DHF 2: Mark 2 Assembly and Modularity

UBCV iGEM 2024

NuCloud

Arduino Microcontroller Bioreactor

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1.0 Introduction

1.1 Background

This is the next design cycle after Mark 1 and is more of re-build rather than a continuation. Mk. 1 had a 2 L vessel with polycarbonate (PC) elements. This mk. 2 will have various changes based on feedback received from users on the wet lab team. All parts will now be printed using polylactic acid (PLA) and the vessel will now be a 160 mL tissue culture flask commercially available. The goals and needs remain the same as before: to culture E. coli capable of producing thermostable terminal deoxynucleotidyl transferase (TdT/DNTT). To be able to effectively achieve this goal, various functions and interfaces were designed to give users the best experience and utility when culturing the bacteria. This includes an agitator, filtered air input and output, thermometer, optical density (OD) sensor for biomass, pumps/motors, microcontrollers, control panel, etc.

2.0 Design

With the introduction of the new vessel, a new base has to be constructed since the tissue culture flask [1] has different dimensions and requires extra stability compared to mk.1. For these reasons, we decided to build a base for the flask with space on the outside for functional components like motors and their respective drivers and circuit boards. All designs with "rails" underneath are meant to go on the "tracks" on the side of the base.

2.1 PLA Parts

The following parts are printed using PLA and their files are available in the appendix:

The base:

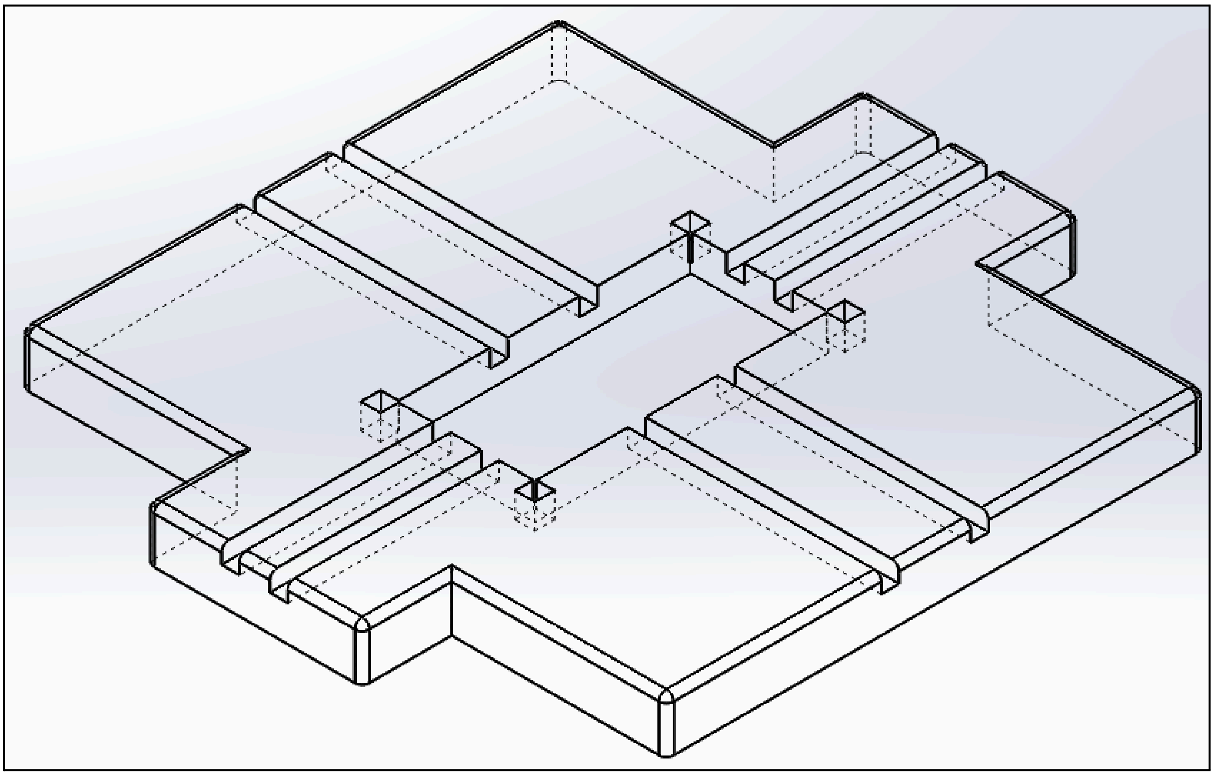

Figure 1: Mk.2 Base with modular attachments, holes for frame and central space for flask

