SOLAR BASED AUTOMATIC IRRIGATION SYSTEM

A Thesis Presented

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First we express our heartiest thanks and thankfulness to almighty Allah for His heavenly gift makes us conceivable to effectively finish this project. We are appreciative and wish our significant our obligation to Shahinur Rahman, Lecturer, Department of Mechanical Engineering, Sonargaon University, Dhaka. Profound hypothetical and hardware knowledge and strong fascination of our supervisor in this field impacted us to do this project. His perpetual patience, scholarly direction ,nonstop support, steady and fiery oversight, productive analysis, important counsel, perusing numerous sub-par draft and adjusting them at all stage have made it conceivable to finish this undertaking.

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ABSTRACT

In Bangladesh the field of agriculture facing a lot of problem & most of us come from a farmer family so we often saw that our father facing also this problem due to water scarcity and interrupted power supply. This condition leads to poor irrigation systems and content thus making the land unfit for agriculture purposes. The solution for such a problem is provided by the solar powered irrigation system. The aim of this paper is to help the farmers to use water effectively and use solar energy for irrigation purpose. The solar power irrigation system will help to reduce the gap between required and consumed energy by using soil moisture sensors and further conserves the resources thereby reducing the wastage of resource

Renewable energy source among all the benefits of solar panels, the most important thing is that solar energy is a truly renewable energy source. Reduces Electricity Bills, Diverse Applications, Low Maintenance Costs, Technology Development

□ Reduced labor.

Timely irrigation - plants being watered when needed.

Management of higher flow rates.

□ Accurate cut-off of water compared to manual checking.

□ Reduced runoff of water and nutrients.

□ Reduced costs for vehicles used to check irrigation.

Automatic solar power irrigation system, an advanced form of solar irrigation system consists of an automatic control to ON and OFF the control valves which aids the farmers by governing the supply of water to the irrigation lands. It also sustains the moisture level of soil that results in better yield

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CHAPTER – 1

INTRODUCTION

1.1 Problem Statement

Irrigation 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. Much irrigation 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. 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.

1.2 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. Irrigation 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.

CHAPTER 2

REQUIRED INPUT DATA

2.1 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.

2.1.2 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.

2.2 Summary

First, we showed our flow chart which contains steps of our Project. Then we showed our block diagram and circuit diagram with some explanation. At lastly, we briefly discussed about working procedure of our project.

CHAPTER – 3

LITERATURE REVIEWS

3.1 Automatic Irrigation system

Irrigation system framework utilizes valves to turn water system ON and OFF. These valves might be effectively automated by utilizing controllers and solenoids. Automating farm or nursery irrigation system permits farmers to apply the perfect proportion of water with flawless timing, no matter what the accessibility of work to turn valves on and off. Moreover, farmers utilizing automation equipment can decrease spillover from over watering soaked soils, try not to inundate at some unacceptable season of day, which will further develop crop execution by guaranteeing satisfactory water and nutrients when required. Automatic Irrigation system is an important device for exact soil moisture control in exceptionally concentrated nursery vegetable creation and it is a simple, precise method for irrigation. It additionally helps in efficient, evacuation of human blunder in changing accessible soil moisture levels and to augment their net benefits. Irrigation is the counterfeit utilization of water to the dirt typically for helping with developing yields. In crop creation it is basically utilized in dry regions and in times of rainfall shortfalls, yet in addition to safeguard plants against frost.

Types of Irrigation Surface irrigation

- Localized irrigation
- Drip Irrigation
- Sprinkler irrigation

Conventional irrigation system techniques like above sprinklers, flood feeding systems typically wet the lower leaves and stem of the plants. The whole soil surface is soaked and often remains wet long after irrigation is finished. Such condition promotes contaminations by leaf form growths. Going against the norm the dribble or stream water system is a kind of

current irrigation system procedure that gradually applies limited quantities of water to a piece of plant root zone. Water is provided every now and again, frequently day to day to keep up with good soil moisture condition and forestall moisture stress in the plant with appropriate utilization of water assets. Drip irrigation saves water in light of the fact that main the plant's root zone gets moisture. Little water is lost to profound permeation in the event that the appropriate sum is applied. Drip irrigation is well known in light of the fact that it can build yields and abatement both water necessities and work. Drip irrigation expects about portion of the water required by sprinkler or surface water system. Lower working tensions and stream rates bring about diminished energy costs. A more serious level of water control is feasible. Plants can be provided with more exact measures of water. Infection and bug harm is decreased in light of the fact that plant foliage stays dry. It is normally decreased to Work cost.

3.2 Arduino Nano

Arduino is open source actual handling which depends on a microcontroller board and an integrated improvement climate for the board to be modified. Arduino acquires a couple of contributions, for instance, switches or sensors and control a couple of different results, for example, lights, motor and others. Arduino program can run on Windows and Linux working frameworks (operating system) inverse to most microcontrollers' structures which run exclusively on Windows. Arduino writing computer programs is not difficult to learn and apply to fledglings and beginners. Arduino is an instrument used to fabricate a superior variant of a PC which have some control over, connect and detect in excess of a typical work station. It's an open-source actual handling stage centered on a direct microcontroller board, and a climate for creating programs for the board. Arduino can be used to make intuitive things, taking contributions from a different assortment of switches or sensors, and controlling a variety of lights, motors, and other actual results. Arduino exercises can be staying lone, or they can be related with programs running on your machine. The board can be amassed manually or purchased preassembled; the open-source IDE can be downloaded for nothing. Centered around the Handling media programming climate, the Arduino programming language is an execution of Wiring, a relative actual figuring stage.

3.2.1 Why using Arduino

Arduino has been utilized in a huge number of various tasks and applications. It runs on Macintosh, Windows, and Linux. Instructors and students use it to construct minimal expense logical instruments, to demonstrate science and physical science standards, or to get everything rolling with programming and mechanical technology. Planners and engineers fabricate intelligent models, performers and craftsmen use it for establishments and to explore different avenues regarding new instruments. Arduino is a critical instrument to learn new things. There are numerous other microcontrollers and microcontroller stages accessible for actual figuring.

These devices take the chaotic subtleties of microcontroller programming and envelop it with a simple to-utilize bundle. Arduino likewise improves on the most common way of working with microcontrollers, yet it offers some benefit for educators, understudies, and intrigued novices over different frameworks.

