AUTOMATIC WATER LEVEL INDICATOR USING ULTRASONIC SENSOR AND GSM MODULE

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ABSTRACT

We live in a world which is moving at such a fast pace that everything if automated will help us to keep our lives going. The project on water level Indicator will help us to know when the water in our tanks is either full or empty and automatically switch on and off the pump as and when necessary. By using the basic principle of ultrasonic sensors, i.e the ECHO method, we calculate the time of the ultrasonic waves travelling to and fro and after a few calculations the answer obtained will be the water level in the tank. By using this concept, the water pump is switched on or off automatically when the water level falls below a certain level.

Keyword:- *Arduino UNO, Ultrasonic sensor, GSM Module, Relays, IC's, Buzzers, etc.*

1. Introduction

In relation with the current framework with so much work and too less time to spare, it is very difficult to keep in touch with the water level in the tanks. Water is essential in every hour of our lives. Hardly anyone keeps in track of the level of water in the overhead tanks. The objective of the project is to measure the level of water in the tank and notify the user about the water level through an SMS alert. This not only helps to keep the tank full but also making it more convenient for our day-to-day chores and also avoiding water wastage. In this project, the water is being measured by using ultrasonic sensors. Initially, the tank is considered to be empty. When the sound waves are transmitted in the environment, they are reflected back as ECHO. This same concept is applied this project. Waves generated by the ultrasonic sensors is sent to the water tank and their time of travelling and coming back is noted and after few calculations we can estimate the level of water in the tank. The motor pump is automatically turned ON when the water level becomes low and turned OFF when the tank is full. These alerts are sent as notifications in our phones through the GSM Module.

2. Literature Survey

[1] Tank Water Level Indicator and Controller Using Arduino by Amrit Kumar Panigrahi, Chandan Kumar Singh, Diwesh Kumar, Nemisha Hota. This paper gave the idea of using echo method. It also helped us in making the system's mechanism simpler.

[2] Electrical Appliances Control Prototype by Using GSM Module and Arduino by Tigor Hamonangan Nasution, Muhammad Anggia Muchtar, Ikhsan Siregar, Ulfi Andayani, Esra Christian,Emerson Pascawira Sinulingga. This paper helped us to understand the connections between the components.

[3] Water Level Indicator using Micro-controller by Mudit Bajpai, Money Saxena. This paper helped us to understand the uses of probe method and how it is cost efficient.

[4] Water Level Monitoring System using IOT by Priya J, Sailusha Chekuri. This method helped us to understand the use of Bluetooth modules and how it can be made as portable device.
[5] Smart Wireless Water Level Monitoring and Pump Controlling System by Madhurima Santra, Sanjoy Biswas, Sibasis Bandhapadhyay, Kaushik Palit. This paper helped us to understand the use of echo method better and how it can be made cost efficient.

3. Proposed System

The project on Automatic Water Level Indicator using Ultrasonic Sensor and GSM Module helps the user to be aware of the water level in the tank through an SMS alert and also pump is switched on and off automatically when the water in the tank reaches a particular threshold level. Arduino is used since its connections are easy as well as its coding being simple. The system also provides continuous water level measurement. It is very useful because the user need not worry about the water content during the peak hours of the day. It not only helps in the daily chores but also prevents water wastage. It reduces human labour, saves time and also keeps the user updated regarding the water content.

4. System Architecture

The system architecture is drawn as follows.

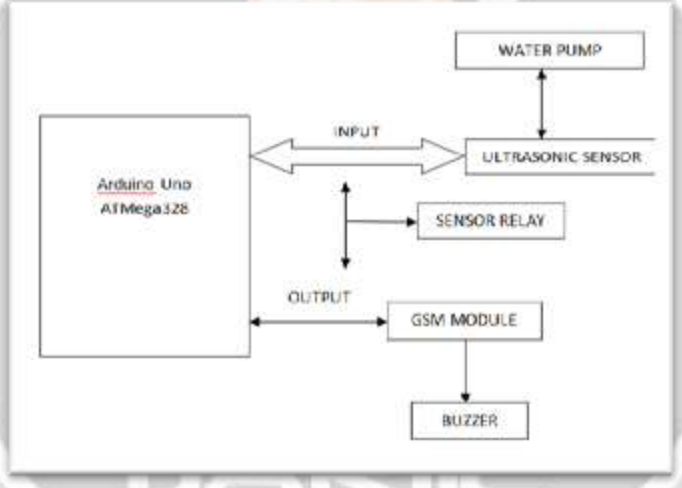

Figure 1. System Architecture

It shows the basic outline of the structure of the project. The various components required are described as follows:

