CHAPTER 1

INTRODUCTION

1.1 Motivation

Water is a vital resource for living creatures, each living creature uses water as per its desires, because of this importance of water in our lives, it is highly necessary to use this resource as effectively and optimal as possible. There are several sectors that come under water consumption; the biggest sector is the agricultural sector which amounts to about 70% of the water consumption. Climate change is a major factor for the unpredictable weather and rainfall patterns. As many of the farmers depend on the monsoons which occur for about four months of the year, changes due to this unpredictable nature of weather harm the crop yield and tend to incur losses. Farmers have stated several times that the monsoon rains have become increasingly unpredictable over the past twenty years, both in the timing of the rainfall and the total amount of rainfall per year. This makes it difficult for farmers to decide which crops are best to plant in which season order to get the highest yields during that particular season.

Though there are all these different advancements in technology farmers prefer continuing with their traditional irrigation procedures thus this requires some amount of convincing. Efficient system is to be proposed to minimize the water wastage. Our goal in this project is to help the farmers with their crop yields by using efficient methods for helping them during the drought season due to deficient rainfall, preventing over flooding of the field due to excess rainfall, decreasing the work load for the farmers on a day to day basis, periodically updating the status of soil parameters and any malfunctioning of the mechanical systems like pumps/motors can be pin pointed and finally to help the farmers figure out which crop is best suited for a particular season.

1.2 Problem Definition

Agricultural area receives power supply usually in non-peak hours; also frequent power cuts and low voltage supply creates a big problem to farmers. If farmer fails to

attend the irrigation, there is a chance of wastage of water and electricity. Also, excess watering leads to soil damage.

1.3 Objective of the Project

The Objective of this project Smart Irrigation System includes supplying only the sufficient amount of water to the plants which results in healthy crop and reduction of water wastage. It reduces the human intervention in the agriculture field.

1.4 Limitations of the Project

The main limitation of the "SMART IRRIGATION SYSTEM USING IoT" is that it can only work for one plant. It can be operated in automatic and manual mode too. In future, the accuracy can be added.

1.5 About IoT

Internet of Things (IoT) is the networking of physical objects that contain electronics embedded within their architecture in order to communicate and sense interactions amongst each other or with respect to the external environment. In the upcoming years, IoT-based technology will offer advanced levels of services and practically change the way people lead their daily lives. Advancements in medicine, power, gene therapies, agriculture, smart cities, and smart homes are just a very few of the categorical examples where IoT is strongly established.

1.5.1 The Three C's of IoT

1. Communication

IoT communicates information to people and systems, such as state and health of equipment (e.g. it's on or off, charged, full or empty) and data from sensors that can monitor a person's vital signs. In most cases, we didn't have access to this information before or it was collected manually and infrequently. For example, an IOT-enabled HVAC system can report if its air filter is clean and functioning properly. Almost every company has a class of assets it could track. GPS-enabled assets can communicate their current location and movement. Location is important for items that move, such as trucks,

but it's also applicable for locating items and people within an organization. In the healthcare industry, IoT can help a hospital track the location of everything from wheelchairs to cardiac defibrillators to surgeons. In the transportation industry, a business can deliver real-time tracking and condition of parcels and pallets. For example, Maersk can use sensors to track the location of a refrigerated shipping container and its current temperature.

2. Control and Automation

In a connected world, a business will have visibility into a device's condition. In many cases, a business or consumer will also be able to remotely control a device. For example, a business can remotely turn on or shut down a specific piece of equipment or adjust the temperature in a climate-controlled environment. Meanwhile, a consumer can use IoT to unlock their car or start the washing machine. Once a performance baseline has been established, a process can send alerts for anomalies and possibly deliver an automated response. For example, if the brake pads on a truck are about to fail, it can prompt the company to take the vehicle out of service and automatically schedule maintenance.

3. Cost Savings

Many companies will adopt IoT to save money. Measurement provides actual performance data and equipment health, instead of just estimates. Businesses, particularly industrial companies, lose money when equipment fails. With new sensor information, IoT can help a company save money by minimizing equipment failure and allowing the business to perform planned maintenance. Sensors can also measuring items, such as driving behavior and speed, to reduce fuel expense and wear and tear on consumables. New smart meters in homes and businesses can also provide data that helps people understand energy consumption and opportunities for cost savings.

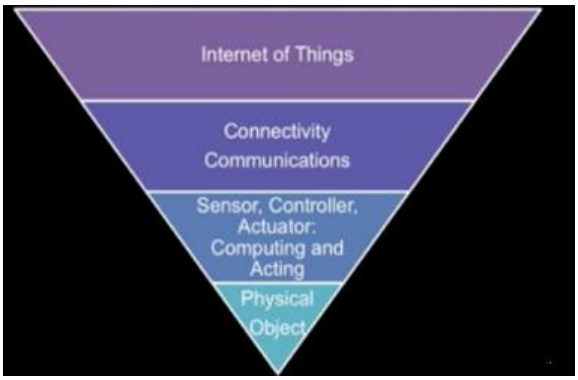


Fig 1.1: IoT Triangle

CHAPTER 2

LITERATURE SURVEY

2.1 Journals and Conference Papers

2.1.1 Journal 1:

SMART IRRIGATION SYSTEM BASED ON SOIL MOISTURE USING IOT

2.1.1.1 Abstract: [1]

This paper focuses primarily on reducing the wastage of water and minimizing the manual labor on field for irrigation so that you can saving time, cash and power of the farmer. The system has three major parts; humidity sensing part, control section and the output section. The soil humidity was detected using soil sensor. The control unit was achieved using arduino. The output is irrigation system which is controlled by the control unit by switching it on and off depending on the soil moisture contents. The real time conditions sensed data is send to the cloud server for storing and decision making and controlling actions.