•Reasonable Arduino boards are somewhat economical contrasted with other microcontroller stages. The most affordable variant of the Arduino module can be collected manually, and, surprisingly, the pre-gathered Arduino modules cost less than 417 Taka.

•Cross-platform - The Arduino Programming (IDE) runs on Windows, Mac OSX, and Linux working frameworks. Most microcontroller frameworks are restricted to Windows.

•Simple, clear programming environment - The Arduino Programming (IDE) is not difficult to-use for beginners, yet adaptable enough for cutting edge clients to exploit too. For teachers, it's advantageously founded on the Handling programming environment, so students figuring out how to program in that climate will be know about how the Arduino IDE works. Here we use Arduino IDE 1.8.1.

•Open source and extensible programming - The Arduino programming is distributed as open source instruments, accessible for augmentation by experienced developers. The language can be extended through C++ libraries, and individuals needing to comprehend the specialized subtleties can take the jump from Arduino to the AVR C programming language

on which it's based. Also, you can add AVR-C code straightforwardly into your Arduino programs in the event that you need to.

•Open source and extensible equipment - The plans of the Arduino boards are distributed under an Inventive Center permit, so experienced circuit designers can make their own rendition of the module, expanding it and further developing it. Indeed, even moderately unpracticed clients can construct the breadboard variant of the module to comprehend how it functions and set aside cash.

Figure 3.1: Arduino IDE Download

Figure3.2 : Arduino NANO

3.3 Soil Moisture Sensor

Two sorts of soil moisture sensors are available in the market — contact and non-contact sensors. A contact soil sensor is utilized in this undertaking since it needs to really look at soil moisture to quantify the electrical conductivity. The moisture sensor gives a simple result, which can undoubtedly be interacted with Arduino. In this task, two sensors can be associated with simple pins A0, of the Arduino board. Every sensor has two pin accessible for connecting with the Arduino board. Here, advanced yield pin (Do) isn't utilized. The water pump and servo motor are constrained by Arduino associated with advanced pins 3 and 9, separately. That is, the servo motor signal control pin is associated with pin 9 of the Arduino board.

CHAPTER 4

Theoretical Model

4.1 Flowchart

Figure 4.1: Flow chart of Project

4.2 Block Diagram of Automatic Irrigation System

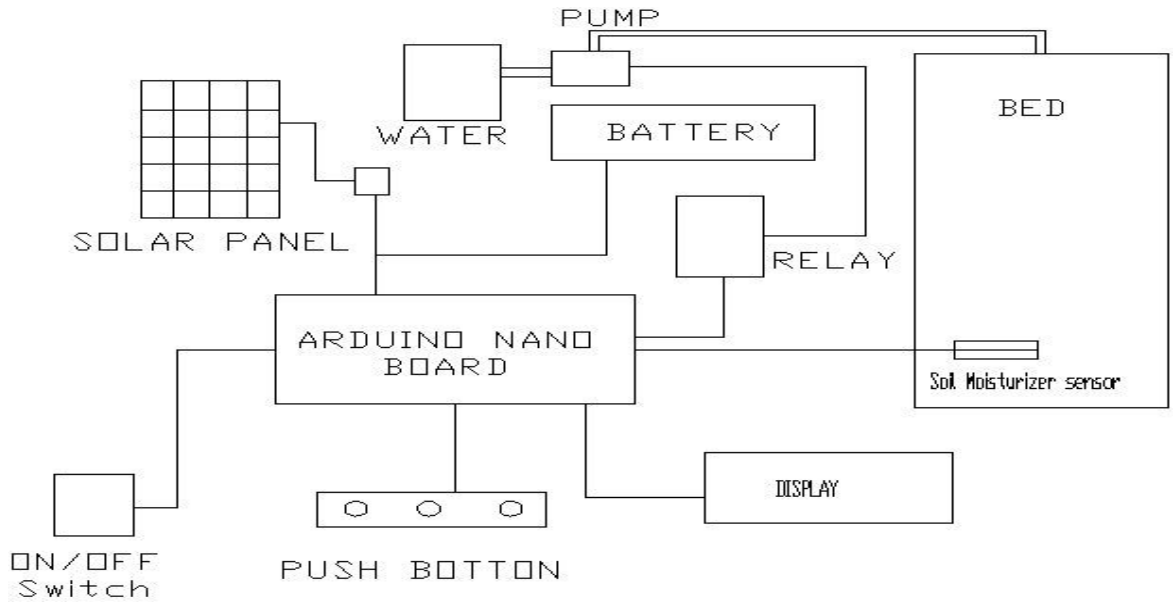

Figure 4.2: Block Diagram of Project

Moisture sensor distinguishes the moister from the plant soil. It conveys simple message to Arduino. Arduino distinguish the signal, process and calculate the information. Arduino send information on LCD. It shows us the information and we can likewise ready to see the information. Each unit is associated with power supply which is an essential for activity.

4.3 Circuit Diagram of Automatic Irrigation System

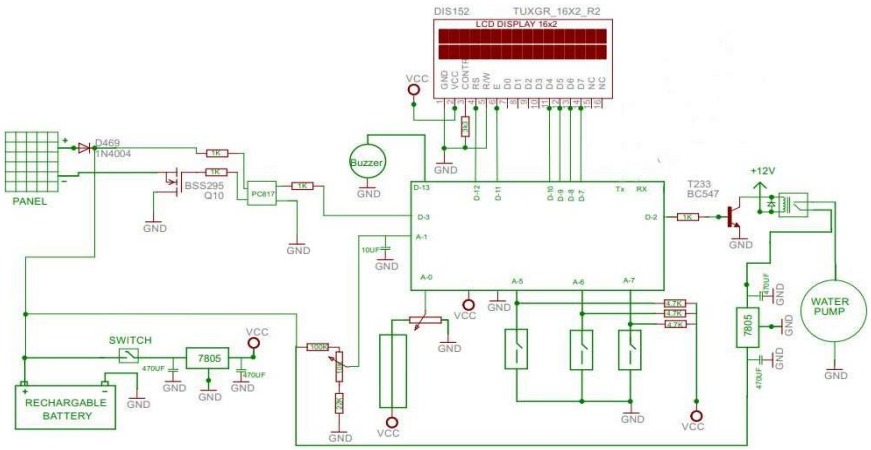

Figure 4.3: Circuit Diagram of Project

Connection of moister screen utilizing moister sensor, Arduino and Bluetooth module is exceptionally simple. Here a liquid crystal display (LCD) is utilized for show the moister which is sent however the moisture sensor. Data pins of LCD to be specific RS, E, D4, D5, D6, D7 are associated with Arduino digital pin number 7, 6, 5, 4, 3, and 2.0ne signal is connected in digital pin 10 and GND.

