Group 43 Presentation

Dane Zieman (dziema2@uic.edu)
Liyuan Chen (lchen79@uic.edu)
Bharat Middha (bmiddh2@uic.edu)

Automatic Connect 4 Playing Robot

Abstract

This project is a robot that plays the game of connect four against a human automatically. It takes the users move from a button, one for each of the seven columns a move can be made in. After the player selects their move, the robot will use AI to decide which column to place its move in. All moves will be made with a series of game piece dispensers and mechanical tracks/slots to dictate which column the dispensed piece falls into.

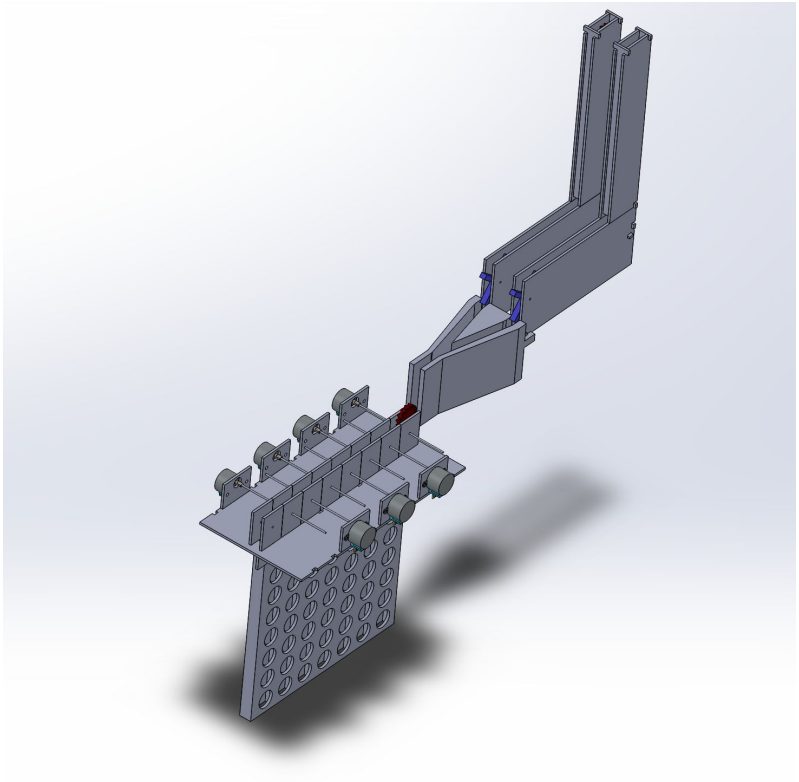
Design

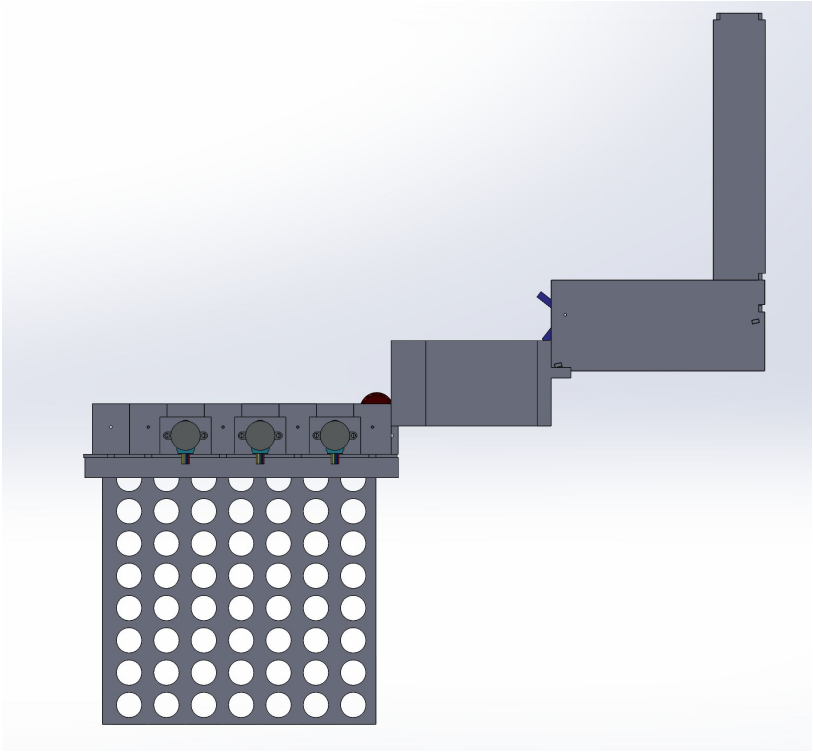
The main design for the connect 4 playing robot is as follows