The frame:

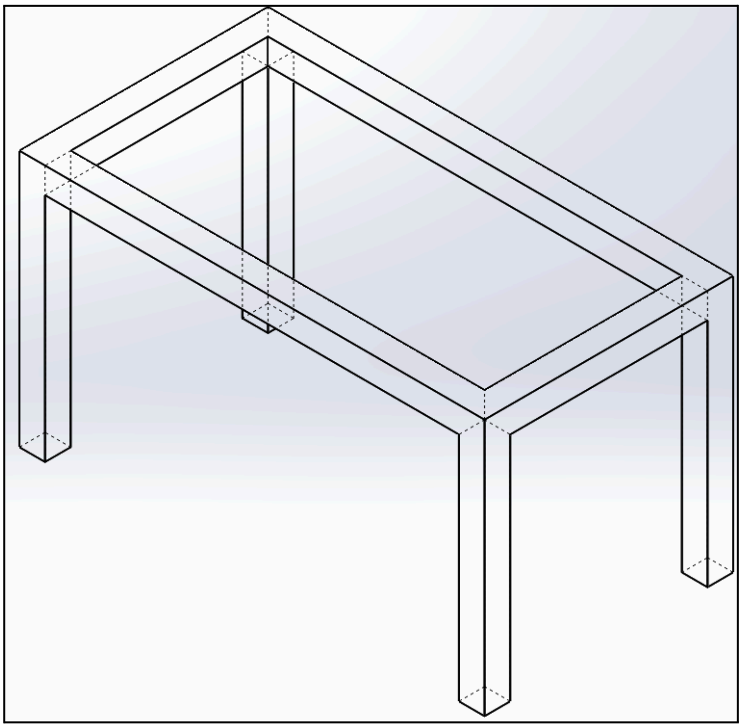

Figure 2: Frame that fits into the base and stabilizes the flask

On-flask module:

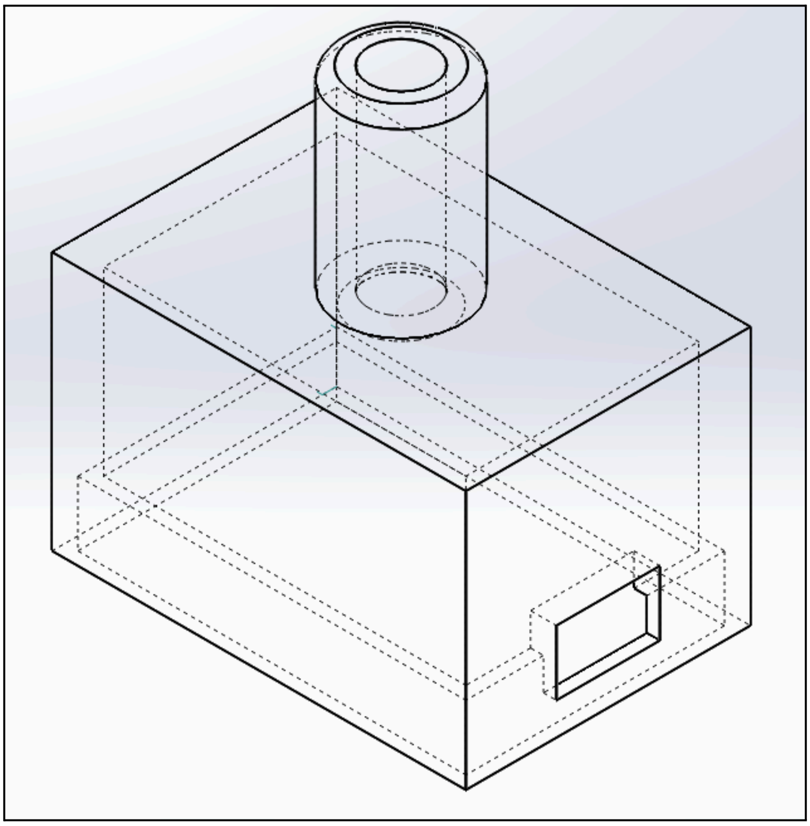

Figure 3: Temperature sensor [4] module (inverted) with square-shaped opening for pins

On-base modules:

