FABRICATION OF LIQUID TANK AUTOMATION SYSTEM

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Declaration

It is declared hereby that this project paper or any part of it has not been submitted to anywhere else for the award of any degree.

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I certify that I have read this project and that, in my opinion, it is fully adequate, in scope & quality as a dissertation for the degree of B.Sc in Engineering.

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Abstract

Generally most of the houses and industries depend upon the overhead tanks as the main source of water. People generally switch on the motor when their taps go dry and switch off the motor when the tank starts overflowing. This results in unnecessary wastage of water and sometimes non-availability of water in emergency. This phenomenon is commonly seen in both Urban and rural areas and this needs to controlled by monitoring water level in the tank, here we need a mechanism capable of switching on the motor when the water level in the tank goes low and switching it off as soon as the water level reaches a maximum level. Automatic water level control can be achieved by monitoring and keeping track of water level with the help of electronic sensors and controllers. Float switch is used to monitor the water level. Water level obtained from float sensor is given to Arduino, where all the calculations and decisions are made. Arduino generate a signal to turn on/off the motor based on water level. This on/off signal and the water level should be communicated to the motor by using relay module. The motor will be controlled automatically based on the water level in the tank. Some of the advantages of Automatic water level control system in overhead tanks are Automatic system replaces human intervention and provides hassle free maintenance, prevents wastage of water, efficient usage of water and energy resources.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Water is a universal solvent which plays an important role in everyday life. The total amount of water available on earth has been estimated at 1.4 billion cubic kilometers, enough to cover the planet with a layer of about 3km. About 95% of the Earths water is unfit for human consumption. About 4% is locked in the polar ice caps, and the rest 1% constitutes all fresh water found in rivers, streams and lakes which is suitable for our consumption. A study estimated that a person in Bangladesh consumes an average of 135 liters per day. This consumption would rise by 40% by the year 2025. This signifies the need to preserve our fresh water resources. Many houses make use of supplementary water tank to store water that is collected from rain water or water pumped from well or underground. At present, water meters are used to calculate the amount of water used at homes. This doesn't provide an efficient method of monitoring the water usage. The water is wasted at each and every outlet knowingly or unknowingly which adds up to huge amount in the end. Efficient management of the water used at homes is very much necessary as, about 50% of water supplied to the cities gets wasted through its improper usage. Water management is only possible, if the user is aware of the quantity of water he uses and the quantity available to him. Water is essential in every hour of our lives. Hardly anyone keeps in track of the level of water in the overhead tanks. Consequently, automatic controlling involves designing a control system to function with minimal or no human interference. The idea can be implicitly used to ascertain and control the level of water in overhead tanks and prevent the wastage. In this Arduino based automatic water level indicator and controller project, the water level is being measured by using ultrasonic sensors. The objective of the project is to measure the level of water in the tank and notify the user about the water level. In "Automatic Water Level Indicator and Controller using Arduino" project, the water is being measured by using float sensors. Initially, the tank is considered to be empty. The motor pump is automatically turned ON when the water level becomes low and turned OFF when the tank is full.

1.2 Background

Water is one of the most important substances on earth. All plants and animals must have water to survive. If there was no water there would be no life on earth. Apart from drinking it to survive, people have many other uses for water. Overhead water tanks are used for Domestic water storage and commercial water storage purposes. They are generally placed over the rooftop of any house, building or apartment. These tanks circulates the water through its distributary channels or pipes to the taps. Generally most of the houses depends upon the overhead tanks as the main source of water. One of the commonly seen situation in every house is that the overflow from the tank made people to switch off the pump. Otherwise they should keep monitoring the tank when the pump is ON and switch off the pump as soon as the tank is full.

What happens when the client or user is not aware of water overflow or he is not at the home while water is overflowing, As a result water resource is being wasted only because of improper management standards that we follow. Efficient usage techniques should be employed to gain better control on resource consumption water wastage is a serious issue that must be considered. Every drop of water counts when it comes to human survival on this planet as we only have a little amount of water available for us.as per the records only 3 percent of the water is available for the inhabitation the remaining 97 percent of the water is situated in the oceans.

We can’t use sea water by any means because it is salty. Now a day’s sea water is being used in energy generation system. So the 3 percent of the water is present in the underground and rivers. Bore wells and pumps are used to extract water from the underground and stored in the tanks or sumps. Such an important and lifesaving resource is being wasted by us. Water wastage is the serious problem for both the rural and urban areas, this can be achieved by using current technologies which are made available by the research community for general use. We can develop an automatic system which can monitor behalf of us. Currently there are many products which can solve this problem but the implementation and maintenance are much difficult. This model does works by communicating wirelessly so the client will no longer worry about the connection wires.

Automatic water level monitoring system uses network of things i.e. this model uses its own local area network to maintain communication between the nodes Microcontrollers calculate and make decisions based on the program given by the developer.

Electronics is the discipline dealing with the development and application of devices and systems involving the flow of electrons in a vacuum, in gaseous media, and in semiconductors. Electronics deals with electrical circuits that involve active electrical components such as vacuum tubes, transistors, diodes, integrated circuits, optoelectronics, and sensors, associated passive electrical components, and interconnection technologies. Commonly, electronic devices contain circuitry consisting primarily or exclusively of active semiconductors supplemented with passive elements; such a circuit is described as an electronic circuit. Electronics is considered to be a branch of physics and electrical engineering.

An electronic component is any physical entity in an electronic system used to affect the electrons or their associated fields in a manner consistent with the intended function of the electronic system. Components are generally intended to be connected together, usually by being soldered to a printed circuit board (PCB), to create an electronic circuit with a particular function (for example an amplifier, radio receiver, or oscillator). Components may be packaged singly, or in more complex groups as integrated circuits. Some common electronic components are capacitors, inductors, resistors, diodes, transistors, etc. Components are often categorized as active or passive.

An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. Embedded systems control many devices in common use today. Ninety-eight percent of all microprocessors are manufactured as components of embedded systems.

In this model we are going to use an Arduino as a microcontroller. Arduino is a very minute part of embedded systems, in fact you can call it as an application product of embedded system. Arduino is just any other microcontroller board, with a specifically designed API and software which makes programming it very easy. Arduino is just a drop of water in Embedded System Ocean.

Most of the day to day problems can be addressed by using the technology. Embedded systems allow us to develop a standalone system which can solve certain problem. Embedded system has the capability to run automatically. It reduces the human involvement in the problem solving once it is assembled and deployed.

1.3 Problem Statement

Most of the times People generally switch on the motor when their taps go dry and switch off the motor when the tank starts overflowing. This results in unnecessary wastage of water and sometimes non-availability of water in emergency. Sometimes people forget to switch OFF the pump by involving in their day to day activities. This results in wastage of both water and power resources. This is the serious problem that must be considered because the global scale of power and water resource wastage will be high.

1.4 Objective

There are some objectives need to be achieved in order to accomplish this project. These objectives will act as a guide and will restrict the system to be implemented for certain situations:

1. To develop water level control system to control the water level in the tank.
3. To check the level of water in the tank. Depending on the water level, the motor switches ON when the water level goes below a predetermined level or the motor switches OFF when the tank is full.
3. To display the water level and other important data on a LCD Display.
4. To monitor the level of water in the tank. If the level inside the tank is low, the motor turns ON. Similarly if the tank is full, the motor turns OFF
5. to prevent over labor of the pumping machine and prevent it from getting bad
6. to avoid wastage of water
7. since the demand of electricity is very high, automatic water level control saves energy

1.5 Summary

The system is design for ensure proper automation system by using arduino nano microcontroller development board. We will use Water Level sensor, LCD display, Relay and water pump to complete the project.

CHAPTER 2

LITERATURE REVIEW

2.1 Literature Review

Asaad Ahmed Mohammed ahmed Eltaieb and Zhang Jian Min, Automatic Water Level Control System. This paper has an implemented Automatic water level control system consisted of arduino to automate the process of water pumping in a tank and has the ability to detect the level of water in a tank and switches ON or OFF the pump accordingly and displays the status on the LCD screen. The system also monitors the level of water in the sump tank (source tank). If the level inside the sump tank is low, the pump will not be switched ON and this protects the motor from dry running. A beep sound is generated when the level in the sump tank is low or if there is any fault with the sensors [1].

Beza Negash Getu and Hussain A. Attia, Automatic Water Level Sensor and Controller System This paper have developed a system which initially tests the availability of water in the tank with the help of a level detector and then adjusts the state of the water pump according to the information collected through the level detector. This design makes use of seven segment display and a motor pump. The proposed system consists of water level sensor and a digital logic processor circuit. The proposed system eliminates manually controlling of water requirements in home and agricultural fields [2].

Priya J, Sailusha Chekuri, water level monitoring system using IoT. This paper introduced a system which proposes a simple water level monitoring system with different levels indicated. It also signifies when the water level is below and above than the requirement. This method helped us to understand the use of Bluetooth modules and how it can be made as a portable device [3].

Madhurima Santra, Sanjoy Biswas, Sibasis Bandhapadhyay and Kaushik Palit, Smart Wireless water level Monitoring & Pump controlling System This paper introduced a system which measures water level by using ultrasonic sensors. The system makes use of water level indicator, water level sensor, water pump controlling system and microcontroller. Ultrasonic sensor gets water level reading and it will send a signal to microcontroller and starts to echo the pulses [4].

K. Santhosh Kumar, G. Mukesh, K. Deepti, Microcontroller based Automatic Water level Control System, The system used microcontroller to automate the process of water pumping in an over-head tank storage system and has the ability to detect the level of water in a tank, switch on/off the pump accordingly and display the status on an LCD screen. This research has successfully provided an improvement on the 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 [5].

Sanam Pudasaini, Anuj Pathak, Sukirti Dhakal and Milan Paudel, “Automatic Water Level Controller with Short Messaging Service (SMS) Notification” This paper proposed Automatic water level controller with Short Messaging Service (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 Aurdino program developing environment and uploaded to the Microcontroller. Water level in the system is controlled automatically. The controller operates on battery power. Whenever the system encounters empty level and the status of load shedding, the SMS notification is sent to the user [6].

The Automatic Water Pump Controller (AWPC), an easy to use compact control box, runs off line voltages between ~80-264 VAC. It includes two water level sensors and a cord for power. A user installs one water level sensor in the water supply reservoir, and the other inside their rooftop water storage tank. Then the user plugs their water pump directly into the control box and activates the system. With no further actions necessary, the AWPC monitors the two water levels and activates the pump at times necessary to keep the rooftop storage tank full while preventing the water pump from siphoning air [9]. For a list of all specifications, see Table 2-1.