Moister sensor data is connected with simple A0 and A1 pin Arduino individually. That whole part is controlled by dc 5volt.

4.4 Working procedure

In our project, Arduino Nano is utilized to control the entire cycle, LCD used to show moister level and water pump status .We place our moister sensor into the soil, it distinguishes moisture from soil and sends analog data in Arduino. Presently Arduino get the analog signal and interaction and actually take a look at the condition and choose pump ON or Off, simultaneously compute the sign then it sends the determined information to LCD. We likewise involved buzzer for an advance notice system when our system is ready to work.

CHAPTER 5

Hardware Development

5.1 Components Name and Quantity

Table No 5.1: Components Name and Quantity

SL	Component Name	Quantity
1	Arduino Nano	1Pcs
2	Moister sensor	1 Pcs
3	16X2 LCD	1 Pcs
4	Buzzer	1 Pcs
5	5w/12Volt Dc water Pump	1 Pcs
6	12v/4Ah Battery	1 Pcs
7	20w Solar panel	1 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
11	Ebonite sheet (3.5*6.5)	1Pcs
12	ON/OFF switch	1 pcs
13	Plastic pipe	

5.2 Arduino Nano

A microcontroller board called the Arduino Nano is based on the ATmega328. It contains 6 analog inputs, a 16 MHz crystal oscillator, 14 digital input/output pins (of which 6 can be used as PWM outputs), a USB port, 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.

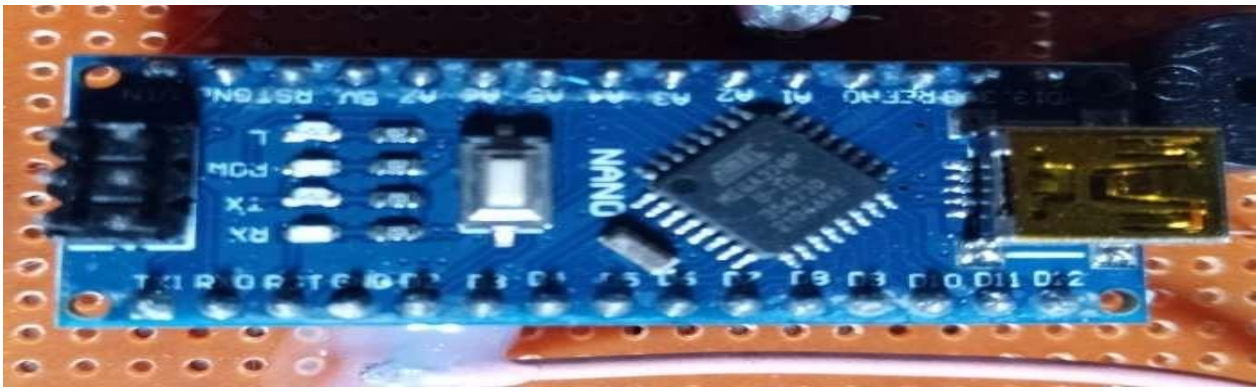

Figure 5.1: Top View of Arduino Nano

5.2.1Technical Specification of Arduino

Table No 5.2: Technical Specification

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

5.2.2 Pin Description of Arduino Nano

Using the pin Mode (), digital Write (), and digital Read () functions, each of the Nano's 14 digital pins can be utilized as an input or an output. They run on 5 volts. A pull-up resistor of

20 to 50 k Ohms is built into each pin, which has a maximum current capacity of 40 mA and is disconnected by default. Additionally, some pins perform specific tasks:

- Serial: 1 and 0 (RX) (TX). used to transmit and receive TTL serial data (RX and TX). The FTDI USB-to-TTL Serial chip's matching pins are connected to these pins.
- 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:

- 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.

5.3 Soil Moisturizer Sensor

The volumetric water content of the soil is measured by soil moisture sensors. Since the removal, drying, and weighting of a sample is necessary for the direct gravimetric measurement of free soil moisture, soil moisture sensors estimate the volumetric water content of the soil indirectly by relying on another soil characteristic, 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.

The soil moisture has an impact on the reflected microwave radiation, which is employed for remote sensing in agriculture and hydrology. Farmers and gardeners can use portable probing tools.

Figure 5.2:Soil moisture Sensor Front View

5.3.1 Hardware Features of Soil moisture Sensor

Table 5.3: 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	

5.3.2 Technology

Typical methods for measuring volumetric water content (soil moisture) indirectly 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.

5.3.3Applications

Agriculture

For agricultural applications, measuring soil moisture is crucial for better irrigation system management by farmers. Farmers are able to generally use less water to cultivate a crop when they are aware of the precise soil moisture conditions in their fields. They are also able to boost yields and the quality of the crop by improved management of soil moisture during critical plant growth stages.

Landscape irrigation

Soil moisture sensors are used in residential lawns and landscapes in urban and suburban settings to communicate 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.

Research

Numerous research applications use soil moisture sensors, including climate research, environmental science, solute transport studies, and as auxiliary sensors for measurements of soil respiration. Other uses include agricultural science and horticulture, which includes irrigation planning.

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.

