replicate.



## METHODS

**Materials:** The system utilizes the IncuKit portable incubator system, two relay modules, an Arduino nano, and power sources.

**Design:** The design was implemented using SolidWorks and will be printed by a 3D printer. The design features a place for the test tubes, a cover, and an optical window.

**Heating System:** Thermal sensor feedback maintains  $35\text{--}40^\circ\text{C}$  for reactions and is controlled using a microcontroller.

**Optical Detection:** Integrated 645 nm LED as excitation source. Emission window has a Cy5 filter for viewing fluorescence. Readout of results can be done by naked eye.

## FUTURE DIRECTIONS

In the future, implementing a custom PCB (printable circuit board), for both temperature regulation and for the microcontroller will create a cohesive design. Additionally, implementing solar to power the device will increase accessibility and limit the need for direct electricity access.

## ACKNOWLEDGEMENTS

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