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DESIGN AND IMPLEMENTATION OF AN AUTOMATIC LIQUID LEVEL PATH

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ABSTRACT

Currently, we live in a world where all fields are developing very rapidly. In particular, the field of water management is developing day by day, and the water supply system is being intelligent automated. Nevertheless, mechanical means and human labor are used to monitor the water level in many water management facilities of our region. This situation causes many problems in the automatic management of the system. In this article, we will consider the process of automating the measurement and control of water level, that is, an automated system that helps to know when the water in the tank is full or empty. In the automation of this system, an ultrasonic sensor that meets the requirements of the time was used. The working principle of ultrasonic sensors is based on the movement of ultrasonic waves over time. The analysis of the results of this experiment showed that the water level measurement and control system did not make more than 1.5% error in different values of the water level. This situation showed that the developed system can be effectively used in all water level control facilities.

1. INTRODUCTION

The project "automatic water level control with an automatic pump control system" is design to monitor the level of water in the tank. The system has an automatic pumping system attached to it so as to refill the tank once the liquid gets to the lower threshold, while offing the pump once the liquid gets to the higher threshold. Sustainability of available water resource in many reasons of the word is now a dominant issue. This problem is quietly related to poor water allocation, inefficient use, and lack of adequate and integrated water management. Water is commonly used for agriculture, industry, and domestic consumption. Therefore, efficient use and water monitoring are potential constraint for home or office water management system. Moreover, the common method of level control for home appliance is simply to start the feed pump at a low level and allow it to run until a higher water level is reached in the water tank.

This water level controller, controls, monitor and maintain the water level in the overhead tank and ensures the continuous flow of water round the clock without the stress of going to switch the pump ON or OFF thereby saving time, energy, water, and prevent the pump from overworking.

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 pre-determined level to prevent dry-run of the pump views by by Y. Sharma (2022)

An automatic water level-controlled device is designed to automatically pump water into the overhead tank, when the water level goes down below a certain minimal level and cut off the supply when the water level reaches certain maximum level and also stop the motor when the level of water in the reservoir drops to a certain minimal level, to avoid drawing dirt from the bottom of the reservoir tank. Also, in turn, triggers an alarm to notify the personnel the dangerous situation.

2. LITERATURE REVIEW

The automatic water level controller using ultrasonic sensor is a system designed to continuously monitor and control the water level path present in the tank. It is equipped with electronic components which detects difference in the tank's water level. The water control system is used to turn on and off pumps, thereby preventing possible overflow. Water level controller has the ability to switch ON the pumping machine when the water in the tank has gone below gauge level and automatically switches OFF the pumping machine when the water in the tank has reach its maximum level. However, there are so many bodies of researchers, examining various aspects of automated water

An empirical review of various projects related to automatic water pumping machines reveals recurring challenges and innovations across different implementations. The Solar-Powered Automatic Water Pumping System led by D. R Kumar at IIT Delhi(2019) was designed to harness solar energy for water pumping. Despite the environmental benefits of using renewable energy, the system faced several issues, such as intermittent solar power supply due to weather conditions and the high initial cost of solar panels, which made it less accessible for widespread adoption. Additionally, exposure to water caused corrosion of the pump components, affecting the longevity and efficiency of the system. These issues emphasize the need for better materials and cost-effective solutions to improve solar-based water pumping technology.

Similarly, the IoT-Based Smart Water Pumping System implemented by Y. Sharma's team at I11 Hyderabad, aimed to integrate modern Internet of Things (IoT) technology into water pumping for real-time monitoring and control. However, the system encountered connectivity issues, especially in remote areas where internet infrastructure is weak or nonexistent. This limitation undermined the system's effectiveness, as IoT sensors rely on stable internet connections to transmit data. Moreover, the high cost of IoT devices and concerns about data security posed additional barriers to the large-scale deployment of this technology. These challenges highlight the need for improved internet connectivity in rural areas and more affordable IoT components to enhance smart water pumping systems.

