# AUTOMATED WATERING THE PLANTS USING ARDUINO

Submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering

By

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**Accredited with Grade "A" by NAAC**

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## DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

## BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of**P.VINAY KUMAR REDDY(38130164) & P. HARI PRANAY (38130160)** who have done the Project work as a team and carried out the project entitled "**AUTOMATED WATERING THE PLANTS USING AURDINO**"under mysupervision from December 2021 to May 2022.

**Internal Guide**

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**Submitted for Viva voce Examination held on** _____

**Internal Examiner** **External Examiner**

# DECLARATION

We, **P. Vinay Kumar Reddy**(Reg no: 38130164) &**P.Hari Pranay Yadav**(Reg no: 38130160) hereby declare that the project report entitled**AUTOMATED WATERING THE PLANTS USING AURDINO** done by me under the guidance of **Dr.R.Pandian, M.E., Ph.D.,** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering Degree in electronic communication and Engineering.

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# ABSTRACT

Internet of Things (IoT) technology has brought revolution to each and every field of common man's life by making everything smart and intelligent. IoT refers to a network of things which make a self-configuring network. The development of Intelligent Smart Farming IoT based devices is day by day turning the face of agriculture production by not only enhancing it but also making it cost-effective and reducing wastage. The aim / objective of this report is to propose IoT based Smart Farming System assisting farmers in getting Live Data (Temperature, Soil Moisture) for efficient environment monitoring which will enable them to increase their overall yield and quality of products. The IoT based Smart Farming System being proposed via this report is integrated with Arduino Technology mixed with different Sensors and a Wifi module producing live data feed that can be obtained online from Thingsspeak.com. The product being proposed is tested on Live Agriculture Fields giving high accuracy over 98% in data feeds.

TheobjectivesofthisreportistoproposedIoTbasedSmartFarming System which will enable farmers to have live data of soil moisture environment temperature at very low cost so that live monitoring can be done. The structure of the report is as follows will cover over of overview of IoT Technology and agriculture-concepts and definition, IOT enabling technologies, IOT application in agriculture, benefits of IOT in agriculture and IOT and agriculture current scenario and future forecasts will cover definition of IOT based smart farming system , the components and modules used in it and working principal of it. Will cover algorithm and flowchart of the overall process carried out in the system and its final graphical output consist of conclusion, future scope and references.

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# LIST OF ABBREVATIONS

**ABBREVIATION EXPANSION**

IOT - Internet and Things

WSN - Wireless Sensor Network

TDMA - Time Division Multiple Access

WSU - Wireless Sensor Units

PTEEN - Periodic Threshold old sensitive Energy-Efficient sensor Network

GPS- Global Positioning System

USB - Universal Serial Bus

DC -Direct current

PWM - Pulse-width modulation

IDE - integrated development environment

FDR - Frequency Domain Reflectometry

AC - Alternative current

TDT - Time Domain Transmission

TDR - Time Domain Reflectometry

PCB - printed circuit

# List of Tables

# CHAPTER-1

# INTRODUCTION

## 1.1 INTRODUCTION

Internet of things IOT consists of two words Internet and Things .The term things in IOT refers to various IOT devices having unique identities and have capabilities to perform remote sensing , actuating and live monitoring of certain sort of data.IOT devices are also enable to have live exchange of data with other connected devices and application either directly or indirectly , or collected data from other devices and process the data and send the data to various servers. The other term internet is define as Global communication Network connecting Trillions of computers across the planets enabling sharing of information .Thus the IOT can be define as:"A dynamic Global Network Infrusture with self configuring capabilities based on standard and inter operable communication to protocol where physical and virtual things have identities, physical attributes ,and virtual personalities and use intelligent interfaces and are seamlessly integrated into the information network ,often communicate data associated with user and their environment." An ideal IOT device consists of various interfaces for making connectivity to other devices which can either be wired or wireless. Any IOT based device consists of following components: • I/O interface for Sensors. • Interface for connecting to Internet. • Interface for Memory and Storage. •InterfaceforAudio/Vide

## 1.2 IOT AND ENABLING TECHNOLOGIES

Internet of Things has a strong backbone of various enabling technologies- Wireless Sensor Networks, Cloud Computing, Big Data, Embedded Systems, Security Protocols and Architectures, Protocols enabling communication, web services, Internet and Search Engines. Wireless Sensor Network (WSN): It consists of various sensors/nodes

which are integrated together to monitor various sorts of data. Cloud Computing: Cloud Computing also known as on-demand computing is a type of Internet based computing which provides shared processing resources and data to computers and other devices on demand. It can be in various forms like IAAS, PAAS, SAAS, DAAS etc. Big Data Analytics: Big data analytics is the process of examining large data sets containing various forms of data types i.e. Big Data to uncover hidden patterns, unknown correlations, market trends, customer preferences and other useful business information. Communication Protocols: They form the backbone of IOT systems to enable connectivity and coupling to applications and these protocols facilitate exchange of data over the network as these protocols enable data exchange formats, data encoding and addressing. Embedded Systems: It is a sort of computer system which consists of both hardware and software to perform specific tasks. It includes microprocessor/microcontroller, RAM/ROM, networking components, I/O units and storage devices

## 1.3 OVERVIEW OF THE PROJECT

DEFINITION IOT BASED SMART FARMING SYSTEM IOT based SMART FARMING SYSTEM is regarded as IOT gadget focusing on Live Monitoring of Environmental data in terms of Temperature, Moisture and other types depending on the sensors integrated with it. The system provides the concept of Plug & Sensell in which farmers can directly implement smart farming by as such putting the System on the field and getting Live Data feeds on various devices like Smart Phones, Tablets etc. and the data generated via sensors can be easily shared and viewed by agriculture consultants anywhere remotely via Cloud Computing technology integration. The system also enables analysis of various sorts of data via Big Data Analytics from time to time.