2.1.2 Journal 2:

SMART IRRIGATION SYSTEM USING IOT AND RASPBERRY PI

2.1.2.1 Abstract: [2]

Today automation is one of the important role in human life. The system is not only provides comfort but also reduce energy, efficiency and time saving. Whenever there is a change in temperature, humidity and current status of rain of the surroundings these sensors senses the change in temperature and humidity and gives an interrupt signal to the raspberry pi. The system can be used to control the water motor automatically and can also monitor the growth of plant by using webcam. We can watch live streaming of farm on mobile phone using suitable application by using Wi-Fi network.

2.1.3 Journal 3:

AUTOMATED SMART IRRIGATION SYSTEM USING RASPBERRY PI

2.1.3.1 Abstract: [3]

An Automated Sprinkler irrigation method distributes water to crops/plants by spraying it over the crops/plants like a natural rainfall. In this thesis we will develop an automated sprinkle system that will help a farmer/people to know about his field, and the status of his plant at his home or he may be residing in any part of the world. This work will helps the farmers to irrigate the farmland in a very efficient manner with automated irrigation system based on soil, humidity, weather .This sprinkler system will provide control for soil temperature, moisture sensing to ensure plants is watered when there is demand, live streaming and also provide the temperature, humidity sensing, forecast lookup from other weather services. Whenever there is a change in temperature, humidity and current status of rain of the surroundings these sensors senses the change in temperature and humidity and gives an interrupt signal to the raspberry pi. Water excess irrigation not only reduces plants production but also damages soil fertility and also causes ecological hazards like water wasting and salinity. In recent years the awareness of water and energy conversation has resulted in the greater use of sprinkler system .Currently the automation is one of the important roles in the human life. It not only provides comfort but also reduce energy, efficiency and time saving.

2.1.4 Conference Paper 1:

MOBILE INTEGRATED SMART IRRIGATION MANAGEMENT AND MONITORING SYSTEM USING IOT

2.1.4.1 Abstract: [4]

This is a Mobile Integrated and smart irrigation system using IOT based on application controlled monitoring system. The idea is to focus on parameters such as temperature and soil moisture. The main objective of this project is to control the water supply and monitor the plants through a Smart phone. The smart phone is connected to

raspberry pi through Bluetooth. The motor is controlled by the smart phone by the values ON and OFF.

2.1.5 Conference Paper 2:

IOT BASED CONTROL AND AUTOMATION OF SMART IRRIGATION SYSTEM

2.1.5.2 Abstract: [5]

Our system is able to deliver optimal water to the plants based on moisture, light and temperature levels which are obtained through sensors. The farmer will be able to monitor the parameters through the mobile app which is integrated with cloud storage. Integration of the GSM module to the Arduino helps us achieve real time updates on the conditions of the plot of land. Any malfunction in the hardware will be sent via message. We use a generic application to turn on and off the motor, this is a safety unit in case any malfunction occurs during the process of automation. After pairing the Bluetooth of the system to our smart phone, the motor can be turned on and off according to convenience.

2.2 Existing System

In India most of the irrigation systems are operated manually. Traditional methods that are used for irrigation, such as overhead sprinkler and flood type, is not that much efficient as it leads to wastage of water. In case of under irrigation, the plants get dried due to lack of sufficient amount of water. In case of over irrigation, the soil and roots are destroyed due to fungus formation.

2.3 Proposed System

In proposed solution, Smart Irrigation System uses Raspberry pi, where it monitors the amount of moisture content in the soil. A threshold value of soil moisture is set and can be varied. In case the soil moisture of the soil deviates from the specified range, the notification is sent to the user to ON/OFF the motor using gsm module. Electricity supply can be monitored using a switch with a led.

CHAPTER 3

FEASIBILITY STUDY

3.1 Introduction

When the client approaches the organization for getting the desired product developed, it comes up with rough idea about what all functions the software must perform and which all features are expected from the software.

Referencing to this information, the analysts does a detailed study about whether the desired system and its functionality are feasible to develop.

This feasibility study is focused towards goal of the organization. This study analyzes whether the software product can be practically materialized in terms of implementation, contribution of project to organization, cost constraints and as per values and objectives of the organization. It explores technical aspects of the project and product such as usability, maintainability, productivity and integration ability.

The output of this phase should be a feasibility study report that should contain adequate comments and recommendations for management about whether or not the project should be undertaken.

3.2 Project Description

This project is named “SMART IRRIGATION SYSTEM USING IoT” which is a mobile application that can be used using a smart phone to control the motor pump for watering the plants by turning the motor on/off and making use of internet for communication. Offline messages are also being sent to the user’s smart phone as acknowledgement when the internet doesn’t work. This would be the main objective of the project as it reduces the wastage of water and electricity by notifying the user frequently about the status of the plant.

3.3 Possible Solutions

This project can be undertaken by the implementation of the two possible solutions:

1) To connect the hardware components to the internet we must first need an interface that would bring them all together. Arduino can be used to operate the soil moisture sensor and to connect it to the internet.

2) We can also make use of Raspberry pi for connecting all the hardware components to its pins and communicating with them by making use of the Wi-Fi module within the OS of raspberry pi which is named as Raspbian OS.

3.4 Most Feasible Solution

After the evaluation of the possible solutions, the most feasible solution for this project is that we make use of Raspberry pi instead of Arduino board. Because of the multitasking and low power consumption of raspberry pi (5V) comparatively with Arduino board (7-12V), it would be effective to use the Raspberry pi. And also, the raspberry pi has got 4 USB ports which would make this project easier rather than complicating it with Arduino.

