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Review Article

Automatic Water Level Controller and Indicator: A Review

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Abstract

These days, Africa's drinking water situation is getting out of control. For this reason, protecting water for both humans and animals is crucial. Because of the overflow of above tanks, water is wasted needlessly in many homes. Such issues can be resolved with an automatic water level indicator and controller. The water level controller works on the premise that because water contains minerals, it conducts electricity. Thus, a circuit can be opened or closed using water. Different circuits in the controller send out different signals in response to changes in the water level. Depending on our needs, these signals are used to turn the motor pump on or off. According to estimates, there are 2 billion cubic kilometers of water on Earth, which is sufficient to cover the planet with a layer that is roughly 3 kilometers thick. The oceans contain around 95% of the water on Earth, which is unsuitable for human use and consumption. All of the fresh water in rivers, streams, and lakes that is fit for human consumption makes up the remaining 1%, with the other 4% being trapped in the polar ice caps. An automatic water level controller and indicator are discussed in this study.

Keywords: *Components, Automatic, Ultrasonic sensor, Save Water, level Controller, Impacts, Drawbacks.*

I. INTRODUCTION

Water is the first thing that comes to mind when I think of my daily routine. This is one of the basic survival needs. People depend on the upper reservoir for everyday use. The upper tank is made of an opaque or cement (concrete) material to prevent algae growth and is closed with a cap to protect it from dust and mosquito infestation. So, the level of water in the tank is unknown. Oftentimes, we turn on the motor and forget to turn it off. Because of this, most of the water will be lost unknowingly. This leads to water scarcity. Therefore, there is a need for a replacement that can start automatically and shut off the motor when the water is filled to the desired level. Automatic water level controllers are products created to automatically control the motor, which helps to ensure that there is a constant reserve of water in the storage tank. These automatic water level controllers are used to automatically fill the overhead tank when it starts up or when it becomes empty and also monitor the water level in it. Automatic water level controllers start the motor when the water level drops below a certain level and turn off the motor when the water rises above a fixed level. The motor will also shut off when the sump water runs out before it fills the upper tank or if the pump is dry and also maintains voltage fluctuations. These are the latest products based on advanced digital technology. This system is versatile. There are also custom variations, such as controlling multiple pumps or multiple tanks. The carbon water level sensor provides contact water level measurement. The system for controlling water levels is an electronic device that controls the operation of the water pump in subterranean and overhead storage tanks when electrically connected to the starting point of any pump assembly motor. It switches on the pump assembly when the water level in the overhead tank falls below the preset level. It switches off the pump mount if the water level in the top tank is fully supplied. OFF switches the pump mounting when the underground tank is at low water level. ON switches the pumping group if the tank has enough water. The automatic system for regulating the water level is the result of technical research. It can automatically switch on and off

the domestic water pump set according to the water level in the reservoir. You can implement this driving pattern at your home or college using less expensive components. The most important advantage of this circuit is that it automatically operates the water pump without any user interaction. The Auto Pump Controller eliminates the need for any manual switching of the pumps installed to pump water from one reservoir to another reservoir. If the water level in the tank falls below a certain level and the water level in the reservoir is above a certain level, it immediately turns on the pump. As the water level in the tank filled to the upper level (M), the pump was automatically turned off. Only when the water level in the tank falls below the level in the tank and the level in the reservoir is above R is the pump turned back on. This automated process is still going on. Automatic controls on the water level can help to minimize energy use by controlling motor functions. This significantly reduces the amount of water and energy loss. The motor will also prevent it from drying out and ensure its longevity [19].