# CHAPTER-2

# LITERATURE SURVEY

## 2.1 Overview

Irrigation is most important for high yield of the farm. Today, by using WSN technology it is possible to monitor and control the environmental conditions as soil moisture, temperature, wind speed, wind pressure, salinity, turbidity, humidity etc for irrigation. Automated irrigation performed by using solenoid valve and pump. Solenoid valve is an electromechanical valve used with liquid controller to control an electronic current through solenoid which is a coil of wire that uses to control the state of the valve according to need of irrigation.

## 2.2 SURVEY OF PREVIOUS WORKS

M.Nesa Sudha et al., 2011 proposed a TDMA based MAC protocol used for collect data such as soil moisture and temperature for optimum irrigation to save energy. MAC protocol plays an important role to reduce energy consumption. Two methods used for energy efficiency as Direct Communication method and aggregation method. Direct Communication method provides collision free transmission of data, because all the sensor nodes send data directly to the base station without the need of header node. This method is better where the base station is near but it is not optimum where the base station is far because sensor nodes consume more energy during transmission of data and if there is much data to the sensor node, sensor nodes quickly damaged. The data aggregation method is better to use rather than direct communication method. The sensor node senses the data and send to the head node. The head node collects data from the entire sensor node, performs aggregation using various aggregation techniques, and then sends data to the base station. Thus by using aggregation method overall energy consumption reduce of the network. The simulation result show that aggregation method provide better performance rather than direct communication method. It provides 10% increase in residual energy and 13% increase in throughput. Sensor nodes consume more energy while transmitting data.

AnujNayak et al., 2014 describe that sensor nodes batteries are charged by using harnessing wind energy. A routing algorithm named DEHAR is proposed to extend overall batteries power. The proposed method is efficient where the amount of sensor nodes very low because of latency experienced due to synchronous sleep scheduling. A small band belt used to harness wind energy to sensor nodes. Wind belt is aero elastic flutter, which is capable for harnessing wind energy. Harnessing wind energy is a renewable energy source. However, the main problem using harnessing wind energy is the unreliability as the power of the wind is not permanent.

Man Zhang et al., 2012 analysis the temporal and spatial variability of soil moisture for the realization of variable irrigation and for improve yield in the farm. Temporal variability adopts the changes of soil moisture at the place where the sensor nodes installed and analyze soil moisture variation at different times according to season. Spatial variability analyses calculate all parameter of soil moisture as average, maximum, minimum in whole area. The temporal variability curve has drawn according to measure data. It showed that the corn was in severe water stress state during the completely monitoring period.

Joaquin Gutierrez et al., 2013 proposed an irrigation system that uses photovoltaic solar panel to power system because electric power supply would be expensive. For water saving purpose, an algorithm developed with threshold value of temperature and soil moisture programmed into a micro controller gateway. The system has a full duplex communication links based on internet cellular interface using GPRS based on mobile data for graphically display and stored in a database server.The automation irrigation system consists of two components were WSU and WIU. Wireless Sensor Units (WSU) components were used for minimize power consumption because microcontroller is well suited by its lower power current in sleep mode. Wireless Information Unit (WIU) transmits soil moisture and temperature data to a web server using GPRS module. The WIU identify recorded and analyzed received temperature and soil moisture data collected by WSU. WIU functionality is bases on microcontroller that programmed to perform different task as to download the date and time information from web server and compare the temperature and soil moisture value with maximum soil moisture and minimum temperature value so that irrigated pumps activated.

SherineM.AbdEl-kader et al., 2013 proposed APTEEN (Periodic Threshold oldsensitive Energy-Efficient sensor Network) protocol. APTEEN is a Hierarchical based routing protocol in which nodes have grouped into clusters. Each cluster has a head node and head node is responsible for broadcast data to the base station. APTEEN broadcast parameters attribute, which is a set of physical parameters, in which the user is interested to obtain info, Thresholds value as Hard Threshold and Soft Threshold, Schedule as TDMA schedule uses to assign slots to save energy, which provide collision free transmission. It controls the energy consumption by changing threshold values and count time. The performance of proposed protocol is better than LEACH on average 79% and by LEACH-C on average 112%.

B. Balaji Bhan et al., 2014 proposed a system to develop WSN based soil moisture controllers that determine the water requirement by comparing soil moisture with predefined threshold value. An intelligent remote system consists of wireless sensor nodes and computer system in which data is transmitted to a server system from where the data accessed by individuals for decision making for automated control of irrigation for the yield productivity. Field validation tests routinely performed on different soils to measure the soil moisture, water amount in soil for efficient irrigation system. If the stored data does not match with the soilmeasured data, an interrupt sent to the pressure unit and stop irrigation automatically.

SbrineKhriji et al., 2014 describe different type of sensor nodes for real monitoring and control of irrigation system. Each node consists of B mote and actuator. TelosB mote is an ultralow power wireless module for monitoring applications. Soil nodes used to measure the soil moisture weather nodes used to measure environmental parameter and actuator used for controlling the opening of valves for irrigation. The system has cost efficient and reduce the power consumption The experimental result shows that the plants are well irrigate and if there is any change in threshold value the system alert to farmer about the problem to take

the appropriate decision.

