Can Fish Teach Robots?

Overhead tracking and control of a mobile robot using learning by demonstration

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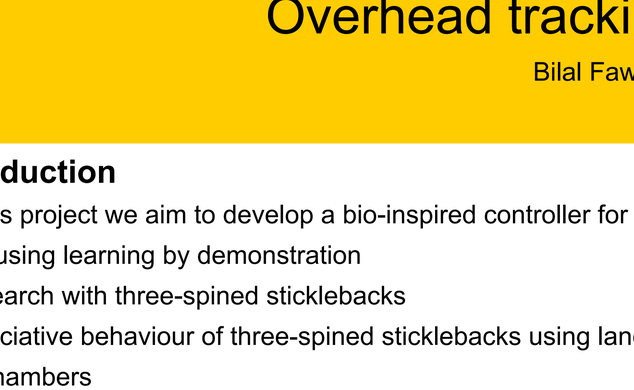
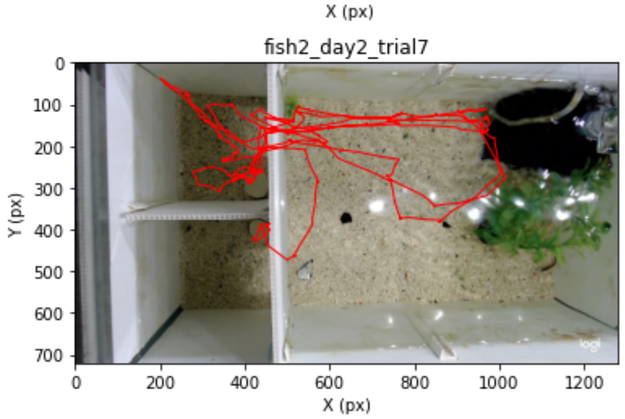
Introduction

- In this project we aim to develop a bio-inspired controller for a mobile robot using learning by demonstration
- Research with three-spined sticklebacks
- Associative behaviour of three-spined sticklebacks using landmarks and chambers

Manually Tracking of Fish

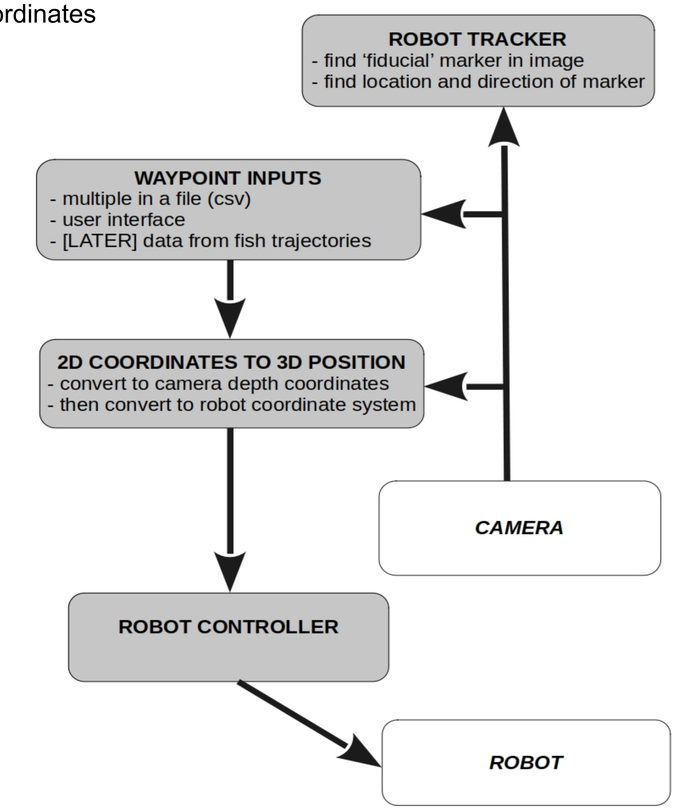
- Manually collected data from three-spined sticklebacks in video trials
- Using Python3 and OpenCV-4.6.0
- Recorded fish pixel coordinates from 1500 frames of each video trial
- Selected the nose and between the eyes to provide us orientation of the fish
- Using this data we can plot the trajectory, and calculate the linear and angular velocities
- This data is then fed through a machine learning algorithm
- The data is then used in the mobile robot to model the behaviour of the fish

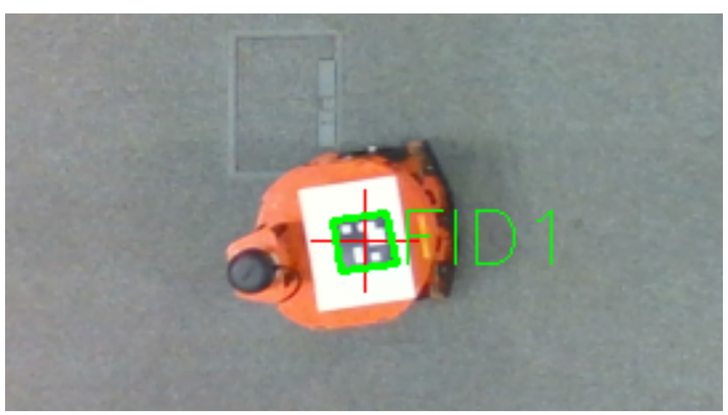




Automated Tracking of Robot

- Small environment with an overhead camera to track the robot
- Tracking the robot is the first step in writing algorithms for robot movement
- The robot is identified by a fiducial marker
- Biggest challenge was getting real distances from the image coordinates





Tango Robot Hardware Components

- Raspberry Pi 3
- Arduino mega
- RPLIDAR A2 (red)
- Sabertooth dual motor controller
- 7 Sharp IR sensors
- Front bumper micro switches
- 4 Infrared fall sensors (2 front, 2 back)
- 6 Ultrasonic sensors (non functional)
- 2 12 volt motors – with hall sensors
- 9 Degrees of freedom IMU
- Voltage reader (motor battery)
- Extra Bluetooth module for Arduino

Machine Learning

- Multi layer perceptron regressor network
- Tries to predict output for given input (numbers)
- "Learns" from large amount of paired data
- 20% of data is reserved for testing after training
- Any number inputs or outputs
- Fish / sensor data = input, movement commands = output
- The robot can learn directly from a real fish!