ECE 445

SENIOR DESIGN LABORATORY

DESIGN THESIS

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# Automatic Intelligent Fishing Rod

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**Team #40**

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# Contents

# 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]

## 1.2 State of the Art of the Design

Creating an intelligent fishing rod involves integrating technology with traditional fishing methods to enhance efficiency, precision, and user experience. This endeavor draws from a multidisciplinary field, including mechanical engineering, robotics, sensor technology, and artificial intelligence (AI). The advent of sensor technology marked a turning point in the design of fishing rods, introducing the concept of "intelligent" equipment. Sensors can detect changes in the environment, such as water temperature and movement, and alterations in the rod's position, signaling when a fish is biting. These sensors significantly increase the chances of a successful catch by alerting the angler to activity that might not be immediately obvious. The integration of robotics and AI into fishing rods is a relatively recent development. Robotics can automate certain actions, such as casting or reeling in the line, based on pre-programmed conditions or real-time data analysis. AI, on the other hand, can process data from various sensors to make predictions about fish behavior and suggest optimal fishing spots and times. AI can also learn from each fishing experience, improving its suggestions over time. [2]

## 1.3 Main contribution of the design

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.

## 1.4 Visual Aid

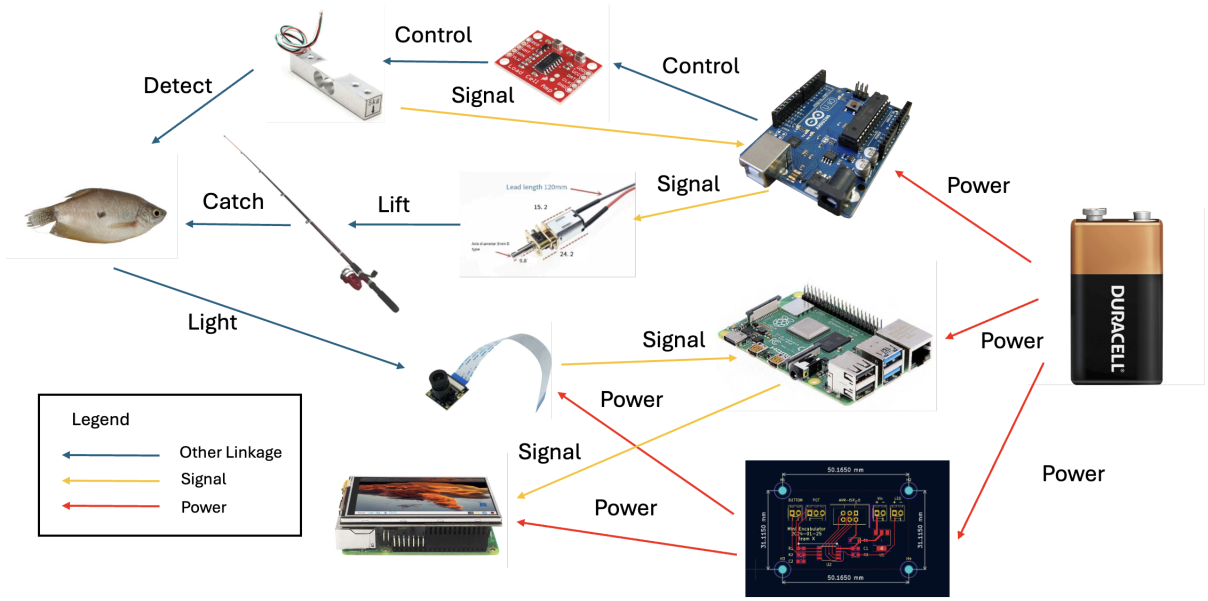



Figure 1: Visual Aid of different components of our system and the connections between them. Chips and sensors are used to detect a fish bite, after which the motor will lift the rod. The development board, camera, and display will be used to show the target fish species to the user.

## 1.5 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 power stably for the whole system.

# 2 Design

## 2.1 Block Diagram

As we can see below, our project contains four parts: Bite-detecting subsystem, Mechanical subsystem, Identification Subsystem, and Power Supply subsystem. We included every component we will use in our project and which part it belong with.

