

SOLAR BASED AUTO IRRIGATION SYSTEM

BY

SAJAL MITTRA

ID: 151-15-5079

AND

MD. NAZMUL HUDA

ID: 142-15-3470

This Report is submitted to the Department of Computer Science for Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering.

Supervised By

MOST. HASNA HENA

Senior Lecturer

Department of CSE

Daffodil International University

Co-Supervised By

MR. SAIFUL ISLAM

Lecturer

Department of CSE

Daffodil International University



DAFFODIL INTERNATIONAL UNIVERSITY

DHAKA, BANGLADESH

DECEMBER 2018

APPROVAL

This Project titled “**Solar Based Auto Irrigation System**”, submitted by **SAJAL MITTRA, ID NO: 151-15-5079** and **MD. NAZMUL HUDA, ID NO: 142-15-3470** to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering (BSc) and approved as to its style and contents. The presentation has been held on **9 December 2018**.

BOARD OF EXAMINERS

Dr. Syed Akhter Hossain
Professor and Head

Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

Chairman

Dr. Sheak Rashed Haider Noori
Associate professor & Associate Head

Department of CSE
Faculty of Science & Information Technology
Daffodil International University

Internal Examiner

Md. Zahid Hasan
Assistant Professor

Department of Computer Science and Engineering
Daffodil International University

Internal Examiner

Dr. Mohammad Shorif Uddin
Professor

Department of Computer Science and Engineering
Jahangirnagar University

External Examiner

DECLARATION

We hereby declare that, this project has been done by us under the supervision of **MOST. HASNA HENA, Senior Lecturer, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree.

Supervised by:

MOST. HASNA HENA
Senior Lecturer
Department of CSE
Daffodil International University

Submitted by:

SAJAL MITTRA
ID: 151-15-5079
Department of CSE
Daffodil International University

MD. NAZMUL HUDA
ID: 142-15-3470
Department of CSE
Daffodil International University

ACKNOWLEDGEMENT

First we express our heartiest thanks and gratefulness to almighty God for His divine blessing makes us possible to complete the final year project successfully.

We really grateful and wish our profound our indebtedness to **MOST. HASNA HENA, Senior Lecturer**, Department of CSE Daffodil International University, Dhaka for remain kind enough to us and making our path easy to complete the project with her deep knowledge in the field of “**DEVELOPMENT PROJECT**” to carry out this project. Her 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 **MOST. HASNA HENA**, Senior Professor, Department of CSE for his kind help to finish our project and also to other faculty member and the staff of CSE department of Daffodil International University.

We would like to thank our entire course mate in Daffodil International University who took part in this discuss while completing the course work.

Finally, we must acknowledge with due respect the constant support and patients of our parents.

ABSTRACT

Agriculture is the source of living of majority for Bangladeshi and it also has a countless influence on economy of the country.

This paper involves the development and formation of automatic irrigation using solar system that uses sensor that determines soil moisture by water level indicator also its pumping system that aims to deliver the needed water based on the assigned soil moisture value. We know that people do not pour the water on to the plants in their gardens when they go to vacation or often forget to water plants. As a result, there is a chance to get the plants damaged. The project we have undertaken is “**Solar Based Auto Irrigation System**”. This project is taken up as BANGLADESH is an agriculture oriented country and the rate at which water resources are depleting is a dangerous threat hence there is a need of smart and efficient way of irrigation. In this project we want to work with renewable energy, solar system. Because of about 40% of the population in Bangladesh having no access to electricity. Now a day’s solar energy is cheaper than electricity. This paper also discusses the prototype design of microcontroller based on water irrigation which detects a soil if watering is required then the water will be maintained at the constant level. If the specific area is irrigated too much with water, there are possibilities that the plant may die due to excessive irrigation. The proposed system uses a microcontroller basically a platform device called Microcontroller where soil moisture sensors are connected in its internal and external ports. It will deliver the needed water according to our verification on soil moisture.

TABLE OF CONTENTS

CONTENTS

Board of examiners.....	ii
Declaration.....	iii
Acknowledgements.....	iv
Abstract.....	v

CHAPTERS

CHAPTER 1: Introduction	1-3
1.1 Introduction	1
1.2 Motivation	1-2
1.3 Objectives	2-3
1.4 Expected Outcome	3
1.5 Report Layout	3
 CHAPTER 2: Background	 4-5
2.1 Introduction	4
2.2 Related Works	4
2.3 Comparative Studies	4-5
2.4 Scope of the Problems	5
2.5 Challenges	5
 CHAPTER 3: Requirement Specification	 6-16
3.1 Business Process Modeling	6
3.2 Requirement Collection and Analysis	7
3.3 Block Diagram and Description	8

3.4 Logical Data Model	9
3.5 Design Requirements	9-16
CHAPTER 4: Design Specification	17-20
4.1 Front-end-Design	17
4.2 Back-end-Design	18
4.3 Interaction Design and UX	19
4.4 Implementation Requirements	20
CHAPTER 5: Implementation and Testing	21-22
5.1 Introduction	21
5.2 Implementation of Database	21
5.3 Implementation of Front-end-Design	21
5.4 Implementation of Interaction	21
5.5 Testing Implementation	21
5.6 Test Result and Reports	22
CHAPTER 6: Conclusion and Future Scope	23
6.1 Discussion and Conclusion	23
6.2 Scope for Further Developments	23
REFERENCES	24

