DESIGN AND CONSTRUCTION OF AN AUTOMATIC WATER PUMP CONTROLLER WITH LCD LEVEL INDICATOR

BY

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DEDICATION

This project is dedicated to the Author and Finisher of my faith, God Almighty who saw me through the good and bad times of the implementation of the project and to my mother, Mrs. E.O. Adaralegbe for her financial and moral support.

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ABSTRACT

This project is titled the design and construction of an automatic water pump controller with level indicator. The project is designed to give a display of water level in a tank and control a pump motor as required. The reading given is in the scale of centimeter and percentage. The project circuitry mainly comprises an ATMEGA328P microcontroller which is the processing unit of the system, 16 X 2 liquid crystal display (LCD) which displays the level of the water in the water tank as well as the status of the water pump, BC547 transistor which is an NPN transistor which works as a switching device to actuate or deactivate water pump, 5V dc Relay which is connected to the AC supply that starts or stops the water pump and an Ultrasonic sensor which is used to sense the distance or level of the water in the water tank. All these work together to give a perfect water pump automating system. The Chapter one of this report is based on the introduction, Background, scope, aim and objectives, significance and application of the project. Chapter two is centered on the review of past related project or research. Chapter three detailed the methodology and Design of the project. Chapter four contains the analysis of results and Implementation of the designs while chapter five concludes the report.

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CHAPTER ONE

1.1 INTRODUCTION

Long before our measurement of time, they dug wells to collect rain water, surface water or groundwater. Initially, water was always collected by hand, but we know that in ancient Egypt, they knew of wells and water wheels.

About 2,200 years ago, the Greek mathematician and physicist Archimedes invented an apparatus that could raise water from river, so it can be used for irrigation. The Romans were good at leading water from the lakes and sources high up, down to the cities The water was led into aqueducts that had an even drop (2 mm per meter) down towards the cities. Therefore, the Romans had no need to develop new pumps.

To regulate the water pressure and to repair water pipes in a certain part of town, the Romans invented the first water towers. The water towers were square and approximately 8 meters high with a water container made of lead at the top. From the water container, water was led out to the city's citizens through pipes made of lead or water pipes made of brick

With the use of valve, the Romans could close individual pipes and water pipes if there was something that needed to be repaired, or if a lot of extra water was needed in the one of the water pipes – for example, for one of the city's any baths.

In our contemporary days, more intelligent ways are needed in making water readily available for use with minimal or no human inspection or control. One of this ways is to design and construct an automatic water pump controller and water indicator which Automatically controls the ON and OFF of the water pump and senses the water level in Overhead tanks.

1.2 BACKGROUND OF THE PROJECT

The project, automatic water pump control system and level indicator is designed to monitor the level of liquid in the tank and thereby controlling the water pump based on the tank's water level. The system has an automatic pumping system attached to it so as to refill the tank once the liquid gets to the lower threshold and switching OFF the pump once the water gets to the higher threshold.

The Sustainability of available water resource is now a dominant issue for many reasons in the world today. 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.

The water level control, controls, monitors and maintains 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. Besides this, liquid level control systems are widely used for monitoring of liquid levels in reservoirs, silos. Proper monitoring is needed to ensure water sustainability is actually being reached, with disbursement linked to sensing and automation, such programmatic approach entails microcontroller based automated water level sensing and controlling.

1.3 STATEMENT OF PROBLEM

It is noticed that water scarcity is one of the major problems facing major cities of the world and wastage during transmission has been identified as a major culprit. Furthermore, it is noticed that most water pumps get damaged quickly due to excessive and unnecessary work out of water pumps. Also, the monitoring of water level in overhead tanks manually has been ineffective.

Many manual techniques have been employed over the years to combat these problem but all proved ineffective. Thus, the need for and Automatic actuating and monitoring system arose.

1.4 SIGNIFICANCE OF THE PROJECT

The following are the significance of Automatic water pump controller and level indicator

a) ***It saves Power:***
By using the project, we can save power. It can be used in places where there is problem of load shedding. As it is automatically controlled, it limits the amount of electricity. This project will be useful in energy conservation as required in today's world.

b) ***It saves money:***
As we know that automatic water level controller conserves power, it saves money as well. Water regulation is optimized using this device, and that means wasted electricity and wasted water is kept at a minimum. This saves a huge amount of money along with manpower

c) ***It maximizes water:***
Additionally, water usage can be maximized with the automatic water pump controller and level indicator. Often, water pumps get more use during the midday. An automatic water pump controller and level indicator is often used because it automatically provides more water during the middle of the day and less water at night. As a result, water remains at its appropriate level at all times. \

d) ***Flexibility:***

This system provides you the flexibility to decide for yourself the water levels for operations of pump set in upper/lower tanks.

1.5 PROJECT AIMS AND OBJECTIVES

The aim of this project is to design and construct an automatic water pump controller and level indicator with switching circuit. Some of the objectives are;

1. To design an automatic water monitoring system
2. To incorporate an interactive medium between the end user and the pumping machine
3. To save energy since the demand of electricity is very high.
4. To ensure instantaneous availability of water.
5. Suitability: These water level controllers are ideally suited for normal water as well as for ultra-low conductivity water with less than 1 micro/mho.
6. Easy to operate: This system comes fitted with sensitivity setting which can be provided with internal settings
7. Safety: The system is safe to operate.
8. Saves water

1.6 APPLICATION OF THE PROJECT

The Automatic water pump controller with level indicator project is a useful device and plays an important role in various industries such as automobile, irrigation, and also at homes, or wherever water is pumped either, underground or overhead.

1.7 SCOPE OF THE PROJECT

This Automatic water pump controller with level indicator project will give a heads-up the instant over-head tank or underground tank is full or goes below the required level, hopefully giving you time to close windows and bring in possessions. In this work, an Ultrasonic sensor is used in the transmitter circuit, which measures the distance of water level from the upper point of the bottle or Tank. The distance is measured in centimeters and sent to receiver circuit. The water level is shown in terms of percentage on a 16×2 LCD module, which is connected to the receiver circuit.

Chapter two gives a literature review of similar works that have been done, while chapter three explains the methodology alongside the components used in designing the project.

Chapter four and five give analysis of the result and the conclusion of the project work respectively.

CHAPTER TWO

2.1 LITERATURE REVIEW

Several works have been done on the control of water pumping machine and level indication before but these systems have their own disadvantages as a result of the method of sensing employed. Khaled *et al.* (2010) introduced the notion of water level monitoring and management within the context of electrical conductivity of the water. The technique of water level monitoring and controlling system concentrated with some basic parts which are softly aggregated together in the proposed method. For water level indication unit can use some LED light which will work for water level indication. By touching different water levels through water level sensor, LED should be indicated as on/off (i.e. on: yes, sensor senses water).

To make special water level sensor the author introduces some convenient materials such as iron rod, nozzles, resistance, rubber etc. A connecting rod made by iron and steel which should be connected with ground and at least four nozzles which should be connected with +5v via a 1kΩ resistance. There is need to bind them together and put a rubber at their joint point which will act as an insulator for every nozzle. When the sensor touches water, nozzles and connecting rod get electric connection using water conductivity. The system can control the water pump by connecting it with an output pin of microcontroller via a motor driver circuit. When microcontroller sends a positive signal (+5v) or a ground signal (0v) to the motor driver circuit, then the water pump become on or off respectively. The author also used a manual switch on the motor driver circuit which is supposed to use for controlling it manually. It makes this system more users friendly.

2.1.1 Design and Development of Automatic Water Flow Meter (International Journal of Computer Science, Engineering and Applications (IJCSEA) Vol.3, No.3, June 2013).

This research paper by Ria Sood, Manjit Kaur, Hemant Lenka emphases on the need of water level controller in irrigation in agriculture. It says that every crop requires different amount of water and this can be done by using automatic water level controller which will also help in reducing wastage of water. Here they use a technique to measure flow of rate of water in irrigation pipelines.