CHAPTER – 6

Related Hardwares & Accessories

6.1 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

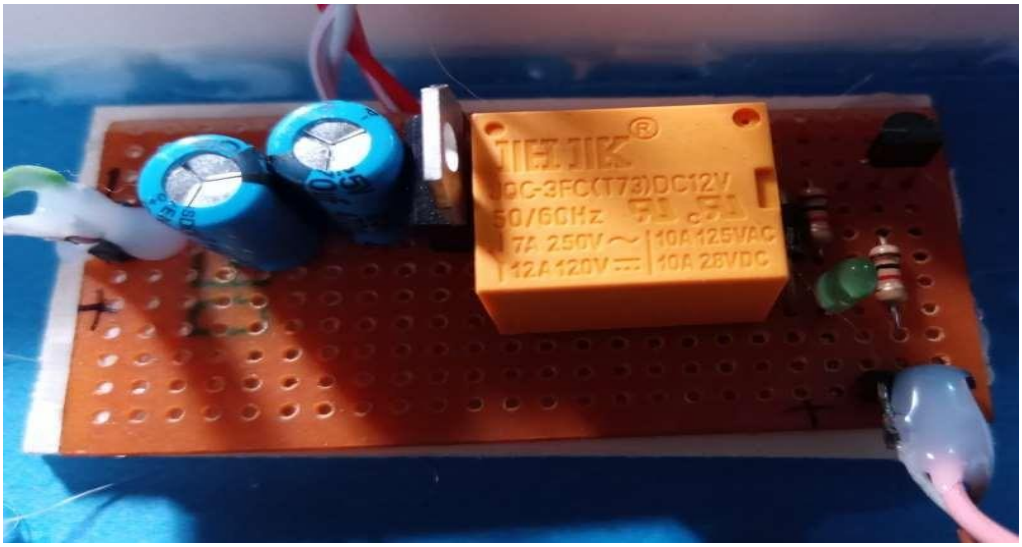

Figure 6.1:Relay Module Top View

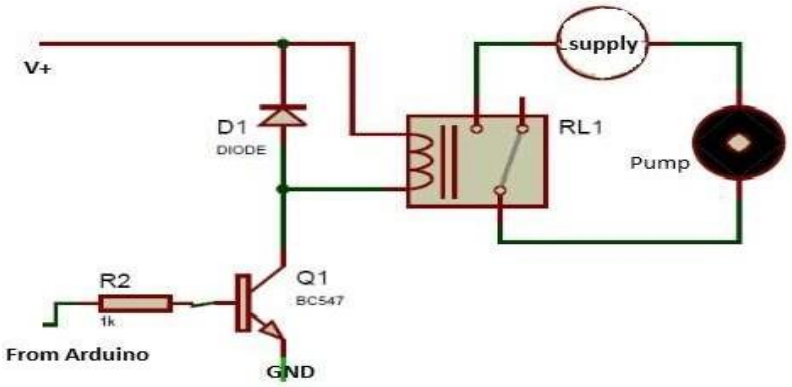

Figure 6.2: Relay Module circuit Diagram

6.2 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.

Figure 6.3:16*2 LCD display

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.

6.3 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.

Figure 6.4: Vero Board (Dot)

6.4 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.

Figure 6.5: piezo buzzer

6.5 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.

Figure 6.6: water pump

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 irrigation 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 irrigation method is more accurate and efficient than the conventional irrigation methods in terms of the amount of the water used for irrigation, 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 irrigation 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 ; Irrigation; Microcontrollers ; Moisture content measurement; Photovoltaic cells : Sensors ; Soil ; Solar Radiation; water pumps; Climate Change; Energy conservation

6.6 ON/OFF Switch

Specifications

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

Figure 6.7: On/off switch

6.7 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.

6.8 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 photo voltaic 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 [2].

CHAPTER -7

Solar Energy

7.1 Solar Energy

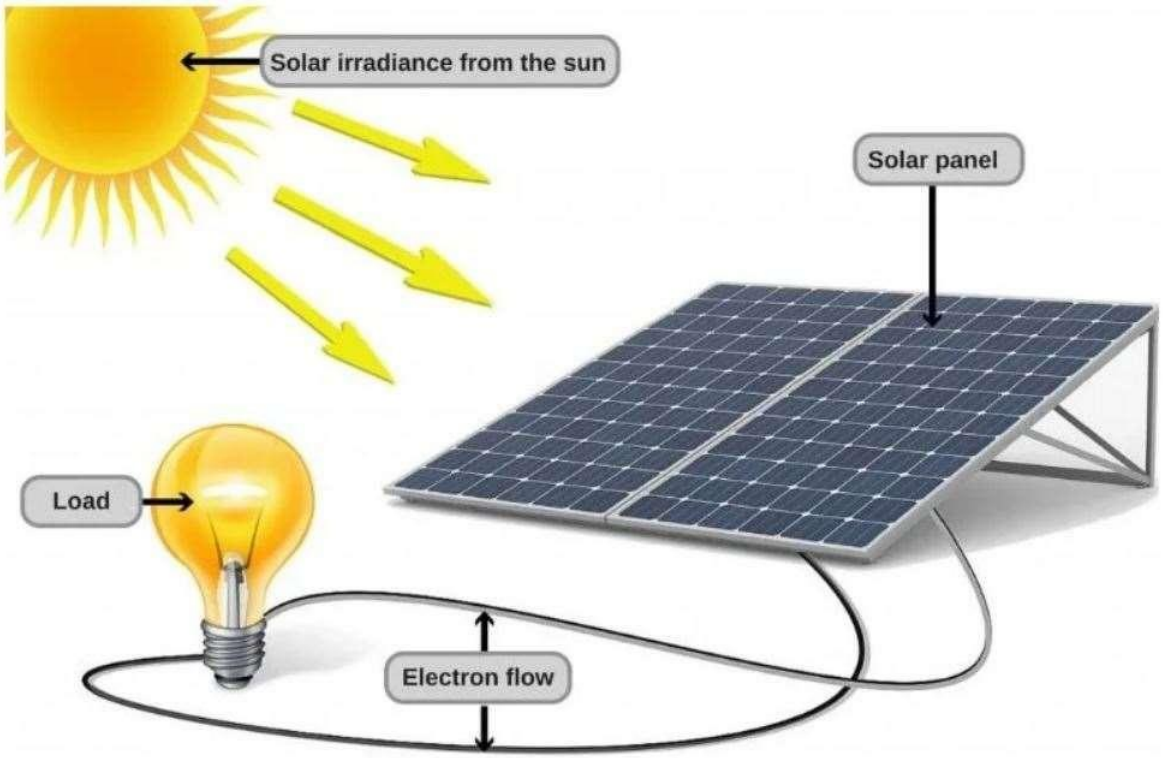

Figure 7.1: Solar Panel

Solar energy is the ultimate source of energy and it is a renewable energy. Solar energy is available in abundance and is a natural energy resource.