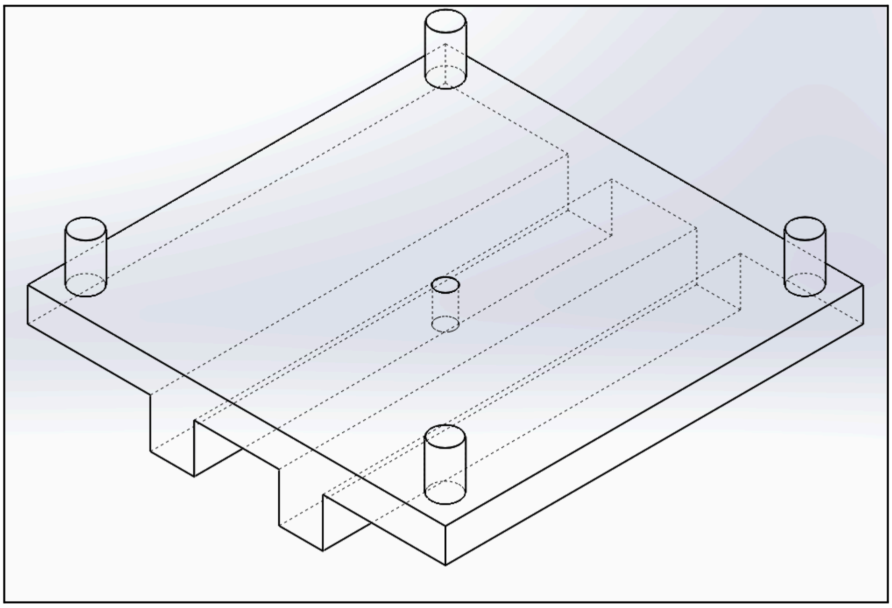

Figure 4: L298N Motor Driver [3] base

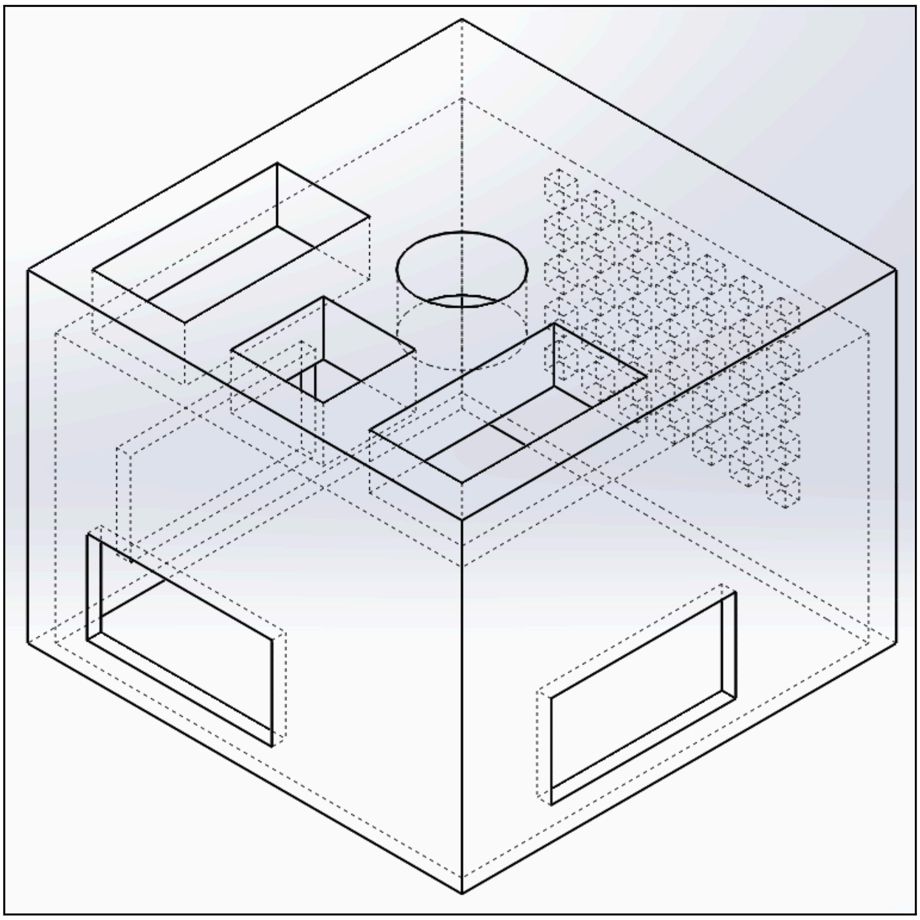

Figure 5: L298N motor driver