Project report submitted in partial fulfillment for the Degree of B. Tech in Applied Electronics & Instrumentation Engineering under Maulana Abul Kalam Azad University of Technology

# WATER LEVEL MONITORING


By

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# CERTIFICATE OF APPROVAL

The project report titled □Water Level Monitoring" prepared by **Gourav Jaiswal**, Roll No: 11705515016, **Luv Agarwal**, Roll No: 11705515023, **Subhadip Roy**, Roll No: 11705515046, and **Rajreeta Maiti**, Roll No: 11705515033; is hereby approved and certified as a creditable study in technological subjects performed in a way sufficient for its acceptance for partial fulfilment of the degree for which it is submitted.

It is to be understood that by this approval, the undersigned do not, necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein, but approve the project only for the purpose for which it is submitted.

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[Supervisor:Mr. Debabrata Bhattacharya]
Applied Electronics & Instrumentation Engineering

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Examiner

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Examiner

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# RECOMMENDATION

I hereby recommend that the project report titled □ **Water Level Monitoring** □ prepared by **Gourav Jaiswal**, Roll No:11705515016, **Luv Agarwal**, Roll No: 11705515023, **Subhadip Roy**, Roll No: 11705515046, and **Rajreeta Maiti**, Roll No: 11705515033; be accepted in partial fulfillment of the requirement for the Degree of Bachelor of Technology in Applied Electronics & Instrumentation Engineering, RCC Institute of Information Technology.

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# ABSTRACT

This project gives us a proper insight into water conservation through the application of a water level monitoring system. Industries and homes where water is used to a large extent can implement the given model to get the information about the water level in real-time. An ultrasonic sensor and a NodeMCU microcontroller are used to achieve the given results. Using the power of internet, simplification can be further achieved for the users as they will be able to view the data from anywhere and thereby giving the users the power to monitor it from anywhere and giving them the power to achieve the control of water loss from everywhere. The need for this control arises due to the fact that water loss is happening at a critical rate and if not controlled the situation will worsen further.

# LIST OF FIGURES

**Figure No and Name** **Page No**

# Content

# CHAPTER 1: INTRODUCTION

The topic of our project is Water Level Monitoring. We intend to design a system which can monitor the level of water from water tanks. We know that the resources of water are continuously depleting, so we need to keep a check on our usage so that no extra water goes unutilized. If we monitor the water level in tanks we ensure that the tank never overflows and hence no extra water loss would happen. Water is one in all the foremost vital basic desires for all living beings. However sadly an enormous quantity of water is being wasted by uncontrolled use. The major losses happen either in homes or industries. So the system can be applied there to fill the void. Our main aim is to design a system which will be versatile, economical and simply configurable which will be able to solve water losing issues. The water level data can be used for various purposes for better management of water source. Monitoring water level from remote location may be very useful when it is not possible to visit location physically every time. The system uses a NodeMCU microcontroller and a HC-SR04 Ultrasonic sensor to do the work. The sensor sends a pulse of ultrasonic waves and the waves after hitting the water source, again are reflected back towards the sensor. The NodeMCU microcontroller computes the time taken for the journey and also computes the distance. After that a pump is used to always help to maintain the water level between 30- 70 % so that the users can always have adequate amount of water supply at their home.

# CHAPTER 2: LITERATURE REVIEW

(1) In the paper by P. Dietz, W. Yerazunis, D. Leigh there is explanation of the advantages of water level monitoring and controlling by using the Wi-Fi or wireless based type of monitoring using the Arduino.

(2) The paper of M. Javanmard, K.A. Abbas and F.Arvin deals with brief explanation of using Arduino to automate the homes. The existing system of the Bluetooth method of automation limitations was analyzed to prove that Android and Arduino make up for a better method of automation.

(3) In the paper by Hicks, F. Tyler, a prototype for Water Level Monitoring is developed for detecting water level through the internet. A central device like microprocessor connects to the internet and receives orders to control sensors. A server manages the users and devices. Android Application acts as a front-end to interact.

(4) The cloud is a platform that connects things around us so that one can access any device anywhere in a user-friendly manner. Applications that use devices such as sensors need immense space to store volumes of big data with huge computation power for real-time processing. Microcontroller Based Automated Water Level Sensing and Controlling: Design and Implementation Issue Proceedings of the World Congress on Engineering and Computer Science is the paper which proposes a method of automation where the cloud using the SHA-1 and Naive Bayes algorithm.

(5) In the paper by S.M. Khaled Reza, Shah Ahsanuzzaman Md. Tariq, and S.M. Mohin Reza is presented the design and implementation concepts for a wireless real-time Water level monitoring system based on Arduino Uno microcontroller as central controllers. The proposed system has two operational modes. i) manually–automated mode in which the user can monitor and control the home appliances from anywhere

in the world using the cellular phone through Wi-Fi communication technology. ii) Self automated mode that makes the controllers be capable of monitoring and controlling different appliances in the home automatically in response to the signals comes from the related sensors. A hardware implementation with Matlab-GUI platform for the proposed system is carried out to show the reliability of the system thus making it a simple, cost-effective and flexible resulting as a good candidate for the smart city future.

(6) The existing system presents a low cost and flexible water level monitoring system using an embedded microprocessor and microcontroller, with IP connectivity for accessing and controlling devices and appliances remotely using Smartphone application. The proposed system by M. Javanmard, K.A. Abbas, and F. Arvin does not require a dedicated server PC with respect to similar systems and offers a novel communication protocol to monitor and control the home environment with more than just the switching functionality.

(7) The need to access and control IOT devices is described in the paper by Osama Mahfooz, Mujtaba Memon, and Asim Iftikhar. For security purposes such as avoiding cyber-crime authentication mechanisms are proposed like: i) Tagging mechanism for access control, ii) Tag Assignment, iii) Selective Publication; finally describing the steps of the algorithm followed.

(8) Low cost and flexible Water level monitoring system is discussed in the paper by Jagadesh Boopathi. An embedded micro web server in Arduino is used with IP connectivity to access and control devices.

(9) The 555-timer- based water-level-controller paper delineates about the existing Water level monitoring system using IR Sensors Also proposal of using the Android

Smartphone to control devices using the Wi-Fi as a communication protocol thus creating a friendly interface force communication between the Raspberry Pi server and the Android device.

(10) Illustration of the method to automate the Water level monitoring using the secure Wi-Fi technology that acts as a server is shown in the paper of S.Jatmiko, A B.Mutiara, Indriati. Various systems that can be monitored are temperature and humidity, motion detection.

