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Precision Level Measurement with Real Time Monitoring For Dynamically Changing Depths in a Container

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ABSTRACT: *The paper deals with the level measurement of the fluid in a dynamically changing closed container with an integrated real time wireless sensor data transmission and reception design for regular monitoring of the level inside the container. The paper proposes a method of using a single ultrasonic sensor to monitor the level of the container and using ardiuno, zig bee module together to collect the sensor data and wirelessly transmit it to be monitored in a display. Through this method a real time wireless monitoring of the level is feasible and an alarm system is included whenever the tank level reaches the maximum and minimum level, moreover using a GSM module a text message is sent to the user as an early warning system.*

KEYWORDS: Level Measurement, Ultrasonic Sensor, Acoustic waves, Arduino, Zigbee Module.

I. INTRODUCTION

Level measurement involved measuring the fluid level within a range, rather than at a one point, producing an analog output that directly correlates to the level in the vessel. The level measurement in a container or tank is highly necessary to prevent overflow, empty and to maintain a constant level in the container. Through the ardiuno the ultrasonic level monitoring sensor is placed on the inner surface of the top cover of the container. The ultrasonic sensor is placed in a location where it has direct line of sight with the surface of the fluid in order to get accurate readings. The data is continuously collected and is wirelessly transmitted by the zig bee module and is received and is displayed in a display. The limit conditions are maintained, when these conditions are triggered a message is sent to the user through the GSM module connected to the ardiuno which alerts the user and the flow is controlled by a control valve.

II. CURRENT TRENDS

The current trend in small scale industries and commercial centers for level measurement in a container utilizes a piezoelectric sensor or a pressure sensor arrangement. In this method the amount of fluid in the container is taken into account and the constant application of pressure on the sensor make result in reduction in its life span and it requires an instalment of multiple sensors at various points on the bottom surface of the container.

III. PROPOSED SYSTEM

The drawbacks of the piezoelectric sensor level measurement is solved using the ultrasonic sensors which transmits ultrasonic waves at high frequency which bounces back from the surface of the fluid in the container and is received by the sensor. In the proposed system only one sensor in direct line of sight which the surface f the fluid is required. The ardiuno Uno is used to collect the analog data from the sensor and through the zig bee module data can be remotely transmitted from long distance to the receiver end where the data is displayed and continuously monitored.

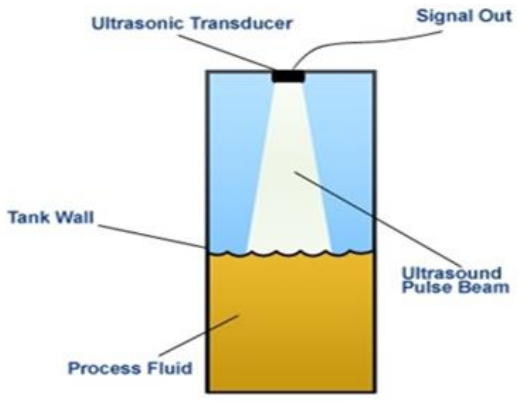

Fig 1. Proposed system for level measurement using ultrasonic sensors

IV. ULTRASONIC LEVEL SENSOR

A) WORKING PRINCIPLE

Fig2.Ultrasonic-Sensor-HC-SR04

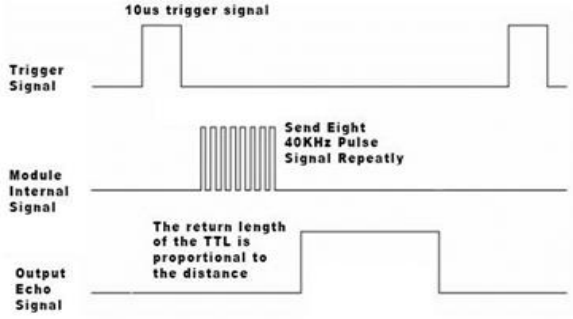

Fig 3. Ultrasonic-Sensor Pulse-Description

The Ultrasonic Sensor sends out a high-frequency sound pulse and then times how long it takes for the echo of the sound to reflect back. The sensor has 2 openings on its front. One opening transmits ultrasonic waves, (like a tiny speaker), the other receives them, (like a tiny microphone).The speed of sound is approximately 341 meters (1100 feet) per second in air. The ultrasonic sensor uses this information along with the time difference between sending and receiving the sound pulse to determine the distance to an object. It uses the following mathematical equation:

Distance = Time x Speed of Sound divided by 2

Time = the time between when an ultrasonic wave is transmitted and when it is received. You divide this number by 2 because the sound wave has to travel to the object and back.

