

SHARIK

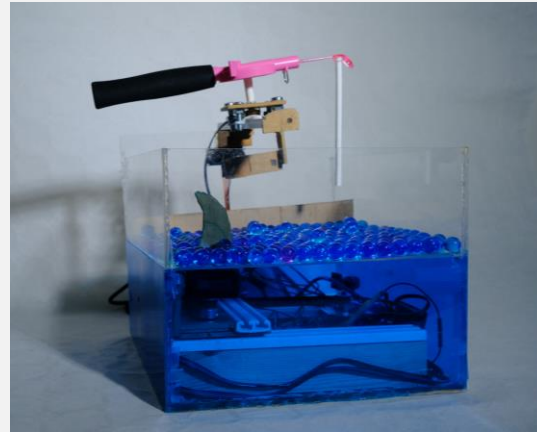
Tank

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User Manual

1

When the game starts, the shark moves randomly.



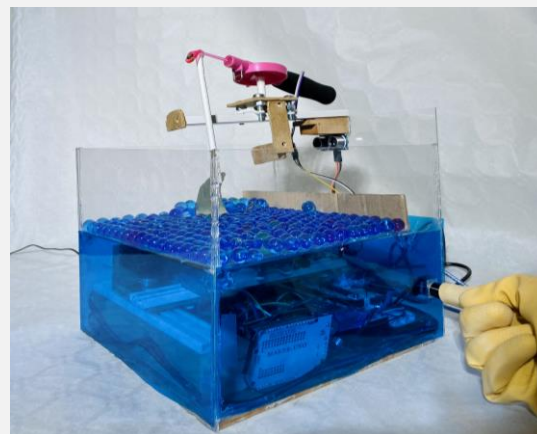
2

Hitting on the right side of the fish tank will scare the shark away from you for a while.



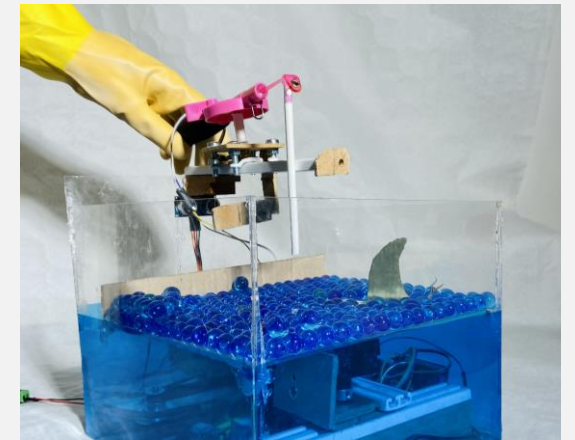
3

Activate the fishing mode by pressing the bottom on the right side of the fish tank.



4

Move the fish rod away from you and rotate it to your desired position. Hold the fishing rod steadily and wait for the shark to take the bait.



5

If you hold the fish rod steady enough, the shark will bite, and you will hear a winning sound effect.



6

The shark will move freely again. You can continue to have fun with the shark tank.

