Design and Construction of A Solar Based Plant Watering System

A Project submitted in partial fulfillment of the requirements for the Award of Degree of

Bachelor of Science in Mechanical Engineering

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Certification

This certify that this project entitled **"Design and Construction Of A Solar Based Plant Watering System"** is done by the following student under my direction supervision and this work has been carried by the laboratories of the Department of Mechanical Engineering under the Faculty of Engineering of Sonargaon university in partial fulfillment of the requirements for the degree of Bachelor of Science in Mechanical Engineering . The presentation of the work was held on May 2023.

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Dedicated to

Our Parents & Teachers

ACKNOWLEDGEMENT

First we express our heartiest thanks and gratefulness to almighty Allah for his divine blessing makes us possible to complete this project successfully. We are grateful and wish our profound our indebtedness to Md Istiaque Zahur, Lecturer**,** Department of Mechanical Engineering, Sonargaon University, Dhaka. Deep theoretical and hardware knowledge & keen interest of our supervisor in this field influenced us to carry out this project. His endless patience, scholarly guidance, continual encouragement, constant and energetic supervision, constructive criticism, valuable advice, reading many inferior draft and correcting them at all stage have made it possible to complete this project.

We would like to express our heartiest gratitude to honorable Head, Department of ME, for his kind help to finish our project and also to other faculty members of the Department of Mechanical Engineering, Sonargaon university.

ABSTRACT

This work aims at developing an entirely automated plant/crop watering system. The main aim behind this system is to conserve the wastage of water and to effectively manage the amount of watering of the plants. It also aims at reducing human labour, effort and errors due to human negligence. It uses solar panels to provide power to the system at daytime. Solar energy is used to run the system during daytime and charge the batteries to operate at night. It uses moisture sensors to sense the level of moisture in the soil. When the moisture content of the soil goes below a certain limit for a plant/crop, the pump system is triggered and the plant/crop is watered. The plants are watered efficiently till the desired value is reached and the pump is switched off automatically.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

By using the concept of Arduino based automatic plant watering system a gardener or farmer can save water up to 50% and power. This concept depends on two plant watering methods those are: conventional plant watering methods like overhead sprinklers, flood type feeding systems i.e. wet the lower leaves and stem of the plants. The area between the crop rows become dry as the large amount of water is consumed by the flood type methods, in which case the farmer depends only on the incidental rainfalls. The crops are been infected by the leaf mold fungi as the soil surface often stays wet and is saturated after plant watering is completed[1]. Overcoming these drawbacks new techniques are been adopted in the plant watering techniques, through which small amounts of water applies to the parts of root zone of a plant. The plant soil moisture stress is prevented by providing required amount of water resources frequently or often daily by which the moisture condition of the soil will retain well. The diagram below shows the entire concept of the modern plant watering system. The traditional techniques like sprinkler or surface plant watering requires / uses nearly half of water sources. Even more precise amounts of water can be supplied for plants. As far as the foliage is dry the plant damage due to disease and insects will be reduced, which further reduces the operating cost. The dry rows between plants will leads to continuous federations during the plant watering process. Fertilizers can be applied through this type of system, and the cost required for will also reduces. The erosion of soil and wind is much reduced by the recent techniques when compared with overhead sprinkler systems. The soil characteristics will define the form of the dripping nature in the root zone of a plant which receives moisture. As the method of dripping will reduce huge water losses it became a popular method by reducing the labor cost and increasing the yields. When the components are activated, all the components will read and gives the output signal to the controller, and the information will be displayed to the user (farmer). The sensor readings are analog in nature so the ADC pin in the controller will convert the analog signals into digital format. Then the controller will access information and when the motors are turned On/Off it will be displayed on the LCD Panel.

1.2 Problem Statement

Plant watering of plants is usually a very time- consuming activity, to be done in a reasonable amount of time; it requires a large amount of human resources. Traditionally all the steps were executed by humans. Nowadays some systems use technology to reduce the number or workers or the time required to water the plants. With such systems, the control is very limited, and many resources are still wasted. Water is one of these resources that are used excessively. Many plant watering is one method used to water the plant. This method represents massive losses since the amount of water given is in excess of the plants needs. The excess water is evacuated by the holes of the pots in greenhouses, or it percolates through the soil in the fields. The contemporary perception of water is that of a free renewable resource that can be used in abundance. It is therefore reasonable to assume that it will soon become a very expensive resource everywhere. In addition to the excess cost of water labor is becoming more and more expensive[2]. As a result, if no effort is invested in optimizing these resources, there will be more money involved in the same process. Technology is probably a solution to reduce costs and prevent loss of resource; this project can be a strong way to tackle such a situation.

1.3 Objective

- The main objective of this project is to design a low cost device in order to control the water pump automatically.
- To save farmers effort, water and time. Plant watering management is a complex decision
- The ability to conserve the natural resources as well as giving a splendid boost to the production of the crops is one of the main aims of incorporating such technology into the agricultural domain of the country

1.4 Scopes

A critical consideration is the installation costs, since costs generally determine the feasibility and viability of a project. The installation must be simple enough for a domestic user. The water saving was also an important aspect, since there is a demand to minimize water loss and to minimize the efficiency of water used. Finally, the possibility for implementing the system at a larger scale should be investigated.

1.5 Methodology

- Collection of information's from books and internet.
- Required components have been purchased from market.

1.5.1 Sources of Information

The required information was found from a variety of sources. Information about the various principles and types of soil moisture probes was acquired from the Ontario Ministry of Agriculture, Food and Rural Affair website [9] and several probe manufacturers and vendors. Different types electric valves were researched on the Internet and a solenoid and solenoid valve was offered by the Mechanical Engineering Department at McGill University. The datasheets of the electronic parts were obtained directly from the manufacturer or from intermediate suppliers[3].

