555 timer-based automatic water level sensor and controller system

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Abstract

The scarcity of water, which is vitally valuable to all living things, is steadily getting worse. A sizable chunk of the district's and the world's urban populations are struggling withthis problem. One of the sources of inspiration for the current work is to explain ways to conserve water and improve the environment, which will guarantee that there will be water for future needs. Therefore, protecting and conserving water is of the utmost importance. Water is wasted needlessly in many homes due to flooding from above-ground tanks and other factors. The Programmed Water Level Regulator can provide a solution to this problem. An automatic water control system offers a key answer to this problem. The system's methodology is entirely dependent on the water's electrical conductivity and the signals it sends to various logic systems.This device stops the water pump from overflowing and provides indicators for various water levels in the above tank.

Keywords—*waterlevel,555timerIc,relay,overhead tank,comparators,waterpump,motordrivingcircuit*

I. INTRODUCTION

A common problem is the loss of water due to overflowing from the above tank that is physically worked. If this waste can be reduced through proper monitoring using a simple circuit, then scarcity and water shortages may be prevented. The circuit will continuously check the high level and base level of the above tank's two water levels. When the water level reaches a certain point, the engine will stop filling the tank from the source and stop the stream of water. Up until it reaches the base level, the engine will remain in an off state. The engine will shut off when the water level drops below the foreground base level.A regulator is anticipated to deal with the required volume or level in underground and above-ground tanks of premises in order to regulate and utilize water.The pumping engine, which uses transfer from the regulator, is a single-stage AC device. The current work uses semiconductors and the clock IC555 instead of combining any microcontrollers. In order to fill the above tank to the desired level or volume of water, it will subsequently turn ON and OFF the home-made water pump. This water level regulator circuit's primary advantage is that it naturally controls the water level with essentially no client connection .It uses simple electronic components. The NE555 IC serves as the circuit's central component. By using the sensory test and circuit of the tank, the water level regulator creates a difference in controlling the amount of water naturally. This system does not just simply monitor the water level in the tank; it also controls the motor when the space above the tank is empty. When the expected amount in the above tank is achieved accompanied Drove indicators, the motor is shut OFF. When subsurface water level is below the predetermined limit, the pump motor is not turned on. By using this design, we can prevent water.

The automatic pump controller reduces the amount of manual switching and interference from people.System operates in accordance with water conductivity.This system features a built-in power supply and a solar power backup system that ensures a constant supply of electricity even during load shedding, which is typical in many nations.The water level regulator we intend to build in our project is based on two identification points in the overhead tank. The water should be contested in these two locations. We use sensors to work with this.In our situation, these sensors have three metallic contacts with space between them at each recognition site.When water arrives at a sensor, a valid circuit must first be preseirted to the extent that the presence of water is recognized; additionally, a signal is given. To get the desired result, this signal should be transmitted through IC555 circuits. When water comes at another sensor, a similar action will occur. Our circuit employs the high and low states of an IC555 to activate or deactivate the TRIAC.

Two circumstances are consistently essential for the engine to put on. If both of them isn't fulfilled the engine will stay off. Various scientists have previously introduced the comparative work in view of microcontroller and GSM network Others have likewise revealed for water level regulator Utilizing Multisim and 555 timer.The objective of this paper is to add extra elements and limiting the expense for its execution [3].We accept that the establishment of such a framework will upgrade legitimate administration and utilization of water in homegrown houses,agricultural or modern regions through checking and control of the amount of use. Such frameworks contribute towards the expect to save our normal assets and keep up with the manageability of the climate as through monitoring,water utilization examples and shortcomings can be distinguished and decrease targets can be arranged [5].