LIST OF FIGURES

FIGURES

Figure 3.1: The business process modeling steps of our project.....	7
Fig-3.3: Block Diagram of Solar Based Auto Irrigation System.....	8
Fig-3.5.1: Solar charge controller of our project instrument.....	9
Fig-3.5.2: Battery of our project instrument.....	10
Fig-3.5.3: Solar Inverter of our project instrument.....	11
Fig-3.5.4: ATmega 328p Microcontroller of our project instrument.....	12
Fig-3.5.5: LCD display of our project instrument.....	13
Fig-3.5.6: Solar panel of our project instrument.....	14
Fig-3.5.7: Relay of our project instrument.....	15
Fig-3.5.8: Soil moisture sensor of our project instrument.....	16
Fig-3.5.9: Arduino Uno R3 of our project instrument.....	17
Fig: 4.1 Front-end-design of our project.....	18
Fig-4.2: Back-end-design of our project.....	19
Fig-4.3: Total View of our project.....	20

CHAPTER 1

Introduction

1.1 Introduction

As we realize that Bangladesh economy is one of the biggest creating economies of the world. The rural part has its biggest commitment in the Bangladesh economy. To accomplish most extreme use of labor and to get greatest benefit in a given stipulated there is a need in the up degree of different designing strategies that are being utilized today. In this manner keeping up legitimate measure of water level in the dirt is one of the essential prerequisites to reap a decent product for appropriate development. On the off chance that we discuss Bangladeshi ranchers they are most noticeably bad hit by the starvation that happens because of disappointment of yields relying on different dry season factors. The over usage of ground water has radically lessened the ground water level over the most recent 15 years. So it is the need of hour to use every last drop of water carefully so it can likewise be utilized by our coming ages moreover. The advancement of our activities will achieve our objective of economical improvement and additionally to remove the outflow of ozone harming substances to a base dimension. As the name of our venture that is AUTOMATIC IRRIGATION SYSTEM with the assistance of the Solar power is a stage to use some new building methods. This venture will be a decent alternative for the little and medium agriculturists who endure each year since disappointment of yields that occurred each year. The usage of this undertaking has a wide degree in the close-by future.

1.2 Motivation

In our daily life, water is essential for us. It is considered to be basic need of human beings, animals, plants etc. water shortage is one of the biggest problem in the world. There should be a solution in this kind of problem. It is no other than water conservation. We have alternative methods developed for the conservation of water. Plants are also essential to human life. Plants need water in order to make their food. Water is one of the basic needs for plant growth. But we must consider such potential situations in watering our plants such

as SOIL MOISTURE SENSING WATER IRRIGATION watering too much, too little and of course, just enough for us to sustain and maintain the plant growth. Keeping your plant properly watered is essential to its health. An automatic water irrigation system project which can also be useful and be able to the environment. This project design study to focus on soil condition of a certain grass/plantation area and determine when the plants need to acquire adequate water. Soil moisture is an essential in monitoring of plant growth. Soil moisture determines the water content of the soil. We will develop a device that will determine the moisture level of the soil. It will help water irrigation system and gives sufficient water for the plants to reach their full growth.

1.3 Objectives

The primary target of this venture was to structure a little scale flooded framework that would utilize water in more efficient route with the end goal to avert overabundance water misfortune and limit the expense of work. The accompanying viewpoints were considered in the decision of structure arrangement

- Installation Cost
- Water Saving
- Human Intervention
- Reliability
- Power Consumption
- Maintenance
- Expandability

The water saving was also an important feature, since there is demand to decrease water loss and to Maximize the efficiency used. The Power consumption must also be monitored.

This is to develop an automated irrigation system by implementing a controlled technique to meet soil moisture requirement that will contribute to water conservation and minimize the labor in the field of gardening.

Specifically, the study aims to:

1. Develop a program for our project using a microcontroller that will process the data from the sensor and control the whole irrigation system;

2. Identify the amount of water to be delivered that will assist in maintaining the level of soil moisture sensor monitor the level of water tank which stores the water that will aid in the irrigation system; and
3. Test the effect of varying moisture content of the soil to the plants with the following indications, at lower than optimized level, at optimized level, and at higher than optimized level.

1.4 Expected Outcome

Irrigation system is simple and cheap for our project. It is more labor intensive and wastes water. If water is brought into the system manually, this requires high labor input. On the other hand, it is important to check the systems and to improve the production and avoid water loss on the plantation. In addition, water costs and increasing water demands, gardeners need to be concerned about conservation.

1.5 Report Layout

Looks is the most important part for anything we present. So report layout is very important to represent our project report. We try to represent our project in a report paper according to chapter by chapter. Every information about project describes here. There are 1 to 6 chapters where represents from initial to final development process. Chapter 1 we discuss only our project introduction, chapter 2 depends on background, chapter 3 represents requirement model, chapter 4 is design part, chapter 5 represent implementation and testing, chapter 6 we discuss conclusion and our future scope. We add some references where we take help our project.

CHAPTER 2

Background

2.1 Introduction

People have to learn small things before doing a big achievement. Success always depends on hard work. We have done a satisfactory project that will be helpful. We completed our cse course, all previous knowledge need to fulfill our project. Solar Based Automatic Irrigation System is a development project for the farmers. We need to study and proper ideas about the system design, embedded system, Electric Circuit design and Digital Electronics for better knowledge about instrument of our our project. We are very grateful to our course teacher. They make us understood about basic knowledge of this course. We have done simple class project during that time. All the knowledge, information, practice make us confident to complete this project.