1.5.2 Required Input Data

Depending on the types of plants to be irrigated, the required soil moisture for growth and maintenance varies. It is also useful to determine the amount of water that the plants absorb during a certain period to choose the size of the reservoir and the refilling frequency. Plants were purchased and placed in a typical environment. The feedback will control levels for most common plant species may be attached to the retail package for convenience.

1.6 Project Outline

This project organized as follows

Chapter- 1 Introduction of the project

Chapter- 2 Reviews the literature

Chapter- 3 Theoretical model

Chapter- 4 Hardware development part.

Chapter- 5 Result and discussion

Chapter- 6 Conclusion

1.7 Summary:

In this chapter, we discussed about our project Automatic plant watering System, where we briefly discuss about project. At the last part of this chapter we discuss about our object, Future scope of the work, methodology and project outline.

CHAPTER 2
LITERATURE REVIEW

2.1 Automatic Plant Watering System

Plant watering system uses valves to turn plant watering ON and OFF. These valves may be easily automated by using controllers and solenoids. Automating farm or nursery plant watering allows farmers to apply the right amount of water at the right time, regardless of the availability of labor to turn valves on and off. In addition, farmers using automation equipment are able to reduce runoff from over watering saturated soils, avoid irrigating at the wrong time of day, which will improve crop performance by ensuring adequate water and nutrients when needed[4]. Automatic Drip Plant watering is a valuable tool for accurate soil moisture control in highly specialized greenhouse vegetable production and it is a simple, precise method for plant watering. It also helps in time saving, removal of human error in adjusting available soil moisture levels and to maximize their net profits. Plant watering is the artificial application of water to the soil usually for assisting in growing crops. In crop production it is mainly used in dry areas and in periods of rainfall shortfalls, but also to protect plants against frost.

Types of Plant watering Surface plant watering

- Localized plant watering
- Drip Plant watering
- Sprinkler plant watering

Conventional plant watering methods like overhead sprinklers, flood type feeding systems usually wet the lower leaves and stem of the plants. The entire soil surface is saturated and often stays wet long after plant watering is completed. Such condition promotes infections by leaf mold fungi. On the contrary the drip or trickle plant watering is a type of modern plant watering technique that slowly applies small amounts of water to part of plant root zone. Water is supplied frequently, often daily to maintain favorable soil moisture condition and prevent moisture stress in the plant with proper use of water resources[4]. Drip plant watering saves water because only the plant's root zone receives moisture. Little water is lost to deep percolation if the proper amount is applied. Drip plant watering is popular because it can increase yields and decrease both water requirements and labor. Drip plant watering requires about half of the water needed by sprinkler or surface plant watering. Lower operating pressures and flow rates result in reduced energy costs. A higher degree of water control is

attainable. Plants can be supplied with more precise amounts of water. Disease and insect damage is reduced because plant foliage stays dry. Operating cost is usually reduced. Federations may continue during the plant watering process because rows between plants remain dry.

2.2 Arduino Nano

Arduino is open source physical processing which is based on a microcontroller board and an incorporated development environment for the board to be programmed. Arduino gains a few inputs, for example, switches or sensors and control a few multiple outputs, for example, lights, engine and others. Arduino program can run on Windows, and Linux operating systems (OS) opposite to most microcontrollers' frameworks which run only on Windows. Arduino programming is easy to learn and apply to beginners and amateurs. Arduino is an instrument used to build a better version of a computer which can control, interact and sense more than a normal desktop computer. It's an open-source physical processing stage focused around a straightforward microcontroller board, and an environment for composing programs for the board. Arduino can be utilized to create interactive items, taking inputs from a diverse collection of switches or sensors, and controlling an assortment of lights, engines, and other physical outputs. Arduino activities can be remaining solitary, or they can be associated with programs running on your machine. The board can be amassed by hand or bought preassembled; the open-source IDE can be downloaded free of charge. Focused around the Processing media programming environment, the Arduino programming language is an execution of Wiring, a comparative physical computing platform.

2.2.1 Arduino

Arduino has been used in thousands of different projects and applications. It runs on Mac, Windows, and Linux. Teachers and students use it to build low cost scientific instruments, to prove chemistry and physics principles, or to get started with programming and robotics. Designers and architects build interactive prototypes, musicians and artists use it for installations and to experiment with new musical instruments. Arduino is a key tool to learn new things. There are many other microcontrollers and microcontroller platforms available for physical computing. 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[5].

- 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 417 Taka.
- Simple, clear programming environment - The Arduino Software (IDE) 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 how the Arduino IDE works. Here we use Arduino IDE 1.8.1.
- 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 plans of the Arduino boards 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.

2.3 Soil Moisture Sensor

Two types of soil moisture sensors are available in the market—contact and non-contact sensors. A contact soil sensor is used in this project because it has to check soil moisture to measure the electrical conductivity. The moisture sensor provides an analogue output, which can easily be interfaced with Arduino. In this project, two sensors can be connected to analogue pins A0, of the Arduino board. Each sensor has two pin available for interfacing with the Arduino board. Here, digital output pin (Do) is not used. The water pump and servo motor are controlled by Arduino connected to digital pins 3 and 9, respectively. That is, the servo motor signal control pin is connected to pin 9 of the Arduino board[6].

2.3.1 History of Soil Moisture Sensor

Technologies commonly used to indirectly measure volumetric water content (soil moisture) include)

- 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.
- 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.

2.4 History of Relay

American scientist Joseph Henry is often claimed to have invented a relay in 1835 in order to improve his version of the electrical telegraph, developed earlier in 1831. However, there is little in the way of official documentation to suggest he had made the discovery prior to 1837.

