Underwater Passive Acoustic Monitor

Jeremiah Dy, Urban Halpern, Omar Zaidi

Project Sponsor: Dr Timothy C. Tricas - University of Hawai'i at Mānoa

UNIVERSITY of HAWAI'I at MĀNOA
SCHOOL of LIFE SCIENCES

Project Background

Introduction

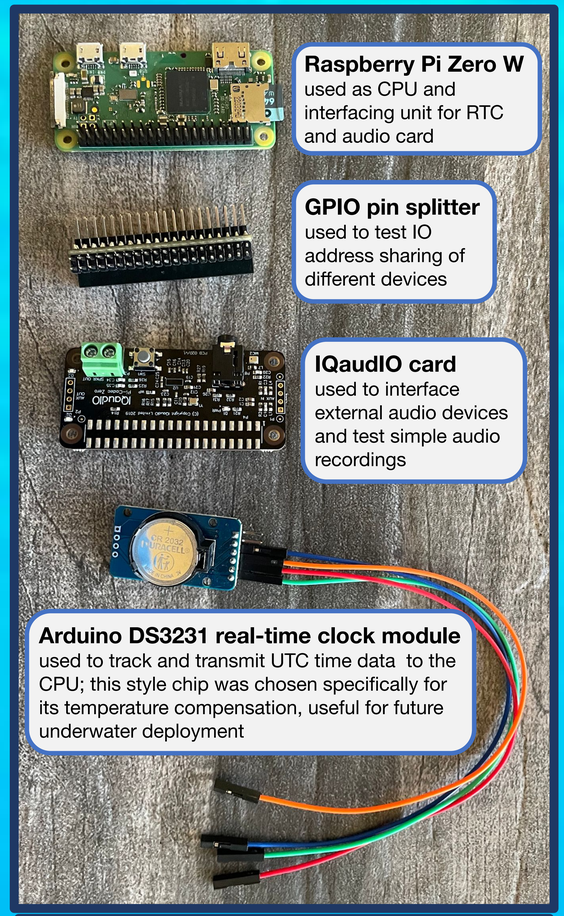
In order to study underwater sounds without disturbing the native sealife, we were tasked with developing a compact device that can record audio files autonomously at predefined intervals. The user should be able to reconfigure specific parameters, such as interval and recording length. The device will eventually be modified to be deployable underwater for long periods of time using external batteries.

Process

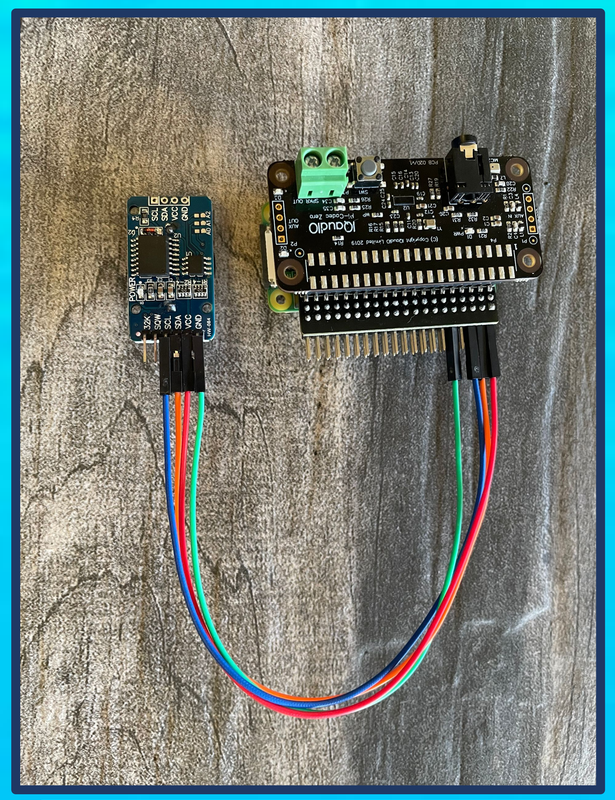
We made use of agile project management to make efficient progress throughout the semester. Once a week, we met with our project sponsor who would split us into groups and assign us an expected deliverable to be completed before the next meeting. Our project required extensive collaboration with engineering students in order to bridge the gap between the hardware and software.

