Controlling Available Water for Irrigation System

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ABSTRACT

Safe and readily available water is important for continuous farming. Water is essential whether for Irrigation system, domestic use, food production or recreational purposes. Controlled water supply and sanitation, and better management of water resources, can boost countries' economic growth and can contribute greatly to poverty reduction. Water wastage is inevitable when there is no personnel or technician to control the water level as at when due. Therefore, there is need for water management system. In this project, a system is designed to monitor the water level in the reservoir and offer a command for irrigation. It implements an ultrasonic sensor, microcontroller, communication module and LCD display. It monitors the level of water in a reservoir and communicates this state via SMS to the person in charge. The system through the ultrasonic sensor measures the distance from the sensor to the liquid surface by ultrasonic signal and the microcontroller turns on the water pump when the water level is low by receiving a command from the user's handset. In a condition when the water level got full, the microcontroller first turned off the water pump and then send a notification to the user indicating the level of water in the reservoir. The system was tested and all the expected notification on the system's state (available water) were received as SMS and displayed on the LCD.

Keywords: Ultrasonic Sensor, Microcontroller, Irrigation, Display and Communication Module

1. INTRODUCTION

Water is one of the natural resources that are important to the survival of humans. The availability of water for irrigation has and will continue to dictate where and to what extent development will occur in a nation. Since water is used by human for day to day activities, it is necessary to monitor the water level to make it available and avoid wastage. (Eiyike, Kpochi, & Abubakar, 2017). Usually, water level measurement was done manually, but this is not effective because of some difficulties such as difficulty to reach the location of the water pump, human error, etc. (Made, Endrowednes, & Pono, 2012). More water is wasted by many uncontrolled ways. This problem is quietly related to poor water allocation, inefficient use, and lack of adequate water management. The best usage of available water for irrigation will improve food production in most developing countries (Nabil, 2002). Therefore, efficient use and constant water monitoring are potential constraints for home and farm water management system. Due to this constrains, water level monitoring system is used to control the water level in order to avoid its overflowing and it will also intimate farm owners of the level of water in the reservoir. The automated method of level detection is introduced to make a device on/off. Moreover, the traditional method of water level control for home and offices is simply to start the pump at a low water level and allow it to run until a higher water level is reached in the water reservoir. Hence, a monitoring system to monitor the reservoir water level and intimate farm owners of the status of the water in the reservoir has to be developed. This is important because irrigation is considered as a technique that allows the farmer to produce all year round (Bashir & Kyung, 2018). If food is produced all the year round, it will be available and this will drive development. Several works have been done in the control of water level. Automatic water level controller was presented by (Ajinkaya & Milind, 2017). The system switches on the water pump motor when the water level drops below the pre-set level in the reservoir and switches the water pump motor off when the water level in the reservoir becomes full. The sensor used are pair of wires which conducts current upon contact with water. There also exist system designs that use complete software like Zigbee in attempting to solve this problem. Other systems exist which uses a GSM phone (Abdullah & Ali, 2014) an RF system, or even a wireless system as a medium to instruct the microcontroller to turn on or off the pumping machine (Maqbool, Chandra, & Dagadi, 2013).

In this paper, water level in the reservoir is monitored by using sensors and information are sent to the user through an SMS notification, then the user sends SMS to turn on the pump and when the reservoir is filled completely, the microcontroller will trigger off the pump and notification will be sent to the user showing water is full.

2. METHODOLOGY

The various units that make up the system is shown in Figure 1.