It uses a Hall Effect Sensor to measure the rate flow. G1/2 Hall Effect water flow sensor is used as a sensing unit with a turbine rotor inside it whose speed of rotation changes with the different rate of flow of water.

2.1.2 Automatic Water Level Controller with Short Messaging Service (SMS) Notification (International Journal of Scientific and Research Publications, Volume 4, Issue 9, September 2014)

This research paper by Sanam Pudasaini, Anuj Pathak, Sukirti Dhakal, Milan Paudel presents a system of an automatic water level controller with SMS notification. SMS notification was added to automatic controller system so that water can be managed by user during load shedding. Two systems work synergistically; automatic level controller system and SMS system. The program was developed in Arduino program developing environment and uploaded to the Microcontroller. Water level in the system is controlled automatically. The controller operates on a battery power. Whenever the system encounters empty level and the status of load shedding, the SMS notification is sent to the user. The system will automate the process by placing a single sensor unit in the tank that will periodically take measurements of the water level and will control the motor automatically. This system eliminates the efforts of people for daily filling of the tank and checks for overflow.

2.1.3 Automatic Water Level Control System (International Journal of Science and Research (IJSR))

This research paper by Asaad Ahmed Mohammedahmed Eltaieb, Zhang Jian Min involves designing and development of automatic water level control system had exposed to the better way of software and hardware architecture that blends together for the interfacing purposes. The system employs the use of advance sensing technology to detect the water level. It uses Arduino and uses relay to control motor. Different wires are attached at different Junctions of the Beaker. When we pour water in the beaker. The water comes in contact with the wire and tells the level of water in the tank. Accordingly, they have displayed the level of water on LCD display. And uses relay to turn ON and OFF the motor.

2.1.4 *Design of automatic irrigation*

Awelewa, *et al.* (2006) designed an automatic irrigation control system to facilitate the automatic supply of adequate water from a reservoir to field or domestic crops in all agricultural seasons. One of the objectives of this work is to see how human control could be removed from irrigation and also to optimize the use of water in the process. The method employed is to continuously monitor the soil moisture level to decide whether irrigation is needed, and how much water is needed in the soil. A pumping mechanism is used to deliver the needed amount of water to the soil. The work can be grouped into four subsystems namely; power supply, sensing unit, control unit and pumping subsystems which make up the automatic irrigation control system. A moisture sensor was constructed to model the electrical resistance of the soil; a regulated 12 volts' power supply unit was constructed to power the system; the control circuit was implemented using operational amplifier and timer; and the pumping subsystem consisting of a submersible low-noise micro water pump was constructed using a small dc-operated motor. System response tests were carried out to determine the time taken for the system to irrigate potted samples of different soil types having different levels of dryness. The results obtained showed that sandy soils require less water than loamy soils and clay soils require the most water for irrigation.

2.1.5 *Design of an automatic water level system*

Ejiofor and Oladipo (2013) design an automatic water level system in which the monitor consists of the following major units: sensors, comparator circuit, microcontroller, display unit, and the pump. The core work of detecting the level of water is done by the comparator. Taking advantage of the electrical conductivity property of water, the copper conductors was used as the water level sensor. When water touches the copper sensor positioned at a particular level in the tank, voltage is transferred to the copper which in turn is transferred to the comparator circuit for further processing. The LM324 comparator was used to compare the inputs from the electrodes in the tank and with a pre-set resistance and output a HIGH or a LOW with respect to the result from the comparison. This HIGH or LOW was fed into the microcontroller which in turn uses this to control the water pump and display the appropriate status on an LCD screen. The programmable Atmel 89C52 microcontroller was programmed in Assembly Language and was used as the processor to control the functionalities of the entire system. A Liquid Crystal Display (LCD) served as the output unit which showed the status of the system on a screen. Relays were used in building a switching unit that simply triggers the pump on or off, depending on the signal received from the microcontroller. Four I/O ports were used and they have the connection to the microcontroller.

2.1.6 Design of a solar powered auto irrigation system

Ishwar, *et al.* (2014) design a solar powered auto irrigation system, the system checks the moisture content in the soil, based on that pumping motor will automatically pump the water into the field. Here tin probes were used as moisture sensor. By using this sensor, it can find whether the soil is wet or dry. If it is dry, pumping motor will pump the water. This project, the main controlling device is AT89S52
microcontroller. Here soil sensor will give the status of the soil to the microcontroller, based on that microcontroller will display the status of the soil on the LCD and switch on or off the pumping motor through relay. The pumping motor will pump the water into the field until the field is wet which is continuously monitored by the microcontroller.

The main objective is to find the maximum sun radiations in order to get maximum charge for the batteries. Electricity can be generated from the sun in several ways. Photovoltaic (PV) has been mainly developed for small and medium-sized applications, from the calculator powered by a single solar cell to the PV power plant. For large -scale generation, concentrating solar thermal power plants have been more common, however new multi megawatt PV plants have been built recently. A photovoltaic cell (PV cell) is a specialized semiconductor that converts visible light into direct current (DC). Some PV cells can produce DC electricity from infrared (IR) or ultraviolet (UV) radiation. Photovoltaic cells are an integral part of solar-electric energy systems, which are becoming increasingly important as alternative sources of power utility. Solar cells generate DC electricity from light, which in turn can be used in many applications such as: charging batteries, powering equipment, etc. This solar tracker works on the photovoltaic technology.

2.1.7 Construction of a flow control system

Thwe and Ohn (2011) construct a Flow control system which is a technology resource for the fluid handling industry's critical disciplines of control, containment and measurement. It covers products, processes, and services for efficient, reliable, and cost-effective control and delivery of fluids in a variety of industries. There are many flow control mechanisms. In this system, automatic water flow control system is implemented and can be used as process control system. As sensing unit, photo interrupter and slotted disk are used to produce pulse train for frequency input of the microcontroller. The sensor signal is counted as frequency and converted to the flow rate by using the software program in PIC. In the system, the rate of water flow was maintained at the desired value 25 liter per minute. This is done by adjusting a valve that controls water. Valve is connected to the DC motor shaft. DC motor can be operated on 12-volts dc. The motor is driven by driver IC TA7291P. This IC has four modes – stop, brake, clockwise (CW), counterclockwise (CCW). IC pin No. 5 and 6 get input commands from PIC 16F628. These commands are manipulated values from the controller and are applied to correct the deviation of the measured value from a desired value. When water flows through the pipe, measured value is made by an opto-coupler with a slotted disk that provides a pulse train proportional to water flow. This pulse train is fed into PIC pin No.12 as a frequency input. These input frequencies within a precise range are converted into flow rate by the program. This flow rate is compared to the set point value.

2.1.8 Development of simple water level indicator

Dipanjan, *et al.* (2016) a simple water level indicator was made using resistors, LEDs, etc. For this it may be designed a water sensor by using conducting wires. In this project the sensor to measure water up to four levels was designed. Take 4 segments of insulated conducting wires. Tore out the ends of these wires, approximately 1cm. Adjust the length of the wire segments according to the water levels. In the following diagram it has been displayed with 4 different colours. The wire with Black colour is connected to buzzer. The wires with colours Yellow, Red, &Green are adjusted to check Level1, Level2, Level3 and

Level4 respectively. Water level indicator works through the following circuit diagram. Here this circuit is connected to 9-volt dc voltage source. The positive end of the dc source is connected to the overhead water tank and the negative end of the dc source is connected the diode LEDs and the buzzer accordingly. The other end of the LED is connected to the 220 ohm resistors and the resistor ends are connected to the separately to the overhead water tank. The buzzer's other end is connected to the overhead water tank here the resistor is not connected. One switch is connected between the positive voltage source of the circuit and the battery.

