NASA Space Apps Challenge

Asunción Chapter

E-WAV

By *Ocean Rangers*

Fabio Bondiman – Commercial Engineering

Félix Zárate – Electronic Engineering

Manuel Aquino – Mechatronic Engineering

Leandro Barros – Visual Designer

Luis Mencia – Informatic Engineering

Lucía Gil – Industrial Designer

Documentation

Introduction:

The E-WAV system is made up of a fleet of autonomous, automated, artificial-intelligence water drones, working in tune, 24 hours a day, collecting all the plastic particles that can be deposited in several collection centers that will retain the trash .

Once the collection center is filled, it will send a signal that will allow a mission to recover the collected waste, having the option of commercial shipping companies to recover the waste through government tax incentives, or direct sale of the waste to be used as raw material, thereby reducing the carbon footprint.

USV (Unmanned surface vehicles)

E-WAV is an unmanned surface vessel, the design of the USV was based on catamarans, which are two vessels of two identical hulls joined together by a rigid deck, it was decided this would be the design because it has more stability than the of a single helmet.

Between the two helmets and the rigid cover the will be a mesh, thus forming a volume of approximately 400 liters which will filter the water and trap the plastic waste until all the available volume is stored, in the front part it will have two folding doors which will open to let the waste in and will close once they are full not to leave the collected waste escape. Once it arrives at the base station, it will open a shovel inside that will empty all debris out of the compartment.

It is powered by two Brushless motors, located in each of its pontoons, which are powered by two lithium-ion batteries, will be charged by solar energy and because they are bidirectional, it will allow the devise to rotate in the place or go in reverse. They will also have fins on their sides, which will rotate individually to help maneuver.

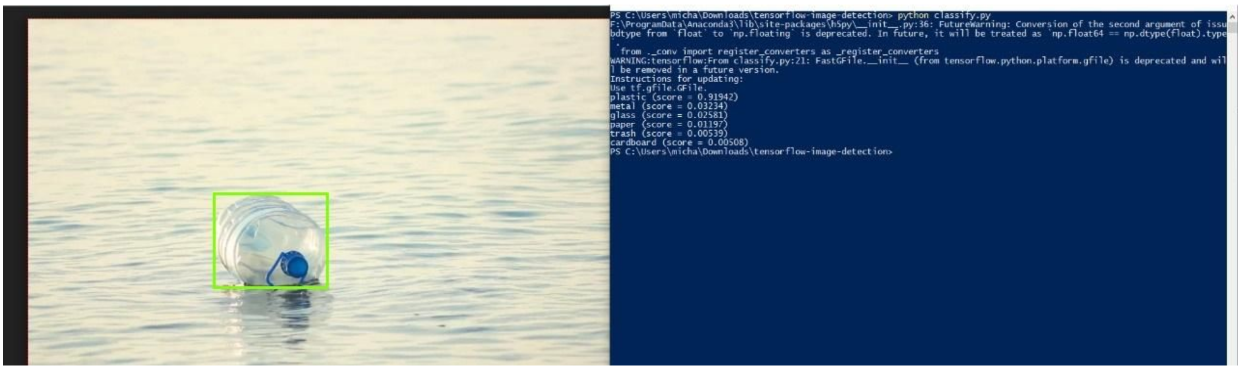
Thanks to the fact that it is equipped with GPS and an Artificial Intelligence system, the USV can move autonomously through the trajectory previously drawn and through the camera that has Artificial Vision and with the help of sensors, it makes decisions to be able to reach complete the task assigned, in addition to collecting different data along the path that the USV follows.

<u>Sensor GPS</u>

The Global Positioning System and originally Navstar GPS, is a system that allows you to determine the position of any object (a person, a vehicle) in the whole Earth with an accuracy of up to 50 centimeters (if differential GPS is used), although the usual are A few meters of precision.

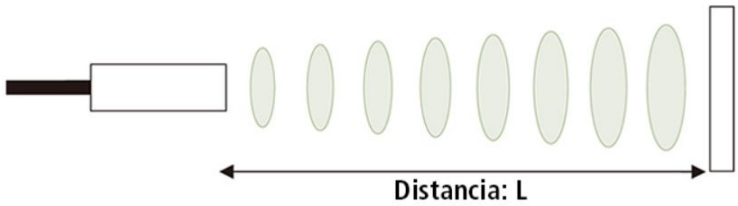
<u>Camera</u>

The devise will detect images of plastics, garbage, metal, paper, glass and cardboard in the ocean to allow the collection and reduction of these materials, particularly plastic, in the ocean waters thanks to image recognition.



Ultrasonic Sensors

Ultrasonic sensors measure distance by using ultrasonic waves. The head emits an ultrasonic wave and receives the reflected wave that returns from the object. Ultrasonic sensors measure the distance to the object by counting the time between



emission and reception.

In a reflective model ultrasonic sensor, a single oscillator emits and receives the ultrasonic waves, alternatively. This allows miniaturization of the sensor head.

