Team 12

Portable Demonstration Unit

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Customer: Endress + Hauser

Customer Background

Endress+Hauser was founded in 1953 in Lörrach, Germany by Georg H. Endress and Ludwig Hauser. Initially the company acted as a distributor for Fieldland Electronics; however, in 1955 the company released its first patent and changed its course forever. Soon after the company rapidly began growing its selections by expanding its sales to additional measurement devices such as liquid flow, pressure, and temperature. Currently, Endress+Hauser is a global leader in measurement instrumentation, services, and solutions for industrial process engineering and offers state of the art instruments for fluid analysis purposes.

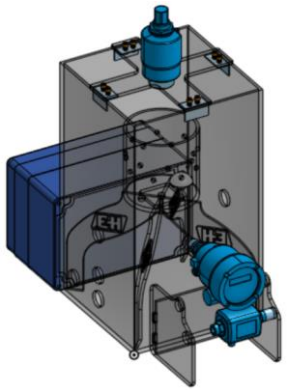
Problem Statement / Scope of Work

Our customer, Endress+Hauser, needs a portable demonstration unit that is easy to use with an easily accessible fluid. The unit must demonstrate the flow, level, and pressure of a fluid in an easy-to understand manner for students ranging from kindergarten to college. Endress+Hauser is a leader in the measurement instrumentation industry. We are employed to design, build, and test a portable demonstration unit to promote automation and manufacturing education to K-12 and college-age students.

Requirements

Requirments			
Req. #	Requirement	Description	Test
1	Feasibility	The unit must be able to be taken in the backseat of a standard car	Examination
2	Audience Appeal	The unit must incorporate a level of interactivity to apeal to audiences	Demonstration
3	Lightweight	The unit should be 40lbs or lighter so that it is possible for most people to transport	Analysis
4	Standard Electric	The unit must be supplied by a standard 110V outlet	Analysis

Final Design



This design includes a pump on the inside at the bottom of the larger tank. This pump feeds the fluid through a ball valve. The ball valve can manually change the flow output through the Picomag where the flow rate is measured. The fluid then flows back through the larger tank and into the smaller tank. The smaller tank has three holes in the bottom. One hole is attached to the pump system to fill the inner tank. Another hole is connected to the Cerabar (located on the outside of the larger tank), which reads the pressure at the bottom of the inner tank. The final hole is used as a mechanical drain for the inner tank. The Micropilot at the top of the system reads the water level of the Inner Tank.

Experimentation and Concepts

Armfield Flow Meter

Strengths:
- Adjustable flow rates
- Interactive
- Portable capability

Weaknesses
- Complicated set-up
- Manually turned on

Water Clock

Strengths:
- Shows inner mechanisms
- Colorful

Weaknesses
- Stationary
- Not interactive

Freestyle Coca-Cola Machine

Strengths:
- Customizable
- Relatively Portable
- Exciting Deliverable

Weaknesses
- Hard to Clean
- Heavy

Failure Modes and Effects Analysis

FMEA - Failure Modes and Effective Analysis									
Key Process Step	Potential Failure Mode	Potential Failure Effects	SEV	Potential Causes	OCC	Current Controls	DET	RPN	Actions Taken
Mechanical									
Data Display	Instument leakages	Unreliable readings	7	Instruments incorectly instaled	5	Visual inspection	2	70	Read user manual/contact customer service
Water Storage	Tank leakages	Water spills onto the display table	10	Cracks along seams and stress points	6	Visual inspection	1	60	Seal with appropriate sealent/aquire new tank
Water Transfer	Connecters/hose leakages	Unable to receive readings	7	Conection points not fully secured	6	Visual inspection	2	84	Wrap Teflon tape around each of the thread and tube connection points
Water Transfer	Pump too weak	Water never reaches the instruments	7	Length of hose is too long	4	Visual inspection	3	84	Shorten length of hose
Water Transfer	Pump too strong	The laminar effect visual component is effected	5	Inlet port is opened more than necessary value	8	Ball valve to control the flow from the pump to the inner tank	1	40	Close inlet port. Create a blockade to force water to go down and out from the hose into the inner tank
Maintance	Unbale to completely drain system	System experiences bacteria buildup	2	Water left in the system	6	Physically dump out remainder of water	5	60	Use a transfer pump for remainder of water
Instrument Support	Stands break/become loose	Unreliable readings of the level sensor	4	Glue used isn't strong enough	5	Let the glue set for a period of 24hrs	6	120	Reglue or recreate the stand

Testing

Testing		
Test	Description	Outcome
Filling Inner Tank	Testing whether filling from the top or the bottom of inner tank would be best	Filling from the bottom of the tank produces a better laminar flow
Small Pump	Test low power pump using varying lengths of tubing	Small pump only works with lengths of tubing shorter than required for the assembly
Large Pump	Test high power pump using varying lengths of tubing	Large pump needs a cap to prevent flow from interfering with the fountain effect coming from the inner tank
Tubing Cap	Test effectivness of tubing cap	Tubing cap works, but will be modified to change the appearance of the flow