This energy consists of radiant light and heat energy from the sun. The sun is an inexhaustible a pollution free source of energy.

Out of all energy emitted by sun only a small fraction of energy is absorbed by the earth. Just this tiny fraction of the sun's energy that hits the earth is enough to meet all our power needs.

Using present solar techniques some of the solar energy reaching the earth is utilized for generating electricity etc. Even then the energy demand met by using solar energy is very less.

The amount of solar energy produced by the sun in an hour, if entirely harvested, can cater to all the power needs of the world for a year. It may sound insane, but it is the truth. It is the reason why most governments & companies are shifting towards solar energy for power sources.

With the increasing population, the demand for energy increases, & the limited resources of fuels won't last long with the rise in consumption. Solar energy can be a great source of non-depleting energy. While the benefits of using solar energy as a power source is unlimited.

7.2 Working Principle of Solar Energy

Solar panels make direct current (DC) electricity as electrons flow one way around a circuit. It's like a battery powering a light bulb. The electrons move from the minus battery side to the lamp's bulb and then return to the battery's positive side.

With alternating current (AC) electricity, electrons are pushed and pulled, occasionally changing direction, like a car engine cylinder. Generators create AC electricity when a wire coil spins near a magnet. There are various types of energy sources that "turn" a generator's handle. Examples are gas or diesel fuel, hydroelectricity, nuclear, coal, wind, or solar.

The U.S. grid uses AC electricity because it is inexpensive to move over long distances. To convert DC into the AC grid, solar panels require an inverter.

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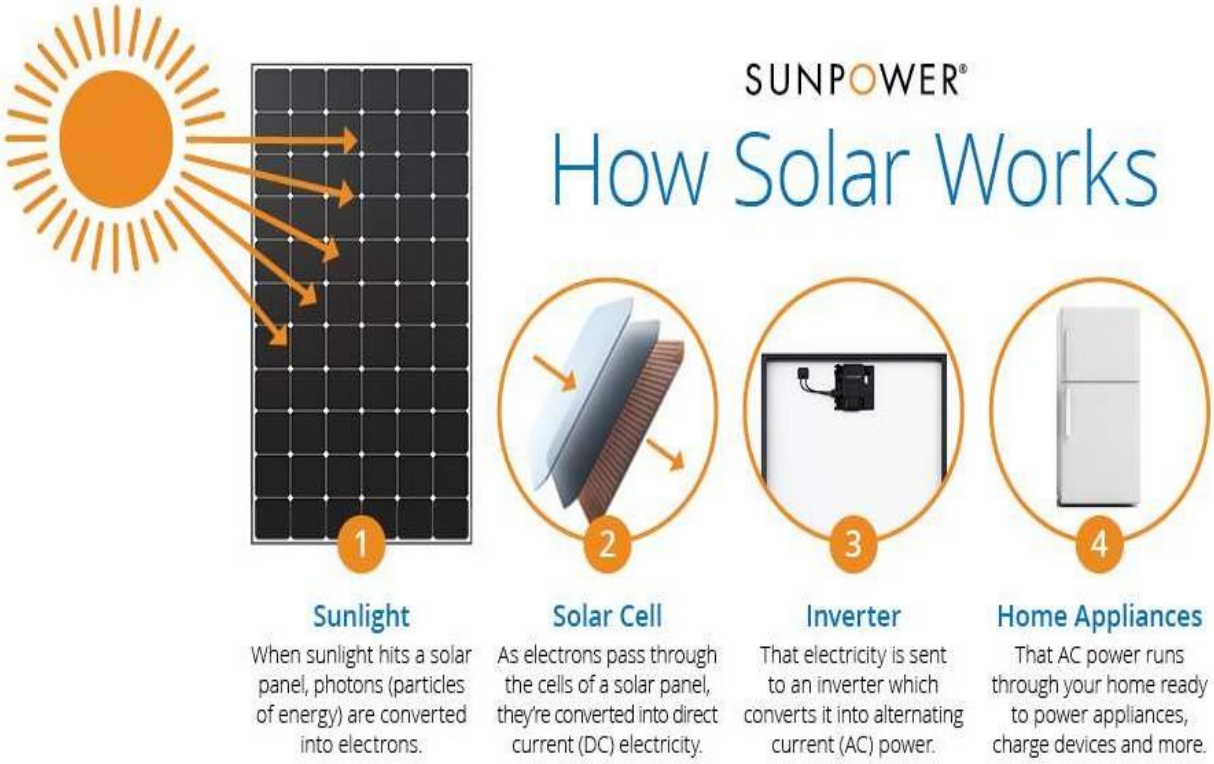

Figure 7.2: How Solar Works

7.3 How does weather affect solar energy?

Low clouds can block light from the sun, which means less solar energy. However, certain cloudy conditions can actually increase the amount of light reaching solar panels. Weather satellites such as those in the GOES-R Series keep an eye on these clouds, which can help scientists make predictions about the capture of solar energy