The Wi-Fi module in the raspberry pi makes it special by connecting to the internet automatically whenever the OS is turned on and this OS can also be monitored by making use of an application called VNC which is to be installed in the Raspbian OS too and be used whenever needed instead of getting a HDMI cable and connecting the Raspberry pi to the laptop and running the program. So, the project turns to be cost-effective, vital and practical.

CHAPTER 4

ANALYSIS

4.1 Introduction

The Analysis Phase is where the project life cycle begins. This is the phase where you break down the deliverables in the high-level Project Charter into the more detailed business requirements. Gathering requirements is the main attraction of the Analysis Phase. The process of gathering requirements is usually more than simply asking the users what they need and writing their answers down. Depending on the complexity of the application, the process for gathering requirements has a clearly defined process of its own. This process consists of a group of repeatable processes that utilize certain techniques to capture, document, communicate, and manage requirements. This formal process, which will be developed in more detail, consists of four basic steps.

1. **Elicitation** – I ask questions, you talk, I listen
2. **Validation** – I analyze, I ask follow-up questions
3. **Specification** – I document, I ask follow-up questions
4. **Verification** – We all agree

Most of the work in the Analysis Phase is performed by the role of analyst.

4.2 Software Requirement Specification

SRS is a document created by system analyst after the requirements are collected from various stakeholders.

SRS defines how the intended software will interact with hardware, external interfaces, speed of operation, response time of system, portability of software across various platforms, maintainability, speed of recovery after crashing, Security, Quality, Limitations etc.

The requirements received from client are written in natural language. It is the responsibility of system analyst to document the requirements in technical language so that they can be comprehended and useful by the software development team.

4.3 Hardware Requirements

The following is the list of hardware requirements

1. Raspberry Pi 3
2. GSM Module
3. 230V Submersible Water Pump
4. 12V Rechargeable Battery
5. Battery Bank
6. Smart Phone
7. Bridge Rectifier
8. Filters
9. Regulator
10. Capacitor
11. Buck Converter
12. Soil Moisture Sensor

1. Raspberry Pi 3

It is a single board computer. It has inbuilt python IDE for programming. It is simply a microcontroller. It also has inbuilt wifi module which is an additional feature.

Fig 4.1: Raspberry Pi

Pin Group	Pin Name	Description
Power Source	+5V,+3.3V,GND,Vin	+5V - power out +3.3V - power out GND – Ground Pin
Communication Interface	UART Interface(RXD, TXD) [(GPIO15,GPIO14)]	UART (UNIVERSAL ASYNCHRONOUS RECEIVER TRANSMITTER) used for interfacing sensors and other devices.
Input Output Pins	26 I/O	Although these some pins have multiple functions, they can be considered as i/o pins.
PWM	Hardware PWM AVAILABLE ON GPIO12, GPIO13, GPIO18, GPIO19	These 4 channels can provide PWM (pulse width modulation) outputs.
External Interrupts	ALL I/O	In the board all i/o pins can be used as interrupts.

Table 4.1: Raspberry Pi 3 Pin Configuration

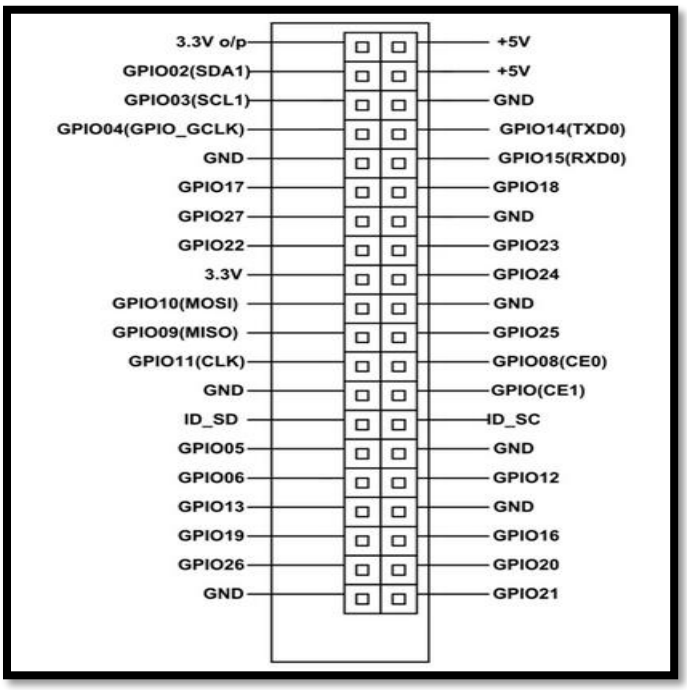


Fig 4.2: Pin Diagram of Raspberry Pi 3

Microprocessor	Broadcom BCM2837 64bit Quad Core Processor
Processor Operating Voltage	3.3V
Raw Voltage input	5V, 2A power source
Maximum current through each I/O pin	16mA
Maximum total current drawn from all I/O pins	54mA
Flash Memory (Operating System)	16Gbytes SSD memory card
Internal RAM	1Gbytes DDR2
Clock Frequency	1.2GHz
GPU	Dual Core Video Core IV® Multimedia Co-Processor. Provides Open GLES 2.0, hardware-accelerated Open VG, and 1080p30 H.264 high-profile decode. Capable of 1Gpixel/s, 1.5Gtexel/s or 24GFLOPs with texture filtering and DMA infrastructure.
Ethernet	10/100 Ethernet
Wireless Connectivity	BCM43143 (802.11 b/g/n Wireless LAN and Bluetooth 4.1)
Operating Temperature	-40ºC to +85ºC

Table 4.2: Raspberry Pi 3 Technical Specifications

Name	Description
Ethernet	Base T Ethernet Socket
USB	2.0 (Four sockets)
Audio Output	3.5mm Jack and HDMI
Video output	HDMI
Camera Connector	15-pin MIPI Camera Serial Interface (CSI-2)
Display Connector	Display Serial Interface (DSI) 15 way flat flex cable connector with two data lanes and a clock lane.
Memory Card Slot	Push/Pull Micro SDIO

Table 4.3: Board Connectors

2. GSM Module (Global System for Mobile communications)

GSM (Global System for Mobile communications) is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. GSM networks operate in four different frequency ranges. Most GSM networks operate

in the 900 MHz or 1800 MHz bands. Some countries in the Americas use the 850 MHz and 1900 MHz bands because the 900 and 1800 MHz frequency bands were already allocated.

