ECE 445

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Senior Design Project Proposal

Automatic Ice Fishing Rod

Team 60

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1 Introduction

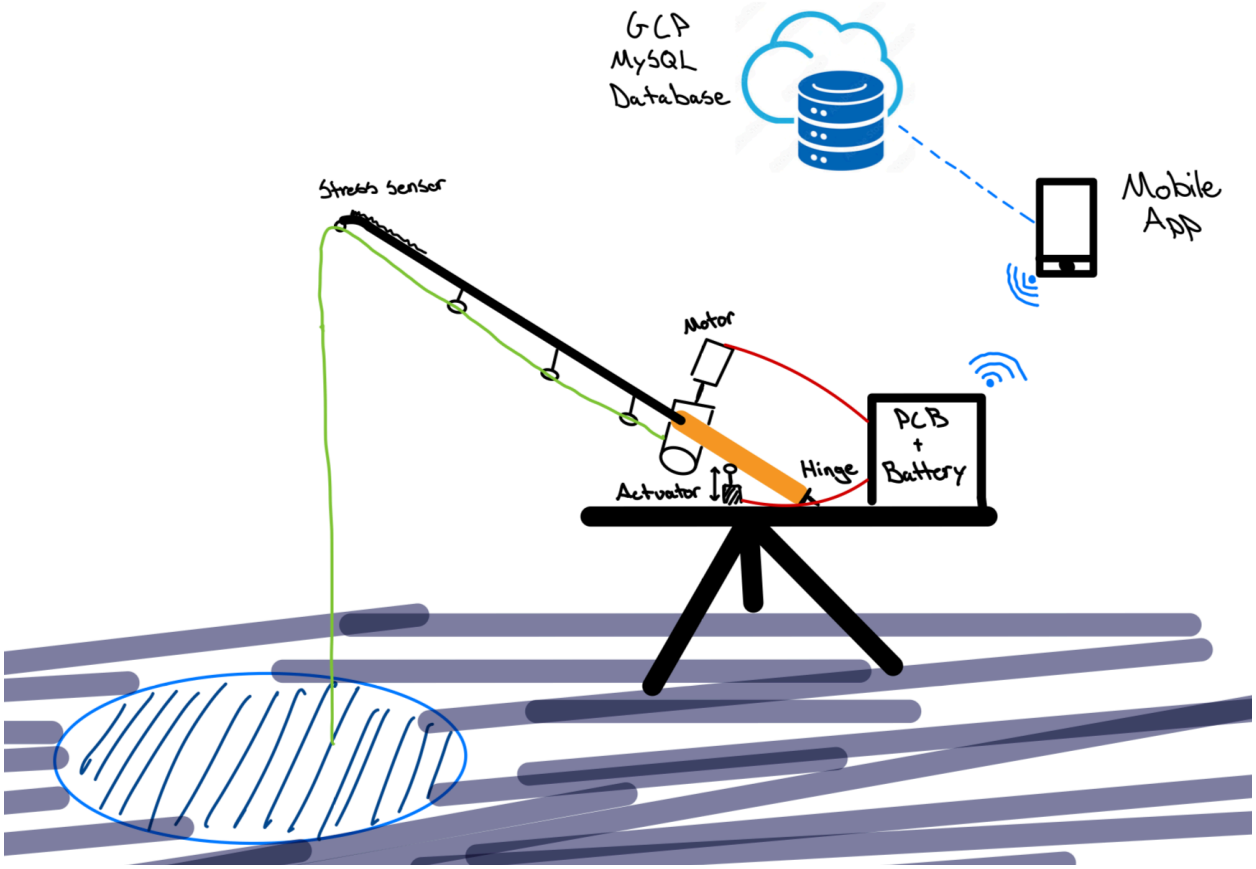
1.1 Problem

Ice fishing can be a very tedious and labor-intensive process. While it is being performed, the fisherman must dedicate all of their attention to the task at hand, constantly jigging the rod, making multitasking impossible. It must be done in a very cold environment as well, which gets uncomfortable after long periods of time. Additionally, there can be long stretches with little to no bites. If the fisherman did not have to constantly attend to the rod, these stretches of no activity would be perfect for taking a break to warm up, eat a meal, etc., but the nature of ice fishing makes this impossible.

