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Automated Water Level Controlling and Detection Using Arduino and GSM Sim Module

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Abstract: ***The objective of our project is to provide an automated water level controlling and monitoring system for preserving water using Arduino and easy-to-use mobile application. Actually there is a lot of drinking water crisis in India and also in other countries. Today we need to preserve water at any cost. In India, we can see many houses as overhead tanks and they keep on overflowing water. It wastes a lot of water as well as electricity. If we do not do anything on this matter than we can face huge scarcity of water. In this project, I Am going to implement automated water level tank controlling system and a mobile application which helps in monitoring the level in the tank.***

Keywords: Arduino, Ultrasonic sensor, Water level, Mobile application, GSM module, Alarm system**,** Relay

1. Introduction

Storage tanks are artificial containers that hold liquids, compressed gases (gas tank) or mediums used for the short- or long-term storage of heat or cold. Large above ground storage tanks filled with hydrocarbon and hazardous liquids such as oil, oil derived products, chemicals and process plant liquids are in widespread use in the UK, Europe and throughout the world. The tanks are generally spread across a large area and use manual detection and measurement methods which are still under development. This makes it more laborious and time consuming to monitor the tank levels.

Remote Monitoring and data collection systems are necessary to collect information from the tanks and monitor the same. So it is necessary to build a system which can be accurate, fast in measurement and simple to install and handle, but has an intelligence which takes decisions in real-time and alerts and communicates when necessary. The data acquisition is done by the sensors used to sense the changes in the liquid level of the tank and is stored in the system's memory. A server collects the information sent from the onboard microcontroller through a GSM modem in the tank; saves it to a database and displays it on a mobile application.

Such intelligent monitoring systems help in effective management of tanks, by assessing the status of the tanks periodically and makes it is easy to control and monitor water level in overhead tanks.

2. Literature Review

- Automatic Water Level Controller (International Journal of Science and Research (IJSR))

This research paper by **Vardaan Mittal** involves measuring of water level with the help of ultrasonic sensors. This system uses automated turning motor ON/OFF with the help of relay which helps in controlling the excess water flow from overhead tanks. Accordingly, they have displayed the level of water on LCD Display.

- Automatic Water Level Control System (International Journal of Science and Research (IJSR))

This research paper by **Asaad Ahmed Mohammedahmed Eltaieb, Zhang Jian Min** involves designing and development of automatic water level control system had exposed to the better way of software and hardware architecture that blends together for the interfacing purposes. The system employs the use of advance sensing technology to detect the water level. It uses Arduino and uses relay to control motor. Different wires are attached at different Junctions of the Beaker. When we pour water in the beaker. The water comes in contact with the wire and tells the level of water in the tank. Accordingly, they have displayed the level of water on LCD display. And uses relay to turn ON and OFF the motor.

3. System Architecture

3.1 Key Components: Description and Uses

3.1.1 Microcontroller (Arduino)

The controller receives signal from the ultrasonic senor and commands from mobile application. The controller responds by turning the alarm OFF after it has been triggered by an overflow in the tank. Once the task is completed, it notifies the user of the same.

3.1.2 Ultrasonic sensor

Ultrasonic sensors can be used to sense the liquid level by placing the sensors at a specified portion in the tank, calculating the level of liquid by time of flight of the ultrasonic wave and correlation with respect to the dimension of the tank, to get a more accurate value. The values thus collected needs to be sent to a server using a wireless communication medium, so that this can be correlated at the Server for display on the tank software system. The data collected at the server end is displayed on a mobile application, thus communicating to the user about the level of liquid, in real time and also evaluating the variation of liquid levels over a period of time.

3.1.3 Mobile application

Mobile app is used to connect user with the automated overflow tank detection system. The user is provided with an unique identification (ID) and password which is required to login the application. Once the user has logged in, he can control the alarm system which has been placed in the tank.