- There will be two dispensers, one for each color of piece
- All of the columns will be covered by flaps
    - When the flap is down, the piece will roll over the top of it, when the flap is up, the piece will crash into it and fall down the column
    - Example: to put a piece into column seven, we would close all the flaps except the seventh one
- The player will press one button, corresponding to the column they wish to insert their piece in
- The dispenser will dispense one player piece in the desired column
- The AI will then decide what move to make, and dispense one of its own pieces into the column it chooses

Design Pictures

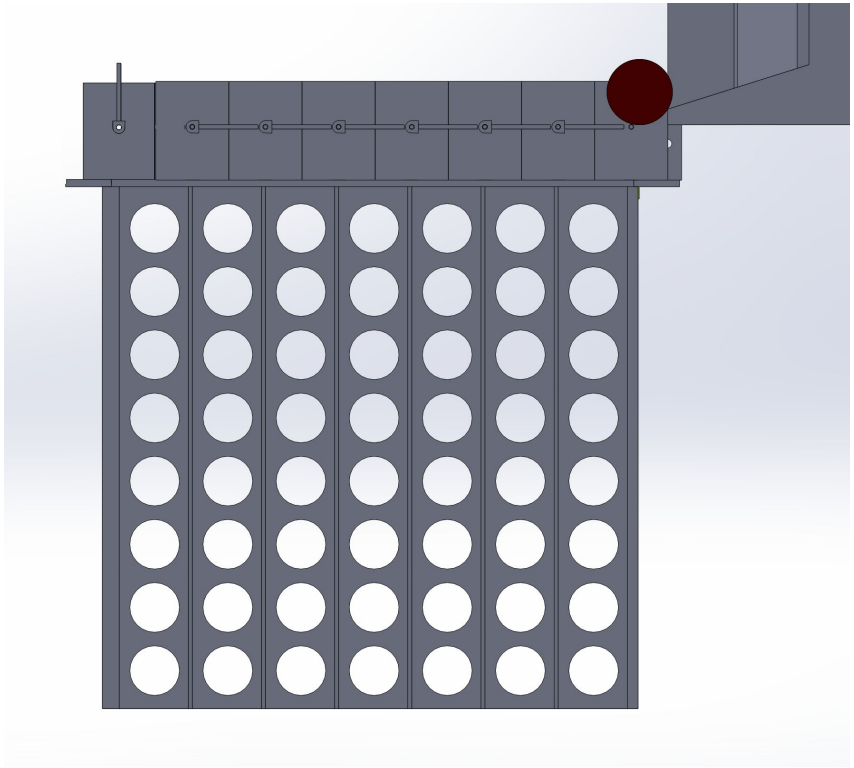
Full Assembly



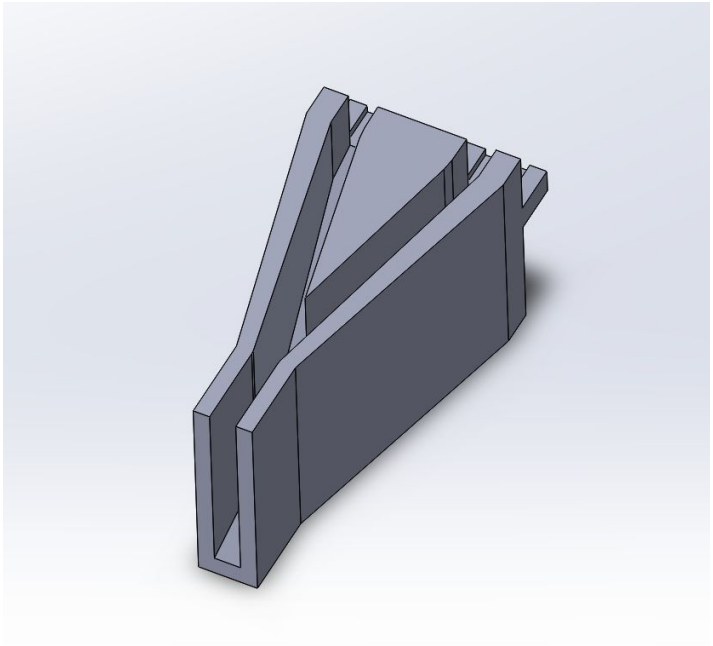


Design Pictures