# CHAPTER 3: INSTRUMENTS USED

## Ultrasonic Sensor:

The HC-SR04 ultrasonic sensor uses sonar to measure distance to an object. It offers excellent range accuracy and stable readings in an easy-to-use package. It operation is not affected by sunlight or black material like sharp range finders are (soft materials like cloth can be difficult to detect). Working Voltage: 5V (DC). Static Current: Less than 2mA. Output Signal: Electric frequency signal, high level 5V, low level 0V. Sensor Angle: Not more than 15 degrees. Detection Distance: 2 to 450 cm. High Precision: Up to 0.3cm. Input Trigger Signal: 10us TTL impulse. Echo Signal: Output TTL PWL signal mode of connection, VCC, trig (T), echo(R), GND. The basic operation principle is below, use IO port TRIG to trigger ranging. It needs 10 us high level signal at least module will send eight 40 kHz square wave automatically and will test if there is any signal returned. If there is signal returned, output will be high level signal via IO port ECHO. The duration of the high level signal is the time from transmitter to receiving with the ultrasonic. Testing distance = duration of high level x sound velocity (340m/s) / 2.


Fig 1. Ultrasonic Sensor

## NodeMCU:

ESP8266 is a highly integrated chip designed for the needs of a new connected world. It offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor. It is Arduino compatible, works great with the latest Arduino IDE/Mongoose IoT/Micropython. NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language. It is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson and SPIFFS. The operating system is XTOS, memory is 128 kBytes and storage is 4 Mbytes.

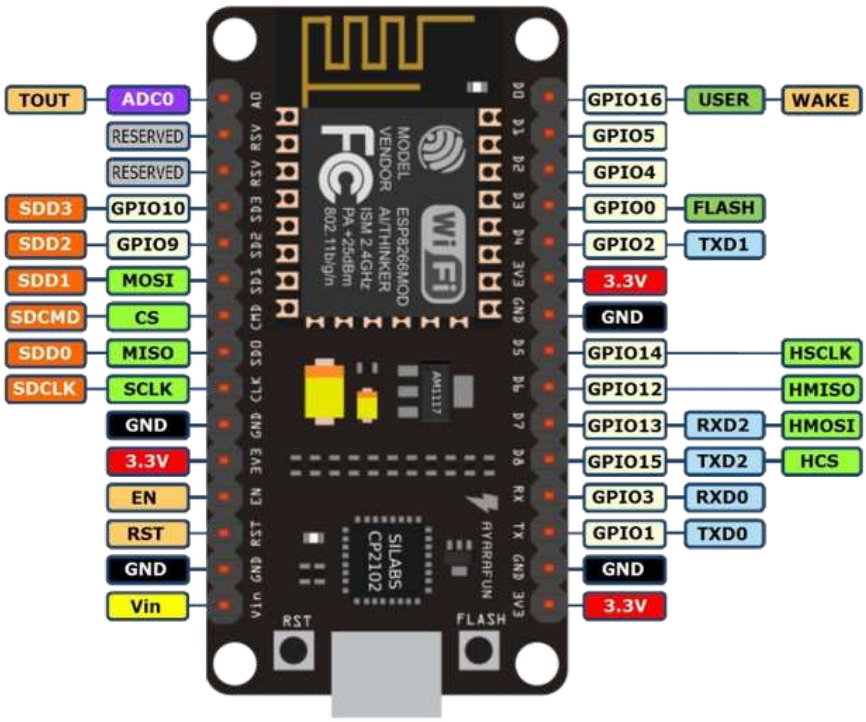



Fig 2. NodeMCU

## Transformer:

A transformer is a static electrical device that transfers electrical energy between two or more circuits. A varying current in one coil of the transformer produces a varying magnetic flux, which, in turn, induces a varying electromotive force across a second coil wound around the same core. Electrical energy can be transferred between the two coils, without a metallic connection between the two circuits. Faraday's law of induction discovered in 1831 described the induced voltage effect in any coil due to changing magnetic flux encircled by the coil. A step-down transformer converts the high voltage (HV) and low current from the primary side to the low voltage (LV) and high current value on the secondary side. This transformer type has a wide application in electronic devices and electrical systems. When it comes to the operation voltage, the step-up transformer application can be roughly divided in two groups: LV (voltages up to 1 kV) and HV application (voltages above 1 kV). Here we use a step down transformer which converts the 230 V AC input to 12 V AC output.

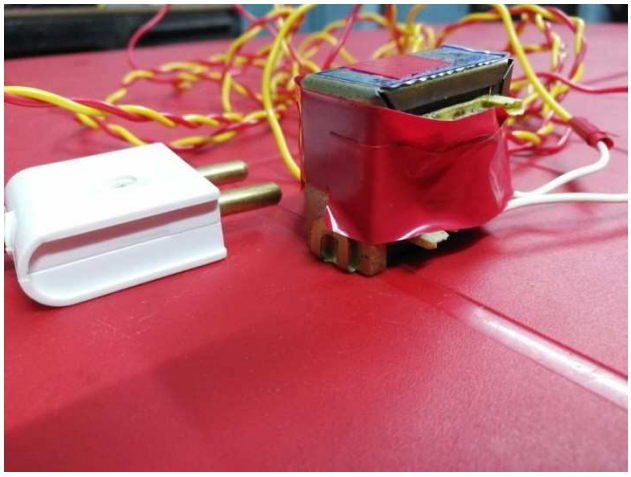


Fig 3. Transformer

## Diode:

A diode is a two-terminal electronic component that conducts current primarily in one direction (asymmetric conductance); it has low (ideally zero) resistance in one direction, and high (ideally infinite) resistance in the other. A diode vacuum tube or thermionic diode is a vacuum tube with two electrodes, a heated cathode and a plate, in which electrons can flow in only one direction, from cathode to plate. A semiconductor diode, the most common type today, is a crystalline piece of semiconductor material with a p–n junction connected to two electrical terminals. Semiconductor diodes were the first semiconductor electronic devices. The discovery of asymmetric electrical conduction across the contact between a crystalline mineral and a metal was made by German physicist Ferdinand Braun in 1874. Today, most diodes are made of silicon, but other materials such as gallium arsenide and germanium are used.

We use four diodes, IN4007 which are to be used in a rectifier circuit.

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. A full-wave rectifier converts the whole of the input waveform to one of constant polarity (positive or negative) at its output. Mathematically, this corresponds to the absolute value function. Full-wave rectification converts both polarities of the input waveform to pulsating DC (direct current), and yields a higher average output voltage. Two diodes and a centre tapped transformer, or four diodes in a bridge configuration and any AC source (including a transformer without centre tap), are needed.