II. BLOCK DIAGRAM

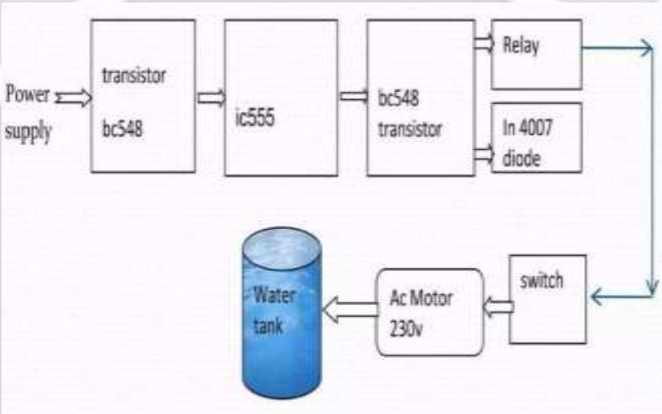

Fig.1.Blockdiagram of automatic water level controller

The designed model's block outline is shown in Fig1. The automatic water level regulator makes use of an underground tank, an above tank, a pump, and a regulator circuit with level testing. Level testing should be set up correctly in the above tank and the controlling device inside the house[1].The data concerning this specific water level regulator is shown in fig.1.It consists of a BC 548 Semiconductor, a NE555 IC timer, a Transfer, an IN4007 Diode, an Engine, and a Tank that may be used to refill the water.When data from 9v-12v is supplied from the battery/power supply to the project, it starts working.This data is provided by the power supply, and the semiconductor will dynamically provide power to the IC 555 timer via the hand-off.The transfer and diode are connected to the result pin of the IC 555 timer.The hand-off is then maintained at a necessary level, and the engine is started by turning on.When the motor is turned on, it is ready to fill the tank by detecting the sensors or the water level in the tank.It is dependent on the amount of water.When the water tank is full, it is naturally shut off.

III. LIST OF COMPONENTS AND OVERVIEW

The list of elements that are required to develop automatic water level controller circuit as shown in the below table[I].

TABLEI.LIST OF ELEMENTS THAT ARE REQUIRED

Component	**Specification**	**Quantity**
Metallic Contacts		2
Transformer	230V/9V,50Hz	1
Diode	1N4001,50V	4
Voltage Regulator	IC MC7805CT	1
Water Pump	5W, 230v	1
555 Timer IC	(4.5V - l6 v)	1

Triac	IC BT136	2
LED	3-5V	1
Transistor	BC 548	2
Capacitor	0.01 pF &470 pF	2
Resistor	100K&470K	3

Some of the main components required are transformer,diode,voltage regulator,water pump,555IC timer,transistor,capacitor and resistor [4]. We will discuss briefly about the each and every component that is listed in the above table[I].

A.Contacts made of Metal:

These are aluminum contacts that transmit power when the gap between them is filled by water. Two contacts at the foot of the tank structure act as the indication for low level of order in our task. Two contacts in the upper half of the tank indicate that water is about to flow.

B.Transformer:

A centre-tapped stepdown transformer is used to provide an acceptable voltage to the full-wave rectifier-We particularly selected three transformer so that the device could be connected directly to the wall outlet. Similarly, centre tapping allows us to generate a positive extremity voltage for the circuit. 230/9V AC, 50 Hz rating.

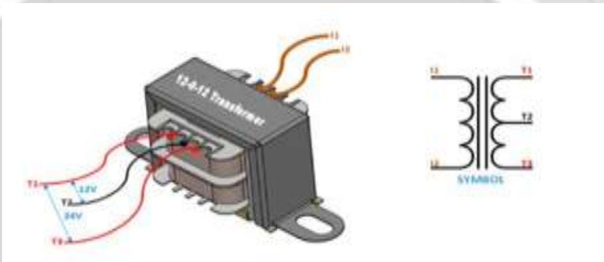

Fig.2.Centre tapped transformer

C.Full-Wave Rectifier:

