FABRICATION OF A PROTOTYPE MODEL OF A SOLAR POWERED SMART WATER LEVEL MONITOR SYSTEM

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STUDENT DECLARATION

This is to certify that the thesis entitled, **"FABRICATION OF A PROTOTYPE MODEL OF A SOLAR POWERED SMART WATER LEVEL MONITOR SYSTEM"** of is an outcome of the investigation carried out by the author under the supervision of **Md. Sojib Kaisar,** Assistant Professor, Department of Mechanical Engineering, [SU]. This thesis or any part of it has not been submitted to elsewhere for the award of any other degree or diploma or other similar title or prize.

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SUPERVISOR CERTIFICATION

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I wish their ever success in life.

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ABSTRACT

Most of the people in residential areas face the problem of running out of water and overflow of water in water tanks due to excess supply of water. It becomes difficult for users to judge the level of water in water tanks. When the pump is turned ON, users will not realize that the water tank is filled, which may result in overflow. Water level indicator and controller system is used to sort out the issues associated with water tank. It is also possible to check the level of the water using sensor so that whenever the water goes below, pump gets turned ON automatically. Also when there is overflow of water in water tank it uses sensor to detect the water level so that if the water level goes above, the pump gets turned off automatically. This system prevents wastage of water. This system not only takes the intelligent decision of switching ON/OFF the water pump depending on the water level present. Also, solar energy is used to power up the water pump. This system also provides provision for storing solar energy which can be used during nights to ON the water pump. owner plays a great role wherever man lives and works. The living standard and prosperity of a nation vary directly with the increase in the use of power. The electricity requirement of the world is increasing at an alarming rate due to industrial growth increased and extensive use of electrical gadgets. According to world energy report we get around 80% of our energy from conventional fossil fuels like oil (36%), natural gas (21%) and coal (23%). It is well known that the time is not so far when all these sources will be completely exhausted. So, alternative sources should be used to avoid energy crisis in the nearby future. The best alternative source is solar energy.

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CHAPTER 1
INTRODUCTION

1.1 Context

We are currently experiencing a water problem, which is a big resource, as well as electric issues, and the most important thing is that we require human involvement and manpower to control these crises. As a result, proper water monitoring and control are required in every field, beginning at home and ending with all types of services. Because we lead such busy lives, we frequently forget to turn off the water pump even when the tank is full, resulting in excessive waste of water and electricity, as the water motor consumes more electrical units. Power outages occur from time to time, resulting in a lack of water supply. To operate the system in older circumstances, such as in buildings and many other places, we need Human Involvement. But, as current technology advances, we know that many projects or methods are being implemented to avoid such problems and to conserve water, which are somewhat sophisticated. Some of their constructions are quite difficult for ordinary people to use, while others simply cannot afford cost estimates and still require staff. To avoid such situations, we must minimize our labor while also improving our electricity infrastructure.

As a result, the main purpose for the development of our project, automatic water level indicator with mobile apps, is to address this issue. Automatic water level indicator with mobile apps is an automatic system that regulates the excessive flow of water from a tank. Around 70% of the hardware resources and 30% of the software resources are included in this system. So, as technology advances, so does implementation, so the control system that we will utilize is already in place, but we have added a new component, which is an android application connection. The majority of residences have subterranean water engines that pump water to rooftop water tanks. When the water motor isn't shut off, a lot of water overflows, and the water tank begins to leak after it reaches its full capacity. [1]

1.2 Problem Statement

Water is an important resource that is utilized in domestic, commercial and industrial applications. Although water is a common resource to man, its availability in some regions has become an issue due to poor water allocation, inefficient use, and lack of adequate and integrated water management. This has necessitated efforts to store water using various water storage schemes such as reservoirs, wells, artificial lakes and water storage tanks, and retrieve

it when needed. Storing water in overhead storage tanks requires the use of electric pumps. By means of an electric pump, water is pumped from the source (a lower surface) to where it is stored and treated (a higher surface) after which it is distributed to where it will be utilized, usually at different surface levels. The use of electric pumps to pump water from a source to where it will be utilized presented some challenges that bother on achieving high energy efficiency and extended lifespan of the pump by controlling when to pump, when to stop pumping and how to monitor the level of water in a storage tank. It is almost impossible for an individual to be able to keep track of the water level in a non-transparent overhead tank without a proper water monitoring system in place. It is difficult to know when the water storage tank is empty or when it is filled up. Hence, proper monitoring of the water level is necessary to avoid wastage of water and to ensure adequate and proper water management, in addition to preserving the lifespan of the pump.

This flexible automatic water level controller and indicator is implemented and found to perform satisfactorily without the need of a microcontroller. The distinction 366 among the available such water level controller circuits and economically affordable is found in the freedom of choosing the level of the overhead tank while pumping the water from the subsurface tank. Their function starts only when the low-level probe from the overhead tank detects a low level, and a bypass button can be supplied to activate the pump at any time. So, the current circuit may be improved by including low-cost controllers such as Arduino and IoT, allowing it to be controlled from anywhere and communicate intelligently through messaging or warnings.

1.3 Objective of the Project

The main objective of this project is to "Fabrication of a prototype model of a solar powered smart water level monitor system'' project for the main purpose is to create a smart system so that we can take many benefits from one project.

- To saves power of this project.
- To construct the smart solar powered water level monitor system.
- To check the performance of our project.

1.4 Background of the Project

This project presents the design and implementation of an android mobile application-based wireless automatic water level controller that efficiently controls the level of water in storage tank. The device float sensor to monitor the water level by sending and receiving electric

waves, and the time taken is converted to distance by the Node MCU microcontroller which gives corresponding digital outputs to either turn ON the water pump (when the water level in the tank is at a chosen minimum level of 1L) or turn OFF the water pump (when the water exceeds the preset maximum level of 3L). The digital output from the microcontroller is interfaced with an android mobile application. A software designed so that we can monitor from anywhere. Besides, we will be able to monitor the temperature and humidity through display and internet. We have worked with solar power to keep the power supply uninterrupted. The project will continue through automatic solar system along with load shedding.

1.5 IoT System

The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. The definition of the Internet of Things has evolved due to the convergence of multiple technologies, real-time analytics, machine learning, commodity sensors, and embedded systems.[2]
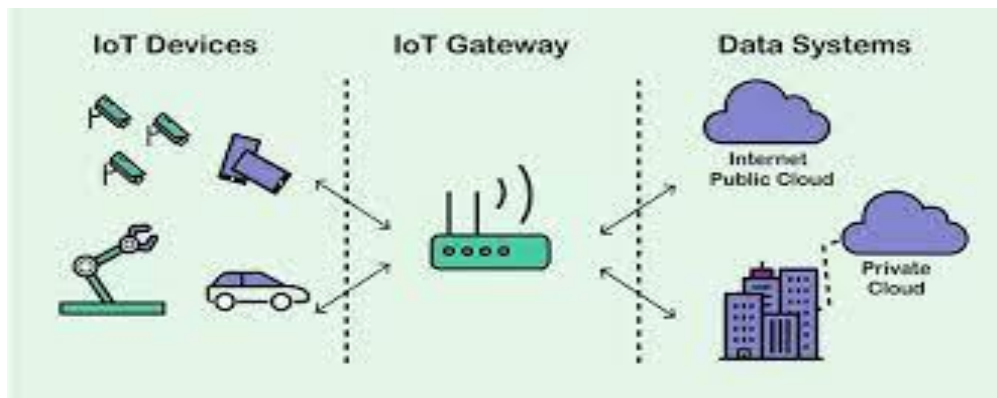
Fig-1.1: IoT System

Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all contribute to enabling the Internet of Things. In the consumer market, IoT technology is most synonymous with products pertaining to the concept of the **"Fabrication of A Prototype Model of A Solar Powered Smart Water Level Monitor System",** covering devices and appliances (such as lighting fixtures, thermostats, home security systems and cameras, and other home

appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as
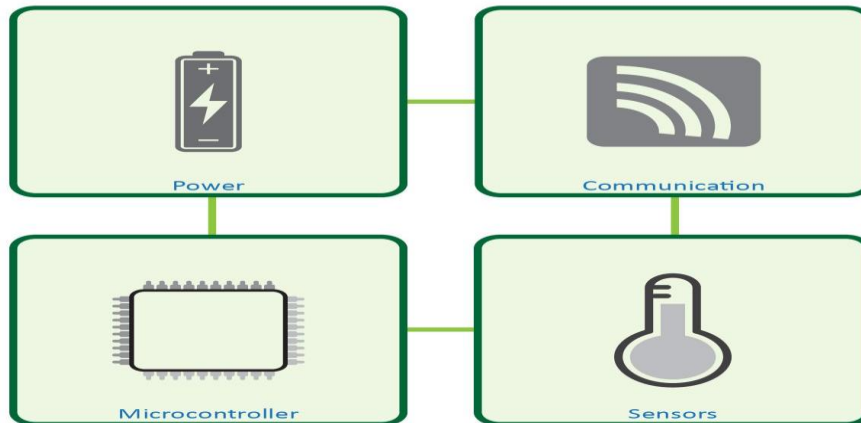
Fig-1.2: Block Diagram of IoT

Smart phones and smart speakers. There are a number of serious concerns about dangers in the growth of IoT, especially in the areas of privacy and security; and consequently, industry and governmental moves to begin to address these.

1.6 Methodology

Basically, the design and development of this project are divided into two main parts which are hardware architecture and software details. In the hardware architecture, the design of the circuit was constructed and the prototype of the project was built. While in the software development, the whole complete prototype was operated via programming codes.