GSM also pioneered a low-cost, to the network carrier, alternative to voice calls, the Short t message service (SMS, also called “text messaging”), which is now supported on other mobile standards as well. Another advantage is that the standard includes one worldwide Emergency telephone number, 112. This makes it easier for international travelers to connect to emergency services without knowing the local emergency number.

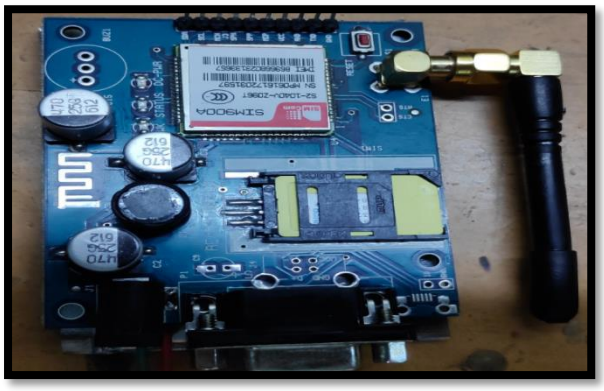


Fig 4.3: GSM Module

3. 230V AC Submersible Water Pump

A submersible pump (or sub pump, electric submersible pump (ESP)) is a device which has a hermetically sealed motor close-coupled to the pump body. The whole assembly is submerged in the fluid to be pumped. The main advantage of this type of pump is that it prevents pump cavitations, a problem associated with a high elevation difference between pump and the fluid surface. Submersible pumps push fluid to the surface as opposed to jet pumps having to pull fluids. Submersibles are more efficient than jet pumps.

Fig 4.4: 230V Submersible Water Pump

4. 12V Rechargeable Battery

The 12V Rechargeable Battery is used as battery backup for the kit. It is used to supply power to GSM Module in case of power failure also.

Fig 4.5: 12V Rechargeable Battery

5. Battery Bank

It is used for backup. It is portable device. In our project this is used to supply power to raspberry pi 3 even in case of power failure.

Fig 4.6: Battery Bank

6. Smart Phone

It is used to control the motor from any place. And also to check the status of irrigation.

Fig 4.7: Smart Phone

7. Bridge Rectifier

There are several ways of connecting diodes to make a rectifier to convert AC to DC. The bridge rectifier is the most important and it produces full-wave varying DC. A full-wave rectifier can also be made from just two diodes if a centre-tap transformer is used, but this method is rarely used now that diodes are cheaper. A single diode can be

used as a rectifier but it only uses the positive (+) parts of the AC wave to produce half-wave varying DC.

A bridge rectifier can be made using four individual diodes, but it is also available in special packages containing the four diodes required. It is called a full-wave rectifier because it uses all the AC wave (both positive and negative sections).

8. Filters

The rectifier produces a D.C. output which is pulsating. But the output should have a constant value over time, like the output of the battery. This is achieved by using a filter circuit. The filter eliminates the pulsations and generates a constant output. Filters are constructed by using inductors and capacitors. The below figures shows the functioning of filter circuit. Among all the available filters in this project we are using c filters.

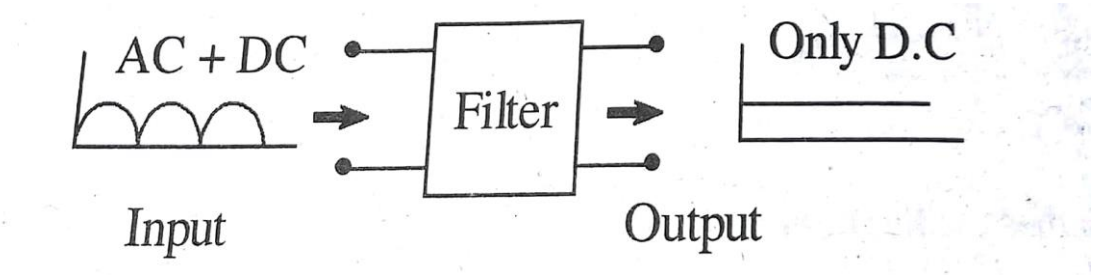


Fig 4.8: Functioning of Filter

9. Regulator

A variable regulated power supply, also called a variable bench power supply, is one which you can continuously adjust the output voltage to your requirements. Varying the output of the power supply is recommended way to test a project after having double checked parts placement against circuit drawings and the parts placement.

This type of regulation is ideal for having a simple variable bench power supply. Actually this is quite important because one of the first projects a hobbyist should undertake is the construction of a variable regulated power supply. While a dedicated supply is quite handy e.g. 5V or 12V, it's much handier to have a variable supply on hand, especially for testing.

Most digital logic circuits and processors need a 5 volt power supply. To use these parts we need to build a regulated 5 volt source. Usually you start with an unregulated power to make a 5 volt power supply; we use a LM7805 voltage regulator IC (Integrated Circuit).