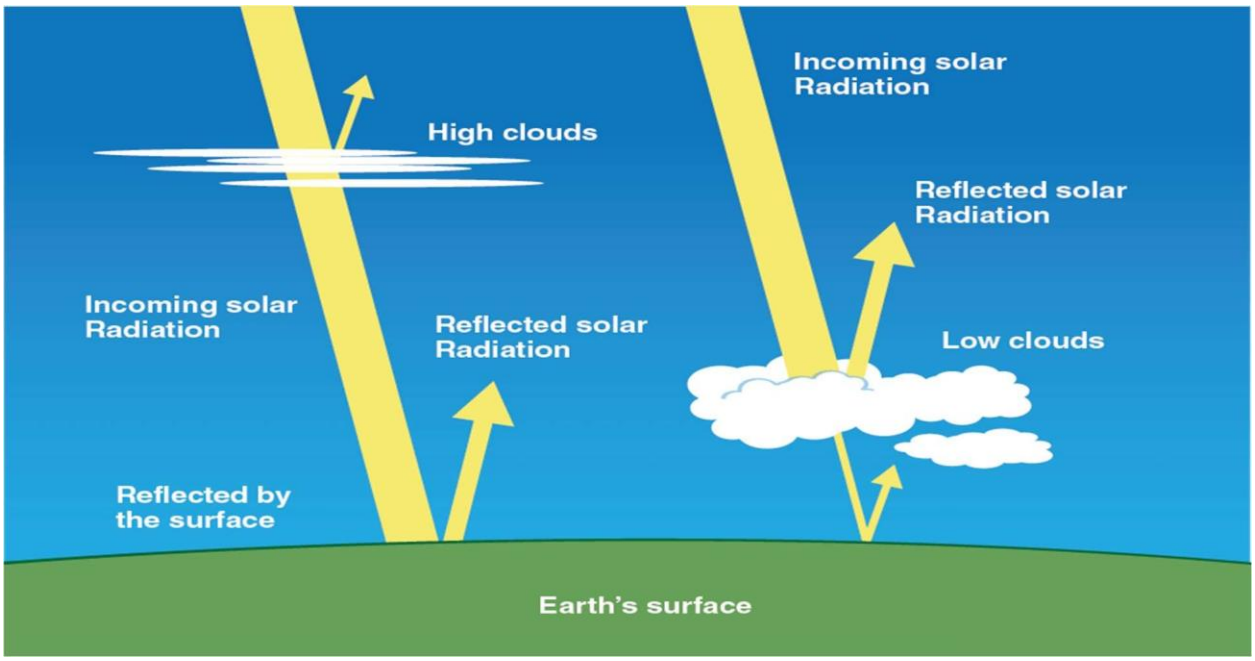

Figure 7.3: How does weather affect solar energy

Life on Earth relies on energy – such as light and heat – from the sun. In fact, energy from the sun, called solar energy, is the most abundant energy resource on Earth. According to the Department of Energy, the amount of sunlight that strikes Earth's surface in 90 minutes is enough to meet the entire world's energy needs for a full year.

I can feel the sun's energy as heat and see it as light. But how do we harness that energy to cook dinner or charge a phone

When sunlight hits low clouds, a lot of that light – and heat – is reflected back into space. When sunlight hits clouds that are high in the atmosphere, those clouds reflect less sunlight energy. However, these high clouds also trap more heat.

Figure7.4: Use of Solar in Arctic

So, if you live in a place that commonly has a lot of low clouds, solar panels might not be able to produce as much energy as they would somewhere else.

However, certain cloudy conditions can be great for the production of solar energy. One example happens when ice crystals inside of high-altitude clouds cause the sunlight to appear brighter than usual. This phenomenon is called cloud leasing because the high clouds act as a lens, focusing the light in a certain region.

More sunlight means more energy, but that's not always a good thing.

People who manage electrical grids – the electricity networks that connect electrical producers with consumers – must keep a careful balance between the energy they generate and the energy their customers consume. This balance is important because unexpected surges in the amount of available electricity can damage electrical devices, or even trigger a power outage. So, producing more solar energy than expected could potentially cause big problem

7.4 How Do Solar Panels Work

1. Solar panels are typically installed on the roof of the home and/or garage. These photovoltaic (PV) cells convert sunlight into direct current (DC) power.

2. The Inverter(s) convert DC electricity from the solar array to the AC electricity found in the building.

3. The inverter feeds electricity into the electrical distribution system.

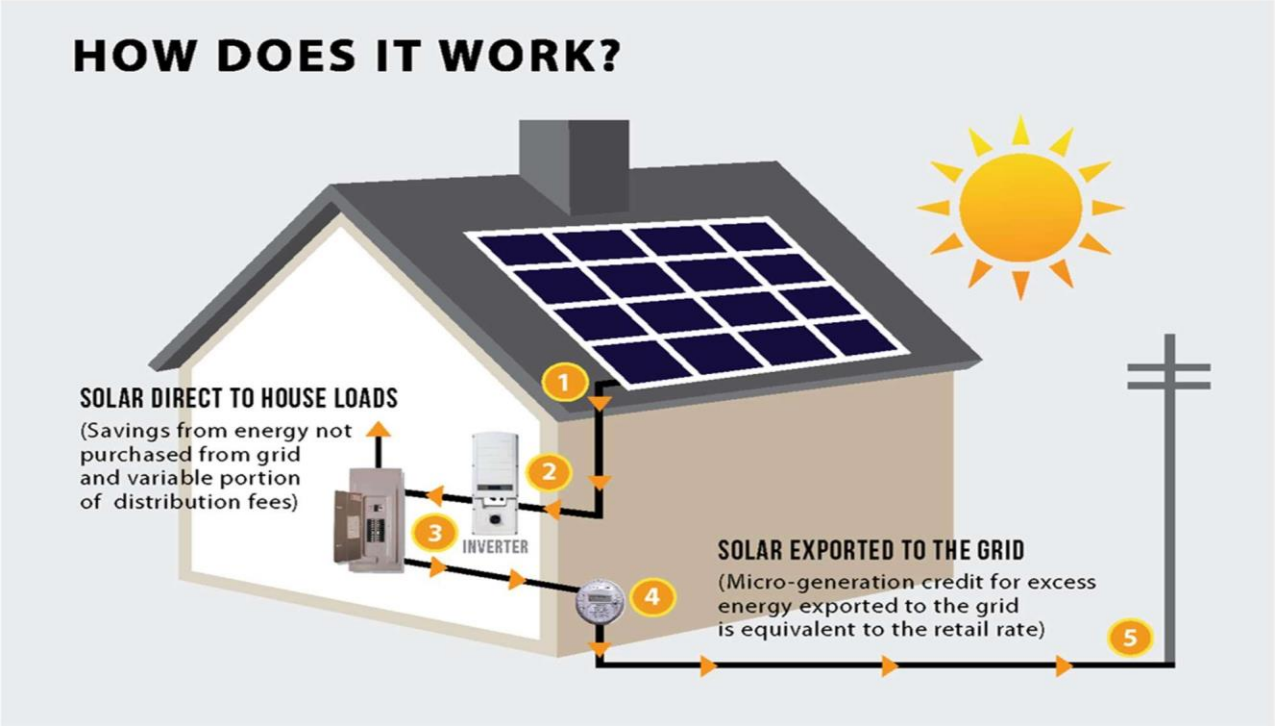

Figure 7.5: How Do Solar Panels Work

4. The bidirectional meter which is supplied free of charge by the Wires Owner, keeps track of both the energy imported from the grid and the energy exported to the grid. Savings and export credits are reflected on your electricity bill.