4.1 Power Supply

It is also known as the driving circuit which is used to supply power to the other electronics devices connected to it depending on the type and requirement the power supply circuits vary.

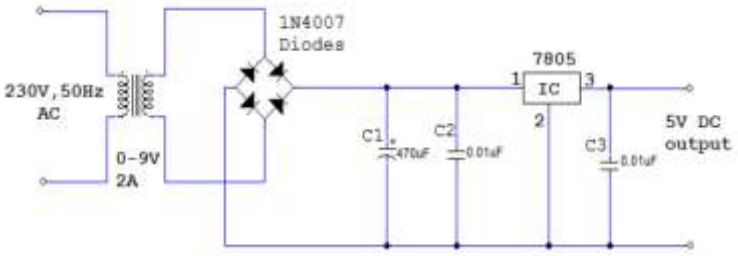

Figure 2. Power Supply Circuit [1]

4.2 Arduino UNO

Arduino UNO has the micro-controller ATmega328 embedded in it. It has 14 digital I/O pins out of which 6 provide PWR output. It is an open-source and provides prototype platform. It also has a 16MHX crystal oscillator attached to it. In addition to the above features, it also has an USB connection, a power jack, an ICSP, header and reset button.

Figure 3. Arduino Uno circuit board [6]

It has everything to support a micro-controller. It can simply be connected to a computer using an USB cable or power it with an AC or a DC adapter or a battery.

4.3 Ultrasonic Sensor (HC-SR04)

It is basically a distance sensor and is used for detecting the distance using SONAR method. It has two ultrasonic transmitters namely the receiver and the control circuit. The transmitter emits a high frequency ultrasonic sound wave which bounces off from any solid object and receiver receives it as an echo. The echo is then processed by the control circuit to calculate the time and the difference between the transmitter and receiver signal. This time can subsequently be used to measure the measure the distance between the sensor and the reflecting object.

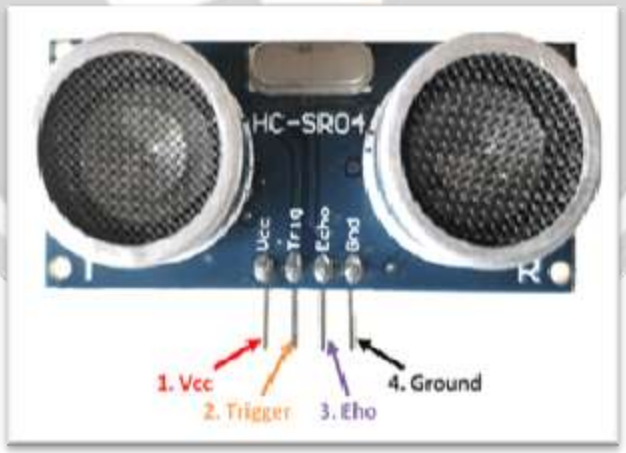

Figure 4. Pin Configurations of Ultrasonic Sensor(HC-SR04) [7]

It has an ultrasonic frequency of 40 KHz and accuracy is nearest to 0.3 cm.

4.4 GSM Modem SIM 900

It is widely used in mobile communication. It has a built in RS232 level converter. It has the ability to send SMS through SMS cell broadcast method.

Figure 5. SIM 900 GPRS/GSM module [8]

Having a baud rate of 9600 – 115200 bps it can send or receive SMS at a very quick pace. It also has a low power consumption which is a major advantage.

4.5 Relay

In order to isolate two circuits electrically and to connect them magnetically relays are used. They are very useful in switching from one circuit to another when they are completely separated.