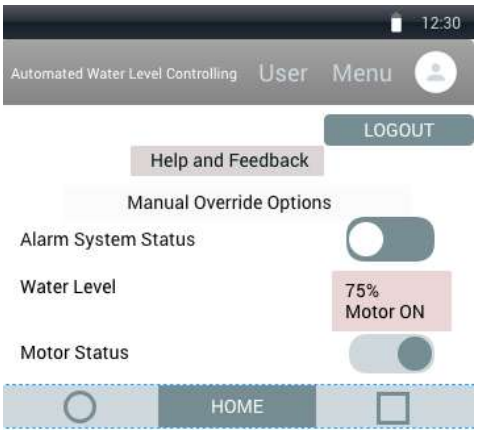

Figure 1: Mobile Application

3.1.4 Relay

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate the switch and provide electrical isolation between two circuits. Since the circuit works on high AC voltage, the sensors can't be directly connected to them. Instead the sensors are connected to relays which in turn are connected to controller and the ac power source. These relays electrically isolate ac power source from controller and prevent it from any damage. Relay use dc input of small voltage for triggering and are ideal to use with a controller. Controller can trigger the relay to close the circuit of ultrasonic sensors and ac power supply.

3.1.5 LCD Display

LCD is the common message displaying device which is used to show the water level in the tank. This LCD display returns the value of the water level to the user which in turn stores the value in the server and show real time data in mobile application.

3.1.6 Buzzer

It is an electronic device used to give sound as it is programmed.

3.2 Hardware Requirements

3.2.1 Arduino Uno R3

Figure 2: Arduino Uno R3

It is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.

3.2.2 Atmega 328p

8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1024B EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timers/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages),programmable watchdog timer with internal oscillator.

3.2.3 Ultrasonic Sensor

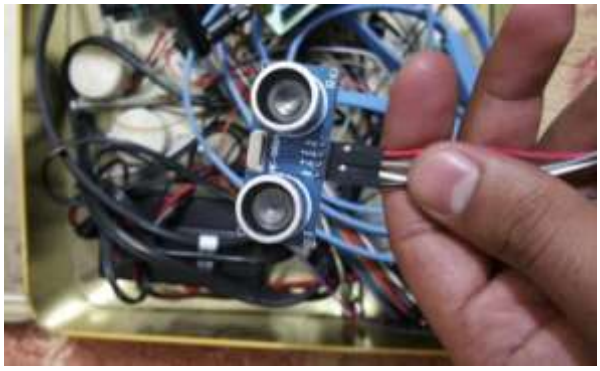

Figure 3: Ultrasonic Sensor

Ultrasonic sensor ranging module HCSR04 provides 2cm-400cm noncontact measurement function, the ranging accuracy can reach to 3mm.the module includes ultrasonic transmitter, receiver and a control circuit. The ultrasonic distance sensor provides precise, non-contact distance measurements from about 0.8 to 120 inches. The ultrasonic sensor emits short bursts of sound and listens for this sound to echo off of nearby objects. The frequency of the sound is too high for humans to hear (it is ultrasonic). The ultrasonic sensor measures the time of flight of the sound burst. A user then computes the distance to an object using this time of flight and the speed of sound (1,126 ft. /s). This sensor uses ultrasonic sound to measure distance just like bats and dolphins do. Ultrasonic sound has such a high pitch that humans cannot hear it. This particular sensor sends out an ultrasonic sound that has a frequency of about 40 kHz, see figure above.

3.2.4 Relay

Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. Arduino cannot control high voltage and current, but a relay can do this job.

There are three configurations of relay:

1) COM = Common Connection
2) NC = Normally Closed Connection
3) NO= Normally Open Connection

Here we have used NO configuration as it acts like a switch since this configuration is open – there will be no contact between COM and NO. When we trigger the relay module, it connects to COM by the electromagnet inside the relay and supply to the load is provided, which switches the alarm OFF.

3.2.5 SIM 900 GPS/GPRS

Figure 4: GSM SIM Module

SIM900 delivers GSM/GPRS 850/900/1800/1900MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mm x 24mm x 3 mm, SIM900 can fit almost all the space requirements in your M2M application, especially for slim and compact demand of design.

