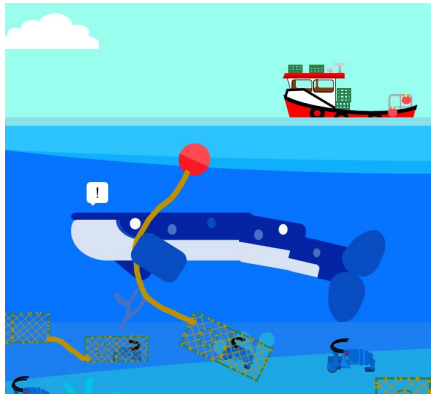
SUPPLYFRAME DESIGNLAB
HACKADAY PRIZE 2021

# EJA

2021 Final Presentation

# Problem

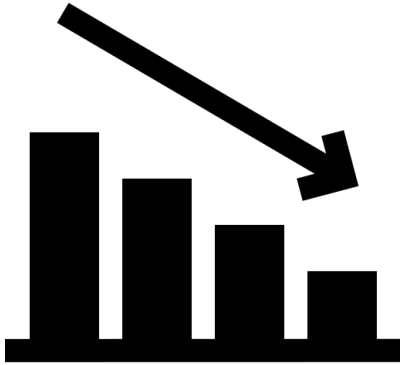


**Reduce whale entanglements**

Marine life can be entangled in the vertical lines that mark traps to surface buoys

**Reliable release mechanism**

Releasing the buoy from the gear or base has to be reliable every single time



**Low cost**

Fishing has many operational costs. Redundancy with multiple units is possible with low cost

open source hardware

**Accessible**

To make this available for all fishers on the planet, the designs are released open source

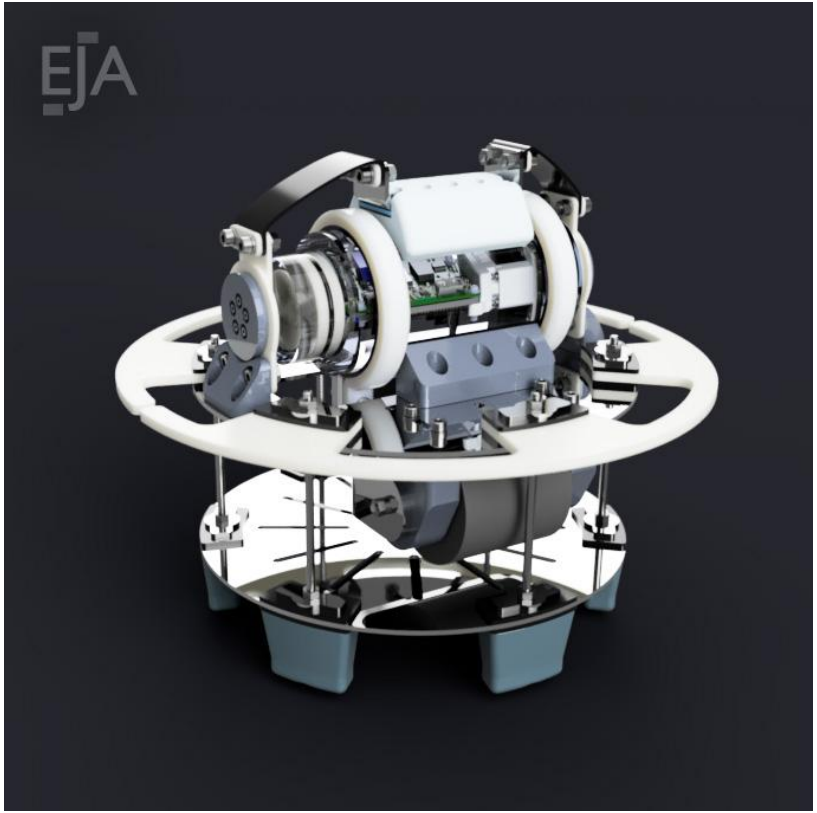
# EJA v2 Demo

# Solution

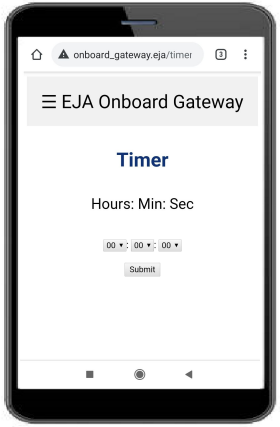
**EJA robot is a ropeless fishing system**