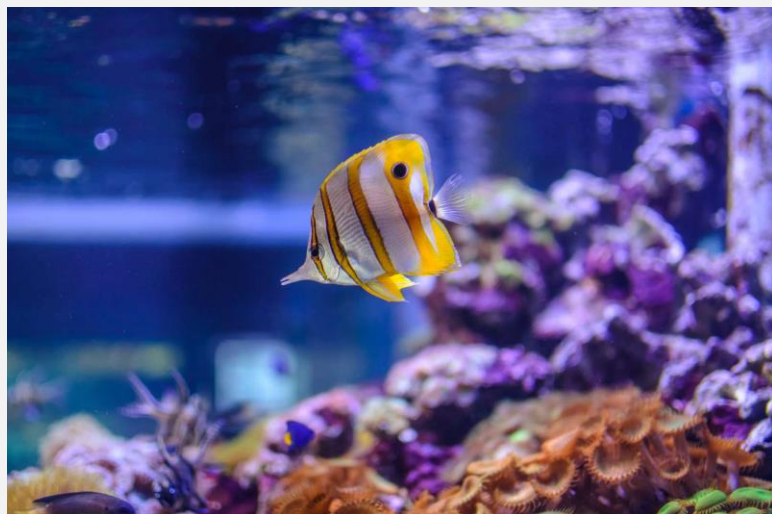


Initial Ideation

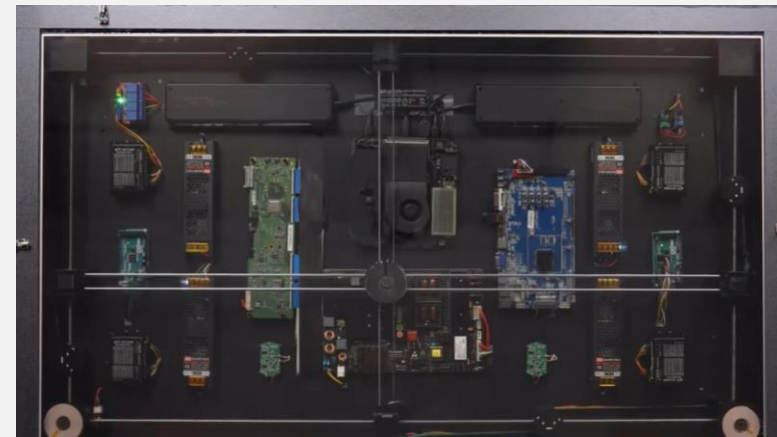
The main difference between pet fish and other pets is that they are more ornamental. There is a lack of direct interaction between owner and fish. Moreover, it is less likely for urban people to experience the fun of outdoor fishing due to the reasons of time-consuming, equipment-costly, and outcome uncertainty.



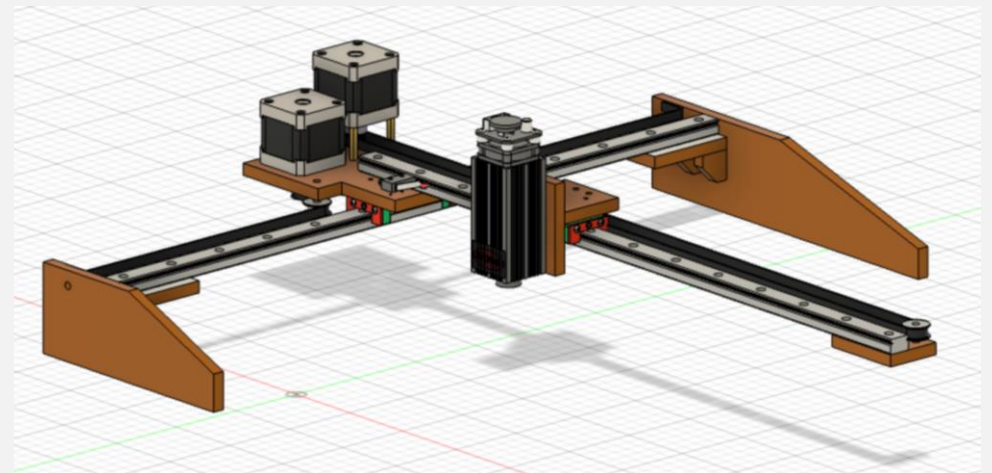
Shark Tank is a fishing simulator that addresses the pain points of outdoor fishing by providing extensive interactions with users to add more fun. Users can enjoy the interactive fish tank anywhere at any time.



The fish tank base mechanism is inspired by AirDeck, an innovative wireless charging station that allows users to place their phones anywhere on the table. The charging dock will automatically locate their phones using step motors and threaded shaft [1].



It is also inspired by a YouTube video that shows how to build a simple CNC machine using step motors and belts [2].



[1] <https://www.youtube.com/watch?v=td4DWtMY7SQ&t=554s>

[2] https://www.bilibili.com/video/BV19v411M7Rs/?spm_id_from=333.337.search-card.all.click&vd_source=85ad8b678ab90b4c0a5b9a7dd9fa94c8

Work Summary

The Stand Moving Mechanism:

Initial concept:

Two step motors connect two threaded shafts to move the stand in the XY plane.