2.2 Related Work

Before doing our project, we have seen some projects which is related with our project.

- Irrigation System
- Smart Irrigation System
- Herb Box Eco System
- Plant Watering System

2.3 Comparative Studies

When we are thinking about farmer related project, we want to do something for farmer which is helps our farmer and our farmers take this opportunity and they done their work very easily. So we research about farmer's related project and we find out some problem. We find out some irrigation system which are not auto system. Some project have smart system which is control smart phone but in that case farmer have to attend in land. But we want try such kinds of a system which is controlled automatic. If any case farmer can't go his land but irrigation will continue according to need of land. So we develop that project.

2.4 Scope of Problems

We realize that Irrigation framework is more work concentrated. Also, it squanders water. Regardless of whether water is brought into the framework physically, this needs high work input. With the end goal to realize that it is essential to check the frameworks and to enhance the creation and dodge water misfortune on the manor.

2.5 Challenges

In our every day life, water is critical to us. It is viewed as fundamental need of individuals, creatures, plants and so forth. Be that as it may, now days, water deficiency is getting to be one of the most serious issue in our nation. There ought to be an answer in this sort of issue. It is no other than water protection. Farmers use their normal irrigation system. But in this system water loss and time loss, so we solve this problem and easy to do this system.

We have some challenges that we complete our project. They are given below:

- Sensor detection of our project
- In the same time continues irrigation with various land
- We use best solar because of weather
- Better Performance

CHAPTER 3

Requirement Specification

3.1 Business Process Modeling

It refers to map out regular business process and find ways to improve them. Process modeling gives an analytical representation and makes them more efficient. It is a standard method of illustrating processes.

There are some benefits of business process modeling:

- Everyone can see how the framework functions.
- Provides consistency.
- Controls the entire procedure.
- Identifies redundancies.
- Eliminates wasteful aspects.
- Gives an unmistakable beginning and completion of the procedure.
- Helps clients bunch comparable process together and envision how they work.
- Analyzes how things are at this moment and
- How they ought to be completed to accomplish better outcome.

The modeler is one of the most important things in BMPS. We ought to invest a ton of energy to learn it before resolving to purchase a suite.

Incredible modeling instruments ought to be:

- Easy to learn for the business department.
- Simple for communicate with other department.
- Less expensive.
- Capability of simulating workflow before implementing.

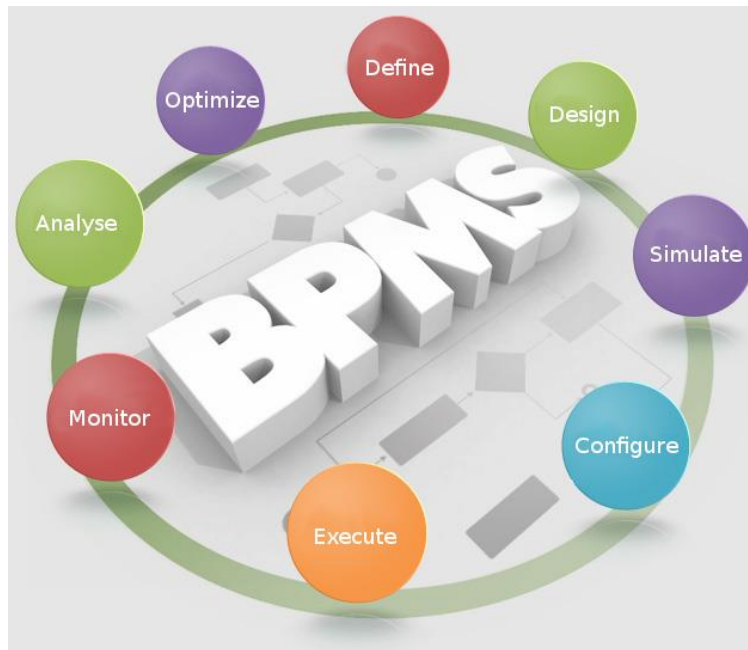


Figure 3.1: The business process modeling steps

3.2 Requirement Collection and Analysis

There are various requirements to complete our project. Some of them are given below:

- Need a mono-crystal solar panel charges from the sun.
- Solar charger controller MAX 6A-12V, 10W-50W detects high, medium, low charge level.
- Battery 12V, 7.5AH stores charge.
- Motor AC 220V, 50HZ, 15W serve water.
- Inverter 500W, DC 12V to AC 220V converts current.
- Relay channel connects equipment.
- Soil moisture sensor uses for water level.
- Arduino Uno R3 for control whole project.
- LCD display to show output and input.
- ATmega 328p Microcontroller for program saving.
- Using Wire for connecting one device to another device.

3.3 Block Diagram and Description

As shown Fig: 5.1 Block Diagram of Solar Power Auto Irrigation System. At first solar panel gather charge from the sun then by using solar charge controller, battery stores charge. Then inverter convert charge DC to AC. In addition, Inverter connected to relay channel. Relay channel creates two side connection. One part is connected to water pump and another part is connected to microcontroller. On the contrary, microcontroller connected to soil moisture sensor. This soil moisture sensor detects water level and on-off motor.