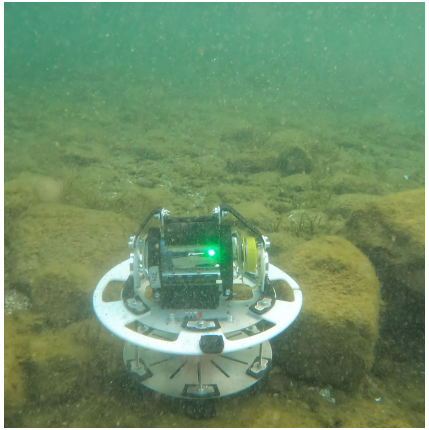
To decrease the amount of time of the line in the water, the buoy is launched to the surface only after certain sensor data or time.

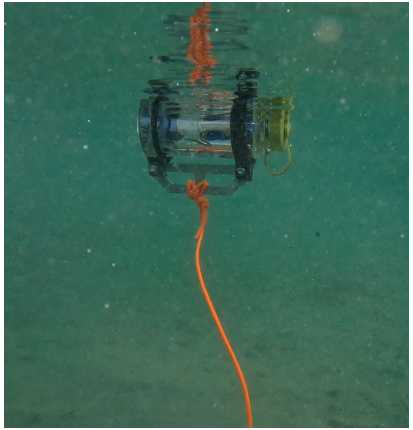
- Intelligent buoy
- 30 m / 100 ft
- ~7 kg
- GPS, LoRa, BLE
- 1x 18650 battery (3000 mAh)
- Estimated battery life: 2 days
- Magnetically coupled wiper (servo motor)
- Capability for additional sensor payloads