It is claimed that English inventor Edward Davy *"certainly invented the electric relay"* in his electric telegraph 1835.

A simple device, which is now called a relay, was included in the original 1840 telegraph patent of Samuel Morse. The mechanism described acted as a digital amplifier, repeating the telegraph signal, and thus allowing signals to be propagated as far as desired. This overcame the problem of limited range of earlier telegraphy schemes.

The word *relay* appears in the context of electromagnetic operations from 1860.

CHAPTER 3
THE PRATICAL MODEL

3.1 Introduction

In this project, Atmega328 microcontroller will be used to program an application The Moister sensor will detect the moister level send analog data signal to microcontroller. The microcontroller will use the data to process, analyze and calculate the specific information about the moister, and then it will be display on a 16x2 screen (LCD – 16x2).

3.2 Flow Chart

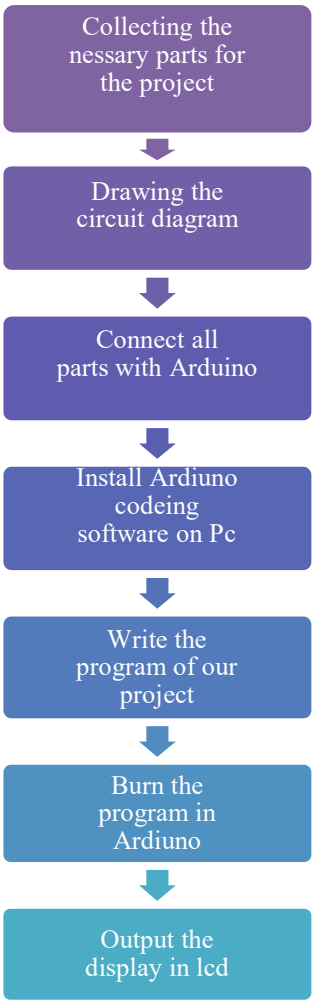


Fig 3.1: Flow chart of Project

3.3 Block Diagram OF Automatic Plant Watering System

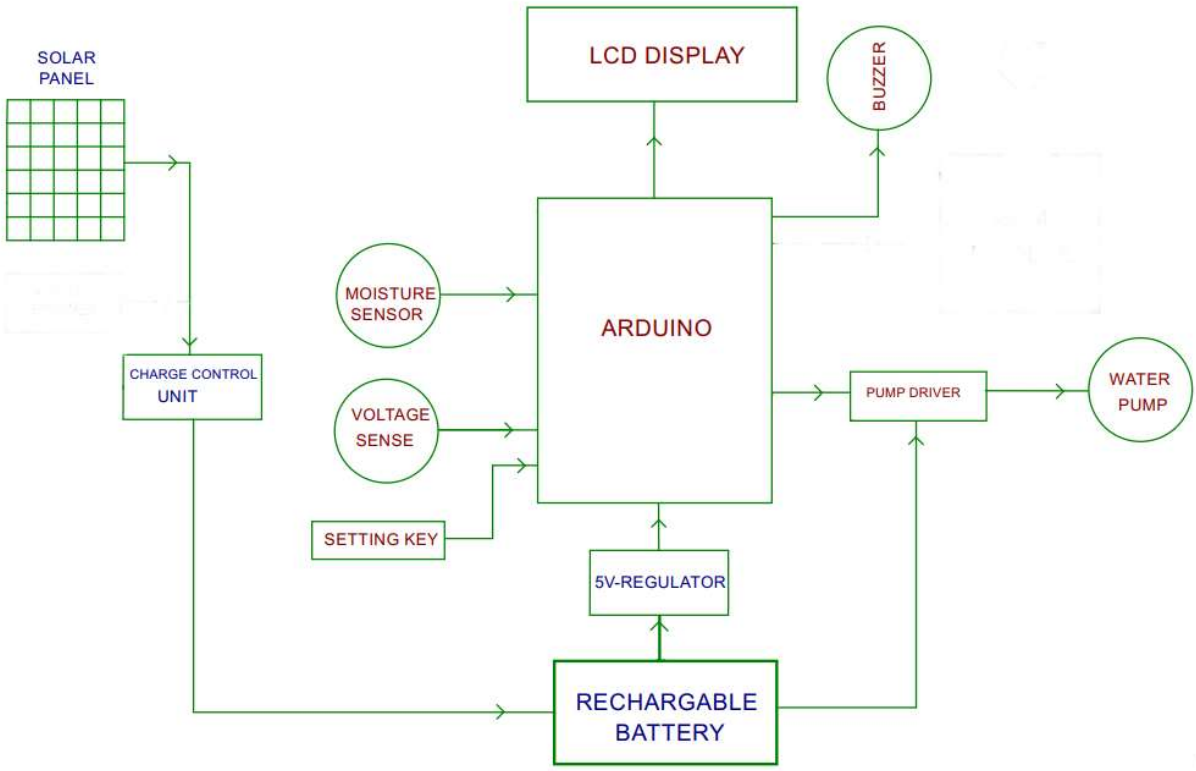


Fig 3.2: Block Diagram

Moisture sensor detects the moister from the plant soil. It sends analog signal to Arduino. Arduino detect the signal, process and calculate the data. Arduino send data on LCD. It shows us the data and we can also able to see the data. Every unit is connected to power supply which is a prerequisite for operation.