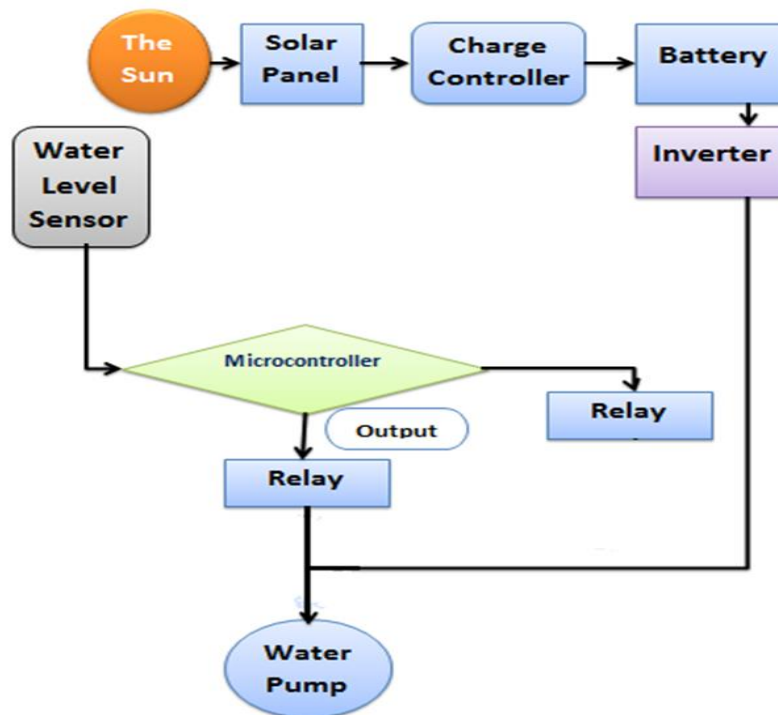


Fig-3.3: Block Diagram of Solar Based Auto Irrigation System

3.4 Logical Data Model

A logical data model refers to describe the data in details without regard to how the will be physical implemented in circuit. It is the technique of representing data architecture and organization in a graphical way. It provides information about various circuit relationship. There are some features of logical data model:

- Having all connections and relationship among them.
- Includes all attributes for each entity that is specified.
- Moisture sensor is specified for each entity.

3.5 Design Requirement

To design our project, we use lots of material. Some of them are given below:

3.5.1 Solar Charge Controller

As shown in Fig: 3.5.1 solar charge controllers is a device to produce electricity from the only source of our solar system that is sun. On the other hand, It is very effective to achieve the daily power demand. Solar charge controller provides a freedom to produce own electricity with a single invest of establishment.



Fig-3.5.1: Solar charge controller

While A sun oriented charge controller is a voltage or flow controller to charge the battery and shield electric cells from over-charging. Generally, it requires around 12V to get completely charged. The range of charge controllers are from MAX 6A, 10W-50W that we use. [1]

3.5.2 Battery

As shown in Fig: 3.5.2 the Battery is an electric device, used to store solar energy and supplied to the equivalent loads. [2]

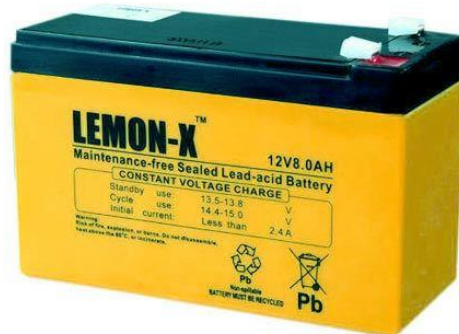


Fig-3.5.2: Battery

3.5.3 Inverter

From Fig: 3.5.3 The inverters converted into Direct Current (DC) to Alternating Current (AC). While The inverters work by taking in power from a Direct Current (DC). The power is generated in the range of DC 12V to AC 220V. By the inversion process, DC power is converted into AC power. We use 500W for our project purpose. There are some features about inverter: [3]

- High efficiency and outstanding energy harvest in a modular design.
- Save time and money.
- Central and micro inverters can be up to 95% efficient.



Fig-3.5.3: Solar Inverter

3.5.4 ATmega 328p Microcontroller

As shown in Fig: 3.5.4 The ATmega328p is a single-chip microcontroller created by Atmel in the mega AVR family. It has a modified 8-bit RISC processor core. [4]

Features include:

- High Performance, Low Power Design.
- 8-Bit Microcontroller Atmel AVR advanced RISC architecture.
- Memory Includes.
- Features Include.
- Additional Features.
- I/O and Package.
- Operating voltage.
- Operating temperature range.