# EJA: How does it work?





### 1. Timer activated

Fishers set the time of when they want the buoy to be launched

### 2. Robot deployed

The robot is attached to the traps/pots and travels to the seafloor

### 3. Buoy launched

At the correct time, the buoy is released and ascends to the surface

### 4. Location broadcast

GPS of the buoy is sent to the gateway for the gear to be retrieved

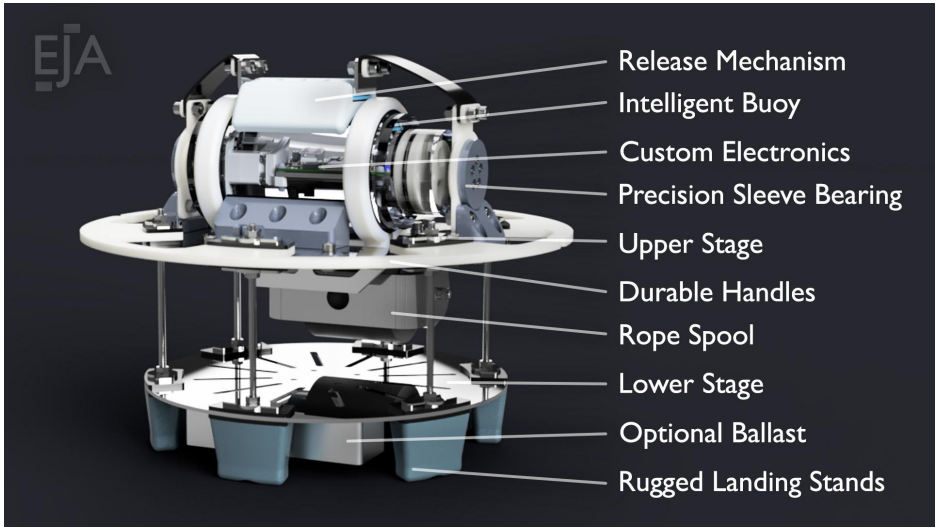
# EJA v2 Release Mechanism

# EJA v2 Buoy Ascent

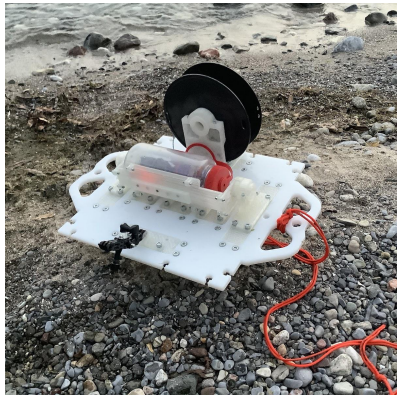
# Design

Comprised of different materials for each purpose:

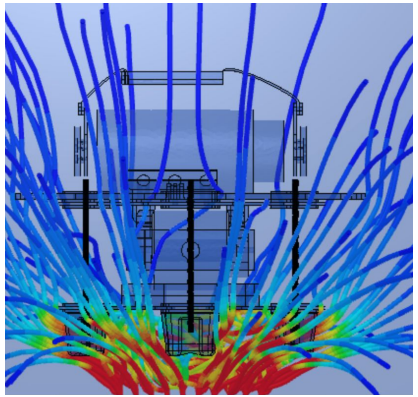
- Sleeve bearing (delrin + milled aluminum)
- HDPE handles
- ⅛” Aluminum stage bases
- Paracord spool 100 ft / 30 m
- 3D printed nylon stands, clamps, holders
- Metal internal wiper and bracket
- Nalgene enclosure for buoy
- PTFE tape on threads
- Rubber bumpers, custom metal washers
- O-ring piece as backup
- Wooden deck for transporting *(incredibly useful)*
- … and electrical tape!



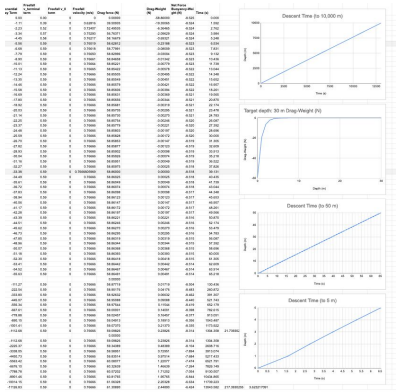
# How it reached this point: backed up with analysis



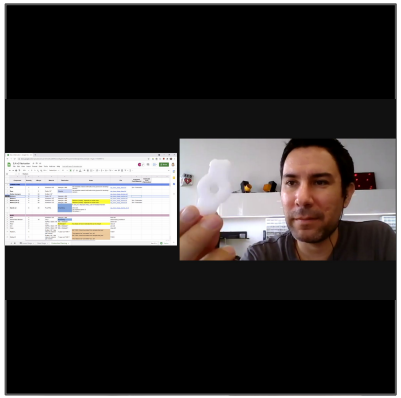
**Prototyping**
Through v1 prototype, figured out how all the pieces link together to form this system. Many concept sketches too