3.4 Circuit Diagram of Automatic Plant Watering System

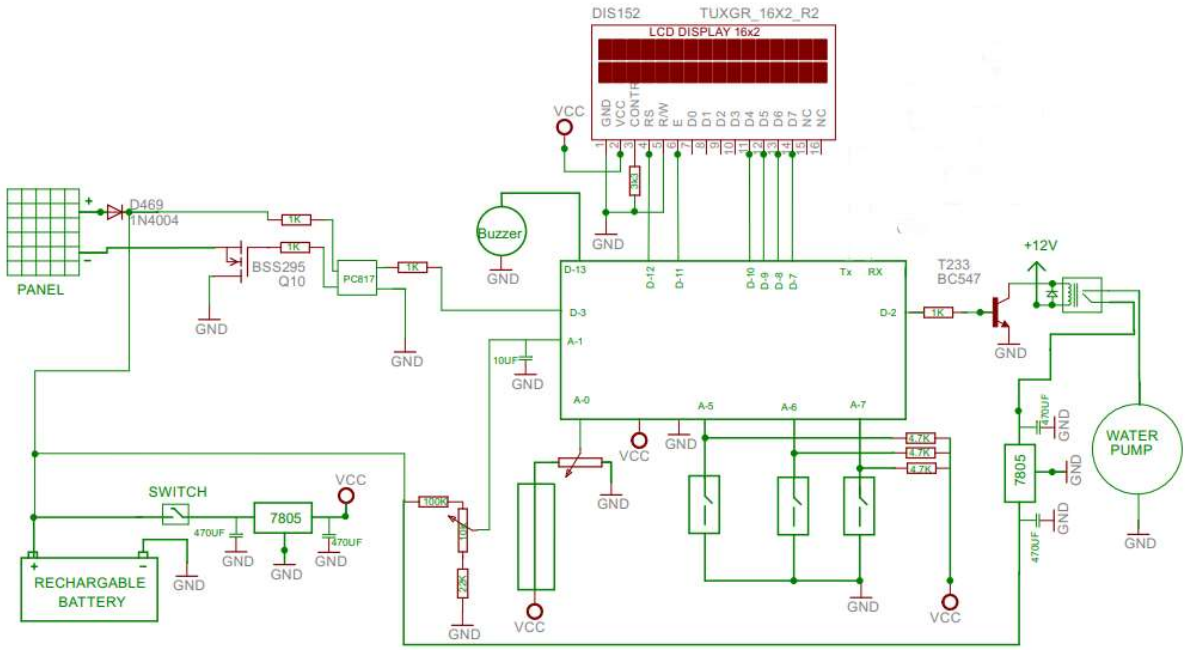


Fig 3.4: Circuit Diagram of automatic plant watering system

Connection of moister monitor using moister sensor, Arduino and Bluetooth module is very simple. Here a liquid crystal display (LCD) is used for display the moister which is sent though the moisture sensor. Data pins of LCD namely RS, E, D4, D5, D6, D7 are connected to Arduino digital pin number 7, 6, 5, 4, 3, and 2.0ne buzzer is connected in digital pin 10 and GND.

Moister sensor data is connected to analog A0 and A1 pin Arduino respectively. That entire component is powered by dc 5volt.

3.6 Working Procedure

In our project, Arduino Nano is used to control the whole process, LCD used to display moister level and water pump status. We place our moister sensor into the soil, it detects moisture from soil and sends analog information in Arduino. Now Arduino receive the analog signal and process and check the condition and decide pump ON or Off, At the same time calculate the signal then it sends the calculated data to LCD. We also used buzzer for a warning system when our system is ready to work.