Fig-1.3: Methodology

1.7 Motivation for Project

A poorly motivated team has been known to unravel even the best project plan. A good project manager needs to know how to harness the initial excitement that comes wit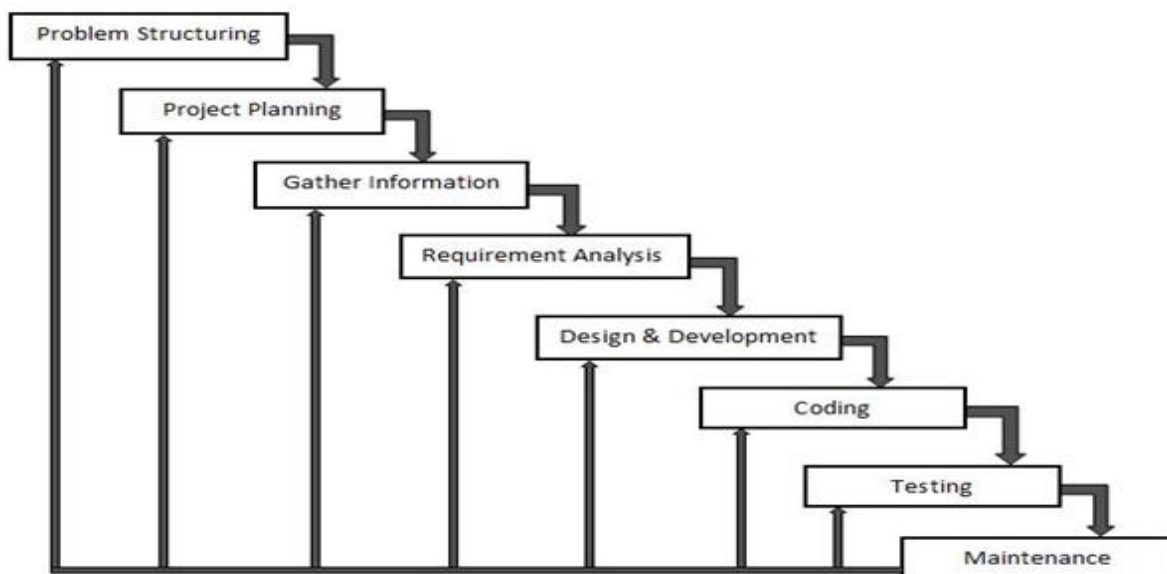h starting a project and use it to maintain motivation – leading to success throughout the project's lifecycle. We now know that contemporary project managers need to be more than just schedulers and contract managers. They need excellent skills in managing those complex human elements that have the potential to bring any project down.

1.8 Project Management

Management of any project can be briefly disintegrated into several phases. Our project has been decomposed into the following phases:

Experimentation: This phase involved discussions regarding necessary equipment regarding the project. The study of related already existing projects, gathering required theoretical learning. It also included figuring out the coding part, by developing simple algorithms and flowcharts to design the whole process

Design: This phase was, designing layout of the application, and the necessary features to be included. The objective of project management is to produce a complete project which complies with the objectives. In many cases, the objective of project management is also to shape or reform the client's brief to feasibly address the objectives. Once the objectives are clearly established, they should influence all decisions made by other people involved in the project.
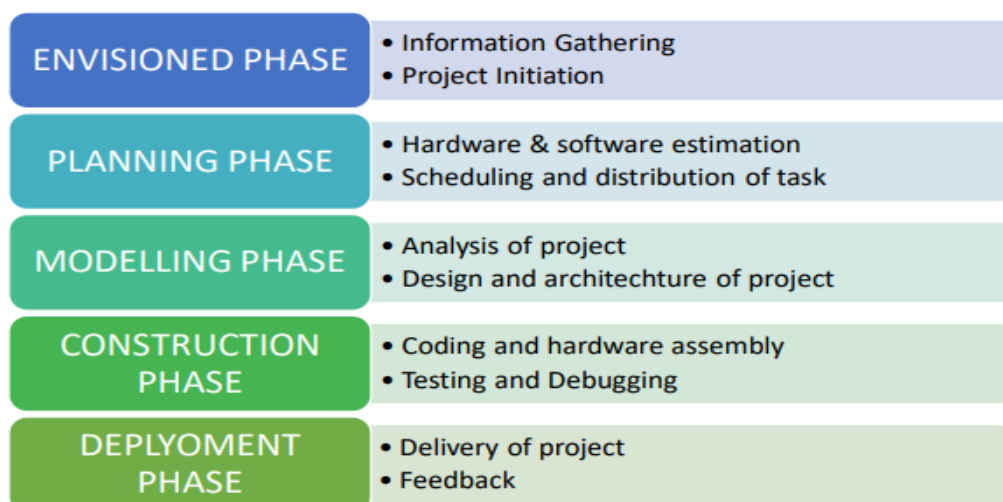
Fig-1.4: Project Management

Development and Testing: This phase had the development of the application. A project is a temporary and unique endeavor designed to produce a product, service, or result with a defined beginning and end undertaken to meet unique goals and objectives, typically to bring about beneficial change or added value. The temporary nature of projects stands in contrast with business as usual which are repetitive, permanent, or semi-permanent functional activities to produce products or services. In practice, the management of such distinct production approaches requires the development of distinct technical skills and management strategies.

CHAPTER 2
LITERATURE REVIEW

2.1 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 India 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**.**[3]

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 microcontroller" project, the water is being measured by using Float Sensor. 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.

2.2 Solar Home System (SHS)

The direct conversion of sunlight into electricity is called photovoltaic solar energy conversion. An essential component of Photo Voltaic (PV) system is the solar cell, in which the photovoltaic effect takes place. When light falls on the semiconductors of the cell, it produces a small electric current. Photovoltaic modules, or panels, consist of a number of cells connected together to provide voltages and currents high enough for practical use. More common in rural electrification programs is the use of solar PV as stand-alone systems in households, social institutions, or places of productive or business activities.
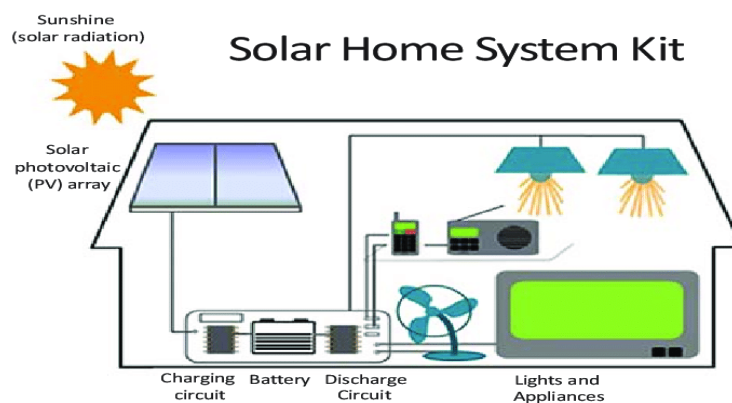

Fig-2.1: Solar Home System (SHS)

Generally, the system is referred to as 'Solar Home System' (SHS).The SHS providing load is low ,but can be sufficient for powering of lights, radios, television sets, and to refrigerate medicines at rural clinics.

2.3 Solar Cells

A photovoltaic system also solar power system is a power system designed to purvey usable solar power by means of photovoltaic. It consists of an arrangement of different components, with solar panels to absorb and convert sunlight into electricity, a solar inverter to switch the electric current from DC to AC, as well as mounting, cabling, and other electrical accessories to set up a working method. The long term average sunshine data indicates that the period of bright sunshine hours in the coastal regions of Bangladesh varies from 3 to 11 hours daily. PV cells generate electricity from sunlight. Materials used in computer chips are like to materials used in Photo voltaic cells.[4]

Fig-2.2: Solar Cell

2.3.1 Types of Solar Panel

Following are the different types of solar panels classified according to the generation of solar panel: [5]

- Monocrystalline Solar Panels (Mono-SI)
- Polycrystalline Solar Panels (Poly-SI)
- Amorphous Silicon Solar Cell (A-Si)
- Thin-Film Solar Cells (TFSC)
- Biohybrid Solar Cell
- Concentrated PV Cell (CVP and HCVP)
- Cadmium Telluride Solar Cell (CdTe)

Monocrystalline Solar Panels (Mono-SI): The monocrystalline solar panel is made of monocrystalline silicon is the purest. They are available in the form of an equally dark look and rounded edges. The reason for the high purity of silicon is that this type of solar panel has the highest efficiency of above 20% rate.

The benefits of using monocrystalline solar panels have a higher power output, occupy less space, and last longer. They are also costly compared to other types of solar panels. Another benefit to consider is that they are slightly less affected by high temperatures than polycrystalline panels.

Polycrystalline Solar Panels (Poly-SI): The polycrystalline solar panels have a unique look than other panels. This type of solar panel has squares, and its angles are not cut. The appearance of this panel has a blue and speckled look. These solar panels are manufactured by melting the raw silicon, which is a quicker and less expensive process compared to monocrystalline panels.

This is also due to lower efficiency of around 15%, lower space efficiency, and a shorter lifespan, even at lower final prices, because they are affected to a greater degree by warmer temperatures.

But, the difference between mono- and polycrystalline types of solar panels is not so important and the choice of using suitable solar panels will depend on your specific situation. This provides slightly more space efficiency at a higher cost, but the power outputs are the same.

Second Generation Solar Panels: These cells differ from first-generation solar cells and are essentially used for photovoltaic power stations integrated with buildings or smaller solar systems.

These are the different types of solar panels that one uses mainly in the manufacture of a pocket calculator. The amorphous silicon solar panel uses triple-layered technology, which is the most excellent of the thin film variety.

The thickness of this solar sheet is around about 1 micrometer. It is approximately about one-millionth of a meter. With only a 7% efficiency rate, these cells are less efficient than crystalline silicon ones, which have an efficiency rate of circa 18%. The benefit of using this solar panel is that it is available at a low cost.

Thin-Film Solar Cells (TFSC): Thin-film solar panels are also known as TFSC. These are made by placing one or more films of PV material, such as silicon, cadmium, and copper, on a substrate. They are easy to produce, and economies of scale make them cheaper than options due to the low content required for their production.

Thin-film solar cells are flexible and less affected by high temperatures. Using these solar cells, opens up plenty of opportunities for alternative applications. The disadvantage of these solar cells is that it takes more space, generally making them unsuitable for residential establishments.

Furthermore, they offer the lowest warranty because their lifespan is shorter than mono- and polycrystalline-type solar panels. It is best to installment where a lot of space is available.

