

Automatic Liquid Control System for Overhead Storage Tank in Households

Hara Prasad Tripathy, Priyabrata Pattanaik, Sushanta Kumar Kamilla

Abstract: *The scarcity of drinking water in near future attracts the attention of the researcher how to control the use of water as per the need. Now this is a major global problem rising in front of all to avoid the crisis of fresh water. Hence, it is not only extremely crucial to preserve and save water but also to reduce the unnecessary use of water. Especially, in many houses in India, there is unnecessary wastage of water due to unnoticed water leakage from faucets and overflow in overhead storage tanks. This is where automatic liquid control system comes into picture. The operation of liquid control system is based upon the fact that liquid primarily water acts as a hindrance for sound waves emitting from the ultrasonic sensor. Rise and fall of water level results in triggering on and off switch which further enables or disables the motor pump as per the requirement. This paper has achieved its primary objective i.e. noncontact liquid monitoring system employing Arduino Uno.*

Keywords: *Arduino Uno, Ultrasonic Sensor HC SCR04, Liquid Controlled, Household, Motor Pump.*

I. INTRODUCTION

In our day to day life, there should be some physical parts that require to be controlled so as for them to perform their expected behaviors. A control system comes into picture, which manages commands, directs or regulates the behavior of different devices or systems. Consequently, unmanned system involves planning a control system to perform with no human interference. Intellectual systems are already getting used in an exceedingly wide selection of fields as well as from medical sciences to money sciences, education, law, and so on [1].

The observance of liquid level in the tank is very important within the applications associated with agriculture, flood hindrance, and trade, etc. the majority aspects of human life have undergone speedy development. This development is majorly due to science and technology backbone. For e.g. development of computer has not only increased calculation speed but also it has developed a wide variety of fields where the computer system is used to control various types of hardware in an automated way.

This development is supported by the advancement of physics and knowledge technology. Computer-based system can also be enforced for optimizing liquid flow management to reduce flood caused by water overflow [2].

Automatic liquid level controller comprises of series of modules that controls controller circuit in a storage tank. The sensor for sensing liquid level is made up with a metal plate mounted on the storage tank wherein the sensor is used to detect the levels of liquid present in the storage tank. Here, Arduino-Uno can be used to automate the pumping of liquid into storage tank including the ability of sensing the level of liquid in the storage tank and controlling the switching operation of the pump accordingly [3].

This paper reflects liquid monitoring system by contactless method implemented using Arduino-Uno. The depth of the liquid present in the storage tank is measured by ultrasonic sensor. Hence, the liquid level existing in the tank is known. On the basis of results from the sensor, the Arduino program transfers the data to the Arduino board. The pump is switched ON when the sensor senses low level in tank and is switched OFF when sensor detects that the liquid level reaches to the maximum level in the storage tank. Arduino analyzes the result from the ultrasonic sensor and displays the information i.e. liquid level in the storage tank on the display unit. In the earlier devices, normal iron sensor has been used as a contact sensor which gets corroded over time [4]. Again, previously the system only notified the user that the tank was empty. But in the present description, the system automatically turns on and off the motor pump according to the water present in the system with stainless type sensor.

II. SYSTEM DESCRIPTION

Our proposed system comprises of mainly two types of components:

Ultrasonic Sensor
Arduino Uno

A. Ultrasonic Sensor Module

The module works on the principle of sound propagation technique. A sound wave is transmitted which consists of 8 cycles of 40 kHz ultra sound signal towards the obstacle. The sound wave is reflected back from the obstacle and is received by the receiver. [5] Thus, the level of the liquid from the lid of the storage tank is simply calculated by the formula;

$$\text{Distance} = (\text{time} * \text{speed}) / 2$$

The product of speed and time is divided by two, since the time is the sum of time taken to strike the obstacle and reflect back. Thus, the time taken by the sound wave is basically half of the total time taken.

This system comprises HC-SCR04 Ultrasonic module.

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It usually consists of 4 pins i.e. ground, VCC, trigger and sound wave. The ground pin and the VCC pins of the sensor are attached to the ground and the 5-volt pins on the Arduino board, respectively. The trigger and the echo pins to any digital input/output pin on the Arduino board.

In order to generate the ultrasound signal, the trigger is set on the high state for 10 micro seconds. It then sends out an 8-cycle sonic burst which travel at the speed of sound which is 343 m/s and it is received by the echo pin.

