DEVELOPMENT OF SMART WATER LEVEL CONTROLLER USING SMS MODULE

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Abstract

Water is among the most valuable resources on the planet is and it covers almost 70% of the earth's surface. In recent time, everyone has a tight schedule that prevents regular checking of the domestic water tank level. It is interesting to know that water level measurement can be done smartly such that when the tank is filled, message would be automatically transmitted as an alert to the owner using GSM applications such as sms for immediate response, instead of waiting until the tank became empty. Consequently, this paper presents development of a smart water level controller using sms module. The device consists of a smart water container that serves as a tank, an open-source hardware microcontroller with its integrated development environment through which the programming code is compiled and executed, an ultrasonic sensor for level detections, a GSM module with communication link for sms mobile communication, and a power distribution system to power the entire system. A flowchart was developed to show the procedural steps involved from design to testing. On completion of the prototype, test results were obtained, presented and discussed. Having tested satisfactory, the prototype was commissioned and found it application in the departmental water storage tank.

1. Introduction

System robotization is a thing of joy that needs advanced technology and worldwide appreciation. The development of a smart water level controller using sms module is a typical illustration of a system robot. Although, it is on record that 70% of the landmass is enthralled by water, yet, a huge failure of water coffers performing to frequent famines has been endured in some parts of the world. One of the enterprises to palliate this problem is creating a procedure that will reduce the wastage of water in household, agrarian setups, and the industries. Certain hazards similar to the boiler bursts due to unforeseen lowering of the water position can be

avoided through the control using this smart system. A GSM communication system is handed which makes the system user-friendly by furnishing a sms announcement to the user on their mobile phones. The GSM device is used to control the liquid position by giving sms alert of the chance of liquid filled into the system. An Arduino is a microcontroller that is programmed in any of these programmable languages similar to C and C++ in Arduino software (Pudasaini Et Al., 2014). Arduino is an enciphered device and used in commanding other biases similar to an ultrasonic detector, GSM module, and other circuits.

(Preethi et al., 2015) measures water position with the help of ultrasonic sensor. It uses an automated, turning motor on/ off with the help of a relay which helps in controlling the redundant water inflow from overhead tanks. Consequently, the water level was displayed on the LCD. (Ahmed Mohammedahmed Eltaieb & Jian Min, 2013) carried out the design and enhancement of a computerized water level monitoring system which uncovers an efficient way of software application and tackling hardware that blends for the purpose of interfacing. The device additionally makes use of advanced technology to descry the position of the water. The motor is controlled by Arduino and a relay. Different cables are connected at different junctions of the bucket used in this paper. When water is poured into the bucket, the cables come in contact with the water body and tell the position of the water in the bucket. Consequently, they present the position of water on the GSM and the relay is used to switch on and off the motor.

Component robotization is on the increase, reducing cost, user‘s interference, and time saving. The water tank overflows as the top of the water in the tank cannot be aimlessly guessed. During pumping water, it's frequently needed that the proprietor of the tank put a stop to other activities until the water in the tank is full. This difficulty can be excluded by introducing a system that sense and present the water position so that the motor can be turned off at the applicable set duration so that electricity, time, and water are inversely saved. As a result, mechanized water position index and regulator using Arduino can be used on a massive scale base where manpower demand and the installation process are made easier (Shetty, 2020).

Currently, the internet has changed the commerce pattern of life. Internet of thing (IoT) has potentially added a new dimension that enables smarter object communication (SOC). The paper proffers a simple water monitoring system with indicated different situations. The paper also signifies when the water position is above or below the demand stated in this paper. System design and armature are considerably bandied in the paper, therefore being a cost-effective and simple strategy to cover the water position system (Priya & Chekuri, 2017).

In (Sood et al., 2013), a design and enhancement of mechanized water inflow cadence is presented. This research emphasized the need for a water level monitor in agrarian irrigation. This paper says that each crop needs a different quantum of water and this can be achieve by using an automated water position regulator which will as well help in reduction of wastage of water. This approach was a device to calculate the inflow rate of water available in the irrigation channel. This device makes use of Hall Effect sensor to measure the charge of inflow. G1/ 2 Hall

Effect water inflow detector is used as a seeing unit with a turbine rotor internally whose velocity of gyration adjusted with the difference in rate of inflow of water.

Utmost of the authors and their designs all have the same limitation: the electrode touching the water body. The electrode is made of conductors and normally when the conductor stays long in the water body it causes corrosion and this leads to the impurity of the water which isn't aseptic to the body and can cause the spread of diseases. But this design of a smart water level controller using an sms module will exclude the use of electrodes by using the ultrasonic sensor to descry the position of the water and the GSM module to shoot communication and admit commands from the users to reduce the mortal intervention and water wastage.

2. Material and Method

There are numerous styles of designing an automatic water level control with a switching device but all these methodologies bear user's interventions. In this design, a smart water level controller is designed using electronic control to refill the water without the user's intervention.