Third Generation Solar Cells: Third-generation solar panels include a type of thin film technology, but most are in the development stage. Any of them produce electricity utilizing natural materials; others use inorganic materials.

Biohybrid Solar Cell: The biohybrid solar cells were founded by an expert team from Vanderbilt University. The concept of this new technology is to take advantage of Photosystem 1 and thus simulate the natural process of photosynthesis.

Many of the materials applied in this cell are related to traditional methods. Combining multiple layers of photosystem 1 makes the transformation from chemical to electrical energy more efficiently. That is 1000 times more effective than the first-generation types of solar panels.

Concentrated PV Cell (CVP and HCVP): Compared to other types of solar panels, such CVP cells have a name that makes them so efficient: curved mirror surfaces, lenses, and sometimes cooling systems are also used to bind the sun's rays, and thus their efficiency increases.

Concentrated PV cells produce electrical energy as traditional photovoltaic systems do. The efficiency rate of those multi-junction type solar panels is 41%, one of the highest of all photovoltaic systems.

Cadmium Telluride Solar Cell (CdTe): In these different types of solar panels, cadmium telluride is used in this photovoltaic technology. That allows the production of solar cells at a meager cost and thus a shorter period (for less than one year).

In all solar energy technology, it requires minimal water for production. The advantage of using these solar cells will keep their carbon footprint as low as possible. The main drawback of using cadmium telluride is its quality of being toxic if ingested or inhaled.

Especially in Europe, as many people are very concerned about using the technology behind this type of solar panel, this is one of the biggest hurdles to overcome.

2.3.2 Manufacturing Solar Cells

Manufacturing common silicon-based solar cells require a number of different processes starting from a raw material called Quartzite, which is a form of quartz sandstone rock. First Quartzite, also referred to as silica sand, is converted into metallurgical grade silicon by combining Carbon and Quartzite in an arc furnace. This process occurs at very high temperatures and results in 99% pure silicon. The next step is to convert the metallurgical grade silicon into pure Polysilicon using either a chemical purification process called the Siemens process, or upgraded metallurgical-grade silicon (UMG-Si), using less costly metallurgical processes.

Next, the polysilicon is doped with trace amounts of either boron or phosphorous to become either P-type or N-type silicon. At this stage, the polycrystalline silicon can be melted and cast into large rectangular blocks and thinly sliced using a diamond wire cutting method to produce the polycrystalline or multi-crystalline wafers.

To manufacture the more efficient monocrystalline wafer or cells, the doped silicon can be made into a pure solid crystal ingot using the Czochralski process. This process involves melting the polycrystalline silicon under high pressure and temperature to slowly grow a single large monocrystalline crystal known as an ingot.
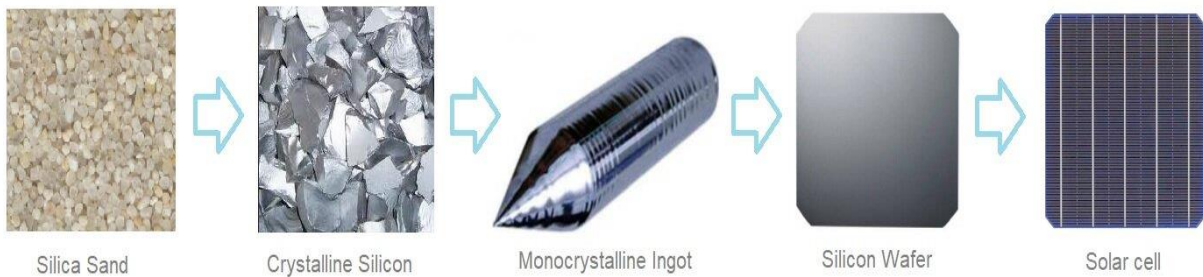
Fig-2.3: The basic materials and steps involved in making a monocrystalline silicon solar cell

Steps to manufacture monocrystalline PV cells:

- Silica sand is purified in an arc furnace to create 99% pure silicon .

- The 99% silicon is further refined close to 100% pure silicon.

- The silicon is doped with boron or phosphorous (P-type or N-type).

- The doped silicon is melted and extracted into a crystalline ingot.

- The round ingot is diamond wire-cut into thin square wafers.

- The thin base wafer is coated with an ultra-thin layer of either P-type or N-type silicon to form the PN-junction.

- An anti-reflective layer and metallic fingers are added to the cell surface.

- Flat ribbon busbars (as shown) or thin wire (MBB) busbars are added.

Six Main Components of a Solar Panel:

- Solar photovoltaic cells

- Toughened Glass - 3 to 3.5mm thick

- Extruded Aluminum frame

- Encapsulation - EVA film layers

- Polymer rear back-sheet

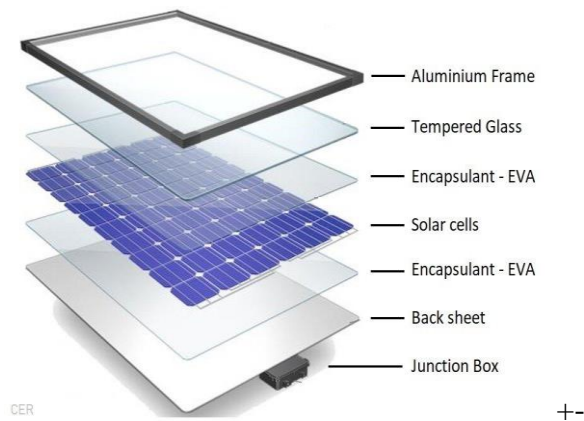- Junction box - diodes and connectors

Fig-2.4: Components of Solar Panel

2.4 Node MCU

NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language. It is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson and SPIFFS.

NodeMCU was created shortly after the ESP8266 came out. On December 30, 2013, Espressif Systems began production of the ESP8266.The ESP8266 is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core,[citation needed] widely used in IoT applications (see related projects). NodeMCU started on 13 Oct 2014, when Hong committed the first file of nodemcu-firmware to GitHub.Two months later, the project expanded to include an open-hardware platform when developer Huang R committed the gerber file of an ESP8266 board, named devkit v0.9.
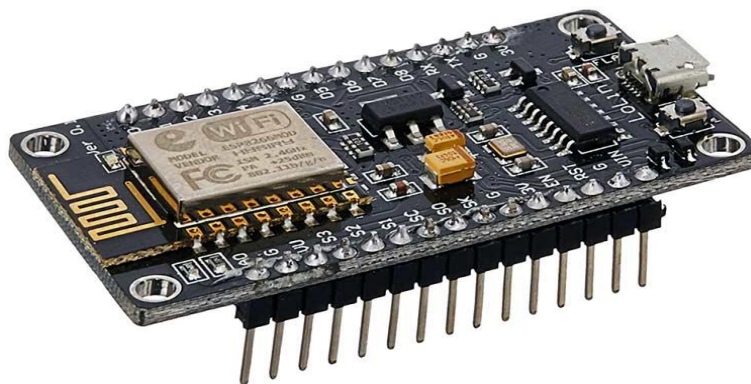

Fig-2.5: Node MCU

2.4.1 Technical Specifications of Node MCU

- Power input: 4.5V ~ 9V (10VMAX), USB-powered
- Transfer rate: 110-460800bps
- Support UART / GPIO data communication interface
- Support Smart Link Smart Networking
- Working temperature: -40°C ~ + 125°C
- Drive Type: Dual high-power H-bridge
- Don't need to download resetting
- A great set of tools to develop ESP8266
- Flash size: 4MByte
- Lowest cost WI-FI

2.5 Buck Module

The LM2596 series of regulators are monolithic integrated circuits that provide all the active functions for a step-down (buck) switching regulator, capable of driving a 3-A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, and an adjustable output version. Requiring a minimum number of external components, these regulators are simple to use and include internal frequency compensation, and a fixed frequency oscillator. The LM2596 series operates at a switching frequency of 150 kHz, thus allowing smaller sized filter components than what would be required with lower frequency switching regulators. Available in a standard 7-pin TO-220 package with several different lead bend options, and a 7-pin TO-263 surface mount package.
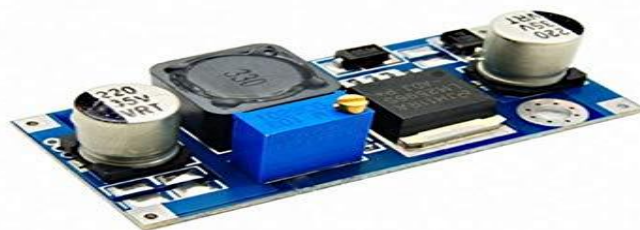

Fig-2.6: LM2596 Voltage Converter

2.6 Adapter

12V 5A Micro Power Adapter. For using with Arduino /Raspberry Pi 3 Model A+/B/B+/Zero and running any other high current devices.

2.6.1 Specifications of Adapter

- Input: 100V - 240V AC, 50Hz/60Hz.
- Output: 12V 5A.

Fig-2.7: Adapter

2.7 LCD Display

A Liquid crystal display (LCD) is a flat display that uses the light modulating properties of liquid display. They are common in consumer devices such as video players, gaming devices, clocks, telephones, computers, calculators etc.

A (20×4) LCD panel consists of 20 columns and 4 rows. It can show up to 16 characters in 2 lines.

You may want to have a look on these similar products:

1. LCD Display (20×4) with Header soldered

2. LCD display module (20×4)

3. LCD display module advanced (20×4)

4. 3 wire LCD module (20×4)

5. I2C LCD Display (20×4)

6. Arduino LCD keypad shield

7. LCD Display (20×4)

| Pin	Function
VSS	connected to ground
VDD	connected to a +5V power supply
VO	to adjust the contrast
RS	A register select pin that controls where in the LCD's memory you are writing data to. You can select either the data register, which holds what goes on the screen, or an instruction register, which is where the LCD's controller looks for instructions on what to do next.
R/W	A Read/Write pin to select between reading and writing mode
E	An enabling pin that reads the information when High level (1) is received. The instructions are run when the signal changes from High level to Low level.
D0-D7	to read and write data
A	Pins that control the LCD backlight. Connect A to 3.3v.
K	Pins that control the LCD backlight. Connect K to GND.