Flap Configuration for inserting into seventh column

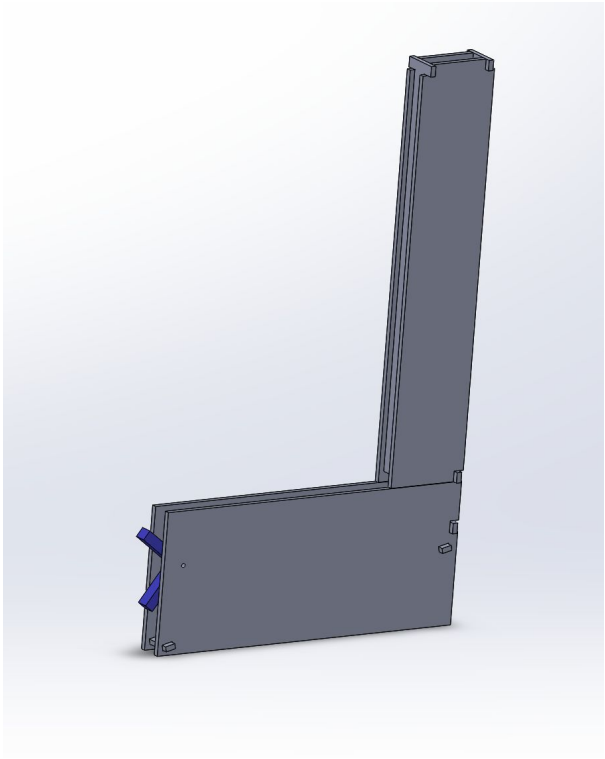


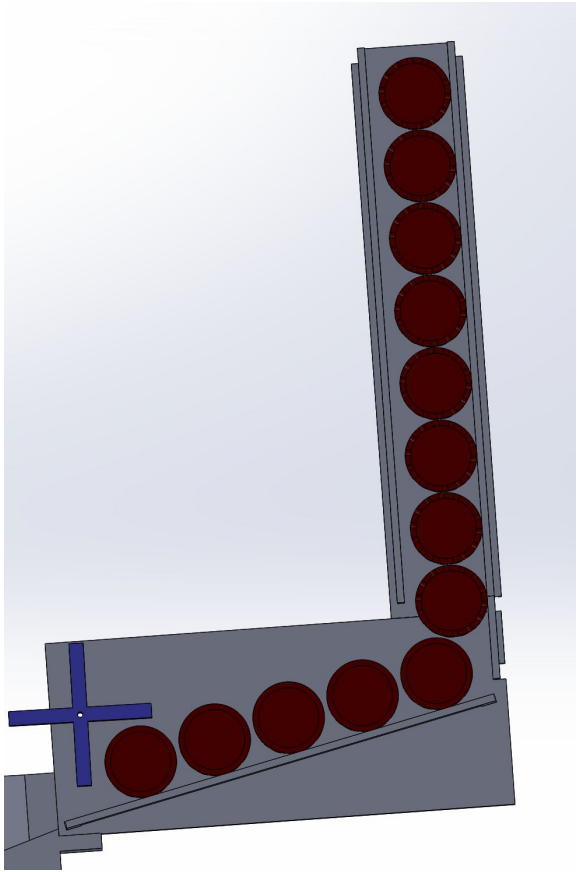
Y - Channel



Design Pictures

Dispenser Pictures

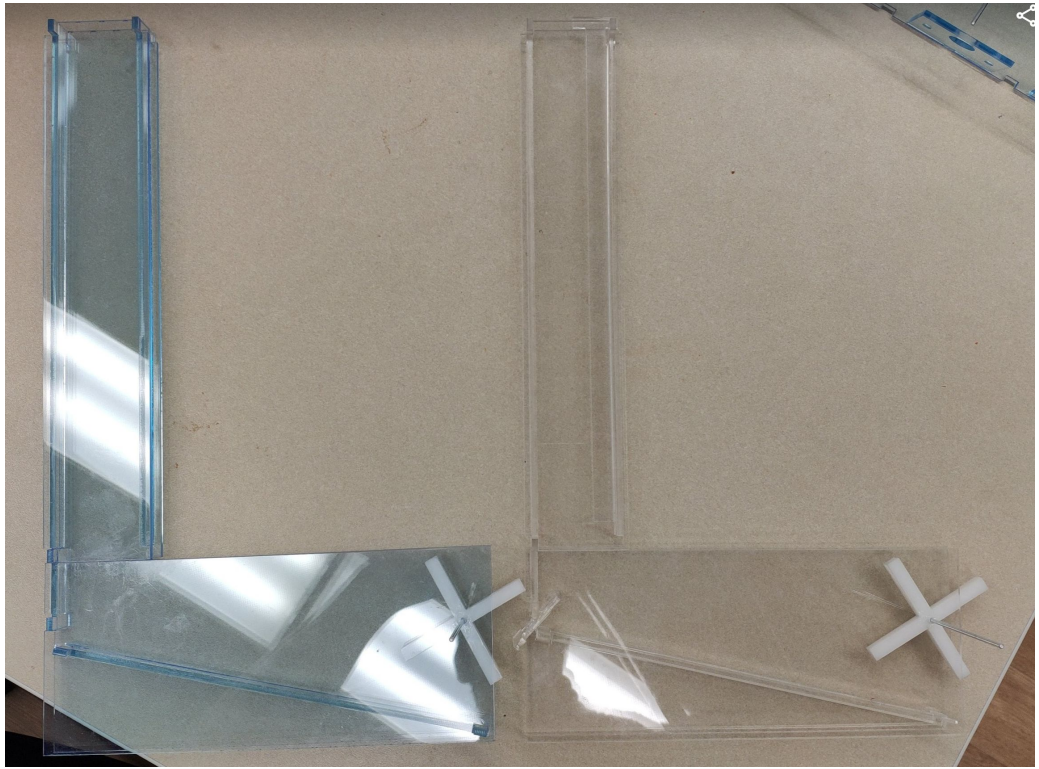




Assembly - Overview

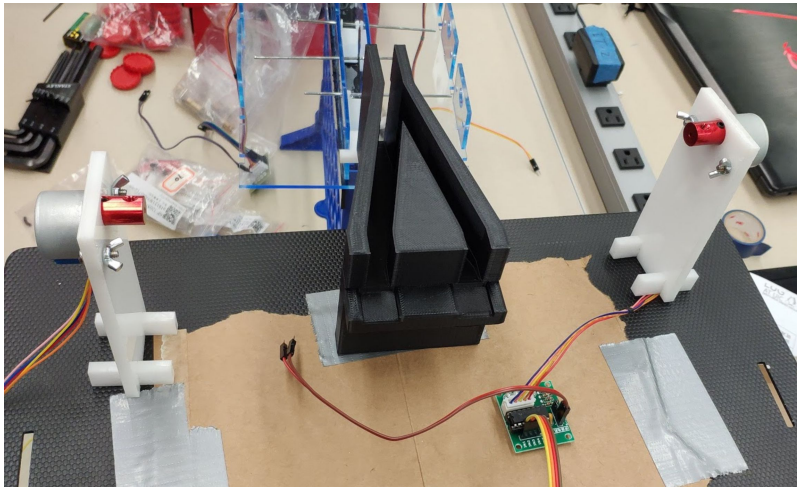
- The robot consists of 3 Units:
  - Dispenser Unit
  - Ramp Unit
  - Flap Unit