2.1 Description of Major Circuit Component

2.1.1 Transformer

A converter that is used either for stepping up (amplifying) or stepping down (reducing) the voltage is known as a transformer. Transformer is used in many of the electrical / electronic circuit. There are two kinds of transformer which are step up transformer and step down transformer. In step up transformer the secondary side is greater than the primary side while in step down transformer the primary side is greater than the secondary side. Energy can be conveyed between two or more different coils without conductive connection between two circuits.

By the law of induction stated by Faraday:

$$Vp = -Np\ \frac{d\emptyset}{dt} \quad (1)$$

$$Vs = -Ns\frac{d\emptyset}{dt} \quad (2)$$

Where

Vp = voltage on the primary side

Vs = voltage on the secondary side

Np = number of turns on primary side

Ns = number of turns on secondary side

$\frac{d\emptyset}{dt}$ = change in magnetic flux through one turn of the winding over time

Combining equations (1) and (2),

$$\text{Turns ratio} = \frac{Vp}{Vs} = \frac{Np}{Ns} \quad (3)$$

For step up transformer, $Ns > Np$

For step down transformer, $Ns < Np$

The relation in equation 4 is presented by the law of conservation of energy

$$S = \text{IpVp} = \text{IsVs} \quad (4)$$

Combining equation (3) and (4)

$$\frac{Vp}{Vs} = \frac{Is}{Ip} = \frac{Np}{Ns} \quad (5)$$

where

S = Apparent power

I = Current

V= Voltage

Is = primary current

Ip = secondary current

However, the transformer used in this paper was a step-down transformer.

2.1.2 Diodes

A diode is an electronic element that allows the flow of current in a direction. Its resistivity at one end is lower and higher at the other end. Semiconductor substance with a pn junction connected to two electrical pins/legs (terminal) is a crystalline composition which is the generally applied kind of a semiconductor presently. A pn junction crystallized either silicon or germanium demitasse and is known as rectifier diodes. These diodes are made up of semiconductor substance and applied in rectification procedure. These groups of diode allow the current to flow in forward bias and block the inflow of current in reversed bias. Semiconductor diodes were the first semiconductor electronic devices. The ideal diode law states that (Lingam, 2008):

$$I = Io\ (e^{\frac{g7}{kT}} - 1) \quad (6)$$

Where

I = the net current flowing through the diode
I_0 = "dark saturation current", the diode leakage current density in the absence of light
V = applied voltage across the terminals of the diode
q = absolute value of electron charge
k = Boltzmann's constant
T = absolute temperature (K)

Diodes are further classified based on their functions. These classes include, Light emitting diodes, power diode and Zener diodes (Lingam, 2008).

Light Emitting Diode: A light-emitting diode (LED) is a kind of diode that emits a glow when current passes through its terminals. When current passes through the pins/legs (terminal) of this diode, it generates light. In different terms, light is generated when a sufficient quantum of encouraging current passes through the LED. In multiple diodes, this glow emitted is not seeable as their frequency situations that don't allow visibility. LEDs are accessible in multiple colors such as tricolor LEDs that can radiate three colors at a time. The color of the light is dependable on the energy interval of the semiconductor applied.

Power Diode: A kind of diode generally used in power inventories circuits is known as a power diode. Just like normal diode, a power diode has two-terminals and allows the inflow of current in one direction. A power diode varies in structure from a standard diode to allow this advanced current level.

Zener Diode: This is the most applicable kind of diode as it can give a steady source voltage. Zener diode is operated in rear bias and disintegrates down on the appearance of a specific voltage. However, a stable voltage is achieved when the current passing through the resistor is repressed. This diode is extensively used in power inventories to supply a reference voltage.

2.1.3 Bridge Rectifier:

A bridge rectifier is a motor made up of four diodes which makes a full wave rectifier that rectifies AC mains input to DC output. Bridge rectifiers are considerably used in power inventories that give the demanded DC voltage for electronic factors. D1, D2, D3 & D4 along

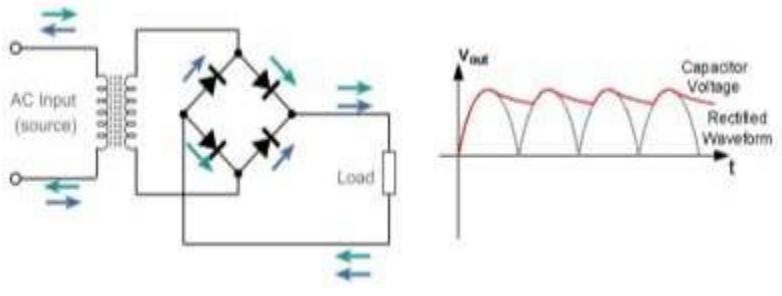


Figure 1: Circuit diagram of a Bridge Rectifier

with a load resistor (RL) are used for designing the bridge rectifier. These diodes are connected in a way such that AC is converted to DC efficiently. The output of the input signal applied across the terminal A and B can be achieved across the load resistor (RL). Also, load resistor (RL) is connected between two terminals like C and D. During the positive cycle, two diodes like D1 and D3 will conduct electricity and during the negative cycle, two diodes like D2 and D4 will conduct electricity.