Table 1: LCD Display Outline
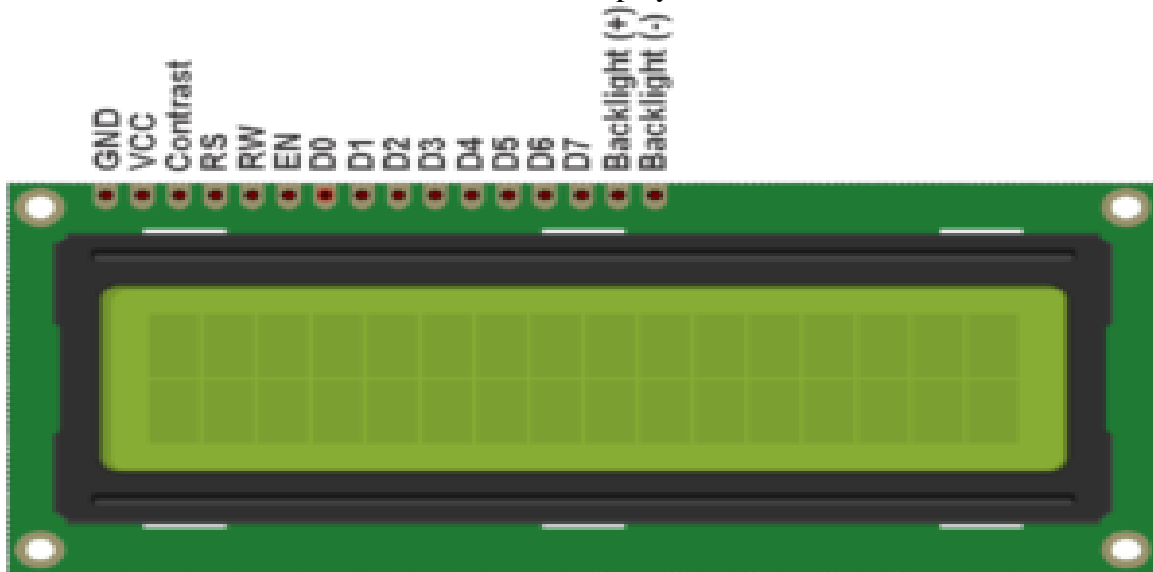
Fig-2.8: LCD Display

2.8 Float Sensor

A float switch is a type of level sensor, a device used to detect the level of liquid within a tank. The switch may be used to control a pump, as an indicator, an alarm, or to control other devices.One type of float switch uses a mercury switch inside a hinged float. Another common type is a float that raises a rod to actuate a microswitch. One pattern uses a reed switch mounted in a tube; a float, containing a magnet, surrounds the tube and is guided by it. When the float raises the magnet to the reed switch, it closes. Several reeds can be mounted in the tube for different level indications by one assembly.

Fig-2.9: Float Sensor

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A P45 Small Float Level Control Switch Plastic Float Switch is a type of level sensor, a device used to detect the level of liquid within a tank. It is neither a complicated circuit nor does it provide power. It is a simple structure, easy to use level control device; furthermore, this switch has a mechanical switch than those of the average small sized switches.

As long as the material used is in the correct shape and nature of any liquid or pressure, you can control the temperature. Applications of this Switch include shipbuilding industry, generating equipment, petrochemical and food industry, water treatment equipment, dyeing, and finishing industry, and hydraulic machinery.

2.8.1 Technical Specifications of Float Sensor

- Contact Rating: 10 W.
- Switching Voltage: 220 V.
- Switching Current: 0.5 A.
- Breakdown Voltage: 220 VDC.
- Carry Current: 1 A.
- Contact Resistance: 100 mΩ.

2.9 Pump Motor

DC 5V Pump Mini water pump For Fountain Garden Mini water circulation System.

2.9.1 Specifications of Pump Motor

- DC Voltage:2.5-6V.
- Maximum lift:40-110cm / 15.75"-43.4".
- Flow rate:80-120L/H.
- Outside diameter of water outlet: 7.45mm / 0.3" (our 7mm inner diameter tube is ok for this pump).
- Inside diameter of water outlet: 4.7mm / 0.18".
- Diameter: Approx. 24mm / 0.95".
- Length: Approx. 45mm / 1.8".
- Height: Approx. 33mm / 1.30".
- Material: Engineering plastic.
- Driving mode: brushless dc design, magnetic driving.

Fig-2.10: Pump Motor

2.10 Relay Module

A relay is an electrically operated device. It has a control system and (also called input circuit or input contactor) and controlled system (also called output circuit or output cont. actor). It is frequently used in automatic control circuit. To put it simply, it is an automatic switch to controlling a high-current circuit with a low-current signal.

The advantages of a relay lie in its lower inertia of the moving, stability, long-term reliability and small volume. It is widely adopted in devices of power protection, automation technology, sport, remote control, reconnaissance and communication, as well as in devices of electro mechanics and power electronics. Generally speaking, a relay contains an induction part which can reflect input variable like current, voltage, power, resistance, frequency, temperature, pressure, speed and light etc. It also contains an actuator module (output) which can energize or de-energize the connection of controlled circuit. There is an intermediary part between input part and output part that is used to coupling and isolate input current, as well as actuate the output. When the rated value of input (voltage, current and temperature etc.) is above the critical value, the controlled output circuit of relay will be energized or de-energized.

NB: input into a relay can be divided into two categories: electrical quantities (including current, voltage, frequency, power etc.) and non- electrical quantities (including temperature, pressure, speed, etc.)
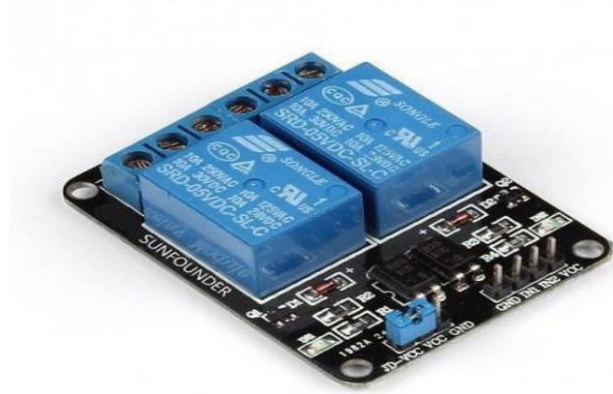
Fig-2.11: Relay Module

2.10.1 Features of Relay Module

The features of 1-Channel Relay module are as follow:

- Good in safety. In power system and high voltage system, the lower current can control the higher one.
- 1-channel high voltage system output, meeting the needs of single channel control.
- Wide range of controllable voltage.
- Being able to control high load current, which can reach 240V, 10A
- With a normally-open (NO) contact and a normally-closed (NC) contacts

2.10.2 Interface Specifications of Relay Module

The output contacts of a relay (including NO, NC, and the common port) works as a SPDT – Single Pole Double Throw switch. Its operating principle is as follow: VCC----5V,

GND----for ground

IN1 connects to the control valve which output 3V-5V

Output contacts: connect to applications
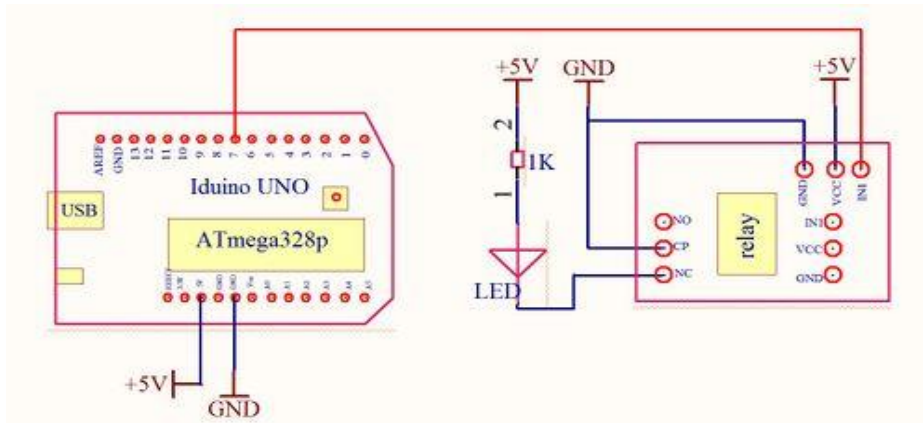
Interface Connecting and Setting:

Fig-2.12: Schematic of Relay Module

Arduino board (any versions), wires, LED, 5v power supply. Software resource: Arduino IDE the one-channel relay can be programmed to realize the open and close automatically. NB: customers can use any software or firmware to control the module as long as the IN1 of which can input a voltage of 3V-5V.
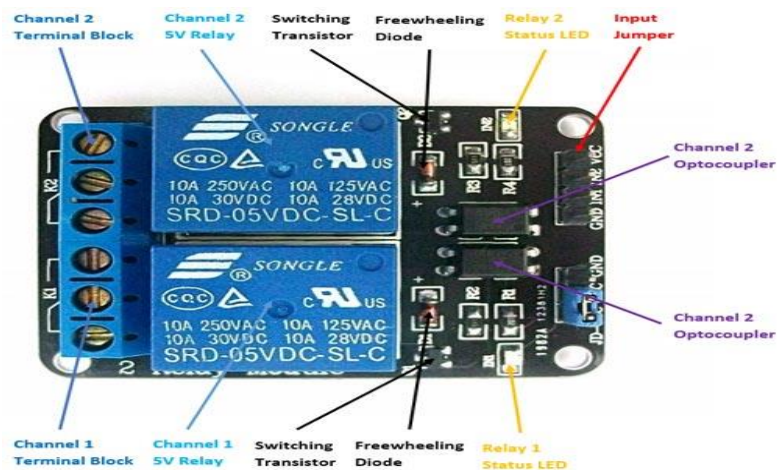

Fig-2.13: Pin out of Relay Module

you can do further development with the development tool you like as well as test it in the way of testing firmware. Firmware test: after the connection as in picture1-4, pay attention to the blink of LED, listen to the flicker of relay when it is working.