The distance can be calculated with the following formula:

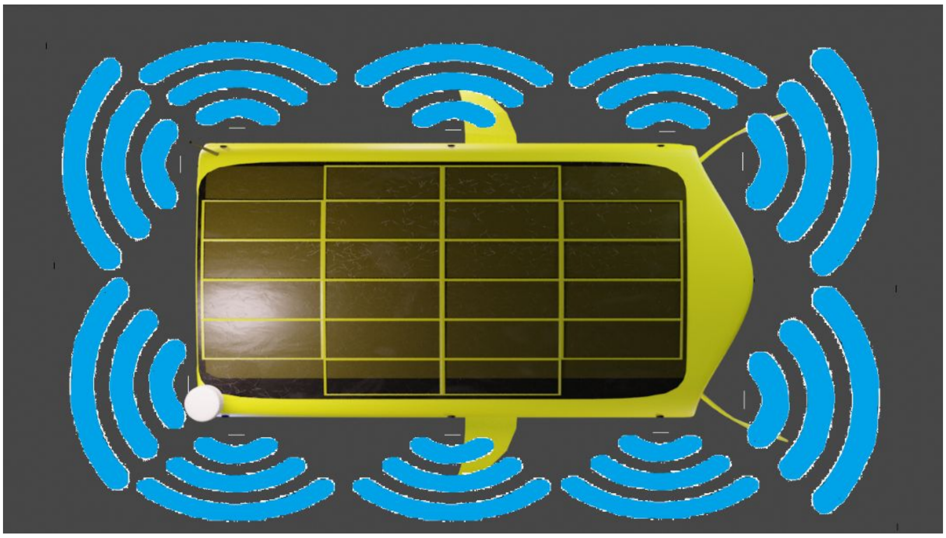
Distance $L = 1/2 \times T \times C$

where L is the distance, T is the time between transmission and reception, and C is the speed of sound. (The value is multiplied by 1/2 since T is the round trip time).

Features

The following list shows the typical features enabled by the detection system.

- Transparent object detectable: Since ultrasonic waves can be reflected on a glass or liquid surface, and return to the head, even transparent objects can be detected.
- Resistant to fog and dirt: Detection is not affected by the accumulation of dust or dirt.
- Complexly detectable objects: Presence detection is stable, even for objects such as mesh trays or springs.



Then synchronizing these sensors you can obtain a 360 ° survey around the USV, thus being able to detect any object that is around it.

Anemometer Sensor

The anemometer or anemograph is a meteorological device used to measure wind speed and thus help in predicting the weather.

Through this sensor the USV will be able to identify the wind speed and direction and use it in its favor, either by decreasing its power to save battery power or increase the power to counteract wind thrust.

Turbidity Sensor

Turbidity or turbidity is understood as the degree of transparency lost by water or some other colorless liquid due to the presence of suspended particles. The greater the amount of solids suspended in the liquid, the greater the degree of turbidity. In water purification and wastewater treatment, turbidity is considered a good parameter to determine water quality, the higher the turbidity, the lower the quality.

PH sensor

The pH meter is an instrument used to measure the acidity or alkalinity of a solution, also called pH. The pH is the unit of measurement that describes the degree of acidity or alkalinity and is measured on a scale ranging from 0 to 14.

Temperature sensor

Temperature sensors are devices that transform temperature changes into changes in electrical signals that are processed by electrical or electronic equipment.

Gyroscope Sensor

The gyroscope, or gyro, is a device that measures or maintains rotational movement. MEMS (microelectromechanical systems) gyroscopes are small, inexpensive sensors to measure angular velocity. Angular velocity units are measured in degrees per second (° / s) or revolutions per second (RPS). The angular velocity is simply a measure of the rotation speed.

Gyros, similar to the previous one, can be used to determine orientation and are found in most autonomous navigation systems. For example, if you want to balance a robot, the gyroscope can be used to measure the rotation of the balanced position and send the corrections to an engine.

"All the readings of this sensor will be stored to leave a record of the measurements at the different points of its trajectory, so that it can then be used in future investigations."

Collection point

The base station will consist of a satellite internet system also with the Lorawan system for intercommunication with water drones, as well as other sensors to extract environmental data.

The base will be attached to a buoy near the garbage island where the water drones will be collecting the garbage for later storage in these. The garbage storage system will have a reusable fine mesh bag that is easy to remove.

To deposit garbage waste from the water drone, it will be hooked to the base station through a system of swing doors so as not to let the previously stored garbage escape. This plant will have a capacity of 100 downloads, for later collection.