The full wave rectifier comprises of four 1N4007 diodes and two 0.1pF capacitors. lt is utilized to convert the AC supply of the power source to DC supply which will run greater part of the circuit components.It changes over an AC voltage into a dc voltage utilizing both half patterns of the applied ac voltage. for this reason, it utilizes two diodes of which one conducts during one half cycle while the other conducts during the other half pattern of the applied AC voltage.During the positive half pattern of the input voltage, the diode D2 becomes forward one-sided and D4 becomes opposite one-sided. Consequently D2 conducts and D4 stays OFF. The load current moves throughD2 and the voltage drop across the load will be equivalent to the input voltage. Presently during the negative half pattern of the information voltage, diode D2 becomes reverse one-sided and D4 becomes forward one-sided. Consequently D2 stays OFF and D3 conducts. The load current courses through D3 and the voltage drop across the load will be equivalent to the input voltage [4].

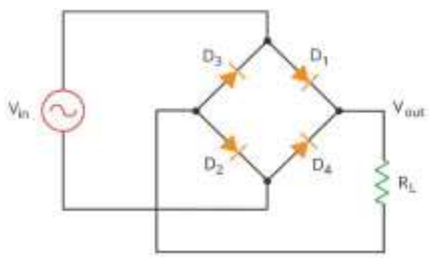

Fig.3.Fullwave Rectifier

D.Voltage Regulator:

A voltage regulator is an integrated circuit (IC) that maintains a constant fixed output voltage regardless of load or input voltage changes. It can do this in a variety of ways depending on the topology of the circuit in them, but for the sake of keeping this project simple, we will focus mostly on the linear regulator. A linear voltage regulator operates by automatically changing the resistance through a feedback loop, allowing for variations in both load and input while maintaining a constant output voltage.

Fig.4.Voltage Regulator

E.Water pump:

The centrifugal pump is commonly used in submersible fountain pumps and air conditioning equipment. Water is drawn into one side of the pump as the impeller inside it revolves. The power and size of the impeller determine the direction of water flow. More water can be pumped if the impeller is larger. As the impeller rotates, centrifugal force propels water from the inlet (placed near the centre of rotation of the impeller) through the surfaces of the impeller to the outer regions of the valve (thus the term centrifugal pump). This water is directed to the outflow as it collects in the valve's outer regions. The water exiting the valve causes the water pressure to drop. The pump pulls in new water at the input to match the pace at which the water flows out the outlet.

Fig.5.Water Pump

F. 555 IC Timer:

In this case, we use a bi-stable version of the 555 timer as a flipflop component.A Schmitt Trigger, also known as a Bistable Mode, has stable states of high and low. The circuit enters into high state by lowering the trigger information. Circuit results enter the low state when the Reset input is made low.A synchronized circuit used in oscillator and generation applications is the 555 timer integrated circuit. IC555 package is a silicon chip that comes in an 8-pin dual inline package and contains 25 semiconductors, 2 diodes, and 15 resistors. The package view IC555 timer is shown in the Fig.6.

Fig.6. IC555 package view

The 555 timer is actually what controls everything. The timer, as shown in Fig.7, has two comparators and a flip flop available inside. Pin 2 is maintained in the upper level of the above tank, and pin 6 is kept in the bottom level. Power can transmit fairly well through water. Therefore, when Vcc is submerged in water, the water conveys the value of Vcc [3].

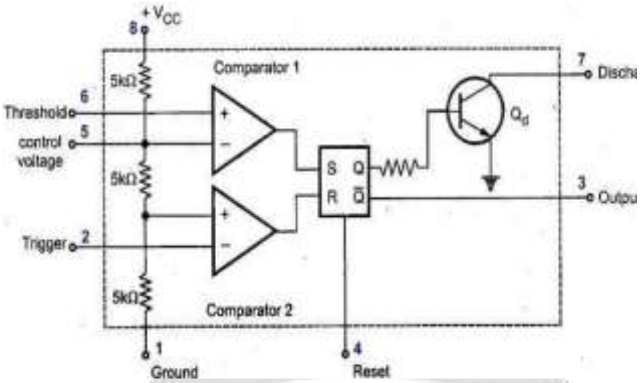

Fig.7. IC555 timer internal structure

Explanation of IC555 pins:

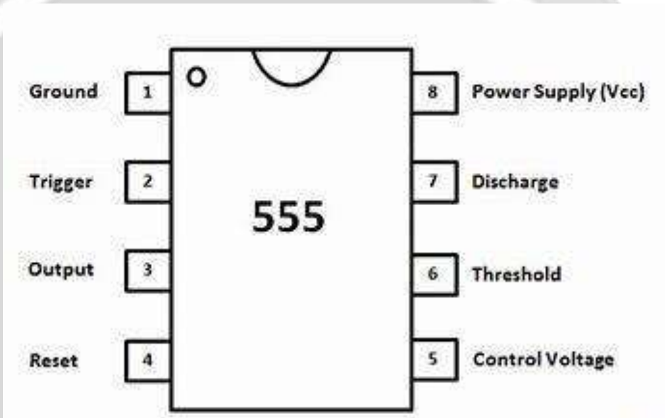

Fig.8.IC555 pin diagram

The Pin diagram of 555IC is shown in the above Fig.8.It consists of 8 pins which are given below,we will discuss the 8 pins that are mentioned above in a detailed manner.

Pin 1: Ground

Every voltage is evaluated in relation to this terminal.

Pin 2: Trigger

Two comparators are used by the IC 555. Three equal voltage make up the voltage divider. The voltage of the comparator 2 non-inverting terminal is set at VCC/3 due to the voltage divider.The comparator 2 result increases when the trigger information is somewhat off from VCC/3. The output is provided by the R-S flip-flop's reset contribution. Therefore, a high comparator 2 result resets the flip-flop.

Pin 3: Result

The flip-flop's complementary signal result ($\overline{Q}$) is transferred to pin 3, which is the final output. There are two ways to connect the load. One is connected to pin 3 and ground, and the other is to pin 8.

Pin 4: Reset

This interferes with the timing device. When pin 4 is grounded, the device no longer functions and turns off. Pin 4 functions as the IC 555's on/off component in this way. When this reset input is instantly grounded, any remaining capabilities inside the timer are revoked.

Pin 5: Control voltage

The majority of applications do not make use of external control voltage input. This pin serves as Comparator 1's inverting input terminal. The voltage divider maintains this input's voltage at 2/3 VCC This serves as the comparator 1's reference level for comparing the threshold. Pin 5 must receive external input if the reference level required for comparator 1 is greater than 2/3 VCC.The reference level for comparator 1 alternates between being above and below 2/3 VCC if external input is applied to pin 5 on an alternating basis. This makes it feasible to emit pulses with a configurable pulse width, This process, known as pulse width modulation, is made feasible by pin 5.

Pin 6: Threshold

This is comparator 1 non-inverting input terminal. The pin 6 is subjected to the external voltage. The result of comparator 1 turns high when this voltage is more than 2/3 of VCC. This is given to the R-S flip-flop's set contribution. The flip-flop is set by the comparator 1 result, which was high. Flip-flop's Q is now both high and low. As a result, the output of IC 555 at pin 3 becomes low.

Pin 7:Discharge

For bipolar timers, this pin is an open-collector (O.C.) output; for CMOS timers, it is an open-drain (O.D.) output. When OUTPUT is low, this pin can be utilized to discharge a capacitor. This pin is unused in bistable and Schmitt trigger modes, allowing it to be utilized as an alternate output.

Pin 8: Power supply

The supply voltage range for bipolar timers is commonly 4.5 to 16 volts (some are specified for up to 18 volts, however most will run as low as 3 volts). The supply voltage range for CMOS timers is normally 2 to 15 volts (some are specified for up to 18 volts, while others are specified as low as 1 volt).

G.Traic:

TRIACs are a type of thyristor that is tightly coupled with silicon-controlled rectifiers (SCR).But whereas SCRS, being unidirectional devices (that is, they can only carry current in one way), TRIACs are bidirectional and can carry current in both directions [4].the ICBT136 traic is shown in Fig9.