There exist both monetary and location-based constraints associated with this project. The AWPC must function in various countries such as the U.S. which uses 110V or Indonesia which uses 220V. One must also keep in mind the various wall outlet types [3]. Making the system easy to install and independent of the users’ water system offers yet another challenge. This may require designing protection circuitry in case a user makes a mistake during installation. For a list of all specifications, see Table 2-1.

As with all products, there exist many economic impacts likely to result following the implementation of this project. Many companies benefit from the need for goods and services associated with the project such as shipping, raw materials, parts, manufacturing, and labor. Almost every aspect of the creation of the AWPC requires labor in some shape or form making it an important aspect. Local banks also benefit from the additional purchase made by the businesses and the product user. Users benefit from the AWPC through its elongation of the water pump's lifetime and overall less power usage. With an effective control system in place, the water pump malfunctions far less resulting in less money used for repairs and replacements. Besides the initial investment of buying the product, there exist no upkeep costs beyond its use of power with the exception of repair costs in the event of break-down. This becomes more and more likely throughout the product's lifetime until a replacement becomes necessary. Users have the option of replacing the water level sensors, the only replaceable part, in case they alone fail.

The AWPC requires a user already have a compatible water pump to use in conjunction with the control box. The may require users to purchase a new water pump further stimulating local economy while helping ensure a fully functioning autonomous water pump system for the user. The user of the AWPC, someone who seeks autonomous control of their home water system, pays low overall costs for the affordable product. Not including design or testing cost estimates, the estimated sum of parts totals $100[4]-[7]. Table C-1 lists specific cost estimates. The project takes an estimated 150 hours of development time ending around April of 2016.

The estimated fixed costs total $9240 to design and development a prototype followed by an estimated $100 per unit plus labor likely meaning $200 per unit. If each unit sells for $250, a positive profit margin would emerge after 185 units sold assuming inefficient manufacturing. Assembling this product through lean manufacturing practices on a production line would result in much lower production costs. However, this would result in higher from the investment necessary to create a manufacturing line. If it costs an estimated $50,000 to create a manufacturing line that reduced production costs to roughly $100 and the selling price remained $250, it would require 334 units sold to make profit. However, these factories could produce the units at a much faster rate than if not created through lean manufacturing. If 500 units sell per year, the device makes $75,000 yearly profit.

The materials that make up the AWPC include electronics composed of metals mined out of the earth. Sometimes these mining operations impact ecosystems quite seriously due to the overall destruction of the surrounding environment. The manufacturing process uses harsh chemicals, which if not disposed of properly, seep into water supplies contaminating drinking water for humans and animals alike [2]. Like all other electronics, the AWPC consumes power which puts pressure on power generation plants to produce more energy. This requires burning more fossil fuels resulting in more greenhouse gasses emitted into the atmosphere. Greenhouse gasses also accumulate from the increased vehicle presence caused by the need to transport the AWPC. The atmosphere warms as the gasses build up leading to the degradation of various ecosystems reliant on very specific temperatures such as aquatic ecosystems. Once the lifetime of the product has elapsed, the users must properly recycle the waste so it does not decompose quickly and releases toxic chemicals. Often times this waste ends up in developing countries negatively affecting both the people and animals living there.

The AWPC serves as an easy-to-use control box requiring no user input beyond initial installation. As a result, users likely struggle when attempting to fix malfunctions, and when they occur, instead buy a new unit. While this benefits profit in terms of number of units sold, it also leads to less sustainability as more units require more resources. The AWPC must last a long period of time necessitating a quality build. With no regular maintenance required, the unit requires very little upkeep associated with the product aside from power costs. The product could potentially include easily replaceable internal parts as an upgrade, but this would drive up manufacturing costs. Also, the implementation of the electronics within the AWPC requires the use of rare earth metals. Users can help sustain this resource if they disable the components and recycle them correctly. However, this often does not happen resulting in aggressive nonsustainable consumption of resources.

The modular design of the AWPC allows the individual manufacturing of the modules. The circuitry likely requires the longest manufacturing time due to its small size and precision design. The other components such as the microprocessor and water level sensors come premade and ready to integrate into the full assembly. Instillation of the AWPC consists of placing the two level sensors, plugging in the water pump to the AWPC, and supplying power from a nearby wall outlet.

The automated water pump controller’s strives to store water and use it when the water company does not provide water to the costumers. The system needs minimal maintenance for the sensors used to read water levels [7]. The system only requires connection to residential wallsocket voltages in order to perform its functions. In terms of potential improvements, the incorporation of a solar panel to reduce energy usage would make the product greener for the environment. However, the implementation of a solar panel would require a battery to store the resulting charge. The batteries contain chemicals such as sulfuric acid which can harm the environment. The AWPC could also potentially benefit from a wind generated power source depending on average weather conditions of the region

With respect to the Institute of Electrical and Electronics Engineers (IEEE) code of ethics, the AWPC upholds ethical principles as an ethical device. The designers of said product accept no bribery and discriminate against no persons based on race, religion, gender, disability, age, national origin, sexual orientation, gender identity, or gender expression. Designers perform research when deciding all price estimates and completion time estimates to ensure they honestly reflect likely end costs. Designers make the completed product with the welfare of the public in mind by including warning labels to help prevent incorrect usage. If unforeseen or unintended conflicts arise resulting from the production or use of the device, steps responsible parties must take steps to remedy said conflicts. While the designers of the project have intention to uphold the IEEE code of ethics, the power to do so may lie with different people. If a governing body purchased the AWPC in bulk and distributed them as they see fit, discrimination may become an issue. This applies to the acceptance of bribes and setting fair prices as well.

From a utilitarian perspective, the AWPC can do both good and bad. An individual user utilizing this device gains happiness not having to constantly monitor his/her water system. This allows for optimal water transfer so that the user can enjoy water regularly. If someone only introduces a few devices into a community, those without the AWPC find less water available from time to time due to the more efficient water draw from those with the device. This could cause them unhappiness. However, if all members of a community used the AWPC then all members would benefit equally and the average happiness of the community would rise. With initial successes, the governing body of the area may decide to include the device as part of the water utility spreading the technology for others to benefit from resulting in even more happiness.

The use of the AWPC helps users have more efficient access to clean water when they need it. Having a consistent supply of clean water helps maintain public health and safety. In addition, the autonomous nature of the AWPC allows people living with physical disabilities or ailments to forgo the arduous work associated with periodically fixing their water pump system. Not all aspects of the AWPC benefit people’s health. The electronics inside the AWPC require a manufacturing process reliant on harsh chemicals that dangerous to the labor force if work sites do not take proper precautions. As stated in section 5, these chemicals can sometimes leak into water supplies making anyone who uses the water for drinking ill. In addition, the manufacturing setting in general presents a danger for workers due to the large machinery often present. The device itself runs on high voltages which can deliver painful and dangerous shock if irresponsibly tampered with. Because the setting of the system necessitates placement outdoors and near bodies of water, the device has an increased chance of becoming wet and, therefore, higher chance of electric shock to the user. This same high voltage concerns during testing because wrong wire placement can result in electric shock nearby people and damage to surrounding components. Also, any metals the water level sensors contain may rust and compromise the safety of the water and make it harmful to drink [7].

2.2 Design Specifications

The Automated Water Pump Controller (AWPC) offers a solution to the problem. Two water level sensors monitor the water level of both the ground-level water reservoir and the rooftop residential water tank. Similarly, the controller turns off the water pump if the rooftop tank reaches a water level of greater than or equal to 95%. This prevents the tank from overflowing and wasting water. Residents in the situation described above usually own a water pump which is used to transfer their water to the rooftop tank. To accommodate this, the AWPC uses the input power source to power up the water pump. This allows for the controlling of most common water pumps users may own. The AWPC also relies on the same power range as the power source, allowing for use in a variety of regions [3]. Ideally, installation only requires mounting the water sensors in the two water tanks, plugging the water pump into the AWPC, and plugging in the AWPC to the nearest residential power outlet. The system then runs autonomously as a weather resistant control box capable of surviving outdoors for years at a time. By owning the AWPC, users do not have to worry about checking the water level in the underground water reservoir several times a day. In other words, the AWPC takes care of the tedious routine of preventing the priming and potential malfunctioning of the water pump. The AWPC turns on the water pump when the underground water reservoir reaches full capacity and it turns it off before the water pump can suck in air. This maximizes the water pump life

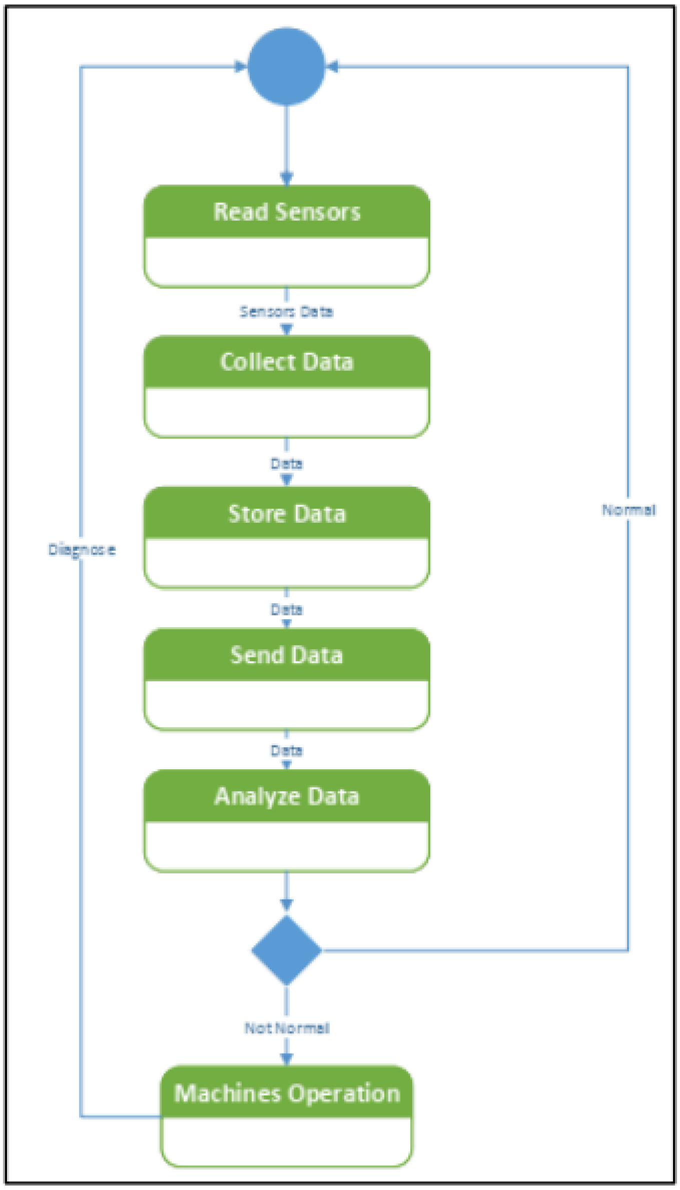

Fig 2.1: State Diagram

2.3 Application

The uses of a water level indicator include the following applications:

- Can be used in water tanks to control water levels
- Automatically turn ON/OFF pumps
- Can be used in factories, commercial complexes, apartments, home,
- Fuel tank level gauging

- Oil tank level control
- High & low-level alarms
- Pool water level control
- Life station switches
- Cooling tower water level control
- Sewage pump level control
- Remote monitoring liquid
- Water level control
- Pump controller
- Stream level monitoring
- Sump pump
- Tsunami warning and sea level monitoring
- Process batch control & monitoring
- Irrigation control

2.4 Advantages

- This prototype detects the water level in the tank and switch ON/OFF accordingly.
- The burden of client is reduced by automating the motor switching according to the water level.
- Easy installation
- Minimal maintenance
- Compact design
- Automatically adjusts water levels
- Save money by using less electricity and water
- Can help avoid seepage of roofs and walls due to tanks overflowing
- Automatic operation saves manual labor time
- Consumes a small amount little energy, perfect for on-going operations
- Indicates water levels in any type of storage tank or body of liquid

2.5 Disadvantages

- The maximum and minimum threshold points should be included in the program manually at each installation.
- Require AC Power supply at the overhead tank.

CHAPTER 3

HARDWARE COMPONENT

3.1 Introduction

Hardware is the most important part of any project. In this chapter, we explain used component of our project.

3.2 Hardware Required

The hardware required is divided in the following category:

- Arduino Nano
- Water Sensor
- LCD Display
- Relay
- Pump
- Buck Converter

3.3 Arduino UNO

Arduino is an open-source prototyping platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.

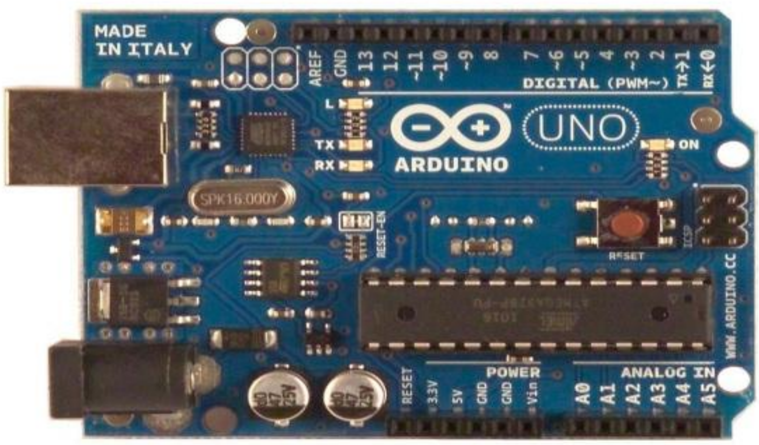

Fig 3.1: Arduino UNO

it can tell that board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language and the Arduino Software (IDE), based on Processing.

3.3.1 Technical specifications:

Table 3.1: Technical specifications of Arduino Nano

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	8
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P)of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz

3.3.2 Microcontroller ATMEGA328P

The Atmel® picoPower® ATmega328/P is a low-power CMOS 8-bit microcontroller based on the AVR® enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega328/P achieves throughputs close to 1MIPS per MHz. This empowers system designer to optimize the device for power consumption versus processing speed.

The Atmel AVR® core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in a single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers. The ATmega328/P provides the following features: 32Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 1Kbytes EEPROM, 2Kbytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, Real Time Counter (RTC), three flexible Timer/Counters with compare modes and PWM, 1 serial programmable USARTs , 1 byte-oriented 2-wire Serial Interface (I2C), a 6- channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages) , a programmable Watchdog Timer with internal Oscillator, an SPI serial port, and six software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low power consumption. In Extended Standby mode, both the main oscillator and the asynchronous timer continue to run. Atmel offers the QTouch® library for embedding capacitive touch buttons, sliders and wheels functionality into AVR microcontrollers. The patented charge-transfer signal acquisition offers robust sensing and includes fully debounced reporting of touch keys and includes Adjacent Key Suppression® (AKS™) technology for unambiguous detection of key events. The easy-to-use QTouch Suite toolchain allows you to explore, develop and debug your own touch applications. The device is manufactured using Atmel's high density non-volatile memory technology.

The On-chip ISP Flash allows the program memory to be reprogrammed In-System through an SPI serial interface, by a conventional nonvolatile memory programmer, or by an On-chip Boot program running on the AVR core. The Boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega328/P is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications.

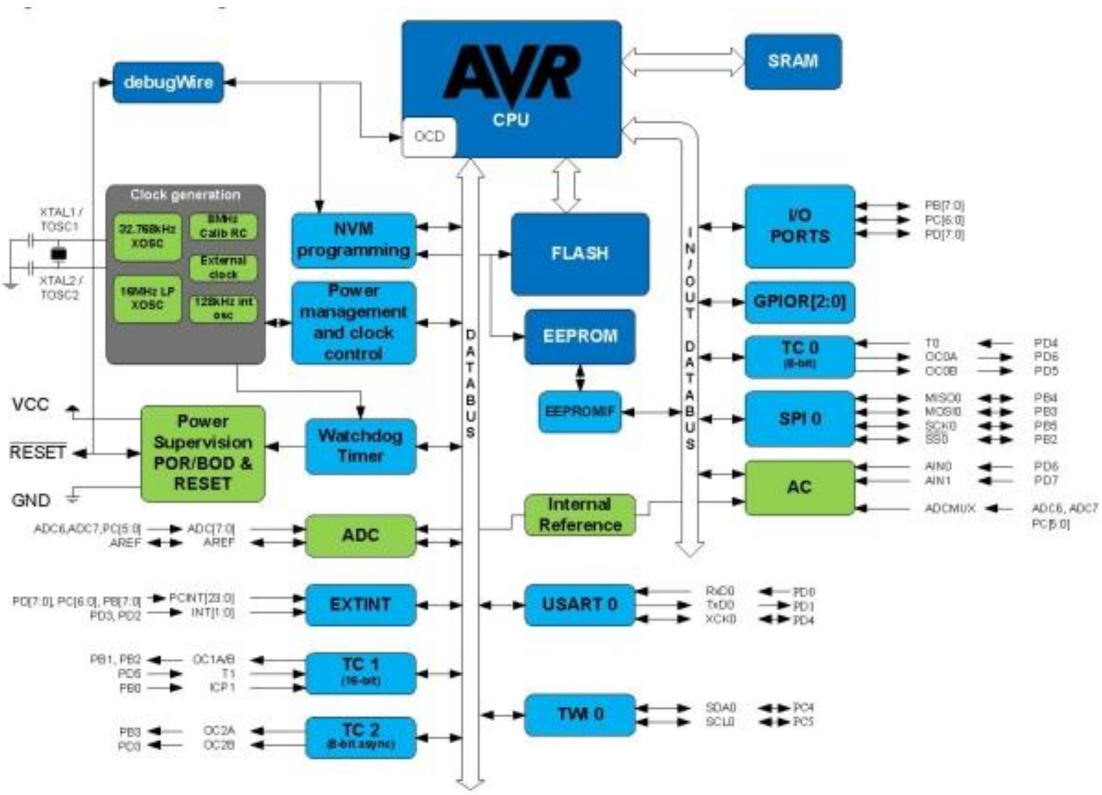

Fig 3.2: ATmega328 Microcontroller Architecture

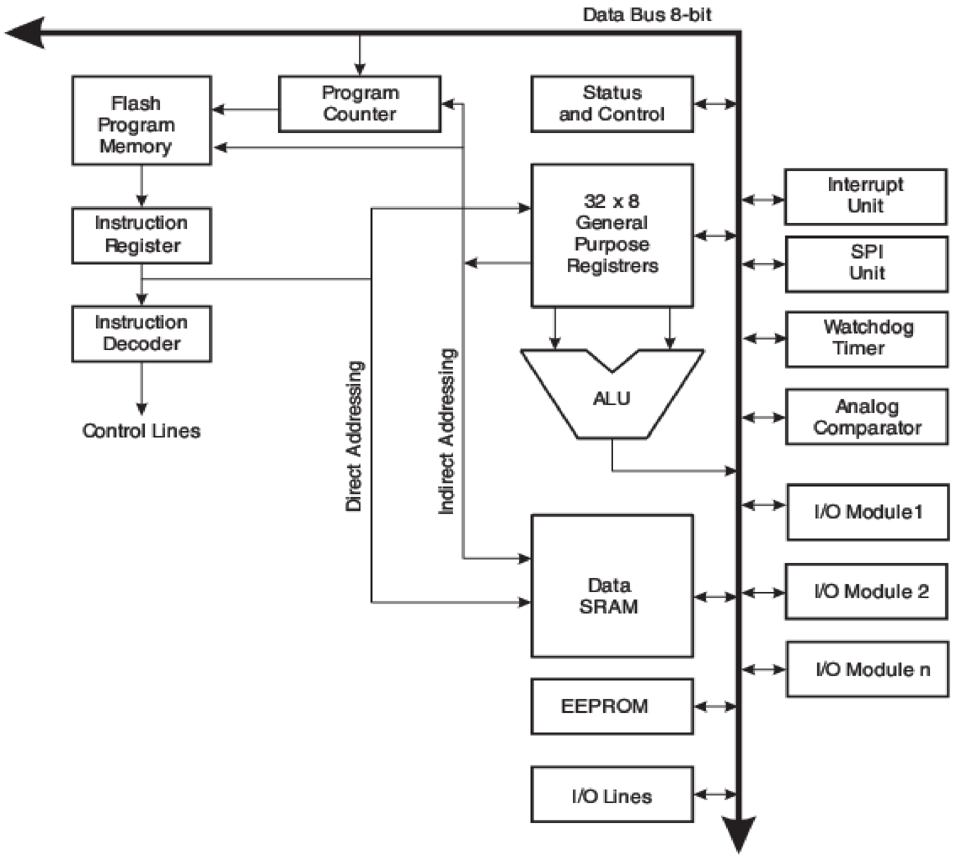

Fig 3.3: Block diagram of the AVR CPU Core architecture

The ATmega328/P is supported with a full suite of program and system development tools including: C Compilers, Macro Assemblers, Program Debugger/Simulators, In-Circuit Emulators, and Evaluation kits.the program memory is the single-level pipelining. The concept of pre-fetching the next instruction while executing one instruction enables the instructions to be executed in every clock cycle and the program memory is in the System Reprogrammable Flash memory.