2.1.4 Voltage Regulator:

Voltage regulator also described as a ―controller‖ is used for regulating and control of voltage. It has just three pins and seems like a simple device but it is indeed a certifiably complicated circuitry or IC. It is used to converts changing input voltages to produces a more stable ―regulated‖ output voltage. Voltage controllers are accessible in different ranges of output. The two last integers in the name denote the output voltages. as shown in table 1 (Neverova & Semanov, 1981).

Table 1 Voltage Regulator Output Voltages

NAME	VOLTAGE
LM7805	+5V
LM7809	+9V
LM7812	+12V
LM7905	-5V
LM7909	-9V
LM7912	-12V

2.1.5 Capacitor

An electrical/electronic element that stores energy for a little period of time is known as capacitor. The forms of applied capacitors differ extensively; majority of the capacitor made up of no less than two conductors separated by an insulator (dielectric) when there is voltage detection around the positive charge on one side of the plate and a negative charge on the other side of the plate. In electrical networks, capacitors are used extensively. An absolute capacitor is depicted by stable capacitance C, measured in farads:

$$C = \frac{Q}{V} \quad (7)$$

Where

C = Capacitance

V = Voltage

Q = Electric Charge

In practical application of these devices, incremental changes defines the capacitance (Bird, 2003)

$$C = \frac{dQ}{dV} \tag{8}$$

The maximum energy stored in a capacitor can store is represented by (Bird, 2003):

$$E = \frac{1}{2} CV^2 = \frac{1}{2}\frac{sA}{d} \tag{9}$$

where

E = energy stored in the capacitor

d = diameter between the dielectric plates

A = area of the dielectric plates

The equation for capacitor charging can be expressed as the time constant at which it charges

$$T = R * C \tag{10}$$

where

R = Resistance

C = Capacitance

The capacitor discharge is the function of time during the discharge period

$$Vc = Vs * e^{\frac{-t}{RC}} \tag{11}$$

Where

Vc = voltage across the capacitor

RC = Time constant

Vs = Supply voltage

t = Time

2.1.6 Resistor

The resistor is an electrical/electronic element that resists the inflow of electric current. Resistors can be found in nearly all electrical/electronic circuit. Resistor has different value for different operations. The value of a resistor can be measured with the use of a digital multi-meter or by the use of resistor color coding. Resistor is measured in ohms (Ω). This ratio is represented by ohm's law:(Bird, 2003)

$$R = \frac{v}{i} \quad (\Omega) \tag{12}$$

where

R = resistance measured in ohms

V = voltage across the resistor

I = current across the resistor

Resistors are applicable for different purposes. Few instances involve the reduction of electric current, dividing voltage, generation of heat, control gaining, and time constants setting. There are two main kinds of resistor which are fixed resistor and variable resistors like a potentiometer, rheostat, and thermistor.

The power dissipated (P) by a resistor is given in equation (13)

$$P = I^2R \ (W) \tag{13}$$

2.1.7 Relays

The relays are frequently used to control the pump. There are three layouts of a relay, namely; Common Connection (COM), Typically Closed Connection (NC), and Typically Open Connection (NO) [10]. In this paper, NO configuration was selected and used because of its function as a switch. Also, since this configuration is open, there will be no connection between COM and NO. When the relay module is activated, it connects to COM via electromagnet within the relay, and therefore, electricity supply to the load is applied, which switches the alarm OFF (Prayash, 2018).

2.2 Methodology

In this research, the use of an ultrasonic sensor, Arduino, and GSM module for controlling and watching the water level in an overhead tank will be employed. Smart water level controller using SMS module will use GSM network to transmit the status of the current water position in the overhead reserviour from 0% to 100% to the proprietor‘s mobile. This research used the ultrasonic sensor to determine the exact water position present in the reserviour and send the

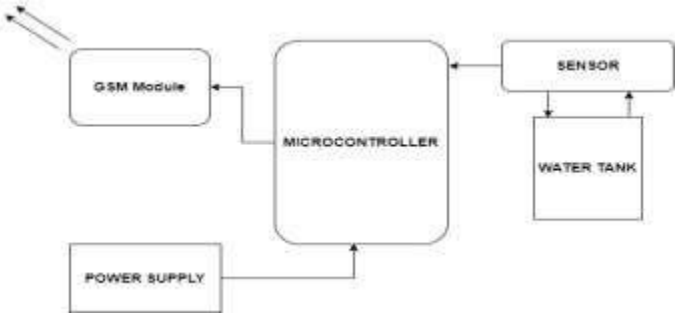


Figure 2: Block Diagram of Smart Water Level Controller Using SMS Module

exact water level in the tank in probability from 0% to 100% by just transmitting an SMS alert to the user‘s phone incontinently. Arduino is used as the brain box of this research, ultrasonic sensor is used to replace the old strategy of electrode insertion into the water due to its capability to quantify the level of the water using the echo of the water and send exact values without any physical contact with the water body. Figure 2 summarized the subsections involved in carrying out the research.