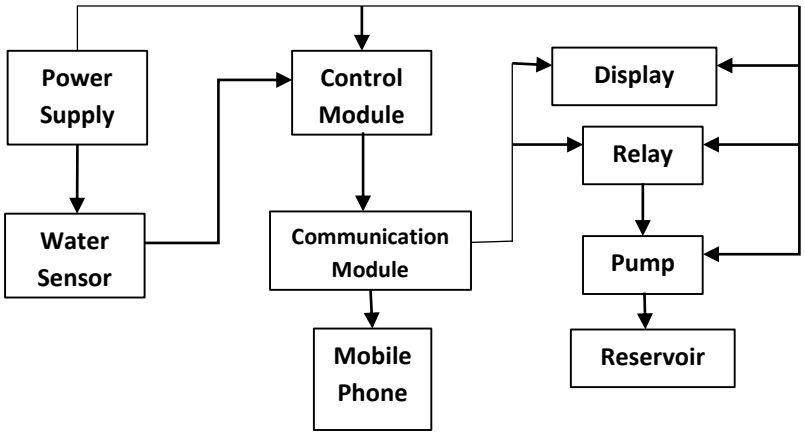


Fig. 1: Block diagram

Power Supply

This section provides for all the dc power required for the driving of the system. It takes in ac input and converts it to dc supply the system requires. It consists of a transformer, a rectifier, capacitors and regulators. The output of this unit is dual, 12 V and 5 V respectively. The rectifier is a bridge rectifier which converts the ac to a pulsating dc, while capacitors are used to filter off the ripples on the pulsating dc. Voltage regulators LM7812 and LM7805 were chosen.

Water Sensor

This stage is built on the HCSR04 water level sensor. It's an ultrasonic ranging module that provides 2cm to 4cm non-contact measurement function. It consists of four (4) pins, namely, Vcc, trigger, echo and ground respectively as shown in Figure 2. The sensor incorporates ultrasonic transmitter which transmits an ultrasonic wave, this wave travels in the air and when it gets obstructed by any material it gets reflected back toward the sensor and is observed by the ultrasonic receiver module. It has the following operational parameters, 5 V input voltage, 2cm to 80cm practical measuring distance, <15 measuring angle and 15 mA current. The trigger pin (2) is an output pin which is kept high for 10 µs for measurement initialization while sending ultrasonic wave. The echo pin (3) is also an output pin, it is also kept high for a period of time taken for the ultrasonic wave to return back to the sensor.

Controller Module

This module is a micro-controller module which contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. The micro-controller implemented is the Arduino microcontroller. On the kit is the ATmega328p microprocessor, which houses a 32 kilobytes of in-system programmable flash program memory, with read-while-write capabilities, 1024 bytes EEPROM, 2 Kbyte SRAM, 32 general purpose I/O lines, 32 general purpose registers, 10-bit ADC, to mention a few features. The microcontroller possesses 14 digital I/O pins, 6 analog inputs, 16 MHz crystal oscillator, a USB connection, a power jack. It is powered by a 5 V (4.7 V – 5.3 V) dc supply. It uses a low to select a command register and a high to select a data register, low to write to register and high to read from register. The pin configuration of the microprocessor and mapping with Arduino kit is as shown in Figure 3.