2.1.9 Design an automatic water level controller

Abang, (2013) Design an automatic water level controller for both overhead and underground tank is designed to monitor the level of water in a tank. It displays the level of water and when it is at the lowest level; a pump is activated automatically to refill the tank. When the tank is filled to its maximum capacity, the pump is automatically de-energized. Several circuits are put together to ensure proper working of this design, and the block diagram includes the supply unit, the micro-processor unit, the sensor unit, the display unit and the pump drives unit. The power unit is responsible for turning on the entire circuit. Some components are used to set up power unit and they include; a 15v step down transformer, a bridge rectifier circuit, a smoothening capacitor and a voltage regulator IC. The microprocessor (AT89S50) controls virtually all the actions carried out in this design. (AT89S50) is used in the design. The sensor unit is responsible for sensing the level of water and transfer the current position of water to the microprocessor. The display unit in the circuit is use to physically show the current position of water in the tank, the properties of seven segment display are been used. He stated that there are many methods of designing an automatic water level control with switching device but all these methodologies require human assistance. In this project an automatic water level control for both overhead and underground tank with switching device is designed using electronic control to refill the water without human intervention. The system design was carefully arranged to refill the water tank any time water get low to a certain level finally the system automatically shut down the water pump by putting the electric pump by putting the electric pump off when the tank is full

2.1.10 Design of water level indicator with alarms

Ahmed, *et al,* (2015) designed a Water Level Indicator with Alarms Using PIC Microcontroller, this design is to solve that problem. This design not only indicates the amount of water present in the overhead tank but also gives an indication when the tank is full. This design uses widely PIC microcontroller 18F452, bilateral switches to indicate the water level through LCD display. When the water is empty the wires in the tank are open circuited and resistor pulls the switch low hence and open the switch. As the water fill in the first reservoir tank its fill-up percentage shown in the LCD display. Today in the world most of the developing countries using this in their home and also industries. All probes used to implement was made of aluminum. The design is applicable for both reservoir and main tank in home or industries.PIC 18F452 used in this design. There is also buzzer and LCD in this design. LCD used to show the level of water in both reservoir and main tank. Buzzer used to create a siren to stop the pump or water coming channel. There are 10 DIP switches used in this design. These switches indicate water level of both tanks. PIC microcontrollers also controls the motor which pumps the water in the tank from the reservoir. In the auto mode, motor is automatically turned on when water level reaches 20% in the tank and it is turned off when water level reaches 100%. Choose PIC microcontroller for programming flexibility, faster speed of execution since microcontrollers are fully integrated inside the processor

2.1.11 Design and implement a microcontroller based water pump controller

Olufemi *et al,* (2016) design and implement a microcontroller based water pump controller a microcontroller based, the water pump controller aimed reducing water wastages and pump failures, due to not switching it off immediately when not needed. The control system from which water level of both tanks are observed with simultaneous water pump control is based on existing water level technology using the principle of ultrasound for level sensing. A prototype of the proposed microcontroller based water pump controller was fabricated and tested. This paper provided an improvement on existing water level controllers by its use of calibrated circuit to indicate the water level and use of DC instead of ac power, thereby eliminating risk of electrocution. The developed system is capable of powering a 1HP pump from the input voltage, which can deliver an output current up to 20A. The system will help to eliminate the cost and inefficiency of human interference associated with manual monitoring and controlling of pump, while maximizing the performance and life span of the electric water pump. In the water level indication unit, light emitting diode (LED) light which will work for water level indication is used. By touching different water levels through water level sensor, LED should be indicated as ON/OFF. When the sensor touches water, nozzles and connecting rod get electric connection using water conductivity (Khaled et al., 2010). The pump is controlled by connecting it with an output pin of the microcontroller via a motor driver circuit.

2.1.12 Design a simple, automatic water level controller

Viswanathan (2004) design a simple, automatic water level controller for overhead tanks that switches on/off the pump motor when water in the tank goes below above the minimum/maximum level. The water level is sensed by two floats to operate the switches for controlling the pump motor. Each sensors float is suspended from above using an aluminum rod. This arrangement is encased in a PVC pipe and fixed vertically on the inside wall of the water tank. Such sensors are more reliable than induction-type sensors. Sensor one senses the minimum water level, while sensor two senses the maximum water level. Leaf switches S1 and S2 (used in tape recorders) are fixed at the top of the sensor units such that when the floats are lifted, the attached 5mm dia. (approximate value) aluminum rods push the moving contacts (P1 and P2) of leaf switches S1 and S2 from normally closed (N/C) position to normally open (N/O) position. Similarly, when the water level goes down, the moving contacts revert back to their original positions. Normally, N/C contact of switch S1 is connected to ground and N/C contact of switch S2 is connected to 12V power supply. IC 555 is wired such that when its trigger pin 2 is grounded it gets triggered, and when reset pin 4 is grounded it gets reset. Threshold pin 6 and discharge pin 7 are not used in the circuit. When water in the tank goes below the minimum level, moving contacts (P1 and P2) of both leaf switches will be in N/C position. That means trigger pin 2 and reset pin 4 of IC1 are connected to ground and 12V, respectively. This triggers IC1 and its output goes high to energize relay RL1 through driver transistor SL100 (T1). The pump motor is switched on and it starts pumping water into the overhead tank if switch S3 is 'on.' As the water level in the tank rises, the float of sensor 1 goes up. This shifts the moving contact of switch S1 to N/O position and trigger pin 2 of IC1 gets connected to 12V. This doesn't have any impact on IC1 and its output remains high to keep the pump motor running.

2.1.13 Design a low cost automatic water level control

Ishwar and Laloo (2013) Design a low cost automatic water level control, in which water level controller depends on two detection points in the OHT. The water level must be controlled at these two points. To facilitate this, we use sensors. In our case, these sensors are metallic contacts with space between them present at each detection point. When water reaches a sensor, a proper circuit must be present such that the presence of water is detected and a signal is produced. This signal must pass through logic circuits to give the correct actuator output. Also it must be strong enough to activate the actuator as shown in figure 2.1 below. A similar action must take place when water reaches another sensor. The circuit essentially uses the high and low states of a NAND gate to activate or deactivate the actuator. Simply put, relay on the ON and OFF states of the actuator. Metallic contacts are L-shaped aluminum contacts which conduct electricity when the space between them is bridged by water. For the project, L-shaped brackets were used. Two contacts at the bottom part of the tank form the indicator for low level of water. Similarly, two contacts at the upper part of the tank indicate that water is about to overflow. They assembled the circuit which works on the conduction of electricity by water. The circuit works using logic gates and the output obtained is in the form of ON and OFF state of the centrifugal submersible pump.

2.1.14 Design water level monitoring system

Bhad, *et al* (2016) Design water level monitoring system in real time mode using WSN. Automatic water level monitoring is possible with the help of WSN (wireless sensor network) which is an attractive field of environment monitoring. In current system it is not possible to monitor the water level accurately, due to natural disaster water levels increases, and it is hard to detect the actual level and volume of water therefore many problems have to face so to overcome this drawback it was proposed a system which monitors the water level periodically. To help of wireless sensor network and send the notification message to the mobile application user and digital notification board. For that communication it will form zigbee network which has lower energy and real time behavior and it automatically check the water level periodically. A number of software and hardware implementation techniques were used to design and develop the system. A microcontroller, water level sensor and a pair of Raspberry pi and DAS have been used to design the system. The Sensor used to detect the water level, then the data will go to transmit and receive through the Raspberry pi and the whole procedure is then control by this unit. The WSN system is thus suitable for the water source like dam, river, Lake Etc. The system explains the auto monitoring of the water level. The requirements of WSN increases very much, because they are used in a many different application areas sensor generates high frequency sound waves and evaluates the echo from the water level of the reservoirs which is received back by the sensor. At the transmission side, a DAS module has been attached to transmit the sensor data through Raspberry pi. At the receiving side, another Raspberry pi module has been also used to receive the sense data. An integrated Light Emitting Diode (LED) associated with DAS module is also used for real time display of water level sensed data. The Light Emitting Diode (LED) is used to indicate the different level of water and an alarm (beeper) will be active in the case of overflow and empty level.