2.2.1 Microcontroller (Arduino Uno):

Arduino Uno was used as controller of the system. Connection is established between the Tx and Rx of the GSM board and the Rx and Tx of the Arduino board respectively and a ground connection is formed between the two modules. The Echo pin and Trigger pin of the ultrasonic sensor are connected to pin 3 and pin 2 of Arduino respectively. The diagram Arduino Uno showing the pins is shown in Figure 3 while the descriptions of the configured pins are show on Table 2.

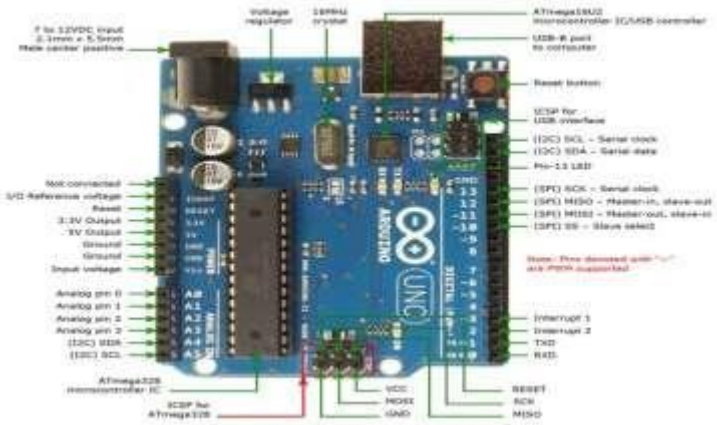


Figure 3: Diagram of Arduino UNO

Table 2 Arduino Uno Configuration Pins

Pin Category	Pin Name	Pin Details
POWER	Vin, 3.3V, 5V, GND	Vin: Input voltage to Arduino when using an external power source. 5V: Regulated power supply used to power microcontroller and other components on the board. 3.3V: 3.3V supply generated by on-board voltage regulator. Maximum current draw is 50mA. GND: ground pins.
Reset	Reset	Resets the microcontroller
Analog pins	A0 – A5	Used to provide analog input in the range of 0-5v
Input/output pins	Digital pins 0 – 13	Can be used as input or output pins
Serial	0(Rx), 1(Tx)	Used to receive and transmit TTL serial data
External interrupts	2, 3	To trigger an interrupt
PWM	3, 5, 6, 9, 11	Provide 8-bit PWM output
SPI	10 (SS), 11(MOSI), 12 (MISO) AND 13 (SCK)	Used for SPI communication
Inbuilt LED	13	To turn on the inbuilt LED
TWI	A4 (SDA), A5 (SCA)	Used for TWI communication
AREF	AREF	To provide reference voltage for input voltage.

2.2.2 Sensor Circuit

HC- SR04 Ultrasonic sensor is used to sense the position of water in the reservoir. Vastly sensitive ultrasonic sensor is powered by the operating voltage of the output pin of Arduino Uno. The ultrasonic sensor generates exact, non-contact interval measures of about 0.8 to 120 inch. Ultrasonic sensor transmits low spurts of sound and listens for this sound to echo off of close things. The frequency of the sound is altitudinous for humans to catch on (it is ultrasonic). The ultrasonic sensor measures the duration of flight of the sound burst. A user also computes the distance to an thing exploiting this flight duration and the speed of sound (ft./s). Ultrasonic sound has such a high pitch that humans cannot hear it. This particular detector transmits an ultrasonic sound that has a frequency of around 40 kHz. The ultrasonic sensor transmits short bursts of sound and listens for this sound to echo off of close objects. The frequency of the sound is high for humans to hear (it is ultrasonic). The ultrasonic sensor measures the duration of flight of the sound burst. A user also computes the distance to an object using this flight duration and the speed of sound (ft./ s). This sensor uses ultrasonic sound to measure distance just like batons and dolphins do. Ultrasonic sound has such a high pitch that humans cannot hear it. This particular sensor transmits an ultrasonic sound that has a frequency of about 40 kH (Prayash, 2018). The HC- SR04 Ultrasonic Sensor has four pins and this pins‘ configurations are epitomized as follows.

• Pin1 (Vcc): provides a 5V power supply to the sensor.

• Pin2 (Trigger): This is an input pin, used to initialize dimension by transmitting ultrasonic waves by keeping this pin high for 10us.

• Pin3 (Echo): This is an output pin, which goes high for a certain time period and it'll be substitutive to the duration of the time for the wave to return back to the sensor.

• Pin4 (Ground): This is a ground pin used for the connection to the GND of the system.