Fig.9. ICBT136 Traic

H.Relay:

In general, all Relays are basic switches that can be operated both electrically and mechanically. Most high-end industrial application devices feature relays for effective operation. The switching mechanism is carried out with the help of electromagnets [1].the sample view of relay is shown in the Fig10.

Fig.10.Relay

I. Indicating LEDs:

Three bright LEDs have been employed to demonstrate whether the 555 timer IC is in a high state or in a low state. and also to know the pump's ON/OFF state.A resistance of 1000ohm should be connected in series with the LED to protect it from high voltages [4].

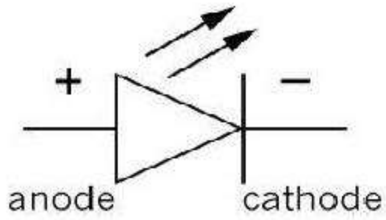

Fig.11.LEDs

J. Resistors:

Various resistors are employed as needed in the circuit's construction.In general,all resistors are 1/4 watt rated are used [1].

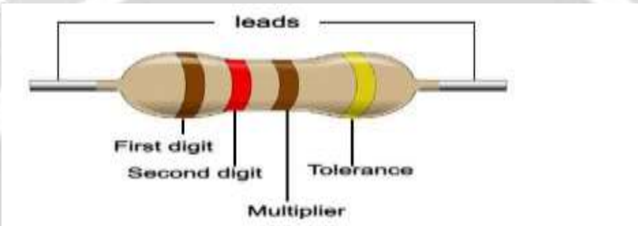

Fig.12.Resistors

K.Capacitor:

A capacitor is a device with two terminals that uses an electric charge to store energy. It is formed up of two electrical conductors separated by a gap. The gap between the conductors can be filled by a vacuum or a dielectric, which is an insulating substance.

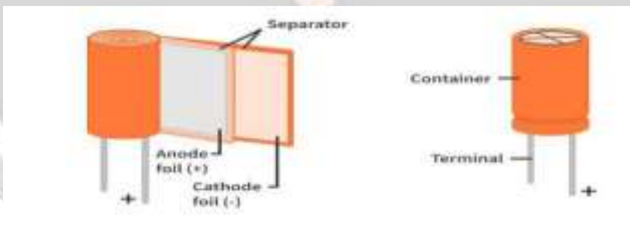

Fig.13.Capacitor

IV. **CIRCUIT DIAGRAM AND ITS OPERATION**

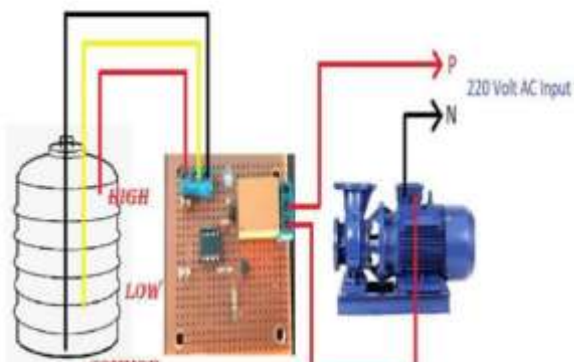

Fig.14.Basic circuit diagram of automatic water level controller

The circuit diagram of automatic water level controller using 555IC timer is shown in the Fig.14.This water controller design is very effective and sensitive to any unexpected change in the water tank [2]. Initially, 230v AC is fed to the input of the step-down transformer (230v/9v).This 9v AC is sent to a bridge circuit, which produces a 9v DC output.The resulting DC is now sent into the input of a voltage-regulated IC7805, which delivers output as 5volts.

The probe from the bottom level is attached to the 555 IC's trigger (2nd) pin. When the second pin is submerged in water, the voltage at that pin is Vcc [4].When the water level drops, the second pin becomes separated from the water, and the potential at the trigger pin falls below Vcc.Then the output of 555 rises. then The output of the IC555 causes the gate to be trigger, causing the TRIAC to begin conduct.