Software test code:

```
void setup () {
pin Mode (7, OUTPUT);
}
void loop () {
```

20

```
pin Mode (7, OUTPUT);
delay (2000);
digital Write (7, LOW);
delay (2000);
}
```

2.11 Charge Controller

A charge controller, charge regulator or battery regulator limits the rate at which electric current is added to or drawn from electric batteries. It prevents overcharging and may protect against overvoltage, which can reduce battery performance or lifespan and may pose a safety risk. It may also prevent completely draining ("deep discharging") a battery, or perform controlled discharges, depending on the battery technology, to protect battery life. The terms "charge controller" or "charge regulator" may refer to either a stand-alone device, or to control circuitry integrated within a battery pack, battery-powered device, or battery charger.

Fig-2.14: Charge Controller

2.12 Battery

Most automotive batteries are 12V, lead seal batteries. Nearly all car, motorcycle and tractor batteries are 12-volt, lead-acid batteries. These batteries can provide hundreds of amps of electrical current for a short period of time. This is why these batteries are commonly used in automotive applications. Not all 12-volt, lead-acid batteries are interchangeable, however. It is important to consider the automobile's electrical requirements before attempting to install a 12-volt battery.

Fig-2.15: 12V Battery

Battery Voltage: Even though most car, motorcycle and tractor batteries are sold as "12-volt" batteries, the nominal voltage of a fully charged battery is closer to 12.6 volts. The electrochemical reaction between the lead plates and the battery electrolyte is what produces the voltage differential between the positive and negative terminals on a battery. Over time, the lead plates within the battery will become covered with lead sulfate crystals. These crystals inhibit the electrochemical reaction between the lead plates and the electrolyte, causing a drop in battery voltage

Electrical Current Capacity: The electrical current capacity for each battery is rated using two metrics: "cranking amps" and "cold cranking amps." Cranking amps are a measure of how much electrical current (as measured in amps) a battery can provide for 30 seconds at 32 degrees Fahrenheit. Cold cranking amps are a measure of how much electrical current a battery can provide for 30 seconds at 0 degrees Fahrenheit. Since the electrochemical processes that produce electrical energy in a battery are affected by cold temperatures, a battery will always produce more cranking amps than cold cranking amps.

Reserve Capacity: If the alternator (or generator in some older vehicles) fails, the battery is the sole source of electrical power for that vehicle. Batteries are designed to operate for several minutes in the event of an electrical failure. A battery's "reserve capacity" is a measure of how long, in minutes, a battery can deliver 25 amperes of electrical current during a charging system failure.

2.13 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. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operation.

Fig-2.16: Relay with Base

2.14 Literature Survey

Santosh Anand., et al **[7]** This paper is about automatic water control system using IoT senses ,the water movement and afterward demonstrates the water level inside the container and passes information to the owner through pop up message. This IoT is associated with smartphones , laptops, computers, and multiple sensors. Their system includes a water level sensor built into the container, as well as an IR sensor for controlling the flow of water from the tap. With the 120db water leak alarm, it can detect a leak in a pipe and alert you. In the case of a low, medium, or high level of water in the water tank, continuous water flow from the tap. Water leak alarm will send a notification to your phone via a pop-up message stating that there is a leak in the pipe. As a result, users can make their own selections. This is where the project's working premise will be demonstrated. i.e. an automatic water control system that monitors water flow and displays the water level within the container, as well as informing the owner via a pop-up message.

Mallikarjun.G. Hudedmani a., et al [8] The Automatic Water Level Controller is described in this paper as a solution to this problem. The operation of their water level controller is based on the fact that water has overflow and electricity concerns. The controller's detecting probes and circuits detect when the water level rises or falls. These signals are utilised to turn on or

off the pump motor depending on the situation. A buzzer will be included as an optional function to stop the input water for the subterranean tank's water level. Turn off the tap to avoid overflow, future shortages, and unnecessary water billing by the water supply board.

P. Nancy Rachel a., et al [9] The Arduino-based water level indicator and controller is described in this paper. Basically, an ultrasonic sensor will be placed on top of the water tank to manage the water level. When sound waves travel through the environment, they return to their source as an echo as soon as they hit an obstruction. Typically, they will employ an ultrasonic sensor to calculate the delay time. A code can be programmed into the Arduino using this delay period to determine the distance between the water level and the sensor. Maximum and minimum limits can be determined based on the requirements, and this information can then be used to automatically turn on or off the water supply.

Ms. Pooja K a., et al [10] This paper first tests and indicates the water level, allowing the pump to be turned off at the proper moment, saving water, electricity, and time. This article usually focuses on requiring the least amount of manpower and making the installation process easier to use for everyone. This innovation of "Water Level Indicator and Controller Using Arduino" project may surely be beneficial on a big scale due to the low manpower requirements and the ease of installation, making it more accessible to everyone.

Sanam Pudasaini., et al [11] System of automatic level controllers with sms. In the arduino programme development environment, a programme was created and uploaded to the microcontroller. The water level in the system is automatically controlled using ultrasonic sensors. The controller is powered by batteries. The user receives a sms notification whenever the system detects an empty tank level or an overload condition. The water distribution procedure works like this: if electricity is available, the system will check the tank's water level. If there is a problem with the power, the user is notified by SMS so that he may make necessary water arrangements. As soon as the water level in the water tank reaches the MAX level, the motor will turn off.

CHAPTER 3

CONSTRUCTION PROCESS

3.1 Introduction

The project "automatic water controller" is design to monitor the level of liquid in the tank. The system has an automatic pumping system attached to it so as to refill the tank once the water gets to the lower threshold, while offing the pump once the water gets to the higher threshold. 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.[12]

In this project, we have worked with an indicator on an automatic water level controller. When we looked up our topic on the internet, we realized that most of the projects used microcontrollers or IC 555, We did include any of these circuits in our model. Several methods have been developed to achieve this monitoring and control. For example, presented a microcontroller based automatic water level control system which utilizes copper conductors as the water level sensor. Since this system offers a form of water level detection that involves contact between the sensor and the water, the sensor is susceptible to corrosion which reduces its sensitivity and poses threat to health. Also, utilized a metallic sensor encased in a plastic tubing but immersed in the tank and connected to a regulator by well insulated output cables. This system requires the use of complex wiring and it is prone to wire damage. Interestingly, it is possible to achieve this monitoring and control using wireless means by utilizing ultrasonic sensors, Internet of Things (IoT), Global System for Mobile Communication (GSM) technology, programmable logic controllers (PLCs), radio frequency (RF) communication and Zigbee technology. While the above wireless systems can monitor and control the water level in the storage tanks, they do not have the flexibility of being controlled remotely by the user.

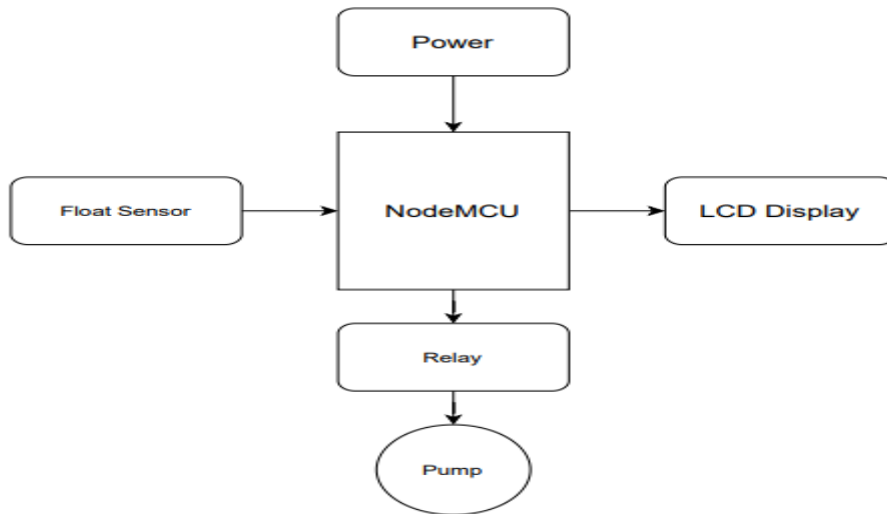## 3.2 Block Diagram of This Project

Fig-3.1: Block Diagram

3.3 Circuit Diagram of This Project

For our project we have created the circuit in protest software. In the project we used solar and adapter as power supply. Confirmed the supply system through a relay, which is mentioned in the circuit. Here we have switched the water motor on and off through the relay module. We have done data monitoring from LCD display. We have used float sensor for water level monitoring. Each of our devices is connected to the programming microcontroller Node MCU. The automatic water motor will be started through the relay by taking the command from the sensor. We can monitor the data from the display and through the Internet.
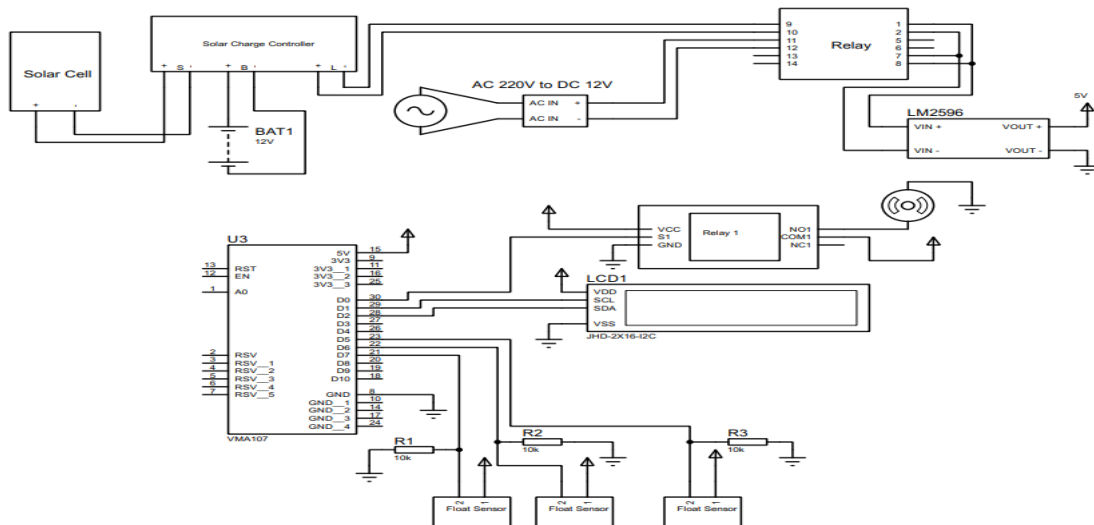

Fig-3.2: Circuit Diagram

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3.4 Software Tools

The software that is used to program the microcontroller is open-source-software and can be downloaded for free on www.arduino.cc. With this "Arduino software" we can write little programs with the microcontroller. These programs are called "Sketch". We are transferred to the microcontroller by USB cable. More on that later on the subject "programming".[13]

- **Installation** Now one after another the Arduino software and the USB driver for the board have to be installed.

