Team 8

Empowering Young Engineers: Exploring Hydraulic System

Team 8

Endress+Hauser
People for Process Automation

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Customer Background

Imagination Station is a creative space for children and families. It offers interactive exhibits, workshops, and activities designed to stimulate children's imaginations and foster creativity through hands-on learning experiences.

Endress+Hauser is a global leader in measurement instrumentation, services and solutions for industrial process engineering.

Problem Statement

The goal of this project is to design and construct a portable demonstration unit that incorporates Endress + Hauser's measurement sensors.

The unit will be easily interactive and aesthetically comprehensible for K-12 and college students in demonstrating the functionality of different sensors and the principles of fluid mechanics.

Requirements

The requirements contain key components addressed by Imagination Station & Endress + Hauser

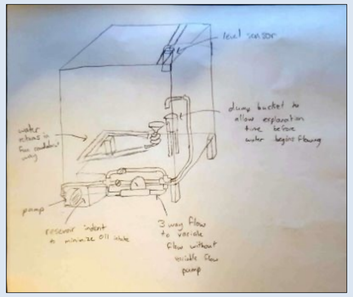
From Imagination Station:
These factors come from the need to encourage engagement amongst students, while also taking their safety into consideration.

- Easily maintained
- Safe for children K-12
- Interactive
- Does not leak
- Manuals for construction, repair, etc. included
- Lesson plan included
- Easily transported by vehicle
- Carrying case included

From Endress + Hauser:
These factors are required to properly the sensors provided by Endress+Hauser

- Utilize Endress + Hauser sensors
- Display sensor readings

Experimentation and Concepts



Initial Concept

In the initial bucket pump design, water and oil were to be used to create a density aspect. To prevent oil intake, a dip in the reservoir section of the system was to be included.

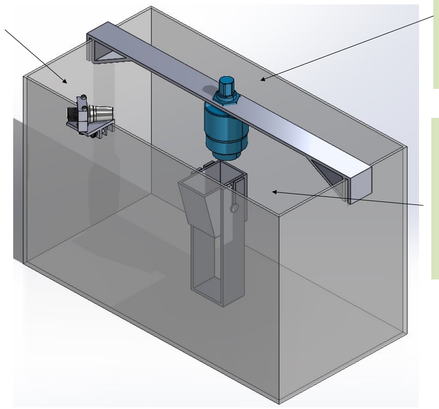
The audience could turn several knobs to control the flow of the water and move the level sensor on the top of the tank. Endress + Hauser's flow sensor would be used on the outside of the tank to display the flow of the system.

Final Concept

Water is pumped through nozzle to create a water shooter. Nozzle is used to fill components of the unit

Water wheel spins when water from nozzle is used to trigger motion (not pictured)

Water moves through connected tubes for flow display (not pictured)

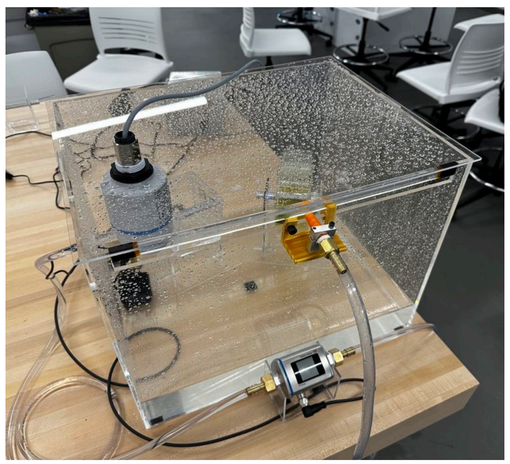


Level sensor positioned above dump-bucket to monitor water level and predict dump

Tip bucket can be filled with water to trigger a tipping motion. 2 tip buckets included, at differing heights

Final Design

The bucket-dump design elevates water play by incorporating a dynamic gaming element. Children can actively participate by directing streams of water into the dumping buckets or at the water wheel. This feature facilitates learning opportunities as explanations and discussions can naturally occur between turns.



Testing

Picomag

Measures and displays the flow of the water that is pumped from the tank through the tubes. Sensor was added for design integration and was tested prior to addition to ensure readings were as expected.

Micropilot

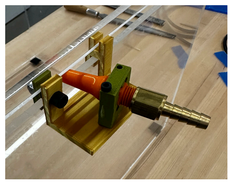
Measures and displays the level of the water as the tank fills. Similar to the Picomag, this sensor was added for design integration and was tested prior to addition to ensure readings were as expected.

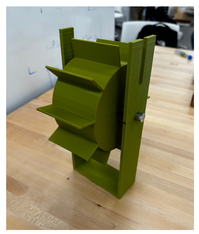
Adjustable Pump

To allow a controllable flow, it was important to incorporate an adjustable pump. This pump was tested to find the ideal setting that would reach each element inside the tank without difficulty and would trigger the expected outcome of said element.

Sliding Mechanism for Nozzle

To control the direction of the water flow from the pump, the team iterated on multiple design for the mechanism with varying design, size, and maneuverability.





Density Feature

The design was altered throughout the development of the unit to find an optimal height so the flow can spin the wheel without it touching the water.

Center of Mass Feature

When the design was initially tested, it was tipping prior to being filled. In the final version, counterweight was added on the opposite side to balance the bucket.