2.2.3 GSM Module (SIM900)

SIM900 GSM Module is the lowest and cheapest module for GPRS/ GSM communication. It's common with Arduino and microcontrollers in the utmost of enrooted operation. the use of a mobile sim for communication is provided by the GSM/GPRS technology. It uses a 900 and 1800 MHz frequency band and allows user to admit/ transmit mobile calls and SMS. The keypad and display interface allows the inventors to make the customize operation with it. Likewise, it also has modes, command mode and data mode. In every country, the GPRS/ GSM have different protocols/ frequencies to operate. Command mode helps the inventors to modify the

dereliction setting according to their essentials. GSM for wireless communication constantly uses periodical communication to interface with the microcontroller system and needs AT commands for its operation. These commands are transmitted by the microcontroller. This module requires a SIM card just like mobile phones and likewise has an IMEI number analogous to a mobile phone (Prayash, 2018). The arrangement is shown on a published circuit board (PCB) as illustrated in Figure 4.

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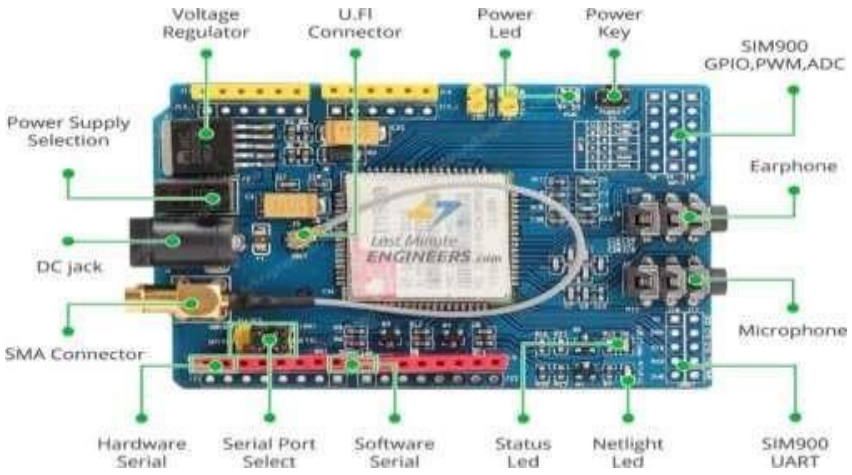


Figure 4: Diagram of GSM Module

2.2.4 Power Supply Unit

A 220/12V transformer was used to step down the input 220V AC voltage to 12V AC, diode was used for full wave rectification of the stepped down 12V AC to DC, capacitor was used for filtering the AC ripples and 7809 regulator was used to further regulate and stabilize the output voltage to 9V DC supply. Block diagram of this arrangement can be seen in Figure 5 while the power supply subsection circuit is show in Figure 6(Today, 2008).



Figure 5: Block Diagram of Power Supply

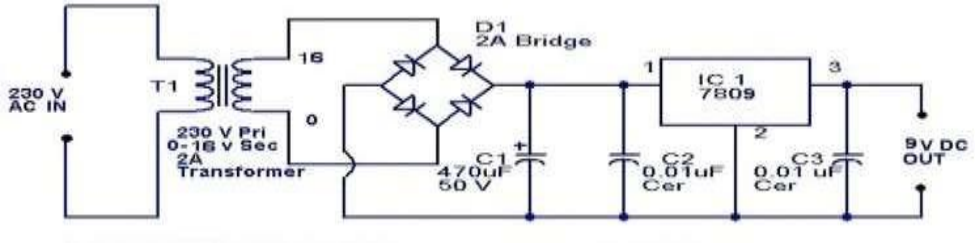


Figure 6**:** Diagram of Power Supply Circuit (Shetty, 2020)

2.3 Implementation of the Sub circuits

Connections

A conceptual design of the project is designed to know how the circuit will look like and how each component used will function to the best of their capacity. The design gives an overview of the roles of the major block, how they are integrated, and the information flow arrangement. After the design has been made, the construction of the circuit begins; the microcontroller used is established on the circuit design with minor hardware connection and flexibility. The other component such as the GSM module, ultrasonic sensor and a power supply pack were used for the construction of the hardware part.