- **Installation and setup of the Arduino software**

1. We have downloaded the Arduino software from www.arduino.cc and installed it on the computer (This was NOT connected to the PC). After that we opened the software file and installed the program named arduino.exe.

Two set ups on the program are important and should be considered.

a) The board that we want to connect has to be selected on the Arduino software. The "Arduino Uno" is here known as "Arduino / Genuine Uno".

b) We have to choose the right "Serial-Port", to let the computer know to which port the board has been connected. That is only possible if the USB driver has been installed correctly. It can be checked this way:

At the moment the Arduino wasn't connected to the PC. If we now choose "Port", under the field "Tool", we will already see one or more ports here (COM1/ COM2/ COM3…). The quantity of the shown ports doesn't depend on the quantity of the USB ports on the computer. When the board gets connected to the computer, we will find one more port.
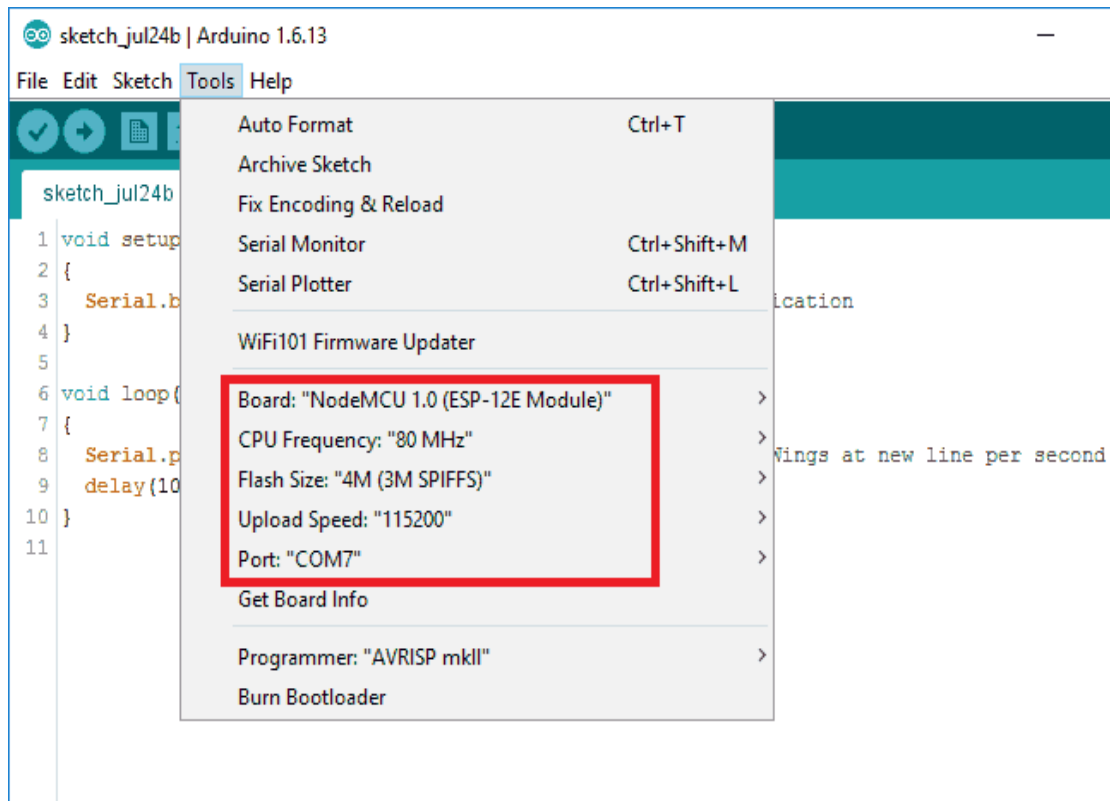
Fig-3.3: Program Installation Process

3.5 Programming
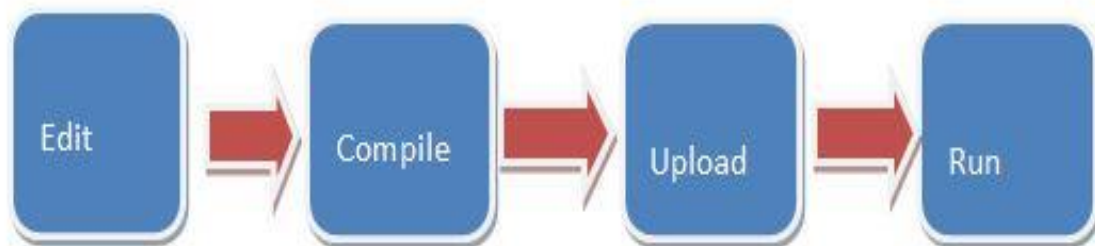
The development cycle is divided into 4 phases:

Fig-3.4: Flowchart of the Compiling Process

Compile: Compile means to translate the sketch into machine language, also known as object.

Code Run: Arduino sketch is executed as soon as terminates the step of uploading on the board.

3.6 Arduino Program Development

- Based on C++ without 80% of the instructions.
- A handful of new commands.
- Programs are called 'sketches'.
- Sketches need two functions:
- void setup ( )
- Void loop ( )
- Setup ( ) runs first and once.
- loop ( ) runs over and over, until power is lost or a new sketch is loaded.

3.7 Android Apps

The Blynk software is mainly operated over the Internet. This software has a specific server for sending data. This software has to be registered on the specified server, then login to the software with email and password. Data is passed to the server through the controller's Internet head, the server sends software data, which we can monitor from anywhere.
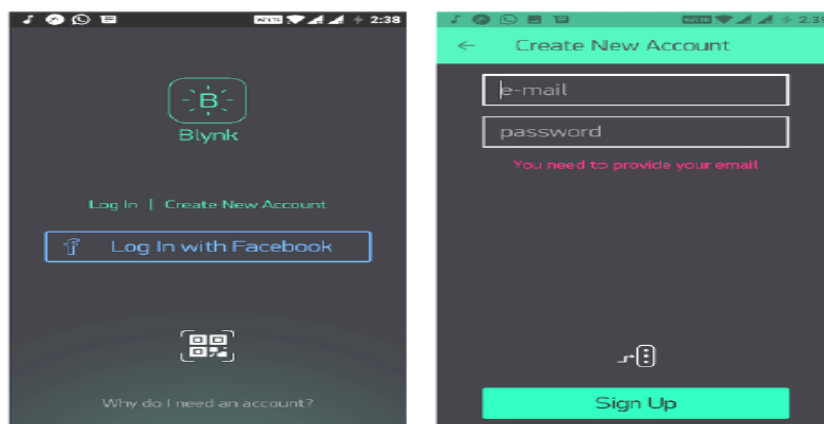

Fig-3.5: Blynk Android Webapps

3.8 Proposed Project in Proteus

Proteus 8 is best simulation software for various designs with microcontroller. It is mainly popular because of availability of almost all microcontrollers in it. So it is a handy tool to test programs and embedded designs for electronics hobbyist. You can simulate your programming of microcontroller in Proteus 8 Simulation Software. After simulating your circuit in Proteus 8 Software you can directly make PCB design with it so it could be a all in

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one package for students and hobbyists.So I think now you have a little bit idea about what is proteus software.
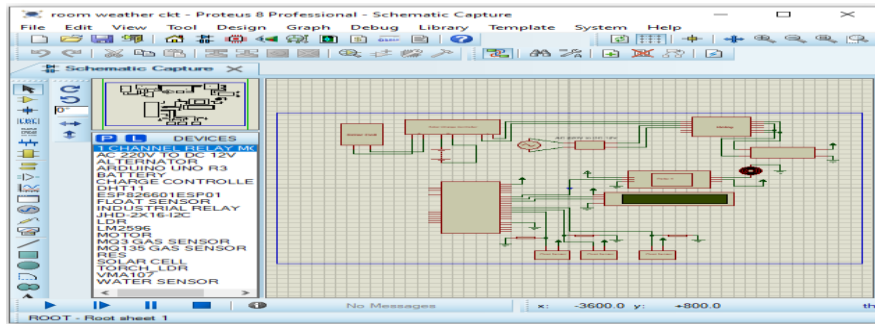