Yunseop Kim et al., 2008 represents real time monitoring and control of variable rate irrigation controller. The sensor nodes measure environmental parameter and transmit data to base station where base station process data through a user-friendly decision making program and all data commands send to irrigation control station. The Irrigation control station sends machine location using GPS to the base station, send control signal back to irrigation control

Fiona Regan et al., 2009develop heterogeneous real time water monitoring network system to monitor water quality parameter such as pH, temperature, turbidity and conductivity. The implementation of intelligent sensors incorporating TEDS (Transducer Electronic Data Sheet) which is a machinereadable specification of the sensor characteristics, enable sensors to interfaced with the system in a plug and play fashion. PSOC system used to create generic sensor interface. The plug and play capabilities enabled by the developed WSN platform allow for integration of any commercially available water quality sensors. PSOC plug and play system capable of transmitted data to the sensor that processed data for transmission to the web.

Joaquin Gutierrez et al., 2015 represents that the sensors use Smartphone to capture and process images of soils. Images can be capture to estimate the water content of the soil. The router node is used to forward collected values to the gateway that provide automatically pump the water to the crop in a field. An Android app used for connectivity such as Wi-Fi. Android app wakes up the Smartphone by using given parameters. In-built camera takes an RGB picture of the soil through an anti-reflective glass window to take estimation of wet and dry area. The mobile app enables the Wi-Fi connection of Smartphone to transmit the estimation value to the gateway via a router node for control an irrigation water .

# CHAPTER-3

# Aim And Scope of the presentinvestigation

## 3.1 Aim of the project:

Since nowadays, in the age of advanced technology and electronics, the life style of the human should me smart, simpler, easier and much more convenient. So, therefore; there is a need for many automated systems in human's daily life routine to reduce their daily activities and jobs. Here an idea of one such system named as automatic plant watering system is very useful. As many people are facing a lot of problem watering the plants in the garden, especially when they away from the home. This model uses sensor technologies with microcontroller in order to make a smart switching device to help millions of people.

In its most basic form, system is programmed in such a way that soil moisture sensor which senses the moisture level from the plant at particular instance of time, if moisture level of the sensor is less than the specified value of threshold which is predefined according to the particular plant than the desired amount of water is supplied to plant till it's moisture level reaches to the predefined threshold value. System involves humidity and temperature sensor which keep tracks the current atmosphere of the system and has an influence when watering happens. Solenoid valve will control the water flow in the system, when Arduino reads value from moisture sensor it triggers the solenoid valve according to the desired condition.

### 3.2 Existing System

During day to day activities many people often forget to water their plants and thus it becomes challenging for them to keep their plants healthy and alive. Also it is a challenge for farmers to maintain their fields and manage watering of plants during shortage of water. Based on the above background, we thought that it is necessary to implement the automated system which will take care of plants. In the existing system we can't automatically water the plants and we need to be there at every situation in order to detect the moisture of soil which is burden to us and time taking process

## 3.3 PROPOSED SYSTEM

Automatic watering of plants is based on Internet Of Things(IOT).In this proposed system we use Arduino uno software and hardware, Soil moisture sensor, Rechargable Battery, Relay Module, Dc motor. The sensors automatically checks the soil moisture and based on some threshold value if soil is dry then it waters the plant and if soil is wet which is more than threshold value then is stops watering the plants.

# CHAPTER-4

# MATERIALS AND METHODS

## 4.1 ARDUINO UNO:-

Fig:4.1 :arduino uno

Arduino UNO is a microcontroller board it has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connec-tion, a power jack, an ICSP header, and a reset button. It con-tains everything needed to support the microcontroller; simp-ly connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started

### 4.1.1 ARDUINO

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can communicate with software running on

your computer (e.g. Flash, Processing, MaxMSP.) The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free.

There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handy board, and many others offer similar functionality. All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems:

- **Inexpensive** - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than $50
- **Cross-platform** - The Arduino software runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.
- **Simple, clear programming environment** - The Arduino programming environment is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with the look and feel of Arduino
- **Open source and extensible software**- The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.
- **Open source and extensible hardware** - The Arduino is based on Atmel's ATMEGA8 and ATMEGA168/ATMEGA2560 microcontrollers. The plans for the modules are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it.

Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money

### 4.1.2 OVERVIEW:-

The Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.
You can find here your board warranty informations.
Getting Started
You can find in the Getting Started section all the information you need to configure your board, use the Arduino Software (IDE), and start tinker with coding and electronics.
Need Help?