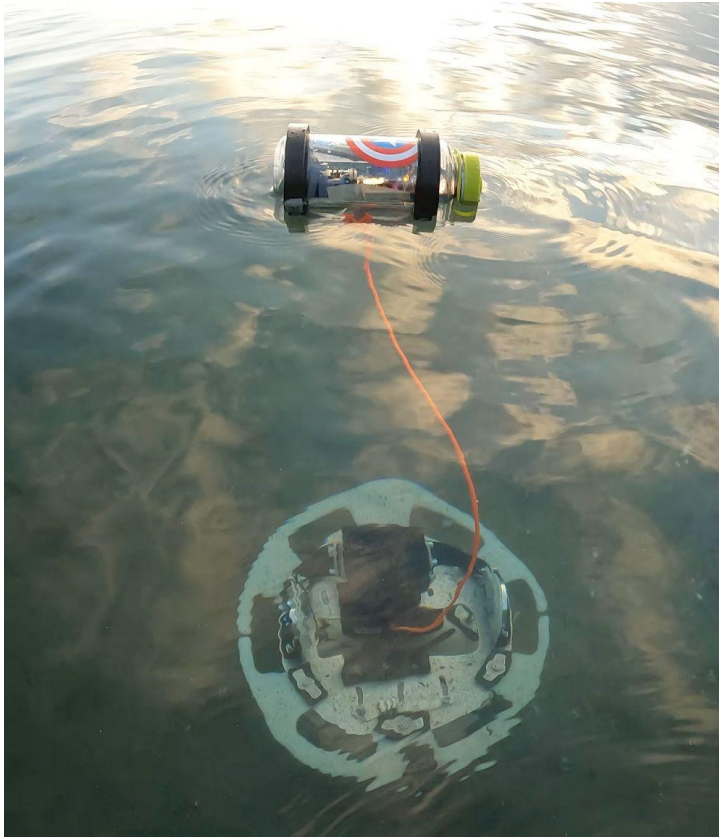
**CFD Simulation**
After CAD model designed, used computational fluid dynamics to analyze system on entry to water



**Physics Model**
Developed a physics model to determine weight:buoyancy ratio, rope tension, descent velocity, drag force



**Experts**
Learning from others, such as the DesignLab Dream Teams meetings with Giovanni, saved us from many pitfalls



# Evaluation

The Canadian Wildlife Federation developed a framework for classifying ropeless fishing systems based on functionality critical to fishers.

Here's the areas where EJA is strongest:

- Durability
- Safe to use
- Easy to reset
- Easy to store

With additional software development, the following could be met:

- Detectability of traps
- Enforcement & monitoring

# Overall Cost

This cost number reflects quantity ONE. Cost will go down with larger production runs.

1 gateway + 1 buoy + 1 base

The largest unknown is the fabrication cost, which depends on quantity and shop.

Amount of time to assemble was ~15 hours. This would decrease with streamlined instructions.

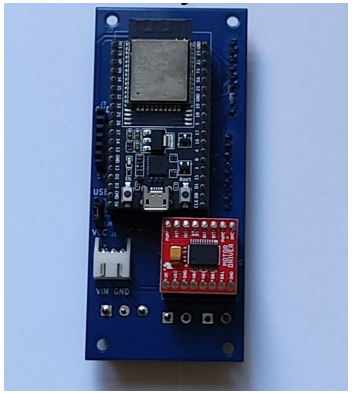
- Electronics: $184.45
- Hardware: $326.01
- Raw Materials + Fabrication: ~$1500