Fig-3.6: User Interface of Proteus 8.9

3.9 Project Flow Chart

In any programming related project there is a part named "flowchart" is must. As per rules we made our project flowchart then wrote our proposed project program. There are several parts of our project thus many flowcharts we made.
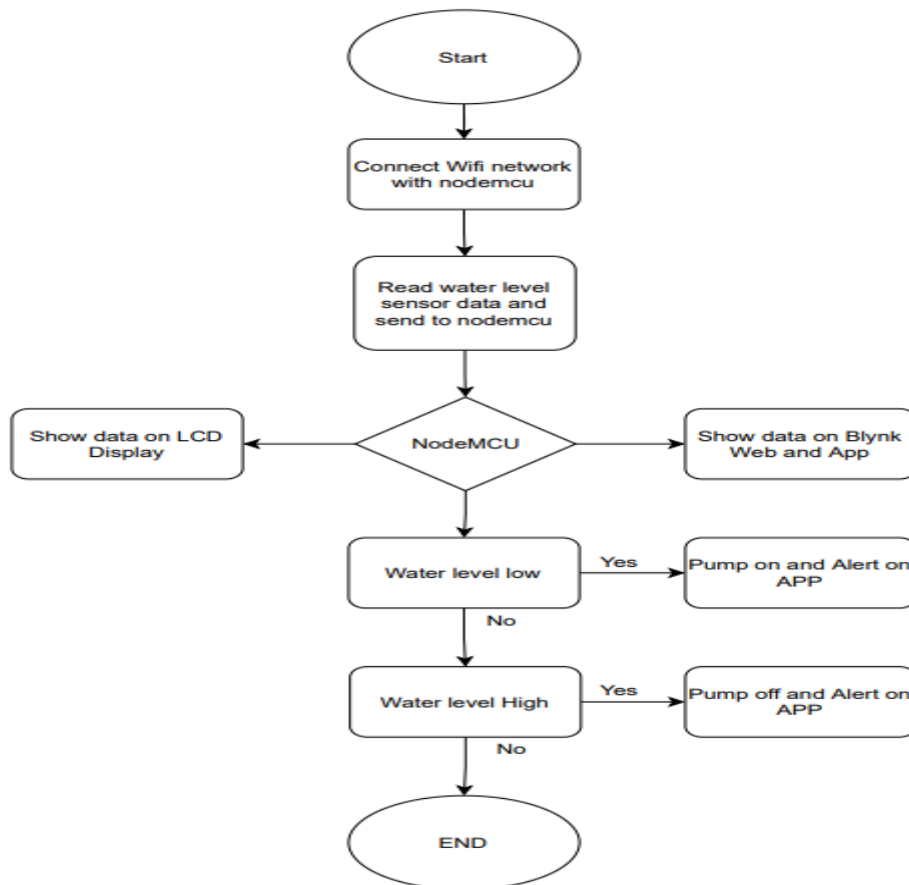

Fig-3.7: Project Flow Chart

CHAPTER 4

PERFORMANCE STUDY

4.1 Introduction

Solar panel efficiency is a measure of the amount of sunlight (irradiation) that falls on the surface of a solar panel and is converted into electricity. Due to the many advances in photovoltaic technology over recent years, the average panel conversion efficiency has increased from 15% to well over 20%. This large jump in efficiency resulted in the power rating of a standard size panel increasing from 250W up to 400W.[14]

Solar panel efficiency is determined by two main factors; the photovoltaic (PV) cell efficiency, based on the cell design and silicon type, and the total panel efficiency, based on the cell layout, configuration and panel size. Increasing the panel size can also increase efficiency due to creating a larger surface area to capture sunlight, with the most powerful solar panels now achieving up to 700W power ratings.

4.2 Efficient Solar Panels

The last two years have seen a surge in manufacturers releasing more efficient solar panels based on high-performance N-type heterojunction (HJT) and IBC cells. For the first time, the efficiency of the top 10 panels is now at or above 22%. SunPower Maxeon panels still lead the pack, but only just as the new Canadian Solar, Panasonic Ever Volt H, and REC Alpha Pure panels featuring N-type HJT cells are close behind. High-performance panels from SPIC and Bolinas using IBC cells have also closed the gap, plus next-generation panels featuring multi-busbar (MBB) half-cut N-type TOPCon cells from Jinko Solar, and Phono Solar have helped increase panel efficiency up to 22%.

More efficient panels using N-type cells also benefit from a lower rate of light-induced degradation or LID, which is as low as 0.25% of power loss per year. When calculated over the 25-year life of the panel, many of these high-efficiency panels are guaranteed to still generate 90% or more of the original rated capacity, depending on the manufacturer's warranty details.

4.3 Performance Test

Field test procedure for the solar system

Equipment Required:

- Digital multimeter.
- Active polar panel.
- Inverters

Test Procedure:

1. Measure and record the battery voltage before connection to charging system. Voltage should be > 12 V.

2. Connect solar system as described under installation.

3. Record panel number, battery number, ASC number, GARS number.

4. Perform ASC field test outlined in previous section. Record voltage from

ASC field test.

5. Run system for two days. Check operation each day.

To measure the panels' performance, we used a third-party certified digital meter. Using this meter, we measured the output of each system. logging real-time energy production data every minute. We conducted this test for nearly a week.

For our solar panel's performance test, we compared the real performance of the solar panels that we use in our installations with another well-recognized brand. For this particular test, we measured the performance of the 10W (19.2% rated efficiency) against another premium 10w solar panel (19% rated efficiency). We set up the solar panels next to each other on a south-facing roof.
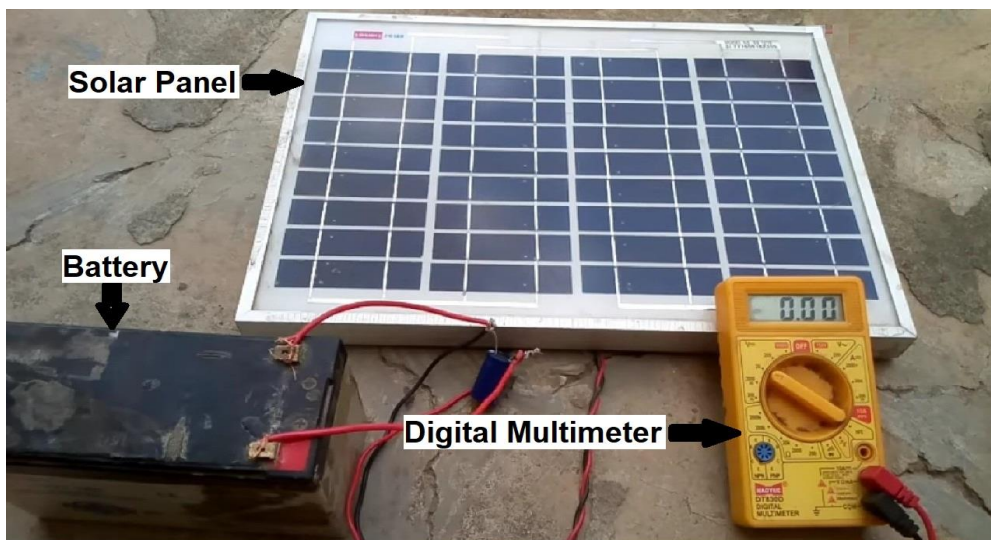

Fig-4.1: Solar Panels Performance Test

The everyday routine begins with water. This is one of the basic survival needs. People depend on the upper reservoir for everyday use. The upper tank is made of an opaque or cement (concrete) material to prevent algae growth and is closed with a cap to protect from dust and mosquito infestation. So, the level of water in the tank is unknown. Oftentimes, we turn on the motor and forget to turn it off, because of this most of the water will be lost unknowingly. This leads to water scarcity.

Therefore, there is a need for a replacement that can start automatically, and shut off the motor when the water is filled to the desired level.

Automatic water level controllers are a product created to automatically control the motor, which helps to ensure that there is a constant reserve of water in the storage tank. These automatic water level controllers are used to automatically fill the overhead tank when it starts up or when it becomes empty and also monitor the water level in it.

Automatic water level controllers start the motor when the water level drops below a certain level and turn off the motor when the water rises above a fixed level. The motor will also shut off when the sump water runs out before it fills the upper tank, or if the pump is dry and also maintains voltage fluctuations. These are the latest products based on advanced digital technology. This system is Versatile. There are also custom variations such as controlling multiple pumps or multiple tanks. The carbon water level sensor provides contact water level measurement.
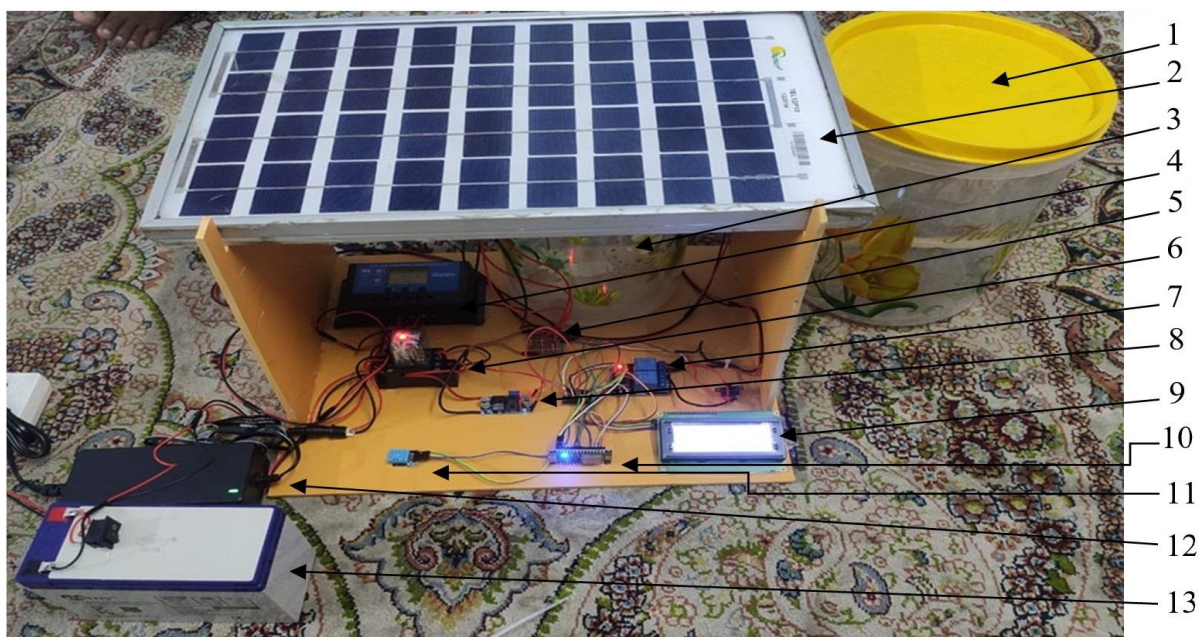

Fig-4.2: Project Picture

1. Reserve Tank.   9. LCD Display.
2. Solar Panel.   10. Node MCU.
3. Water Tank.   11. Adapter.
4. Charge Controller. 12. Battery.
5. Resistor.
6. Relay.
7. Relay Module.
8. Buck Module.