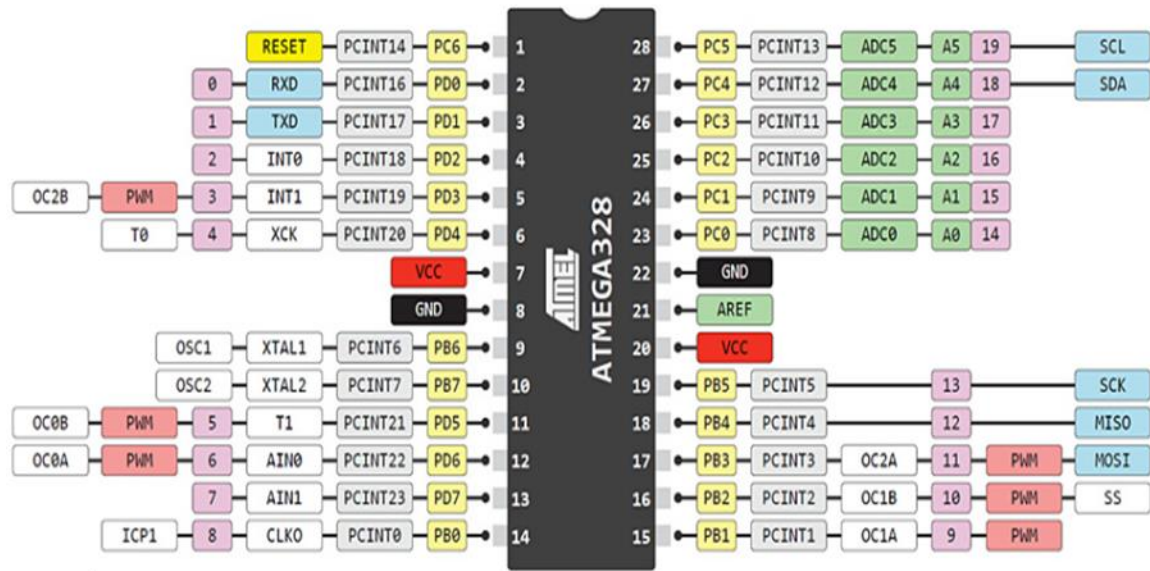


Fig-3.5.4: ATmega 328p Microcontroller

3.5.5 LCD (Liquid Crystal Display)

LCD is a liquid crystal display to produce a visible image. For displaying input and output LCD display is more useful and very effective. [5]

Features include:

- Good color reproduction
- Very thin
- Lightweight
- Perfect sharpness at native resolution
- Excellent longevity
- No screen burn-in effect
- Do not flicker like CRT

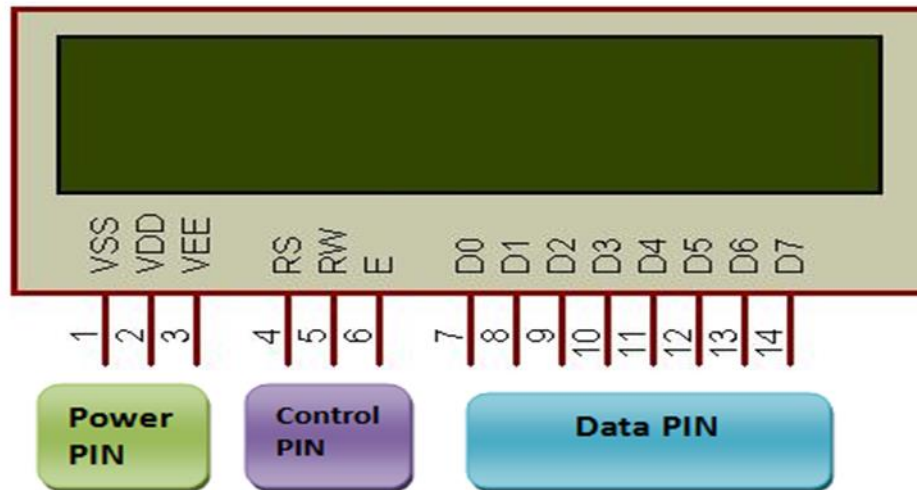


Fig-3.5.5: LCD display

3.5.6 Solar Panel

We know that a solar panel charges from the sun. [6]

Features include:

- Infinite sources
- It is Free-of-charge
- It does not cause any pollution
- It is low power consuming devices can be powered by solar energy effectively
- Solar panel Cleans energy
- It is very cheap
- High intensity in summer season



Fig-3.5.6: Solar panel

3.5.7 Relay

A relay is an electromagnetic switch. It is utilized applications to turn on and a circuit by a low power flag or where a few circuits must be controlled by one flag. Which is Shown in Fig: 3.5.7 [7]

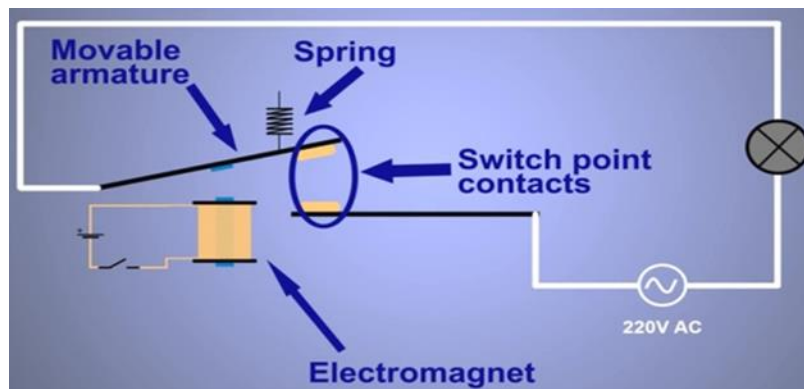


Fig-3.5.7: Relay

3.5.8 Soil Moisture Sensor

As shown in Fig: 3.5.8 Soil moisture sensors measure the volumetric water content in soil. As we realize that property and soil dampness must be aligned and may differ contingent upon natural factors, for example, soil type, temperature, or electric conductivity. Then again, reflected microwave radiation is influenced by the dirt dampness. Likewise, it is utilized for remote detecting in hydrology and farming. [8]

