

# DETECTION AND TRACKING ELECTRIC FISH

## USING ELECTRIC ORGAN DISCHARGES

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### Introduction

In this project, it is aimed to establish a system that can detect the *position* and *orientation* of weakly electric fish. Most electric fish can detect electric fields because they are electroreceptive. We have created a project that uses each *Eigenmannia virescens*'s unique electrical signals to recognize and locate weakly electric fish. A grid of electrodes is used to record these signals.

300 Hz  
800 Hz

Position & Orientation



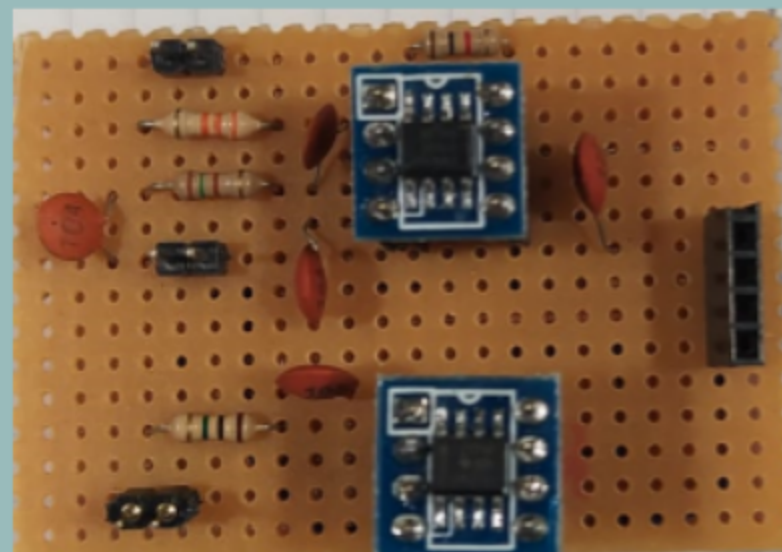
*Eigenmannia Virescens*

### Methodology

The purpose of this project is to use the electric organ discharge from electric fish to locate and follow their underwater motions. The electric fish continuously transmits electric current to the water by means of an electric organ. Even in the absence of visual information, the fish can detect its surroundings by altering the amplitude and phase of its electric field. To detect and track the fish's movements online and in real-time, the captured data will be processed by a computer.