V. BLOCK DIAGRAM

The block diagram of the level measurement of dynamically changing depths is proposed as follows

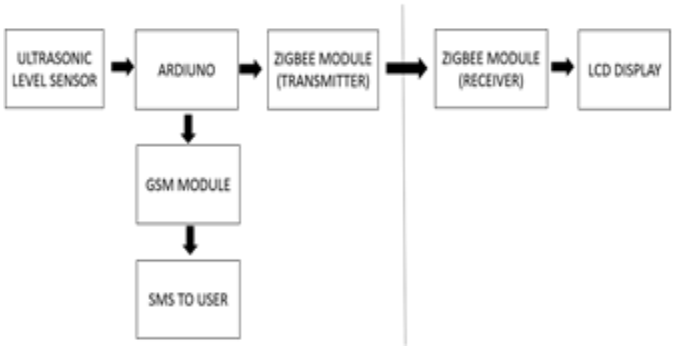

Fig 6. Block diagram of the proposed system

In a closed container consist of an ardiuno, zig bee and GSM module in a remote location with the senor installed onto the inner top surface of the container the receiving end consists of another zig bee module for processing the obtained data and displays it.

VI. LEVEL MEASUREMENT BY ULTRASONIC SENSOR

Fig 4. Instalment of ultrasonic sensor on the top of the container

Fig 5. Container taken for level measurement study

In the proposed system the ultrasonic senor measures the amount of empty space in the container and using the below calculation the amount of fluid in the closed irregular container is measured

$V_F = D_U - H$

V_F - Volume of fluid in the container

D_U -Distance measured from the sensor to the surface of the fluid

H- Height of the container.

Through the above formula the real time level can be calculated and displayed in the display both in a graphical and pictorial representation and the readings are also sent as a SMS to the user through the GSM module.

VII. REAL TIME MONITORING

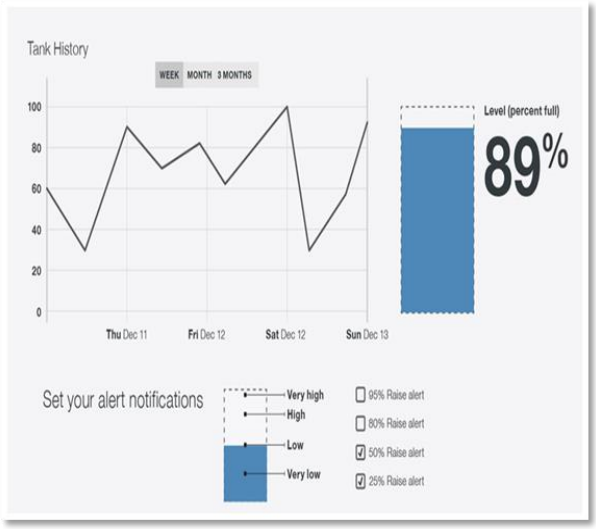

Fig 7. Real time monitoring of the level of fluid inside the container

VIII. FUTURE IMPROVEMENTS

The future improvements involves the use of water proof sensors to protect the sensor from the splattering of fluid and to improve its life efficiency and to implement a sensor nodal network to link level measurement of multiple tanks systems and monitoring them simultaneously is an area of concentration. Moreover the arduino is also connected to a pump which controls the flow of liquid into the container and shuts off the flow when the maximum required level has been reached. Through this both monitoring and controlling of level in a container can been done successfully.

IX. CONCLUSION:

The paper provides an insight to the use of ultrasonic level sensor to measure the level of fluid in an irregular container body and to transmit the data in real time with high accuracy and developed an early warning system to alert the user on the volume of fluid inside the tank. The proposed level measurement method is more feasible since implementation is simple and cost effective. The model can be easily implemented in an overhead tank in residential and in commercial centres and with further improvements it can be installed in process industries where level measuring in an important parameter.

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