cover with openings for wiring

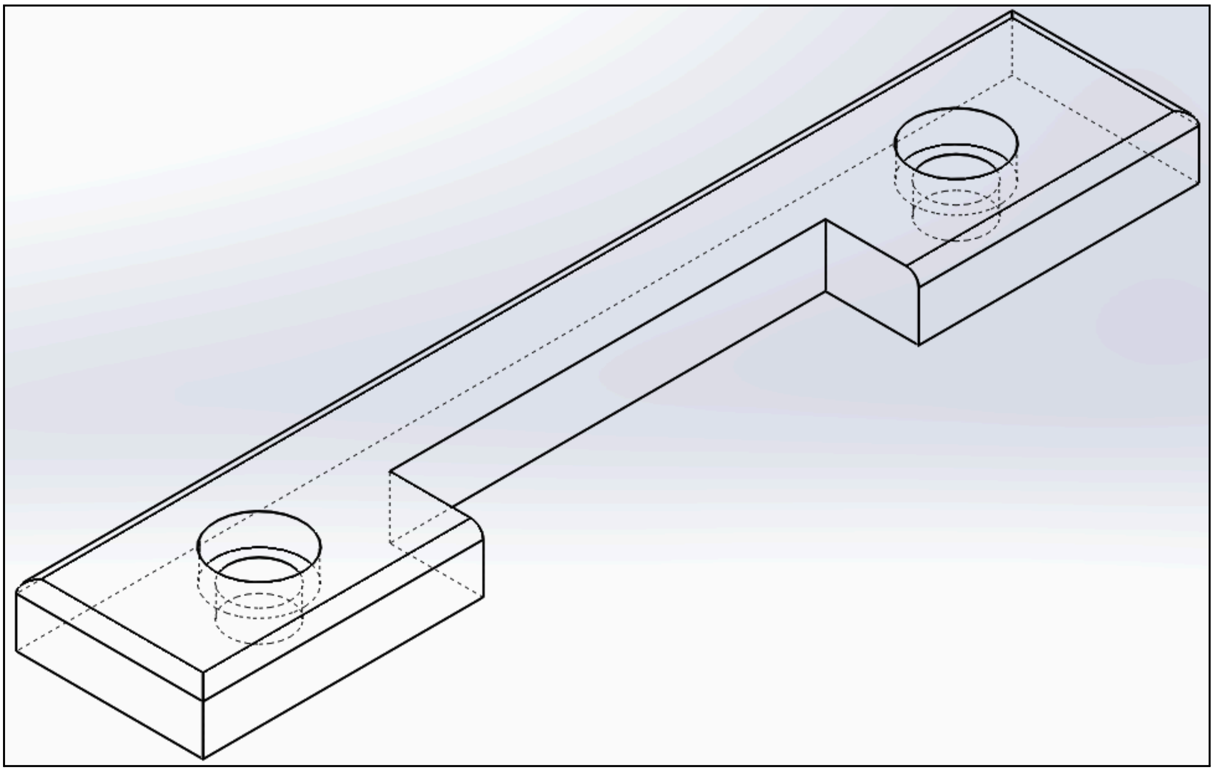

Figure 6: Screw connector bar used to link parts of the base if printed separately