Electric Organ Discharge

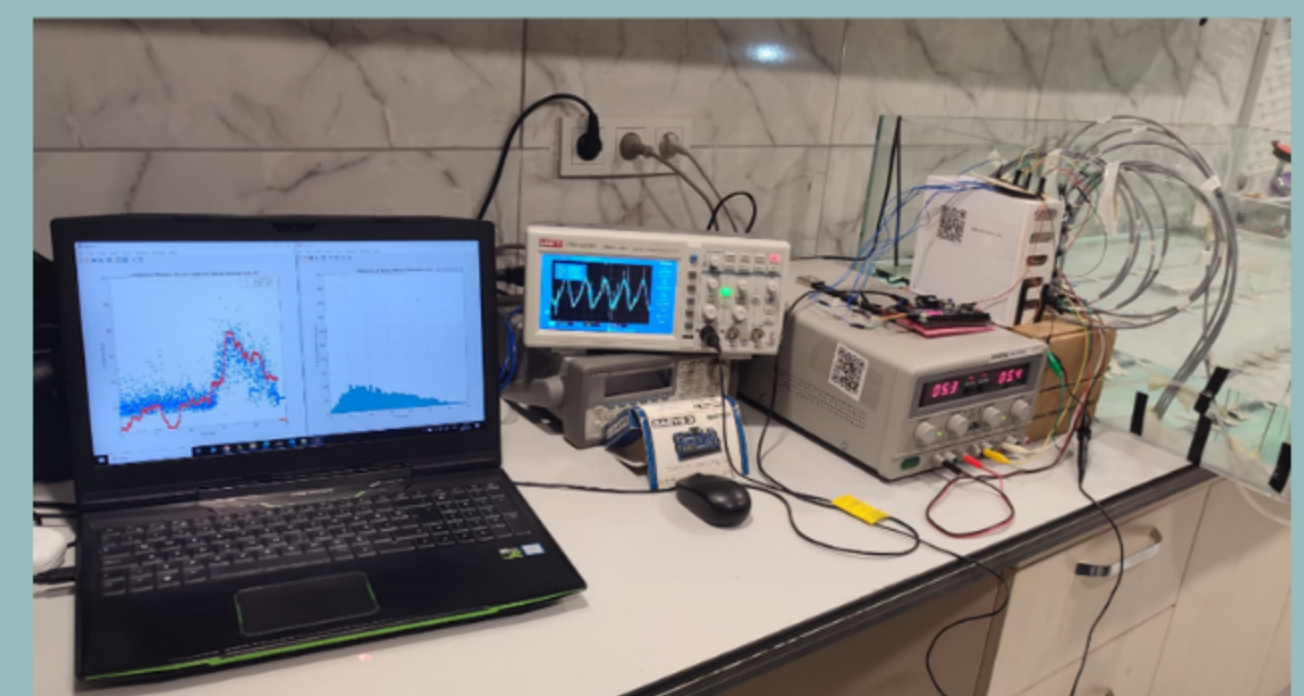
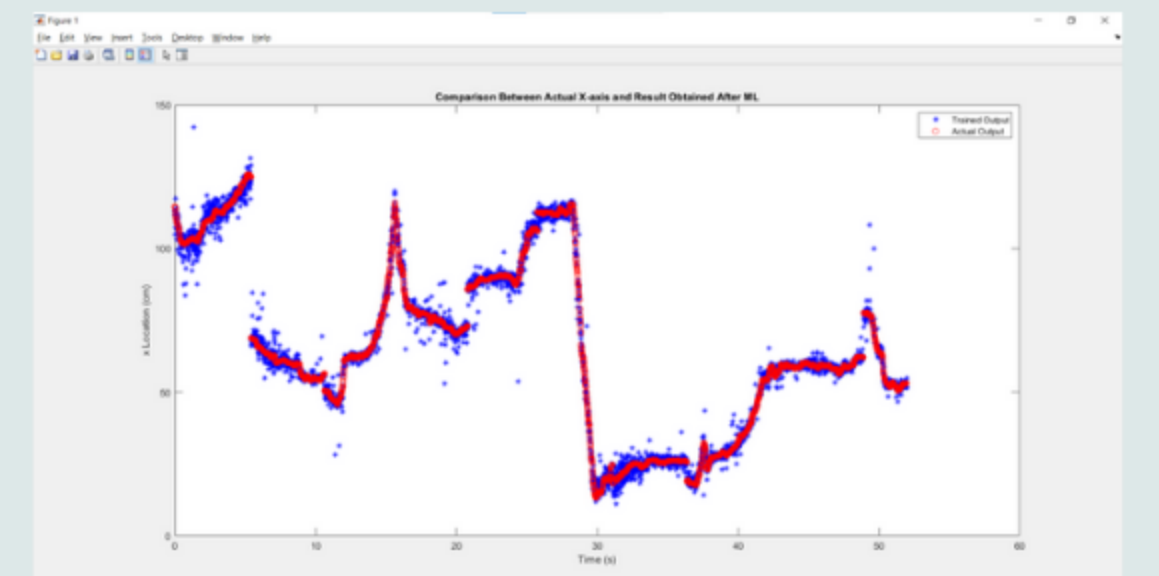
