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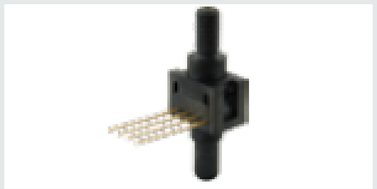
Liquid Level Sensor

Problem Background

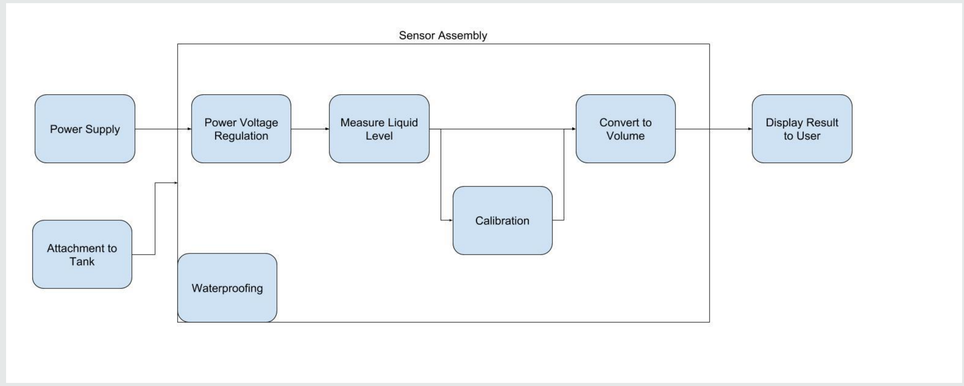
- Visimetrics Inc. desires a means by which the volume of liquid in recreational boat tanks can be measured within 10% of the tank's capacity. This information is important when deciding whether a given tank should be filled/emptied in between outings. Storing locations of these tanks often do not allow for easy manual observation of liquid levels. The specific case presented by Visimetrics Inc. has one tank each for water, blackwater and diesel.

System Concepts

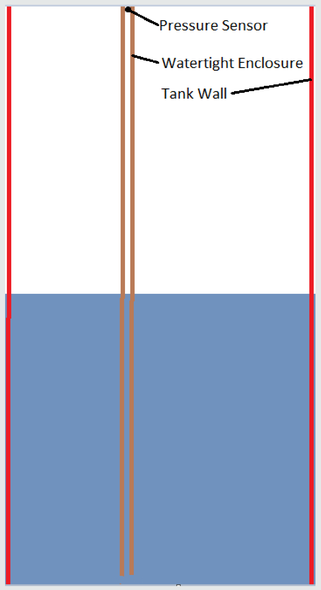
- Using a morphological chart, it was determined that an air pressure sensor would be the best fit for the project deliverables.
- The air will be contained within a long tube centered above the deepest part of the tank.
- A hole will be put in the bottom of the tube to act as a the interface between water and air, keeping the liquid level relatively constant despite waves that are created when the boat is in motion.



- A calibration curve will be used to allow for one-time calibration regardless of tank geometry.
- Because it is air pressure being measured, the design will be independent of tank contents (fluid type) and fouling is avoided



High Level Block Diagram




```
%Assume air is ideal gas.
%Ideal gas Law:PV=nRT
T=298.15;%25 deg C=298.15K
R=8314;%Constant
P=101.325;%101kPa=1 atm
D=0.03;%Tube Diameter
H=0.8;%Tube height
V=pi*D^2/4*H;%m^3 Air Volume in tube
n=P*V/(R*T)%moles of air in tube
%Air pressure difference
deltah=0.010;%Given liquid level difference
deltaV=pi*D^2/4*deltah;%Air volume diffrence
Pnew=n*R*T/(V-deltaV);%Air pressure with new liquid level
deltaP=Pnew-P;%in Kpa
```

Concept Design and Calculation

As the water level rises, the air will inside the tube will push on the pressure sensor located at the top of the long tube. The force exerted on the pressure sensor will increase as the water level around the submerged tube rises. In theory, we should be able to sense the pressure air pressure in the tube at different liquid level.

Once the pressure is read, the information will be processed by a microprocessor and compared with a calibration curve. Then, using the calibration curve, the volume of the tank can be interpolated and the information sent to a screen using UART.

Conclusions

- The measurement and calibration functions are the most critical parts of the design and will thus be the focal point of our prototyping moving forward.
- Air pressure-based level sensors exist in industrial-sized tanks; it is possible to measure liquid level with our desired means.

Next Steps

- A physical proof of concept of the proposed sensor mechanism must be tested to ensure that this approach is feasible on non-industrial sized tanks.
- Wire sensor to microprocessor to display sensor readings to a screen.
- Create microprocessor software to calibrate sensor to a given tank geometry/liquid type combination.
- Once liquid level can be successfully measured, iteratively refine prototype to match client needs.

Acknowledgements

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- Sensor picture taken from Honeywell Miniature Low Pressure Sensors 26PC Series Datasheet