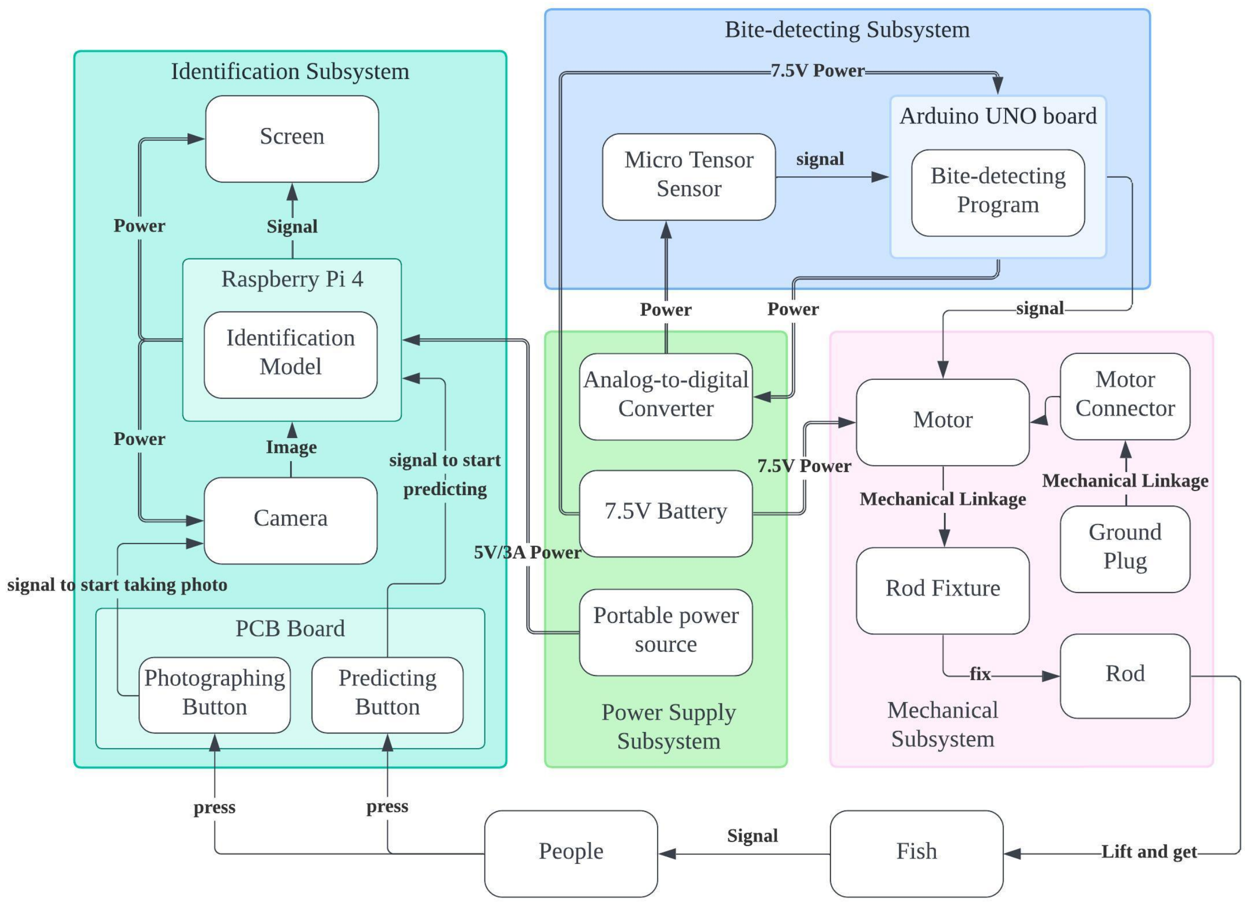



Figure 2: Block Diagram for Automatic Intelligent Fishing Pod. The power supply subsystem is responsible for supplying power to other subsystems. The mechanical subsystem will rotate the rod to catch the fish when the bite-detecting subsystem detects a fish bite. The identification subsystem will output to user the species of the fish just caught.

## 2.2 Physical Design

The figure below shows the physical design of our device. When the fish bites the hook, an Arduino-powered pull sensor detects that the pull is above the critical value and sends a signal through the Arduino to the motor to start spinning. The motor and the fishing rod fixture are connected through 3D printed parts so that the motor can be rotated to drive the fishing rod up. We fixed the other end of the motor with another 3D printed piece for the ground plug. The stability of our device is guaranteed because the ground plug can be inserted directly into the river soil. When we removed the fish, we used the camera and the Raspberry Pi 4 connected to the mobile power to scan the fish and identify the species.

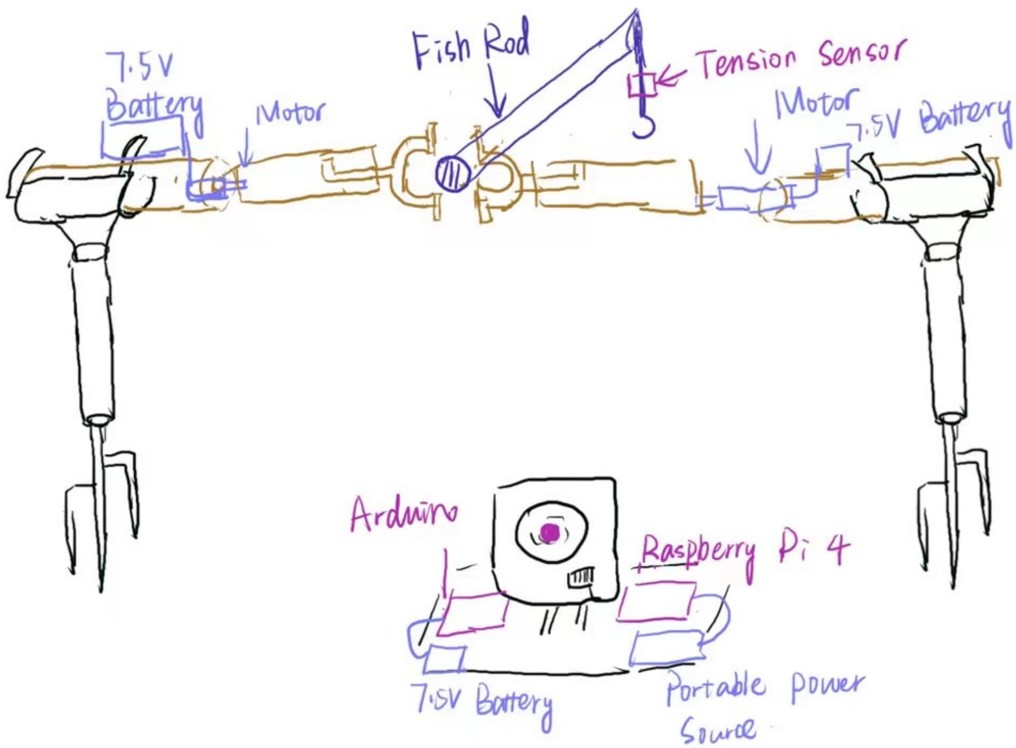



Figure 3: The rod is equipped with a sensor powered by Arduino that detects a fish bite on the hook. If the pull is strong enough, it sends a signal to the motor. The motor rotates a fishing rod fixture that is made using 3D printed parts. To keep the device stable, it uses a ground plug. We remove the fish from the hook and then use a camera and Raspberry Pi 4 to scan it for species identification.

## 2.3 Bite-detecting System:

The bite-detecting system is used to detect the movement of the fish. Since the hooked fish will struggle to escape, we can take advantage of this feature. This subsystem will be deployed on Arduino Uno. The applied sensor is a force sensor on the fishing wire. We also need an analog-to-digital converter between the sensor and Arduino Uno. Therefore, the data collected in real time will be transmitted and analyzed in the program to determine the movement of the mechanical subsystem. Here is the diagram of the bite-detecting subsystem.