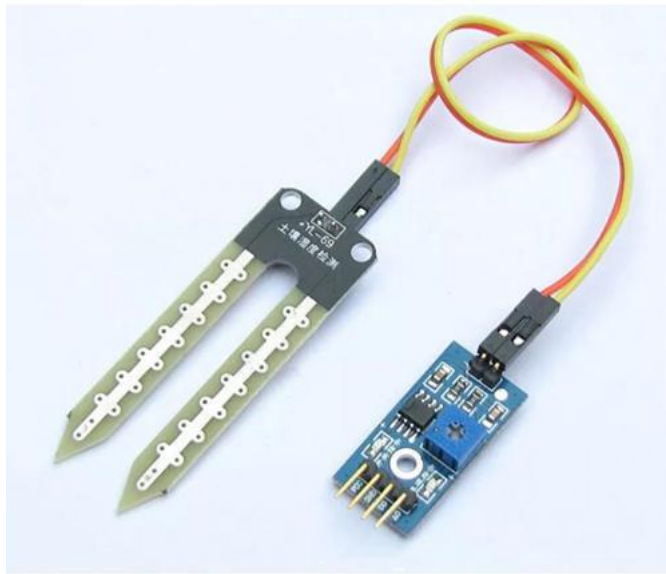


Fig-3.5.8: Soil moisture sensor

3.5.9 Arduino Uno R3

Arduino is a solitary board microcontrollers and microcontroller packs for building advanced gadgets and intuitive objects that can detect and control objects in the physical and computerized world. It uses a variety of microprocessors and controllers. The boards sets of digital and analog input/output (I/O) pins. The boards highlight sequential correspondences interfaces together with Universal Serial Bus (USB) on a few models that additionally are utilized for stacking programs from PCs. [9]

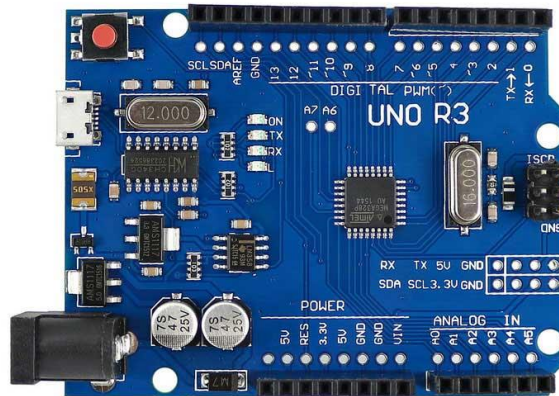


Fig-3.5.9: Arduino Uno R3

CHAPTER 4

Design Specification

4.1 Front-end-Design

We have found the best way is to built out the front end in whatever tools the front end engineers are using. In our case, we built out a style guide using angular material that shows the various elements that comprise most of our project: solar panel, inverter, battery, solar charge controller, arduino, relay channel, motor pump, pipe, wire, hard-board, solar wood frame. At first, solar panel setup with solar wood frame then we setup all the element into the hard-board. At last pipe setup into the motor.