2.1.15 Intelligent irrigation system

Tayyeb, *et al*, (2015) presents an intelligent irrigation system for gardens or orchards to increase the productivity of watering while saving the expenses of labors and the amount of water that need to be watered. The usage of soil moisture sensors, water pump, hose, LDR sensor and a microcontroller which is loaded with C programming codes made this smart system completely intelligent to do the lightening and watering intelligently without any monitoring. To construct this invention one of the most challenging parts of designing was the moisture sensor. Soil moisture sensor allows determining the needs of water to plants. Which it helps avoid wasting water or harming plants by watering too often. When soil is wet, electrical conductivity of water lowers the resistance between the probes. As soil dries, the resistance increases again. To make a suitable and cheap soil moisture sensor a few design was made but each one of them was rejected because of some demerits. The first design of the soil moisture sensor was a simple design which two probes with a fixed distance between them was installed. The probes were able to measure the moisture content of the soil but the reason that the first design was not proved because the erosion of the material was extremely high in wet soil. Another problem thing was that the two probes only occupy a very small area of the irrigation basin. Therefore, it might be problematic if that spot is wet, so the whole plant might not be irrigated.

2.1.16 Analysis of existing oil-pumping system

Rojiha, (2013) analyzed this existing oil-pumping system and discovered that they have a high power-consuming process and needs more manual power. He then proposed a sensor network based intelligent control system for power economy and efficient oil well health monitoring. Several basic sensors were used for oil well data sensing, and the sensed data was given to the controller which processed the oil wells data and it was given to the oil pump control unit which controls the process accordingly. If any abnormality is detected, then the maintenance manager is notified through SMS via the GSM. This system allowed oil wells to be monitored and controlled from remote places.in easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type the text into it. Meanwhile, (Omolola, 2010) worked on the design and construction of a water level detector with pump control based on a microcontroller. The project involved the use of a digital water level detector with pump control and an instrument that indicates the level of water in a tank, using seven-segment display to indicate the following levels; 0%, 25%, 50%, 75%, and 100%. Like (Olabimpe, 2010) it has an alarm to indicate when water is at the 0% level. However, the alarm emits a continuous sound for 10s indicates the 100% level of the tank. Most of the earlier mentioned system use the electrical conductivity of water by installing metallic conductors at separate levels along the tank height to act as sensors. Over time, the metallic conductor corrodes as it comes in contact with the water, thereby making it to lose its electrical conductivity. This also result in reduced water quality due to contamination of the water - change in the pH level, introduction of stains, colorations, deposits and change in taste of the water. In general, the water becomes unhygienic for use and hazardous to health over time. The proposed system addresses these shortcomings as it uses floating switch as its sensing device which do not react or corrode with water when in contact.

2.1.17 Automatic Water Level Controller Cum Indicator

Automatic water level controller cum indicator saves water and protects motor and reduces electricity bill. Automatic water level controller cum indicator is an electronic gadget called (Motor Controlled Automatically on the Basis of liquid W.R. to Sump and Overhead Tank). Our Automatic water level controller cum indicator is manufactured under the name – LIAMOCON. LIAMOCON takes the responsibility of a man who switching On/Off the motor. Our Automatic water level controller cum indicator serves 24 hours' water supply without letting the overhead tank to become dry.

Features

LIAMOCON switches on the motor if: 1) The water in overhead tank falls to prefixed low level i.e., below 75%, 50%, 25% as adjusted. 2) The sump is full irrespective of any levels in the overhead tank at once when power comes. 3) Soft touch needed in case we need to switch on the motor irrespective of any level in the overhead tank. 4) The switch is in manual position

LIAMOCON switches off the motor for the following reasons:

1) Liquid reaches maximum level in the overhead tank.
2) There is a low or high voltage.
3) Liquid in the sump goes below foot valve or as prefixed low level. Liquid does not flow to the overhead tank,

The switch is in off position, Fuse blown off.

Technical Support: Input voltage: 230 Volts AC 50 Hz, Power consumption: 2.5 Watts (approx.), Relay contact rating: One N/O potential free contact rated at 10 Amps at 230 Volts, Trip time delay: 65 Sec. in case of priming fault Working voltage: Motor trips if voltage > 250 or < 160 AC Power on delay: 45 Seconds even in Voltage Fluctuations Auto / Manual: Enables operation of motor. Dimensions (mm): 230 x 150 x 63 (L x B x H) Over all Panel Mounting Front Facia of Liamocon

- Shows clear indication of water levels in the overhead tank and sump tank

- Shows voltage variation if any in the left bottom corner, it shows green indicator for normal voltage, higher red light indicates high voltage and lower red light indicates low voltage
- Has an easy operate-able AUTO-MANUAL feather switch
- Green indicates AUTO Mode, Orange indicates MANUAL Mode and Red indicates dry running of motor
- Soft touch 'NEED' in case to switch on the motor irrespective of any level in the overhead tank
- Soft touch 'SILENCE' for silencing alarm
- Blinking green light indicates liquid flow to overhead tank
- Red indication with beeping sound for overflowing of water from overhead tank
- Side Leap switch enables to power on arid off Direct on for motor

Gives Alarm:

1. When there is a voltage fluctuation
2. When the motor is dry running due to foot valve blockage or priming fault in motor
3. When water overflows from the overhead tank at 'MANUAL' mode

Applications:

Automatic Water level Controller is for Hotels, Factories, Homes Apartments, Commercial Complexes, Drainages, etc., It can be fixed for single phase motor, Single Phase Submersibles, Three Phase motors. (For 3Æ and Single Phase Submersible Starter is necessary) and open well, Bore well and Sump. We can control two motor and two sumps and two overhead tanks by single unit (Auto Change Over).

2.1.18 The concept of water level controller system:

The Water Level Controller System is an Electronic Equipment which when electrically connected to the starter of any given pump-set motor will control the operation of the pump-set depending upon the water level in the Source and Destination Storage Tanks.

Advanced automatic "water level controller" unit Manufactured by M.V.Instrument is a Microprocessor based Electronic Device. This system when electrically connected to a Pump-set starter performs the following functions automatically:

- Switches ON the Pump-set when Water level drops below pre-set level (i.e. T2 level) in Overhead Tank.
- Switches OFF the Pump-set when Water level in Overhead Tank becomes full (i.e. T1 level).
- Switches OFF the Pump-set when Water level is low in Sump/Well/Bore well (i.e. S2 level).
- Switches ON the Pump-set when there is sufficient water in the Sump/ Well / Bore-well (i.e. S1 level).
- Switches OFF the Pump-set when there is a Dry run (i.e. when Water is not being pumped into Overhead Tank due to any reason).
- Low Voltage and High Voltage Protection for the Pump-set is incorporated.
- The system has Surge Voltage/Current Protection for the Pump-set.

CHAPTER THREE

The design of the project entails the drawing and understanding of the simple block diagram of the project to the drawing and simulation of the circuit diagram, programming of the microcontroller, hardware connection, calibration and testing.

3.1 METHODOLOGY

The approach used in this project is such that requires the use of a Depth or Distance sensor, a Microcontroller, a digital display, a relay and a power source.

The depth or distance sensor is used to sense the depth of water in the water tank, the microcontroller is programmed to receive the input signal from the sensor and give a corresponding output to the output devices.

The Digital display is connected to the microcontroller to display the level of water in the water tank and the status of the motor or water pump.

The relay is used to actuate or de-activate the water pump or motor.

In this project, the following specific components were used.

- HC-SR04 Ultrasonic sensor. (Distance sensor)
- ATMEGA328P (Microcontroller)
- Liquid Crystal Display (Digital Display)
- 5V dc relay.

The Arduino board was used to program the microcontroller to perform its required task of receiving input signals from the sensor, processing the signals and giving a corresponding output.