1.2 Solution

Our project aims to create an automated ice fishing rod that eases the challenges associated with ice fishing. The user will have the ability to spool any lb-test line onto the device as with any lure when fishing. The fisherman can set the depth at which his lure hangs below the ice. The fishing rod will have the ability to jig the attached lure in hopes of attracting fish. When a tug occurs at the line, the user will be alerted through an alarm and notification. A mobile app will allow the user to set preferences to the depth of the line and jigging.

1.3 Visual Aid

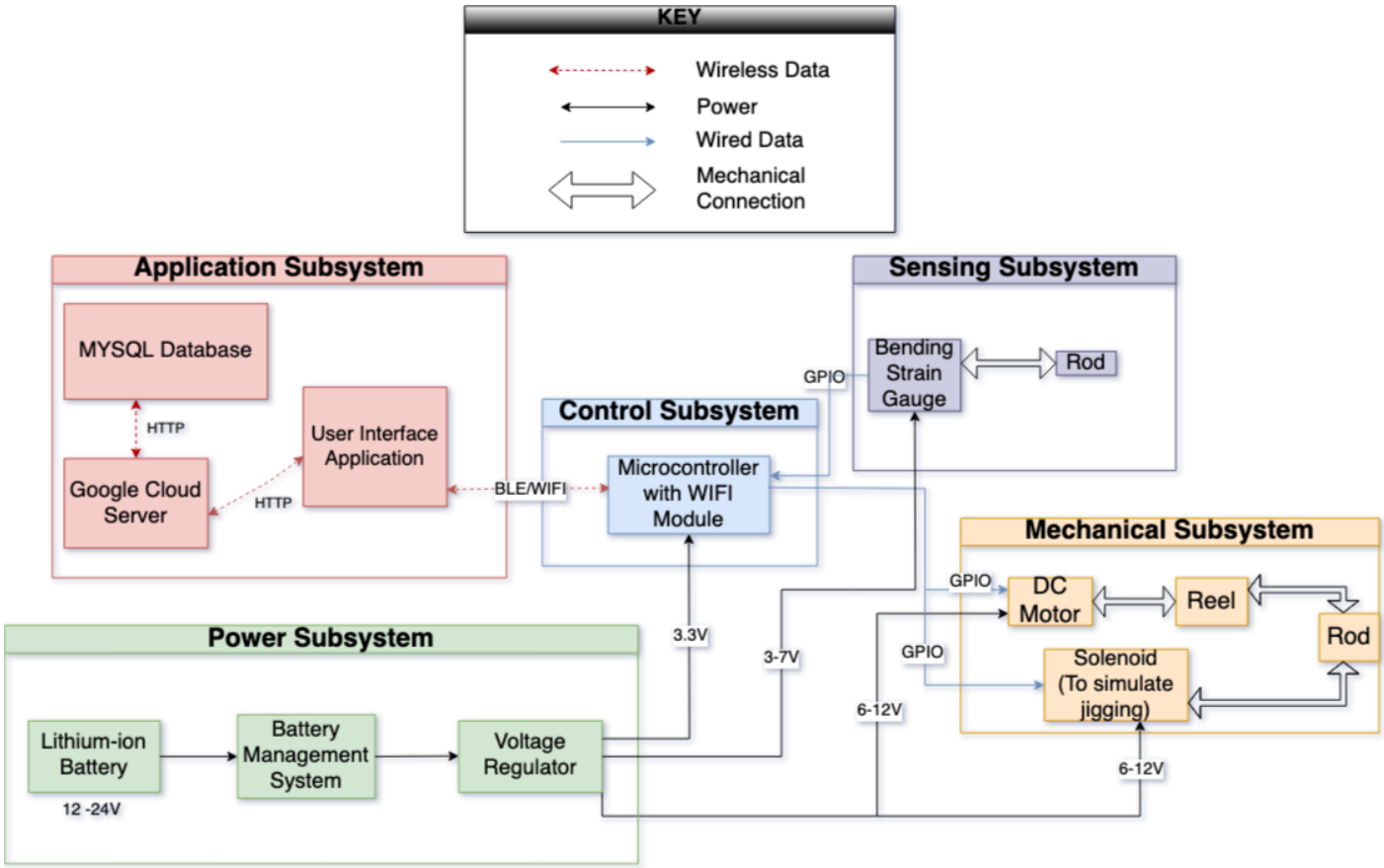


1.4 High-level requirements list

1. The user will be able to set up to 3 different jigging frequencies, a lure depth up to 50 feet (+/- 5 feet) in increments of 1 foot (+/- 0.25 feet), or enable auto reeling.
2. When 10 N (+/- 5 N) is detected, the jigging will halt within 5 seconds of detection, a notification will be sent to the user application, and, if auto reeling is enabled, the line will be reeled in automatically.
3. The user will be able to record their catches in the user application with 7 different data fields. Previous catch information can be viewed in the application.