- On the Software on the Arduino Forum
- On Projects on the Arduino Forum
- On the Product itself through our Customer Support

Table no:4.1.2:ARDINO UNo

| | |
|---|---|
| Microcontroller | ATmega328P |
| Operating Voltage | 5V |
| Input Voltage (recommended) | 7-12V |
| Input Voltage (limit) | 6-20V |
| Digital I/O Pins | 14 (of which 6 provide PWM output) |
| PWM Digital I/O Pins | 6 |
| Analog Input Pins | 6 |
| DC Current per I/O Pin | 20 mA |
| DC Current for 3.3V Pin | 50 mA |
| Flash Memory | 32 KB (ATmega328P)<br>of which 0.5 KB used by bootloader |
| SRAM | 2 KB (ATmega328P) |
| EEPROM | 1 KB (ATmega328P) |
| Clock Speed | 16 MHz |
| Length | 68.6 mm |
| Width | 53.4 mm |
| Weight | 25 g |

## 4.1.3 BASIC ARDUINO CODE DEFINITIONS:

**setup( ):** A function present in every Arduino sketch. Run once before the loop( ) function. Often used to set pinmode to input or output. The setup( ) function looks like:

```
void setup( ){
    //code goes here
}
```

**loop( ):** A function present in every single Arduino sketch. This code happens over and over again. The loop( ) is where (almost) everything happens. The one exception to this is setup( ) and variable declaration. ModKit uses another type of loop called “forever( )” which executes over Serial. The loop( ) function looks like:

```
    void loop( ) {
//code goes here
        }
```

**input:** A pin mode that intakes information.

**output:** A pin mode that sends information.

**HIGH:** Electrical signal present (5V for Uno). Also ON or True in boolean logic.

**LOW:** No electrical signal present (0V). Also OFF or False in boolean logic.

**digitalRead:** Get a HIGH or LOW reading from a pin already declared as an input.

**digitalWrite:** Assign a HIGH or LOW value to a pin already declared as an output.

**analogRead:** Get a value between or including 0 (LOW) and 1023 (HIGH). This allows you to get readings from analog sensors or interfaces that have more than two states.

**analogWrite:** Assign a value between or including 0 (LOW) and 255 (HIGH). This allows you to set output to a PWM value instead of just HIGH or LOW.

**PWM:** Stands for Pulse-Width Modulation, a method of emulating an analog signal through a digital pin. A value between or including 0 and 255. Used with analogWrite.

## 4.1.4 ARDUINO UNO PIN TYPE DEFINITIONS: (TAKE A LOOK AT YOUR ARDUINO BOARD)

| Reset | 3v3 | 5v | Gnd | Vin | Analog In | RX/TX | Digital | PWM(~) | AREF |
|---|---|---|---|---|---|---|---|---|---|
| Resets Arduino sketch on board | 3.3 volts in and out | 5 volts in and out | Ground | Voltage in for sources over 7V (9V - 12V) | Analog inputs, can also be used as Digital | Serial comm. Receive and Transmit | Input or output, HIGH or LOW | Digital pins with output option of PWM | External reference voltage used for analog |

*Table no.-4.1.4 uno pin Type*

## 4.1.5 BASIC ARDUINO PIN REFERENCE SHEET

These boards below use the same micro-controller, just in a different package. The Lilypad is designed for use with conductive thread instead of wire and the Arduino Mini issimply a smaller package without the USB, Barrel Jack and Power Outs. Other boards in the

**Together a voltage divider:-**

It's really pretty easy. Here is a schematic and explanation detailing how

## 4.2SOIL MOISTURE SENSOR

Fig :4.2soil moisture sensor

Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighing of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content.

The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, or electric conductivity. Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture. Portable probe instruments can be used by farmers or gardeners.

Soil moisture sensors typically refer to sensors that estimate volumetric water content. Another class of sensors measure another property of moisture in soils called water potential; these sensors are usually referred to as soil water potential sensors and include tensiometers and gypsum blocks.

A resistive soil moisture sensor works by using the relationship between electrical resistance and water content to gauge the moisture levels of the soil. You'll observe these sensors to possess two exposed probes that are inserted directly into the soil sample.

A soil moisture sensor is a device that measures current soil moisture. Sensors integrated

into the irrigation system aid in scheduling water supply and distribution much more efficiently. Such gauges help to reduce or enhance irrigation for optimum plant growth.
Tensiometers are soil moisture sensors that measure this tension between soil particles and water molecules. In order for plants to access this water they must overcome the tension to draw water molecules away from the soil particles and into their roots.

## 4.2.1AGRICULTURE

Measuring soil moisture is important for agricultural applications to help farmers manage their irrigation systems more efficiently. Knowing the exact soil moisture conditions on their fields, not only are farmers able to generally use less water to grow a crop, they are also able to increase yields and the quality of the crop by improved management of soil moisture during critical plant growth stages.

In urban and suburban areas, landscapes and residential lawns are using soil moisture sensors to interface with an irrigation controller. Connecting a soil moisture sensor to a simple irrigation clock will convert it into a "smart" irrigation controller that prevents irrigation cycles when the soil is already wet, e.g. following a recent rainfall event.

Golf courses are using soil moisture sensors to increase the efficiency of their irrigation systems to prevent over-watering and leaching of fertilizers and other chemicals into the ground.

## 4.2.2 RESEARCH

Soil moisture sensors are used in numerous research applications, e.g. in agricultural science and horticulture including irrigation planning, climate research, or environmental science including solute transport studies and as auxiliary sensors for soil respiration measurements

Simple sensors for gardeners.Relatively cheap and simple devices that do not require a power source are available for checking whether plants have sufficient moisture to thrive. After inserting a probe into the soil for approximately 60 seconds, a meter indicates if the soil is too dry, moist or wet for plants.

## 4.2.3TECHNOLOGIES

Frequency Domain Reflectometry (FDR): The dielectric constant of a certain volume element around the sensor is obtained by measuring the operating frequency of an oscillating circuit.

Time Domain Transmission (TDT) and Time Domain Reflectometry (TDR): The dielectric constant of a certain volume element around the sensor is obtained by measuring the speed of propagation along a buried transmission line; (see also: TDR moisture sensor)

Neutron moisture gauges: The moderator properties of water for neutrons are utilized to estimate soil moisture content between a source and detector probe.