The ultrasonic sensor was used in this project because of its ability to sense distance of water in the water tank without being submerged into the water. A submerging sensor may contaminate the water or/and may cause electrical malfunctioning or hazards.

3.1.1 *DESIGN BLOCK DIAGRAM*

Before carrying out any project, the block diagram was drawn and fully understood. Block diagram gives a pictorial understanding of any work. The block diagram of the project with the major components is as shown below:

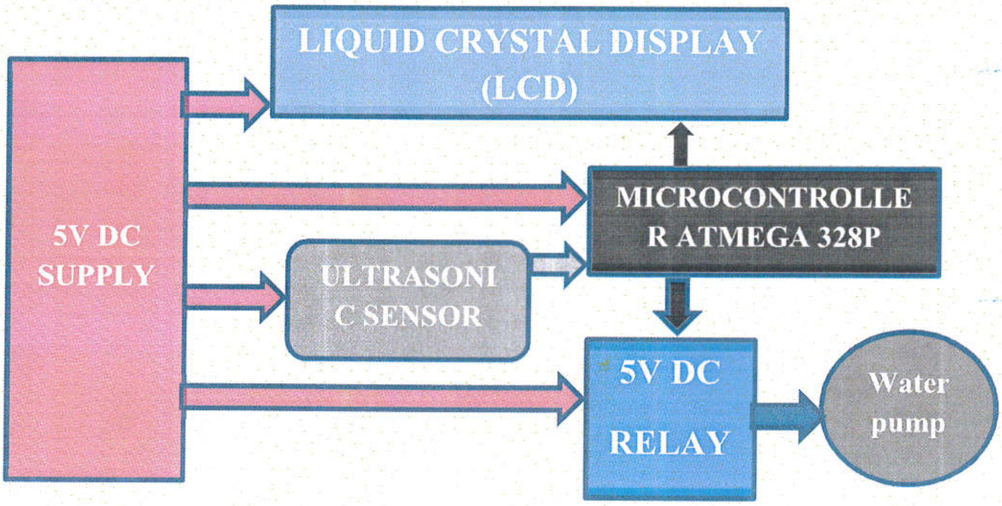

Figure 1: The simple Block diagram of the Automatic water pump controller with level indicator system

3.1.2 *PRINCIPLE OF OPERATION.*

The Automatic water pump controller design is based on a microcontroller which is the central or brain of the project as well as other peripheral components. The components require a power source of 5 volts DC. The power source was gotten from a 12V or 15V adapter. This 12V or 15V is therefore stepped down to 5 volts using a 5V voltage regulator, LM7805.

When the components are turned on, the microcontroller sends an electrical output to the echo pin of the ultrasonic sensor. This signal is converted by the sensor to a sound wave. Therefore, a sound wave is sent by the sensor to sense the distance of the water in the water tank from the position of the ultrasonic sensor. When the sound wave reaches the water level, the sound wave is refracted back to the ultrasonic sensor and the sound energy is converted back to an electrical signal which is sent to the microcontroller through the Trigger pin of the ultrasonic sensor.

Then by applying the formula,

[Range = {(time taken) X Velocity of the transmitted signal (i.e. 340 m/s)} /2], the required distance is obtained

Afterward, the microcontroller sends a corresponding output signal to the LCD to print the level of water in centimeters and in percentage based on the maximum distance of the water tank as programmed in the microcontroller.

A corresponding output signal is also sent to the relay through the BC547 transistor to either open or close the contacts of the relay. The open position of the relay signifies that the water pump will be in the OFF position while a close position of the relay signifies that the water pump will be in the ON position.

3.2 REQUIREMENT SPECIFICATION.

The design of the Automatic water pump controller with level indicator was done with the following required specifications.

- Input Voltage: 220 - 230V AC
- Operating Voltage: 12V – 15V DC stepped down to 5V DC
- Operating Current: 1 Amperes
- Operating Frequency: 50Hz

3.3 DESIGN

3.3.1 CIRCUIT DESIGN

The automatic water pump controller with level indicator circuit is powered by a 12Volts DC power source which is later stepped down to 5V with the use of an LM7805 Voltage Regulator. The 5Volts DC power is then circulated to the VCC pin of the major electronic components. (Microcontroller, LCD, Ultrasonic sensor and the relay coil). The Microcontroller acts as the brain of the circuit by accepting and processing the input electrical signals from the ultrasonic sensor and giving a corresponding output to the LCD and Relay based on the pre-uploaded programs in the microcontroller.

The LCD displays the level of water in the water tank in centimeters and percentage. It also tells the status of the water pump or motor.

The relay controls the on and off position of the water pump or motor. Once it is open circuited the motor is off but when closed circuited, the pump is turned on.

The ultrasonic sensor senses the water level in the water tank by sending and receiving sound waves.

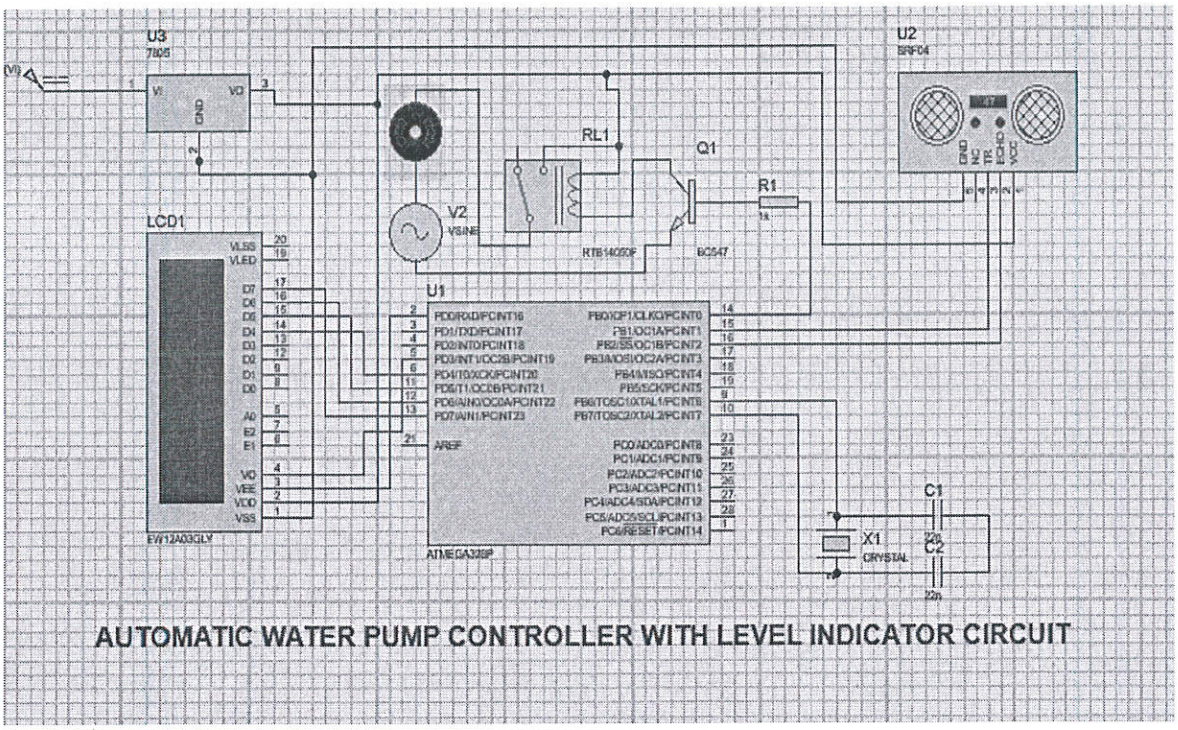

Figure 2: Circuit Diagram of the Automatic Water Pump Controller with Level Indicator

3.3.2 CASING DESIGN

The electrical circuit is being house in a plastic Patrex Box with a plywood cover. Two openings are made on the plywood for both the LCD and the socket outlet for the water pump with a mini hand drill.