5. Your home remains connected to the utility grid to supply you with electricity when you need more power than your system is producing, such as at night.

7.5 How Do Solar Panels Generate Electricity?

The Sun is a source of energy we use to generate electricity. This is called solar power. In Canada, we had the ability to generate 2821 megawatts in 2019. This is more than 16 times what we could generate ten years ago. This is enough electricity to power about 260 440 Canadian households for a year. Although solar power only makes up about 0.5% of our total electricity generation, solar power is increasing in the world.

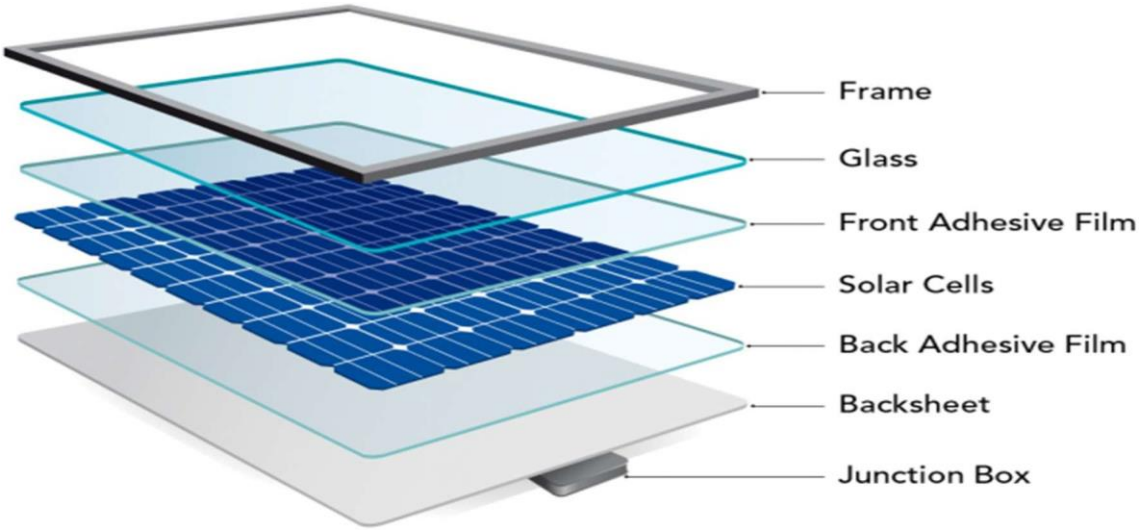

Figure 7.6: Parts of a Solar Panel

Solar power converts energy from the Sun into electrical energy. One way to do this is with photovoltaic materials. These can be used to create an electric current when they're exposed to light. This is called the photovoltaic effect. Photovoltaic cells or solar cells can do this. Manufacturers often put lots of solar cells together to make solar panels.

A solar panel is made of solar cells sandwiched between layers of clear adhesive film. In front of this is a layer of glass held by a frame. Behind is a layer of aluminum called the back sheet which can conduct electricity? The electricity generated by the solar cells leaves the solar panel at the junction box.

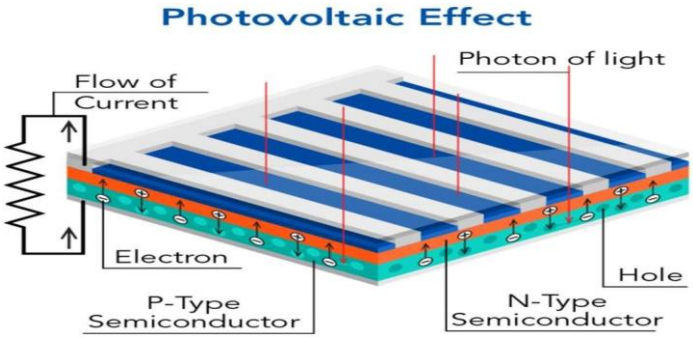

Figure7.7: Photovoltaic Effect

CHAPTER – 8

RESULT AND DISCUSSIONS

8.1 Introduction

Result presents the success as well as the satisfaction. It inspires us to work and keep it up. In this chapter, we show our experiment result and briefly discuss about that. Here also show the cost analysis of our project in this chapter

8.2 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 was 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.

8.3 Project Physical View

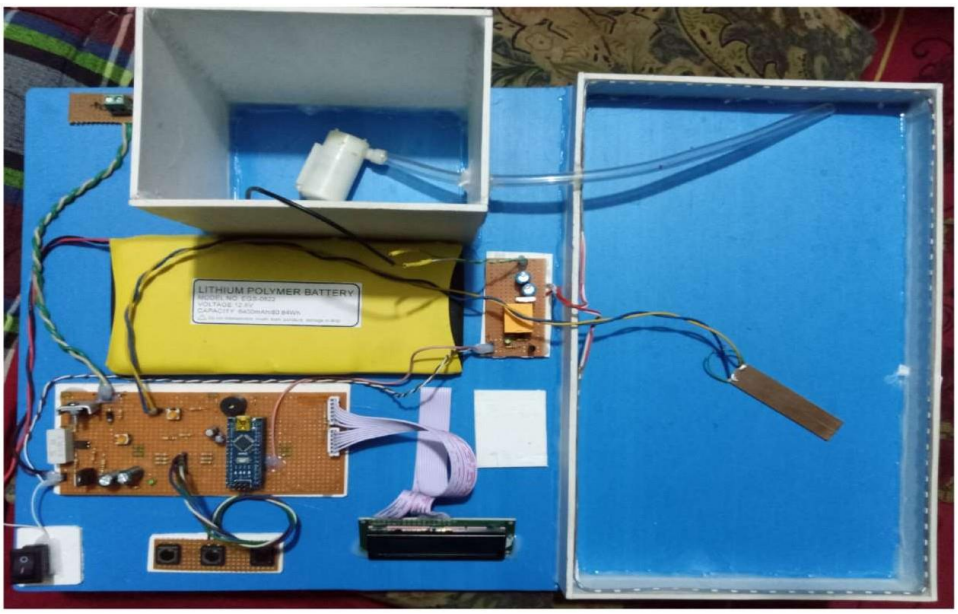

Fig 8.1: Physical View of Project

8.4 Total Project Cost, Quantity and Price

Table 5.1: Equipment Cost

SL	Equipment Name	Quantity	Price(TK)
1	Arduino Nano	1	520
2	20w Solar panel	1	1500
3	12v/4Ah Battery		1100
4	1 channel Relay module	1	250
5	LCD 16*2	1	200
6	Transformer 220/09	1	250
7	PVC White Board	As necessity	80
8	Plastic Meter Board	2	350
9	Vero Board	1	60
10	Glue	7	140
11	Pump	1	480
12	Connecting Wire	As necessity	300
13	DC socket	2	45
14	Piezo buzzer	1	60
15	TIP 122	1	90
16	ON/OFF switch	1	20
17	Soil Moisture sensor	1	200
18	Mini breadboard	1	60
Total Project Cost = 5705 Tk			