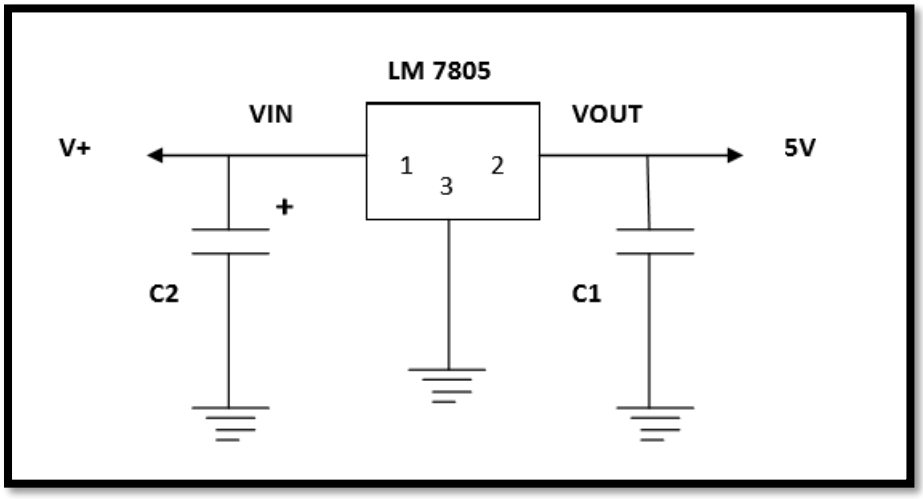


Fig 4.9: LM7805 block diagram

10. Capacitor

A capacitor is a passive two-terminal electronic component that stores electrical energy in an electric field. The effect of a capacitor is known as capacitance. While some capacitance exists between any two electrical conductors in proximity in a circuit, a capacitor is a component designed to add capacitance to a circuit. The capacitor was originally known as a condenser or condensator.

Fig 4.10: Capacitors

11. Buck Converter

A buck converter (step-down converter) is a DC-to-DC power converter which steps down voltage from its input supply to its output load. It is a class of switched-mode power supply (SMPS) typically containing at least two semiconductors (a diode and a transistor) and at least one energy storage element, a capacitor, inductor, or the two in combination. The circuit diagram for a chopper is shown in the below figure.

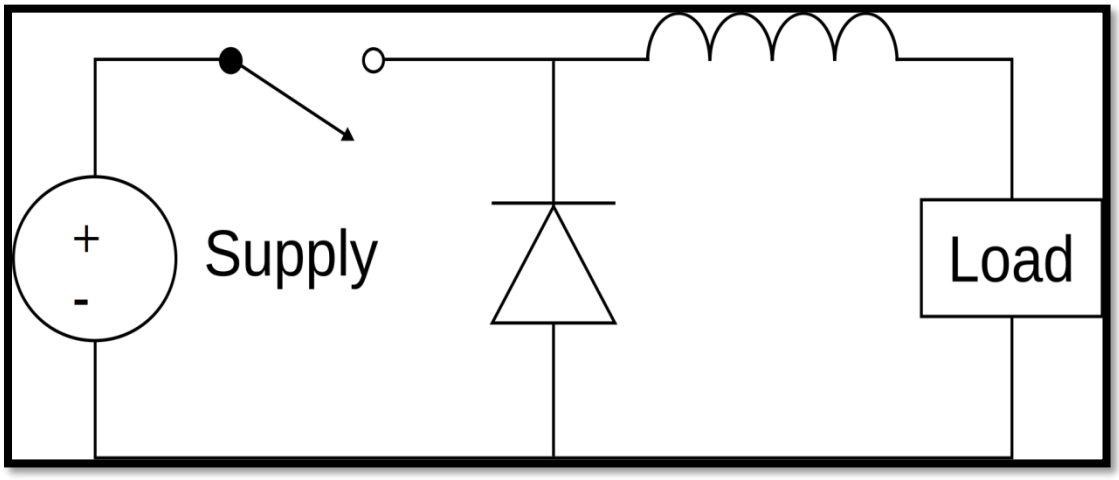


Fig 4.11: Buck Converter

12. Soil Moisture Sensor

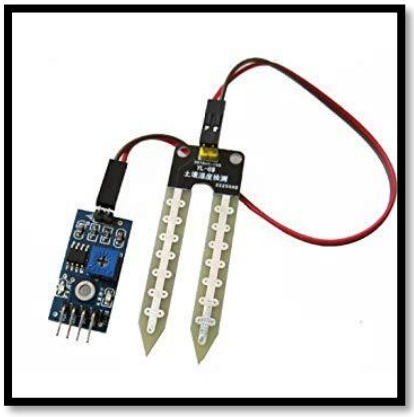


Fig 4.12: Soil Moisture Sensor

Working of Sensor

The soil moisture sensor consists of two probes which are used to measure the volumetric content of water. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value.

When there is more water, the soil will conduct more electricity which means that there will be less resistance. Therefore, the moisture level will be higher. Dry soil conducts electricity poorly, so when there will be less water, then the soil will conduct less electricity which means that there will be more resistance. Therefore, the moisture level will be lower. This sensor can be connected in two modes; Analog mode and digital mode. First, we will connect it in Analog mode and then we will use it in Digital mode.

Specifications

The specifications of the soil moisture sensor FC-28 are as follows

Input Voltage	3.3 – 5V
Output Voltage	0 – 4.2V
Input Current	35mA
Output Signal	Both Analog and Digital

Table 4.4: Soil Sensor Specifications

Pin Out – Soil Moisture Sensor

The soil Moisture sensor FC-28 has four pins

1. VCC: For power
2. A0: Analog output
3. D0: Digital output
4. GND: Ground

The Module also contains a potentiometer which will set the threshold value and then this threshold value will be compared by the LM393 comparator. The output LED will light up and down according to this threshold value.