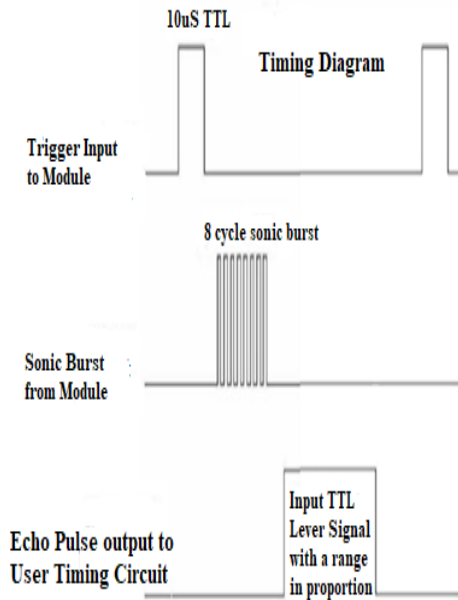


Fig.1. Output waveform of ultrasonic sensor

B. Arduino Uno

Arduino is an open-source controller for building electronics stuffs. Arduino usually contains a user programmable circuit board and a software that is usually programmed by using integrated development environment in computers. It is popular because it contains a large amount of predefined library which makes it easier for the user to develop and create new stuff. Additionally, the Arduino Uno uses a simplified version of C++ which is easier to write and understand. [6] Different types of Arduino are currently present in the market at low cost, those are listed as below:

1. Arduino RS232 (male pins)
2. Arduino Diecimila
3. Arduino Duemilan ov (rev 2009b)
4. Arduino Uno R2
5. Arduino Uno SMD R3
6. Arduino Nano (DIP -30 footprint)

III. CIRCUIT DIAGRAM FOR AUTOMATIC LIQUID LEVEL CONTROLLER

Circuit diagram for liquid level controller is shown in the below figure:

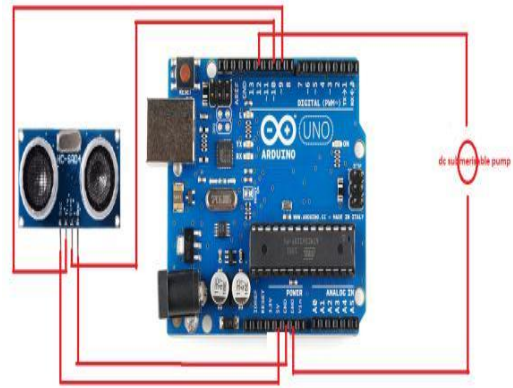


Fig.2. Circuit diagram of liquid level controller

In the above circuit VCC and ground of HC-SRC4 are connected to the 5V and GND pins. Trigger and echo pins are attached to digit 1 pin 9 & 10 of Arduino. DC submersible pump is attached between ground and digital pin 12.

IV. FLOW DIAGRAM

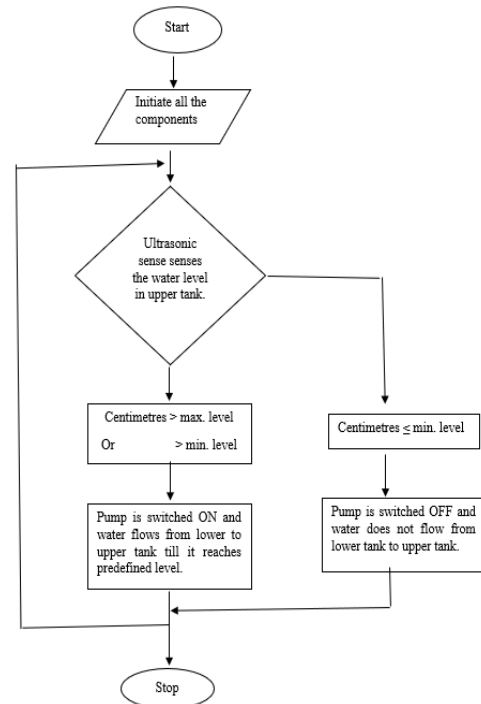


Fig.3. Flow chart of proposed system

V. METHODOLOGY

The present model relates to a contact less liquid monitoring system for monitoring liquid overflow system from overhead storage tank in households. The model mainly comprises of ultrasonic sensor and Arduino Uno Sensor. The ultrasonic sensor is installed on the lid of the tank. It emits ultrasonic waves which senses the level of the water and transmits that information to the Arduino Uno. The Arduino interprets that information and turns motor pump automatically according to the liquid present in the storage tank.



In the previous papers, a sensor is continuously dipped inside the liquid which leads to corrosion of the sensor resulting in decreasing the average life of the system. Also, previously the system only notified the user that the tank was empty. But in the present description, the system automatically turns on and off the motor pump according to the water present in the system.

VI. RESULT AND DISCUSSION

CASE 1 When water is low

The present paper discloses liquid's maximum and minimum level in storage tank as 20 cm and 5 cm, respectively. When liquid level measured by ultrasonic module is 30 cm, it implies that its level is low in the storage tank which triggers the operation of the motor.

CASE 2 When water reaches predefined limit

If the liquid level measured by the module is 5 cm or less than that. It implies that the storage tank is completely filled and Arduino Uno switches off the motor.

VII. CONCLUSIONS

The main objective of this paper is to develop a contact less liquid monitoring system employing Arduino Uno and ultrasonic sensor. This has overcome the disadvantages of the prior system where SS sensor senses the liquid when liquid comes in contact with it. This results in the corrosion of the material used in the ss sensor. The predefined limit can be changed according to size of the storage tank and also according to the liquid type. The motor is switched on and off according to the liquid level present in the storage tank. Thus, our model eliminates the need of human interference needed for monitoring the switching mechanism of the motor.

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