Soil resistivity: Measuring how strongly the soil resists the flow of electricity between two electrodes can be used to determine the soil moisture content.

Galvanic cell: The amount of water present can be determined based on the voltage the soil produces because water acts as an electrolyte and produces electricity. The technology behind this concept is the galvanic cell

### Soil moisture sensor work:-

A small charge is placed on the electrodes and electrical resistance through the sensor is measured. As water is used by plants or as the soil moisture decreases, water is drawn from the sensor and resistance increases. Conversely, as soil moisture increases, resistance decreases.

### Used in soil moisture:-

meter soil moisture sensors use high-frequency capacitance technology to measure the volumetric water content of the soil, meaning they measure the quantity of water on a volume basis compared to the total volume of the soil.

## Testing  soil for moisture:-

Insert a trowel into the soil, then tilt the trowel to check the moisture of garden plants. You can also insert a wooden dowel into the soil to determine the depth of soil moisture. If the dowel comes out clean, the soil is dry. Damp soil will cling to the dowel.

## 4.3 DCMOTOR

Fig:4.3 DC motor

DC motors are configured in many types and sizes, including brush less, servo, and gear motor types. A motor consists of a rotor and a permanent magnetic field stator. The magnetic field is maintained using either permanent magnets or electromagnetic windings. DC motors are most commonly used in variable speed and torque. Motion and controls cover a wide range of components that in some way are used to generate and/or control motion. Areas within this category include bearings and bushings, clutches and brakes, controls and drives, drive components, encoders and resolves, Integrated motion control, limit switches, linear actuators, linear and rotary motion components, linear position sensing, motors (both AC and DC motors), orientation position sensing, pneumatics and pneumatic components, positioning stages, slides and guides, power transmission (mechanical), seals, slip rings, solenoids, springs.

Motors are the devices that provide the actual speed and torque in a drive system. This family includes AC motor types (single and multiphase motors, universal, servo motors, induction, synchronous, and gear motor) and DC motors (brush less, servo

motor, and gear motor) as well as linear, stepper and air motors, and motor contactors and starters.In any electric motor, operation is based on simple electromagnetism. A current-carryingconductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. As you are well aware of from playing with magnets as a kid, opposite (North and South) polarities attract, while like polarities (North and North, South and South) repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.

Let's start by looking at a simple 2-pole DC electric motor (here red represents a magnet or winding with a "North" polarization, while green represents a magnet or winding with a "South" polarization).

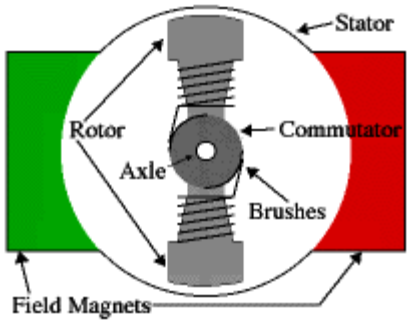


Fig :4.3.a dc motor performance

Every DC motor has six basic parts -- axle, rotor (a.k.a., armature), stator, commutator, field magnet(s), and brushes. In most common DC motors (and all that Beamers will see), the external magnetic field is produced by high-strength permanent magnets1. The stator is the stationary part of the motor -- this includes the motor casing, as well as two or more permanent magnet pole pieces. The rotor (together with the axle and attached commutator) rotates with respect to the stator. The rotor consists of windings (generally on a core), the windings being electrically connected to the commutator. The above diagram shows a common motor layout -- with the rotor inside the stator (field) magnet

A DC motor is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor.

DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in manyapplications.

### 4.3.1DC MOTOR USAGES :-

At home, small DC motors are used in tools, toys and various household appliances. In retail, the applications of DC motors include conveyors and turntables, while in an industrial setting, large DC motor uses also include braking and reversing applications.

DC motors operate on Faraday's principle of electromagnetism which states that a current-carrying conductor experiences a force when placed in a magnetic field.

### 4.3.2TYPES OF DCMOTOR:-

There are 4 main types of DC motors:

- Permanent Magnet DC Motors. The permanent magnet motor uses a permanent magnet to create field flux. ...
- Series DC Motors. In a series DC motor, the field is wound with a few turns of a large wire carrying the full armature current. ...

- Shunt DC Motors. ...
- Compound DC Motors.