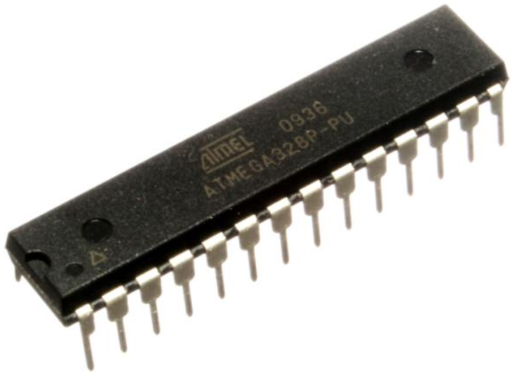

Fig 3.4: Microcontroller IC ATmega 328p

The high-performance Microchip picoPower 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1024B 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, a 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 1.8-4.5 volts. By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

3.3.3 Power supply, inputs and outputs

Either Arduino is supplied with USB connection or with an external power supply (recommended with 7-12V), outputs are going to have a continuous voltage due to voltage regulators and stabilization capacitors present on the board. These power supply pins are:

- **VIN:** it is the input power supply that will have the same voltage that we are supplying the Arduino with the external power supply
- **5V:** power supply of 5V, this voltage may come from VIN pin and a voltage regulator or from the USB connection.
- **3.3V:** power supply that will provide 3.3V generated by an internal regulator, with a maximum current of 50 mA.
- **GND:** grounding pins

3.3.4 Digital inputs and outputs

Each of the 14 digital pins can be used as an input or output. Besides, each pin can supply or receive a maximum of 40 mA and has a pull-p resistance from 20 to 50 kOhm. In addition, some pins have specialized functions such as:

- Pin 0 (RX) and 1 (TX). They are used to receive (RX) and transmit (TX) in TTL serial communication.
- Pin 2 and 3. External interruptions. Pins in charge of interrupting the sequential program stablished by the user.
- Pin 3, 5, 6, 9, 10 and 11. PWM (pulse width modulation). They form 8 output bits with PWM with the function analogWrite ().
- Pin 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI (Serial peripheral interface) communication.
- Pin 13. LED. There is a LED connected to the digital pin 13. When the pin value is HIGH, the LED is on, and when the value is LOW, the LED is off.

3.4 Water Sensor

A float switch detects the level of a liquid in a tank or container. It floats on top of the liquid surface and acts as a mechanical switch as the liquid level goes up or down. They control devices like pumps (pump water in or out), valves (open or close inlet/outlets), or alarms to notify users.

How does a float switch work

In short, a float switch is a mechanical switch that floats on top of a liquid surface. As the liquid level goes up or down, it moves vertically with the liquid level. Depending on the counterweight and pre-set trigger, the mechanical switch opens or closes allowing an electrical current through it to the connected device. Typically, this connected device either stops or starts the inflow of the liquid.

Switching Method

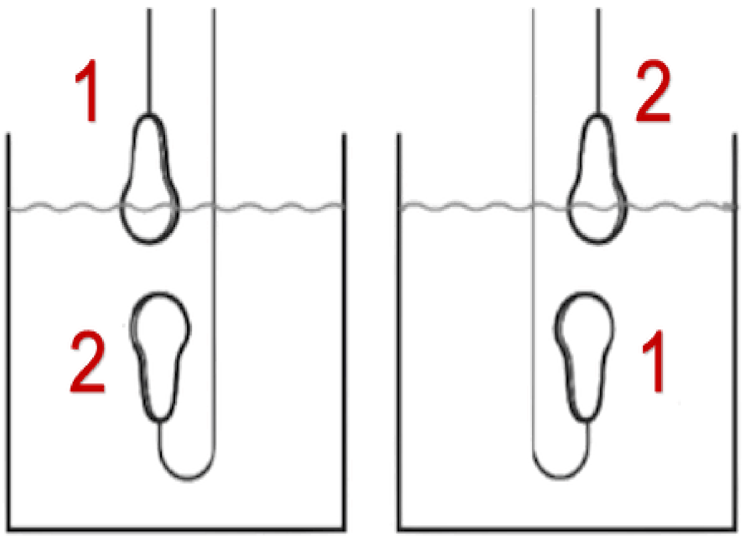

Fig 3.5: Use of Float switch

For a reed switch, if the magnet is close to the reed switch it creates a closed circuit (electric current can flow). Therefore, if the magnet moves away the reed switch will create an open circuit (no electric current can flow). The switch has a maximum switching current and voltage, so ensure you do not exceed this specification. The liquid level controls the float switchs angle, which directly controls the magnets position inside of it.

The vertical float switch installation either has a “fixed point” or an external counterweight. This preset level is the position that the internal mechanical switch goes between open and closed. Figure 2 on the left shows a common application of stopping the inflow of water at a “high” point in a water tank.

The floating body will rise with the water, which causes the magnet to move towards the reed switch and the switch closes. This closed electrical circuit then signals to a pump to stop pumping water into the tank. When the water level decreases, the float switch goes down and in turn moves the magnet away from the reed switch and opens the electrical circuit. The open-circuit then signals to a pump to turn on and pump water into the tank.

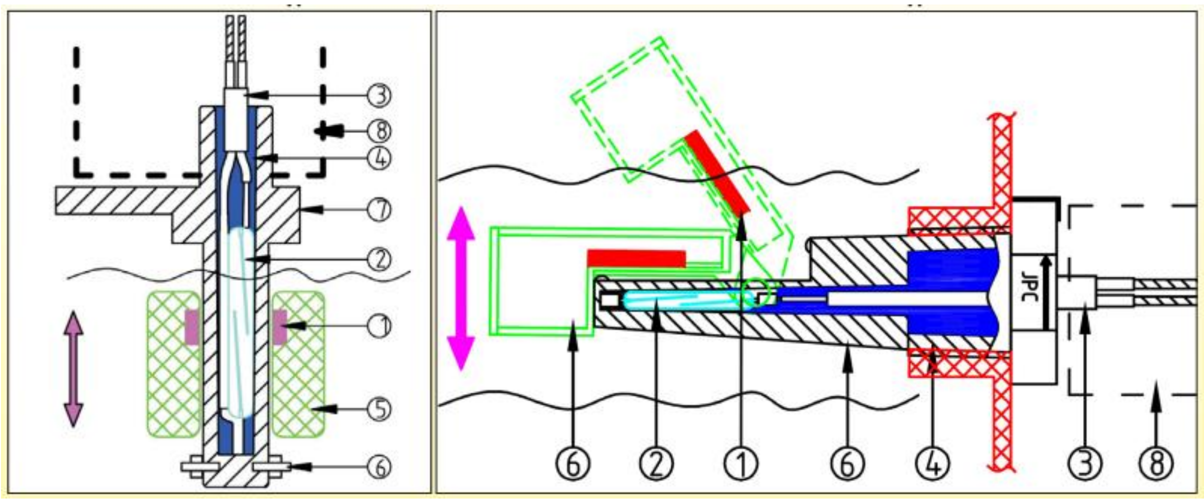

Fig 3.6: Part of float switch

A float level switch is made of 8 main components 1: Magnet attached to the float (In reed switches devices) 5: Float 2: Electrical contact (reed switch or micro-switch) 6: Float displacement limits 3: Electrical connection 7: Level switch body, with its mounting system 4: Resin filling (for devices using a reed switch) 8: Protection box (optional)

Magnet displacement and reed switch operation

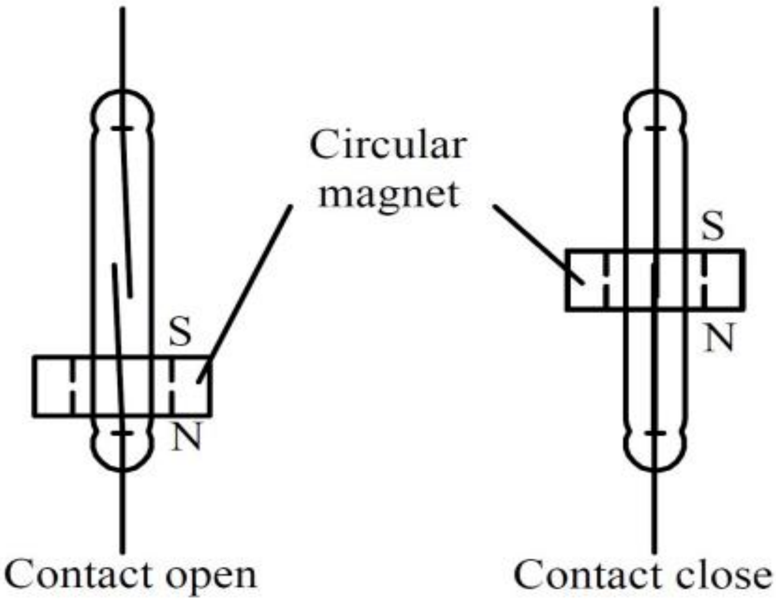

Fig 3.7: Vertical type sensor

In upright models, when the magnet, usually circular and surrounds the reed switch, is below or above the center of the reed switch, the contacts are opened. When the magnet is located at the center of the bulb, the contact is closed.

