SOEN 422 Project Proposal

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Problem

There exists many reasons such as security, tracking, and defense, where the detection of an object and its categorization is critical. For example, many watercrafts involved in tasks such as shipments and defense, need to use techniques "to [...] detect objects on or under the surface of the water"[1]. Once these objects are detected, other devices can interpret and trigger appropriate responses. For instance, many watercrafts use algorithms such as "computer-aided classification (CAC) and automated target recognition (ATR)" to classify detected objects as "mine-like objects"[2]. These detections and classifications have significant impacts in many industries; they aid in international shipments by detecting obstacles in the water[3], they aid in defense by detecting potential ennemy watercrafts[4], and they aid scientists develop nautical charts[5].

The problem to be addressed, in the context of this project, is the detection of unexpected objects.

Proposed Solution

Sound navigation and ranging (SONAR) is a technique that detects objects using sound and can be used to detect unexpected objects.

In view of sonar's ability to address the main problem, the proposed solution involves creating a sonar with Arduino that interacts with an API by sending the position information of any object detected, and receives whether these objects are expected to be there. If the object is unexpected, a buzzer will emit the sound of an alarm to indicate that there is an unexpected object. This alarm will remain until there is a scan with no unexpected objects.

There will be a corresponding user interface that displays a typical sonar display with information such as the current angle, the distance to the detected object, and a visual indication of whether the object was expected or not.

1 "Sonar". *Wikipedia*. Retrieved 2 October 2023.
2 "A Review of Underwater Mine Detection and Classification in Sonar Imagery". *MDPI*. Retrieved 4 October 2023.
3 "NAVIGATION SONAR: MORE THAN UNDERWATER RADAR". *International Hydrographic Organization*. Retrieved 4 October 2023.
4 "IMPORTANCE OF TRAINING AND TESTING WITH ACTIVE SONAR AND EXPLOSIVES". *AFTTEIS*. Retrieved 4 October 2023.
5 "What is sonar?". *National Ocean Service*. Retrieved 4 October 2023.

Listener devices, such as Arduinos and Raspberry Pi's, could then be added to the system. These Arduinos would use a wireless local technology to communicate with the sonar Arduino and be notified whenever a detected object is classified as expected or unexpected along with its location. These Arduinos could then decide their individual responses to these objects.

Initial Design

Serial communication

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Bluetooth communication

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HTTP communication

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Physical Relation

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Sonar MB1040	

Sonar MB1040 — – Distance to nearest object – → TTGO LoRa32

Mounted ↓

Servo ← – Servo Position – TTGO LoRa32

TTGO LoRa32

TTGO LoRa32 · · · Expected/Unexpected Object · · · → **API**

API ← · · · Expected/Unexpected Object · · ·

TTGO LoRa32 – – Distance to nearest object and Servo angle – → **Sonar Visualization (User Interface)**

TTGO LoRa32 – – Tone Frequency – – → **Buzzer**

Expected/Unexpected Object and Object location

Listener   **Listener**   **Listener**