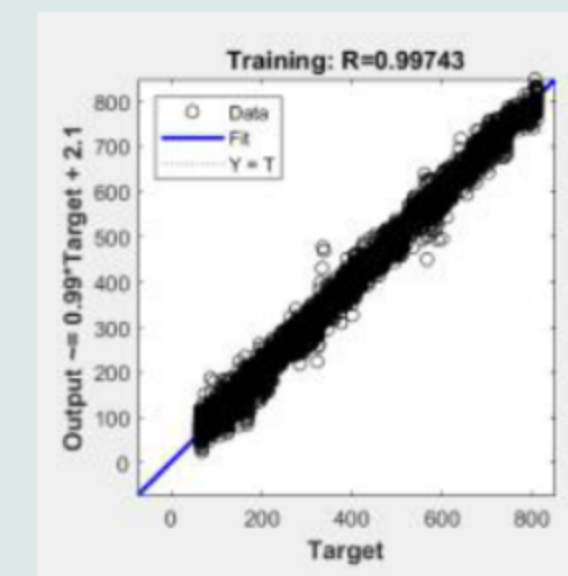
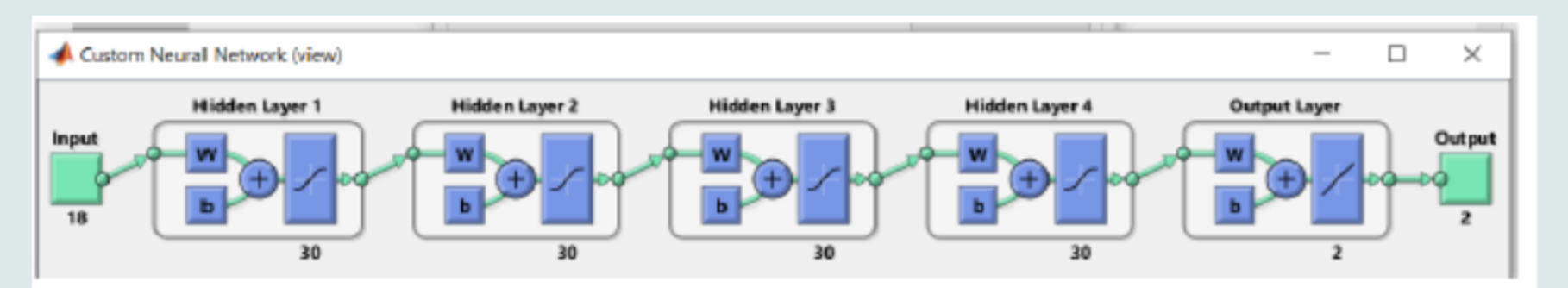
Weakly Electric Signal