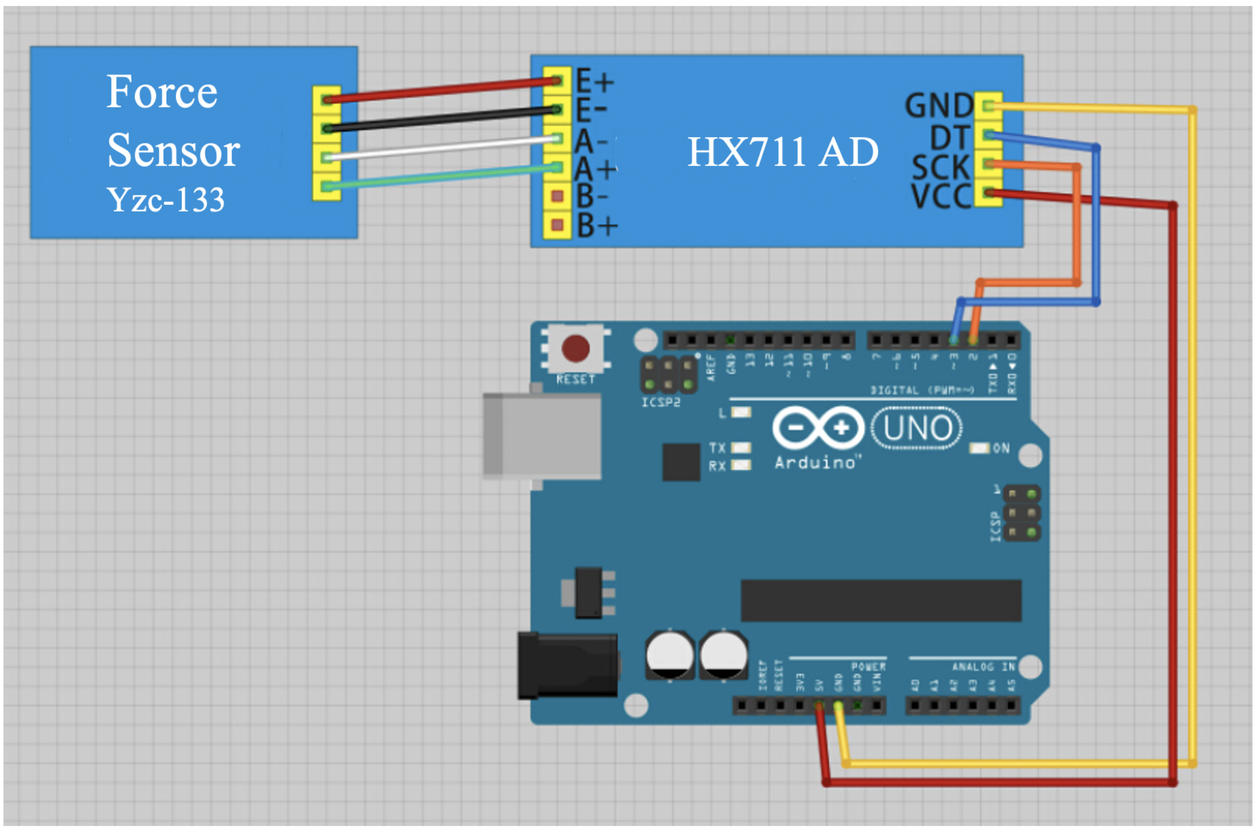



Figure 4: The circuit diagram of the bite-detecting subsystem.

### 2.3.1 The Force Sensor yzc-133

Firstly, 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 sensor with certain precision and capacity. Secondly, we also consider the condition when the hook catches a weed or a rock, which may lead to overload if the capacity is limited. Based on the historical weather parameters' range in Haining [3], we select the yzc-133 sensor to measure the tension on the fishing wire. Some important information [4] about the sensor is shown in Table 1.

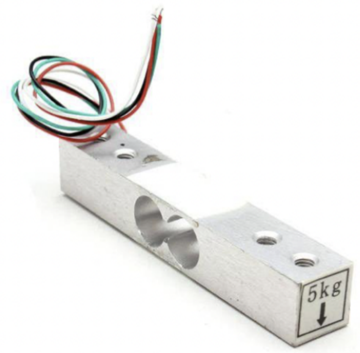



Figure 5: The Force Sensor yzc-133.

| Parameter | Unit | Value |
|---|---|---|
| Capacity | kg | 5 |
| Safe overload | %FS | 120 |
| Rated output | mv/V | 1.0±0.15 |
| Excitation voltage | Vdc | 5 |
| Combined error | %FS | ±0.05 |
| Operating temp range | °C | -21 $\sim$ +40 |
| In/Output impedance | Ohm | 1000±50 |

Table 1: Specifications of yzc-133

**Requirements**

1. The sensor should be able to measure and output accurate data. To ensure these components work correctly, we must support a suitable voltage source.
2. The sensor should not be in contact with water, both river and rain, while in use. To protect the sensor circuit, we will also design a highly waterproof shell for this part.
3. We need to reduce the impact of the sensor itself on fishing.
4. Our fishing goal is to be able to catch fish from 0.03 to 1 kg. The bite of small fish should be detected with an accuracy of at least 80%.

**Verification**

1. The power supply system will enable Arduino to provide voltage to the detecting sensor.
2. To protect the sensor circuit, we will also design a highly waterproof shell for this part.

3. The sensor should be mounted on the fishing wire near the fishing rod instead of near the river, which can decrease the influence from the weight of the sensor.
4. The sensor should be mounted on the fishing wire near the fishing rod instead of near the river, which can decrease the influence from the weight of the sensor. The size of the fish is determined by the size of the hook. Accuracy can be guaranteed by the small error (0.05%) of the sensor.