2 Design

2.1 Block Diagram



2.2 Subsystem Overview

Sensor Subsystem: A flex bend sensor will be placed along the middle of the fishing rod to measure the degree at which the rod bends, thus determining if a fish is on the line. If the bend angle of the rod exceeds normal, the jigging functionality will halt and notify the fisherman. If the auto-reel setting is enabled, the motor will reel the line in as well if enough bend is detected.

Application Subsystem: The user application will allow the user to modify the settings of the fishing device (e.g., depth of the lure, whether to automatically reel in) while also allowing the user to insert/remove catch information from their account. For example, when they make a catch, they can type in the time caught, location, depth of lure, type of fish, etc. into the app, where it will then be uploaded to a GCP database. This information can then be viewed within the app for future reference. Two tables would exist in this MySQL relational database: a user table that contains user information and a catch table that contains catch information. Attributes of the user table would include a unique username,

password, first name, and last name. Attributes of the catch table would include time caught, location, depth of lure, type of fish, length of fish, weight of fish, and other information.

Control Subsystem: An STM32 microcontroller will do the processing on the device itself. The microcontroller will receive, process, and send data to the other components of the device. It will signal the motor how much to reel the line in/out, the frequency at which the solenoid should jig the rod. It will receive data from the flex bend sensor and determine whether the threshold angle is met, causing the microcontroller to signal the mechanical subsystem. The microcontroller will also communicate with the user application through the STM32's bluetooth/WIFI capabilities, receiving the data for the user's desired settings and sending a notification when a fish is detected.

Power Subsystem: We will have lithium-ion batteries connected together in parallel to have adequate charge. There will also be a circuit for the power supply that regulates the power output from the batteries. There will also be a switch on the system to shut off the power supply to prevent the batteries from draining too fast. We will also need a power distribution system that will supply different amounts of electricity to the sensors, motors, and control board. The power subsystem will be designed to maximize efficiency of electricity used and try to reduce energy loss.

Mechanical Subsystem: The mechanical subsystem will consist of an ice fishing rod (short rod length) attached to a tripod stand by a hinge, thus holding the rod upright and dangling the line above the water. An actuator will be attached to the tripod stand, and will push the rod up and down repeatedly to simulate the jigging motion. The fishing reel will have a hand crank on one side that will allow the fisherman to reel in the fish on their own, and on the other side, a DC motor to allow for line to be automatically be reeled in or out.

2.3 Subsystem Requirements

Sensor Subsystem: The sensing system consists of the flex bend sensor mounted in the middle of the fishing pole to detect when the rod bends. The sensor's output will directly connect to the microcontroller. If a bend occurs in the rod that exceeds the predetermined force of 10 N (+/- 5 N), an alert will be sent to the microcontroller which will then alarm the fisherman through the bluetooth/WIFI capabilities on the microcontroller that a fish is on their line.

Application Subsystem: The application subsystem consists of three units: the user application, the Google Cloud Server, and the MySQL database. The user application will force the user to create an account before using the application. Once an account has been created, the user will be able to login into their account, and control the configuration of their automatic ice fishing rod. The application will be presented in a user friendly mode that easily allows the user to set the depth of their lure and turn on/off jigging. The application will directly talk to the microcontroller to relay the desired depth and jigging settings to the fishing rod. Through a server hosted in GCP, the user will be able to receive/post catch information. When a user catches a fish, they can record their catch in the application by 7 different data fields. On the other hand, the user can view past catch information when they login to the application.

Control Subsystem: The control subsystem will consist of an STM32 microcontroller which will be responsible for processing data from other subsystems. The microcontroller will communicate with the application subsystem through the STM32's bluetooth/WIFI module. The microcontroller will receive data from the sensing subsystem, and it will send a notification to the application subsystem if the sensor detects at least 10 N (+/- 5 N) of force. The user settings in the application subsystem (e.g., line depth), will be sent to the microcontroller which will then signal the mechanical subsystem to carry out these settings.

Power Subsystem: The power subsystem will be responsible for delivering power to the other subsystems. This subsystem consists of a lithium-ion battery to provide a power source, a battery management system to protect and optimize the battery, and a voltage regulator to drop the voltage to the values required by other subsystems. The power subsystem will need to deliver 3.3 V (+/- 0.1V) to the microcontroller, 3-7 V (+/- 0.1V) to the flex bend sensor, and 6-12 V (+/- 0.1V) to the motor and solenoid.