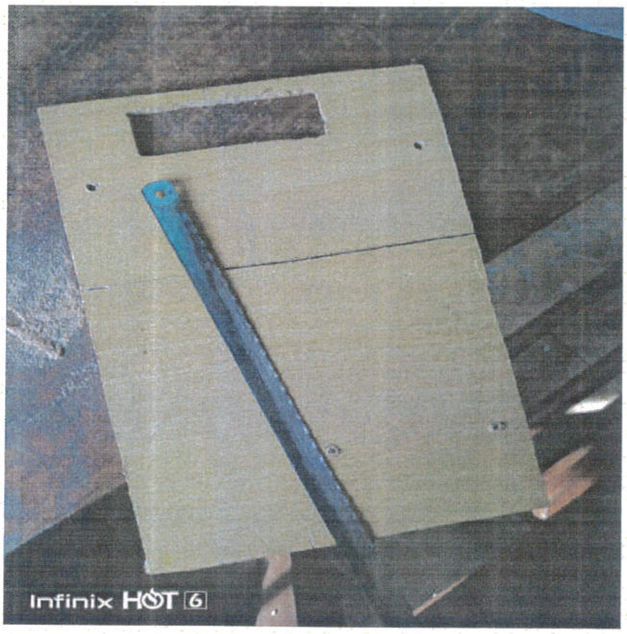

Figure 3: Picture of the plywood used for the packaging

3.4 COMPONENT USED

The main components used for the project are

- IC 7805
- 5V DC relay
- ATMEGA328P
- BC547 transistor
- Liquid crystal display (LCD)
- Ultrasonic distance sensor

a) **IC 7805**

It is a voltage regulator integrated circuit. It belongs to the family of 78xx series of fixed linear voltage regulated ICs. The voltage source in a circuit may have fluctuations and would not give the fixed voltage as output. A constant output voltage value is maintained by this IC. The xx in 78xx indicates the fixed output voltage it is designed to provide. Capacitors are provided + 5V of power supply with the help of IC 7805 which can be then connected as input and output pins depending upon the voltage levels.

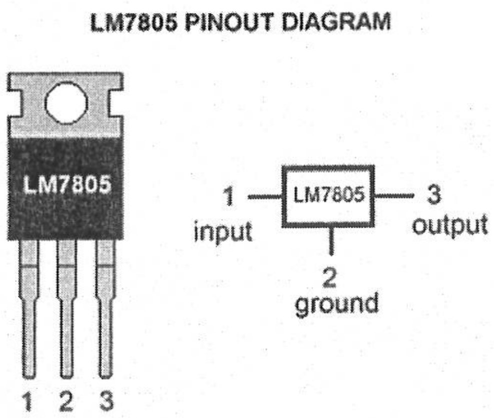

Figure 4: Diagram of IC 7805 with pin configuration

b) RELAY

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. A relay switches one or more *poles*, each of whose contacts can be *thrown* by energizing the coil. Normally open (NO) contacts connect the circuit when the relay is activated; the circuit is disconnected when the relay is inactive. Normally closed (NC) contacts disconnect the circuit when the relay is activated; the circuit is connected when the relay is inactive. Relays are used wherever it is necessary to control a high power or high voltage circuit with a low power circuit.

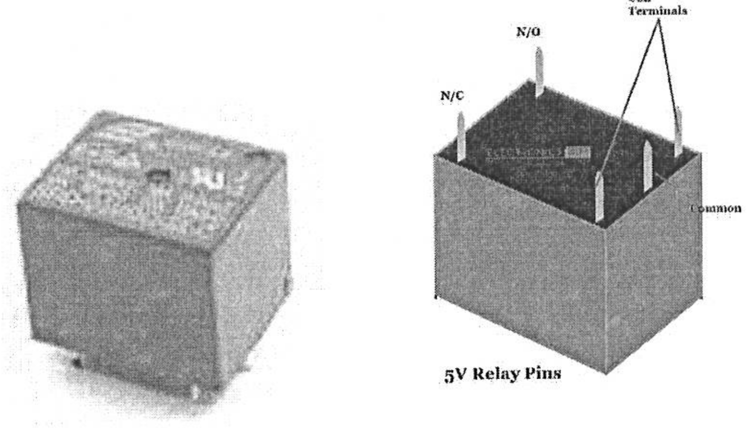

Figure 5: Diagram of a 5 Volts Dc relay with it pins configuration

c) ATMEGA 328

The microcontroller ATMega328 is used in the design. ATMega328 is a high-performance Microchip 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts (Atmel Cooporation, 2000).

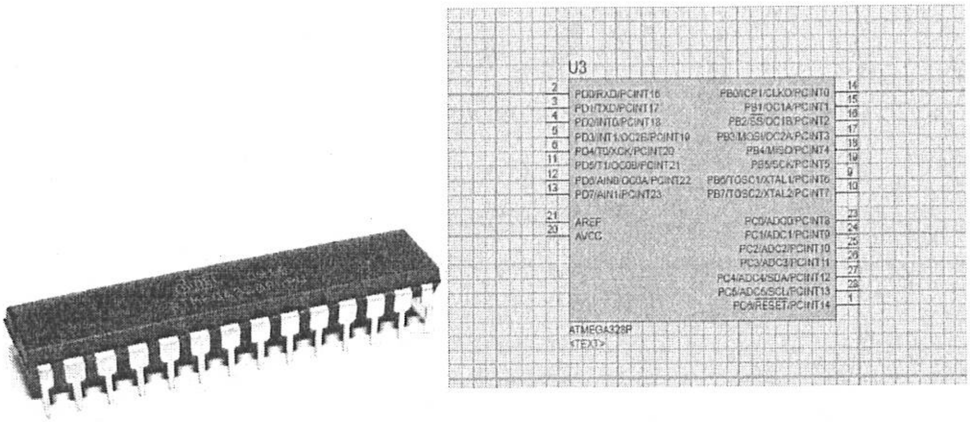

Figure 6: Diagrams of an ATMEGA328 microcontroller with its pin layout

d) BC547 transistor.

BC547 is a NPN transistor hence, the collector and emitter will be left open (reverse biased) when the base pin is held at ground and will be closed (forward biased) when a signal is provided to the base. The maximum amount of current that could flow through the collector pin is 100mA hence, we cannot connect loads that consume more than 100mA using this transistor.

When this transistor is fully biased then it can allow a maximum of 100mA to flow across the collector and emitter. This stage is called Saturation Region and the typical voltage allowed across the collector-emitter (V_{CE}) or Base-emitter (V_{BE}) could be 200 and 900mV respectively. When base current is removed the transistor becomes fully off, this stage is called the cut-off Region and the Base Emitter voltage could be around 600mV.

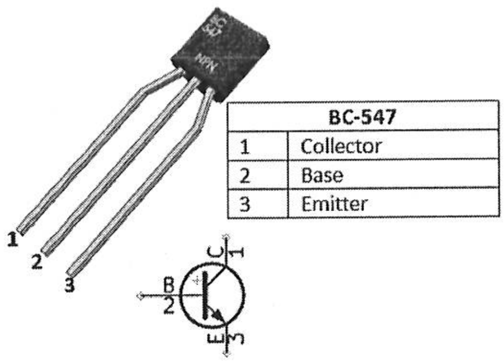

Figure 7: Diagram of a BC547 transistor with Pin layout

e) Liquid Crystal Display (LCD)

A 16x2 Liquid crystal display and Light emitting diode is used in this unit to physically show the current position of water in the tank. A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome.