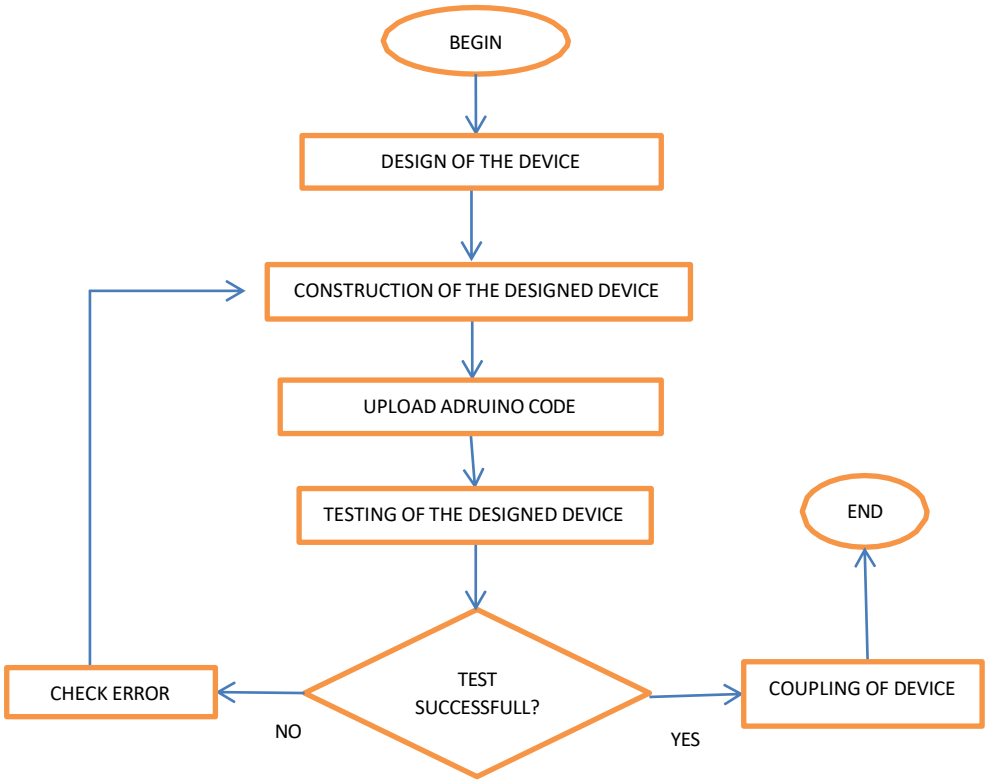


Figure 7: Flow Diagram of Smart Water Level Controller using SMS Module

The hardware part construction includes the connection of ultrasonic sensor, GSM module, establishing the ground connection between the boards, writing a _programming code‘ in line with expected functionality of the system, the uploading of the Arduino code by downloading the Arduino environment, connecting the USB to the board and finally testing the code to see if it run accordingly without any mistake or code error.

In case of no error in the uploading of the code and hardware connection part, then the project can be coupled. The flow chart below shows the implementation of this project.