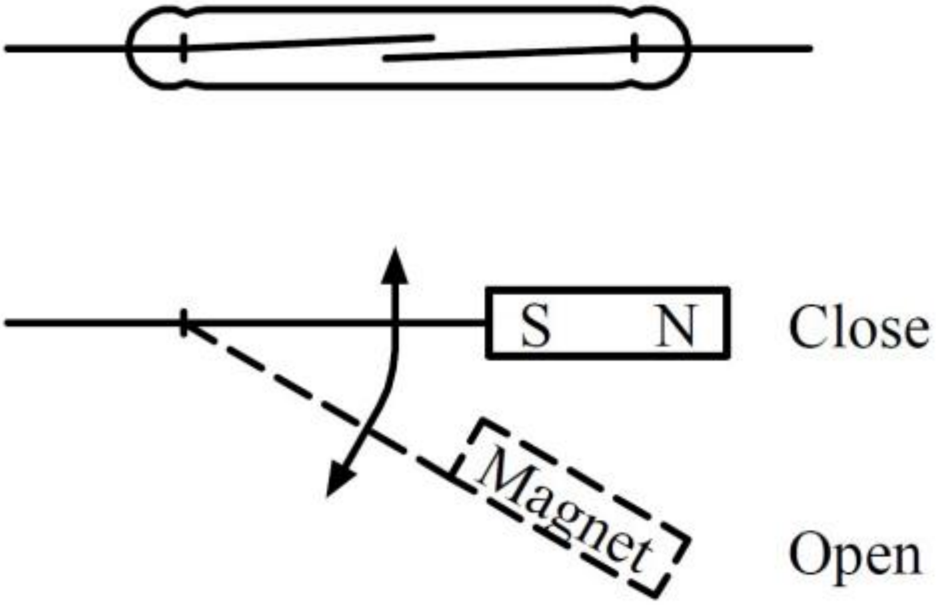

Fig 3.8: Horizontal type

In horizontal models, a flat magnet (rectangular parallelepiped or disc) moves closer to the reed switch when the float turns on its axis when the magnet is close enough to the reed switch, the contact of the latter 's open

1: Magnet

The magnet located inside the float (in devices using reed switch) Selecting a magnet for a level switch application must take into account the characteristics of the liquid in which it will be immersed, of the temperature at which it will be subjected, of its corrosion resistance, of the magnetic field required to operate the switch and its distance to the reed switches. Sintered magnets are shock and vibration sensitive, “bonded” magnets have a low temperature resistance due to the resins used to agglomerate, and Neodymium –Iron-Boron magnets contain 60-75% iron (amount is dependent on grade) and are therefore prone to corrosion. Their price is extremely variable depending on the materials and manufacturing process, and therefore it is the sum of all these parameters that will decide if a type of magnet will be used rather than another in a specific application.

2: The electrical contact system reed switch or a micro-switch.

A certain force is required to actuate the electrical contact device. It can range from a few tenths of grams for systems with reed contacts with a power rating of 10 to 20VA (0.5Amp), to several hundred grams for snap action micro-switches with a 16 or 20Amp electrical rating In general, the force required to operate an electrical contact increases with its electrical rating, and the power available on the detector depends on the float volume. Most level switches in this catalog use reed switches because they are used for detection level in low voltage and low current electronic circuits. This makes possible to design compact devices.

3: Electrical wiring

For reed switches systems, the most common electrical connection is by wires or cable. Given the low electrical rating of reed switches , conductor cross section is generally less than or equal to 0.5 mm ^{2}. If there is no thermal stress or environmental conditions, wires and cables are PVC insulated. Silicone insulation, FEP and Teflon are not recommended because they do not provide hermetic sealing with resin filling and may let in water or moisture inside the product. Tabs or connector outputs are recommended for large quantities.

4: Resin filling (For reed switch types)

The resin filling provides two functions - Mechanically securing the reed in the body, and provide its resistance to tearing (Standards impose a tearing resistance equal to or greater than 10N) - Main electrical insulation of the electrical contact and wiring. This requires a UL94-VO resin. In some customer applications the insulation class I is insufficient, and the contact system must receive and additional insulation to comply to the requirements of insulation class II

5: Float

The main requirements of floats are to have a lower density than the liquid in which they must float, to withstand the pressure and temperature of the medium in which they are located, and remain sealed. The vertical float level switches may receive several floats on the same stem, each float actuating an independent switch. There are three float manufacturing technologies: - Hollow metal floats - Hollow plastic floats, - Plastic foam floats. All three models can be interchangeable on the same axis. In some vertical models using a reed switch, a wise magnet position in the float can allow to reverse the contact open and close positions by simple reverse of the float. On horizontal reed switch model, it is the 180 ° rotation of the entire device which reverses the contact operation

6: Float up and down mechanical stops

The mechanical displacement of the float must be limited to remain within the limits of the magnet position detection by the reed switch. There are on the market float level sensors with clips allowing two select two possible relative positions of the float, a position giving a normally closed contact and one normally open contact. JPC floats are designed for these two positions are possible by simply inverting the float.

7: Mechanism body and mounting system

The body of the mechanism provides several functions: - Device protection against electric shock, water ingress, pressure value, and chemicals. This body must meet the same requirements as the float, but are added special features due to its electrical protection function. Plastics used by JPC for the body are always UL94-VO rated - The float guidance: guiding the float requires the use of plastics that do not wear out easily, with a low friction coefficient - The level switch mounting: This mounting can be secured by NPT or BSPT (Tapered) threads, or BSPP cylindrical threads or metric threads. Tapered threads require sealing on the threads, and the cylindrical threads require sealing by a flat gasket. In general the vertical flow switches are inserted from the inside of the tank, and secured with an outside nut and gasket, and horizontal flow switches are mounted from the outside of the tank on a female fitting. In large quantities applications of vertical level switches, preference is given to a side bracket, which is better suited for screwdriver assembly. Depending on the application level sensors will be mounted at the bottom, side or top of tanks. Mounting solution design can be adapted to these requirements. - Cover: an optional cover can be attached either by a central tapping or by screws and gasket on the body of the level switch.

8: Protection housing

The protection housing can have several functions: - Ingress protection against attacks from the outside environment (rain, dust, shock) - Protection against the conditions in which the product will be installed in its application. In most cases, level switches will be integrated by an OEM into a machine or equipment. Then it is this machine or equipment that will ensure protection against water, dust, shock and other contaminants. - Protection against usual external environment: These are usually plastic housings providing an IPxx (Protection against the penetration of water and dust, EN 60529a degree of protection) and an IKxx

(Protection against shock, EN 50102). - Protection against gas and dust explosive atmospheres: JPC level switches are not designed for use in these environments and therefore do not meet the applicable standards in this field of application

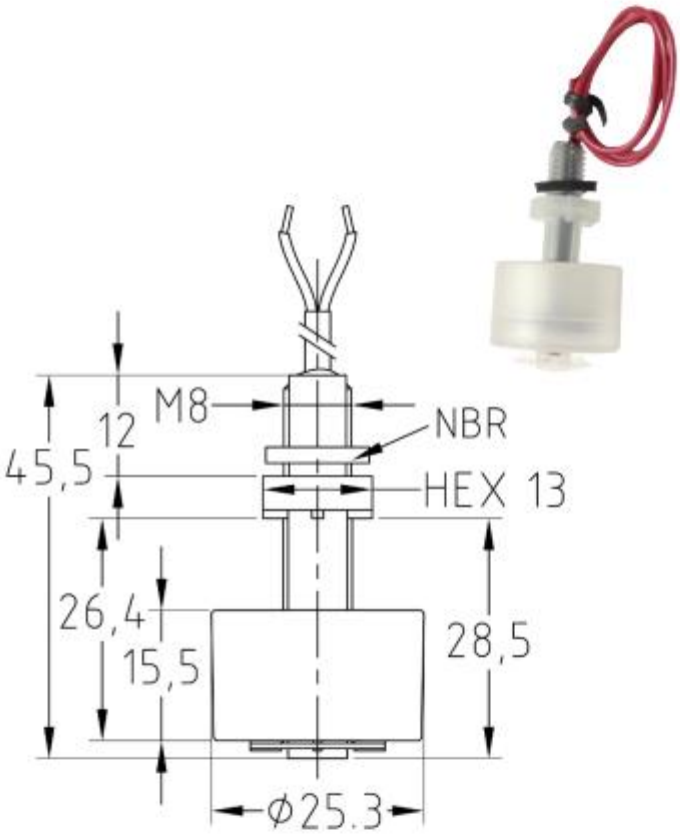

Fig 3.9: DM Type float Switch

Use: low voltage circuits

Main applications: steam generators, coffee machines, vending machines, air conditioning pumps, dehumidifiers. Most application in water level control.

Stem material: polypropylene

Float material: hollow polypropylene

Mounting: vertical, throw wall, with M8 nut and flat NBR gasket

Contact configuration: normally closed when float is down on the stem. It opens when float goes up to the wiring side. Upsetting the float changes the contact configuration into normally open Electrical rating: Low voltage type: maximum power 10 W (VA), max 0.5Amp, max voltage 110VAC. 230VAC type: max power 40 W (VA), max 1Amp. Values for resistive circuit. For inductive or capacitive loads, a contact protection circuit must be used.

Contact resistance: 150mOhms maxi (wires not included) Wires: AWG24 cable, UL style 2464, PVC insulated, length 100, 500, 1000 or 2000 mm

Liquid limits: to be used with liquids chemically compatible with polypropylene, dynamic viscosity higher 0.5x10-4 Pa.s and lower than 10-2 Pa.s, specific gravity higher than 0.9, without magnetic particles.

Ambient temperature: -20+80°C Maximum pressure: 1 bar (15 PSI)

Options: Slosh shield for use in turbulence applications, other cable length, electrical rating 70W, 1A, 250VAC.

3.5 LCD Display

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 combined with polarizers. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and seven-segment displays, as in a digital clock.

Fig 3.10: LCD Display

They use the same basic technology, except that arbitrary images are made from a matrix of small pixels, while other displays have larger elements. LCDs can either be normally on (positive) or off (negative), depending on the polarizer arrangement. For example, a character positive LCD with a backlight will have black lettering on a background that is the color of

the backlight, and a character negative LCD will have a black background with the letters being of the same color as the backlight.
Optical filters are added to white on blue LCDs to give them their characteristic appearance**.**

3.6 Diode

A diode is a specialized electronic component with two electrodes called the anode and the cathode. Most diodes are made with semiconductor materials such as silicon, germanium, or selenium. Some diodes are comprised of metal electrodes in a chamber evacuated or filled with a pure elemental gas at low pressure. Here we used converted AC into DC using a bridge-wave rectifier that consists of four diodes

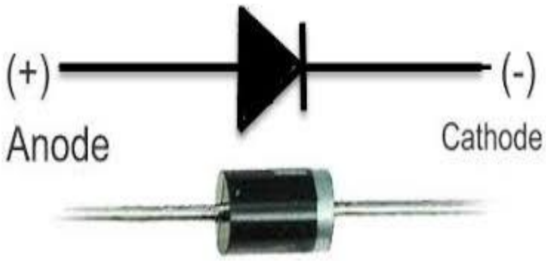

Fig 3.11: Diode symbol.