3.2.6 LCD DISPLAY

LCD is the most common message display device used to display ASCII character. LCDs have become a cheap and easy way to get text display for embedded system. The Common displays are set up as 16 to 20 characters by 1 to 4 lines.

3.2.7 System Requirements

1) Programming languages: Java, HTML, SQL.
2) Arduino IDE: To program Arduino.
3) Android Studio: To build and program Android app.
4) Platform that support android: Android emulator or any mobile on android platform.

4. System Working

Once user has logged in the mobile application, he gets access to control the functionalities of the microcontroller. Then the user can manually turn on the motor for the required time period

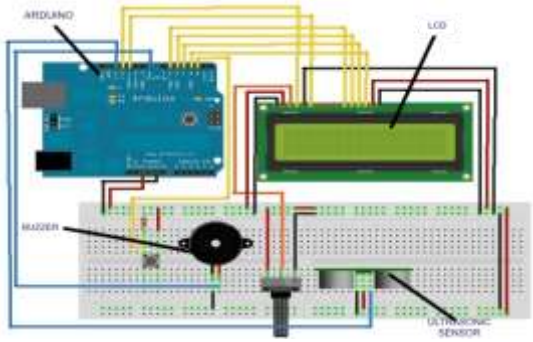

Figure 5: Basic design of the system

After Turning ON the motor constant monitoring of water level has been made with the help of Arduino sensor and LED display which in turn shows the water level in the mobile application.

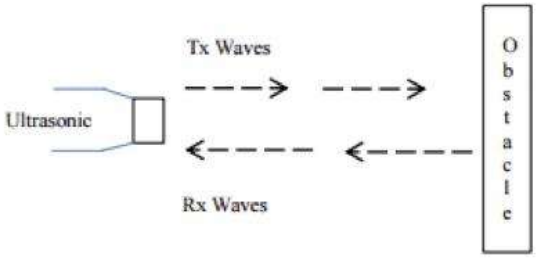

Figure 6: Sensing Operation

The Sensor has two main parts: A transducer that creates an ultrasonic sound and another listens to its echo.
The basic principle of work:

1) Using I/O trigger for at least 10us high level.
2) The module automatically sends 40 KHz and checks weather there is a pulse signal back.
3) If the signal back through high level, time of high I/O duration is the time from sending ultrasonic to return.

- Test Distance = (High Level Time) * (Velocity of sound (340 m/s)) / 2
- To measure the distance of sound we use the formula: Distance = (Time x Speed of Sound) / 2