TOTAL: $2010.46

# Cost

## Intelligent Buoy

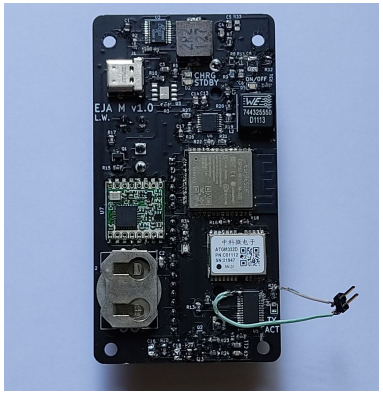
v1



**Buoy B**

$131.02

v2

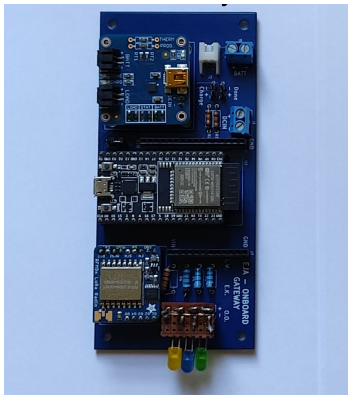


**EJA M (Full)**

$108.39

## Gateway

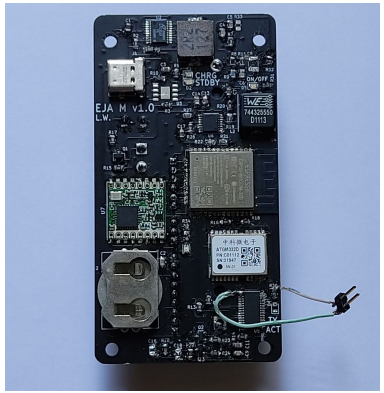
v1



**Onboard Gateway**

$84.34

v2



**EJA M (Reduced)**

$76.07

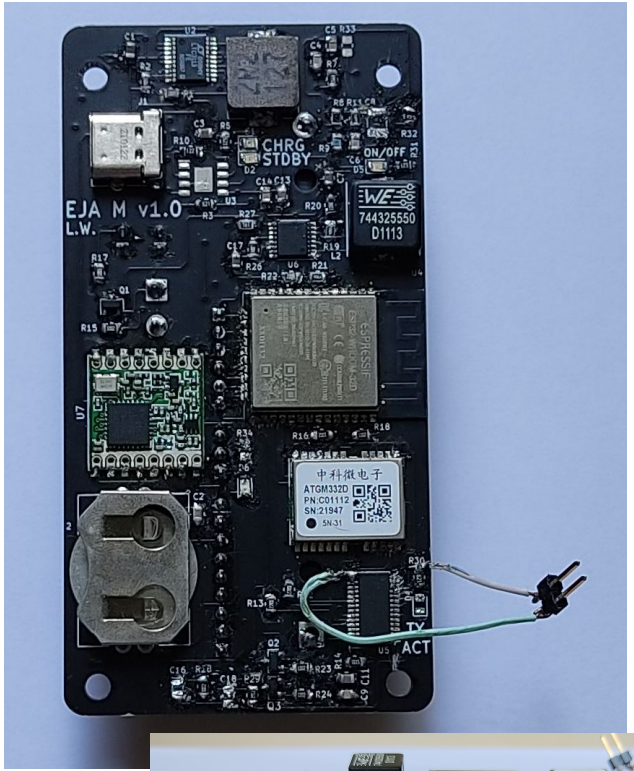
# New Design
# EJA M v1.0

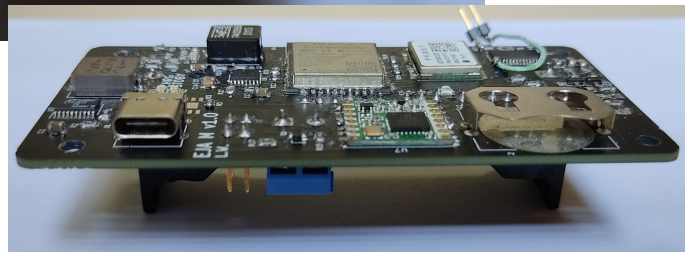
The new design can replace our 3 previous designs Buoy A v1.0, Buoy B v1.0 and Onboard Gateway v1.0.

**Features:**

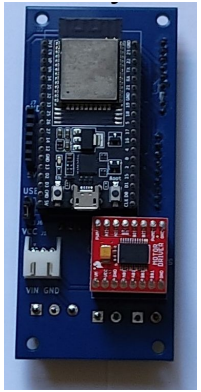
- LoRa
- GPS
- ESP32
- Real Time Clock
- Servo Motor Driver
- Battery Charger
- Accelerometer

A reduced version is proposed to reduce the price when less features are required.