3.7 Buck Converter Module

Fig 3.12: DC-DC Buck Converter

A buck converter (step-down converter) is a DC-to-DC power converter, which steps down voltage from its input to its output. The basic operation of the buck converter has the current in an inductor controlled by two switches. In the idealised converter, all the components are considered to be perfect. Specifically, the switch and the diode have zero voltage drop when on and zero current flow when off, and the inductor has zero series resistance. Further, it is assumed that the input and output voltages do not change over the course of a cycle

3.8 Full wave rectifier

A Full wave rectifier is a circuit arrangement which makes use of both half cycles of input alternating current (AC) and converts them to direct current (DC). ... This arrangement is known as a Bridge Rectifier. It uses the entire AC wave (Both positive and negative sections). Each diode uses 0.7v when conducting and there are always two diodes conducting.

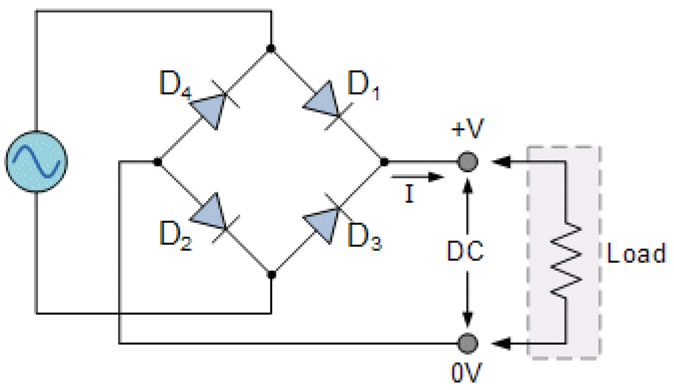

Fig 3.13: Full wave rectifier is a circuit diagram

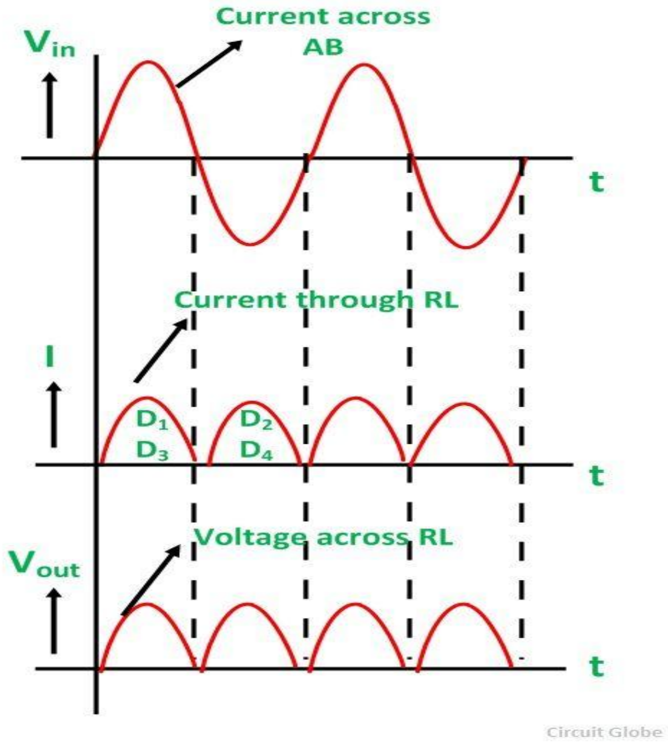

Fig 3.14: Full wave rectifier wave from

3.9 Relay module

The Arduino operates at 5V it can't control these higher voltage devices directly, here we use a single Channel 5V Relay Module to switch the 9V and use the Arduino to control the relay. This is a 5V 1-channel relay interface board, and each channel needs a 15-20mA driver current. It can be used to control various appliances and equipment with large current. It is equipped with high-current relays that work under AC250V 10A or DC30V 10A. It has a standard interface that can be controlled directly by microcontroller.

3.9.1 Working Principle of relay

From the picture below, we can see that when the signal port is at low level, the signal light will light up and the optocoupler 817c (it transforms electrical signals by light and can isolate input and output electrical signals) will conduct, and then the transistor will conduct, the relay coil will be electrified, and the normally open contact of the relay will be closed. When the signal port is at high level, the normally closed contact of the relay will be closed. So, we can connect and disconnect the load by controlling the level of the control signal port. The SRD-05 VDC-SL-C relay has three high voltage terminals (NC, C, and NO) which connect to the device we want to control. The other side has three low voltage pins (Ground, Vcc, and Signal) which connect to the Arduino.

- NC: Normally closed 120-240V terminal
- NO: Normally open 120-240V terminal
- C: Common terminal
- Ground: Connects to the ground pin on the Arduino
- 5V Vcc: Connects the Arduino
- Signal: Carries the trigger signal from the Arduino that activates the relay

Inside the relay is a 120-240V switch that's connected to an electromagnet. When the relay receives a HIGH signal at the signal pin, the electromagnet becomes charged and moves the contacts of the switch open or closed.

Fig 3.15: 5V Relay Module

3.9.2 Pin Description and Features

INPUT	OUTPUT
VCC: Positive supply voltage GND: Ground IN1--IN4: Relay control port	Connect a load, DC 30V/10A，AC 250V/10A

Features:

- Size: 75mm (Length) * 55mm (Width) * 19.3mm (Height)
- Weight: 61g
- PCB Color: Blue
- There are four fixed screw holes at each corner of the board, easy for install and fix. The diameter of the hole is 3.1mm
- High quality Songle relay is used with single pole double throw, a common terminal, a normally open terminal, and a normally closed terminal

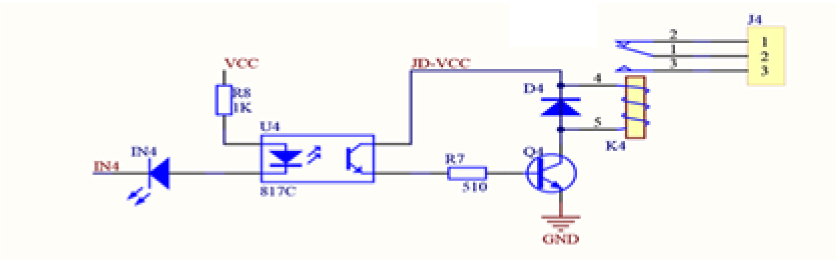

Fig 3.16: 5V Relay Module circuit diagram

3.10 Water Pump

A small pump and a driver. A driver is to produce enough current for the pump, my application wants a twig distance concerning one meter, and therefore this pump is enough. however if we wish to create a system that wants an oversized spray vary, we will would like larger pumps, or maybe a pressurized device to create the projectile even farther, like the watering system in an exceedingly garden

Fig 3.17: Water pump

The pumping of water may be a basic and sensible technique, way more sensible than scooping it up with one's hands or lifting it in a very hand-held bucket. This can be true whether or not the water is drawn from a recent supply, emotional to a required location, purified, or used for irrigation, washing, or waste treatment, or for evacuating water from AN undesirable location. No matter the end result, the energy needed to pump water is a particularly exacting part of water consumption.

3.11 Vero board

Vero board is a strip board brand, a pre-formed copper strips plate material on an insulation plate. Which is the generic name for a type of widely used electronic prototype plate that is characterized by a regular (rectangular) hole of 0.15 mm (3.5 mm), with parallel copper lining strips running in one direction on one side of the edge,

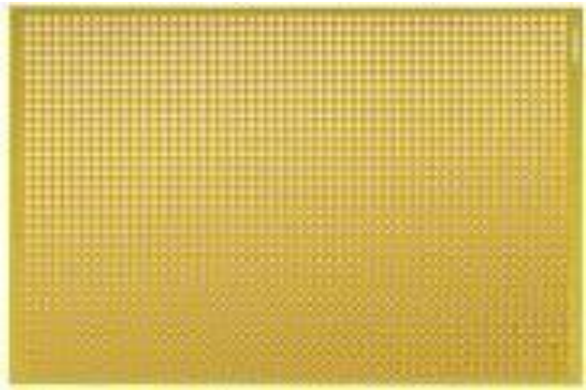

Fig 3.18: Vero Board

Generally, it is also known as the original Vero board product, which is a trademark in the United Kingdom, the British company Vero Technologies Ltd and the Canadian company Pixel Print Ltd. When using the board, the jumps are made on the slopes, normally near holes, to divide the strips into several electrical nodes. With care, it is possible to break between holes to allow components that have two clues of pins only to be separated by a position like row headers together for IDC.

3.12 Jumper Wire

Fig 3.19: Jumper Wire

A jump wire (also known as jumper wire, or jumper) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a bread board or other prototype or test circuit, internally or with other equipment or components, without soldering. Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.

3.13 Software Configuration

Programming software of this line follower is known as ARDUINO-IDE .This is open source programming platform**.** The open-source ARDUINO environment makes it easy to write code and upload it to the input/output board. Here we use ARDUINO-1.8.1 platform.

To conFig software we have to use ARDUINO IDE named arduino.exe To conFig this programmer with computer we need a USB cable then check serial port and select the programmer from IDE platform such as,

After complete configuration IDE is ready for programming. At finally upload main program to new ATMEGA328P using IDE

Fig 3.20: Uploading program to Arduino

When microcontroller will programmed properly a confirmation message will be show, which looks like,

Fig 3.21: Message for upload complete

Now our Arduino UNO is ready to use.

CHAPTER 4

DESIGN AND IMPLEMENTATION

4.1 Introduction

In this chapter fully cover with discuss design and fabrication of this project. Here we will discuss about developed block diagram and briefly describe about the circuit description and also learn about working principle.