II. LITERATURE REVIEW

The proposed system utilizes a combination of sensors, microcontrollers, and actuation mechanisms to provide real-time monitoring and control of water levels. This automated approach offers numerous benefits, including improved water conservation, reduced energy consumption, and enhanced convenience. For smaller tanks, solutions such as ball valves are applicable, which automatically stop the water flow once the tank is full. This is a simple and basic idea for smaller tanks. However, in many large tanks located in buildings, hotels, schools, etc., which require a significant amount of water storage, there is a need to prevent overflow. An electronic solution can be implemented to save water. When the tank is nearing full capacity, it will raise an alarm and stop the water pump. Conversely, it can also help fill the tank when it's empty using an electronic device. The Arduino Uno-based automatic water level indicator and controller is a practical and efficient solution for monitoring and controlling water levels in various applications. This system utilizes ultrasonic sensors to measure water levels by emitting sound waves and calculating the distance based on the echoes they receive after bouncing off obstacles in the water. The Arduino Uno-based automatic water level indicator and controller utilizing ultrasonic sensors is a practical and versatile solution for managing water levels efficiently. It offers accurate measurements, automation, cost-effectiveness, and adaptability for various applications, making it a valuable tool for water level monitoring and control [21]. In [1], the author's paper presented the design of an automatic water level controller. The design system uses a mercury flow switch. The system incorporates two contactors, which are energized to provide a direct online start of the motor. An over-load relay senses the presence of excess current and disconnects the supply, while the mercury flow switch uses the Archimedes principle of flotation to provide electrical contact to switch ON and OFF supply to the motor when the tank is empty or full, respectively. This system is relatively cheap, affordable, and durable. The use of the mercury switch is the main disadvantage of this system. Mercury switches have a relatively slow operating rate due to the inertia of mercury, but they are also highly toxic and accumulate in any food chain. A water level sensor with voltage output readings was designed using a digital logic processing circuit or integrated circuit, a 7-segment display unit, a JK flip-flop sequential circuit, and a motor drive circuit controlled by a relay-based driver [2]. The water level sensors were electrode resistive sensors that depended on the water’s conductivity. At the desired points of level detection, it will conduct electricity between two fixed probe locations or between a probe and the tank wall. The water will complete the circuit, and the sensor output can be used in different ways, such as opening or closing an electronic switch or turning on or off a water pump. An electric water pump controller and level indicator have been designed, making use of metallic conductors or probe sensors, each positioned at different levels along the height of the tank to act as sensors. Similarly to the aforementioned literature, the electrical conductivity of water is exploited. The additional components used are the comparators to monitor the presence of water at the probes and microcontrollers and to drive digital outputs that turn on visual display LEDs that indicate various water levels in the tank [3]. The automatic water level control has been applied practically in the water-replenishing tank of central air conditioning [4] and in the computerized water level control system for the system generator of the Qinshan nuclear power plant [5]. The manual method involves the switching ON and OFF of the power supply to the pump motor manually by an operator when the tank is either empty or full. This method is common with domestic water supply systems where water is pumped from a well to an overhead tank, e.g., borehole water supply. The limitation of this method is that it is prone to overflows and cavitation, resulting in wastage of resources. This is a result of human error due to time wasted in opening and closing valves. So, there is a need for an automatic or “human-less” system to increase efficiency. The objective of this study is to design and construct a portable automatic water level control switch capable of switching on the pump when the water level in the overhead tank goes low and switching it off as soon as the water level reaches a predetermined level to prevent dry-run of the pump in the event the level in the underground tank goes below the suction level [6]. This research paper describes the better ways of software and hardware architecture that blend for interfacing purposes, which includes designing and developing an automated water level control system. To detect the water level, the device uses advanced sensing technology. It controls the motor with an Arduino and a relay. At the beaker's various junctions, separate wires are connected. when we fill the beaker with water. The water makes contact with the wire, which indicates the tank's water level. As a result, the level of water has been reflected on an LCD. The motor is turned on and off with the aid of a relay [7]. Hemant Lenka and his team based their research on the importance of water level controllers in irrigation in agriculture. According to the article, each crop needs a particular amount of water, which can be achieved by using an automated water level controller, which would also help to reduce water waste. They employ a technique to determine