13. Relay

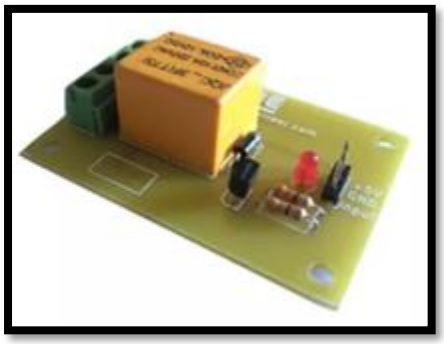


Fig 4.13: Relay

Pin Number	Pin Name	Description
1	Coil End 1	Used to trigger(On/Off) the Relay, Normally one end is connected to 12V and the other end to ground
2	Coil End 2	Used to trigger(On/Off) the Relay, Normally one end is connected to 12V and the other end to ground
3	Common (COM)	Common is connected to one End of the Load that is to be controlled
4	Normally Close (NC)	The other end of the load is either connected to NO or NC. If connected to NC the load remains connected before trigger
5	Normally Open (NO)	The other end of the load is either connected to NO or NC. If connected to NO the load remains disconnected before trigger

Table 4.5: Relay Pin Details

How to Use a Relay?

Relays are most commonly used switching device in electronics. There are two important parameters of relay, first is the Trigger Voltage, this is the voltage required to

turn on the relay that is to change the contact from Common → NC to Common → NO. The other parameter is your Load Voltage & Current, this is the amount of voltage or current that the NC, NO or Common terminal of the relay could withstand, in our case for DC it is maximum of 30V and 10A. Make sure the load you are using falls into this range.

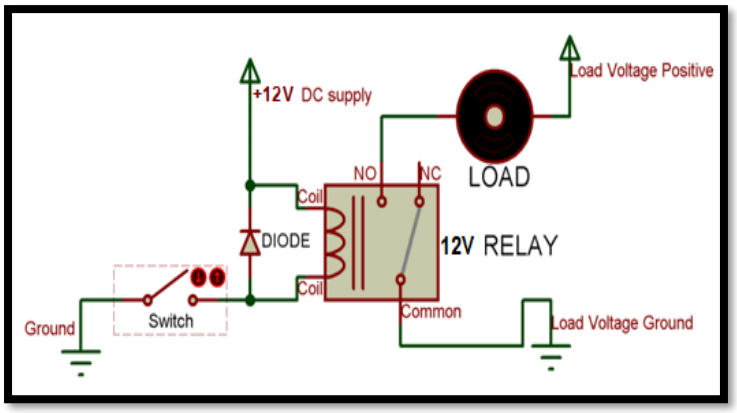


Fig 4.14: Relay circuit

The above diagram is for relay triggering circuit**.** Since the relay has 12V trigger voltage we have used a +12V DC supply to one end of the coil and the other end to ground through a switch. For switching we are using a transistor as a switching device. You can also notice a diode connected across the coil of the relay, this diode is called the Fly back Diode. The purpose of the diode is to protect the switch from high voltage spike that can produced by the relay coil. As shown one end of the load can be connected to the Common pin and the other end is either connected to NO or NC. If connected to NO the load remains disconnected before trigger and if connected to NC the load remains connected before trigger.

14. Transformer

Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC. Step-up transformers increase voltage, step-down transformers reduce voltage. Most power supplies use a step-down transformer to reduce the dangerously high mains voltage (230V in UK) to a safer low voltage. Transformers waste

very little power so the power out is (almost) equal to the power in. Note that as voltage is stepped down current is stepped up.

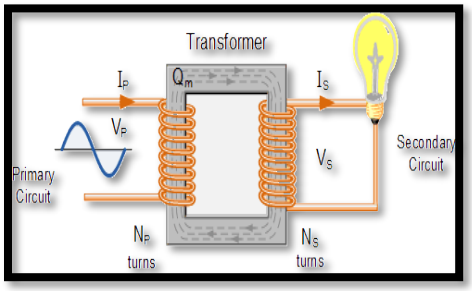


Fig 4.15: Basic diagram of a transformer

4.4 Software Requirements

The following list the list of software requirements

1. Android Studio
2. Ubidots Website
3. VNC Viewer

1. Android Studio

Android Studio is the official IDE for android application development. It works based on IntelliJ IDEA, (IntelliJ IDEA is a special programming environment or integrated development environment (IDE) largely meant for Java. This environment is used especially for the development of programs. It is developed by a company called Jet Brains, which was formally called IntelliJ). You can download the latest version of android studio from Android Studio 2.2 Download, If you are new to installing Android Studio on windows, you will find a file, which is named as **android-studio-bundle-143.3101438-windows.exe.**So just download and run on windows machine.

Installation Procedure

Step 1: Before you launch Android Studio.exe, make sure before launch Android Studio, Our Machine should required installed Java JDK.

Fig: 4.16: Set up Android Studio

Step 2: Once you launched Android Studio, it's time to mention JDK7 path or later version in android studio installer.