The device float sensor to monitor the water level by sending and receiving electric waves, and the time taken is converted to distance by the Node MCU microcontroller which gives corresponding digital outputs to either turn ON the water pump (when the water level in the tank is at a chosen minimum level of 1L) or turn OFF the water pump (when the water exceeds the preset maximum level of 3L). The digital output from the microcontroller is interfaced with an android mobile application. A software designed so that we can monitor from any where. Besides, we will be able to monitor display and internet. We have worked with solar power to keep the power supply uninterrupted. The project will continue through automatic solar system along with load shedding.

Fig-4.3: LCD Display Monitoring System

Special attraction in our project is monitoring and controlling system through internet.In this system we can monitor motor running time, water level monitoring and water level alert system through internet.
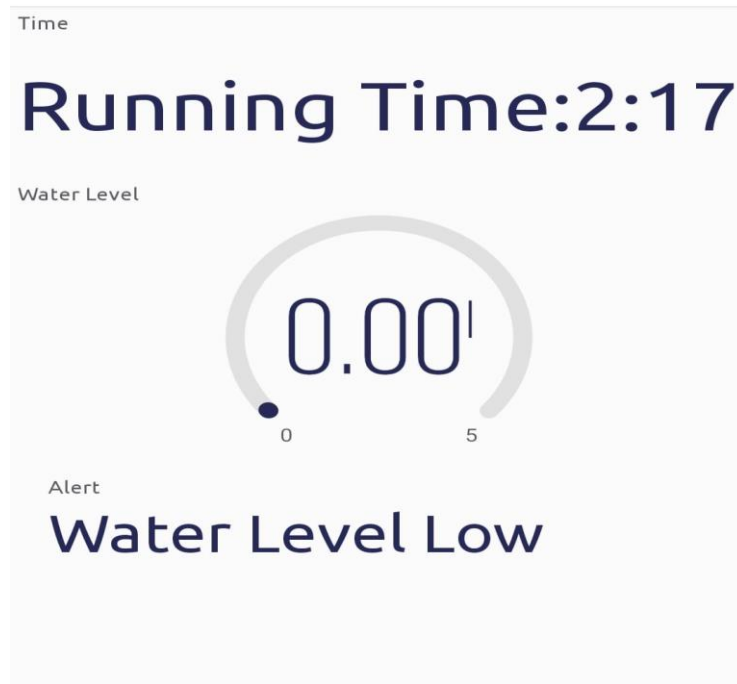
Fig-4.4: Apps Monitoring System

This work presents the design and implementation of an android mobile application-based wireless automatic water level controller that efficiently controls the level of water in storage tank. Based on the results obtained from the tests carried out, it is obvious that this system is more flexible than the existing wireless water level monitoring and control systems as it creates an interactive medium between the end user and the machine by means of the Water HMI mobile application, thus having the flexibility of being controlled remotely by the user. The system when commercialized could be utilized in various applications that require liquid level sensing and control.

Sample calculation for discharge

Given that,

$$D = 4.7\text{mm}$$
$$= 0.0047\text{m}$$
$$= 4.70 \times 10^{-3}\text{m}$$
$$A = \frac{\pi}{4} \times d^2$$
$$= \frac{\pi}{4} \times (0.0047)^2$$
$$= 17.34 \times 10^{-3} m^2$$
$$V = 1.597 \, m/s$$

Discharge of water flow, Q = ?

We know,

$$Q = AV$$

$$= 17.34 \times 10^{-6} \times 1.597$$

$$= 2.76 \times 10^{-5} \, m^3/s$$

$$= 2.76 \times 10^{-5} \times 1000$$

$$= 0.0276 \, L/s$$

$$= 0.0276 \times 3600$$

$$= 99.36 \, L/s \quad \text{Ans.}$$

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

The conclusion of our project is that many people waste water in this day. In order to save or prevent this issue we have created our project utilizing Node MCU. The goal of this article was to construct a basic automatic water level monitor and controller that was low-cost and easy to use. This can be used to monitor the levels of various liquids and oils in corporations and chemical labs, as well as water tanks. When it comes to our project's most significant domain, the motor is the key component that will turn on and off our water flow or water stock. As a result, the "Autocratic Water Level Indicator with Mobile Apps" project may surely be beneficial on a broad scale basis due to the low manpower requirements and the ease of installation, making it more accessible to everyone.

5.2 Recommendations

We have successfully completed our project with available sources. But the results and changes do not depend on expectations. This can be further improved by incorporating the following changes to get better results. The process that we used in the Scotch yoke mechanism does not work efficiently. This skill can be enhanced by using some other mechanisms.

- An SMS can be sent to authority notifying them with the temperature/humidity/LPG gas leakage parameters.
- This will allow the use of advanced sensors.

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[14]   Clean Energy Reviews, Most Efficient Solar Panels.
        https://www.cleanenergyreviews.info/blog/most-efficient-solar-panels

Appendix:

Program for Node MCU:

```
#define BLYNK_PRINT Serial

/* Fill-in your Template ID (only if using Blynk.Cloud) */
#define BLYNK_TEMPLATE_ID "TMPLGE8va6e8"
#define BLYNK_DEVICE_NAME "Water tank"
// #define BLYNK_AUTH_TOKEN "gnXeWcMVaCKggoj2LSHqNNOppUhY1sxI"



#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
// #include "DHT.h"
#include <LiquidCrystal_I2C.h>



LiquidCrystal_I2C lcd(0x27, 20, 4);



// #define DHTPIN D4      // what digital pin we're connected to
// #define DHTTYPE DHT11  // DHT 11
// DHT dht(DHTPIN, DHTTYPE);

// You should get Auth Token in the Blynk App.
// Go to the Project Settings (nut icon).
char auth[] = "gnXeWcMVaCKggoj2LSHqNNOppUhY1sxI";

// Your WiFi credentials.
```

```
// Set password to "" for open networks.
char ssid[] = "student";
char pass[] = "iotstudent";

int wllo = D5;
int wllodata;

int wlmid = D6;
int wlmiddata;

int wlmax = D7;
int wlmaxdata;

int load1;
int relay = D0;

long day = 86400000;  // 86400000 milliseconds in a day
long hour = 3600000;  // 3600000 milliseconds in an hour
long minute = 60000;  // 60000 milliseconds in a minute
long second = 1000;   // 1000 milliseconds in a second

long timeNow;
unsigned long startMillis;
unsigned long elapsedMillis;

int data;
int days;
int hours;
int minutes;
int seconds;

int flag;

String iotdata;
```

```
void setup() {
 // Debug console
 Serial.begin(9600);


  pinMode(wllo, INPUT);
  pinMode(wlmid, INPUT);
  pinMode(wlmax, INPUT);
  pinMode(relay, OUTPUT);

  digitalWrite(relay, HIGH);

 lcd.init();
 lcd.backlight();

 Blynk.begin();

}



void loop() {

 wllodata = digitalRead(wllo);
 wlmiddata = digitalRead(wlmid);
 wlmaxdata = digitalRead(wlmax);




 Serial.print("wllo:");
 Serial.print(wllodata);
 Serial.print("   wlmid:");
```

```
Serial.print(wlmiddata);
Serial.print("  wlmax:");
Serial.println(wlmaxdata);


delay(1000);
lcd.clear();

lcd.setCursor(0, 0);
lcd.print("Running Time:");
lcd.print(minutes);
lcd.print(":");
lcd.print(seconds);
iotdata = "Running Time:" + String(minutes) + ":" + String(seconds);
Serial.println(iotdata);
Blynk.virtualWrite(V0, iotdata);



if (data == 1 && wlmaxdata == 0) {
  timeNow = millis();
  elapsedMillis = (timeNow - startMillis);
  days = elapsedMillis / day;  //number of days
  hours = (elapsedMillis % day) / hour;
  minutes = ((elapsedMillis % day) % hour) / minute;  //and so on...
  seconds = (((elapsedMillis % day) % hour) % minute) / second;
}



if (wllodata == 0 && wlmiddata == 0 && wlmaxdata == 0) {
  Blynk.virtualWrite(V2, 0);
  Blynk.virtualWrite(V4, "Water Level Low");
  // myTime = millis();
  lcd.setCursor(0, 1);
```

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```
  lcd.print("Water Level:");
  lcd.print("0 L");
  digitalWrite(relay, LOW);
  lcd.setCursor(0, 2);
  lcd.print("Water Level Low");
  flag = 1;
}

if (wllodata == 1 && wlmiddata == 0 && wlmaxdata == 0) {
  Blynk.virtualWrite(V2, 1);
  Blynk.virtualWrite(V4, "Water Level Medium");
  lcd.setCursor(0, 1);
  lcd.print("Water Level:");
  lcd.print("1 L");
  lcd.setCursor(0, 2);
  lcd.print("Water Level Medium");
}

if (wllodata == 1 && wlmiddata == 1 && wlmaxdata == 0) {
  Blynk.virtualWrite(V2, 2);
  Blynk.virtualWrite(V4, "Water Level Medium");
  lcd.setCursor(0, 1);
  lcd.print("Water Level:");
  lcd.print("2 L");
  lcd.setCursor(0, 2);
  lcd.print("Water Level Medium");
}

if (wllodata == 1 && wlmiddata == 1 && wlmaxdata == 1) {
  Blynk.virtualWrite(V2, 3);
  Blynk.virtualWrite(V4, "Water level high");
  lcd.setCursor(0, 1);
  lcd.print("Water Level:");
  lcd.print("3 L");
```

```
    digitalWrite(relay, HIGH);
    lcd.setCursor(0, 2);
    lcd.print("Water Level High");
    data = 0;
    flag = 0;
  }
}
```