Tech Stack

Python · Raspberry Pi · IQaudIO · ARDUINO



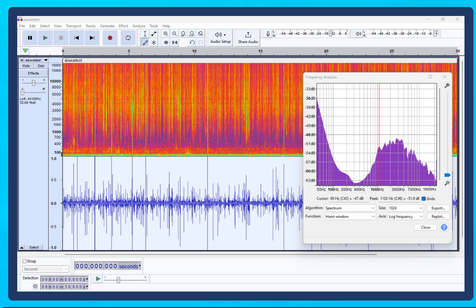
The current prototype device **disassembled** into its components



The **fully assembled** current prototype device

```
Recording for 6 session(s) with a duration of 5 seconds


20:26:50.302091
2024-04-23 20:27:00
Waiting for 9.689456 seconds until the start time (2024-04-23 20:27:00) is reached.
Recording audio with sample rate 44100, duration 5s
Recording complete.
Current date and time: 2024-04-23 20:27:07
Recording saved as: ./output_20240423_202707_1.wav


20:27:07.710755
2024-04-23 20:27:10
Waiting for 2.286784 seconds until the start time (2024-04-23 20:27:10) is reached.
Recording audio with sample rate 44100, duration 5s
Recording complete.
Current date and time: 2024-04-23 20:27:16
Recording saved as: ./output_20240423_202716_2.wav


20:27:17.070958
2024-04-23 20:27:20
Waiting for 2.924524 seconds until the start time (2024-04-23 20:27:20) is reached.
Recording audio with sample rate 44100, duration 5s
Recording complete.
Current date and time: 2024-04-23 20:27:27
Recording saved as: ./output_20240423_202727_3.wav


20:27:27.478298
2024-04-23 20:27:30
Waiting for 2.526057 seconds until the start time (2024-04-23 20:27:30) is reached.
Recording audio with sample rate 44100, duration 5s
Recording complete.
Current date and time: 2024-04-23 20:27:37
Recording saved as: ./output_20240423_202737_4.wav


20:27:37.870257
2024-04-23 20:27:40
Waiting for 2.126029 seconds until the start time (2024-04-23 20:27:40) is reached.
Recording audio with sample rate 44100, duration 5s
Recording complete.
Current date and time: 2024-04-23 20:27:47
Recording saved as: ./output_20240423_202747_5.wav
```

Recording session initiated from laptop connected using ssh



Frequency analysis of snapping shrimp in the Ala Wai Canal

Solution

Tasks Accomplished

- Researched and authored documentation for tasks:
  - Configure and interface Raspberry Pi with audio card
  - Configure and interface Raspberry Pi with real-time clock
  - Configure the Raspberry Pi to execute script on boot up
  - SSH into the Raspberry Pi through LAN connection
- Engineered software to meet needs of biologists
  - Designed a systematic process for setting up a recording session with specified parameters
  - Created a script that could execute scheduled recordings and test the readiness of the hardware

Challenges

- All team members relatively inexperienced with Raspberry Pi, its OS (Raspbian), and its physical interfacing capabilities
- Procurement of specific physical components was often delayed due to geographic location (Hawai'i)
- Scheduling between the sponsor, ICS team, and Marine-Bio team was often difficult due to conflicting availabilities

Future Steps

- Reduction of RPi power draw to maximize recording time
- Develop process for saving the SD card image for reproducibility
- Streamline the hardware and software setup
- Add visual cues to communicate current process (flashing LED while recording)
- Configure audio hat settings for maximum audio clarity and quality

ICS 496 - Spring 2024