CHAPTER 4
HARDWARE DEVELOPMENT

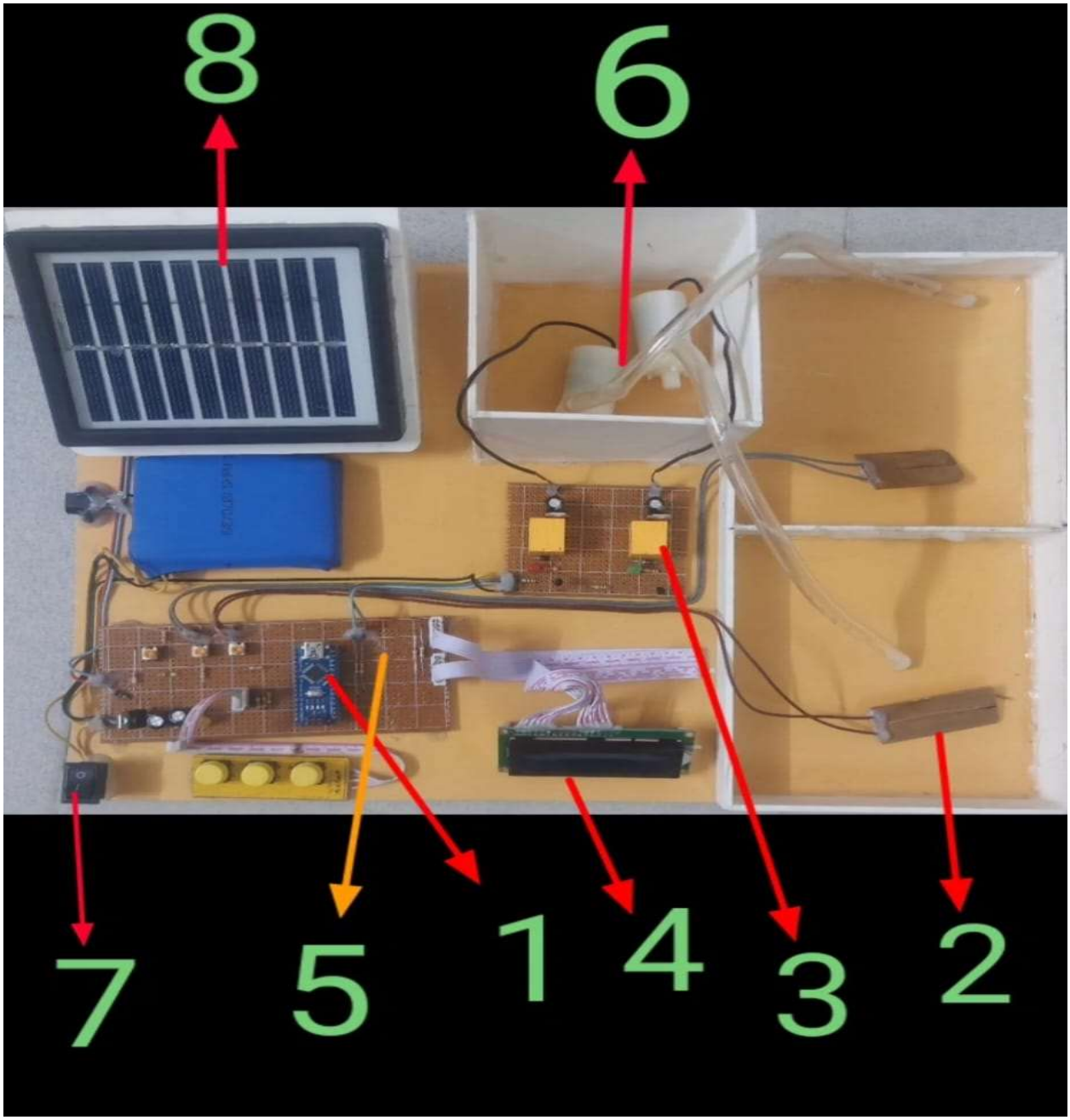
4.1 Introduction

In this chapter, we will discuss about the hardware component that have used in our project. This part will explain the path needed to undertake in order to achieve the goal of the project

4.2 Components Name and Quantity

Table No 4.1: Components Name and Quantity

SL	Component Name	Quantity
1	Arduino Nano	1Pcs
2	Moister sensor	2 Pcs
3	16X2 LCD	1 Pcs
4	Buzzer	1 Pcs
5	5w/12 Volt Dc water Pump	1 Pcs
6	12v/4Ah Battery	1 Pcs
7	20w Solar panel	2 Pcs
8	2 channel 12V Relay Module	1 Pcs
9	Power source (9v,2A and 5v,1A) 12	2 Pcs
10	Connecting Wire	As Require
12	Ebonite sheet (3.5*6.5)	1Pcs
13	Water bottle	2 Pcs
15	NO/OFF switch	3 pcs
17	Plastic pipe	



Name of the Parts:

01. Microcontroller
02. Soil Moisture Sensor
03. Relay
04. LCD Display
05. Vero Board
06. Water Pump
07. Power Switch
08. Solar Panel

4.3 Arduino Nano

The Arduino Nano is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, 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. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, Net media's BX-24, Phi gets, 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.

4.3.1 Technical Specification of Arduino

Table No 4.2: Technical Specification

Microcontroller	ATmega328
Architecture	AVR
Operating Voltage	5 V
Flash Memory	32 KB of which 2 KB used by boot loader
SRAM	2 KB
Clock Speed	16 MHz
Analog I/O Pins	8
EEPROM	1 KB
DC Current per I/O Pins	40 mA (I/O Pins)
Input Voltage	7-12 V
Digital I/O Pins	22
PWM Output	6
Power Consumption	19 mA
PCB Size	18 x 45 mm
Weight	7 g

4.3.2 Pin Description of Arduino Nano

Each of the 14 digital pins on the Nano can be used as an input or output, using pin Mode(), digital Write(), and digital Read() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 k Ohms. In addition, some pins have specialized functions:

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the FTDI USB-to-TTL Serial chip.
- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt () function for details.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analog Write () function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.
- LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Nano has 8 analog inputs, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the analog Reference() function. Analog pins 6 and 7 cannot be used as digital pins. Additionally, some pins have specialized functionality[8].

- I2C: 4 (SDA) and 5 (SCL). Support I2C (TWI) communication using the Wire library (documentation on the Wiring website).

There are a couple of other pins on the board:

- AREF. Reference voltage for the analog inputs. Used with analog Reference().
- Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

4.4 Soil Moisturizer Sensor

Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting 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[9].

4.4.1 Hardware Features of Soil Moisture Sensor

Table 4.3: Hardware Features

Sensitivity	adjustable sensitivity
Module mode	Dual Output mode, a simple digital output, analog output more accurate.
Operating voltage	5v
With edge connector	
A0 small board analog output interface	

4.4.2 Technology

Technologies commonly used to indirectly measure volumetric water content (soil moisture) include)

- 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.

- 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.

4.4.3 Applications

Agriculture

Measuring soil moisture is important for agricultural applications to help farmers manage their plant watering 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.

Landscape Plant watering

In urban and suburban areas, landscapes and residential lawns are using soil moisture sensors to interface with an plant watering controller. Connecting a soil moisture sensor to a simple plant watering clock will convert it into a "smart" plant watering controller that prevents plant watering 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 plant watering systems to prevent over-watering and leaching of fertilizers and other chemicals into the ground.

Research

Soil moisture sensors are used in numerous research applications, e.g. in agricultural science and horticulture including plant watering 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.

4.5 Relay Module

This is a LOW Level 5V 2-channel relay interface board, and each channel needs a 15-20mA driver current. It can be used to control various appliances and equipment with large current. It is equipped with high-current relays that work under AC250V 10A or DC30V 10A. It has a standard interface that can be controlled directly by microcontroller.

- COM- Common pin.
- NC- Normally Closed, in which case NC is connected with COM when INT1 is set low and disconnected when INT1 is high.
- NO- Normally Open, in which case NO is disconnected with COM1 when INT1 is set low and connected when INT1 is high.