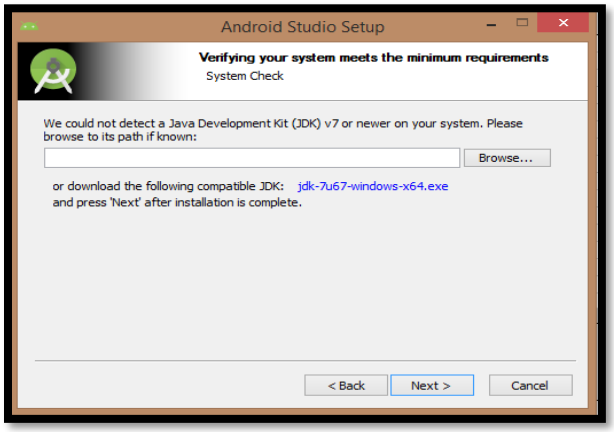


Fig: 4.17: Verifying the requirements

Step 3: Initiating JDK to android SDK

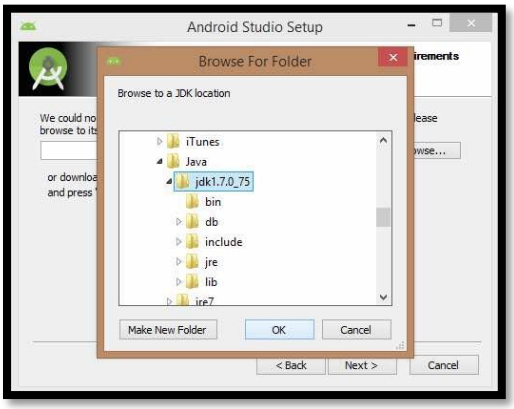


Fig: 4.18: Initiating JDK to android SDK

Step 4: Need to check the components, which are required to create applications, like Android Studio, Android SDK etc.

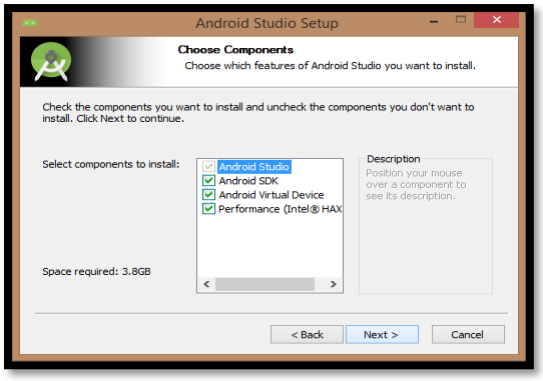


Fig: 4.19: Choosing other components

Step 5: Need to specify the location of local machine path for Android studio and Android SDK.

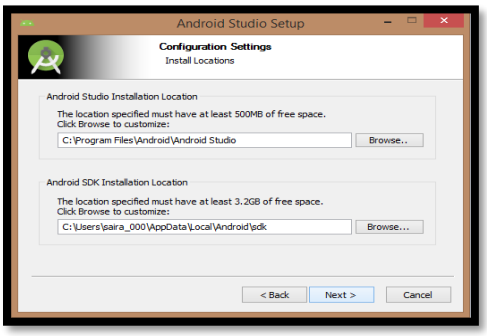


Fig: 4.20: Set the Android studio and Android SDK installation locations

Step 6: Need to specify the ram space for Android emulator by default it would take 512MB of local machine RAM.

Fig 4.21: Specifying the RAM space

Step 7: At final stage, it would extract SDK packages into our local machine, it would take a while time to finish the task and would take 2626MB of Hard disk space.

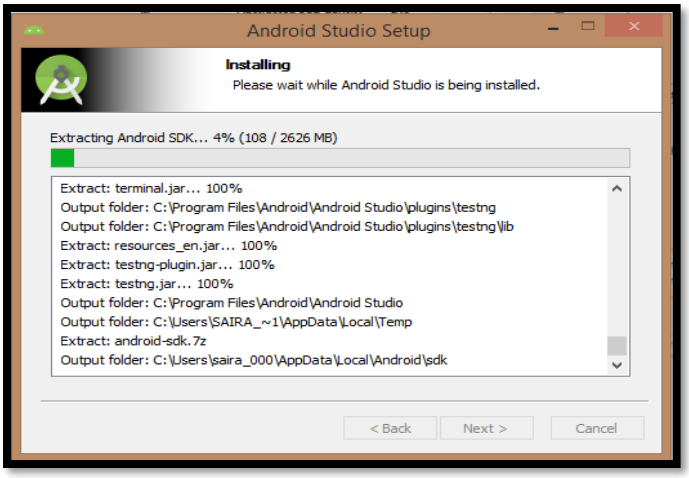


Fig: 4.22: Extracting SDK packages

Step 8: After done all above steps perfectly, you must get finish button and it opens android studio project with Welcome to android studio message.

Fig: 4.23: Welcome screen

Step 9: You can start your application development by calling start a new android studio project. In a new installation frame should ask Application name, package information and location of the project.

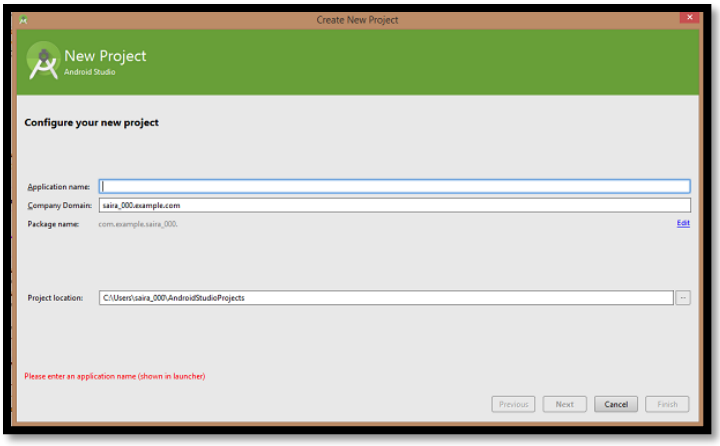


Fig: 4.24: Creating new project

Step 10: After entered application name, it going to be called select the form factors your application runs on, here need to specify Minimum SDK.