4.2 Block Diagram

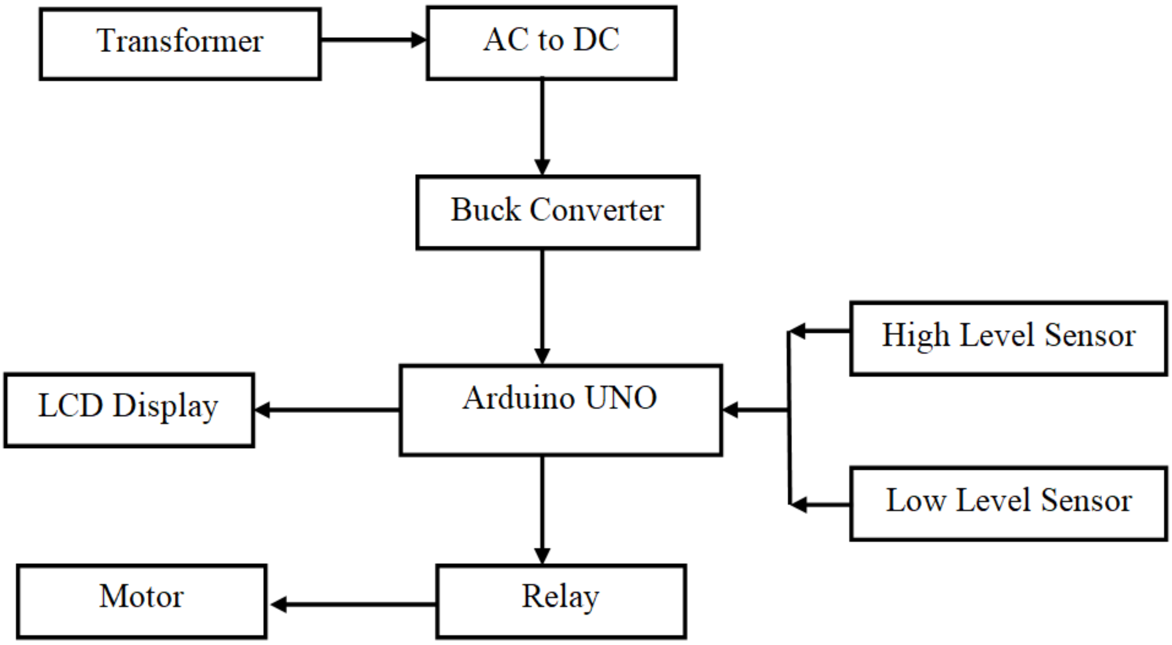

Fig 4.1: Block Diagram of the System

4.3 Methodology

- After the detail literature survey through the books, periodical, journal, magazine, websites. The idea of the project is well defined.
- The logic is derived for the intelligence of the System. It is programmed and burn it to the Arduino by using the software Arduino IDE.

➢ The accuracy and viability of the program and electronic components is tested in the simulation software Proteus.

➢ After the successful simulation result it is implemented in the hardware.

➢ After the finishing the programming, electrical and electronics part, the stable, reliable and flexible mechanical design and fabrication is completed.

➢ Finally system is tested and encountered error is omitted.

4.4 Circuit Diagram

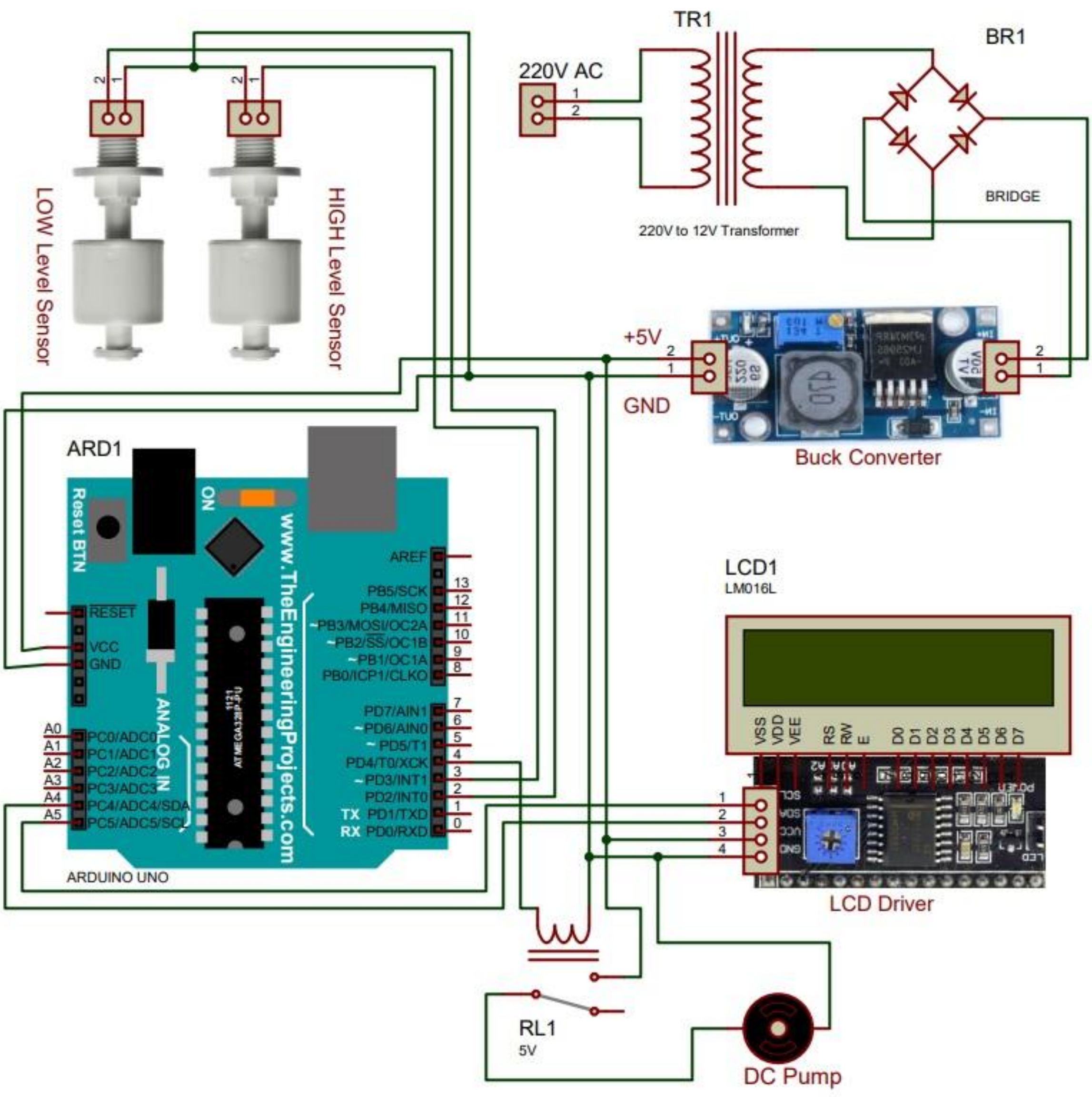

Fig 4.2: Circuit Diagram of the system

4.5 Description of code

The ASCII text file Arduino atmosphere makes it simple to write down code and transfer it to the I/O board. It runs on Windows, Mac OS X, and Linux.

The screenshot Arduino 1.6.8 is shown below

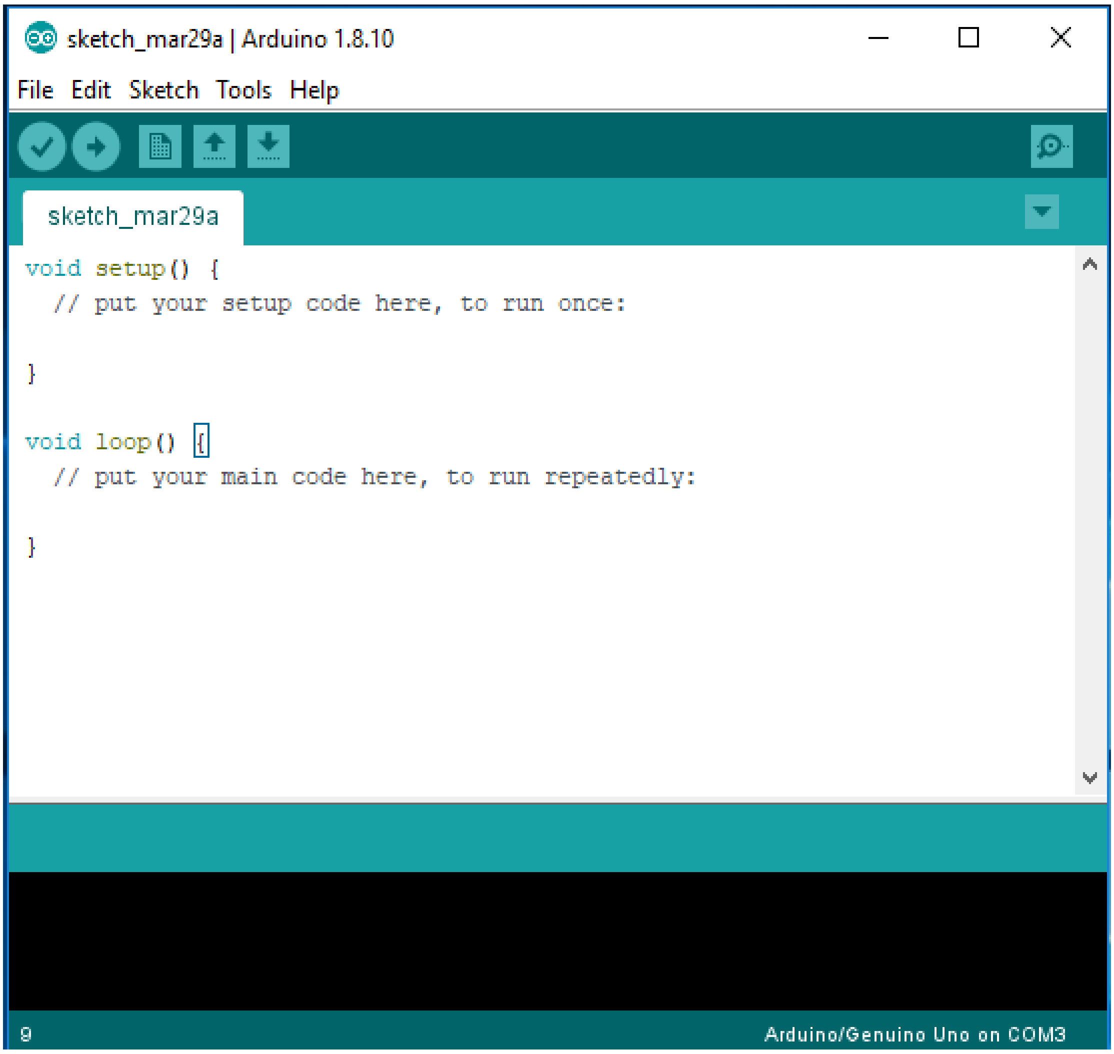

Fig 4.3: Arduino Compiler.

The atmosphere is written in Java and supported process, avr-gcc, and different open supply code. It is in addition capable of assembling and uploading programs to the board with oneclick. there's generally no requisite to edit create files or run programs on a command-line interface. Albeit building on command-line is feasible if needed with some third-party implements like Ino.