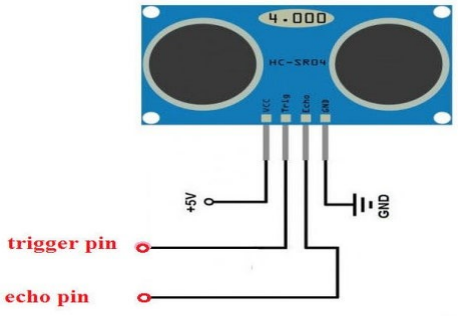


Fig. 2: The H-SRO4 Ultrasonic sensor

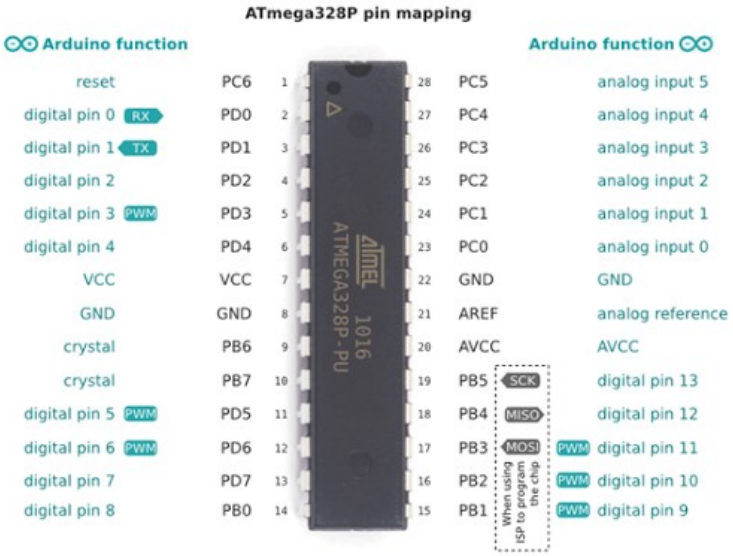
The output is configured for HIGH state, they include Pins 6, 11, 12, 13 and 28. For communication with the display, pins 19, 18, 17, 16 and 15 are so configured. Pins 27 and 26 are dc voltage input pins. Pins 4 and 5 are configured to communicate with communication module for transmission of various messages to the mobile phone.

Communication Module

This unit interacts with the microcontroller unit to send short message services (SMS) to the user's phone. These are instructive and informative. It is a GSM module, a SIM800L. It comprises of electronic components and more importantly a special type of chip capable of modulating or demodulating signals for the purpose of mobile communication. SIM800L comprises of 68 pins pad and is designed with power saving feature, consuming current as low as 0.7 mA in sleep mode. Figure 5 shows its pins configuration. The SIM800L module was used with an 8 pins SIM card holder, Molex 91228. The RXD and TXD, pins 9 and 10, are connected to the pin 14 and 15 of the microcontroller kit respectively.

Relay Module

Active and passive devices were chosen to drive the relay, these devices are diodes, resistors, capacitors and transistors. The relay is a 12 V dc 150 mA device. The transistors were arranged in switch mode to be triggered by the microcontroller. This relay coils opens or closes when the transistors are biased in their mode. The diodes are chosen to prevent flow of back current through the circuit from the relay coils. The relay is driven by the signal on the pin 17 of the microcontroller. The relay switches on the pump when it is closed by the signal on the microcontroller output pin.



Water Pump

Fig. 3: ATMega328p pin configuration and microcontroller mapping

This section is responsible for the pumping of water from the surface reservoir to the overhead tank. A 12 V 100mA dc pump was selected to the prototype design.

Display

The display selected is a liquid crystal display (LCD), which displays the various level of the water in the surface tank. The LCD implemented is a 16 pin device. It has the following features; Operating Voltage is 4.7V to 5.3V, Current consumption is 1mA without backlight, Alphanumeric LCD display module, meaning can display alphabets and numbers, and works on both 8-bit and 4-bit mode. A variable resistor of value 546K was connected across 2 and3 of the LCD its brightness the pin 4 and 6 was connected to pin 3 and 4 of the microcontroller respectively. The pin 11, 12, 13 and 14 on the LCD screen were connected to 5, 6, 7 and 8 on the microcontroller kit. The pin 1 and 16 on the LCD screen were grounded. A 100k resistor was connected across pin 15 to reduce the voltage drop on the LCD screen.

The designed system circuit diagram produce with protuse is as shown in Fig. 6.