the rate of water flow in irrigation pipelines. It measures the rate of flow with a Hall Effect Sensor. The G1/2 Hall Effect water flow sensor is a sensing device that contains a turbine rotor whose speed varies depending on the rate of water flow [8]. Anuj Pathak and his colleagues present an automated water level controller with SMS notification in this research paper. Maintenance of water can be done by users during load shedding thanks to the addition of SMS notifications to the automatic controller system. The automatic level controller and the SMS system function together in a synergistic way. The software was created in the Arduino programming environment and then transferred to the microcontroller. The system's water level is automatically maintained. Battery power is used to run the controller. The user receives an SMS notification whenever the device detects an empty level and the status of load shedding. The process will be automated by installing a single sensor device in the tank that will take water level measurements regularly and power the motor automatically. This device removes the need for people to fill the tank regularly and monitors for leakage [9]. An ATMEGA328, ultrasonic sensor, buzzer, and Xilinx were used to design the device. Three tanks, each with its own set of ultrasonic sensors, were used in the experiment. The controller was an Arduino board. When the machine was turned on, water flowed through tank 1, indicating that tank 2 had been filled and the buzzer had been activated to show that two or more tanks had been filled. Following that, tank 3 was filled before the level indicator controller detected it, at which point the water supply was turned off. As a result, there was no water waste. Xilinx ISE was used to build and implement the same on an FPGA. In comparison to microcontrollers, FPGA has proved to be more beneficial for automating multiple water tanks [10]. An Arduino UNO, an ultrasonic sensor, and a pump are included in the proposed model. An ultrasonic sensor was used to determine the water level. There was a link between the Arduino and the LABVIEW software. The Arduino turned on and off the pump based on the sensor readings, and the water was filled into the tank, as shown on the LABVIEW front screen. If there is no water in the lower tank and the pump is turned on, the pump will be disabled and energy will be lost. This is because the ultrasonic sensor is only mounted in the upper tank and not the lower tank [11]. The water level sensor, buzzer, and water pump were used to create the prototype. The controller received the water level sensed by the sensor, which was then passed to the Bluetooth module, which then transmitted the information to the registered mobile. Additionally, a buzzer was used as a signal. When exposed to a damp atmosphere, the sensor takes the form of a touch sensor, with a measurement range of just 4 cm and a short lifetime. Having power applied to the probe continuously speeds up the rate of corrosion dramatically [12]. An Arduino microcontroller, a water level sensor, and a cell phone were used to create the prototype. The controller received the level of water sensed by the water level sensor and updated the information on the server. The cell phone receives the information stored on the server by working the buttons on the mobile. The user decides whether to turn on or off the motor. A contact-type sensor is used. When exposed to moisture, the measurement range is small and the lifetime is short. Intervention by humans is needed [13]. The float switches, the 89S52 microcontroller, and the ESP8266 Wi-Fi module were used to build the prototype. Four tanks were taken in this operation. The sensing factor was afloat. The information was transmitted to the ESP8266 Wi-Fi module, which will upload it to the server. Water level sensors and motor driver circuits were controlled by the microcontroller. A total of 16 float switches are used in the system. The contact-type float switches are easily stuck and do not move; they have poor accuracy and precision, and they require regular maintenance [14]. The most recent solution, as explained, is to use an image sensor to measure water levels. Unlike other types of sensors, it can provide information about the environment around the sensor as well as the water level, allowing the measured data to be verified. It also has the benefit of not being influenced by the weather. Commenting on his encounters with the radar sensor and the surrounding area, According to Rikk Smith [15], we've been really happy with this sensor because it was simple and easy to mount, and we haven't had to touch it in over five months. The module consists of hardware and software to control the operation of pumping water in an overhead tank storage system. It can determine the presence of water in the tank, turn on and off the pump, and view the status on an LCD screen. Through using a calibrated circuit to show the water level and using DC instead of AC power, this research has successfully enhanced existing water level controls, reducing the risk of static shock [16]. The system proposed in this paper is a basic water level monitoring system with multiple stages indicated. It also indicates when the water level falls below or rises above the required level. This method allowed us to better understand how Bluetooth modules work and how they can be used to create a portable device [17]. This paper describes a device that uses ultrasonic sensors to determine the depth of water. A water level indicator, a water level sensor, a water pump control system, and a microcontroller are all included in the system. The ultrasonic sensor detects the presence of water, sends a signal to the microcontroller, and the pulses begin to echo [18]. The intended device's goal or aims are to create an automatic water level management system with automatic control. In this project, sensors are placed at various levels of the tank, and the integrated circuit uses these sensors to monitor the level of the liquid at any given time [19].

III. ELEMENTS UTILIZED IN THE AUTOMATIC WATER LEVEL INDICATOR AND CONTROLLER'S IMPLEMENTATION

The methods employed in this water level indicator with an automatic ON/OFF water pump system focused on a few fundamental components that are gently combined. Below are basic descriptions of a few sections.

1. Water Level Indicator Unit

   The American Standard Code for Information Interchange (ASCII) character is shown on a 16 by 2 liquid crystal display (LCD) for the water level indicating unit. There are 128 characteristics in the 7-bit ASCII character set. It

includes the capital and lowercase English letters A–Z, the numerals 0–9, and a few special characters. For embedded systems, the LCD has emerged as a simple and affordable means of displaying text.

2. Water Level Sensor
   The HC-SR04 ultrasonic distance sensor is used to create a unique water level sensor. With a range precision of up to 3 mm, this affordable sensor offers non-contact measurement capabilities from 2 cm to 400 cm. An ultrasonic transmitter, a receiver, and a control circuit are all included in each HC-SR04 module. Depending on the application, this sensor's extra control circuitry can also stop inconsistent bounce data.
3. Water Pump Controlling Unit
   A relay driver circuit is used to link the water pump to an Arduino output pin for control. The relay driver circuit receives a positive signal plus five (+5v) from the Arduino microcontroller. Motors [23–24] are linked to the relay circuit's output on the cable's negative end. A 220-volt AC current is connected to the cable's positive side.
4. The Arduino Microcontroller Unit
   A computer on a chip, the microcontroller can be configured to carry out nearly any control, sequencing, monitoring, and display task. It becomes the obvious choice for the designer due to its comparatively inexpensive cost [22].

Conclusion

This article's objective was to review research on inexpensive, user-friendly automatic water level monitors and controllers. Water tanks in our homes and surroundings, as well as the levels of different liquids and oils in businesses and chemical laboratories, may all be monitored with this. Additionally, I have covered the benefits and drawbacks of the water level monitor and controller [20]. The elements utilized to demonstrate this study are discussed.

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