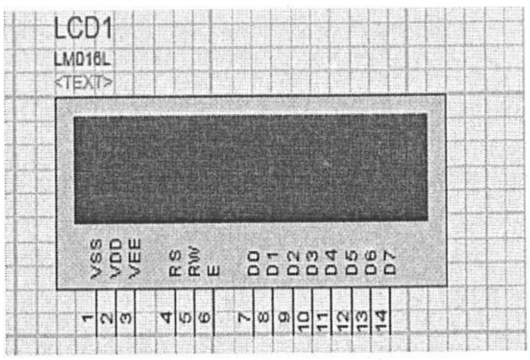

Figure 8: Schematic Diagram of a (16 X 2) Liquid Crystal Display

f) Ultrasonic Sensor

It is basically a distance sensor and is used for detecting the distance using SONAR method. It has two ultrasonic transmitters namely the receiver and the control circuit. The transmitter emits a high frequency ultrasonic sound wave which bounces off from any solid object and receiver receives it as an echo. The echo is then processed by the control circuit to calculate the time and the difference between the transmitter and receiver signal. This time can subsequently be used to measure the measure the distance between the sensor and the reflecting object. It has an ultrasonic frequency of 40 KHz and accuracy is nearest to 0.3 cm.

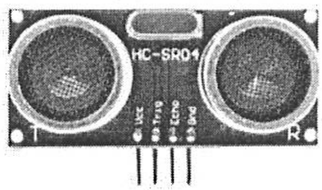

Figure 9: Diagram of an Ultrasonic Sensor

CHAPTER FOUR

IMPLEMENTATION, TESTING, ANALYSIS OF RESULTS AND DISCUSSION.

4.1 IMPLEMENTATION

The project comprised of the hardware and software design. The hardware design of the project had phases which started from the simulation of the circuit on Proteus software, observing the behavior of the circuit on the Arduino Uno Board and bread board to the final soldering of the components on the Vero board.

In achieving the software design part, the Arduino IDE software was used in writing and uploading the codes on the Microcontroller.

4.2 TESTING.

Testing is one of the important stages in the development of any new product, repair of existing ones or modification of existing projects because it is very difficult to trace a fault in a finished work, especially when the work to be tested is too complex. For the purpose of this project, two stages of testing are involved

- ✓ Pre-implementation testing
- ✓ Post-implementation testing.

4.2.1 PRE-IMPLEMENTATION TESTING

This stage involves the testing of each component used in the project to ensure proper performance of all the components before soldering on the Vero board. The pre-implementation involves the testing of the Voltage Regulator, Relay, LCD, Microcontroller, BC547 transistor and the Ultrasonic sensor before soldering them on the Vero Board. With the aid of a Multi-meter, I confirmed the values of some of the discrete components.

4.2.2 POST-IMPLEMENTATION TESTING

After implementing the circuit on a project board, the different sections of the complete system were tested to ensure that they were in good operating condition. The continuity test was carried out to ensure that the circuit or components are properly linked together. This test was carried out before power was supplied to the circuit. Finally, after troubleshooting has been done on the whole circuit, power was supplied to the circuit. Visual troubleshooting was also carried out at this stage to ensure that the components do not burn out.

Afterwards, a water pump was connected to the output of the circuit and the water pump came up automatically when the water level in the tank is below 10 percent and turns off automatically when the water level is less than or equal to 10 percent.

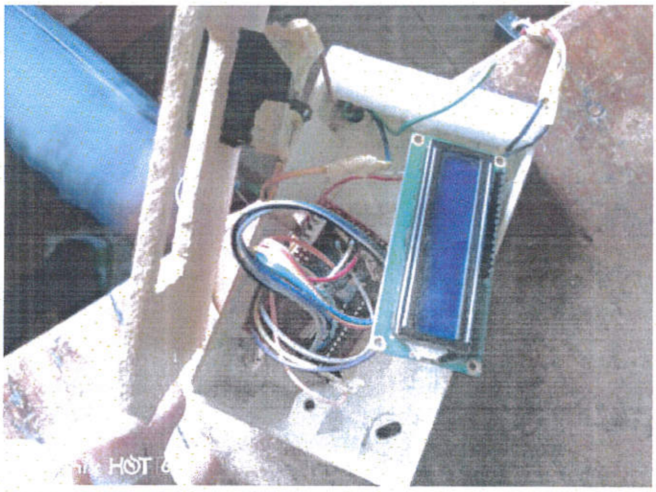

Figure 10: Picture of the project before coupling

Figure 11: Picture of the mini water tank and the positioning of the ultrasonic sensor

Figure 12: Picture of the coupled circuit and the water tank

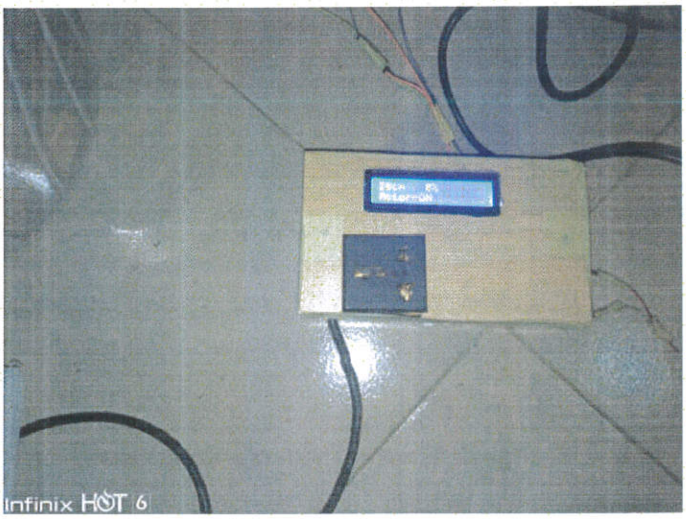

Figure 13: Picture of the project with readings.

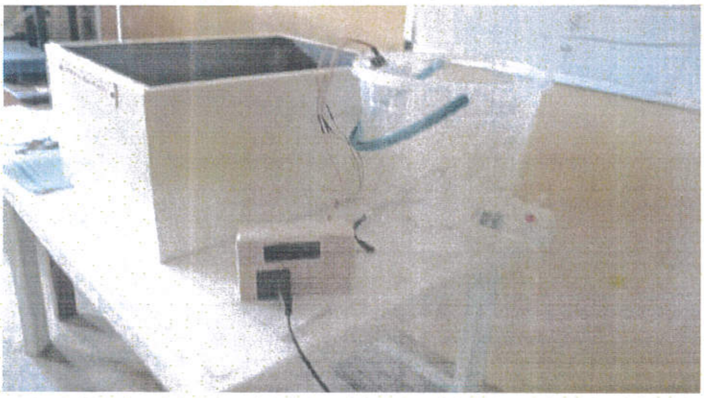

Figure 14: Picture of the Project while testing

4.3 ANALYSIS OF RESULTS AND OBSERVATION

The project is aimed at creating an automatic water pump controller with level indicator. The maximum height of the water tank used in testing the project is 28.5 centimeters.

The circuit was set to start the pump once the water level is below 10 percent, that is approximately 3 centimeters. It is also tested and confirmed that the pump turns off automatically when the water level is at 10 percent.

The LCD displays the water level in both Centimeters and percentage based on the distance measured by the ultrasonic sensor at every 1 – 2 seconds.

4.4 PROJECT MANAGEMENT

This session explains the division of stages involved in the actualization of the project with respect to time.

4.4.1 PROJECT SCHEDULE

The chart below shoes the schedule of tasks involved in the completion of the project with respect to time.