Figure 6. Relays [9]

The relays comprise of an input and an output section. The input section has a coil which produces magnetic field when a small voltage from an electrical circuit is applied. This applied voltage is known as the operating voltage.

4.6 IC 7806

It is a voltage regulator integrated circuit. It belongs to the family of 78xx series of fixed linear voltage regulated ICs. The voltage source in a circuit may have fluctuations and would not give the fixed voltage as output. A constant output voltage value is maintained by this IC.

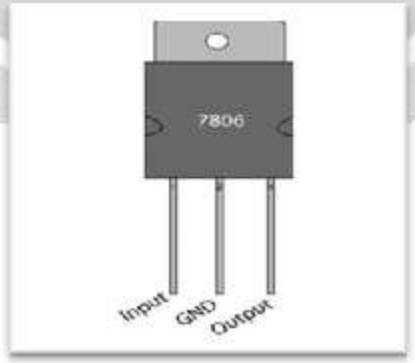

Figure 7. Pin configuration of IC 7806 [10]

The xx in 78xx indicates the fixed output voltage it is designed to provide. **C**apacitors are provided + 6V of power supply with the help of IC 7806 which can be then connected as input and output pins depending upon the voltage levels.

4.7 IC ULN2003

ULN2003 IC is one of the most commonly used Motor driver IC. This IC comes in handy when the need arises to drive high current loads using digital logic circuits like Op-maps, Timers, Gates, Arduino, PIC, ARM etc. For example a motor that requires 9V and 300mA to run cannot be powered by an Arduino I/O, hence we use this IC to source enough current and voltage for the load.

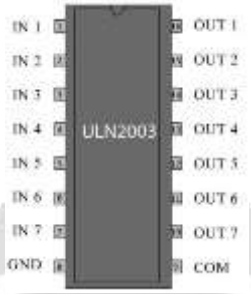

Figure 8. Pin configuration of IC ULN2003 **[11]**

This IC is commonly used to drive Relay modules, Motors, high current LEDs and even Stepper Motors. In general this IC permits a low-power circuit to control signals or to switch high current ON and OFF which is electrically isolated from the controlling circuit.

4.8 Connecting Wires

In any electronic circuitry wires are the conductive connections between the elements in contact. Theoretically, they have zero resistance and provide perfect connections. On the breadboard, they look like nice coloured jumper wires.

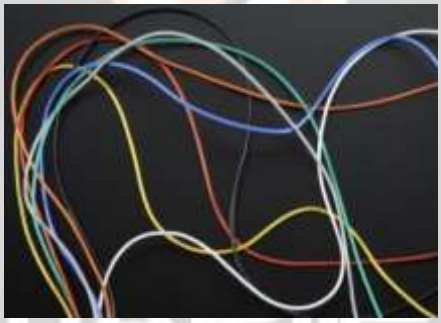

Figure 9. Connecting Wires [12]

5. Module Identification

The project is divided into the following three modules. They are described as follows:

5.1 Ultrasonic Sensor Module (HCSR-04)

It is also known as the input module. First it sends ultrasonic sound waves into the tank and then these waves are reflected back. The speed at which these waves travel is in the range of 340 meters/sec and it is not affected by any barriers or obstacles that might come on its way. These waves are also not deflected so it is very convenient to use. The time at which these waves travel and are reflected back is recorded and the water depth is calculated.

5.2 GSM Modules

In this project the GSM module is used to send the message about the status of the level of water in the tank and also to turn on the motor for opening and closing of the motor when the water in the tank reaches a particular level. It alerts the people living in the house by sending a SMS about the overflow of the water in the tank and to save water from wastage.

5.3 Arduino Module

This works as the brain of our project. By knowing the various pin configurations, the various components can be connected to the Arduino and perform the necessary functions.

5.4 Relay Module

Here, relays are used to connect the ultrasonic sensor (i.e. input) and the GSM module (i.e. output) magnetically when they are electrically separated from each other.