Terminal 2 is similar to terminal 1, except that the control port is INT2

- INT 1- Relay 1 control port
- INT 2- Relay 2 control port

4.6 LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segment and other multi segment LCDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on, A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD, each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD[10].

Pin description as follows

- Pin 7 to pin 14 all 8 pins are responsible for the transfer of data.
- Pin 4-This is Rs i.e., register select pin.
- Pin 5-This is R/W i.e., Read/Write pin.
- Pin 6-This is E i.e., enable pin.
- Pin 2-This is VDD i.e., power supply pin
- Pin1-This is VSS i.e., ground pin.
- Pin3-This is short pin.

4.7 Vero Board

Vero board is a brand of strip board, a pre-formed circuit board material of copper strips on an insulating bonded paper board as with other strip boards, in using Vero board, components are suitably positioned and soldered to the conductors to form the required circuit. Breaks can be made in the tracks, usually around holes, to divide the strips into multiple electrical nodes enabling increased circuit complexity.

This type of wiring board may be utilized for initial electronic circuit development, to construct prototypes for bench testing or in the production of complete electronic units in small quantity.

4.8 Buzzer

Piezo buzzer is an electronic device commonly used to produce sound. Light weight, simple construction and low price make it usable in various applications like car/truck reversing indicator, computers, call bells etc. Piezo buzzer is based on the inverse principle of piezo electricity discovered in 1880 by Jacques and Pierre Curie. It is the phenomena of generating electricity when mechanical pressure is applied to certain materials and the vice versa is also true. Such materials are called piezo electric materials. Piezo electric materials are either naturally available or manmade. Piezo ceramic is class of manmade material, which poses piezo electric effect and is widely used to make disc, the heart of piezo buzzer. When subjected to an alternating electric field they stretch or compress, in accordance with the frequency of the signal thereby producing sound.

4.9 Water Pump

The water pump is used to artificially supply water for a particular task. It can be electronically controlled by interfacing it to a microcontroller. It can be triggered ON/OFF by sending signals as required. The process of artificially supplying water is known as pumping. There are many varieties of water pumps used. This project employs the use of a small DC 6v water pump which is connected to a relay module.

A precise decision or action on water supply for a particular area for crop production is very critical in precision agriculture practices. This paper discusses the development of water pumping control system using a Pulse Width Modulation (PWM) control technique to support water supply of crops based on precision agriculture approach. The input parameters to the control system are soil moisture content, crop planting period, soil type, and climate. Based on these input parameters the control system determines the appropriate amount of water supplied, water pumping time and duration. The prototype of the pumping control system has been built and tested and simulated with real sets of data in Tasikmalaya, West Java, Indonesia. Based from the result of field test, it shows that the built prototype has performed its functionalities correctly on ≥ 85% duty cycle of the PWM for both submersible and suction pumps. To operate on lower PWM duty cycle, submersible pumps can be used since these pump types can operate with minimum of 66% duty cycle.

A PV-powered automatic plant watering system is designed and implemented in this paper. Dominant factors of the system such as the effect of solar radiation on motor power, current, and water discharge are considered in this study. The proposed system is implemented in the field to irrigate corn plant (maize) considering the optimum tilt angle for Duhok city. A new method for measuring the moisture content in the soil and sufficient level of moisture needed for normal growth of the crop is presented to design a timer for the system to reduce the amount of wasted water. Moisture sensors are used to check the availability of water in the soil and to enable the microcontroller to control the operation status of the pump. The results show that the proposed plant watering method is more accurate and efficient than the conventional plant watering methods in terms of the amount of the water used for plant watering, and the accuracy of irrigating times based on changing local climate. The results clearly demonstrate that the proposed system is more cost effective way of plant watering and more environmental friendly in terms of the amount of water used in an area known for water scarcity. KEYWORDS: DC motors; Agricultural Engineering; Climate Mitigation; Crops;

Design engineering; Plant watering; Microcontrollers; Moisture content measurement; Photovoltaic cells: Sensors; Soil; Solar Radiation; water pumps; Climate Change; Energy conservation[11].

4.10 Power Switch

Specifications

- Voltage: 12V
- Switch Color: Black
- Switch Type: Rocker

4.11 Bread Board

A breadboard is a rectangular plastic board with a bunch of tiny holes in it. These holes let you easily insert electronic components to prototype (meaning to build and test an early version of) an electronic circuit, like this one with a battery, switch, resistor, and an LED (light-emitting diode). To learn more about individual electronic components, see our Electronics Primer. The connections are not permanent, so it is easy to remove a component if you make a mistake, or just start over and do a new project. This makes breadboards great for beginners who are new to electronics. You can use breadboards to make all sorts of fun electronics projects, from different types of robots or an electronic drum set, to an electronic rain detector to help conserve water in a garden, just to name a few.

4.12 Solar Panel

Silicon wafers are the base of the most solar cells in the market today, which is called the "first generation" technology. Material costs dominates the cost which becomes sharply for this technology, this material cots mostly silicon wafer that strengthened by low-iron glass cover sheet, and those of other components of the system. This trend is expected to continue as the photovoltaic industry continues to develop [1]. Transformation of the solar radiation into electricity is the most important and initial step in order to understanding the concept of solar energy which occurs by the photovoltaic effect was first observed by Becquerel in the middle of 1950s [2]. This system is basically defined as the emergence of an electric voltage between two electrodes which attached to a solid or liquid system with shining light onto this system. Practically all photovoltaic devices contain a pn-junction in a semiconductor where the photo voltage happened and improved. These photovoltaic devices are also called as solar cells. The important thing about this semiconductor is that what material of this in order to absorb light. The semiconductor material has to be able to absorb a large part of the solar spectrum. The absorption properties of the material is directly related to the light is absorbed in a region more or less close to the surface. When light is absorbed, electron hole pairs are generated and reach the junction where separated by an electric field. Another thing is that semiconductors should be at near as possible as they can even for weakly absorbing semiconductors like silicon has most carriers are generated just near the surface [1]. Solar cells using for practical are packaged into modules which containing either a number of crystalline Si cells connected in series or a layer of thin-film material in series connected. This modules has two main goals, first of all, it protects the solar cells from the environmental hazard and second, it generates a higher voltage than a single cell which can delivers less than 1 Volt [12].