Fig 4. IN4007 Diode

## Voltage Regulator:

The voltage regulator IC 7805 is actually a member of the 78xx series of voltage regulator ICs. It is a fixed linear voltage regulator. The xx present in 78xx represents the value of the fixed output voltage that the particular IC provides. For 7805 IC, it is +5V DC regulated power supply. This regulator IC also adds a provision for a heat sink. The input voltage to this voltage regulator can be up to 35V, and this IC can give a constant 5V for any value of input less than or equal to 35V which is the threshold limit.

The function of Pin 1 is to give the input voltage. It should be in the range of 7V to 35V. We apply an unregulated voltage to this pin for regulation. For 7.2V input, the PIN achieves its maximum efficiency. We connect the ground to this Pin 2. For output and input, this pin is equally neutral (0V). Pin 3 is used to take the regulated output. It will be 5V (4.8-5.2).

In IC 7805 voltage regulator, lots of energy is exhausted in the form of heat. The difference in the value of input voltage and output voltage comes as heat. So, if the difference between input voltage and the output voltage is high, there will be more heat generation. Without a heat sink, this too much heat will cause malfunction.

We call, the bare minimum tolerable difference between the input and output voltage to keep the output voltage at the proper level as dropout voltage. It is better to keep the input voltage 2 to 3V greater than the output voltage, or a suitable heat sink should be placed to dissipate excess heat. We have to calculate the heat sink size properly. The following formula will give an idea of this calculation.
Heat generated = (input voltage – 5) x output current

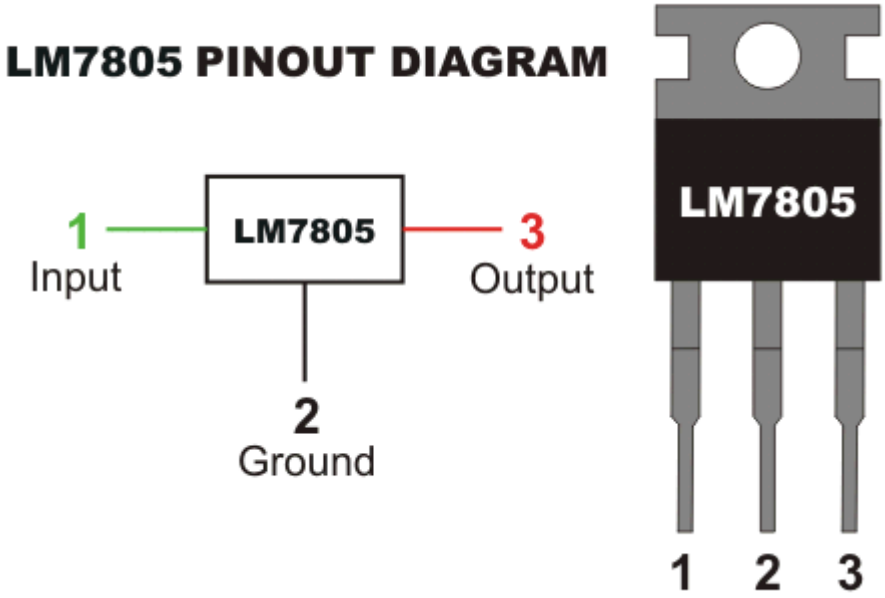



Fig 5. LM7805 Pinout Diagram

## Capacitor:

A capacitor is a passive two-terminal electronic component that stores electrical energy in an electric field. The effect of a capacitor is known as capacitance. While some capacitance exists between any two electrical conductors in proximity in a circuit, a capacitor is a component designed to add capacitance to a circuit. The capacitor was originally known as a condenser or condensator.[1] The original name is still widely used in many languages, but not commonly in English.

The physical form and construction of practical capacitors vary widely and many capacitor types are in common use. Most capacitors contain at least two electrical conductors often in the form of metallic plates or surfaces separated by a dielectric medium. A conductor may be a foil, thin film, sintered bead of metal, or an electrolyte. The nonconducting dielectric acts to increase the capacitor's charge capacity. Materials commonly used as dielectrics include glass, ceramic, plastic film, paper, mica, air, and oxide layers. Capacitors are widely used as parts of electrical circuits in many common electrical devices. Unlike a resistor, an ideal capacitor does not dissipate energy.

When two conductors experience a potential difference, for example, when a capacitor is attached across a battery, an electric field develops across the dielectric, causing a net positive charge to collect on one plate and net negative charge to collect on the other plate. No current actually flows through the dielectric. However, there is a flow of charge through the source circuit. If the condition is maintained sufficiently long, the current through the source circuit ceases. If a time-varying voltage is applied across the leads of the capacitor, the source experiences an ongoing current due to the charging and discharging cycles of the capacitor.

Capacitance is defined as the ratio of the electric charge on each conductor to the potential difference between them. The unit of capacitance in the International System of Units (SI) is the farad (F), defined as one coulomb per volt (1 C/V). Capacitance

values of typical capacitors for use in general electronics range from about 1 picofarad (pF) ($10^{-12}$ F) to about 1 millifarad (mF) ($10^{-3}$ F).

The capacitance of a capacitor is proportional to the surface area of the plates (conductors) and inversely related to the gap between them. In practice, the dielectric between the plates passes a small amount of leakage current. It has an electric field strength limit, known as the breakdown voltage. The conductors and leads introduce an undesired inductance and resistance.

Capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass. In analog filter networks, they smooth the output of power supplies. In resonant circuits they tune radios to particular frequencies.

In electric power transmission systems, they stabilize voltage and power flow.[2] The property of energy storage in capacitors was exploited as dynamic memory in early digital computers.

Here we use a 1000 uf and a 100 uf which are used as bypass capacitor, used to bypass very small extent spikes to the earth.

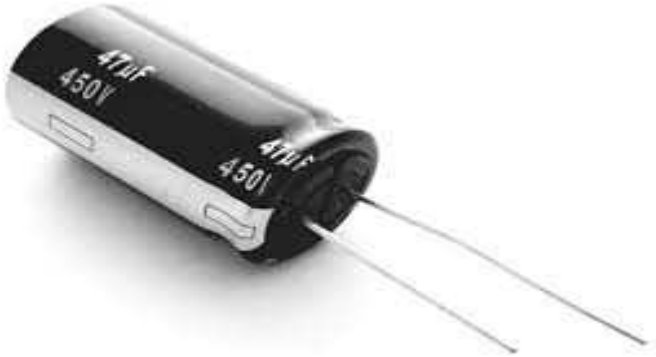



Fig 6. A Capacitor

## LCD Display:

A liquid crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. It has 16 pins and the first one from left to right is the Ground pin. The second pin is the VCC which we connect the 5 volts from the supply. Next is the Vo pin on which we can attach a potentiometer for controlling the contrast of the display.

