Weakly Electric Fish Multisensory

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Introduction

- The reason why this project is possible, because the ghost knife fish can use multisensory abilities to perceive its surroundings. Due to its timid and reclusive nature, it gets under wherever it finds to protect itself. It uses electric field in addition to its vision capability to detect objects around itself in the dark.
- This project aims to create conflicts in perception abilities of the fish and investigate which one it trusts the most in different situations.

Specifications and Design Requirements

- This project integrates mechanical, electronical and software subsystems in a single software/hardware architecture.
- 25 FPS real-time data processing with offline fish tracking and millimeter resolution are the necessities of the project.
- Use of metal parts in the aquarium is avoided to have no affect on fish perception and aquarium must not reflect any light.
- Modularity and flexibility of the setup is the key features of the project .

Solution Methodology

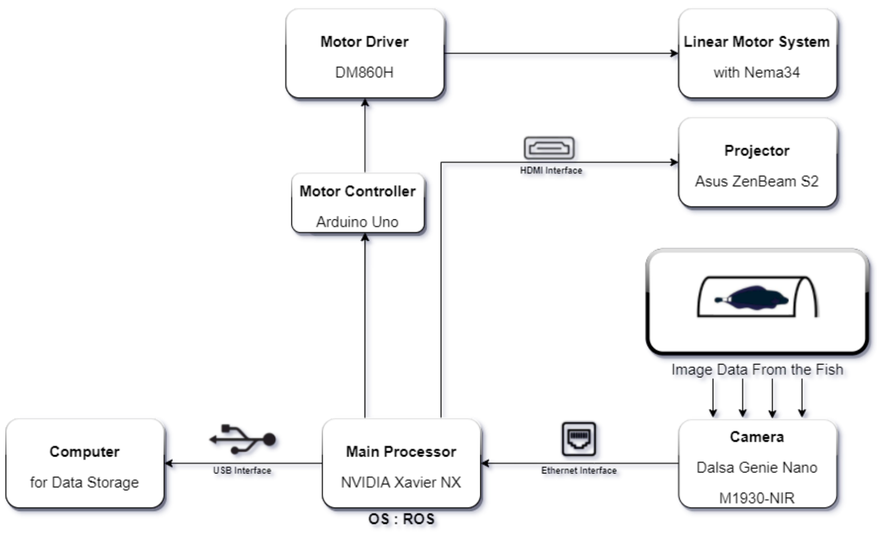

Figure 1: Project Architecture

- Electronic architecture consists of Nvidia Xavier NX board as processing environment to acquire and process data, a projector to project stripes onto the refuge which the fish can get under, motor driver to drive the linear rail stepper motor system, high speed NIR camera placed down below the aquarium to capture the fish movements even in the dark.
- Mechanical architecture consists of the linear rail and its step motor, 3D printed design of ours to hold the refuge and the projector onto motor system, sigma profile design for stabilization of the whole system and improving structural strength and the aquarium itself.
- Software environment is chosen to be ROS (Robot Operating System). This is a real-time OS and it enables us to process real-time data.
- Also, to have no reflection inside the aquarium caused by the projected stripes, it is covered with black folio.

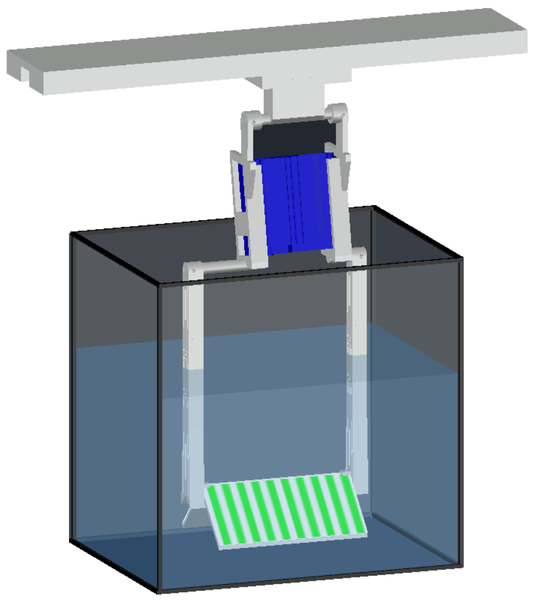

Figure 2: Design Process and Designed Parts

Application Areas

- The outcomes of this project can be used as an important resource in determining sensor priority in areas that require use of multiple sensors such as autonomous technologies and smart devices.

Figure 3: Example of Usage Areas

Results and Discussion

- As a result, the motor is succesfully driven to move sinusoidally, stripes are projected onto the refuge without any unwanted reflections.
- Usage of sigma profile structure stabilized all the equipments.
- Any harm that can be done to fish is avoided by not using any metal or other chemicals inside the aquarium.
- On modularity and flexibility aspect, this setup is compatible with different aquarium sizes and various motor types.

