ECE 445

SENIOR DESIGN LABORATORY

PROPOSAL

Automatic Intelligent Fishing Pod

Team #40

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1 Introduction

1.1 Background and Overview

Fishing is a popular activity and way of life with a rich history in cultures around the world. However, traditional fishing methods require anglers to invest a lot of time, patience, and skill. They often have to wait for hours for a fish to take the bait, which can be unpredictable and frustrating. With the advancement of technology, there is growing interest in developing automated solutions to simplify the fishing process and enhance the overall experience. By accurately identifying fish species, anglers can make informed decisions about which fish to keep and which to release, helping to protect aquatic ecosystems and maintain fragile species populations. Our project uses sensor technology, mechanical structures, automated control systems, and machine vision to design and implement a device that can automatically detect, capture, and identify fish. This innovation aims to reduce the burden on anglers and improve fishing efficiency and convenience. By combining modern technology with traditional fishing methods, we hope to offer a new fishing experience to enthusiasts, making it easier for them to enjoy this ancient and wonderful activity.

1.2 Overview of the Solution

Our solution introduces an innovative approach to fishing by developing an automated fishing rod system. The system seamlessly integrates advanced sensor technology, mechanical construction, automation and machine vision to revolutionize the fishing experience. The automated rod system simplifies the fishing process and greatly reduces the time and effort required by the angler. By utilizing micro-tension sensors and micro-water level sensors, the system can accurately detect fish bites, eliminating the need for continuous monitoring of fishing rods. This increased efficiency allows anglers to engage in other activities while the system handles the fishing process autonomously. A key feature of the system is the ability to accurately identify fish species using machine vision technology. After the catch, the system activates the camera to visually inspect the caught fish, providing real-time species identification.

1.3 High-level Requirement List

The pod's mechanics are designed for ease of use, featuring an automatic baiting system and a responsive rod lifting mechanism.

1. Bite-detecting Subsystem: The accuracy rate of catching fish is higher than 80%.
2. Identification System: An identification system is used to identify fish species with accuracy over 90%.
3. Mechanical Subsystem: Successfully catches fish from 0.03 to 1 kilogram.
4. Power Supply Subsystem: Successfully supply the whole system which 1.5V battery

1.4 Visual Aid

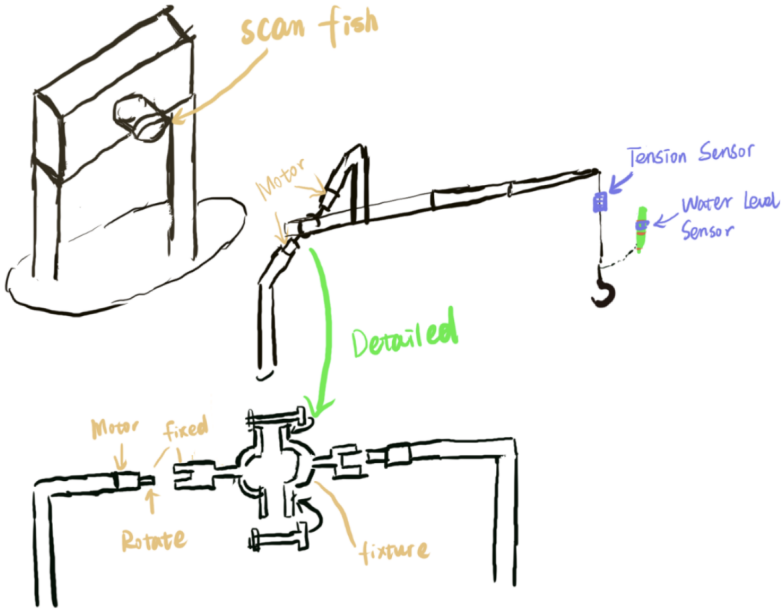

Figure 1: Visual Aid.

2 Design and Requirement

2.1 Block Diagram

As we can see in below, our project contains four part: Bite-detecting subsystem, Mechanical subsystem, Identification Subsystem and Power Supply subsystem.