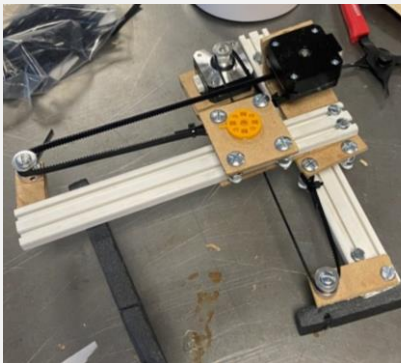
Cons: The step motors need to operate at high speed to move the stand efficiently, which sometimes overheat the chips.



Final concept:

Two high torque drive belts connect to two linear sliding plates powered by two step motors to move the stand in the XY plane.

Pros: High efficiency that avoids overheating of the chips; minimum space requirements.



Convert step motor rotational steps to linear distance:

$$r = \frac{s_r}{p_r} = 10$$

r = The revolution ratio between the step motor and the pulley

s_r = The step motor revolution (200 steps/revolution)

p_r = The pulley revolution (20 teeth/revolution)

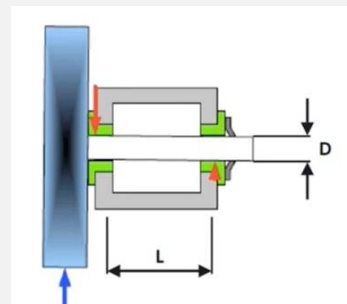
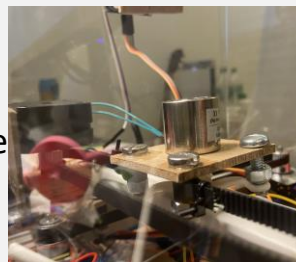
$$d_s = \frac{d_p}{10} = 0.2\text{mm}$$

d_s = Step motor one step distance

d_p = Belt pitch (2mm)

The shaft

Four linear bearings have placed in polyamide shafts. The belt is connected to one side of the two bearings for linear movement.



$$\frac{L}{D} = \frac{1.2\text{cm}}{0.4\text{cm}} = 3$$

L = Length of sliding linear bearing
 D = height of linear sliding linear bearing

The sliding mechanism does not jamb and the motion happens constantly.

The Fishing Hook Locating Mechanism:

Initial concept 1:

Place five ultrasonic sensors on each side of the fish tank to locate the fish pole.

Cons: Costly and requires many input and output ports.

Initial concept 2:

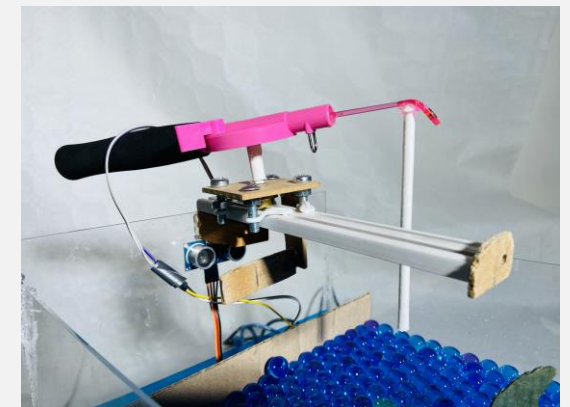
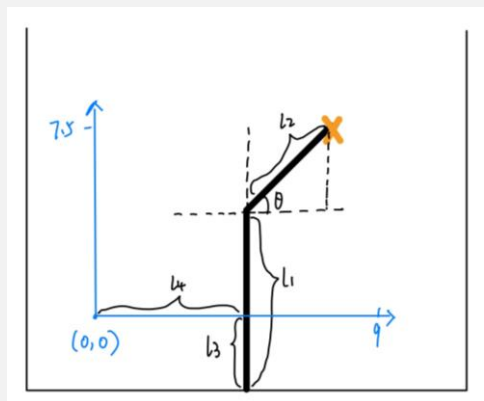
Connect two perpendicular infrared red barrier sensors to the fishing hook.

Cons: Difficult to control the sensors that signal the desired direction.



