Polytechnic Senior Capstone – Team 19

Endress + Hauser Imagination Station Wave Generator Musuem Unit

Jess Laverdure, Lexi Frederick, Calvin Spencer, Dominic Picciolo
Mentor: Ralph Munguia

PURDUE UNIVERSITY
Polytechnic Institute

Problem Statement

Traditional lecture-based methods and static visuals often make it difficult for children to grasp physical concepts. To address this, our project is developing an interactive wave generator equipped with E+H sensors, allowing children to visualize and explore wave behavior in real time. The sensors will measure wave height and speed, enhancing the educational experience for museum visitors.

Customer Background

Endress and Hauser:
E+H is a global leader in products, solutions, and services for industrial process measurement. For this project we are using ultrasonic sensors.

Imagination Station:
Imagination Stations is a non-profit, museum for children K-12 that focuses on STEM activities and exhibits.

Requirements

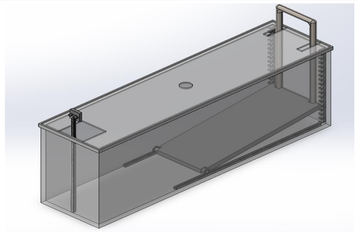
Key requirements from both Imagination Station and Endress + Hauser:

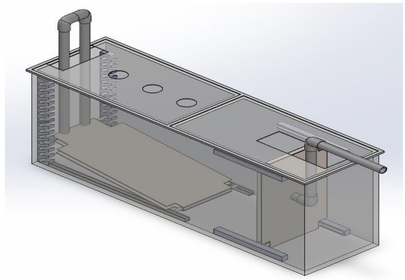
Endress + Hauser:
- Utilize Sensor's
- Have sensor data displayed

Imagination Station:
- Watertight
- Interactive and Engaging
- Child proof
- Informative of scientific principles

Experiments and Concepts

First Design: A very early design utilized a wave pushing mechanism derived from the last team's progress with the project. A weight was to be dropped into the water to displace water and create the wave effect. Much like how a water droplet creates ripples when it hits a larger body of water.



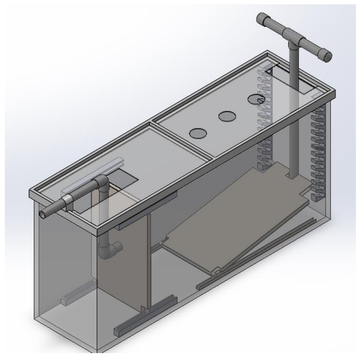


Second Design:
A new method of wave generation was ideated. This concept pushes water columns uniformly instead of creating ripples. This would create more uniform waves.

Sensors:
Measures peaks of waves. There are three stationary sensors attached in the lid.

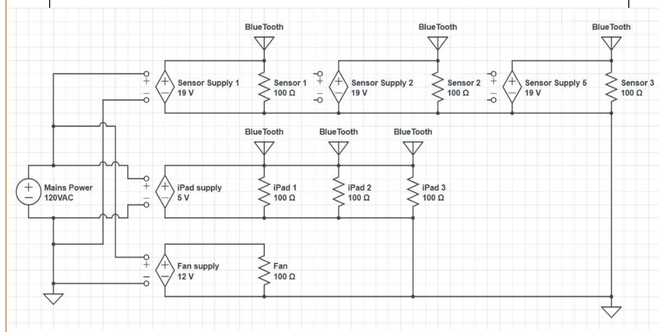
Final Design

The final design is a 50-gallon fish tank that has a movable sea floor to simulate how water hits shores at different angles. There is also a water pusher that allows the user to push the water and simulate the creation of a wave by pushing an entire water column at once. The angle adjustable floor will be used to demonstrate how the steepness of the shore affects wave shoaling. There are sensors that measure the height of the water versus time and plots the data onto a graph.



Electrical

The electrical system is composed of 3 main systems. The first is a 19 V system that runs the sensors. The second is a 5 V system that charges the iPads. The third is a 12 V system that powers the ventilation fan. Lastly the iPads and sensors are connected via Bluetooth.



Testing

During testing we mainly focused on 3 issues:
- How well waves crash when the floor moves
  - The goal was to generate clean waves that are able to be replicated with ease
- If water goes underneath the pusher
  - Water did go underneath the pusher; however, it was not significant when examining wave creation
- Sensors connecting and making graphs
  - We ran into problems in the beginning with getting the sensors connected to the iPads and finding