4.12.1 Solar Energy

Simply put, solar is the most abundant source of energy on Earth. About 173,000 terawatts of solar energy strike the Earth at any given time - more than 10,000 times the world's total energy needs.

By capturing the sun's energy and turning it into electricity for your home or business, solar energy is a key solution in combating the current climate crisis and reducing our dependence on fossil fuels.

4.12.2 Working Mechanism

Our sun is a natural nuclear reactor. It releases tiny packets of energy called photons, which travel the 93 million miles from the sun to Earth in about 8.5 minutes. Every hour, enough photons impact our planet to generate enough solar energy to theoretically satisfy global energy needs for an entire year. Currently photovoltaic power accounts for only five-tenths of one percent of the energy consumed in the United States. But solar technology is improving and the cost of going solar is dropping rapidly, so our ability to harness the sun's abundance of energy is on the rise. In 2017,the International Energy Agency showed that solar had become the world's fastest-growing source of power – marking the first time that solar energy's growth had surpassed that of all other fuels. Since then solar has continued to grow and break records around the globe.

4.12.3 Weather Affect on Solar Energy

Weather conditions can impact the amount of electricity a solar system produces, but not exactly in the way you might think. Perfect conditions for producing solar energy include a clear sunny day, of course. But like most electronics, solar panels are actually more efficient in cold weather than warm weather. This allows the panel to produce more electricity in the same amount of time. As the temperature rises, the panel generates less voltage and produces less electricity. But even though solar panels are more efficient in cold weather, they don't necessarily produce more electricity in the winter than in summer. Sunnier weather often occurs in the warmer summer months. In addition to fewer clouds, the sun is usually out for more of the day. So even though your panels may be less efficient in warm weather, they'll still likely produce more electricity in summer than in winter.

4.12.4 Solar Energy Efficient

Obviously, some states get more sun than others. So the real question is: if weather can affect solar energy production, are some states better candidates for solar energy than others? The short answer is yes, but not necessarily because of weather. Take clouds for example. Anyone who has been sunburned on a cloudy day knows that solar radiation penetrates through clouds. For that same reason, solar panels can still produce electricity on cloudy days. But depending on the cloud cover and the quality of the solar panels, the efficiency of the solar panels electricity production commonly drops from 10 to 25 percent or more compared to a sunny day. In other words, solar power can still work well in typically cloudy, cold locations. New York, San Francisco, Milwaukee, Boston, Seattle - all of those cities experience

inclement weather, from rain and fog to blizzards, yet they're also cities where people see huge savings by getting solar. No matter where you live, solar energy can be an excellent investment and an excellent way to help combat climate change. How much you'll save - and how quickly you'll see a return on your investment in a particular state - depends on many factors, like the cost of electricity, solar incentives available, net metering, and the quality of your solar panels.

4.12.5 Solar Panels Working Mechanism

When photons hit a solar cell, they knock electrons loose from their atoms. If conductors are attached to the positive and negative sides of a cell, it forms an electrical circuit. When electrons flow through such a circuit, they generate electricity. Multiple cells make up a solar panel, and multiple panels (modules) can be wired together to form a solar array. The more panels you can deploy, the more energy you can expect to generate.

4.12.6 Solar Panels Construction

Photovoltaic (PV) solar panels are made up of many solar cells. Solar cells are made of silicon, like semiconductors. They are constructed with a positive layer and a negative layer, which together create an electric field, just like in a battery.

4.12.7 Solar Panels Method for Generation

PV solar panels generate direct current (DC) electricity. With DC electricity, electrons flow in one direction around a circuit. This example shows a battery powering a light bulb. The electrons move from the negative side of the battery, through the lamp, and return to the positive side of the battery. With AC (alternating current) electricity, electrons are pushed and pulled, periodically reversing direction, much like the cylinder of a car's engine. Generators create AC electricity when a coil of wire is spun next to a magnet. Many different energy sources can "turn the handle" of this generator, such as gas or diesel fuel, hydroelectricity, nuclear, coal, wind, or solar.