## 4.4 RELAY MODULE

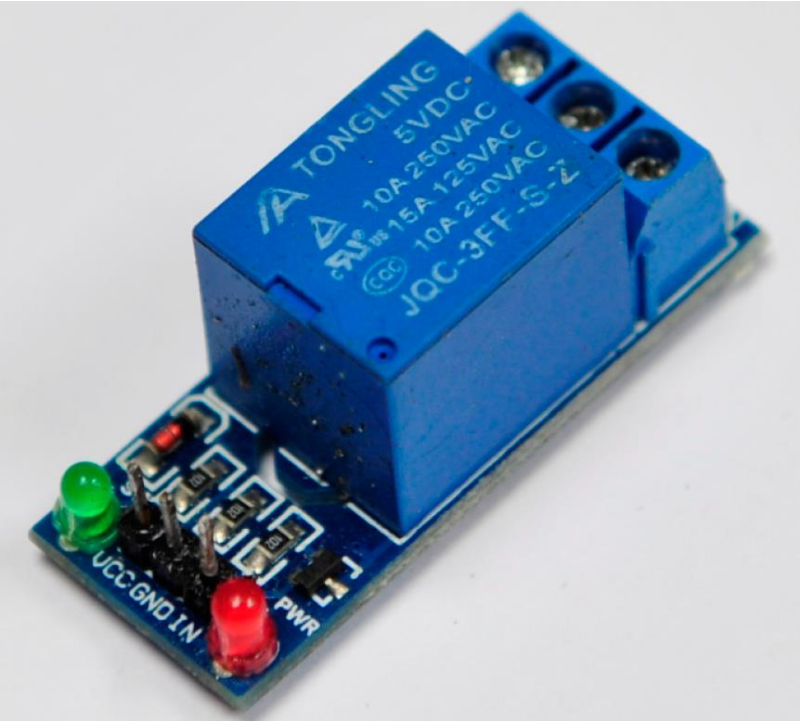


Fig : 4.4 RELAY MODULE

A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof.

Relays are used where it is necessary to control a circuit by an independent low-power signal, or where several circuits must be controlled by one signal. Relays were first used in long-distance telegraph circuits as signal repeaters: they refresh the signal coming in from one circuit by transmitting it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

The traditional form of a relay uses an electromagnet to close or open the contacts, but other operating principles have been invented, such as in solid-state relays which use semiconductor properties for control without relying on moving parts. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to

protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called *protective relays*

Latching relays require only a single pulse of control power to operate the switch persistently. Another pulse applied to a second set of control terminals, or a pulse with opposite polarity, resets the switch, while repeated pulses of the same kind have no effects. Magnetic latching relays are useful in applications when interrupted power should not affect the circuits that the relay is controlling.

A simple electromagnetic relay consists of a coil of wire wrapped around a soft iron core (a solenoid), an iron yoke which provides a low reluctance path for magnetic flux, a movable iron armature, and one or more sets of contacts (there are two contacts in the relay pictured). The armature is hinged to the yoke and mechanically linked to one or more sets of moving contacts. The armature is held in place by a spring so that when the relay is de-energized there is an air gap in the magnetic circuit. In this condition, one of the two sets of contacts in the relay pictured is closed, and the other set is open. Other relays may have more or fewer sets of contacts depending on their function. The relay in the picture also has a wire connecting the armature to the yoke. This ensures continuity of the circuit between the moving contacts on the armature, and the circuit track on the printed circuit board (PCB) via the yoke, which is soldered to the PCB.

When an electric current is passed through the coil it generates a magnetic field that activates the armature, and the consequent movement of the movable contact(s) either makes or breaks (depending upon construction) a connection with a fixed contact. If the set of contacts was closed when the relay was de-energized, then the movement opens the contacts and breaks the connection, and vice versa if the contacts were open. When the current to the coil is switched off, the armature is returned by a force, approximately half as strong as the magnetic force, to its relaxed position. Usually this force is provided by a spring, but gravity is also used commonly in industrial motor starters. Most relays are manufactured to operate quickly. In a low-voltage application this reduces noise; in a high voltage or current application it reduces arcing.

When the coil is energized with direct current, a diode or resistor is often placed across the coil to dissipate the energy from the collapsing magnetic field at deactivation, which would

otherwise generate a voltage spike dangerous to semiconductor circuit components. Such diodes were not widely used before the application of transistors as relay drivers, but soon became ubiquitous as early germanium transistors were easily destroyed by this surge. Some automotive relays include a diode inside the relay case. Resistors, while more durable than diodes, are less efficient at eliminating voltage spikes generated by relaysand therefore not as commonly used.

If the relay is driving a large, or especially a reactive load, there may be a similar problem of surge currents around the relay output contacts. In this case a snubber circuit (a capacitor and resistor in series) across the contacts may absorb the surge. Suitably rated capacitors and the associated resistor are sold as a single packaged component for this commonplace use.

If the coil is designed to be energized with alternating current (AC), some method is used to split the flux into two out-of-phase components which add together, increasing the minimum pull on the armature during the AC cycle. Typically this is done with a small copper "shading ring" crimped around a portion of the core that creates the delayed, out-of-phase component which holds the contacts during the zero crossings of the control voltage.

Contact materials for relays vary by application. Materials with low contact resistance may be oxidized by the air, or may tend to "stick" instead of cleanly parting when opening. Contact material may be optimized for low electrical resistance, high strength to withstand repeated operations, or high capacity to withstand the heat of an arc. Where very low resistance is required, or low thermally-induced voltages are desired, gold-plated contacts may be used, along with palladium and other non-oxidizing, semi-precious metals. Silver or silver-plated contacts are used for signal switching. Mercury-wetted relays make and break circuits using a thin, self-renewing film of liquid mercury. For higher-power relays switching many amperes, such as motor circuit contactors, contacts are made with a mixtures of silver and cadmium oxide, providing low contact resistance and high resistance to the heat of arcing. Contacts used in circuits carrying scores or hundreds of amperes may include additional structures for heat dissipation and management of the arc produced when interrupting the circuit. Some relays have field-replaceable contacts, such as certain machine tool relays; these may be replaced when worn out, or changed between normally open and normally closed state, to allow for changes in the controlled circuit

### 4.4.1 Relay module:-

The relay module is an electrically operated switch that can be turned on or off deciding to let current flow through or not. They are designed to be controlled with low voltages like 3.3V like the ESP32, ESP8266, etc, or 5V like your Arduino.Converting a small electrical input into a high-current output is no easy feat, but this task is necessary to efficiently operate a wide range of standard appliances and vehicles. Many circuits achieve these conversions through the use of relays, which are indispensable in all kinds of electronic equipment.Relays are normally used in the control panels, manufacturing and building automation to control the power along with switching the smaller current values in a control circuit.