### 2.3.2 ADC HX711AD

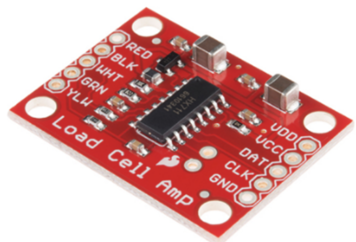



Figure 6: ADC HX711AD

HX711AD is a 24-bit analog-to-digital converter for weigh scales, which is suitable for our bite-detecting subsystem. It can change the output voltage of the sensor from analog to digital so that it can be used by MCU. Some important information [5] about this ADC is shown in Table 2.

| Parameter | Unit | Value |
|---|---|---|
| Full scale differential input range | V | ±0.5 |
| Power supply voltage | V | 2.6 ∼ 5.5 |
| Output data coding | HEX | 800000 ∼ 7FFFFF |
| Selectable gain | N/A | 32/64/128 |
| Operating temp | °C | -40 ∼ +85 |

Table 2: Specifications of HX711AD

**Requirements**

1. The ADC should be connected to the sensor properly with some protective measures. It is because the ADC along with the Arduino Uno will be placed near the motor. The distance between them is long and the circuit is vulnerable to damage.

**Verification**

1. We can place the wire inside the fishing rod to make it durable and waterproof. By encasing the wire within the fishing rod, it becomes inherently protected against water ingress, safeguarding the electrical components from corrosion and potential short circuits. Besides, threaded through the fishing rod, the wire remains neatly organized and free from entanglements. This ensures optimal cable management, preventing tangles or snags that could potentially disrupt the functionality of the circuit.

#### 2.3.3 Bite-detecting Program

When a fish gets caught, the sensor will have a linear voltage output from 0.03 to 1 mV. And it should be less than 5mV under normal circumstances. Here is the brief flowchart of the detecting program on the Arduino board.

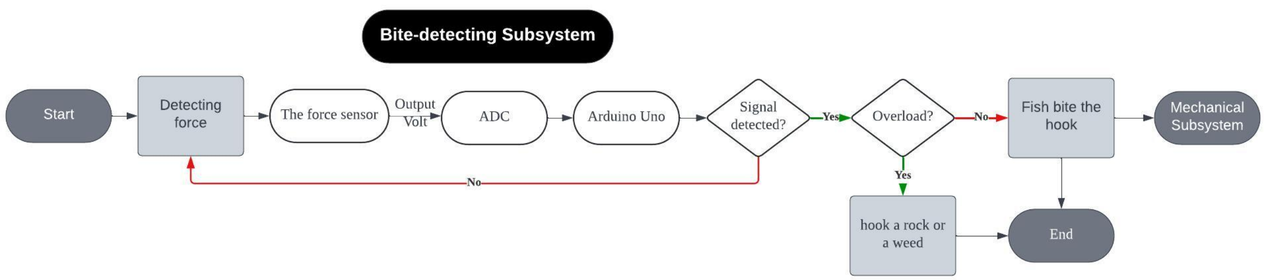



Figure 7: Bite-detecting Program flowchart

**Requirements**

1. Define a maximum allowable weight threshold that the force sensor can reliably handle without risking overload. This threshold should be determined based on the specifications of the sensor and the capabilities of the system components.

**Verification**

1. The program will power off the sensor if the output is out of capacity. We have an if statement inside the program. If the measured weight is over 5kg, it will print "Overload warning." then exit. We can press the button on the Arduino board to restart the program.

## 2.4 Identification System:

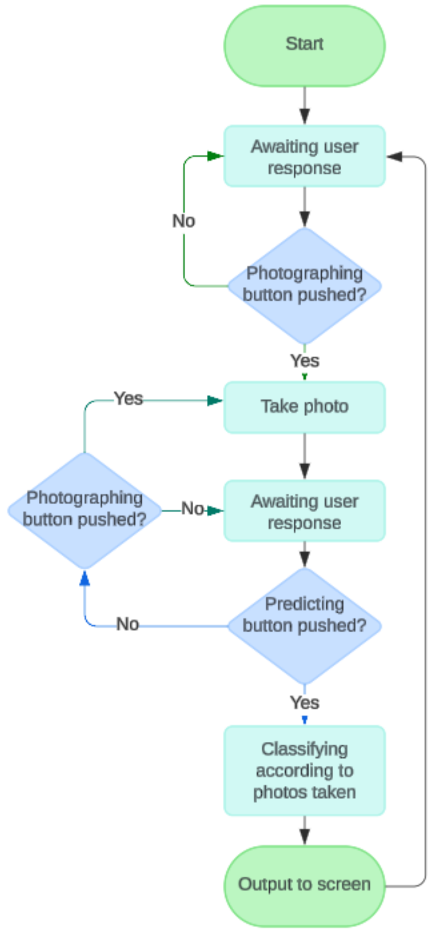



Figure 8: Identification Subsystem flowchart

**Subsystem Description**

The identification subsystem is used after the fishing process. This subsystem aims to take a photo of the fish that get caught and then identify the species of it. To achieve this, a high-resolution camera captures an image of the fish and then sends it to a pre-trained model for prediction-making. A camera and a development board perform the whole process. A PCB board will be attached to let human users input the signals for taking photos and the signals for starting the prediction. The image taken from the camera will be the input of our model, which will be loaded into the development board. The data used to train our model will be labeled images of freshwater fish that weigh from 0.03kg to 1kg and can be caught in rivers and lakes. The model's output will be the fish species. This is a classification process that takes images as input. Convolutional Neural Network (CNN), a type of deep learning algorithm that can automatically detect image patterns, is suitable for this target. After the prediction is made, the predicted name of the species will be displayed on a screen for the users.

**Requirements:**

1. This whole design should be able to stand alone. Thus, the identification subsystem should not rely on computers. The camera and the display screen should be activated by signals taken from users.
2. The model is expected to reach an accuracy of over 90%.

**Verification:**

1. After the model is trained, it will be loaded onto a development board. The development board will be connected to the camera, taking several images of the fish caught. The testing procedure of this subsystem will be conducted together with the power subsystem, which will power the Raspberry Pi 4 Model B development board, requiring a voltage of 5V[6]. The power subsystem will also power the camera and display screen. A PCB board design will be implemented to ensure that the voltage and power supplyed match the demanded 3.3V[7][8]. The PCB board will also be responsible for taking photographing and predicting signals from users by two buttons.
2. During training, the train and test sets will be partitioned from the dataset as disjoint sets. The dataset will be shuffled before training. After the model is trained and loaded into the development board, it will make predictions according to several images representing different fish poses and let the results vote for the final prediction.