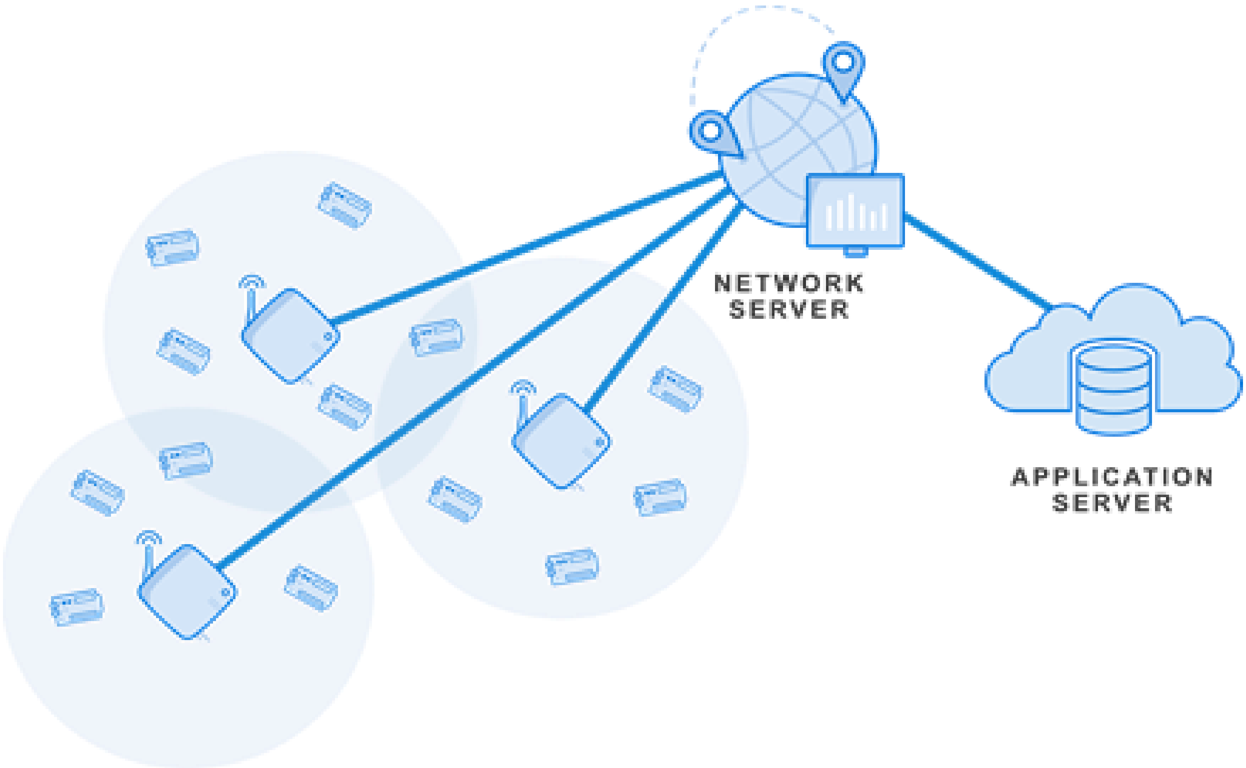
Network System Communication

The system will be based on a mesh network built following the LoRaWAN protocol.

This protocol allows the transmission of data at low speed with a long range and low power consumption. The mesh network is designed to function as the backbone network that will support the other parts of the sensor network.

A mesh network was chosen for fundamental reasons. First, a mesh network can be dynamically reconfigured. Second, a mesh network is scalable. It requires low installation costs and allows easy expansion.

The operation will be built at the base station where the garbage will be unloaded. It is intended that the base has the necessary infrastructure to support the entire network and store the data collected for later sending to the cloud. This includes a base station as LoRaWAN access points. The power of the transceivers should be around 168 dBm to ensure sufficient coverage and will operate in the frequency band of 902-928 MHz. The antenna will be connected to a transceiver unit that will encode the data in the TCP / IP protocol. This unit will send the data to a cloud storage system that will ensure that the information is stored and backed up securely, for later analysis. This information can be used for research on ocean quality for marine life.



Estimated costs

Based on previous experiences in robotics from the team members, we estimated a cost of electronic and mechanic parts, using the information provided by NASA datasets of environmental conditions in place.

Aquatic Drone Components	Unit Cost (USD)	Quantity	Subtotal
Motor brushless	$500	2	$1,000
Regenerative Motor dual drive	$500	1	$500
Solar panels	$500	1	$500
Charge controler	$200	1	$200
Litium ion battery	$1,000	2	$2,000
DC-DC converter	$50	1	$50
steppers motor	$30	4	$120
Motor driver	$30	2	$60
fiberglass frame	$1,200	1	$1,200
Wihtp anthenna	$60	1	$60
LoRaWAN transceiver	$20	1	$20
bluetooth transceiver	$30	1	$30
Micro-controler	$50	1	$50
Camera	$50	1	$50
Mesh	$50	1	$50
Sensors			
anemometer sensor	$400	1	$400
GPS	$250	1	$250
Ultrasonic sensor x12	$110	12	$1,320
PH sensor	$20	1	$20
Gyroscopic sensor	$20	1	$20
turbidity sensor	$20	1	$20
		total	$7,920

Buoy	Unit Cost (USD)	Quantity	Subtotal
gateway	$1,800	1	$1,800
backhaul	$2,000	1	$2,000
			$3,800

Conclusion

We are in charge of looking after the planet and its oceans, we’re all connected and affect each other across the world.

We hope for a better world, a clean world, and it depends on escalable and innovative solutions to change big problems like plastic pollution in the oceans.