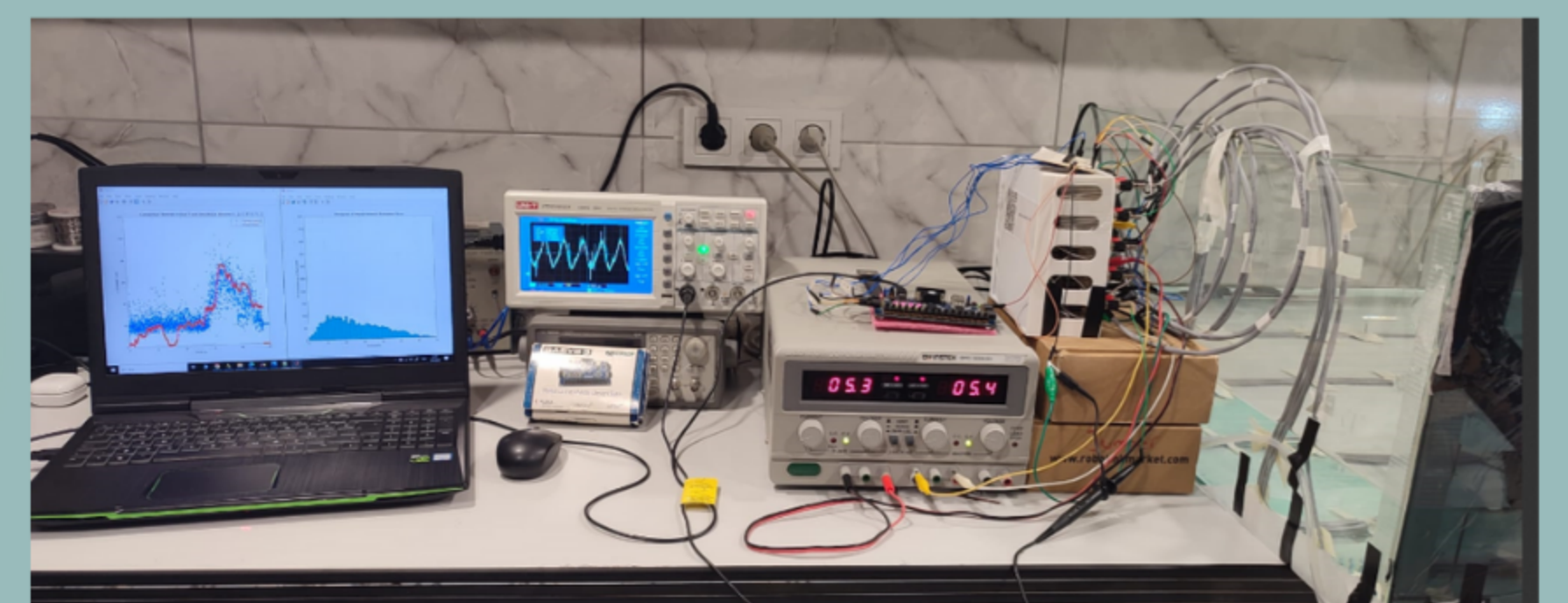
*Electric Circuit Design*

### Results

The data obtained from *Eigenmannia virescens* with the help of silver electrodes was processed with an ADC on the FPGA after filtering in the circuit. We have compared the results obtained with the neural network with the image data taken from the *real-time camera* installed on the aquarium system. As a result, we have achieved an *average error of 1.48 cm* by using the tracking approach.



*Aquarium Setup*



*Aquarium Setup*

### References

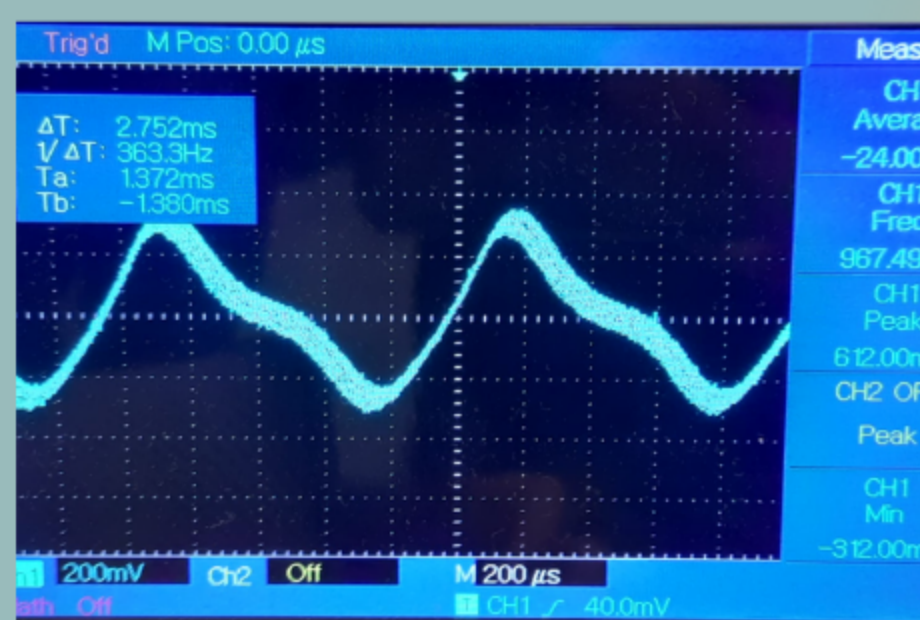
- M. S. Madhav, R. P. Jayakumar, A. Demir, S. A. Stamper, E. S. Fortune ve N. J. Cowan, «High-resolution behavioral mapping of electric fishes in Amazonian habitats,» Nature, 11 April 2018.
- H. H. Zakon ve G. T. Smith , «Weakly Electric Fish: Behavior, Neurobiology, and Neuroendocrinology,» Hormones, Brain and Behavior, Academic Press, 2002, pp. 349-374.
- M. Madhav, Nonlinear Processing of Sensory Interference Drives Social Behavior in Weakly Electric Fis, 2014.