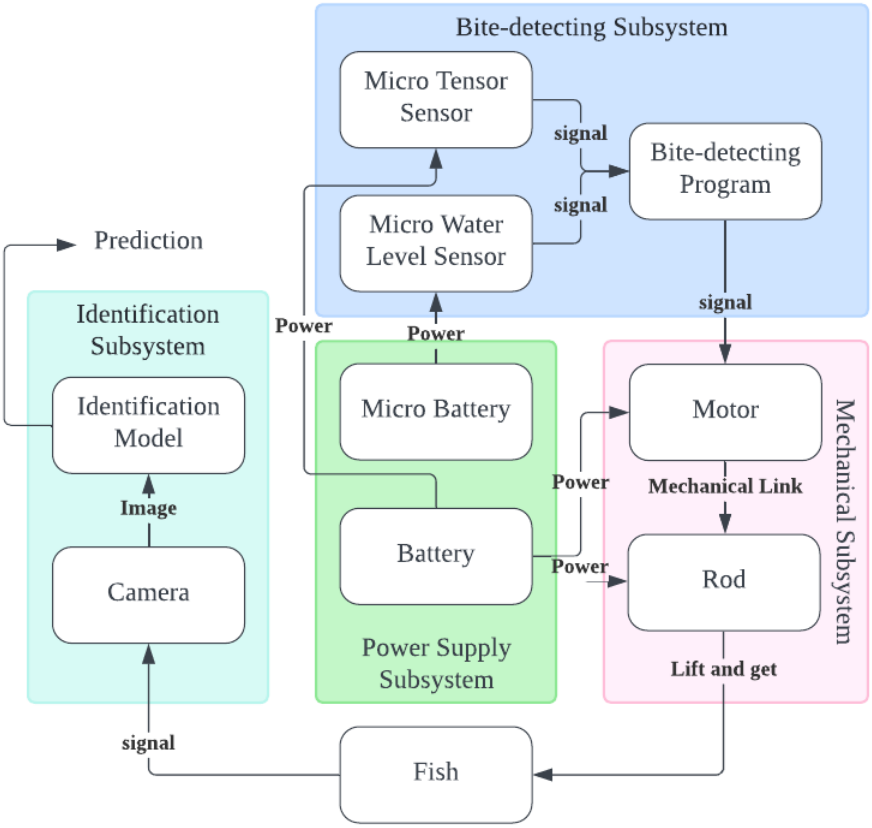

Figure 2: Block Diagram.

2.2 Subsystem Overview

Bite-detecting System: A bite-detecting system is designed to detect whether we catch any fish. It includes two sensors. One is a micro tension sensor mounted on the fishing wire. Another is a micro water level sensor mounted on the float. Thus, once a fish bites the hook, two sensors will emit the signal to rod-lifting system to lift the fishing pod.

Identification System: An identification system using machine vision technology and sensors is used to identify fish species. After a fish gets caught, the machine vision system will be activated when a fish is placed in front of the camera, and then it identifies the fish species.

Mechanical System: The overall mechanical structure is achieved in the form of modified fishing rods. When a fish is identified, the signal system will send a signal to the electronic control system of the control motor, and then the motor with a speed of 2rpm will drive the fishing rod to rise slowly near the human position through the linkage mechanical structure, so as to achieve the purpose of getting the fish.

Power Supply Subsystem: A power system supplies the power of each subsystem, including the linkage between each subsystem and independent parts such as the power of buoy. We use batteries to provide a stable power supply. In the rod lifting device, we will use the battery to drive a motor with a speed of 2 to drive the rod up.

2.2.1 Bite-detecting Subsystem

The bite-detecting system includes two sensors to detect the movement of the fish. Since the hooked fish will struggle to escape, we can take advantage of this feature.

First, there will be great tension on the fishing wire when a fish gets caught. To achieve the goal of catching fish from 0.03 to 1 kilogram, we need to prepare a tension with certain precision. When the tension on the wire reaches a certain value, the sensor will emit a signal to the lifting system. And we also need to consider the weight of the float and the hook. Therefore, the threshold of this sensor will probably be adjusted during the test session. Besides, the sensor needs to be small enough to avoid affecting the fishing process. Moreover, a professional fishing wire is needed to prevent breakage when lifting the rod.