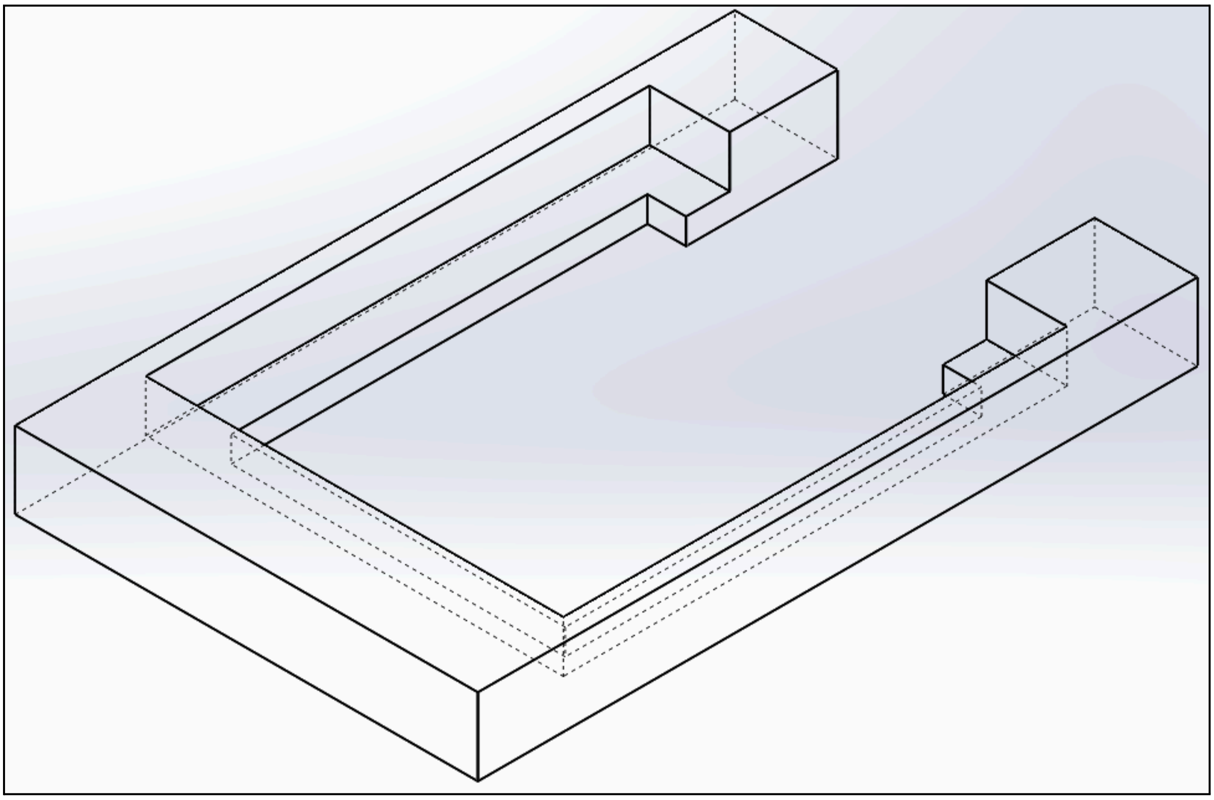

Figure 7: Temperature sensor casing for on-flask module

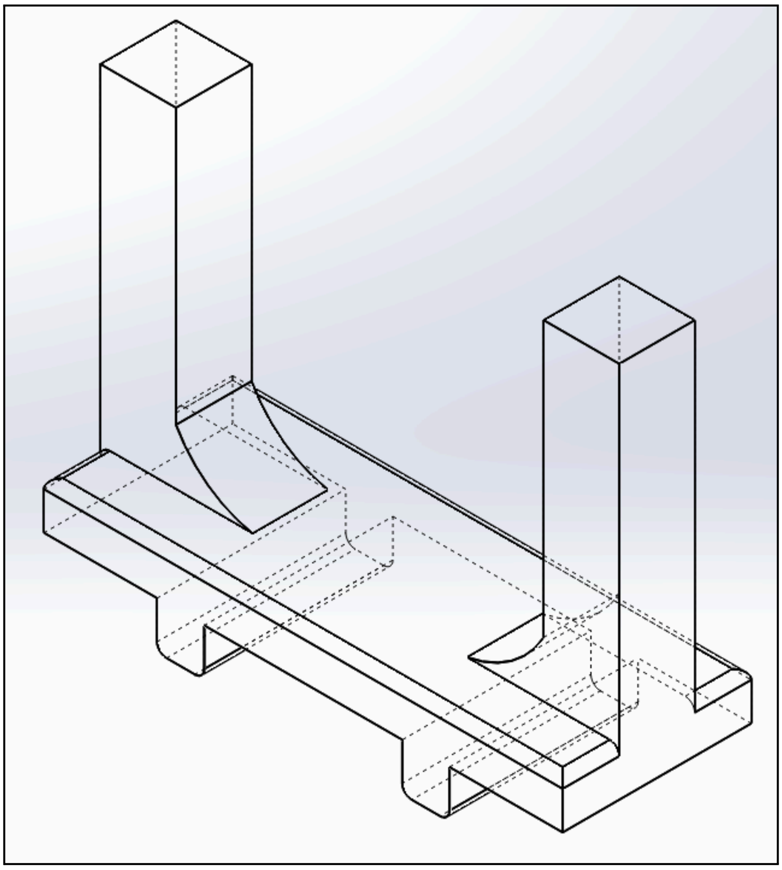

Figure 8: Peristaltic Pump mount (screwed on)