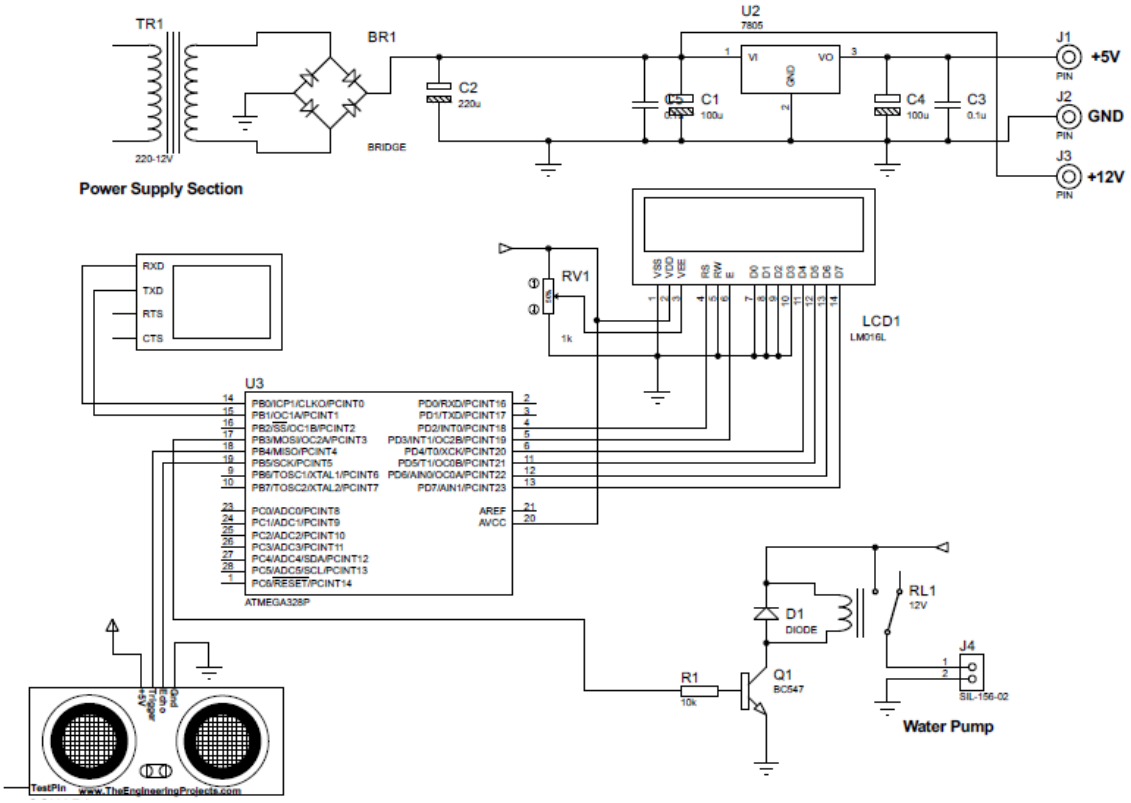


Figure 6: Complete circuitry for the water level controller using GSM

3. RESULTS AND DISCUSSION

The circuit in Fig. 6 was implemented and put into operation. The Plate 1 to Plate 5 are various displays gotten on the LCD at different state and times.

Plate 1: LCD pump on display

The Plate 1 is the LCD display when the tank was 34.48% full. At this time the pump is still pumping. Plates 2 -5 are SMS notification on the mobile phone intimating on the state of the water pumping activity. When water level in the tank is full, the system sends an SMS to alert on the need to on the pump (Plate 2). Pump initialization and state SMS notification is what Plates 3 and 4 reveals. As soon as the pump is 100% full, the notification on Plate 5 is prompted on the mobile phone and the microcontroller turns off the pump. The system communicates with the user when the water level is above 30% and below 70%. Thus, water for irrigation is controlled and manage with minimal or no wastage.

4. CONCLUSION

This system provides a solution to the problem of water overflowing the reservoir during pumping from the source. Water is judiciously pumped without wastage. This management of water will achieve its availability for irrigation. The monitoring of water level in the reservoir is also achieved in this work. This will yield prompt response for its need. With the SMS, the reliability of water availability is high as when no message is received system failure will be signaled. Hence, maintainability and reliability of water for irrigation is ensued.

5. RECOMMENDATION

This system is useful in industries where liquid is dealt with. For instance, in filling stations, instead of using long sticks or pipes to ascertain the level of liquid, the system will yield stress free and descent liquid level determination. Furthermore, the system should be deployed for control of available water for irrigation system.

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