3. Results and Discussion

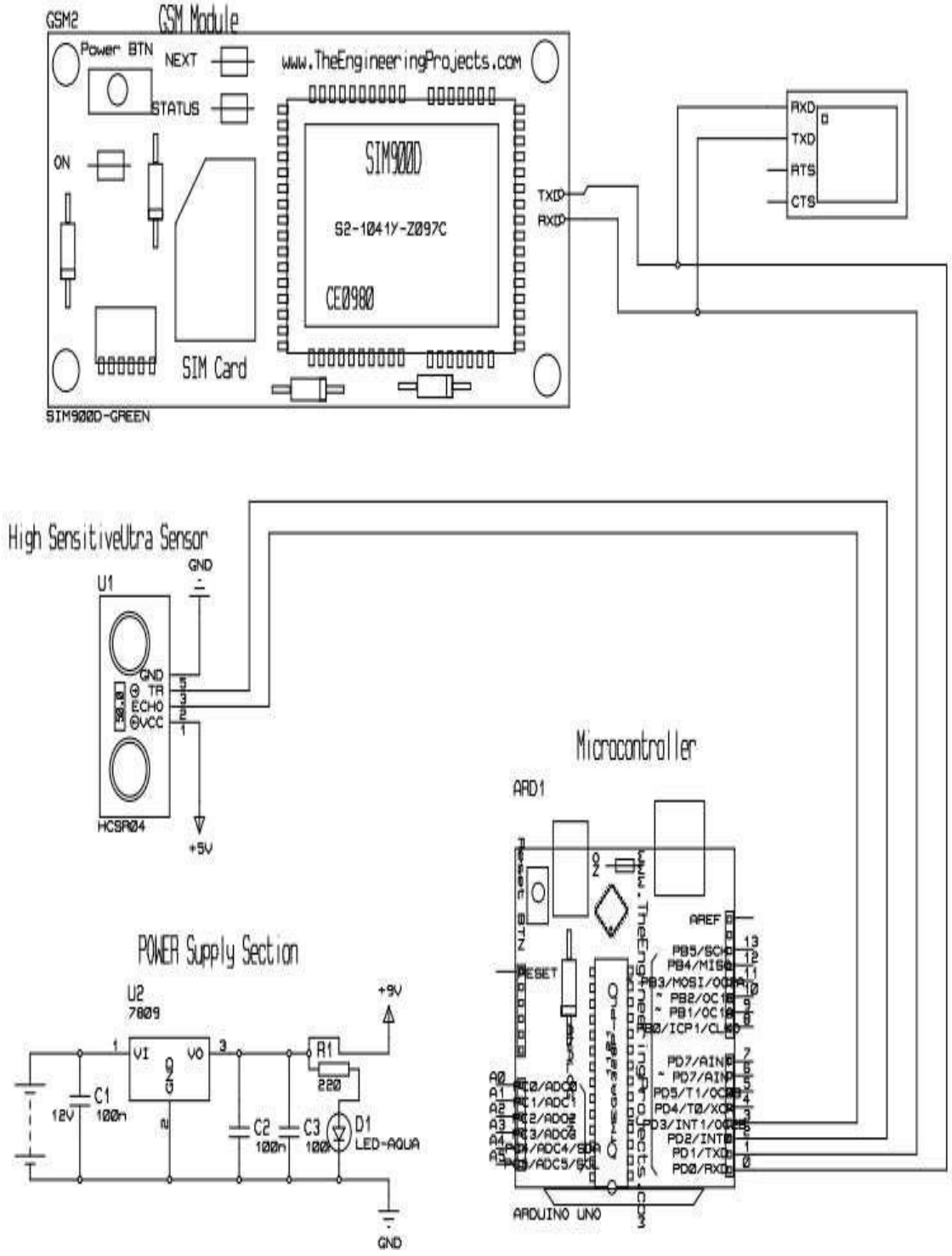


Figure 8: Circuit Diagram of The Smart Water Level Controller Using Sms Module

Testing and integration is done to make sure that the design is performing duly as anticipated there by allowing one or truly aimed users for which the design was targeted for, treasure its performance and inversely approaches exploited in the design and integration of several modules of the construction. Nonetheless, this involves checking to make certain that all the various units and subsystem work appropriately, also there has to be quality interface existing between the output and input unit subsystems. All the components/modules were connected together, and a device was created. All component and section performed as defined in the design. Tests such as component test, transformer test, ultrasonic sensor test, GSM module test and live test were carried out. Component like resistor, capacitor, LED, regulator, diode, relay used in the project are tested. The result of the testing is provided in Table 3.

Table 3 Results of Tested Components Used

S/N	Components	Test performed	Status
1.	Resistor	Continuity test and resistance test	Okay
2.	Diode	Continuity test and voltage drop test	Okay
3.	Capacitor	Charging and Discharging test	Okay
4.	Regulator (LM7809)	Continuity test	Okay
5.	Relay		Okay
6.	LED		Okay
7.	Arduino	Pins testing	Okay

The above components are tested using some of the equation and formulas stated in the chapter two the project write up and the continuity test was performed using the help of digital multi-meter. All components are tested OK.

The rating of the transformer as expected was 220V/12V, 1000mA. From the AC mains power supply, the primary windings receive 220V input; and the output was scaled to be 16.75 using the formulas stated above. Test data on transformer has it that the resistances of the primary windings for step down transformer is greater than that of the secondary side these were established.

When performing an ultrasonic test, recall that the ultrasonic sensor has 4 pins. There is a ground connection established between the Arduino and the sensor, when the GND pin and VCC pin of the sensor is connected to the GND of the Arduino. Echo pin and Trigger pin of the sensor are connected to the pin 3 and 2 of the Arduino. When the trigger pin of the sensor is applied, an

ultrasound wave was transmitted from the transmitter through the echo pin, the reflected signal was observed. After all tests are performed, the sensor was deemed okay to use.

For the GSM module test, the module was tested for proper SMS functionality, this is done by uploading the test code below to Arduino

```
void setup ()
{
delay(20000);
delay(20000);

delay(20000);
serial.begin(9600);
serial.println("AT+CMGF=1");
delay(1000);
serial.println("AT+CMGF=\"+ 2348083990565\"\r");
delay(1000);
serial.println(" GSM Modem is working fine!");
delay(100);
serial.println((char)26);
delay(1000);
}
void loop ()
{
}
```

After the code has been uploaded, an SMS was sent to the mobile indicating that the GSM modem is working fine. During the test mistake such as incorrect TX/RX/GND connection was avoided and the Tx and Rx of the GSM was removed before the upload of the code to avoid error.

On completion of the prototype, live test which involves electrical power supply and Gasoline generator were used to power the device at different time. Each time this is done, the device sent a message through the GSM module to the mobile phone indicating that the system is ready to receive command as it is shown in Figure 9. The ultrasonic sensor calculates the percentage of

the water in the tank to check if the water level is low or high. Figure 10 and Figure 11 shows the message displayed when the circuit was low and it was high and the command given to the relay (either to turn on the motor which is the pump or turn off the pump), the message displayed was sent to the mobile phone through the GSM module as shown in Figure 12. However, after draining some amount of water in the tank, message would be sent to the device to check for the percentage of water left in the tank and the ultrasonic sensor calculates the level remained in the tank and sent to the mobile phone through the GSM module which is also shown in Figure 12. After all the tests have been done, it's evident that the device performed according to the given command and to satisfaction. The behavior of the components and the behavior of the device were observed and noted ok.