S. K. Goyal (2021) of ICAR-CSSRI, Karnal, developed an Automated Water Pumping System for Irrigation, designed to help farmers maintain optimal soil moisture levels. This system, however, faced several technical challenges. The soil moisture sensors, critical for detecting when the system should activate, often experienced accuracy issues, leading to either overwatering or underwatering. Power outages caused timer malfunctions, further compromising the system's reliability. Additionally, the pumps often clogged due to debris in the water, reducing their efficiency and increasing maintenance costs. These findings suggest that for agricultural applications, more robust sensor technology and protection mechanisms for pumps are essential for the successful implementation of automatic water pumping systems.

The Float Switch-Based Automatic Water Pumping System developed by Mr. Vinod Kumar (2021) from Jal Nigam, UP designed with a simpler mechanism for detecting water levels and automatically turning pumps on and off. While it was effective in principle, the system encountered durability issues with the float switch, which wore out over time due to constant exposure to water. Furthermore, the system struggled with pump overloading, especially when water demand was high, which could lead to mechanical failure. Corrosion of the pump components also remained a persistent problem. These issues point to the need for more durable materials and better-designed components to ensure the reliability of float-switch-based systems in the long term.

Lastly, the Automatic Water Pumping System for Firefighting (2020), developed by a team led by P. S. Bhatnagar at NIT Kurukshetra (2019) addressed the unique needs of firefighting, requiring high-pressure pumps for rapid water delivery. However, the system faced challenges such as ensuring reliability during emergencies, where system failure could be catastrophic. Additionally, ensuring the availability of an adequate water source during fire emergencies was another significant concern. These challenges underscore the importance of designing emergency systems with redundant safety measures and ensuring that water sources are readily accessible when needed.

In summary, while these various automatic water pumping systems have advanced the field, they each encounter distinct challenges related to cost, durability, reliability, and performance under specific conditions. These issues suggest that ongoing research and development efforts should focus on enhancing sensor accuracy, material resilience, and overall system reliability to optimize the performance of water pumping systems across different applications.

3. METHODOLOGY

The analysis of the design calculation procedure for the project was carrying out base on the specification function it is carried out. The design was performed in stages. And the whole project was then implemented by coupling all the stages together, the design procedures for each stage are as follows: -

