Project Title: MagDrop4

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Project Goal

The goal of MagDrop4 is to create an engaging and competitive Connect4-playing machine that can seamlessly interact with a human player in real-time. By integrating advanced embedded systems, mechanical precision, and strategic gameplay, MagDrop4 aims to demonstrate the capabilities of autonomous systems in responsive, interactive applications. The project also serves as a practical exploration of sensor integration, motor control, and real-time decision-making within an embedded system framework.

Project Approach

To achieve this, MagDrop4 combines a custom-built linear belt actuator, powered by a stepper motor, with an electromagnet end effector that precisely handles and places the custom-made 3D printed game disks with steel inserts. A set of IR sensors at each column allows the machine to monitor and react to the human player's moves, updating its strategy based on the evolving game state. The system is powered by a Raspberry Pi, which manages the game logic, motor control, and sensor input, creating a dynamic response to each move.

Progress

We've developed a first prototype of MagDrop4 in CAD (see Figure 1). We successfully designed a belt-driven system powered by a single stepper motor. This stepper motor with a step size of 0.9°, combined with two limit switches positioned at the ends of the rail, ensures precise movement of the sledge. While this prototype is a great initial step, several improvements are planned. We need to redesign the magazine to increase its capacity, allowing for more game pieces to be stored and deployed. Additionally, we still need to implement the mounting for the linear sled, as it currently hovers without a fixed support structure.

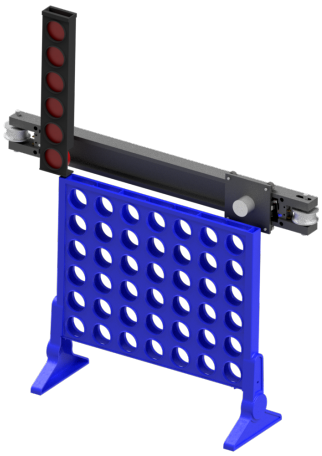

Figure 1: Rendering of the first prototype

Resources

All the essential parts for MagDrop4 are listed in the table, showing both items we're purchasing and those we already have on hand, each with its corresponding price and checkoff number. We've slightly exceeded the $100 budget, but this covers all important components, including a Raspberry Pi, a stepper motor, power supplies, and bearings.
Our custom frame components, including the rail, sled, and mounting structures will be 3D printed. This approach gives us flexibility in the design process and is virtually free, since we can use the 3D printers in Cory Supernode and pay for the filament we use. Besides these listed items, only minor additions like wires or washers may be needed as we assemble the system.

Name	**Qty**	**Checkoff #**	**Price**	**Link**
Raspberry Pi 3 Model B+	1	13	-	Link
Electromagnet	1	245	-	Link
Limit Switch	2	145	-	Link
IR Receiver & Transmitter	7	265	-	Link
Stepper Motor	1	213	-	Link
On-Off Toggle Switch	1	141	-	Link
USB Power Supply	1	301	-	Link
USB 2.0 A to Micro B cable	1	318	-	Link
Connect 4 Game Set	1	-	$ 9.99	Link
Sledge Bearing (BS69310-5)	6	-	$ 10.20	Link
Stepper Motor Driver (DRV8825)	1	-	$ 8.99	Link
DRV8825 Extension Board	1	-	$ 7.99	Link
Power Supply 24V	1	-	$ 19.99	Link
Timing Pulley with Teeth (2GT-40T_11_5)	1	-	$ 5.35	Link
Timing Pulley without Teeth (2GT-40T_11_5)	1	-	$ 5.35	Link
2GT Timing Belt	1	-	$ 2.95	Link
Steel Disk Inserts	1	-	$ 19.99	Link
Various Screws, Nuts and Washers	1	-	≈ $ 30	Link
		Total	**$120.81**	

Table 1: Purchase and Checkoff Part List

Major Risks

Major risks include challenges in constructing and testing the custom linear actuator, ensuring smooth integration of hardware and software components, and maintaining real-time response accuracy to enable interactive gameplay. Additionally, reliance on 3D-printed parts introduces potential delays or issues with part quality, which could impact system precision and reliability.

Timeline & Responsibilities

- November 18: Murtaz and Giorgiana finish the game software model
- November 21: Leon and Ashvin finalize actuator assembly and testing.
- November 28: Finish hardware and software integration
- December 8: Work on final demo and integration

GitHub Repo

https://github.com/Loneli999/MagDrop4.git