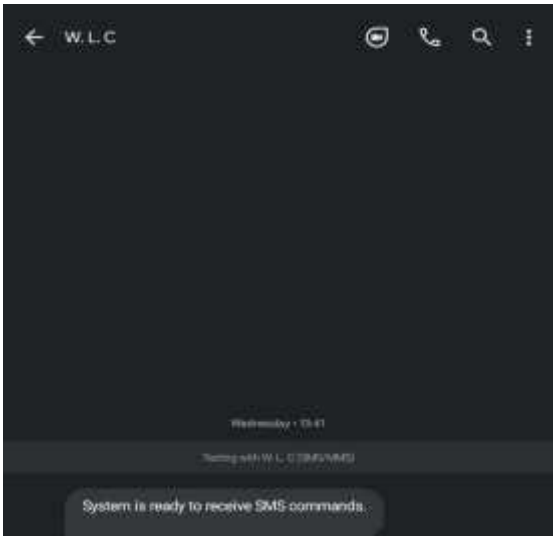


Figure 9: Diagram of the command received when powered up



Figure 10: Displayed image of when the tank is low



Figure 11 : Displayed image of when the tank is high

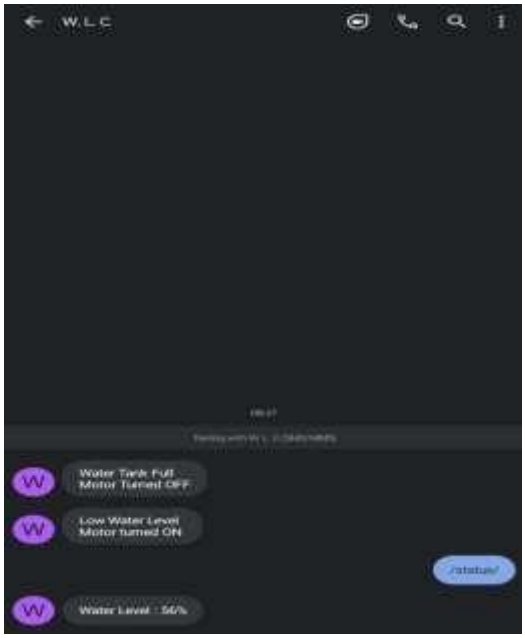


Figure 12: Diagram of the message received at each command

4. Conclusion

An average living being on planet earth survival depends on water as it is one of the most treasured resources on earth. Sadly, a substantial quantity of water is being wasted due to an unrestrained use and wastage. Certain water level controlling and monitoring systems are also recommended thus far but nearly all these of the methods still have one or two disadvantages. Efforts were made to overcome these disadvantages and to apply an efficient system. The purpose of this project was to put in place a system that can solve the water wasting problem and provide a hygienic environment for all, Also to implement a user-friendly system which has now been achieved.

References

Ahmed Mohammedahmed Eltaieb, A., & Jian Min, Z. (2013). Automatic Water Level Control System. *International Journal of Science and Research (IJSR) ISSN*, *4*(12), 1505–1509. www.ijsr.net

Bird, J. (2003). Electrical Circuit Theory and Technology. In *Electrical Circuit Theory and Technology*. https://doi.org/10.4324/9780080505169

LINGAM, K. etal; (2008). *Electronic Devices & Circuits Ii B . Tech I Semester*. 173.

NEVEROVA, V. P., & SEMANOV, B. A. (1981). Voltage Regulator. *Instrum Exp Tech*, *V 24*(N

6 PT 2), 1478. https://doi.org/10.4324/9780080505367-26

Prayash. (2018). Automated Water Level Controlling and Detection Using Arduino and GSM Sim Module. *International Journal of Science and Research (IJSR)*, *7*(6), 535–538. https://doi.org/10.21275/ART20183233

Preethi, D., Anusha, J., Sravani, M. V., Puviarasi, R., & Sindhu Bala, M. (2015). Automatic water level controller. *International Journal of Applied Engineering Research*, *10*(33 Special Issue), 26581–26587.

Priya, J., & Chekuri, S. (2017). Water Level Monitoring System Using Iot. *International Research Journal of Engineering and Technology*, 1813–1817. www.irjet.net

Pudasaini, S., Pathak, A., Dhakal, S., & Paudel, M. (2014). Automatic Water Level Controller with Short Messaging Service (SMS) Notification. *International Journal of Scientific and Research Publications*, *4*(9), 1–4. www.ijsrp.org

Shetty, A. D. (2020). Automatic Water Level Indicator and Controller Using Arduino. *International Research Journal of Engineering and Technology*, *May*, 5342–5346. www.irjet.net

Sood, R., Kaur, M., & Lenka, H. (2013). *D Esign and D Evelopment of a Utomatic*. *3*(3), 49–59.

Today, C. (2008). *Design of 9 V regulator using 7809 with circuit diagram and schematics*. Electronic Circuits and Diagrams-Electronic Projects and Design. http://www.circuitstoday.com/9-v-regulator-using-7809