### 4.4.2 Advantages of relays

- Simple and effective operation. The operating principle of a relay is really simple. ...
- Circuit multiplication. Relays can switch many contacts at once. ...
- Galvanic isolation. ...
- Voltage conversion. ...
- Accessory options. ...
- AC or DC contact switching. ...
- Compact size and low cost. ...
- Terminal connection.

## 4.5 RECHARGEABLE BATTERY


Fig:4.5 rechargeable battery

A rechargeable battery, storage battery, or secondary cell (formally a type of energy accumulator), is a type of electrical battery which can be charged, discharged into a load, and recharged many times, as opposed to a disposable or primary battery, which is supplied fully charged and discarded after use. It is composed of one or more electrochemical cells. The term "accumulator" is used as it accumulates and stores energy through a reversible electrochemical reaction. Rechargeable batteries are produced in many different shapes and sizes, ranging from button cells to megawatt systems connected to stabilize an electrical distribution network. Several different combinations of electrode materials and electrolytes are used, including lead–acid, zinc–air, nickel–cadmium (NiCd), nickel–metal hydride (NiMH), lithium-ion (Li-ion), lithium iron phosphate (LiFePO4), and lithium-ion polymer (Li-ion polymer).

Rechargeable batteries typically initially cost more than disposable batteries, but have a much lower total cost of ownership and environmental impact, as they can be recharged inexpensively many times before they need replacing. Some rechargeable battery types are available in the same sizes and voltages as disposable types, and can be used interchangeably with them.

Billions of dollars in research are being investedaround the world for improving batteries and industry also focuses on building better batteries.

## Rechargeable battery:-

A rechargeable battery is an energy storage device that can be charged again after being discharged by applying DC current to its terminals.

## 4.5.1Typesis rechargeable:-

Common types of rechargeable batteries are lead-acid, nickel-cadmium (NiCd), nickel-metal hydride (NiMH), lithium-ion (Li-ion), lithium-ion polymer (LiPo), and rechargeable alkaline batteries.

## 4.5.2Application:

Devices which use rechargeable batteries include automobile starters, portable consumer devices, light vehicles (such as motorized wheelchairs,golf carts, electrical bicycles, and electric forklifts) road vehicles (cars, vans, trucks, motorbikes), trains, small airplanes, tools, uninterruptible power supplies, and battery storage power stations. Emerging applications in hybrid internal combustion-battery and electric vehicles drive the technology to reduce cost, weight, and size, and increase lifetime.

Older rechargeable batteries self-discharge relatively rapidly, and require charging before first use; some newer low self-discharge NiMH batteries hold their charge for many months, and are typically sold factory-charged to about 70% of their rated capacity.

Battery storage power stations use rechargeable batteries for load-leveling (storing electric energy at times of low demand for use during peak periods) and for renewable energy uses (such as storing power generated from photovoltaic arrays during the day to be used at night). Load-leveling reduces the maximum power which a plant must be able to generate, reducing capital cost and the need for peaking power plants.

Small rechargeable batteries can power portable electronic devices, power tools, appliances, and so on. Heavy-duty batteries power electric vehicles, ranging

from scooters to locomotives and ships. They areusedin distributedelectricity generation and in stand-alone power systems.

### 4.5.3 Charging&Discharing.

During charging, the positive active material is oxidized, producing electrons, and the negative material is reduced, consuming electrons. These electrons constitute the current flow in the external circuit. The electrolyte may serve as a simple buffer for internal ion flow between the electrodes, as in lithium-ion and nickel-cadmium cells, or it may be an active participant in the electrochemical reaction, as in lead–acid cells.

The energy used to charge rechargeable batteries usually comes from a battery charger using AC mains electricity, although some are equipped to use a vehicle's 12-volt DC power outlet. The voltage of the source must be higher than that of the battery to force current to flow into it, but not too much higher or the battery may be damaged.

Chargers take from a few minutes to several hours to charge a battery. Slow "dumb" chargers without voltage or temperature-sensing capabilities will charge at a low rate, typically taking 14 hours or more to reach a full charge. Rapid chargers can typically charge cells in two to five hours, depending on the model, with the fastest taking as little as fifteen minutes. Fast chargers must have multiple ways of detecting when a cell reaches full charge (change in terminal voltage, temperature, etc.) to stop charging before harmful overcharging or overheating occurs. The fastest chargers often incorporate cooling fans to keep the cells from overheating. Battery packs intended for rapid charging may include a temperature sensor that the charger uses to protect the pack; the sensor will have one or more additional electrical contacts.

Different battery chemistries require different charging schemes. For example, some battery types can be safely recharged from a constant voltage source. Other types need to be charged with a regulated current source that tapers as the battery reaches fully charged voltage. Charging a battery incorrectly can damage a battery; in extreme cases, batteries can overheat, catch fire, or explosively vent their contents.