Secondly, we designed another sensor to increase the accuracy of catching fish. And we chose a water level sensor. This is inspired by the phenomenon of sinking float. When a fish bites the hook, the float will sink into the water to remind the angler to reel out the fishing line. Thus, to finish this process automatically, we can use a float with a micro water level sensor attached to it. If the water submerged the float for a period, the sensor could emit a signal to system c. When these two sensors are activated at the same time, it is very likely that a fish bites the hook.

2.2.2 Identification Subsystem

The identification system implemented for the fishing process has a crucial objective, which is to accurately identify the species of the fish that has been caught. To achieve this, a high-resolution camera is used to capture an image of the fish, which is then sent to a large-scale fish dataset created by a team of experts, including O. Ulucan, D. Karakaya, and M. Turkan. [1] This dataset comprises a vast collection of images of different fish species, which the system uses to classify and predict the species of the caught fish.

The classification process is carried out using a Convolutional Neural Network (CNN), which is a type of deep learning algorithm that can automatically detect patterns in images. Before the fishing process begins, the CNN is to be trained using a subset of the dataset to optimize its performance. This training enables the neural network to learn the

distinguishing features of each fish species, which it can then use to classify and predict the species of the caught fish.

The classification problem is challenging due to the many different fish species available, and the similarities that exist between some of them. However, the model is designed to achieve an accuracy of at least 90%, which is a high level of precision. Moreover, the results are expected to be provided within a few seconds, which will enable the fishermen to quickly identify the species of the fish they catch and avoid any accidental catch of endangered or protected species.

2.2.3 Mechanical Subsystem

When the two sensors reach the critical value, the signal of catching the fish is simultaneously transmitted to the mechanical device, which is transmitted to the motor through a microcontroller similar to Arduino, so that the motor starts to turn. Taking into account the bite time of the fish, the motor turns about three seconds after the sensor reaches the critical time.

For the mechanical device, we use two vertical rods inserted into the soil to play a better fixing role. The two motors are welded to the rods used for fixation. When the motor starts to rotate, the rod is driven by the fixture to rotate, so as to achieve the purpose of liftng the rod. Considering that the length of the fishing line is about 1.8m, in order to prevent the fishing line from swinging or winding, we will take a slow closing method. After investigation, the 2rpm motor on the market is in line with our prediction of the lifting speed of the rod, so we tentatively decided on this speed.

Through the control of the single chip computer, we can set the fishing rod to be lifted to the vertical Angle with the ground to stop lifting, then the process of rising the rod is completed. Then we just need to wait for the swing of the line to decrease, and then remove the fish from the hook.

For the other part of the mechanism, the scan recognition device, we take a camera-like shape structure, and the results of the scan can ideally be viewed with a mobile APP.

2.2.4 Power Supply Subsystem

A power system supplies the power of each subsystem, including the linkage between each subsystem and independent parts such as the power of buoy. We use batteries to provide a stable power supply. In the rod lifting device, we will use the battery to drive a motor with a speed of 2 to drive the rod up. The battery we use is 5V battery. We will calculate how many battery we need to use in the later work.

2.3 Tolerant Analysis

1. Although the accuracy of the model is expected to be high, the prediction can still be incorrect due to various factors such as fish size, pose, and environment.

2. The driving force of the motor may not be able to steadily lift the rod. If the driving force is insufficient, we consider using multiple motors.
3. The device may disengage from the ground when catching a fish that exceeds the weight. If so, we will replace the design with the ground fixed.

3 Ethics and Safety

3.0.1 Ethical Considerations

We prioritize animal welfare and conservation principles in our automated fishing process. Our system promotes responsible fishing practices by ensuring humane treatment of fish and adherence to fishing regulations and quotas. Accurate identification of fish species enables anglers to make informed decisions, contributing to sustainable fishing practices and protection of vulnerable species.

3.0.2 Safety Measures

Safety is a top priority in the design and operation of the automatic fishing rod system. The system is equipped with various safety features to mitigate risks and ensure user protection.

Robust construction: The fishing rods and components are constructed from durable materials to withstand the rigors of fishing environments.

Automatic shutoff: The system is equipped with automatic shutoff mechanisms to deactivate the motor and prevent accidents in case of malfunction or entanglement.

References

[1] D. O.Ulucan and M.Turkan. ""A large-scale dataset for fish segmentation and classification"." (2020).