Next, The RS pin or register select pin is used for selecting whether we will send commands or data to the LCD. For example if the RS pin is set on low state or zero volts, then we are sending commands to the LCD like: set the cursor to a specific location, clear the display, turn off the display and so on. And when RS pin is set on High state or 5 volts we are sending data or characters to the LCD.

Next comes the R / W pin which selects the mode whether we will read or write to the LCD. Here the write mode is obvious and it is used for writing or sending commands and data to the LCD. The read mode is used by the LCD itself when executing the program which we don't have a need to discuss about it in this tutorial.

Next is the E pin which enables the writing to the registers, or the next 8 data pins from D0 to D7. So through this pins we are sending the 8 bits data when we are writing to the registers or for example if we want to see the latter uppercase A on the display we will send 0100 0001 to the registers according to the ASCII table.

And the last two pins A and K, or anode and cathode are for the LED back light.

After all we don't have to worry much about how the LCD works, as the Liquid Crystal Library takes care for almost everything. From the Arduino's official website you can find and see the functions of the library which enable easy use of the LCD. We can use the Library in 4 or 8 bit mode. In this tutorial we will use it in 4 bit mode, or we will just use 4 of the 8 data pins.

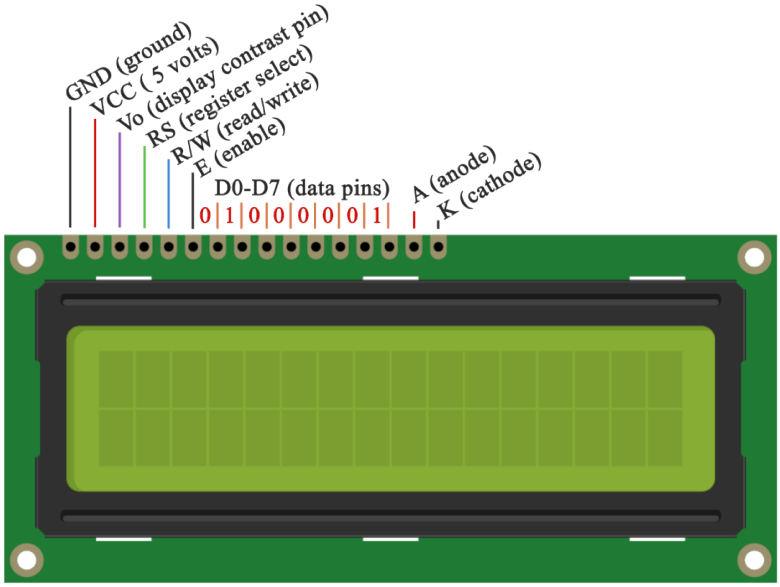



Fig 7. 16*2 LCD Display

## I2C:

Inter-Integrated Circuit (I2C) panel is a synchronous, multi-master, multi-slave, packet switched, single-ended, serial compound bus. I²C uses only two bidirectional open collector or open drain lines, Serial Data Line (SDA) and Serial Clock Line (SCL), pulled up with resistors. Typical voltages used are +5 V or +3.3 V, although systems with other voltages are permitted.

The I²C reference design has a 7-bit address space, with a rarely-used 10-bit extension. Common I²C bus speeds are the 100 kbit/s standard mode and the 400 kbit/s Fast mode. There is also a 10 kbit/s low-speed mode, but arbitrarily low clock frequencies are also allowed. Recent revisions of I²C can host more nodes and run at faster speeds (400 kbit/s Fast mode, 1 Mbit/s Fast mode plus or Fm+, and 3.4 Mbit/s High Speed mode). These speeds are more widely used on embedded systems than on PCs.

Note the bit rates are quoted for the transfers between master and slave without clock stretching or other hardware overhead. Protocol overheads include a slave address and perhaps a register address within the slave device, as well as per-byte ACK/NACK bits. Thus the actual transfer rate of user data is lower than those peak bit rates alone would imply. For example, if each interaction with a slave inefficiently allows only 1 byte of data to be transferred, the data rate will be less than half the peak bit rate.

The number of nodes which can exist on a given I²C bus is limited by the address space and also by the total bus capacitance of 400 pF, which restricts practical communication distances to a few meters. The relatively high impedance and low noise immunity requires a common ground potential, which again restricts practical use to communication within the same PC board or small system of boards.

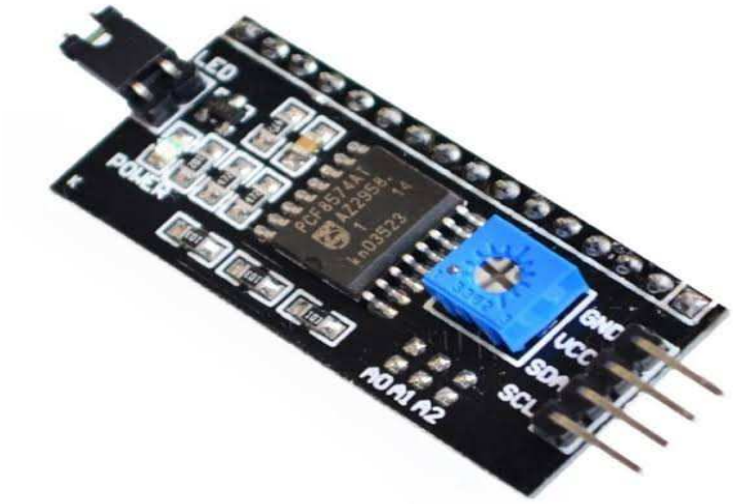



Fig 8. An I2C Panel

## BC547 Transistor:

It is an NPN bi-polar junction transistor. Together with other electronic components, such as resistors, coils, and capacitors, it can be used as the active component for switches and amplifiers. Like all other NPN transistors, this type has an emitter terminal, a base or control terminal, and a collector terminal. In a typical configuration, the current flowing from the base to the emitter controls the collector current. A short vertical line, which is the base, can indicate the transistor schematic for an NPN transistor, and the emitter, which is a diagonal line connecting to the base, is an arrowhead pointing away from the base.