Mechanical Subsystem: The mechanical subsystem will consist of the rod and reel of the fishing pole, as well as a 6-12 V DC motor and a 6-12 V solenoid. The solenoid will be connected to the base of the rod, moving up and down to simulate the jigging motion. The motor will be attached to the reel, allowing the fishing line to be reeled in and out. The mechanical subsystem's motor and solenoid will receive data from the microcontroller, such as how much the motor should rotate to lower the lure, when the motor should rotate to reel in the lure, what frequency the solenoid should jig the rod, and when the solenoid should stop the jigging motion.

2.4 Tolerance Analysis

We use a bluetooth system on our microcontroller that might draw a lot of energy from the battery. Using a low energy bluetooth setting will reduce the range of the microcontroller and might make the application not able to communicate with the system if the user is away. We have to make sure that we set the low energy bluetooth configuration properly by updating the software and then testing the signal from different testing distances.

We could also run into issues with our power system not delivering proper current to the different components. The maximum current into the powerline on the STM32 is 100 mA. The 6-12 V actuator needs a current of 1 A for no load and 5 A for max load. The motor will also need 1 A at current. The STM32 needs to be way below 100 mA so we can use a circuit with 120 ohms of resistance to reduce the current.

3 Ethics and Safety

When developing an automatic ice fishing rod, it's essential to consider various ethical and safety issues, both during the development process and in terms of potential misuse. The IEEE and ACM (Association for Computing Machinery) Codes of Ethics provide general guidelines that can be applied to our project. The issues listed below ensure our project upholds to the highest standards established:

Privacy Concerns (ACM Code 1.6)

Any time personal data is being collected and stored, there is a risk of a breach of privacy. Our application will allow users to upload data to a GCP database, which will contain two tables: one for personal information and one for catch information. The main privacy concern deals with the former, as this table will contain the user's first and last name. In the application's privacy policies, we will clearly state that the information they are submitting will be stored in a database, and ask that they only proceed if they give us consent to store their data. In the event that this database is hacked, this information could be used for malicious purposes that could potentially harm the user. In order to minimize these consequences in the event of an attack, this risk will be clearly stated in the privacy policies, and will inform the user that they may use an alias when submitting this information if they wish to take extra precautions.

Transparency and Honesty (ACM Code 1.3)

When developing a new product, it is important to fully document the entire design and implementation processes. Data should not be tampered with and no values should be altered to ensure honesty and transparency. The claimed capabilities of our design must accurately reflect its actual capabilities, so users receive the quality they expect. In order to make sure we are transparent throughout our development, we will thoroughly document the process in our lab notebooks. We will also make our code open sourced so that users can understand our system and how it works. The claimed values will be realistic and accurate, and will be reported with tolerance values (e.g., +/- 5 N) to account for slight differences in conditions, equipment, etc.

Mechanical and Electrical Safety (IEEE 1.1)

These codes involve safety issues related to mechanical and electrical failures in the rod or its deployment mechanisms.To mitigate these issues we will employ the following precautions. The battery and PCB will be enclosed in an element-proof box to minimize the risk of electric shock and mechanical/electrical damage to the system. The system components will also be properly grounded. The automatic reeling system will operate at a frequency that is safe for the user as the fisherman's line will not be reeled in excessively fast. We will rigorously test the mechanical stability of the rod to ensure that it can withstand the stress of catching multiple fish of varying sizes.

User Training and Guidelines (ACM Code 1.2)

This code relates to safety issues surrounding Injuries due to improper use or lack of understanding of the equipment. In our user manual we will have instructions for using the rod. To mitigate this issue we will provide clear user manuals, safety guidelines, and potentially implement features like emergency stop mechanisms. These instructions will include how to turn on and off the system. There will also be an analog off switch on the power delivery circuit to cut power in cases of extreme malfunction. The user manual will also have safety guidelines such as how far to stand from the rod and advise against putting your hands near the hook. Our user manual will also advise against tampering and have information about how to handle component breakdown such as battery corrosion or leakage.

References

Code of Ethics - Association for Computing Machinery, www.acm.org/code-of-ethics. Accessed 7 Feb. 2024.

“IEEE Code of Ethics.” *IEEE*, www.ieee.org/about/corporate/governance/p7-8.html. Accessed 7 Feb. 2024.