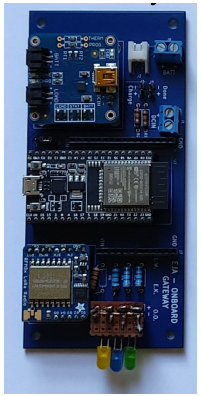


# Design Process

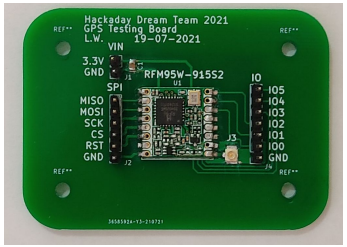


Buoy B

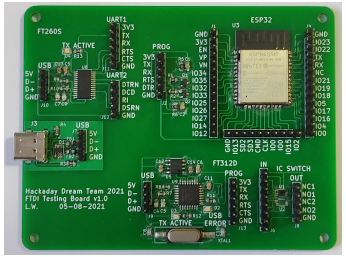


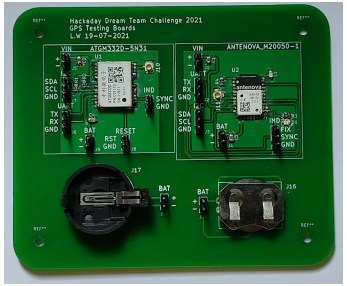
Onboard Gateway

LoRa




USB C and FTDI



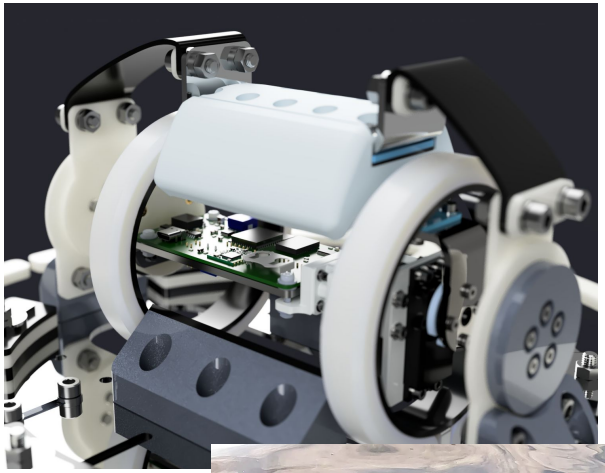




GPS


EJA M

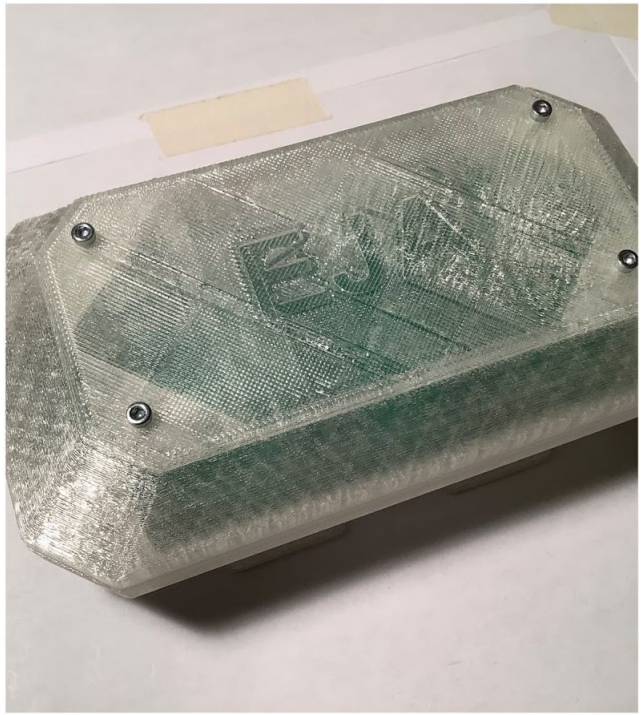
# Features - Buoy

| Features | Buoy A v1.0 (2020) | Buoy B v1.0 (2020) | EJA M v1.0 (2021) |
|---|---|---|---|
| LoRa | ✅ | ✅ | ✅ |
| GPS | ✅ | ✅ | ✅ |
| ESP32 | ✅ | ✅ | ✅ |
| Real Time Clock | ✅ | ✅ | ✅ |
| Servo Motor Driver | ✅ | ✅ | ✅ |
| DC Motor Driver | ✅ | ✅ | |
| 4G(LTE) | ✅ | | |
| Battery Charger | | | ✅ |
| Accelerometer | | | ✅ |