CHAPTER 5
RESULT AND DISCUSSIONS

5.1 Practical Physical View

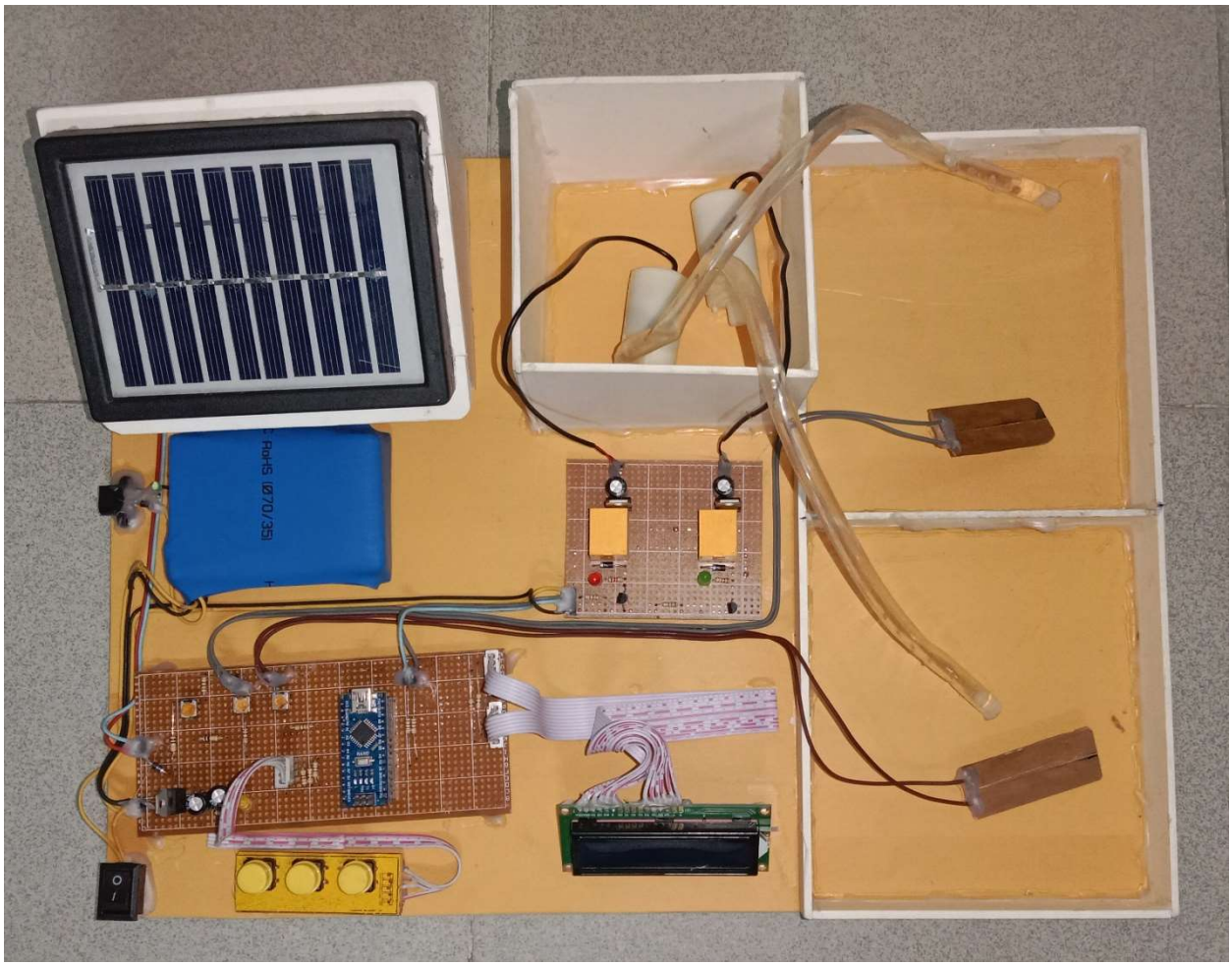


Figure 5.1: practical physical view

5.2 Result of the Project

Figure 5.2: Showing the moisture level and pump status on LCD

5.3 Discussion

The main objective of this project is to design a low cost device in order to control the water pump automatically. This automatic plant watering system senses the moisture content of the soil and automatically switches the pump when the power is on. A proper usage of plant watering system is very important because the main reason is the shortage of land reserved water due to lack of rain, unplanned use of water as a result large amounts of water goes waste. For this reason, we use this automatic plant watering system, and this system is very useful in all climatic conditions. The project is designed to develop an automatic plant watering system which switches the pump motor ON/OFF on sensing the moisture content of the soil. In the field of agriculture, use of proper method of plant watering is important. The project uses an ARDUINO NANO open source microcontroller which is programmed to receive the input signal of varying moisture condition of the soil through the sensing arrangement. Once the controller receives this signal, it generates an output that drives a relay for operating the water pump. An automation of plant watering systems has several positive effects. Once installed, the water distribution on fields or small-scale gardens is easier and does not have to be permanently controlled by an operator. There are several solutions to design automated plant watering systems.

5.4 Advantages of This Project

1. Anyone can use this
2. Gardener and farmer can use this.
3. Cost efficient.
4. Saving time, power and water.
5. Low power consumption.
6. Easy to Setup

5.5 Result of the Project

- With our project we became successful to demonstrate with regarding the objectives of the project.
- The moisture content of the three different types of field were measured successfully.
- Motor automatically turn on or off with the different level of moisture content in the soil.
- Gardener or Farmer successfully got the status of his fields whether dry or wet by LCD.

CHAPTER 6
CONCLUSIONS

6.1 Conclusions

The primary applications for this project are for gardeners and farmers who do not have enough time to water their crops/plants. It also covers those farmers who are wasteful of water during plant watering. The project can be extended to greenhouses where manual supervision is far and few in between. The principle can be extended to create fully automated gardens and farmlands. Combined with the principle of rain water harvesting, it could lead to huge water savings if applied in the right manner. In agricultural lands with severe shortage of rainfall, this model can be successfully applied to achieve great results with most types of soil[13].

6.2 Limitations of the Work

In the load shading period the machine will be turn off and measuring process will also turn off automatically. By adding the battery backup, we can remove this problem. Accept it, we are getting some noise from our sensor. By adding a better sensor, we can remove this problem. This moister uptake method relies upon several assumptions and it has been shown that the results can deviate up to 10% from the true value.

6.3 Future Scope of the work

This project can be further developed in future by adding GSM module to make a text message or phone call for alarm. Without it, we can enhance the feature of this project by using solar technology for power supply We can also measure water level of my reserve water tank can be monitored using this technology.

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