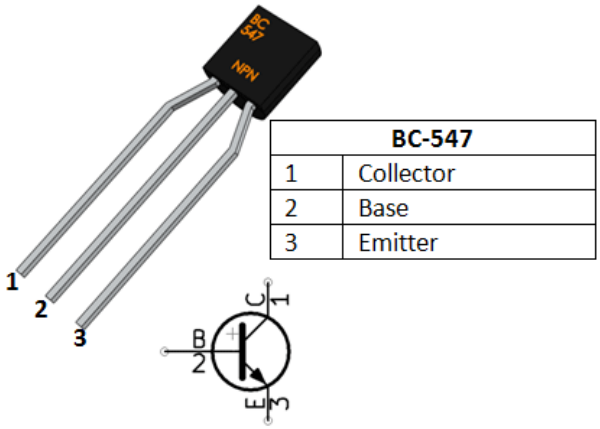
There are various types of transistors, and the BC547 is a bipolar junction transistor (BJT). There are also transistors that have one junction, such as the junction field-effect transistor, or no junctions at all, such as the metal oxide field-effect transistor (MOSFET). During the design and manufacture of transistors, the characteristics can be predefined and achieved. The negative (N)-type material inside an NPN transistor has an excess of electrons, while the positive (P)-type material has a lack of electrons, both due to a contamination process called doping.

The BC547 transistor comes in one package. When several are placed in a single package, it is usually referred to as a transistor array.Arrays is commonly used in digital switching. Eight transistors may be placed in one package to make layout much easier, for example.

To make use of a transistor as an audio preamplifier, a direct current (DC) source is needed, such as a 12-volt (V) power supply. In a common emitter configuration, the negative side of the power supply is alternating current (AC)-coupled to the emitter

via a capacitor. There is also a small resistance connecting the power supply to the emitter. The power supply is then connected to the collector via a resistor, which may be referred to as a limiting resistor. When the collector-to-emitter current flows, there will be a voltage drop in the limiting resistor, and in the idle state, the collector voltage is typically 6 V.

Transistor circuit design requires a thorough understanding of current-voltage ratings of various components, such as transistors and resistors. One goal is to keep the components from burning up, while another is to make the circuit work. Saving electricity is also important, such as in the case of battery-operated devices.




| BC-547 | |
|---|---|
| 1 | Collector |
| 2 | Base |
| 3 | Emitter |

Fig 9. BC547 Transistor

## Buzzer:

It is an audio signalling device, which may be mechanical, electrochemical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke. Here we are using a piezoelectric buzzer.

Early devices were based on an electromechanical system identical to an electric bell without the metal gong. Similarly, a relay may be connected to interrupt its own actuating current, causing the contacts to buzz. Often these units were anchored to a wall or ceiling to use it as a sounding board. The word "buzzer" comes from the rasping noise that electromechanical buzzers made.

A joy buzzer is an example of a purely mechanical buzzer and they require drivers. Other examples of them are doorbells.

A piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source, driven with a piezoelectric audio amplifier. Sounds commonly used to indicate that a button has been pressed are a click, a ring or a beep.

A piezoelectric buzzer/beeper also depends on acoustic cavity resonance or Helmholtz resonance to produce an audible beep.

Fig 10. Buzzer

## Single Channel Relay:

A relay is an electrically operated switch. A single channel relay has three channels through the help of which it does the switching control.

Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. 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. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays". Magnetic latching relays require one pulse of coil power to move their contacts in one direction, and another, redirected pulse to move them back. Repeated pulses from the same input have no effect. Magnetic latching relays are useful in applications where interrupted power should not affect the circuits that the relay is controlling.

Magnetic latching relays can have either single or dual coils. On a single coil device, the relay will operate in one direction when power is applied with one polarity, and

will reset when the polarity is reversed. On a dual coil device, when polarized voltage is applied to the reset coil the contacts will transition. AC controlled magnetic latch relays have single coils that employ steering diodes to differentiate between operate and reset commands. It was used in long distance telegraph circuits, repeating the signal coming in from one circuit and re-transmitting it to another.


Fig 11. Single Channel Relay

## Water Pump:

We use 12 V DC water pump which helps to pump water from the source to the tank. A water pump is powered by a device called an impeller. The impeller is a bit like a turbine. It has many curved blades, which channel the water through the pump.

The impeller spins very fast. The curved blades channel water into the eye, or center of the impeller, but that water flows along to the outside of the blades. Because the impeller moves fast, the centrifugal force compresses the water against the outside of the blade. This pressure causes the water to rocket forward in a high-speed jet out of the impeller. This speed creates pressure on the outlet side of the pump, pushing the water through the pipe.

Smaller electric water pumps, such as the kinds used in homes, usually have small DC motors. The DC motor is contained in a sealed case attached to the impeller and powers it through a simple gear drive. In the center of the motor is a rotor with coils around it. Around those coils are magnets, which create a permanent magnetic field that flows through the rotor. When the motor turns on, electricity runs through the coils, producing a magnetic field that repels the magnets around the rotor, causing the

rotor to spin around 180 degrees. When the rotor spins, the direction of the electricity in the coils flips, pushing the rotor again and causing it to spin the rest of the way around. Through a series of pushes, the rotor continues to spin, driving the impeller and powering the pump.

Fig 12. 12 V DC Pump

# CHAPTER 4: WORKING PRINCIPLE

## 5V DC Supply:

For this we are using a 230V to 12V AC Step down transformer which is then converted into 5 V DC supply through the help of a filter circuit and then a 7805 IC which converts the voltage finally to 5 V DC supply. The capacitor before and after the 7805 IC are bypass capacitor which are used to bypass small extent spikes to the earth.