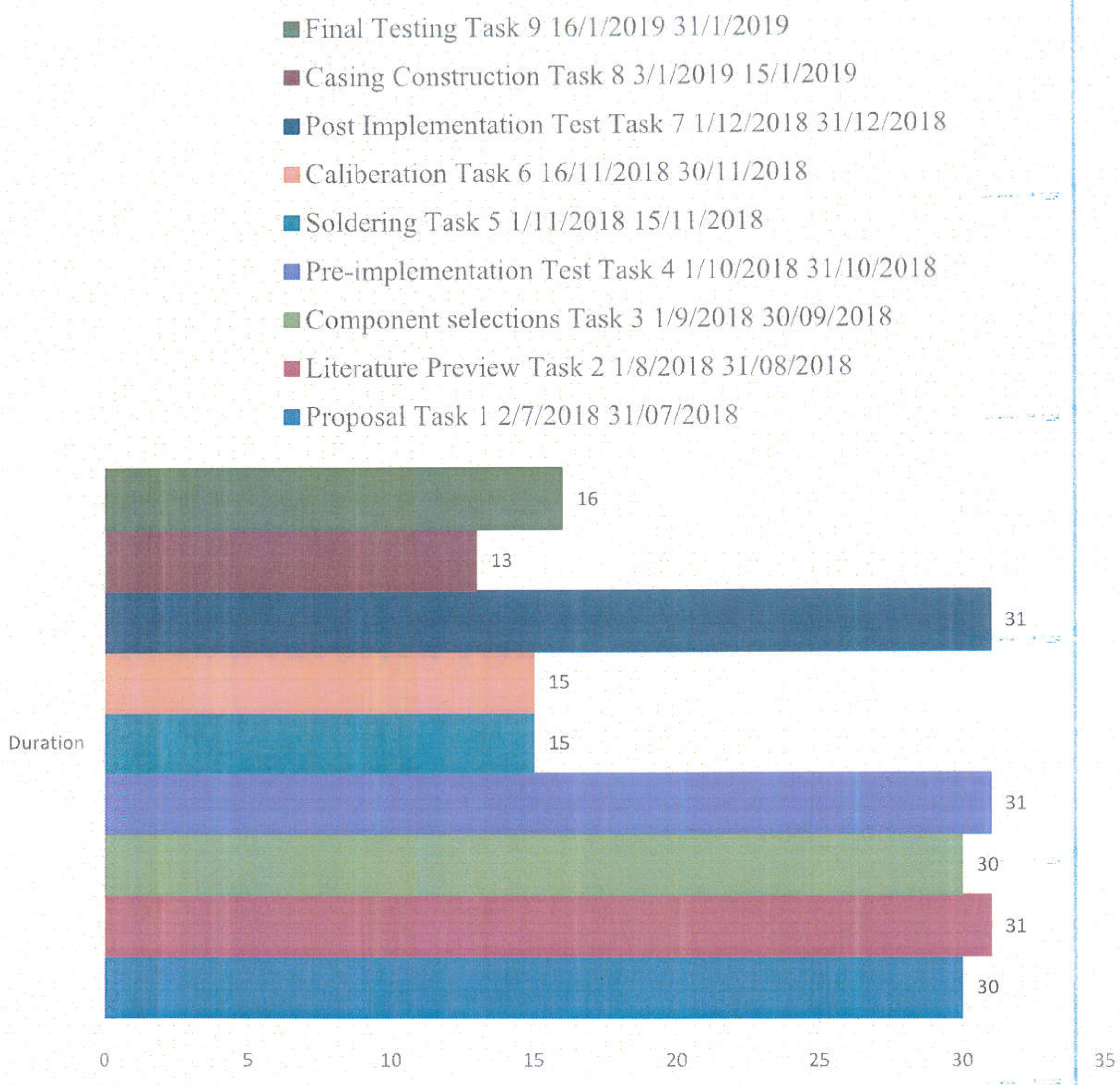

Figure 15: A chart of the project schedules

4.4.2 SOCIAL, LEGAL, ETHICAL AND PROFESSIONAL CONSIDERATIONS.

It was ensured that the selection of the project components conforms to the IEEE standard and specifications. I equally ensured that the project is safe for use. The materials used for packaging the project has a very high resistivity value.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The course of undergoing this project has disclosed numerous important things about an automatic water level controller. Ranging from its economic importance and recommendation based on the use of this automatic water level controller.

In present days, there are many parts on earth which face scarcity of water, calamities like draught etc. Energy production is laborious and cannot be misused. The water tank overflows as the height of water in the tank cannot be randomly guessed. This leads to extra energy consumption, which is a high concern in the present era. People also need to wait and stop doing their other activities until the tank is full. Hence, here is an idea which senses and indicates the water level so that the pump can be switched off on appropriate time and save water, electricity and time as well.

Hence with the successful design and construction of this project, a more efficient way of ensuring continuous flow and pumping of water is provided even in the absence of the operator. This provides the possibility that is can still put on his/her appliance (pump) in the absence of the user.

5.2 RECOMMENDATION

This project is designed to be used in our homes and industries where the need for accurate flow and pumping of water is needed. And should be used and maintain by a qualified personnel.

5.3 CONTRIBUTION TO KNOWLEDGE

The design and construction of the Automatic water pump controller with level indicator has exposed me more to the use of microcontrollers in Automation systems. The project has also broadened my knowledge on Arduino programming. It has also improved my soldering skill and my simulation skills.

In general, I have learnt that for every automatic system designs, there must input, processing and then output units.

5.4 CHALLENGES ENCOUNTERED

The following are the challenges encountered when implementing this project.

1. Purchase of Components: Some of the components needed for the implementation were not gotten from my locality so I had to order for some of them. The ordering of these components from an online store caused a delay in commencement of the project.
2. Programming of the Microcontroller: This project is the first project I have ever embarked on using a Microcontroller. Therefore, it was a bit challenging and tasking to learn how to program the microcontroller using Arduino LAB.

5.5 FUTURE WORKS

The following are my recommendations:

1. Advanced method of controlling the water pump like a phone application can be incorporated into the system.
2. A simple Alarm system can also be incorporated.

5.6 CRITICAL APPRAISAL

The project is confirmed to automatically control water pump depending on the level of water in the water tank. Although, modifications are still needed on how water pumps can be controlled not only depending on the level of water in the water tank but also the availability of water in the well or water source.

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Automatic Water Level Controller With Short Messaging Service (Sms) Notification (International Journal Of Scientific And Research Publications, Volume 4, Issue 9, September 2014)

Automatic Water Level Control System (International Journal Of Science And Research (Ijsr))

APPENDIX

Source code used:

```
#include <LiquidCrystal.h>

#define trigger 10

#define echo 11

#define motor 8

#define buzzer 12

LiquidCrystal lcd(2,3,4,5,6,7);

float time=0,distance=0;

int temp=0;

void setup()

{

 lcd.begin(16,2);

 pinMode(trigger,OUTPUT);

 pinMode(echo,INPUT);

 pinMode(motor, OUTPUT);

 pinMode(buzzer, OUTPUT);

 lcd.print("  WATER LEVEL ");

 lcd.setCursor(0,1);

 lcd.print("CONTROL SYSTEM");

 delay(200);
```

```
}
void loop()
{
 long time=0, distance=0, percentage, max_distance=28.50,min_distance=1;
 digitalWrite(trigger,LOW);
 delayMicroseconds(1);
 digitalWrite(trigger,HIGH);
 delayMicroseconds(2);
 digitalWrite(trigger,LOW);
 delayMicroseconds(1);
 time=pulseIn(echo,HIGH);
 distance=((time)/29);
percentage=(2.77777777778*(max_distance - distance));
 lcd.clear();
 lcd.print(distance-0.5);
 lcd.print("cm    ");
  lcd.print(percentage);
 lcd.print("%");
  lcd.setCursor(0,1);
  lcd.print("...processing...");
 delay(200);
```

```
lcd.print(percentage);

lcd.print("%");

lcd.setCursor(0,1);

lcd.print("Motor-ON");

delay(500);

digitalWrite(buzzer,HIGH);

delay(500);

}}
```


COST EVALUATION

ITEM/ COMPONENTS	COST (NAIRA)
IC 7805	50
Ultrasonic Sensor	500
Liquid crystal display	600
DIP socket	50
Relay	200
BC547 Transistor	20
Vero Board	300
Connecting Cables	300
Patrex	400
15V Adapter	2500
ATMEGA 328P microcontroller	600
Miscellaneous	4000
TOTAL	**9520**