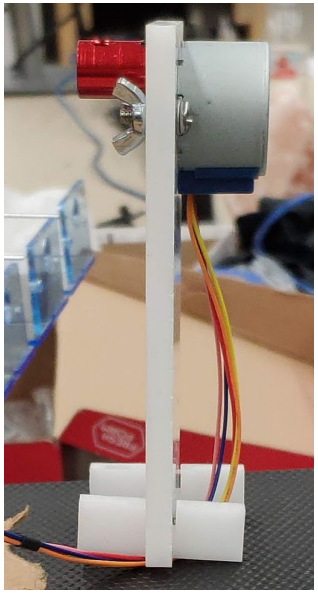
Assembly - Dispenser Unit



- Each dispenser is made of 9 pieces of acrylic that been fused together using methylene chloride
- Propellers were made from 2 laser cut crossed fused together, and then super glued onto an axle

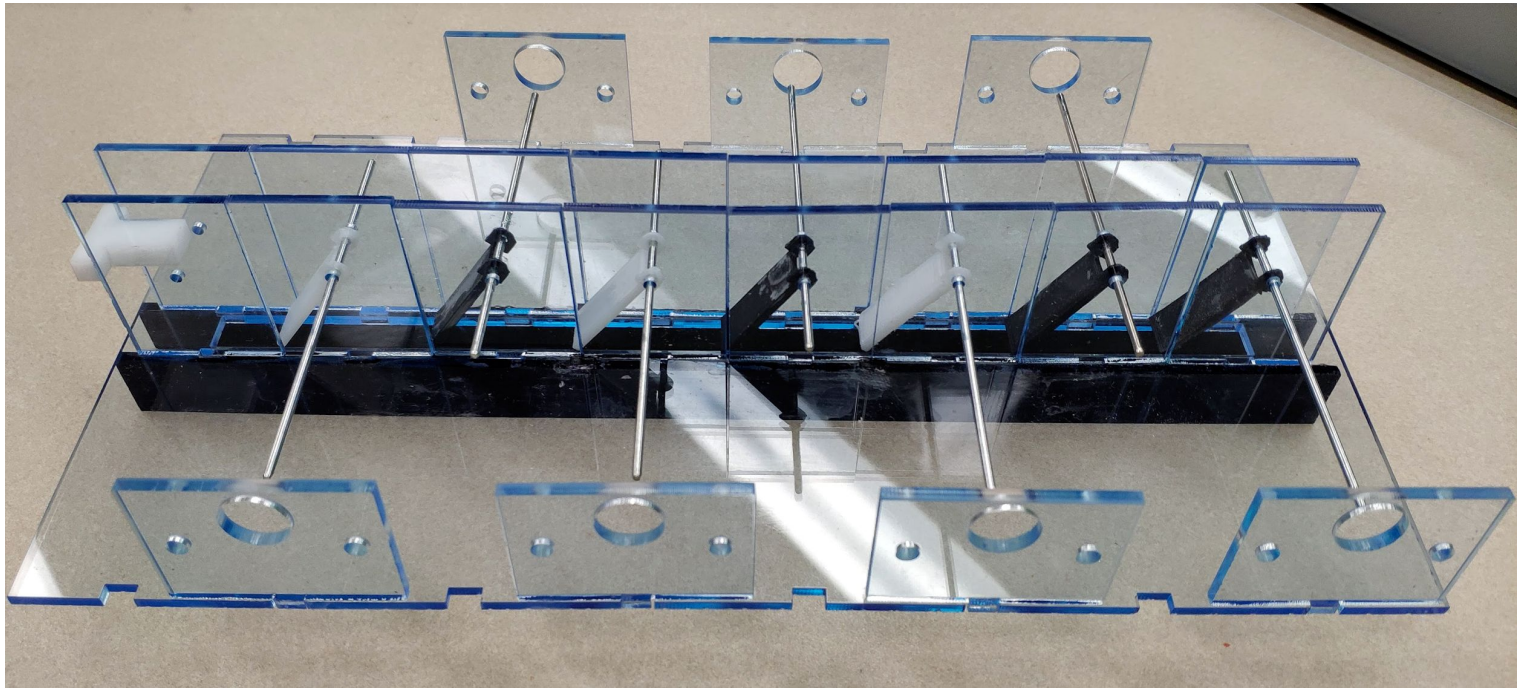
Assembly - Ramp Unit





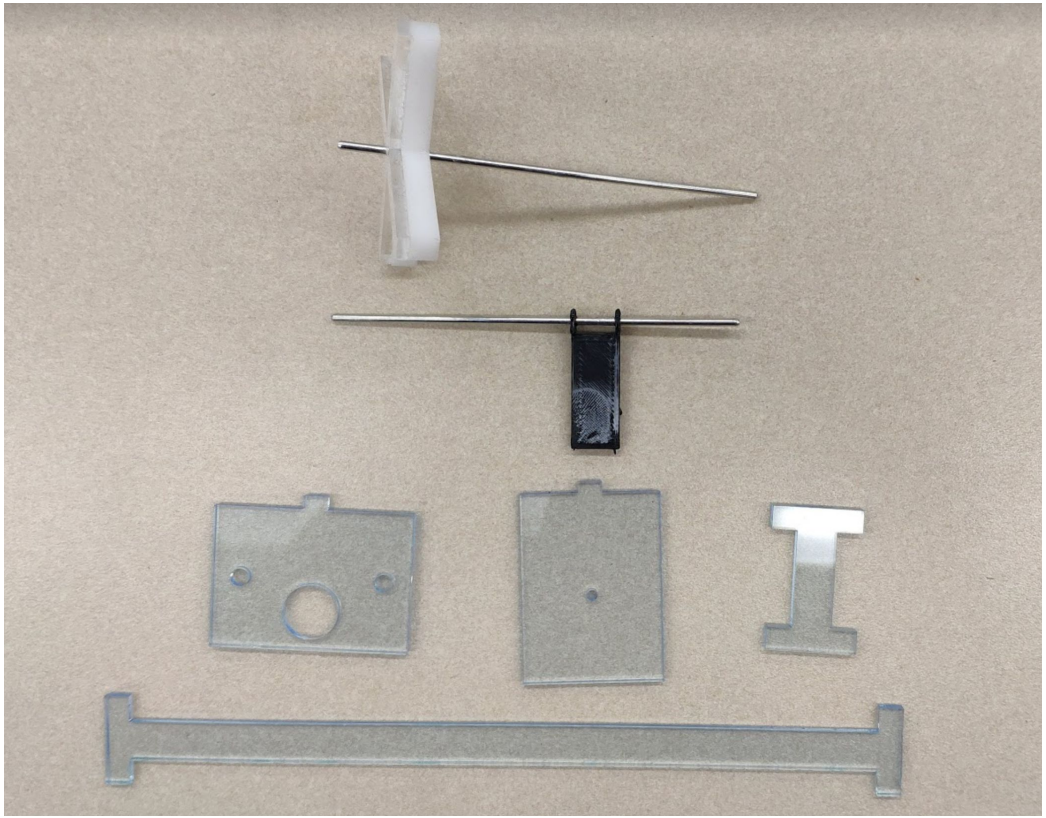
- The black Y block is 3D printed
- The white motor mount are made of 3 pieces of acrylic bonded together

Assembly - Flap Unit



- 29 pieces of acrylic
- 7 axles
- 7 3D printed flaps

Assembly - Flap Unit



AI Implementation

- Inspired by http://blog.gamesolver.org/solving-connect-four/01-introduction/
- Utilizes Minimax Search with Alpha-Beta Pruning
- Board state stored as a bitmap for storage efficiency

Circuit Components

Arduino MEGA

2 Arduino Nanos

MCP23017 GPIO Expander

nRF24 2.4 GHz Transceivers

16x2 LCD

9 Buttons

LED

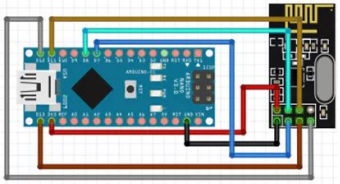
9 Stepper motors

Communication

This project uses SPI, SERIAL, and I2C for communicating with different devices.

The nRF24 Transceiver communicate over SPI (MISO, MOSI).

The MCP23017 IC communivates over I2C.