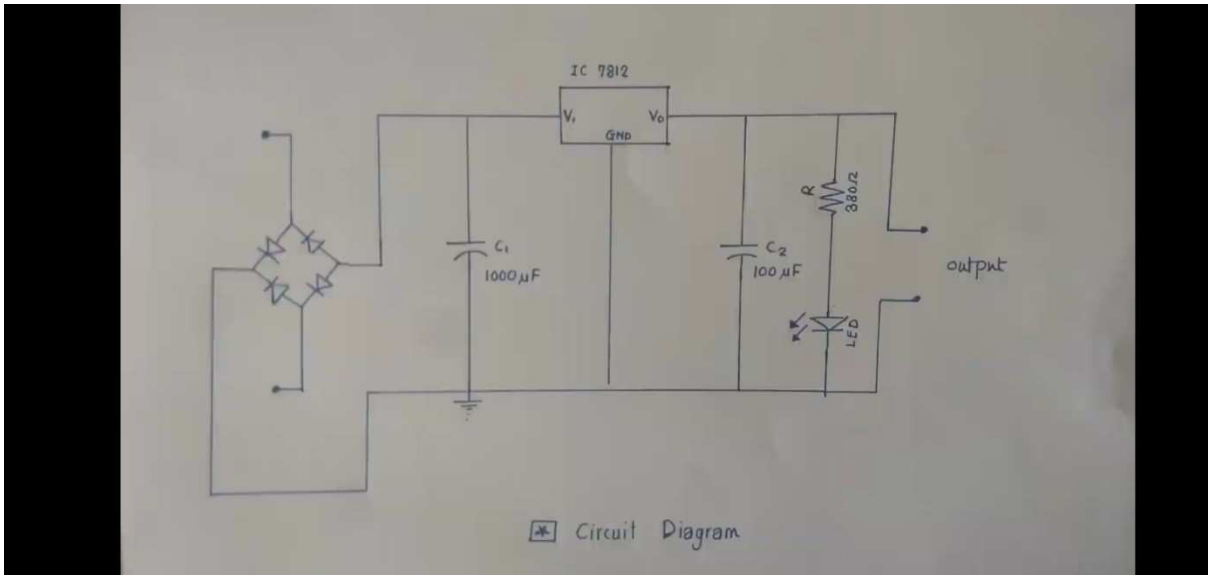



Fig 13. Circuit Diagram

## Distance Measurement:

The ultrasonic sensor emits an ultrasound at 40 000 Hz which travels through the air and if there is an object or obstacle on its path It will bounce back to the module. Considering the travel time and the speed of the sound you can calculate the distance. The HC-SR04 Ultrasonic Module has 4 pins, Ground, VCC, Trig and Echo. In order to generate the ultrasound you need to set the Trig on a High State for 10 µs. That will send out an 8 cycle sonic burst which will travel at the speed sound and it will be received in the Echo pin. The Echo pin will output the time in microseconds the sound wave travelled. For example, if the object is 10 cm away from the sensor, and the speed of the sound is 340 m/s or 0.034 cm/µs the sound wave will need to travel about 294 u seconds. But what we will get from the Echo pin will be double that number because the sound wave needs to travel forward and bounce backward. So in order to get the distance in cm we need to multiply the received travel time value from the echo pin by 0.034 and divide it by 2.

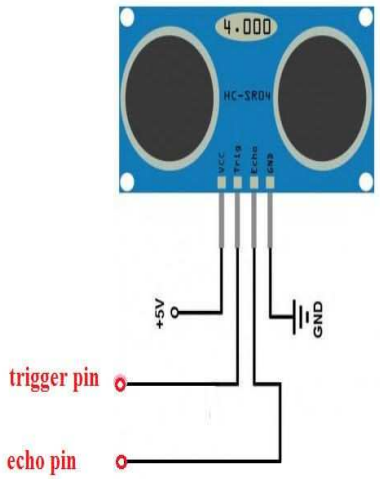



Fig 14. Diagram showing connection for the sensor

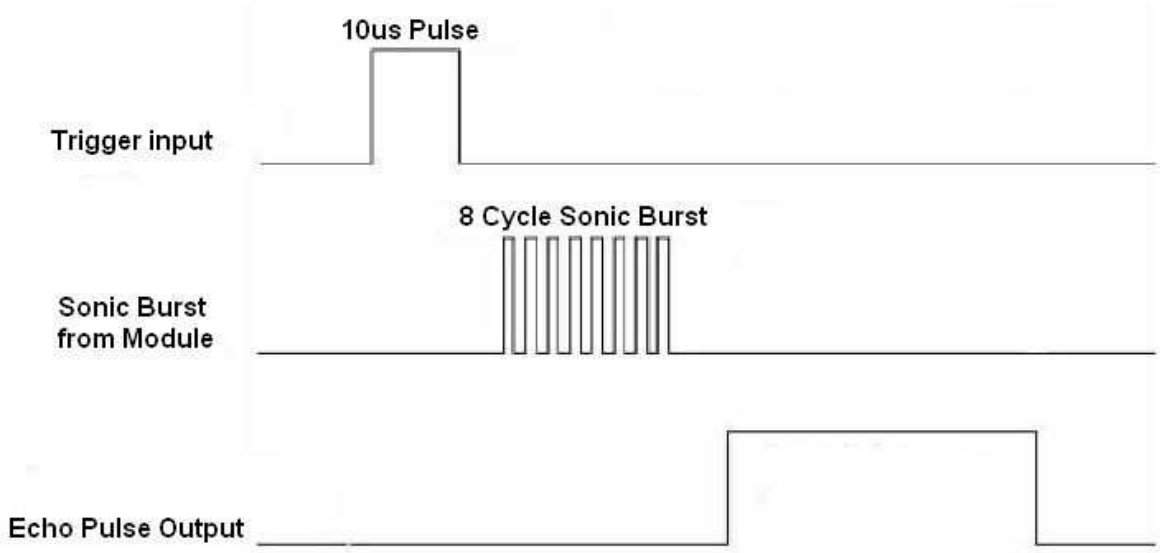



Fig 15. Working of the HC-SR04 Sensor

## Implementation:

In this circuit we have implemented the design by connecting the VCC pin of the sensor to the +5V, which is taken from the supply designed. The GND pin is

connected to NodeMcu GND pin. The Trigger pin and the Echo pin are connected to two input/output pins of the microcontroller.

The NodeMCU uses the “pulseIn” function from the Arduino IDE to calculate the time taken for the sound waves to hit the obstacle and comes back and after that uses mathematical functions to give us the distance of the water level from the top.