### Acknowledgements

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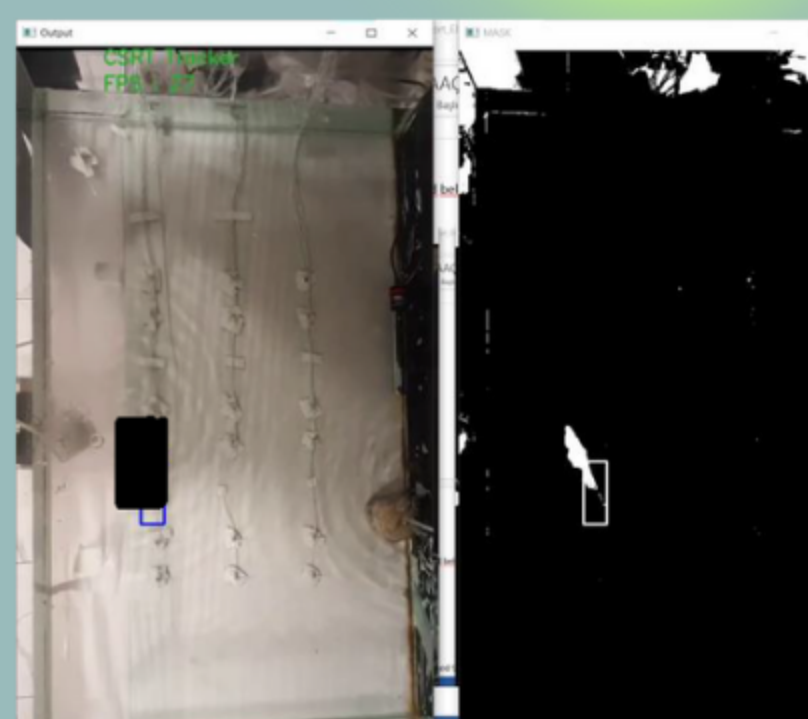
*Circuit Setup*



*Electrical Signal of Eigenmannia Virescens*

Frequency Filtering

Image Processing



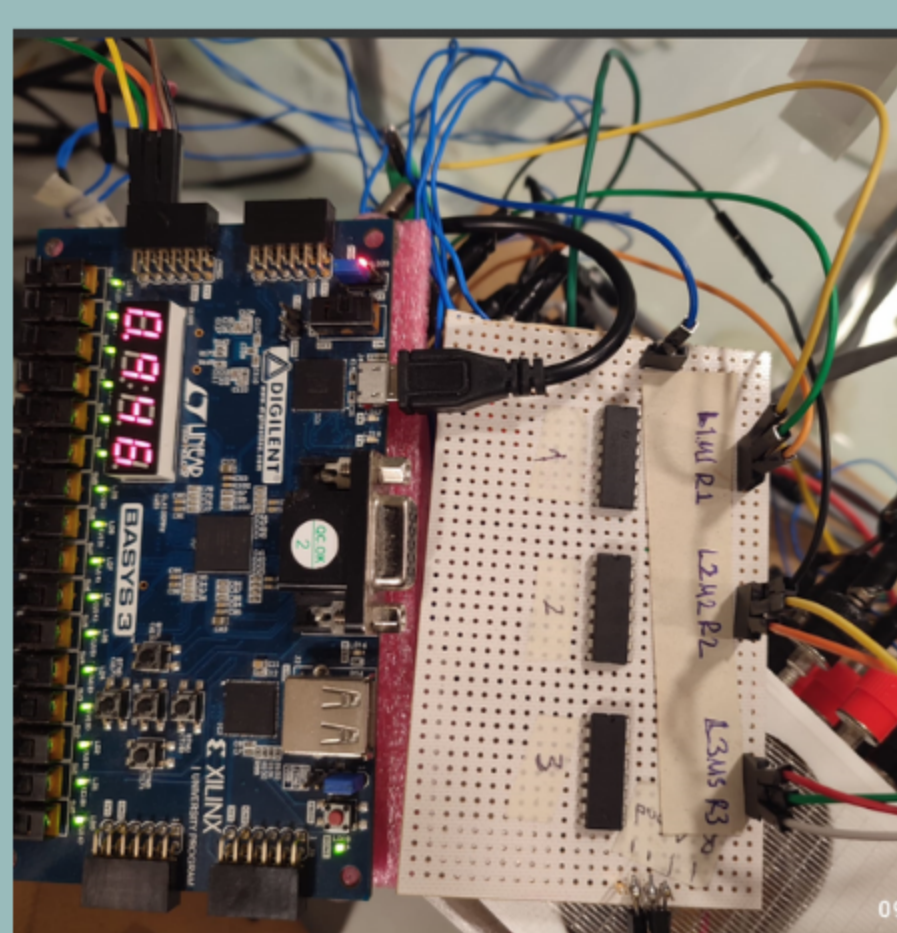
*Image Processing*

ADC Mechanism in FPGA

Machine Learning



*Overall System Overview*



*Setup For Analog Digital Converter*