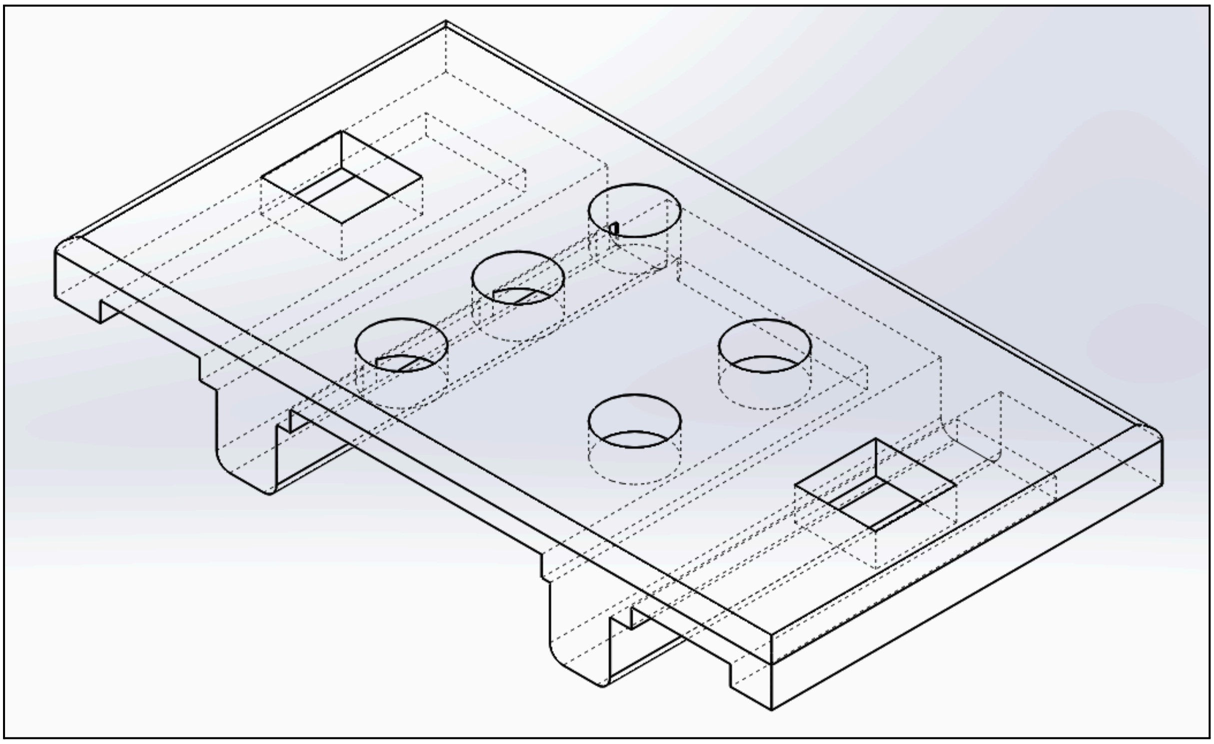

Figure 9: Control panel with 2 buttons and 5 LEDs

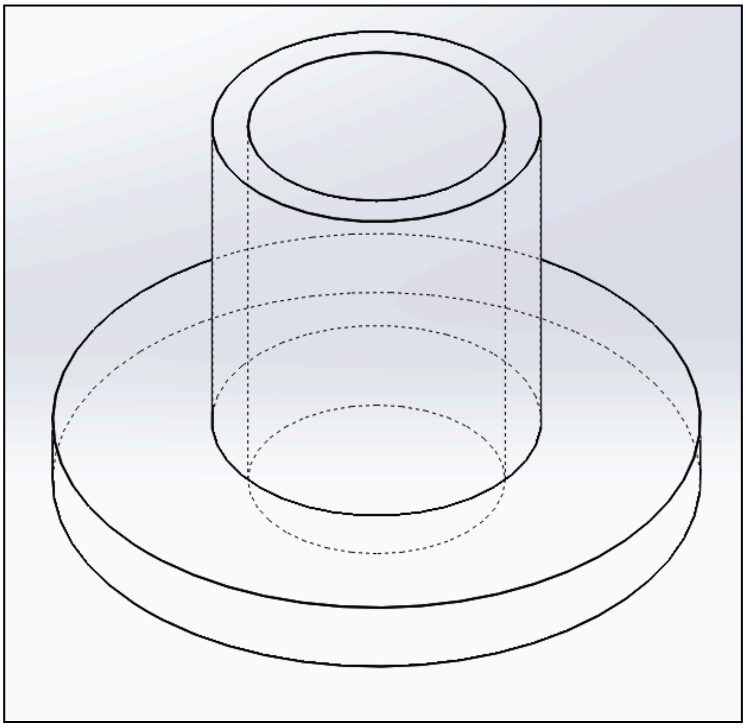

Figure 10: Pipette holders for cap and drilled holes in flask

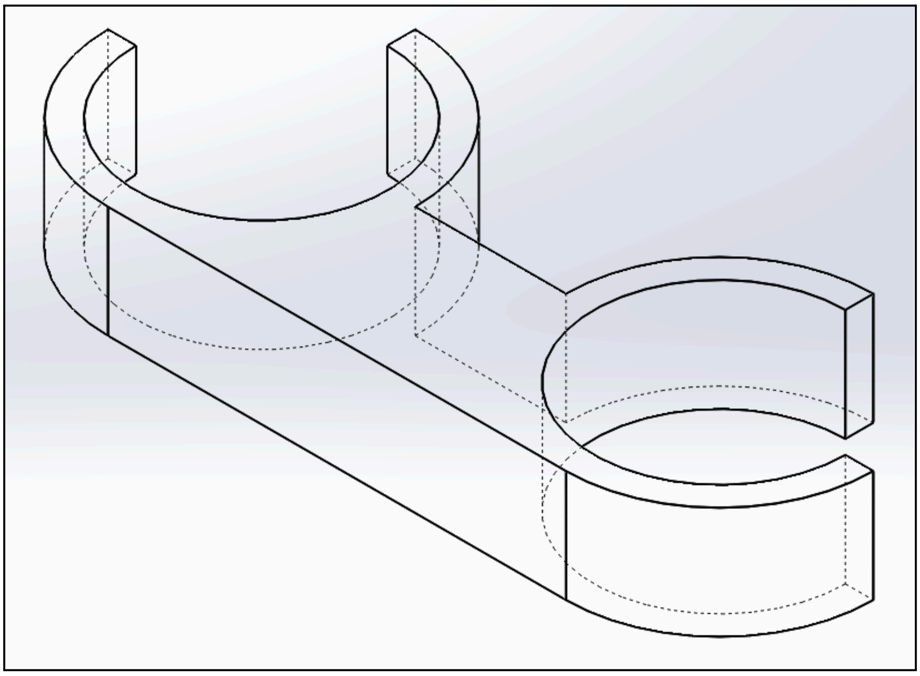

Figure 11: 1/4“ inch tubing holder

The base rails are different sizes and but in future iterations, rails will be standardized to 8.70 mm ± 0.2 mm apart from the inside. This will help standardize all the modular components so everything is swap and add.