The Arduino IDE comes with a C/C++ library known as "Wiring"(from the project of an equivalent name), that makes several mundane input/output operations rather more facile. Arduino programs area unit indited in C/C++, albeit users solely would like outline 2 functions to create a runnable program.

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The compiled window of my code is show.

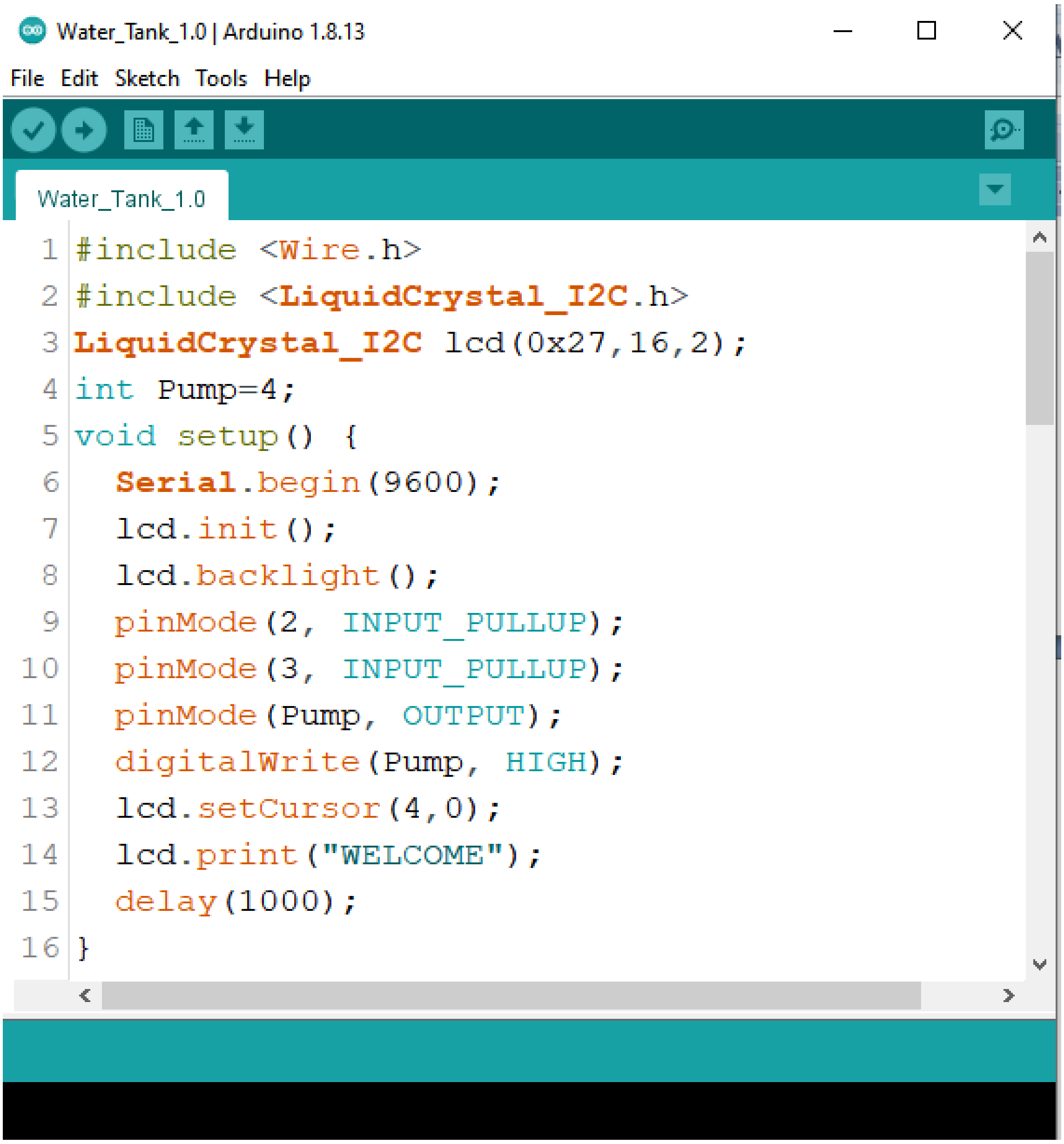

Fig 3.4: Compiled Code ino.

4.6 Project Image

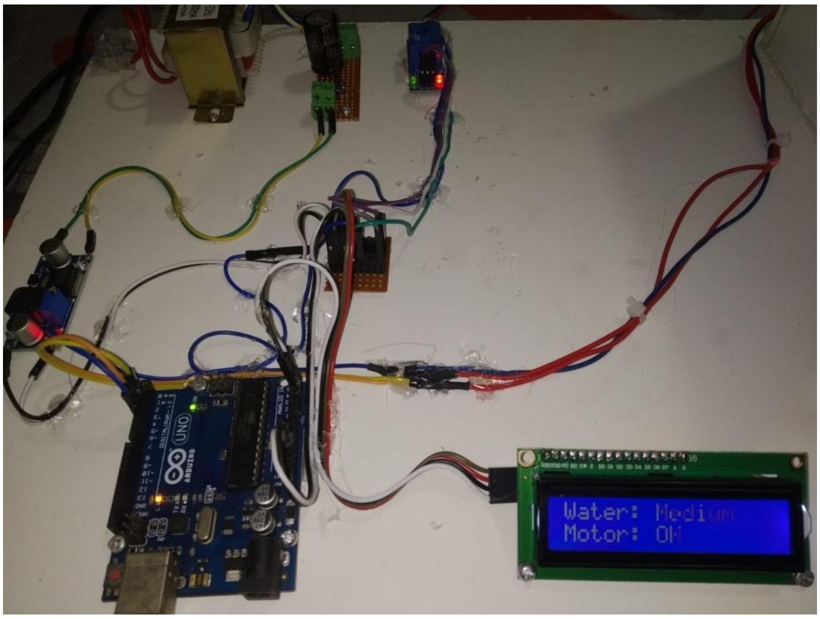

Fig 3.5: Liquid Tank controller

Fig 3.6: Liquid Tank

CHAPTER 5

RESULT AND DISCUSSION

5.1 Introduction

This chapter contains the results obtained and discussion about the project. We have also covered discussions about advantages, disadvantages and limitation of current version of the protection system.

5.2 Result

In our project water sensor and Microcontroller are the core of Water level Detector and controller. The objective of circuit is to automatically turn ON and turn OFF the water pumping system. It uses LCD display to indicate the water present in the Liquid Tank and the current condition of pumping system. It minimizes the loss of water due to overflow from the tank. The sensor of Water Level Detector and Controller is to be installed on the top of the tank such that it can measure the level of water present in the tank from top to bottom. When water level reaches to the maximum defined height the motor automatically turns OFF and when water level reaches to minimum defined level the motor turns ON automatically. This eliminates the problem of turning ON/OFF the motor manually by an individual.

In this way, it can saves water overflow from tank and aslo saves electrical energy require for pumping system. It also helps in reducing manual works as circuit is automatic. The experimental model was made according to the circuit diagram show in chapter 3 topic 3.4 and the result were as expected.

Fig 4.1: Low Tank Alarm

Fig 4.2: Medium Tank Alarm

Fig 4.3: Tank Full Alarm

5.3 Discussion

Automation of the various components around us has been widely increased to reduce human intervention and save time. The Liquid 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. 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. Therefore "Automatic Water Level Indicator and Controller Using Arduino" project can definitely be useful on a large scale basis due to minimum requirement of man power and also the installation process being easier making more compatible for everyone to use.

CHAPTER 06

CONCLUSION AND FUTURE WORK

6.1 Conclusion

The experimental set-up for controlling the liquid level is designed and developed successfully. The system was designed successfully using Arduino uno microcontroller for two levels. Automatic control system has been introduced to control water level (low level and high level) in a tank. Closed loop control system has been implemented and tested successfully Effective Water and power management in houses. And we don’t have to look after the motor anymore. There are certain limitations to this model. Some of them are addressed below:

- The maximum and minimum threshold limits of the tank are variable for tank to tank.
- The power supply for the model needs AC supply at the tank client should deploy one if it is not avail at present.
- The obstructions decrease the communication distance so that the better frequency ranges should be deployed.

6.2 Future Work

- The GSM board to send the real time notifications to the client.
- Automatic detection of tank depth while installation using ultrasonic sensor.
- Optimizing the power usage and noise decreasing in wireless communication.
- This module can be adapted to connect to the internet by giving a gprs connection with 2G network.
- This system can be altered with high processing Microcontrollers like raspberry pi to take this model to a whole new level of IoT.
- By adding IoT the data analytics on water usage can be made possible so that the clear picture of water wastage with respect to different analysis can be achieved.

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Appendix

Program Code:

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,16,2);
int Pump=4;
void setup() {
  Serial.begin(9600);
  lcd.init();
  lcd.backlight();
  pinMode(2, INPUT_PULLUP);
  pinMode(3, INPUT_PULLUP);
  pinMode(Pump, OUTPUT);
  digitalWrite(Pump, HIGH);
  lcd.setCursor(4,0);
  lcd.print("WELCOME");
  delay(1000);
}

void loop() {
  lcd.clear();
    int LowsensorVal = digitalRead(2);
    int HighsensorVal = digitalRead(3);
    Serial.print(LowsensorVal);
    Serial.println(HighsensorVal);

if (LowsensorVal == HIGH && HighsensorVal== HIGH)
  {
   lcd.setCursor(0,0);
  lcd.print("Water: Low    ");
  lcd.setCursor(0,1);
  lcd.print("Motor: ON    ");
```

```
  digitalWrite(Pump, LOW);
  }



if (LowsensorVal == LOW && HighsensorVal== HIGH)
  {
  lcd.setCursor(0,0);
  lcd.print("Water: Medium   ");
  lcd.setCursor(0,1);
  lcd.print("Motor: ON  ");
  digitalWrite(Pump, LOW);
  }

if (LowsensorVal == HIGH && HighsensorVal== LOW)
  {
  digitalWrite(Pump, HIGH);
  lcd.setCursor(0,0);
  lcd.print("Sensor: ERROR   ");
  lcd.setCursor(0,1);
  lcd.print("Motor : E  ");
  }

if (LowsensorVal == LOW && HighsensorVal== LOW)
  {
    digitalWrite(Pump, HIGH);
      lcd.setCursor(0,0);
  lcd.print("Water: Full   ");
  lcd.setCursor(0,1);
  lcd.print("Motor: OFF  ");
  }
  delay(1000);
}
```