System Layout

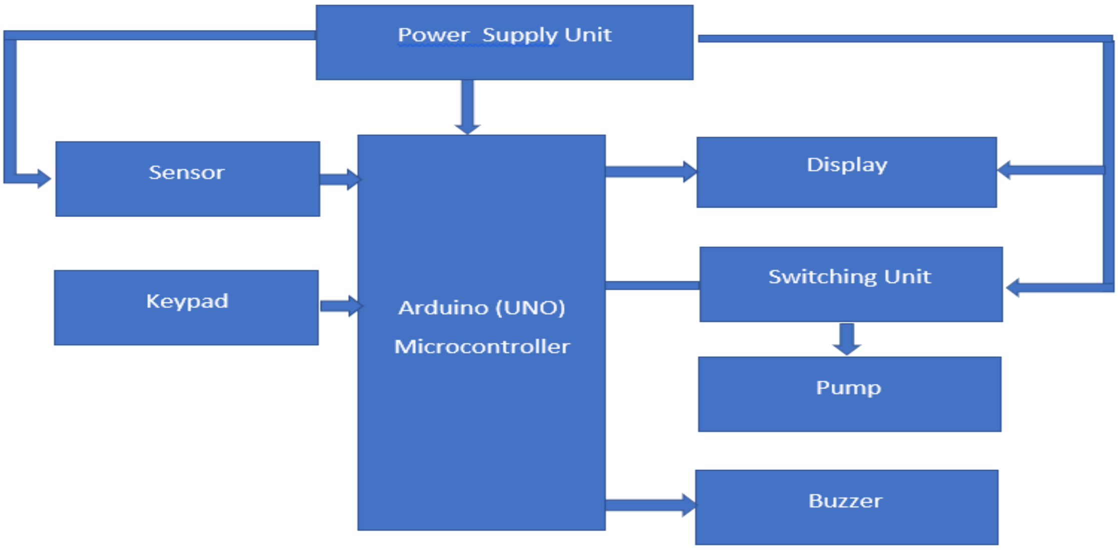

Figure 1: Block Diagram

Circuit Diagram

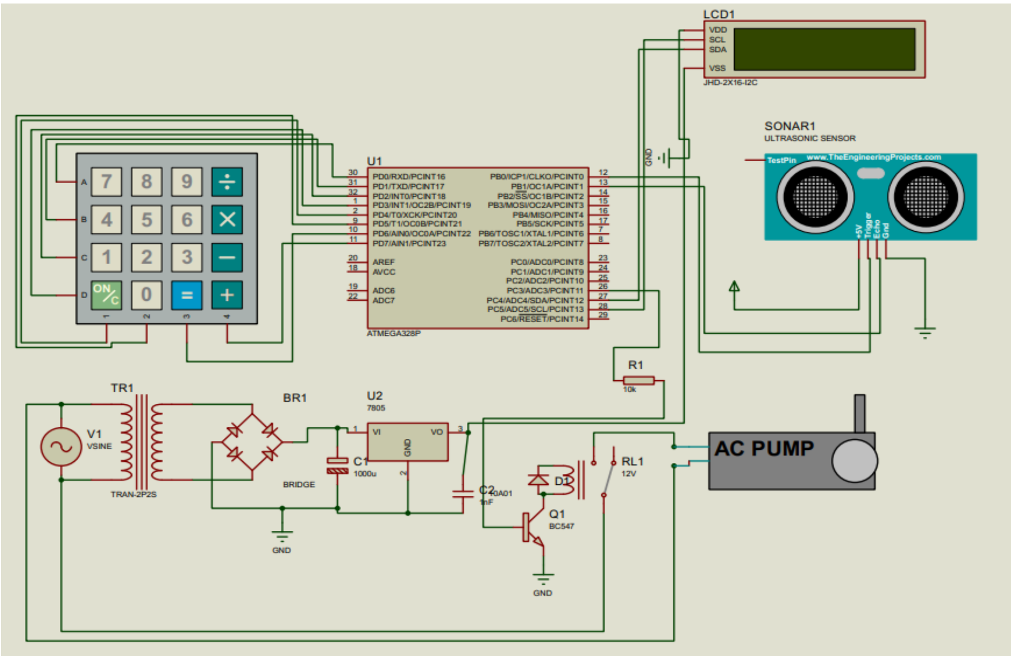

Figure 2: Circuit Diagram

Principle of operation

The ultrasonic sensor as a trigger and an echo pin. The Arduino provides a high signal of 10microseconds to this pin. After the HC-SR04 is triggered, it sends out eight 40Khz sound waves to the surface of the water. On getting to the surface of the water, the wave is echoed back to the sensor and the Arduino reads the echo pin to determine time spent between triggering and receiving of the echo. Since we know that the speed of sound is around 340m/s then we can calculate the distance using;

$$\text{Distance} = \frac{\text{time} \times \text{Speed of sound}}{2}$$

To determine the level of the water in the tank we must know the total length of the tank. It is this value that will enable us calibrate our tank to our taste.