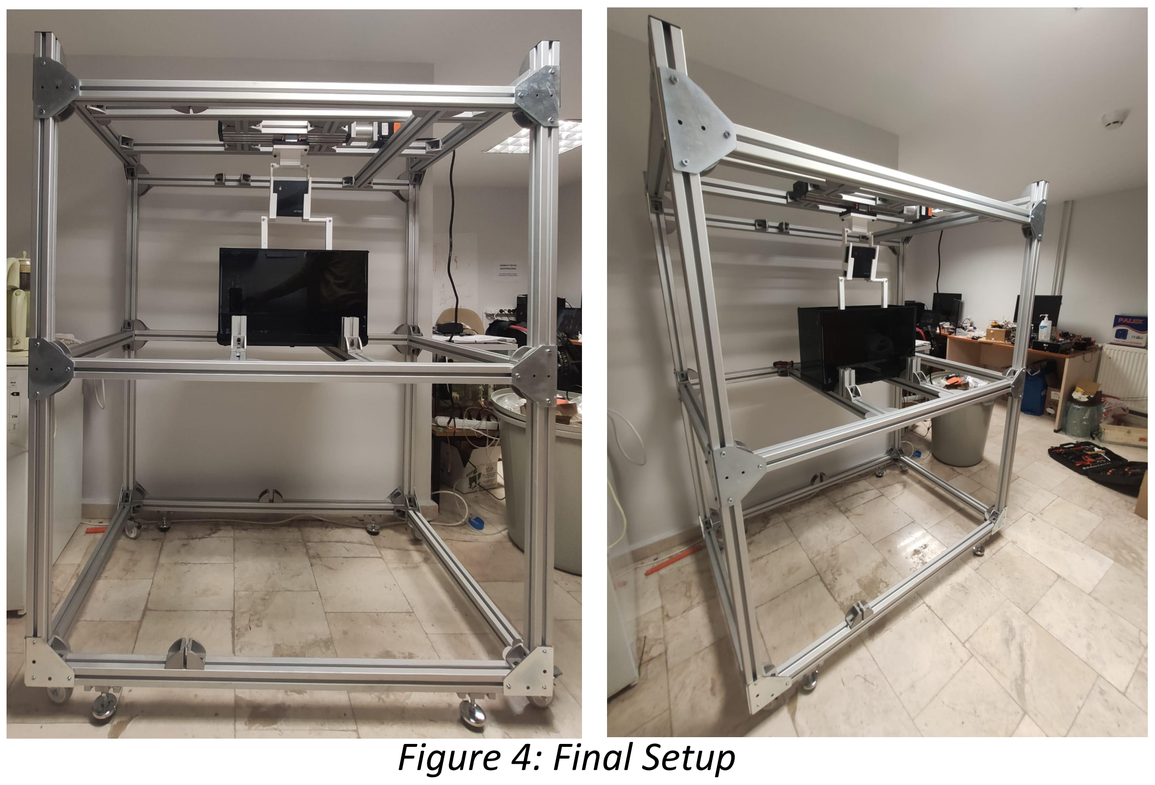

Figure 4: Final Setup

- As we can see from the figure on the right, even though the environment is pitch black, reflections from the aquarium are minimized.
- Although we minimized the reflections, stripes still can be seen easily from under the refuge.

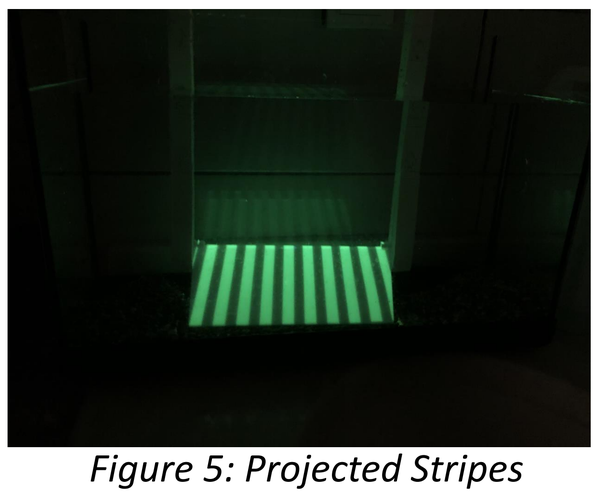

Figure 5: Projected Stripes

References

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- Uyanik Ismail, Stamper Sarah A., Cowan Noah J., Fortune Eric S. 2019. "Sensory Cues Modulate Smooth Pursuit and Active Sensing Movements." Frontiers in Behavioral Neuroscience 59.

Acknowledgements

- This project was completed within the context of ELE401-402 Graduation Project courses in Hacettepe University, Faculty of Engineering, Department of Electrical and Electronics Engineering.
- We thank Asst. Prof. İsmail UYANIK for his invaluable contributions to our project.