Fig 16. 5V Supply Circuit

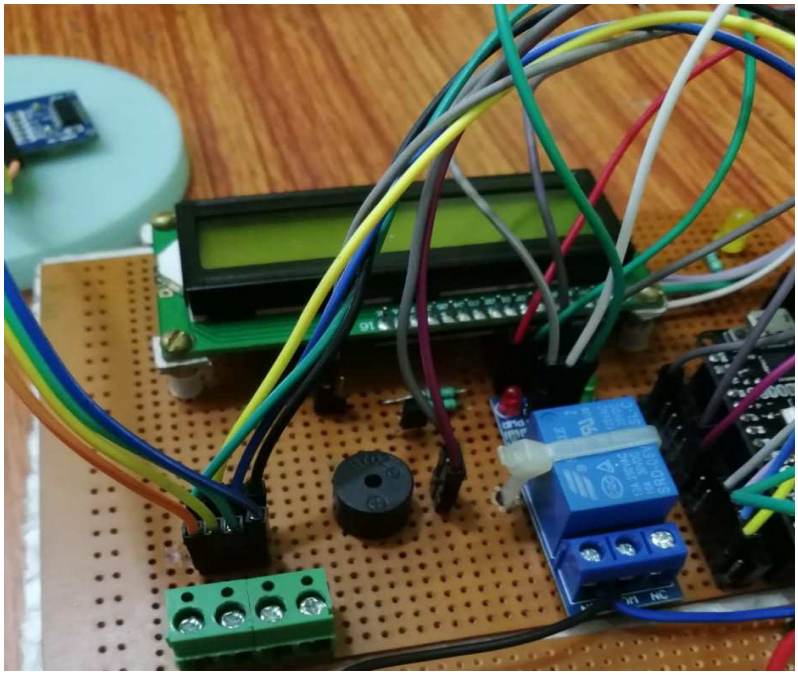


Fig 17. Circuit Containg Relay,LCD and Buzzer

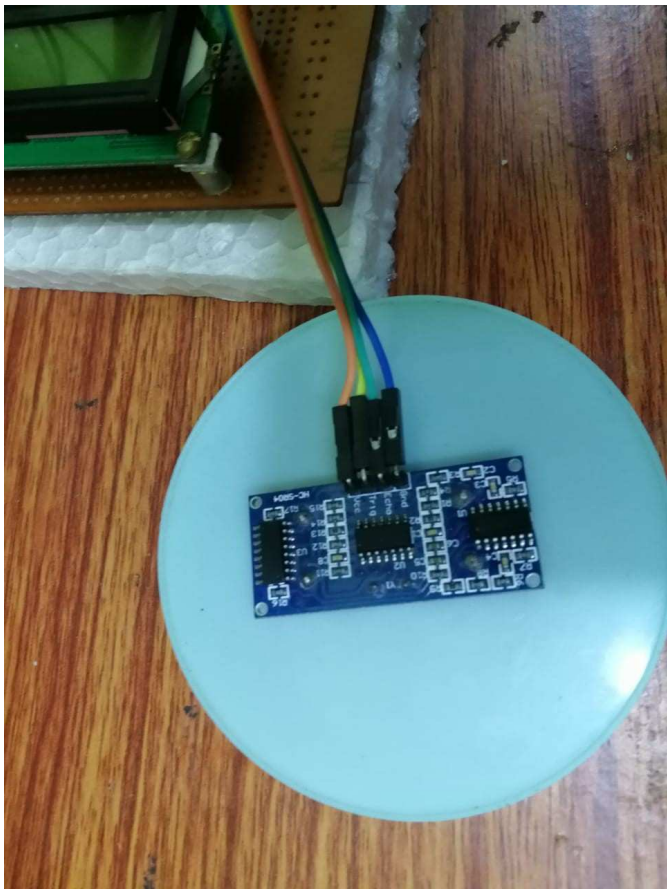


Fig 18. Ultrasonic Sensor attached on a lid

## Displaying of data:

Interfacing the LCD display with the I2C panel is done which helps to reduce the number of pins required to be connected with the LCD. The I2C device helps to reduce the number of pins to 4. The LCD shows the distance of water level from the top and also whether the pump is on or not.

## Control Action:

The distance data is used for a control action in which a relay and a water pump is used which always maintains the water level between 30 – 70 % of the height of the tank. One wire of pump is grounded, and the second wire is inserted into the NO output of relay. The Common output of relay is given with 12 V DC supply with the help of an adapter. In the input of relay we have VCC which has 5V DC supply, the GND pin is grounded. And the IN (Input) pin we give a signal from the NodeMcu but since the output is of the digital state 3.3 V , it is first amplified using a BC547 transistor and then given to the relay which converts the 3.3V state to 5V so that the relay can understand the value. The NO output is disconnected when the IN is set LOW and connected when IN is HIGH. It will get HIGH till the distance reaches 70% so that the pump is ON and will get LOW when the distance reaches 70% and the pump is switched off.

## Buzzer Action:

The buzzer has two pins, one is connected to GND Pin of NodeMCU and the other is connected to I/O pin of NodeMcu. It goes ON at first when the pump goes ON and goes ON when the pump goes OFF.

