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Automated Water Level Control System

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ABSTRACT

Water plays a very important the role in daily life, and proper management of water resources in necessary to avoid wastage. In many houses, industries, and agricultural areas, water tanks are filled manually by operating pumps, People may forget to switch OFF the pump after the tank is full, resulting in water wastage and loss of electricity and water overflow and extra power consumption. An automated water level control system is used to avoid this problem. This system automatically measures the water level in thank with the help of sensors and controls the pump motor without any manual effort. The sensors send signals to the Atmega328microcontroller, and based on these signals, the controller switches the water pump ON or OFF through a relay circuit. This system saves water, power, and time and is simple and affordable to use.

1. INTRODUCTION

Water is very important in our daily life and is used in homes, agriculture, and industries for different purposes. In many places, water tanks are still operated manually, where people need to switch the motor ON and OFF repeatedly. Due to this manual process, water often overflows or the motor continues running even after the tank becomes full. This leads to wastage of water and electricity and may also damage the water pump. To overcome these problems, we developed an Automated Water Level Control System. This system automatically monitors the water level using sensors and controls the water pump without requiring human involvement. When the water level goes below a certain limit, the motor starts automatically, and when the tank is filled, the motor stops on its own.

2. BLOCK DIAGRAM

The automated water level controller system is developed to automatically monitor and control the water level in a tank using an Arduino Uno microcontroller based on the ATmega328. The system senses the water level, processes the information, and controls the water pump automatically without requiring manual operation. The DC power supply provides the necessary electrical power to the entire system. It converts the available input power into a regulated DC voltage required for operating the Arduino board, sensors, relay module, LCD display, and other components used. An ultrasonic sensor is used to measure the water level inside the small tank. It sends ultrasonic waves toward the water surface and receives the reflected echo signal. By calculating the time taken for the echo to return, the Arduino determines the distance between the sensor and the water level, which helps identify whether the tank is empty, partially filled, or full. The Arduino Uno with ATmega328 microcontroller acts as the main controller of the system. It receives signals from both the ultrasonic sensor and the water level sensor, processes these inputs according to the programmed instructions, and controls the output devices such as the relay module, LCD display, and buzzer. The water level sensor detects the presence of water at different levels in the tank. This provides additional confirmation of the water level and improves the overall reliability of the system. The LCD display is used to show the current status of the system, including water level information and pump condition (ON or OFF). This makes monitoring easy for the user. A buzzer is included to provide an alert sound when the water level becomes very low or when the tank reaches the maximum level. This warning helps the user understand the system condition immediately. The relay module works as an electrically controlled switch. Since the Arduino cannot directly operate a high-power device, the relay allows safe switching of the water pump based on the control signal received from the Arduino. The water pump automatically starts when the water level is low and stops once the tank becomes full. This automatic operation prevents water overflow, avoids dry running of the pump, and saves both water and electricalenergy.

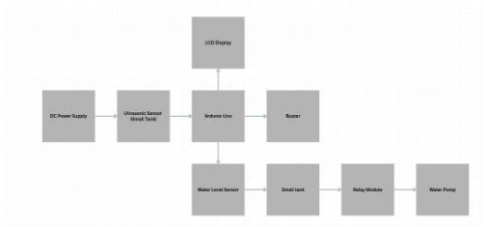

Fig -1 Block diagram

2.1 Working

The automated water level control system is developed to automatically monitor and maintain the water level in a storage tank using an Arduino Uno microcontroller based on the ATmega328. The system eliminates manual switching of the water pump and prevents problems such as water overflow and dry running of the motor. The operation of the system starts with the ultrasonic sensor, which is mounted at the top of the main water tank. This sensor continuously measures the distance between the sensor and the water surface by transmitting ultrasonic waves and receiving the reflected echo signal. The measured distance is sent to the Arduino Uno, where it is converted into water level information. Based on predefined minimum and maximum levels programmed in the microcontroller, decisions are taken automatically. A water level sensor is placed in the small tank or water source tank to detect whether water is available for pumping. This step is important because running the pump without water can damage the motor. The sensor sends an electrical signal to the Arduino indicating the presence or absence of water. The Arduino Uno (ATmega328) acts as the central control unit of the entire system. It continuously reads input signals from both sensors and processes the data according to the programmed logic. When the water level in the main tank falls below the minimum limit and water is detected in the small tank, the Arduino sends a control signal to the relay module. The relay module works as an electrically operated switch. When activated by the Arduino, it closes the circuit and turns ON the water pump. The pump then starts transferring water from the small tank to the main storage tank. During this process, the ultrasonic sensor keeps monitoring the increasing water level and sends updated information to the controller. As soon as the water level reaches the maximum preset value, the Arduino sends a signal to deactivate the relay module. This action turns OFF the water pump automatically, preventing overflow of water. If the small tank does not contain sufficient water, the Arduino will not allow the pump to start, ensuring safe operation. The LCD display is connected to the Arduino to provide actual operation time information such as water level percentage, pump status (ON/OFF), and warning messages. This makes the system easy to monitor by the user. A buzzer is also included to give an audible alert when the tank becomes full or when there is no water available in the source tank. Jumper wires are used to interconnect all electronic components, ensuring proper signal and power transmission throughout the circuit. The entire system operates using a regulated power supply, providing stable voltage to the Arduino and other modules.