### 4.5.4Rate for discharging

Battery charging and discharging rates are often discussed by referencing a "C" rate of current. The C rate is that which would theoretically fully charge or discharge the battery in one hour. For example, trickle charging might be performed at C/20 (or a "20-hour" rate), while typical charging and discharging may occur at C/2 (two hours for full capacity). The available capacity of electrochemical cells varies depending on the discharge rate. Some energy is lost in the internal resistance of cell components (plates, electrolyte, interconnections), and the rate of discharge is limited by the speed at which chemicals in the cell can move about. For lead-acid cells, the relationship between time and discharge rate is described by Peukert's law; a lead-acid cell that can no longer sustain a usable terminal voltage at a high current may still have usable capacity, if discharged at a much lower rate. Data sheets for rechargeable cells often list the discharge capacity on 8-hour or 20-hour or other stated time; cells for uninterruptible power supply systems may be rated at 15-minute discharge.

### 4.5.5Lifespan and cycle stability

If batteries are used repeatedly even without mistreatment, they lose capacity as the number of charge cycles increases, until they are eventually considered to have reached the end of their useful life. Different battery systems have differing mechanisms for wearing out. For example, in lead-acid batteries, not all the active material is restored to the plates on each charge/discharge cycle; eventually enough material is lost that the battery capacity is reduced. In lithium-ion types, especially on deep discharge, some reactive lithium metal can be formed on charging, which is no longer available to participate in the next discharge cycle. Sealed batteries may lose moisture from their liquid electrolyte, especially if overcharged or operated at high temperature.

# CHAPTER -5

# PERFORMANCE ANALYSIS

## 5.1 Overview

Whenever me and my family go for vacations, I used to get worried about my plants because they need water on regular basis. I gone through several options to solve this problem as plants need water according to the moisture level of soil. So I have made Automatic Plant Watering System Using Arduino UNO.

In this system, soil moisture sensor senses the moisture level of the soil. If soil will get dry then sensor senses low moisture level and automatically switches on the water pump to supply water to the plant. As plant get sufficient water and soil get wet then sensor senses enough moisture in soil. After which the water pump will automatically getstopped.

I have used a self made water pump in this system using 5 volt DC motor. I could use 12 volt water pump in the system but to operate this, it will require a relay module. So, to reduce all these hardware complexity, I made DC motor based water pump using diode, transistor and registers combinedcircuitwhichoperatesDCmotoraccordingtotheArduinocode.

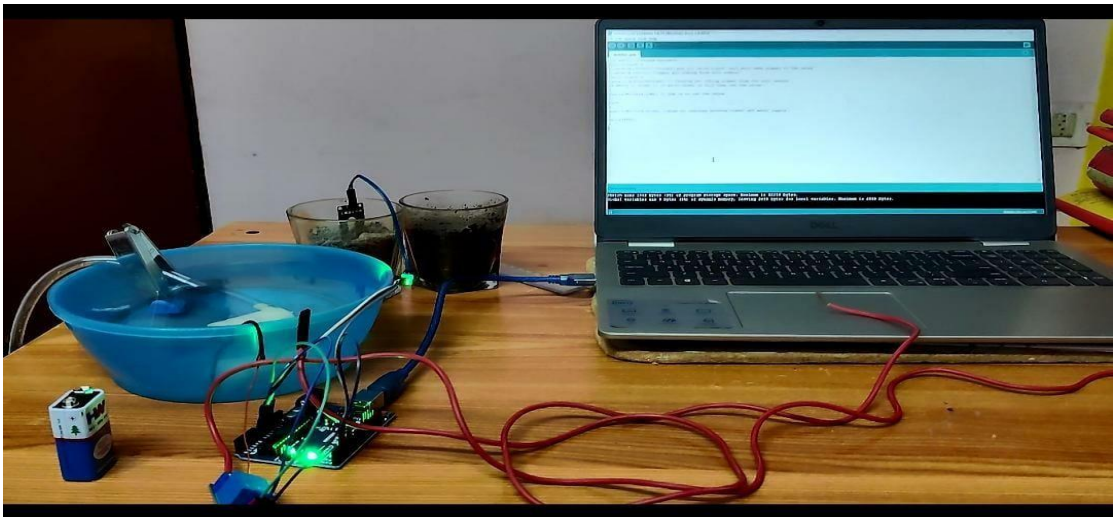

Fig 5.1 Proposed Diagram

# CHAPTER-6

# SUMMARY AND CONCLUSION

## 6.1 SUMMARY

Soil Moisture has been proposed using Arduino and CloudComputing.TheSystemhashighefficiencyandaccuracyinfetching the live data of temperature and soil moisture. The IoT based smart farming System being proposed via this report will assist farmers in increasing the agriculture yield and take efficient care of food production as the System will always provide helping hand to farmers for getting accurate live feed of environmental temperature and soil moisture with more than 99% accurate results

### 6.2 CONCLUSION

An automatic plant irrigation system using Arduino is designed in this project. The prototype of the model worked properly when tested on different soils. The components that we use in the system are readily available and easy to operate. Thus, this system acts as an effectual method of irrigation. It is far better than the manual irrigation process which requires a lot of manpower and time. By using the app, thefarmer can operate the system from distant places. The farmer can utilize this time in other significant activities. Also, the major issue of water scarcity is dealt with. No amount of water is wasted in the process of irrigation.

Thus, this system can be very useful in areas where water is in short supply. As the required amount of water is provided to the crop, the crop growth is better. Farmers can thus benefit from the enhanced crop yields. The project is tested for different types of soils and it works properly. The future work of the system can include the addition of temperature sensors and a more powerful motor to pump water to the fields. Thus, the large-scale implementation of the project can also be done.

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