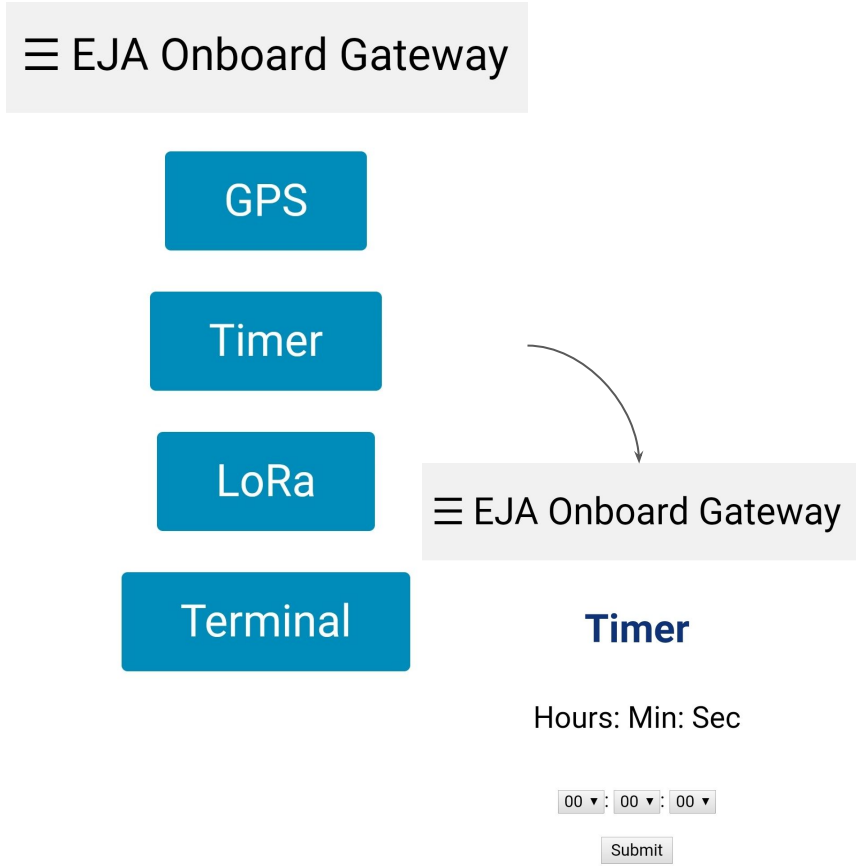
# Features - Gateway

| Features | Onboard Gateway v1.0 (2020) | EJA M v1.0 (2021) |
|---|---|---|
| LoRa | ✅ | ✅ |
| ESP32 | ✅ | ✅ |
| Real Time Clock | | ✅ |
| Battery Charger | ✅ | ✅ |



# User Interface

- Set the timer for each buoy
- Track the position of the buoys directly from the app
- Receive notifications from the buoys when they reach the surface
- Update and troubleshoot the buoys



# Next Steps

## Prototyping

- Replace FTDI IC
- Fix ON/OFF circuit
- Manage power consumption
- Fix servo module design
- Field testing

## EVT

**Engineering Validation Tests**

- Hardware & software integration
- Implement notifications
- Include datalogging
- Facilitate troubleshooting
- Develop phone application

## DVT

**Design Validation Tests**

- Extensive beta tests
- Adjust to required depth (rope, ballast and buoyancy)
- Receive feedback from real fishers
- Improve assembly instructions

# Links

Check out our project page and source repositories to learn more

- Project page
- Call for beta testers
- Electronics Github repository
- Design Github repository

**Find everything on Hackaday.io page:**

https://hackaday.io/project/173457-2021-hdp-dream-team-eja



# Thank You!

Thank you to everyone who has helped and been a part of this project

- Supplyframe and Hackaday
- Giovanni Salinas
- Majenta Strongheart
- Bruce Dominguez
- Jason Alford
- Bob Eder - Dungeness Crab Fisher in Newport, OR
- Clarissa Redwine
- Dr. Ed Trippel
- Oluwatobi Oyinlola (Tobi)
- Conservation X Labs
- *Plus more who have been kind enough to lend their experience in telling us more about fishing!*

SUPPLYFRAME DESIGNLAB
HACKADAY PRIZE 2021

Supplyframe

Digi-Key ELECTRONICS