Ping-Pong Playing Robot

UVU MECHANICAL ENGINEERING
UTAH VALLEY UNIVERSITY

Patrick Butler, David Evans, Daniel Hernandez, Noah Parker & Derek Wright

Coach: Dr. Matt Jensen

MOTIVATION/PURPOSE

Create a robot that can compete against a human in a game of ping-pong.

CONCEPT SELECTION

Using comparative and brainstorming tools – such as morph charts and scoring matrices - we conceived and compared 34 potential design concepts. By this process, we were able to consider numerous factors and determined our selected design of a gantry system.

CONCEPT SCORING MATRIX

Selection Criteria	Weights (%)	Gantry System	Robot Arm	4-Paddle Arm
Hit Velocity	10	3	5	4
Ease of Setup/Transportation	5	3	5	4
Cost/Part Quality	10	4	2	5
Range of Motion (Volume)	23	5	3	2
Paddle Velocity/Location	25	4	5	3
Accuracy of Return Ball in Play	17	4	5	2
Stability/Moments Created	10	4	3	5
Total		4.08	4.04	3.4
Tie Breaker – Dependent on Complexity of System 1 – Most Complex 5 – Least Complex		3	1	-

Concept Scoring Matrix

DIGITAL DESIGN

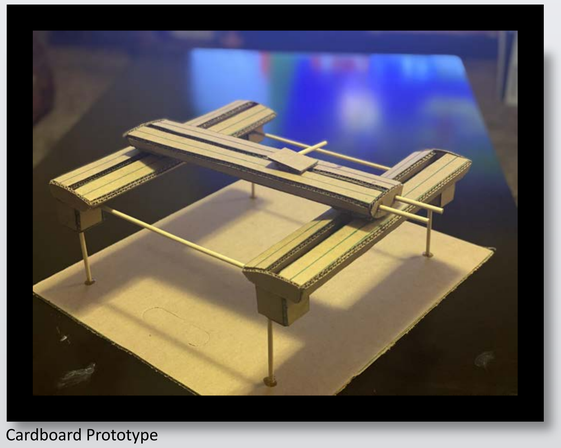
Using Solid Works, we were able to create a completely virtual design utilizing as many parts as possible that could be bought off the shelf. Minimizing the amount of custom parts to be made, reducing time and cost in design and manufacturing.

Solid Works Virtual Design

DESIGN SPECIFICATION

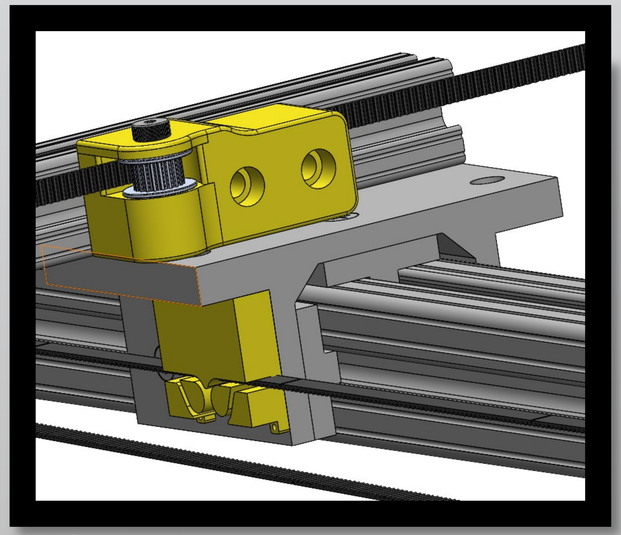
Our selected design was a gantry system with 3 DOF. This allowed for a paddle to move across the table plane and rotate about a vertical axis. Allowing us to:

- Minimize parts needed
- Minimize complexity
- Maximize movement speed



Cardboard Prototype

Physical prototypes were used to verify the viability of our selected design. AutoCAD was used to model each of the custom parts. These parts were 3D printed, physically tested, and redesigned through several iterations until they achieved their desired functionality.

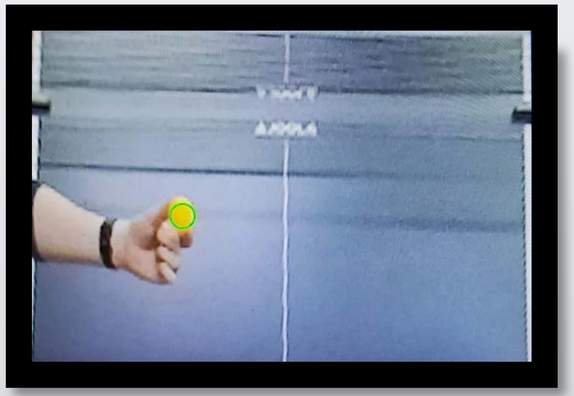


Belt Hardware Custom Parts

Ball Tracking

We completed a process of design and review – analogous to our selection of a gantry system - to select a method of tracking the ball. STEREOLABS' ZED 2i, was selected for its:

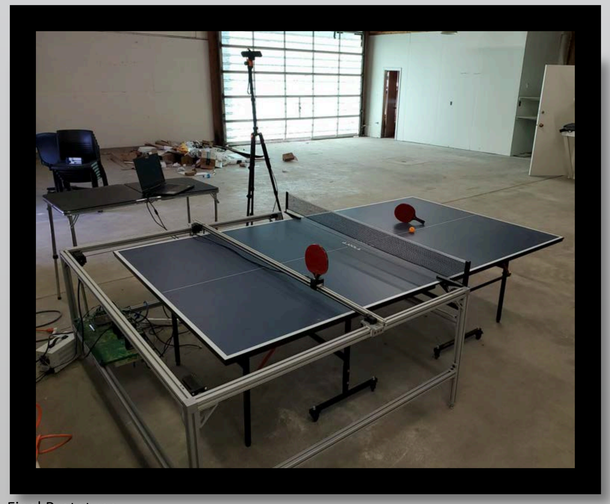
- High Framerate
- High Resolution
- Built-in functionalities for object tracking.



Visual Zed 2i Output

RESULTS

We built a robot that can track a ball in 3 dimensions and move a paddle with three degrees of freedom. It tracks the ball and moves the paddle with sufficient speeds to play a game of ping-pong. This allowed our team to successfully complete the project within the time constraints. Future projects will have the ability to improve the robot by increasing the complexity, such as adding addition degrees of freedom.



Final Prototype