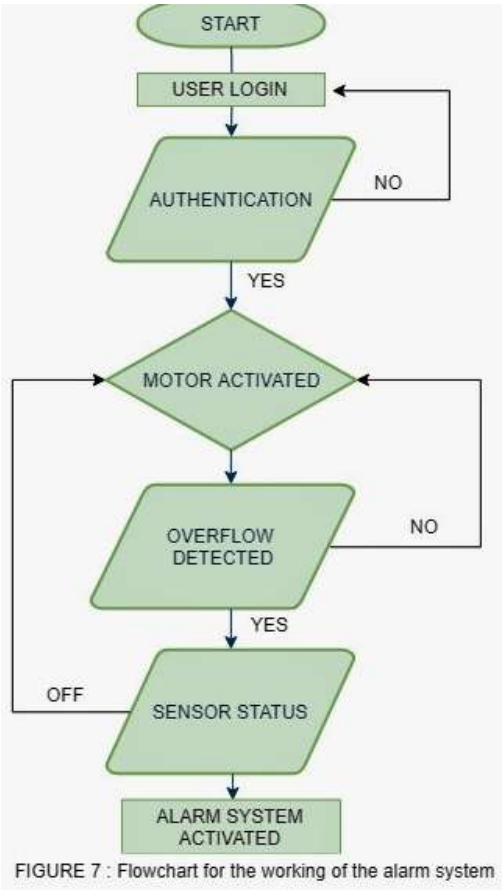

FIGURE 7 : Flowchart for the working of the alarm system

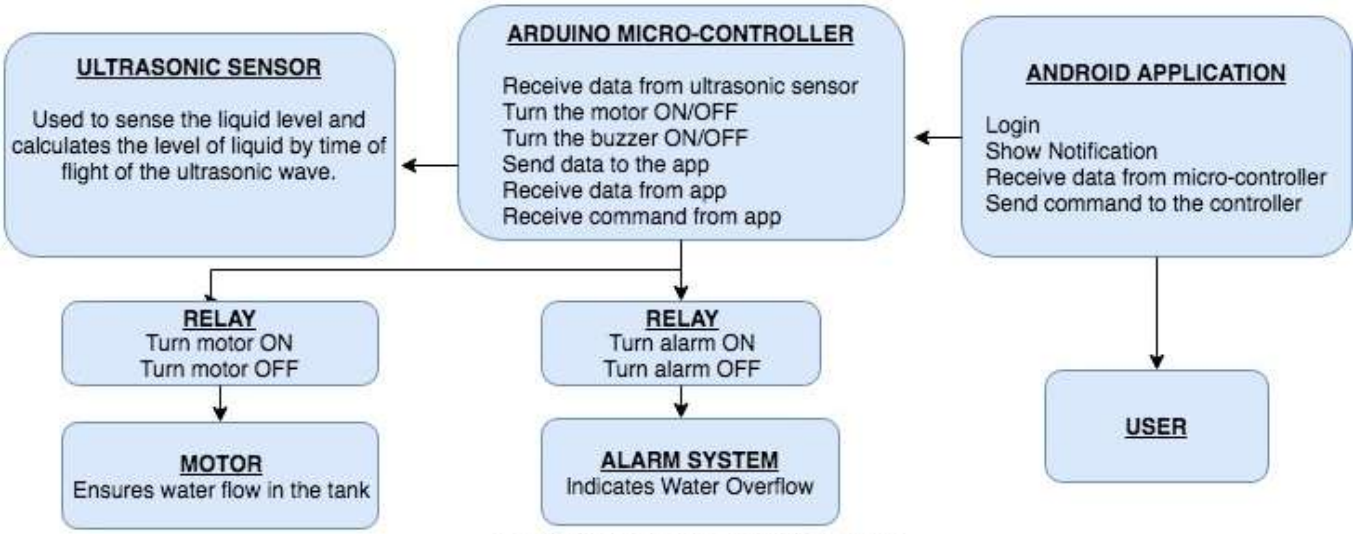

FIGURE 8 : Class Diagram of the System

If the ultrasonic sensor sense the liquid level and calculates the level of liquid by time of flight of the ultrasonic waves, it sends information to the microcontroller (Arduino Uno R3) about the presence of water level in the tank. Microcontroller processes this information and further sends a triggering signal to relay. When the relay is triggered, it changes its configuration from No (Normally Open Connection) to COM (Common Connection) by the electromagnet inside the relay and supply to the load (alarm system) is provided. The circuit is closed until we trigger the state of relay to low. Once the alarm starts, a sound is sent out from the speakers. The sound of the alarm is so set that the user gets information about the overflow in the water tank.

Furthermore, an automated voice call is made to the user cautioning him about the overflow of the water. The user can then decide whether to turn off the alarm system from the provided mobile application.

5. Conclusion

Alarm system using Arduino and android mobile application is useful for as it saves their time and resources. It provides warning regarding the overflow of water in the tank. The system employs the use of advance sensing technology to detect the water level.

This project involved designing and development of automatic water level control system had exposed to the better way of software and hardware architecture that blends together for the interfacing purposes.

Furthermore, the mobile application brings out the possibility of accessing the system from any place at any time which is very important in this modern era of technology.

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Author Profile

Prayash is currently a student at the Department of Information Technology, College of Technology, GBPUA&T, Pantnagar, Uttarakhand, India. He is interested in Entrepreneurship and Programming. He is also working in Entrepreneurship and Development cell, Pantnagar.