2.2 Materials Required

- Arduino Uno
- Ultrasonic sensor
- Water pump
- Relay module
- Buzzer
- LCD display (16*2)
- Water level sensor
- Small tank.
- Data cable

3. COMPONENT LIST

3.1 Arduino Uno

The ATmega328p is the main controller of the system and works as the brain of the circuit. It receives signals from the water level sensor to check the amount of water in the tank. Based on the programmed instructions, it controls the relay to switch the water pump ON or OFF automatically. When the water level is low, the pump starts, and when the tank becomes full, the pump stops. This automatic control helps prevent water overflow and reduces manual work.

Fig -3.1 Arduino Uno

3.2 Ultrasonic Sensor

The ultrasonic sensor is used in an automatic water level system to measure the water level without direct contact with water. It works by sending ultrasonic sound waves toward the surface of the water and receiving the reflected echo signal. The sensor calculates the distance between the sensor and the water surface based on the time taken for the echo to return. This distance information is sent to the microcontroller, such as the ATmega328, for processing. When the water level becomes low, the controller activates the relay module to switch ON the water pump, and when the tank reaches the required level, the pump is turned OFF automatically. Since the ultrasonic sensor does not touch the water, it reduces corrosion and increases system reliability. This method provides accurate measurement, low maintenance, and efficient automatic control of the water tank level.

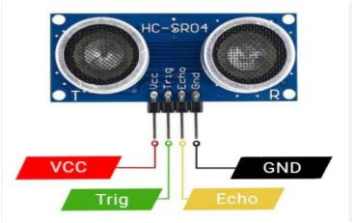

Fig -3.2 Ultrasonic sensor

3.3 Water Pump

The water pump is an important output device used in the automatic water level control system to transfer water into the storage tank. It is controlled indirectly by the ATmega328 microcontroller through a relay module because the pump operates at high voltage while the microcontroller works at low voltage. When the water level sensor detects a low water level, the microcontroller sends a signal to the relay, which switches ON the water pump and starts filling the tank. As the water level reaches the maximum limit, the controller turns OFF the relay, stopping the pump automatically. This automatic operation prevents water overflow and protects the pump from running without water. The use of a water pump in the system reduces manual effort and ensures continuous and efficient water supply.


Fig -3.3 water pump

3.4 Relay Module

The relay module is an electronic switching device used in the automatic water level control system to control the water pump safely. Since the ATmega328 microcontroller operates at low voltage and cannot directly handle high-voltage devices, the relay acts as an interface between the controller and the water pump. The relay module receives a control signal from a digital output pin of the microcontroller. When the controller sends a HIGH signal, the relay activates and completes the circuit, turning the water pump ON. When the signal becomes LOW, the relay disconnects the circuit and switches the pump OFF. The relay provides electrical isolation between the control circuit and the high-power load, which protects the microcontroller from damage and ensures safe operation of the system.

Fig -3.4 Relay module

3.3 16×2 LCD Display

The 16×2 LCD display is used in the automatic water level control system to show the current status of the water level and pump operation. It can display 16 characters in each line and has two lines, which makes it suitable for showing short messages such as "Water Level Low," "Tank Full," or "Pump ON." The LCD is connected to the ATmega328 microcontroller using control pins like RS (Register Select), EN (Enable), and data pins D4 to D7 in 4-bit mode to reduce the number of connections. The microcontroller sends commands and data to the LCD to display the required information based on sensor input. When the water level changes, the display updates automatically, allowing the user to easily monitor the system condition. The LCD operates at 5V supply and provides a simple and clear way to observe system performance.

Fig -3.5 16×2 LCD display

3.4 Water Level Sensor

To detect the amount of water present in the tank. The sensor is placed at different levels inside the tank to monitor low, medium, and full water conditions. It works by sensing the presence of water through electrical conductivity or contact detection and sends signals to the ATmega328 microcontroller. When the water level drops below a specified point, the sensor sends a signal indicating a low level, and the microcontroller activates the relay module to switch ON the water pump. As the water level increases and reaches the maximum level, the sensor sends another signal to stop the pump automatically. This process prevents water overflow and avoids dry running of the motor. The water level sensor helps in automatic operation, reduces human effort, and improves efficient water management.

Fig- 3.6 water level sensor

3.5 Buzzer

The buzzer is used in the automatic water level control system as an alert device to provide sound indications about the system status. It is connected to one of the digital output pins of the ATmega328 microcontroller. The buzzer produces a sound when it receives a signal from the controller, helping users know important conditions such as low water level, tank full status, or pump operation. When the water level becomes low or reaches the maximum limit, the microcontroller activates the buzzer to give an audible alert. This sound notification allows users to understand the system condition without checking the tank manually. The buzzer operates at low voltage and consumes very little power, making it suitable for automatic monitoring systems.

Fig -3.7 Buzzer

3.6 Data Cable

A data cable is a type of cable used to transfer data between two electronic devices. It helps devices communicate and share information such as files, images, videos, and documents. Data cables are commonly used to connect devices like smartphones, computers, printers, and external storage devices. They transmit data in the form of electrical signals from one device to another. Common types of data cables include USB cables,

Ethernet cables, and micro-USB cables. Data cables are very important in modern technology because they allow fast and reliable data transfer between devices.

Fig. Data cable

4. CONCLUSIONS

The automated water level control system provides an efficient solution for automatic monitoring and control of water tanks. The system provides an efficient solution for automatic monitoring and control of water wastage and saves electrical energy by operating the pump automatically. It minimizes human effort and prevent motor damage caused by overflow and dry running conditions. The design is simple, reliable, and low cost effective for practical implementation.

5. ACKNOWLEDGEMENT

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