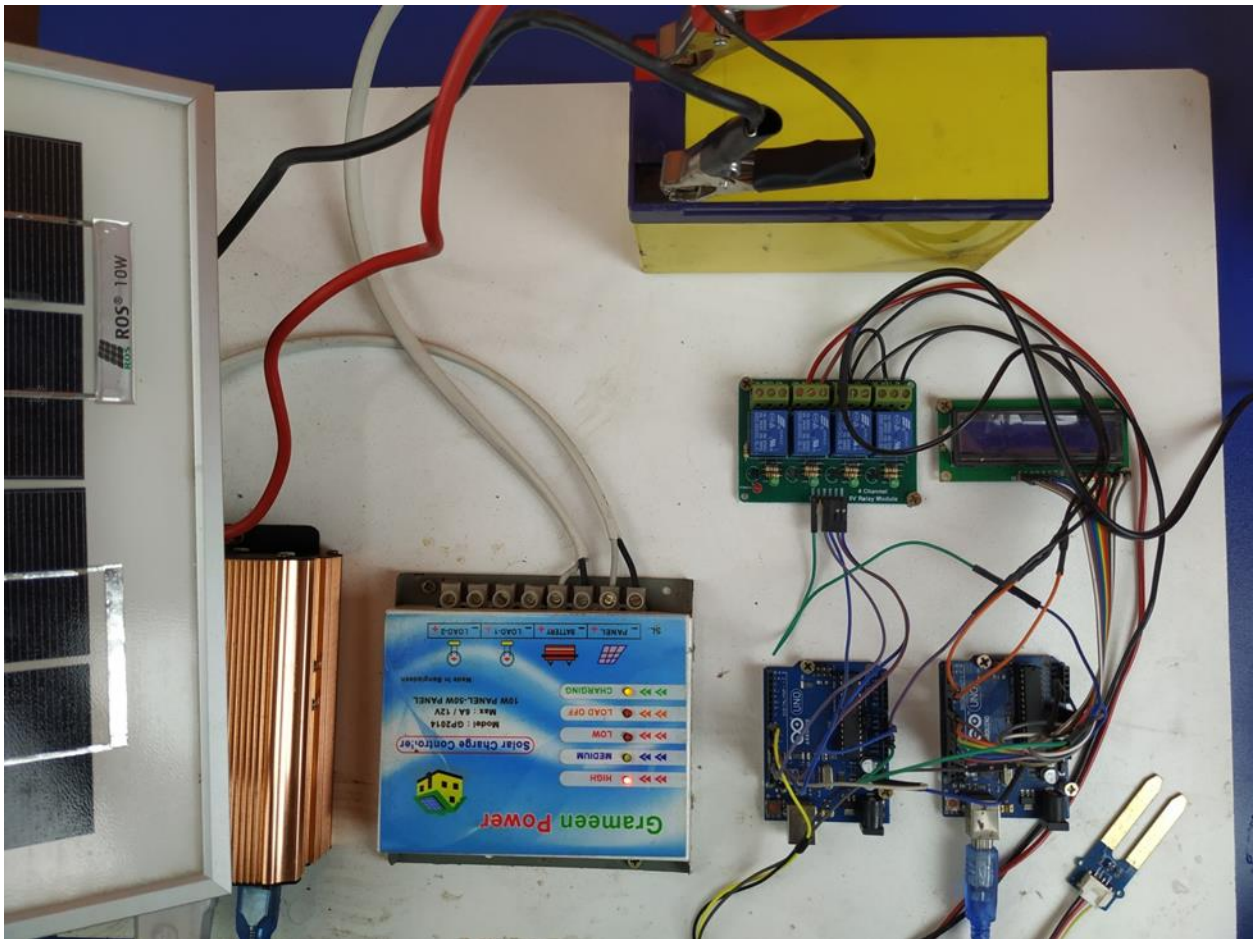


Fig: 4.1 Front-end-design

4.2 Back-end-Design

For designing back-end of our project, we use arduino program for controlling hole system. For showing our project performance we use a lcd display which is controlled by arduino program. We setup our wire connection in arduino board according to arduino program where we declare pin number. All the arduino program save in ATmega 328p Microcontroller. For showing our project performance we use water and water pot.

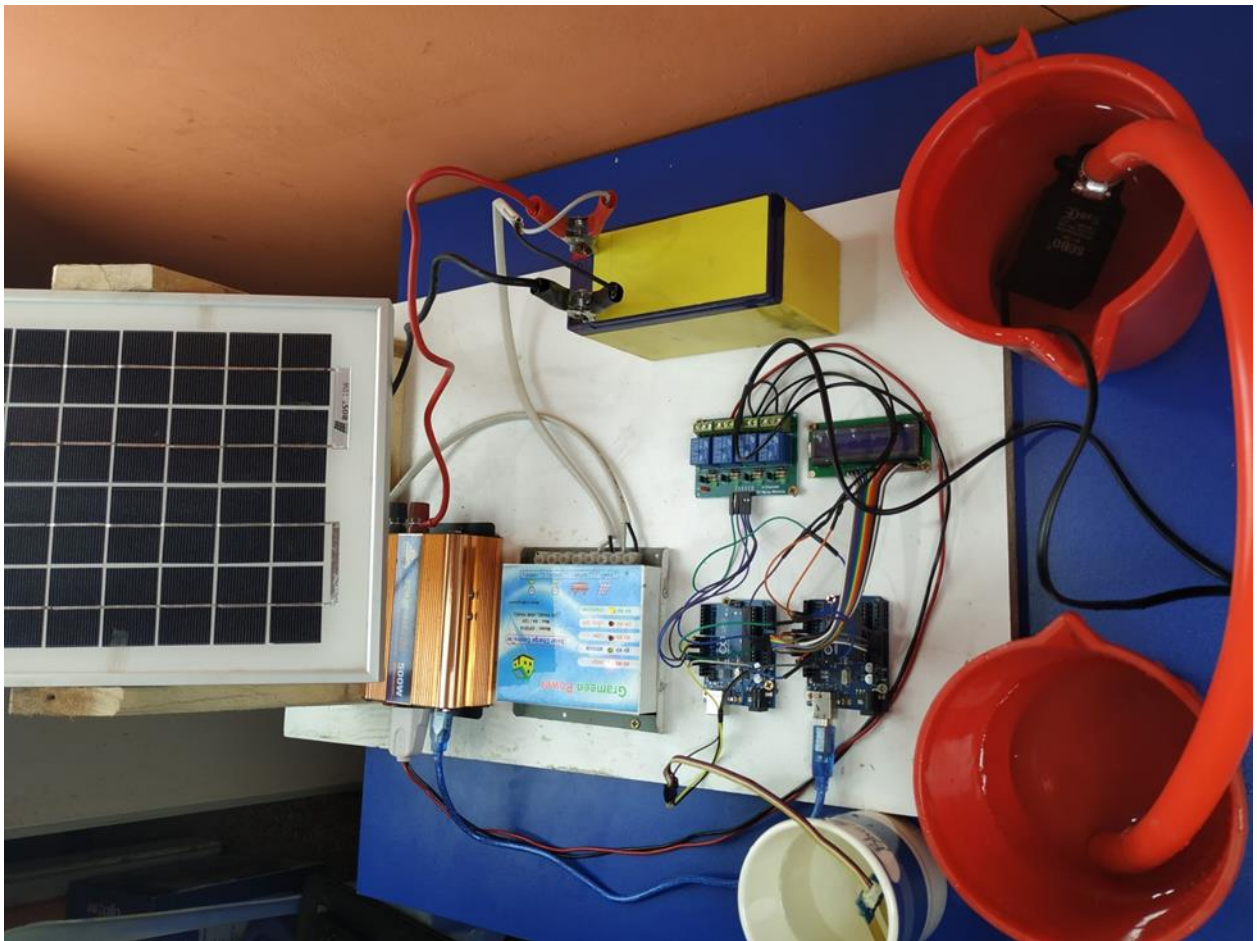


Fig-4.2: Back-end-design

4.3 Interaction Design and UX

Interaction design focuses on creating engaging interfaces with well thought out behaviors.