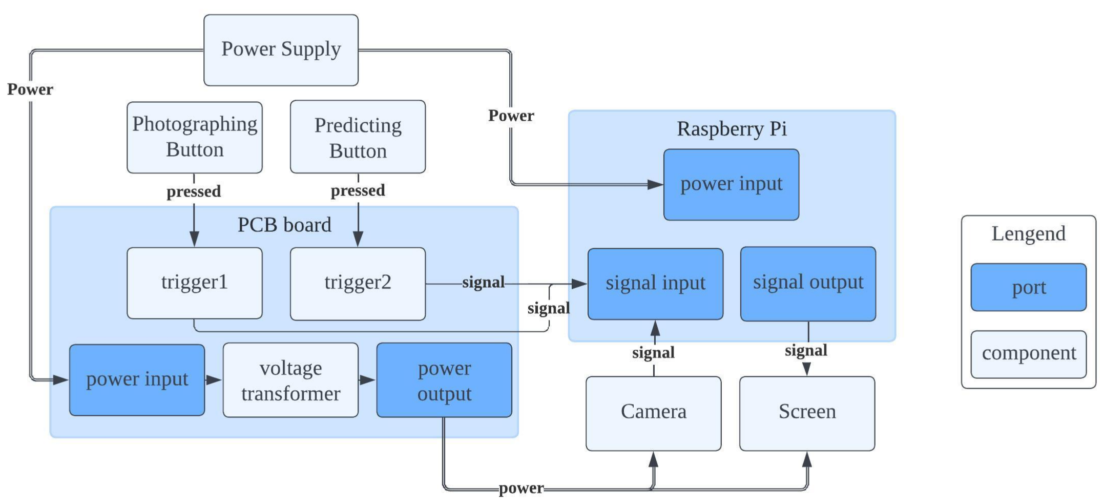



Figure 9: Illustration of connections of the PCB board. The PCB board will take in power from the power subsystem. A voltage transformer will be implemented to supply stable voltage for the camera and the display screen. The photographing button and the Predicting button will be fixed on the PCB board. Once pressed, the PCB board will send signals to Raspberry Pi.

**Training dataset Construction**

Our model is supposed to take three-channel RGB images as input. The images will be cropped to the same size, 2592*1944, before training, which matches the resolution of camera ov5647[8]. For images of sizes $(\alpha * 2952) * (\alpha * 1944)$, shrinking or expanding will be applied to resize the images. For shrinking, each new pixel will be calculated by the average of a block of old pixels. For a pixel in the new image at location $(m, n)$, the RGB value vector will be calculated by:

$$\sum_{i,j}(Prev\_RGB[m * \lceil\alpha\rceil + i][n * \lceil(\alpha)\rceil + j])/\lceil(\alpha)\rceil^2)$$

For expanding, each pixel in the original image will be simply expanded to a block of pixels, the size of which is $\lfloor(1/\alpha)\rfloor * \lfloor(1/\alpha)\rfloor$. To prevent changing the size of fish in images, for those whose size cannot be represented by $(\alpha * 2952) * (\alpha * 1944)$, manual cropping will be first applied to make it into a size of $(\alpha * 2952) * (\alpha * 1944)$. Then, shrinking or expanding will be applied.

The size of the dataset is expected to be $K * N$, indicating that the dataset is composed of $K$ classes and $N$ images in each class. $K$ is expected to be small, within the $[5, 10]$ range. $N$ will also not be large, within the $[200, 1000]$ range.

This relatively small dataset can be exposed to the potential risks of overfitting[9].

**Model construction**

To prevent overfitting and other unwanted factors from interfering with the accuracy of our small dataset, the structure of our CNN should be carefully chosen. Experiments conducted by L. Brigato and L. Iocchi on 10 classes using CNN show that for small-data problems, low-complexity CNNs are comparable to or better than high-complexity ones[10]. Thus, the model will not be composed of complex structured layers. The CNN architecture is supposed to be made of Convolutions and max-polling layers as feature extractors and is supposed to minimize the standard classification loss represented by:

$$\frac{1}{t}\sum_{i=1}^{t} L_c(y_i,\ f_\theta(x_i)) \tag{1}$$

## 2.5 Mechanical System:

### 2.5.1 Rod Holder to the Ground

For the connection between the fishing rod holder and the ground, our initial idea was to use 3D printing to insert it into the ground for fixing, so the end of the holder was designed as a pointed shape. But because of the high cost, we searched the Internet for ready-made products and modified them.

Figure 10: Rod Holder to the Ground

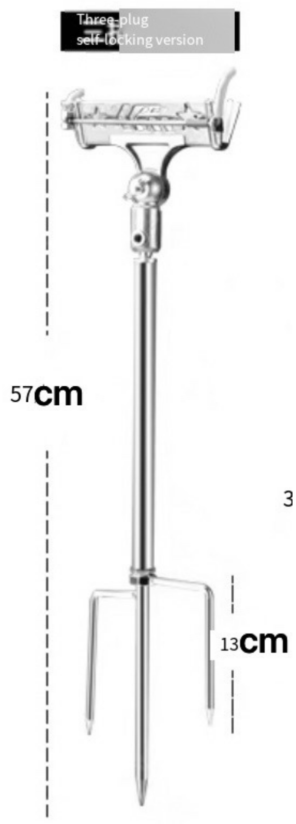



Table 3: Specification of Fishing Ground Plug

| Parameter | Unit | Value |
|---|---|---|
| Height from ground to horizontal support | cm | 57 |
| The depth of the ground thrust into the soil | cm | $10 \sim 13$ |
| Hardness of stainless steel | HRC | $56 \sim 60$ |

**Requirements:**

1. The ground plug should allow enough height for the fishing rod to be recovered so that the end of the fishing rod does not touch the ground.
2. The ground plug needs to withstand the force of the wind and the gravity of the fish while it is firmly anchored in the ground.
3. The place that holds the 3D-printed rod needs to withstand a certain torque to ensure that it does not break.

**Verification:**

1. This problem can be avoided by measuring and reserving the height of the ground plug.
2. The torsion force and gravity generated by 0.03kg to 1kg fish were simulated to determine the bearing capacity of the ground plug.
3. By buying back the physical product and 3D printing part, the experiment simulated the stability of the lock-in device.