The trigger and echo pins of the ultrasonic sensor are connected to pins 9 and 8 of the Arduino respectively. The LCD is connected to the Arduino in 4-bit mode with the control pins RS, RW and EN connected to pins 2, GND and 3 respectively. The data pins D4-D7 are connected to pins 4 ,5 ,6 and 7 respectively. The negative terminal of the motor is connected at pin 11 of Arduino through ULN2003 for turning on or turning off the water pump

The Ultrasonic sensor module is placed at the top of bucket (water tank) for demonstration. This sensor module will read the distance between itself and the water surface and it will show the level of water and the status of the motor on the LCD screen. If the distance is greater than or equal to 40 cm then Arduino turns ON the water pump. The LCD will show "LEVEL: LOW" and "MOTOR: ON". When the distance reaches distance about 10cm Arduino turns OFF the relay and LCD will show "LEVEL: FULL" and "MOTOR: OFF". The LCD will also display medium and high levels when it gets to these points.

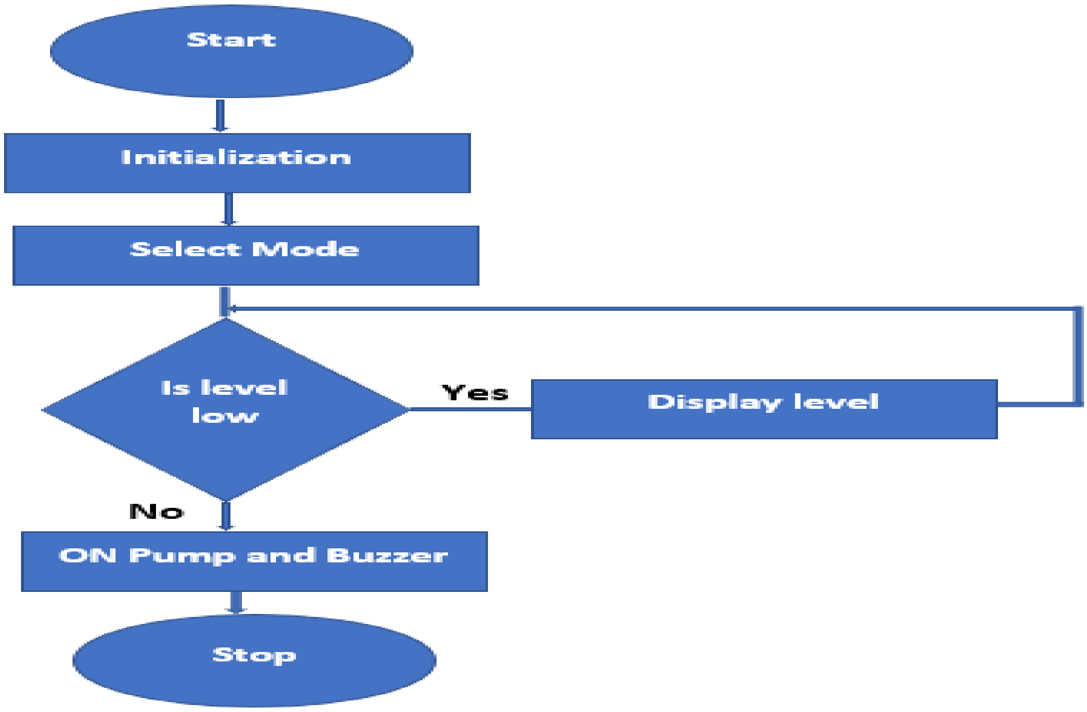

Figure. 3 Flow Chart

4. RESULT AND DISCUSSION

Table 1: Result

Higher Tank	Lower Tank	Water Pump	Buzzer (Alarm)
< 30 Litter	< 25 Litter	OFF	ON
< 30 Litter	>25 Litter	ON	OFF
>30 Litter	>25 Litter	OFF	OFF

5. CONCLUSION

The aim of the project is to design and implement an automatic water level controller using ultrasonic sensor for water supply to be installed for domestic and industrial used. The device was found to be working fairy properly based on its design and relatively cheap components involved in its realization, the aim of the project can be said to have been achieved.

The circuit used in the implementation of this project has been observed to have some limitations for higher tank capacity much bigger water pump will be used to provide large capacity of water within short period of time which will ensure the availability of the water.

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