UX means user experience. It is the most important and effective part in the project. Because first of all users see the total view. View should be attractive, flexible and effective so that users may like our project. Here we see some UX views in our proposed system.



Fig-4.3: Total View

At first, user connects battery then switch on inverter. So the project will start to work. User connects pipe to the field and setup moisture sensor into the field to detect water level. Solar panel setup straight to the sun.

4.4 Implementation Requirements

Our project runs with the help of arduino program. This program are effective for our project.

\we have needed some configuration requirements:

- Needed to install arduino IDE.
- Setup solar panel straight to sun.
- Setup battery connection.
- Start inverter switch.
- Setup moisture sensor into the field.
- Setup pipeline into the field.

CHAPTER 5

Implementation and Testing

5.1 Introduction

We are already done the requirement in chapter 5, now it's time to implement those in real life environment stage. There are different strategic decision should be made for successful implementation of our project. The system should be reviewed time to time for checking that the implementation will successful and also prevent the error.

5.2 Implementation of Database

We don't use any database. But we save our program in microcontroller. We can say that microcontroller is our main features of database.

5.3 Implementation of Front-end-Design

For implementing front-end we use a hard-board for setup all elements. By the help of solar panel, inverter, battery, solar charge controller, arduino, relay channel, motor pump, pipe, wire we made our project more interactive from any other project.

5.4 Implementation of Interaction

For implementing the interaction of our application we use arduino program in back-end language. By the help of arduino board we connect our wire connection according to declare the pin number which is making any kind of interactive project.

5.5 Testing Implementation

System testing is the trying of a total and completely equipment item. The usage procedure is presumably the most basic phase of the undertaking, as it doesn't require a tremendous responsibility as far as labor and monetary assets, and can be very troublesome of the everyday task of the association. [10]

5.6 Test Result and Reports

This is the final step in testing. The testing of arduino program, equipment, administrations will be a progressing procedure all through the usage procedure. The establishment of arduino programming will typically be completed by an authority cabling shop who will test the links. Real things of hardware, for example, Battery, Inverter should be tried for right activity. We check pump motor, is it properly works or not. Then we check moisture sensor and its level. We check solar panel and its position and check the connection of the all elements.

CHAPTER 6

Conclusion and Future Scope

6.1 Discussion and Conclusion

The principle venture are for farmers and nursery workers who don't have bounteous time to water their products or plants. It likewise satisfy those farmers who are inefficient of water amid water system. The undertaking can be reached out to green houses where manual administration is far and few in the middle. The standard can be stretched out to make totally robotized patio nurseries and farmlands. Aggregate with the guideline of rain water collecting, it could prompt huge water reserve funds whenever connected in the correct way. In horticultural land with serious lack of precipitation, this model can be viably connected to accomplish incredible outcomes with most kinds of soil.

6.2 Scope for Further Developments

The automatic irrigation system is going to be very useful in the future. The components required for this type irrigation system is moisture sensors, relays, and submersible type pump. The automatic irrigation is supposed by sensing the soil condition as wet or dry. It is an effective use of water in irrigation system. This is more effective for the farmers.

In future the advances in Nano innovation, the upgrades in shrewd framework and power gadgets have a viable job in executing sun based vitality approaches. Our administration, Research and labs, different sun based associations are endeavoring to make this sun oriented siphon set as all agrarian field and easy to use. Give we a chance to have an expectation so that in one fine day all ranch arrives in Bangladesh are furnished with sun powered siphon sets with SMS caution.

Rain firearm sensor can be included when it rains or surges and this shield the field and dodges surges. Rain water collecting should be possible and this gathered water can be utilized to soak fields. Hooters can be the point at which it gives alarm at different events, for example, interference discovery, surges and so on. In Future we utilize IR sensors any protest going into fields can be identified and cautioned.

REFERENCES

- [1] Solar Charge Controller available at<<http://www.solarsrne.com/?gclid=EAIaIQobChMI2vXtw7u23gIVU66WCh2e3gH2EAA YA SAAEgKBJvD_BwE>> last accessed on 02-11-2018 at 1.30 A.M
- [2] Battery available at<< <https://en.wikipedia.org/wiki/Battery>>> last accessed on 02-11-2018 at 1.45 A.M
- [3] Inverter available at << https://en.wikipedia.org/wiki/Solar_inverter>>last accessed on 02-11-2018 at 3.30 P.M
- [4] ATmega 328p Microcontroller available at << <https://en.wikipedia.org/wiki/ATmega328>>>last accessed on 02-11-2018 at 3.30 P.M
- [5] LCD (Liquid Crystal Display) available at << https://en.wikipedia.org/wiki/Liquid-crystal_display>> last accessed on 29-10-2018 at 3.30 P.M
- [6] Solar Panel available at <<https://en.wikipedia.org/wiki/Solar_panel>> last accessed on 29-10-2018 at 3.30 P.M
- [7] Relay available at << https://en.wikipedia.org/wiki/Relay_channel>>last accessed on 15-10-2018 at 9.30 A.M
- [8] Soil Moisture Sensor available at <<https://en.wikipedia.org/wiki/Soil_moisture_sensor>> last accessed on 25-10-2018 at 1.30 P.M
- [9] Arduino Uno R3 available at << <https://www.pololu.com/product/2191>>>last accessed on 17-10-2018 at 11.00 A.M
- [10] Testing Implementation available at << <http://www.technologyuk.net/telecommunications/networks/implementation-and-testing.shtml>>> last accessed on 31-10-2018 at 3.30 A.M