### 2.5.2 Motor

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 micro controller 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 selection of the motor, we try to use a small speed, can withstand the torque of the larger motor, so that it can withstand the larger weight of the fishing rod. The picture is a finished motor we selected from the Internet. The size parameters are shown in the figure. By connecting the governor, its speed can be adjusted from 4rpm to 40rpm. At present, we plan to choose a speed of 4rpm for the experiment.

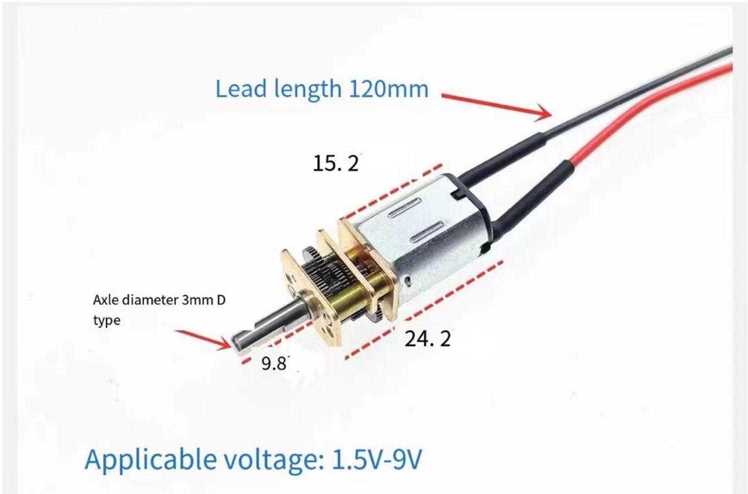
Table 4: Specification of Motor

| Parameter | Unit | Value |
|---|---|---|
| Length, width and height of the motor | mm | 34*12*10 |
| Motor shaft diameter | mm | 3.0 |
| Motor speed | RPM | $4 \sim 40$ |
| Motor speed | V | $1.5 \sim 9$ |

**Requirements:**

1. Speed regulation can be performed according to the voltage input of Arduino, and the speed can be stabilized at a relatively low speed as far as possible.

Figure 11: Motor




2. It can withstand the torque provided by $0.03 \sim 1$kg fish struggling with it.

**Verifications:**

1. Connect and experiment with the Arduino program and code.
2. Use the dynamometer to measure the force of the general fish struggle and apply a similar torque to the motor to test whether it can rotate normally.

#### 2.5.3 The Linkage and the Fixture for the Fishing Rod

The linkage device at both ends of the motor is shown in the figure. The shaft of the motor links the fixture so that the jig and fishing rod rise as the motor rotates.

For the fixation between the fixture and the fishing rod, we initially used the 3D printing situation to manufacture. Screws are threaded through four holes and secured by nuts. If the stiffness of the 3D printed part is insufficient, we consider buying the finished steel pipe clamp from the Internet and modifying it to make its size conform to the fishing rod.

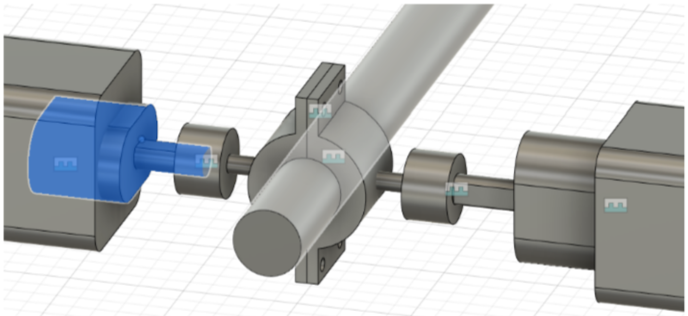


Figure 12: General Structure of Connection and Fixture Device

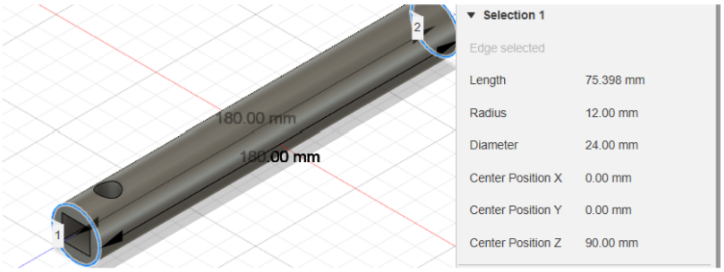



Figure 13: The Structure Connecting the Ground Plug to the Motor

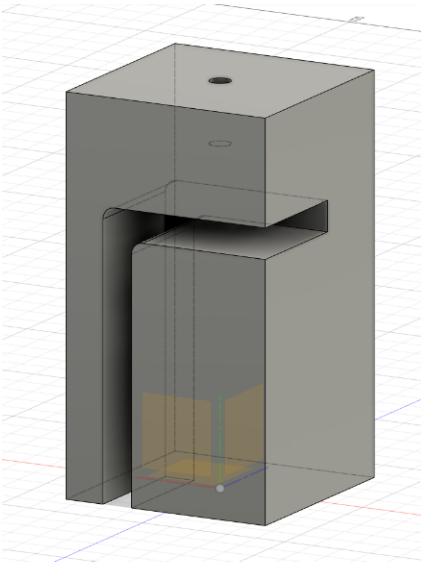


Figure 14: The Structure of Connecting the Motor to the Rod Fixture

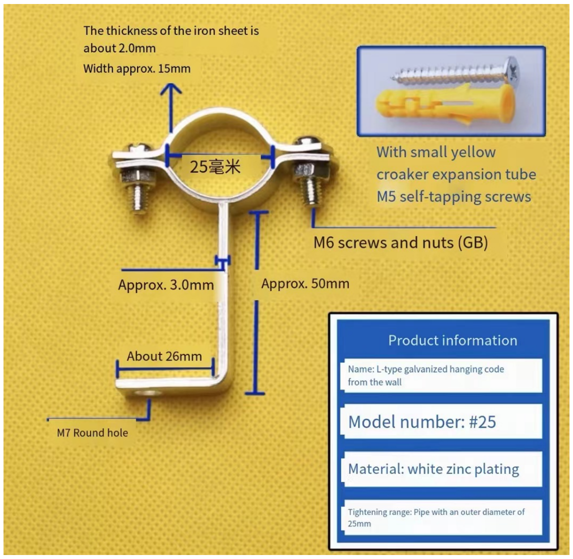



Figure 15: Rod Fixture

**Requirements:**

1. two 3D modeled parts, keeping them non-sliding.
2. 3D printed parts need to withstand the torque required to fish.