# CHAPTER 5: EXPERIMENTAL RESULTS

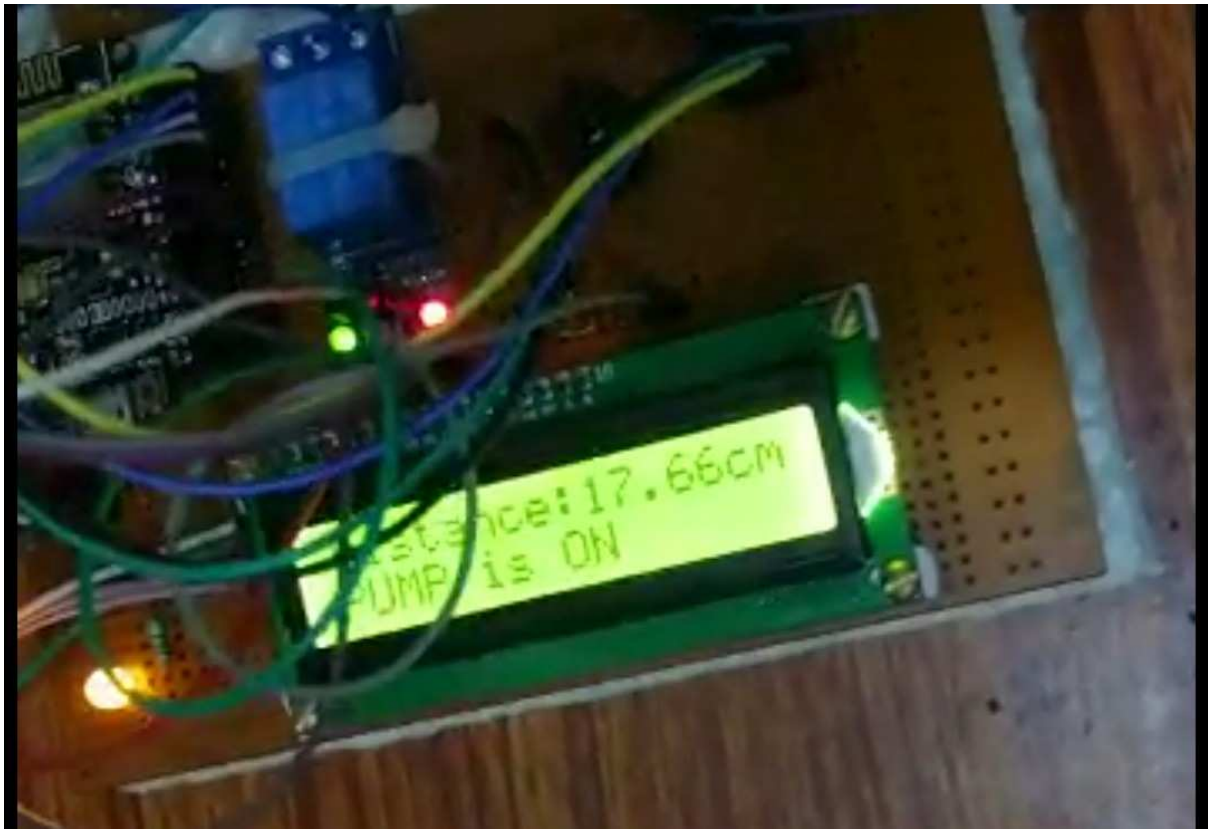



Fig 19. LCD Display displaying the distance

As we can see that the test demo shows us that the NodeMCU has calculated the time taken for the pulse to travel and return back and also uses the mathematical functions to calculate the distance from time data. As we can see the delay function enables us to get different data after the given specified time delay. This delay function helps us to view the water level in real-time after given specified time periods. The distance represented is from the top of the tank, i.e., we get the data of how much the water level is below the top of the tank. The same data is then used to run the control action circuit for keeping the water level in the tank always between 30-70 % of the total height. Also the Buzzer goes ON and OFF as specified.

# CHAPTER 6: CONCLUSION

The project enables us to observe the level of water from a distant location and helps us to track it and protect it from overflowing and thereby enabling the user to ensure that no extra water gets used and there is no excess loss of water. We know that the major place where water gets wasted is industries and homes. So using this proposed system will help to minimize the water loss to a large extent. If the user knows about the water level in real-time he/she has the power to maintain the water loss to an extent by maintaining the water at a sustainable height, i.e., between 30-70% of the height of the original tank to ensure no overflowing.

# CHAPTER 7: FUTURE SCOPE

This project has extensive scope in the industrial field and the housing sector; by using a level control loop it can be ensured that the water level does not cross a certain limit and also by using a pump it is ensured that a minimum height is always achieved. These days in our busy life we need messages as reminder in our phones or laptops that are connected by internet and this system can give reminders regarding the water level to the user every-time in his/her hand. It will also help in creating a smart city centered around the idea of water preservation.

# REFERENCES

[1] P. Dietz, W. Yerazunis, D. Leigh, Very Low -Cost Sensing and Communication Using Bidirectional LEDs, UbiComp 2011: Proceedings, vol. 2864, pp. 175`-191, 2003.

[2] M. Javanmard, K.A. Abbas and F.Arvin,"A Microcontroller Based Monitoring System for Batch TeaDryer", CCSE Journal of Agricultural Science, Vol. 1, No. 2, December 2012

[3] Hicks, F., Tyler, G.; & Edwards, T.W.Pump Application Engineering- McGraw-Hill Book Company, New York.

[4] Microcontroller Based Automated Water Level Sensing and Controlling: Design and Implementation Issue Proceedings of the World Congress on Engineering and Computer Science, pp 220-225.

[5] S.M. Khaled Reza, Shah Ahsanuzzaman Md. Tariq, and S.M. Mohin Reza, "Microcontroller Based Automated Water Level Sensing and Controlling: Design and Implementation Issue," Proceedings of the World Congress on Engineering and Computer Science, vol I, 2014.

[6] M. Javanmard, K.A. Abbas, and F. Arvin, "A Microcontroller- Based Monitoring System for Batch Tea Dryer," CCSE Journal of Agricultural Science, vol. 1, no. 2,2013.

[7] Osama Mahfooz, Mujtaba Memon, and Asim Iftikhar, "Project Review on Water Level Sensing Using PLC," Journal of Engineering & Technology Science, vol. 2, no. 2, pp. 160-170,2012.

[8] Jagadesh Boopathi, “555 Timer Based Water Level Controller,” Electronics Tutorials by Jagansindia, Inc., 23 June 2013.

[9] http://ece.jagansindia.in/2013/06/555-timer- basedwater-level-controller.

[10] S.Jatmiko, A B.Mutiara, Indriati ―Prototype of water level detection system with wireless Journal of Theoretical and Applied Information Technology Vol. 37 pp 52-59, 2012.

[11] Automatic Water Level Indicator and Pump Controller using Arduino from https://www.robotsthenextspeciesonearth.com/p/blog-page_14.html

[12]Distance Measurement Using HC-SR04 via NodeMCU from www.instructables.com/id/Distance-Measurement-Using-HC-SR04-Via-NodeMCU/

# APPENDIX

Program Code to calculate the distance and implement the control action:

```
#include <Wire.h>

#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27, 16, 2);


const int buzzer = D5;

const int relay = D6;

const int trigPin = D1;

const int echoPin = D2;


long duration;

float distance;

int f=0;

void setup()

{

pinMode(buzzer, OUTPUT);

pinMode(relay, OUTPUT);

pinMode(trigPin, OUTPUT);

pinMode(echoPin, INPUT);

Serial.begin(9600);

Wire.begin(2,0);
```

```
  lcd.init();
  lcd.backlight();
}
void loop()
{
lcd.setCursor(1,0);

digitalWrite(trigPin, LOW);
delayMicroseconds(2);

digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);

duration = pulseIn(echoPin, HIGH);

distance= duration*0.034/2;

Serial.print("Distance: ");
Serial.println(distance);
lcd.setCursor(0,0);
lcd.print("Distance:");
lcd.print(distance, 2);
```

```
lcd.print("cm");
delay(10);


if(distance==18 || distance>=18)
  {
    f=1;
    if(f==1 && distance>7)
    {
     digitalWrite(relay, HIGH);
     digitalWrite(buzzer, HIGH);
     delay(550);
    digitalWrite(buzzer, LOW);
     lcd.setCursor(0,1);
     lcd.print("PUMP is ON");
    }
    f=1;
  }
  else if (f==1 && distance>7)
  {
    digitalWrite(relay, HIGH);
    lcd.setCursor(0,1);
    lcd.print("PUMP is ON");
  }
```

```
  else if (f==0 && distance>7)
  {
   digitalWrite(relay, LOW);
   lcd.setCursor(0,1);
   lcd.print("PUMP is OFF");
  }
  else if(distance<7)
  {
   digitalWrite(relay, LOW);
   digitalWrite(buzzer, HIGH);
    delay(550);
   digitalWrite(buzzer, LOW);
    delay(550);
   lcd.setCursor(0,1);
   lcd.print("PUMP is OFF");
   f=0;
  }
delay(1000);
lcd.clear();
  }
```

Mathematics: The controller uses time taken and converts it into distance using the formula: (duration/2) / 29.1; this gives the distance in cm.