Final concept:

Fishing rod connects with a potentiometer that receives the rod rotating degree, while the ultrasonic sensor detects the rod moving distance; they collaborate to locate the fishhook position.



l_1 = The fishing rod moving distance along Y axis

l_2 = The distance between the fishhook and the potentiometer

l_3 = The distance between the plate and the rod start position

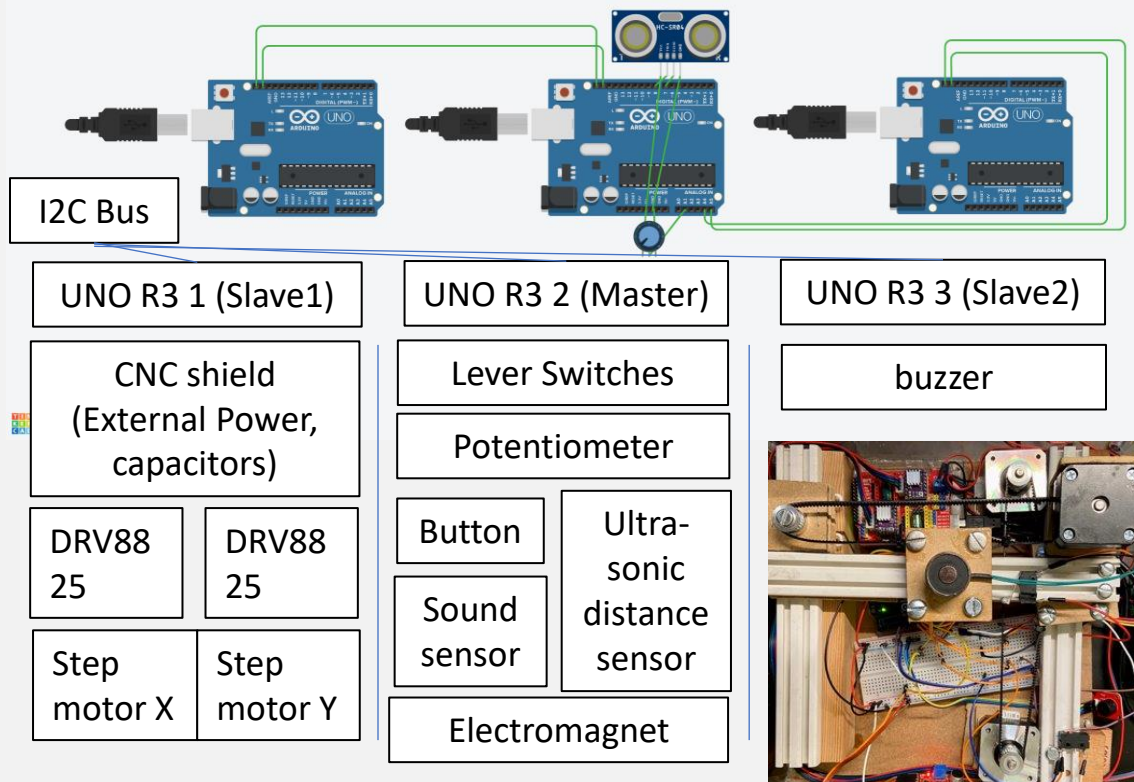
l_4 = The horizontal distance between the origin and the rod

θ = The rotational degree

The fishhook location:

$$(l_2 \cos(\theta) \pm l_4, l_1 + l_2 \sin(\theta) - l_3)$$

Electronics & Software



Problems & solution:

- Step motors cannot arrive the destination at the same time – $\text{Distance}(\text{short}) / (\text{Distance}(\text{long}) / \text{speedMax}) = \text{shorter motor speed}$
- Having multiple loop running at the same time – I2C, use of Interrupt, `millis()` (not ideal)
- Sending 16bits int via I2C – send by 2 8bit byte and add them (by MWWalker)

Libraries used:

1. AccelStepper
2. MultiStepper

-- Author @ Mike McCauley

These two libraries allow the steppers move simultaneously, reaching the destination at the similar time. Distances are turned into steps and the `run()` method is called for moving 1 step towards them.

3. Wire

This library is used for the I2C. Bytes are transmitted between boards.

Program flow:

