Industrial Ultrasonic Tank Liquid Capacity Indicator

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Introduction

Industrial automation is a vast area of research & implemented in different scales. A large number of researchesare conducting throughout the world to find optimum and most cost effective systems. In these researches, instruments measuring liquids and control systems are taken very important place (Mohammad, 2009.). Using this technology it indicates liquid capacity and control liquid automatically.

Results two weeks industrial visit and I have seen this issue at Palwatta sugar factory & distillery plant use manual capacity level measuring techniques (Figure 2) or mechanical systems (Figure 1) to measure tanks liquid stock. These manual systems need additional human resources and mechanical systems to overcome the errors due to the friction of pulleys and ropes. Because of these issues inaccurate readings are obtained.

Figure 1. Mechanical tank liquid level indicate systems

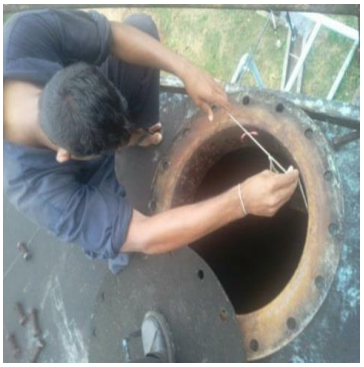

Figure 2. Manual Liquid level measuring techniques

Materials and Methodology

The current studies use an ultrasonic waves to measure distance between reference point and the liquid surface (Figure 3).

Figure 3. Testing distance measure inside laboratory

Ultrasonic sensors are oneof the most frequently used sensors in robotic applications and many other industrial applications. They are often used to detect the distance of objects in industrial applications and industrial automation. It can also be used to measure the wind speed , direction anddistance (Mohammad, 2009). Certain limitations of the ultrasonic sensors cause major effect on the success of the related applications and they often become the reason for the failures of those as well.

Ultrasonic sensors works according to the same principle as the radar or sonar. It generates high frequency signals and the receiver waits for the echo or direct transmitted signal and calculates the time interval for the arrival of the echo or the direct signal to determine the distance. Most often ultrasonic sensors are used to determine the presence of obstacles (Rose, 1999).

But in here by placing the transmitters and the receivers in distant locations, the time taken by the ultrasonic signal to travel from the transmitter to the receiver was measured. In this project 400ST160 ultrasonic transmitters and the 400SR160 ultrasonic receivers were used. This type wasused due to high sensitivity and sound pressure level, low cost, excellent temperature and humidity durability.

400SR160 ultrasonic transmitter and receiver was tracked until 3m distance. The signal was transferred to the micro Arduino and displayed the results in the LCD display. In final testing Arduino Mega demonstration board was used but arduino pro mini demonstration board can reduce cost and equipment size. The embedded system programme was designed using Arduino IDE 1.5.2.

In initial setup of the instrument the shape (cylindrical or cubical) of the tank, radius (if cylindrical) or length and width (if cubical) with height were input to the system using Matrix 4x4 keypad. With those data and inputs from ultrasonic sensor, system automatically calculated liquid capacity inside the tank frequently.

Using this instrument rapid liquid capacity change inside the tank can be measured. The readings were taken in each 12□s with 1mm*tank area accuracy. The liquid capacity increasing or decreasing rate can be measured by the instrument.

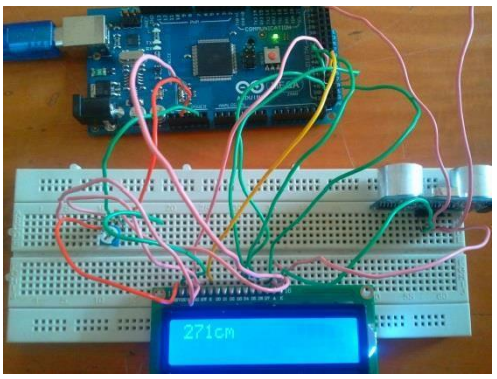

Figure 4. Final Testing Design

Results and Discussion

Ultrasonic sensors detected maximum 3.00 meters and minimum 0.03 meters. Because of this the instrument use only for measuring liquid capacity less than 3 meters height tanks. The readings were taken in each 12 micro seconds with 1mm*tank area accuracy.

Not only industrial applications, this instrument can be used to measure home tank water capacity and so many applications.

Main benefit of this instrument is that it will not touch the liquid. And easy to fix without any changes or upgrade existing system. It is less expensive and easy to setup.

Accuracy of the instrument is 0.001m*Area of tank. Because of the waves inside the tank it can be shown error readings. To minimize the errors input pump should always place in the bottom of the tank and the tank must fully covered with wind[Figure 4].

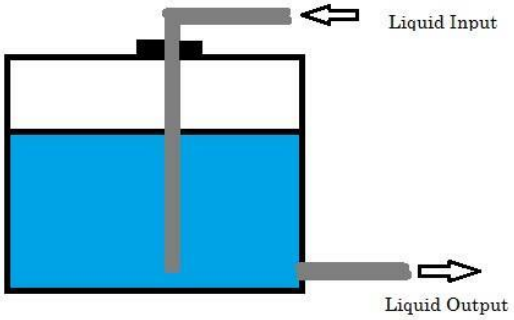

Figure 5. Tank liquid input and output system

Conclusions

This study showed a simple, low cost setup using ultrasonic sensors to detect liquid capacity in between 0.03 m to 3 m height tanks. It can be installed easily and maintenance is possible. The accuracy of the system is up to the acceptable level.

References

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