6. Working Principle

When the circuit is switched on the ultrasonic sensor transmits the generated sound signal to the bottom of the water tank which is the target and whose water level is to be measured. The signal after touching the base of the tank is reflected back and is received by the receiver of the ultrasonic sensor. The time taken through the entire journey of the transmitted signal is recorded. Then by applying the formula,

Range = {(time taken) X Velocity of the transmitted signal (i.e. 340 m/s)} /2

The output obtained is the required distance.

Figure 10. Data flow Diagram

This measured level if is below the threshold level of 2cm then the pump will automatically be switched on and an SMS alert will be received at the user's phone. Henceforth, when the water reaches a particular level the motor will automatically turn off and again a notification through SMS will be provided indicating the tank is full to the user. This is the working principle used in our project.

The block diagram is shown as below:

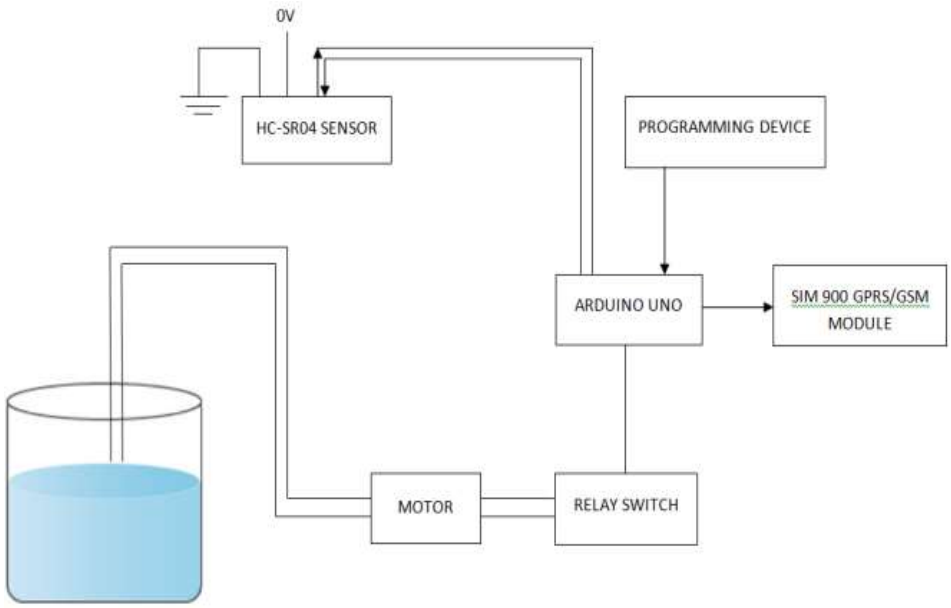

Figure 11. Block diagram

7. Calculations and Result Analysis

Considering the temperature conditions to be 28℃, an estimation is drawn regarding the distance measurement of the sensors to the base of the tank. The measurements were done using a measuring tape and the results are tabulated as follows:

Actual Distance (cm)	Measured Distance (cm)	Error
30	32	+2
60	61.5	+1.5
90	90	+0
120	121	+1
150	152	+2

Table 1: Range Measurements and corresponding errors

The error percentage is calculated as:

Error Percentage = [(Measured Distance-Actual Distance)/Actual Distance]*100%

%error = [{(32+61.5+90+121+152) - (30+60+90+120+150)}/(30+60+90+120+150)]*100%

%error = [(456.5 – 450)/450]*100%

%error = (6.5/450)*100%

%error = 0.014444444*100%

%error = 1.44444%

8. Applications

It can be used in multiple applied ways. Some of them are as follows:

- It can be used in large scale to control the water level in dams to prevent flood and other such problems.
- It can be used to control water wastage in the municipality corporation tanks which supply water in a particular area.
- It can widely be used in industrial purposes as well.

9. Future enhancements

The project can also be installed with pH sensors which will help to regulate the acidity or alkalinity of the water.

10. Conclusion

Automation of the various components around us has been widely increased to reduce human intervention and save time. It is known that improper water management can have harmful effects on both the system and the environment. The main objective of this project is not only to reduce manual labour but also help save water in an efficient manner. Finally, a conclusion can drawn that this project can definitely be useful on a large scale basis due to its minimum requirement of man power and also the installation process being easier making it more compatible for everyone to use.

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