8.5 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

8.6 Discussion

The main objective of this project is to design a low cost device in order to control the water pump automatically. This automatic irrigation system senses the moisture content of the soil and automatically switches the pump when the power is on. A proper usage of irrigation 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 irrigation 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 irrigation 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 irrigation 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 irrigation systems.

8.7 Summary of the Results and discussions

In this chapter, we briefly discuss and show the result of our experiment. Here, we show several outputs and try to make it easier. And we also Advantages and added the cost analysis. So, we hope that this project will be helpful for gardener and farmer their garden and plant watering.

CHAPTER – 9

CONCLUSIONS

9.1 Conclusions

The primary applications for this gardeners and farmers who need more opportunity to water their yields/plants. It likewise covers those ranchers who are inefficient of water during irrigation. The project can be stretched out to nurseries where manual management is far and not in the middle between. The standard can be stretched out to make completely automated nurseries and farmlands. Joined with the rule of downpour water harvesting, it could prompt enormous water reserve funds whenever applied in the correct way. In farming grounds with serious shortage of rainfall, this model can be effectively applied to accomplish extraordinary outcomes with most kinds of soil.

9.2 Limitations of the work

In the load shading period the machine will be switch off and estimating cycle will likewise switch off naturally. By adding the battery backup, we can eliminate this issue. Acknowledge it, we are getting some clamor from our sensor. By adding a superior sensor, we can eliminate this issue. This moister take-up technique depends upon a few assumptions and it has been demonstrated the way that the outcomes can stray up to 10% from the genuine worth.

9.3 Future scope of the work

This project can be additionally evolved in future by adding GSM module to make an instant message or call for caution.

CHAPTER 10

Obstacles

10.1 Problem faced to make project.

* We face many kinds of problems to make this project.

* When we think we will make this project, we were in confusion that how we will design our project & will be success in this project or not?

* When we go to buy our projects parts like battery motor & others things then we face that, how many prices of these parts.

* First time, when we run this, then

Motor has cracked.

* We collect those components from different places of Dhaka.

* We collect many kinds of data from different link like website, YouTube etc.

* We work on this project from many days ago.

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Ref#3.https://youtu.be/GHfr_8nRH6o

Ref#4.https://youtu.be/i7g_k8_kCDQ

Ref#5.https://youtu.be/uzq5l5thxXw

Ref#6.https://youtu.be/sCaT3Iurqwk

Ref#7.https://youtu.be/mm-n45_84u8

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Ref#2.Our friends.

APPENDIX

Program Description:

```
#include <LiquidCrystal.h>

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

int relay1=8;

int relay2=9;

int buz=11;

void setup() {

   lcd.begin(16, 2);

 // Print a message to the LCD.

 lcd.setCursor(0,0);

 lcd.print(" Automatic");

 lcd.setCursor(0,1);

 lcd.print("irrigation Systm");

 delay(2000);

 lcd.clear();

 lcd.setCursor(0,0);

 lcd.print("Al-amin Kowser,");

 lcd.setCursor(0,1);

 lcd.print("Mokter,Arif,

 Iftekhar"); delay(2000);

 lcd.setCursor(0,0);

 lcd.print("ID: 133-33-1637");
```

```
  lcd.setCursor(0,1);
 lcd.print("ID: 133-33-1577");
 delay(2000);
 lcd.clear();
 pinMode(relay1,OUTPUT);
 pinMode(buz,OUTPUT);
 digitalWrite(buz,HIGH);
 delay(1000);
 digitalWrite(buz,LOW);
}
void loop()
{
 int sensorValue = analogRead(A0);
 int sensorValue2 = analogRead(A1);
 delay(100);
 // apply the calibration to the sensor reading
 sensorValue = map(sensorValue, 200, 1017, 100, 0);
 sensorValue2 = map(sensorValue2, 200, 1017, 100, 0);
 lcd.clear();
 lcd.setCursor(0,0);
 lcd.print("Wet1=");
 lcd.setCursor(5,0);
 lcd.print(sensorValue);
```

```
  lcd.setCursor(8,0);
  lcd.print("%");
  lcd.setCursor(0,1);
  lcd.print("Wet2=");
  lcd.setCursor(5,1);
  lcd.print(sensorValue2);
      lcd.setCursor(8,1);
  lcd.print("%");
if ((sensorValue<80) && (sensorValue2<80)  )
{
  digitalWrite(relay1,HIGH);
  digitalWrite(relay2,HIGH);
  lcd.setCursor(10,0);
  lcd.print("M1=ON ");
  lcd.setCursor(10,1);
  lcd.print("M2=ON ");
}
else if ((sensorValue<80) && (sensorValue2>80))
{
  digitalWrite(relay1,HIGH);
  digitalWrite(relay2,LOW);
  lcd.setCursor(10,0);
```

```
  lcd.print("M1=ON ");

  lcd.setCursor(10,1);

  lcd.print("M2=OFF");

}
else if ((sensorValue>80) &&  (sensorValue2<80) )
{

  digitalWrite(relay1,LOW);

  digitalWrite(relay2,HIGH);

  lcd.setCursor(10,0);

  lcd.print("M1=OFF");

  lcd.setCursor(10,1);

  lcd.print("M2=ON ");

}
else if ((sensorValue>80)&& (sensorValue2>80) )
{

  digitalWrite(relay1,LOW);

  digitalWrite(relay2,LOW);

  lcd.setCursor(10,0);

  lcd.print("M1=OFF");

  lcd.setCursor(10,1);

  lcd.print("M2=OFF");

}
```

```
else
    {
    //Serial.print("no match found");
    }
```