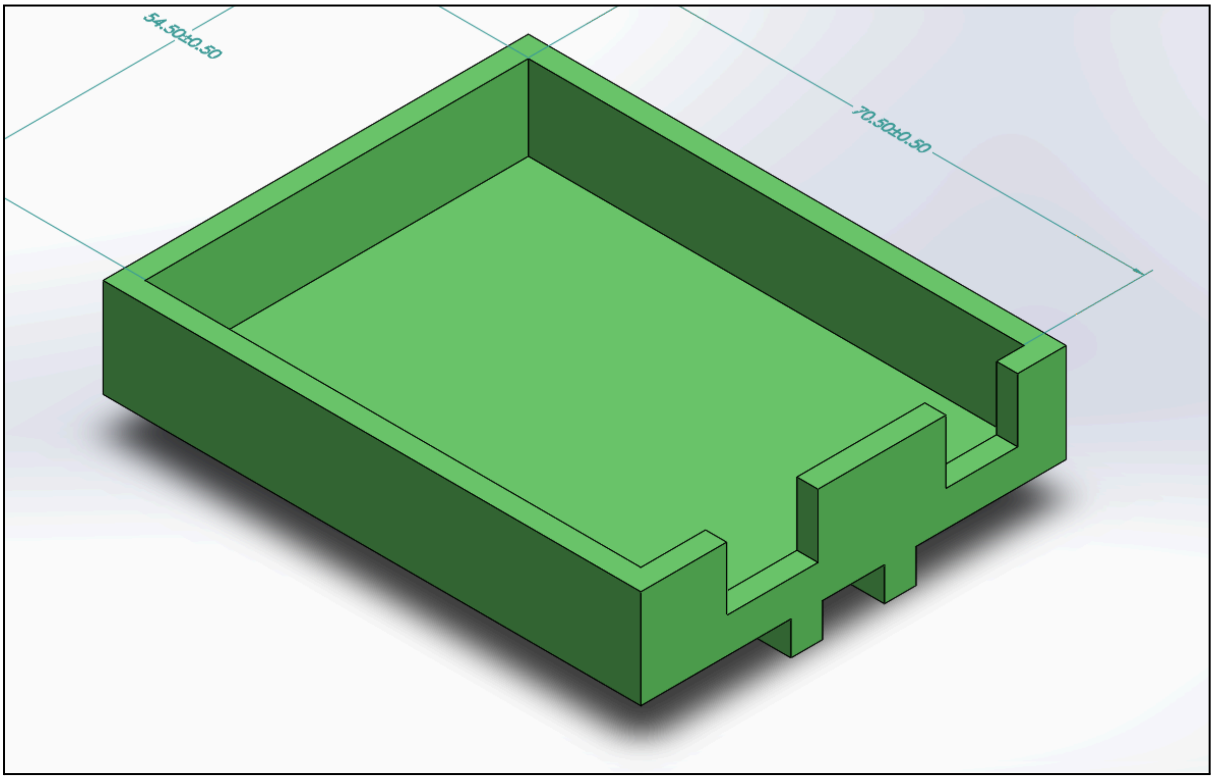

Figure 12: Arduino UNO Base

This is used to hold the microcontroller that is responsible for controlling the motor driver and, in turn, the peristaltic pump

2.2 Circuit Design

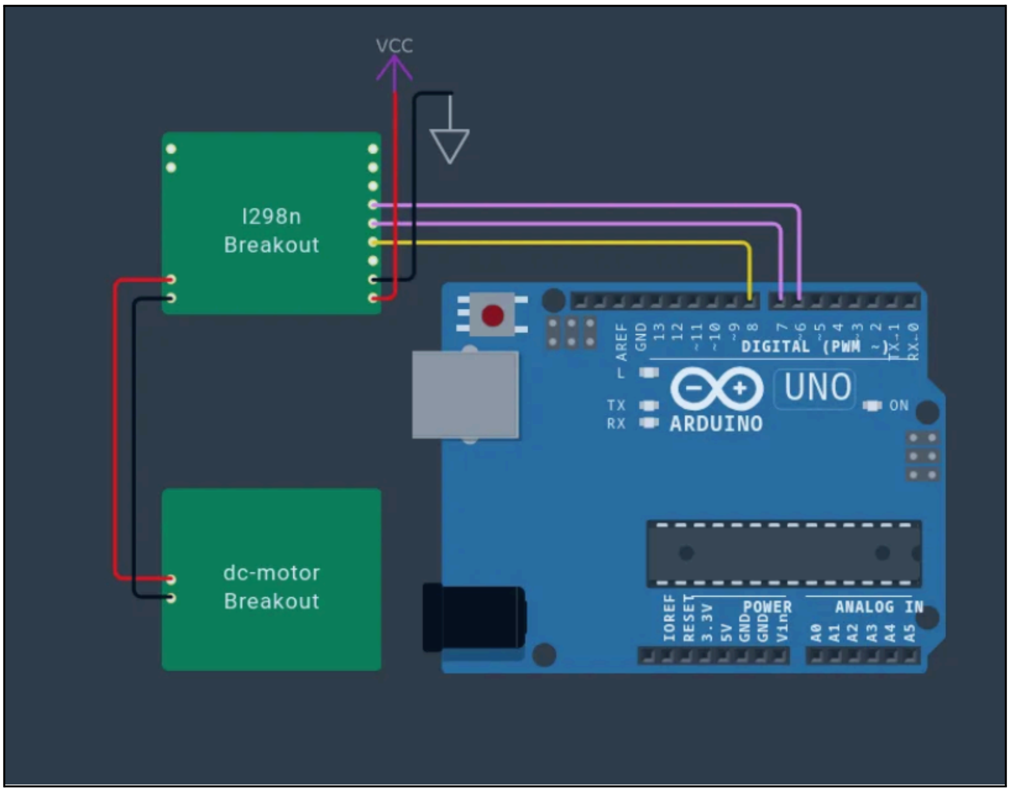

Figure 13: Circuit diagram for mk.2

This circuit diagram illustrates the connections between an Arduino Uno board, a l298n breakout board, and a DC motor breakout used in mk.2. An Arduino Uno board is the main controller in this setup and a l298n breakout board is connected to the Arduino for motor control.A DC motor is acting as a peristaltic pump. Power is supplied to the l298n breakout from the arduino, which is powered by a wall adapter power supply. This setup is designed for controlling a DC motor using an Arduino, with the l298n serving as an interface between the microcontroller and the motor to handle the higher power requirements of the motor.

Appendix

[1]
'Product - Sarstedt'. Accessed: Sep. 21, 2024. [Online]. Available: https://www.sarstedt.com/en/products/laboratory/cell-tissue-culture/cultivation/product/83.3912.502/

[2]
'UBC-iGEM/Hardware-2024: Files (STL/SLDPRT/SLDASM) from Notion available for public viewing'. Accessed: Sep. 21, 2024. [Online]. Available: https://github.com/UBC-iGEM/Hardware-2024