Division of labor

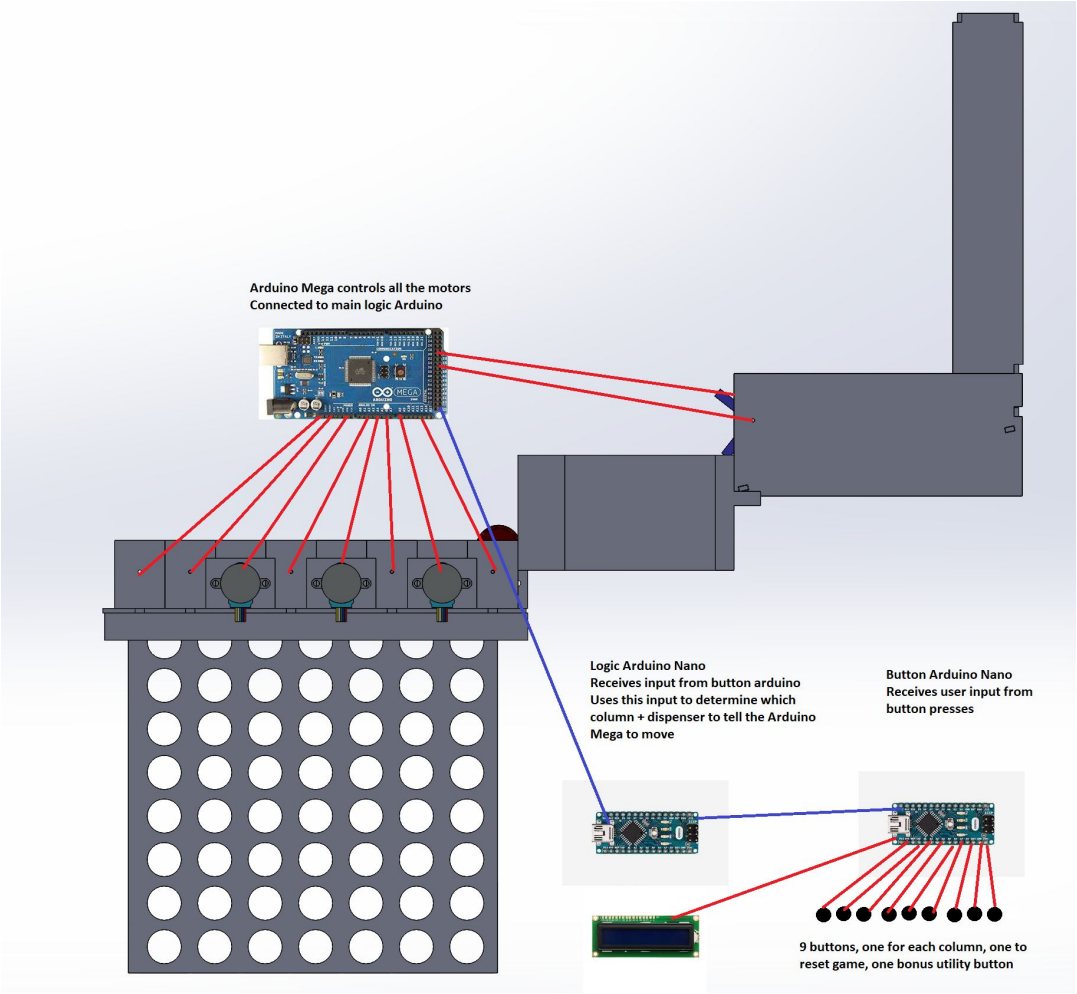
The Arduino MEGA drives 9 stepper motors and uses the AccelStepper library to open and close the column gates and fire the dispensers.

One of the Arduino Nanos is a wireless controller which send button inputs to the “game logic” arduino.

The other Arduino Nano is the game logic arduino which runs the game logic, wirelessly receives button inputs from the user and sends signals over seral to the MEGA to trigger column gates and dispensers.

Circuitry

Circuit High level diagram



What Worked

Team will talk about what worked

- Dispensers worked as intended
- The pieces were able to roll over the track and fall into place as expected
- The design drawings were accurate to the real life product, and the end product was able to be assembled
- The Y-channel worked to combine the output of both the dispensers into one
- The communication logic between the arduinos worked
- The motors were able to be all connected, and performed as intended

What Didn’t Work

Team will talk about what didn’t work

- Some of the parts could be modified to be made easier to assembly, and less prone to small assembly errors
- Gravity feed wasn’t enough to reach all columns, can remedy this with a track
- Minor changes had to be made to the dispensers to make them work, would fix these errors so the quick fixes aren’t necessary
- Timing between dispenses and could be optimized
- AI could be improved