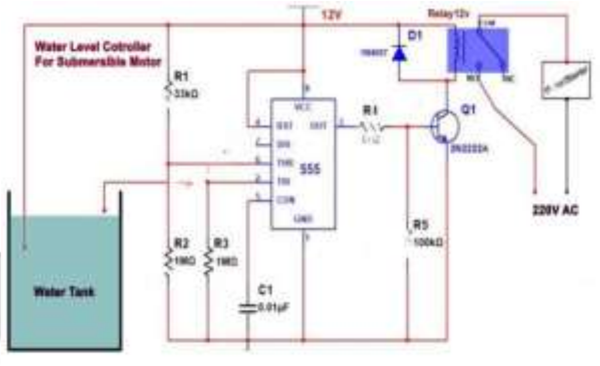

Fig.15.Schematic circuit diagram of automatic water level controller

The schematic diagram of automatic water level controller using 555IC timer is shown in the Fig.15.As the water level increases, the top level probe is submerged and the transistor turns on. Vce=0.2v is the collector voltage.The IC is reset by a low voltage at the fourth pin. As a result, the output of the 555 becomes 0 volt. Hence, the motor will shut off automatically.

V.RESULT AND DISCUSSIONS

Design and development of the automatic water level controller have been accomplished [4].The suggested water level controller's circuit diagram, shown in Fig.14, highlights a variety of components. The main component is a step-down transformer that is intended to convert 230 volts AC to 9 volts AC, which is then constrained to 5 volts DC by a voltage regulator. The integrated circuit of the water level controller system needs 5 volts of direct current to operate [2].Depending on the water level, the pump motor is turned on and off. The automated water level controller outperforms other traditional techniques because to its dependable technology and is also more affordable and long-lasting. In terms of system response in water level control with respect to the non-linearity generated by pumps and sensors, the automatic water level controller is a promising controller. The circuit schematic was followed for building the experimental model, and the outcomes were as anticipated. When the overhead tank was about to get dry, the motor pump turned on, and when it was about to overflow, it turned off.Whenever the volume of the water exceeds the level that was set, the monitoring system needs around 1/2 seconds for it to cease and restart the motor.The main issue we've encountered is establishing a stable output voltage from the IC 555, which occasionally alternates at 1.5–2 V and makes it difficult for the motor to electrically start. Therefore, it has a benefit over other kinds of water level controllers. The additional advantage of our system is that it features a built-in, inexpensive continuous electricity supply system that delivers affordable energy.

The above tank's volume of water as well as the levels in all the other tanks are easily detected and controlled by the water level controller system. presently majority individuals and companies employ pumps for preserving water in overhead tanks. Nobody is able to determine how much water is in the tank while it is empty, and few can predict whether the tank will be full. As a result, the water in the tank overflows, losing both water and energy.By employing a water level controller circuit with an IC 555, it is possible to manage the volume of water's spilling level and address issue of this nature. The overhead water tanks, swimming pool heaters, etc., can all employ water level controllers because their production costs are minimal. Circuits that control the level of water are employed in manufacturing facilities, pharmaceutical plants as well as other conducting liquid storage systems.The amount of water in a tank can be easily shown by using this straightforward IC555-based water level controller circuit. The motor switches off when the tank is full. At this point we've constructed three levels (Common, Low, and High); if additional levels are required, you are able to construct alerts or LEDs. After tanks are entirely filled, the motor will Shut down.

VI.CONCLUSIONS

During the present day, while the Earth's supply of drinking water diminishes by the minute, every drop of water counts. Since water serves as a basic element for every living creature, water scarcity can be handled through diligent tracking and minimizing excess water waste. The major goal of this study is to minimize and control water waste, as well as avoid persistent use of electricity by the motor when there is no water at its source. Another goal of this effort is to reduce the expense of its development and execution.A water level controller is a simple but efficient solution to reduce water waste. Its cheap cost elements and simple design result in a great piece of technology for the average person.

VII.ACKNOWLEDGMENT

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