**Verification:**

1. The expansion error of 0.5mm is maintained in the Fusion360 modeling software and then modified according to the 3D printed entity.
2. Based on the measured torque mentioned earlier, computer simulations were carried out to test whether the PLA material was subjected to reasonable pressure.

## 2.6 Power Supply Subsystem:

A power system supplies the power of each subsystem, including the linkage between each subsystem and independent parts such as the buoy's power. We use batteries and a portable power source to provide a stable power supply. In the rod-lifting device, we will use Arduino UNO to control and supply power for the sensors and motors. The battery we use to supply the Arduino board is a 7.5V battery. For the Identification subsystem, we load the trained model into berry Pi to identify the kind of fish. The power supply we chose for Raspberry Pi is a 5V/3A portable power source. The camera and screen we use in the identification subsystem connect directly with Raspberry Pi and get power from the board.

**Requirements:**

1. Supply power for Arduino UNO with 7.5V battery
2. Supply power for Raspberry Pi 4 Model B with 5V/3A portable power source.

**Verification:**

1. As mentioned in the datasheet of Arduino Uno R4 Minima, the recommended input voltage is 6-24 V if using Pin VIN. It can also use 5V DC via a USB-C connector.[11]
2. As mentioned on the Raspberry Pi website, It can use 5V/3A DC via a USB-C connector.[6]

## 2.7 Tolerance Analysis

### 2.7.1 Feasibility Analysis

The whole system will be tested in a relatively more stable environment in the lab. A water tank is supposed to simulate the climate of peaceful open water, which is a better choice for fishing than in fierce waves. Also, it is easier for the fishing process to be triggered because the density of fish can be controlled in this case. In this testing process, fish can be attracted to our system much more efficiently than in open water. Overall, the proposed testing plan enables us to show the functions of our design more conveniently. Several factors still need careful consideration in cases of natural open water and our proposed testing plan.

### 2.7.2 Hardware

As for the force sensor, we have successfully linked it to Arduino and can output the force apply on the force sensor. We will use spring tensioner to test the accuracy of our electrical tensor sensor. We will later on working on the test of the stability of power supply subsystem. The testing plan including using voltmeter to test the voltage between positive pole and negative pole of each component to see if it is stable. Also, while we use PCB to power up the camera and screen linked to raspberry pi, we will also test to get the suitable voltage that can be apply to them.

Table 5: Specification of Motor

| Components | Power |
|---|---|
| Arduino Uno R4 Minima | Input voltage (VIN): 6-24 V<br>DC Current per I/O<br>Pin: 8 mA |
| Force Sensor yzc-133 | Working Voltage: 5V<br>Working Current: $\approx$ 5mA<br>Power: $\approx$ 25mW |
| ADC HX711 | Working Voltage: 2.6$\sim$5.5V<br>Working Current: $\leq$ 1.5mA<br>Power: $\leq$8.25mW |
| Motor | Power supply voltage: 1.5$\sim$9V |
| Raspberry Pi 4 Model B | 5V/3A |

### 2.7.3 Software

The model implemented for the identification subsystem will be tested on both the test set, which is a partition from the dataset, and real-world cases. Before putting into use, the model will undergo multiple tests on the different randomized partitions of the dataset after the training process is finished to prevent over-fitting. The performance will be evaluated by four dimensions: classification accuracy, precision, recall, and f1.

Table 6: Expectations for accuracy

| Accuracy Measurement | Expected Value |
|---|---|
| Classification accuracy | =90% |
| Precision | =90% |
| Recall | =85% |
| F1 | =(2*0.9*0.85)/(0.9+0.85) |

Classification accuracy represents the proportion of correctly classified images.

$$ClassificationAcc = \frac{TruePos + True_Neg}{TruePos + TrueNeg + FalsePos + FalseNeg}$$

Precision represents the proportion of correctly predicted positive instances (true positives) out of all instances predicted as positive.

$$Precision = \frac{TruePos}{TruePos + FalsePos}$$

Recall represents the proportion of correctly predicted positive instances (true positives) out of all actual positives.

$$Recall = \frac{TruePos}{TruePos + FalseNeg}$$

F1 represents a combinational measurement of Precision and Recall.

$$F1 = \frac{2 * Precision * Recall}{Precision + Recall}$$

### 2.7.4 Mechanical System

Due to the weight of the fish and the resistance to the hook, we need to analyze whether the fragile 3D printed part can withstand these forces[12]. When the fishing line pulls up the fish, the maximum force is the resistance of the water, and the formula is:

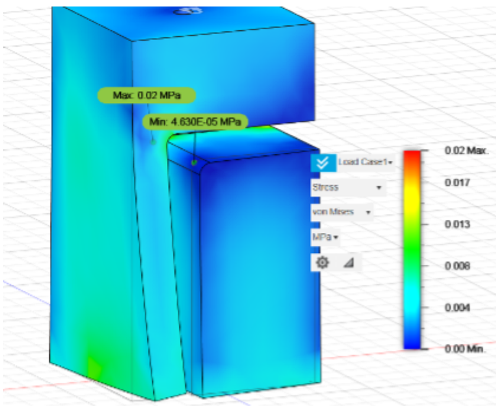
$$F_{drag} = 0.5 \times drag\_coef \times A \times v^2$$

The range of drag coefficient is generally 0.1 to 0.2. We choose the maximum resistance coefficient to calculate whether the 3D printed part can withstand the force of the fish bite. The weight range of our target fish is 0.03 1kg, here we choose the maximum 1kg. After calculation, the resistance of the fish weighing about 1kg to the hook is around 3.6N. In addition, the gravity of a 1kg fish is 9.8N, we use these two main forces to sum up the torque of the fish:

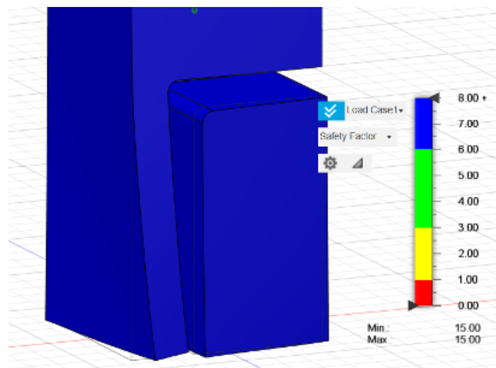
$$\tau = F \times r$$

About 14N*m of torque is applied to the part, and the simulation analysis with Fusion 360 is as follows:

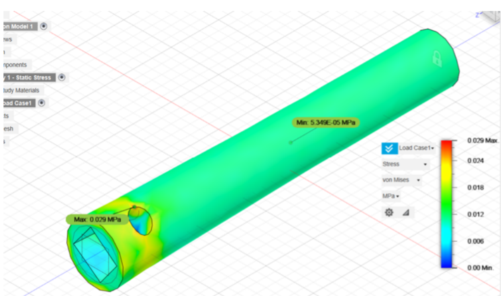
**Safety Factor of Motor Connecting Structure** The Safety Factor of both parts is around 15, much higher than 2, so the risk of collapse is relatively small.



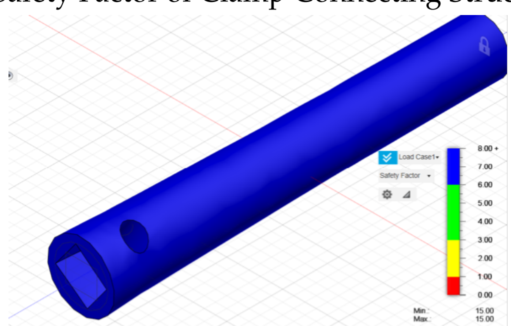

(a) Stress of Clamp Connecting Structure




(b) Safety Factor of Clamp Connecting Structure



(c) Stress of Motor Connecting Structure



(d) Safety Factor of Motor Connecting Structure

Figure 16: Stress and safety factors of Connecting Structures

# 3 Cost Analysis

## 3.1 Bill of Materials

| Components | Cost | Member |
|---|---|---|
| Arduino Uno R4 Minima | ¥ 120.9 | Baiming Li |
| Force Sensor yzc-133 | ¥ 21.6 | Yitong Gu |
| ADC HX711 | ¥ 5 | Ziyi Shen<br>Xinyi Song |
| Motor | ¥ 31.8 | Baiming Li |
| Raspberry Pi 4 Model B | ¥317 (2GB) | Yitong Gu |
| PLA Material | 0.65¥/g ≈¥400 (The institution may supply) | Ziyi Shen<br>Xinyi Song |
| Ground Plug | ¥60 | Baiming Li |
| Rod Fixture | ¥16 | Ziyi Shen<br>Xinyi Song |
| Camera ov5647 | ¥28 | Yitong Gu |
| Screen | ¥49.5 | Yitong Gu |

# 4 Schedule

## 4.1 Weekly Schedule

| Week | Tasks | Member |
|---|---|---|
| 4/1 | 3D print and test the connector | Baiming Li |
| 4/1 | Constructing dataset for the model | Yitong Gu |
| 4/1 | Test the sensor and the ADC | Ziyi Shen<br>Xinyi Song |
| 4/8 | Optimize 3D printed parts based on installation problems<br>Compare the practicability of different print fillings. | Baiming Li |
| 4/8 | Constructing model | Yitong Gu |
| 4/8 | Finish coding on the Arduino Uno<br>Connect the bite-detecting subsystem | Ziyi Shen<br>Xinyi Song |
| 4/15 | Test the hardware near the river. | Baiming Li |
| 4/15 | Test the bite-detecting subsystem with a water tank and goldfish indoors | Ziyi Shen<br>Xinyi Song |
| 4/15 | Training Model | Yitong Gu |
| 4/22 | Loading model into development board | Yitong Gu |
| 4/22 | Test the bite-detecting subsystem along with the mechanical subsystem | Ziyi Shen<br>Xinyi Song |
| 4/29 | Testing and debugging model with camera and screen | Yitong Gu |
| 5/6 | Test and debug the whole project together | Baiming Li<br>Xinyi Song<br>Yitong Gu<br>Ziyi Shen |

# 5 Ethics and Safety

## 5.1 Ethical Considerations

According to the IEEE Code of Ethics [13], we recognize the importance of prioritizing the safety, health, and welfare of the public in our professional activities. Therefore, when developing our automatic fishing rod system, we will take the following precautions to address ethical concerns:

1. Accuracy Assurance: To ensure accurate identification of fish species, we will rigorously test and validate our machine vision algorithms, with mechanisms in place to verify and correct misidentifications.

2. Humane Treatment of Fish: Our design will prioritize humane handling and minimizing stress and injury to fish during capture and handling, aligning with ethical principles of respect for animals.

3. Equipment Safety Checks: Before deployment, we will conduct thorough checks of all components and systems to ensure they meet safety standards and are free from defects or malfunctions.

4. Risk Assessment: We will perform comprehensive risk assessments to identify potential hazards associated with the operation of the automated fishing rod system. Mitigation measures will be implemented to minimize risks to users and bystanders.

By adhering to these ethical guidelines, we aim to develop and deploy our automatic fishing rod system responsibly and ethically, in line with the principles outlined in the IEEE Code of Ethics.

## 5.2 Safety Measures

1. 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.

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

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

4. User instructions: Detailed user manuals are provided to guide users on the proper setup, operation, and maintenance of the system. This includes instructions on handling equipment safely and using appropriate protective gear.

5. Environmental safeguards: Measures are implemented to minimize environmental impact, such as avoiding damage to aquatic habitats and non-target species.

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