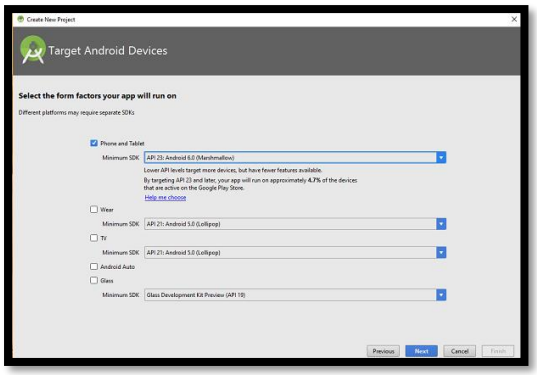


Fig: 4.25: Select target categories

Step 11: The next level of installation should contain selecting the activity to mobile; it specifies the default layout for Applications.

Fig: 4.26: Selecting an activity

Step 12: At the final stage it going to be open development tool to write the application code.

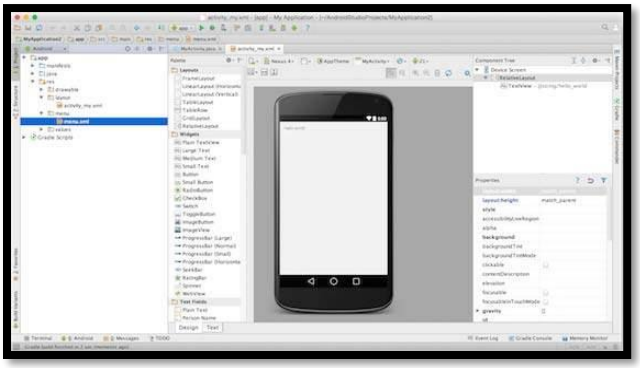


Fig: 4.27: Android studio workspace

2. Ubidots Website

Ubidots is a website which serves as a platform for developing IoT Projects. It provides the users with industrial and educational services. In our project we have used the educational site to connect our device.

How to connect to the device?

Step 1: Open Ubidots.

Fig: 4.28: Ubidots website

Step 2: If you are a new user sign up else login into the website.

Fig: 4.29: Homepage of ubidots

Step 3: Create a new Device by clicking on the + symbol. And give a name to your device.

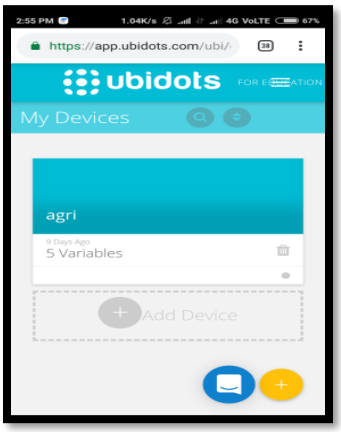


Fig: 4.30: Creating a new device

Step 4: Open the device and add variables by clicking on the + symbol and provide the required information like name etc.

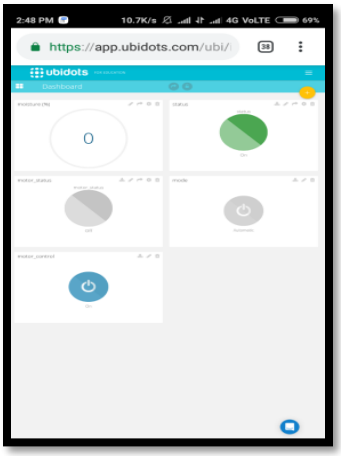


Fig: 4.31: Adding and naming the variables

Step 5: Add required events to happen like sending email when the motor is turned on or off etc by clicking on the + symbol.

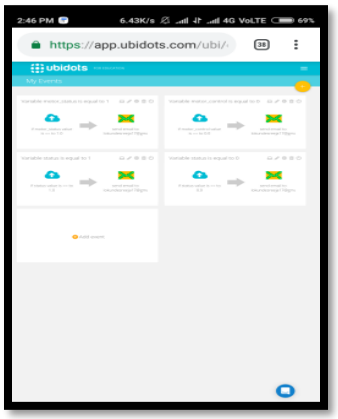


Fig: 4.32: Adding required events

Step 6: Select the device, variable, threshold value and provide the email address to which the mail should be sent.

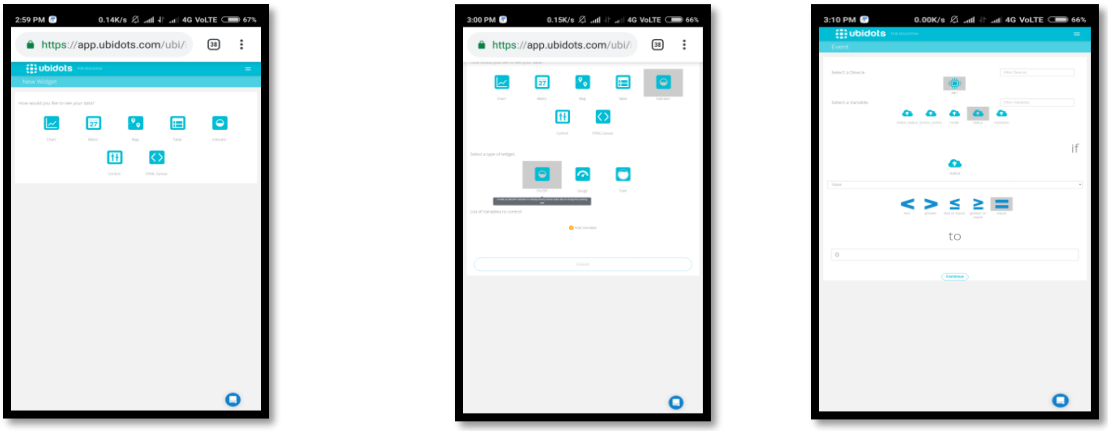


Fig: 4.33: Selecting device, variable, threshold value and providing email address

3. VNC Viewer

Sometimes it is not convenient to work directly on the Raspberry Pi. Maybe you would like to work on it from another device by remote control.

VNC is a graphical desktop sharing system that allows you to remotely control the desktop interface of one computer (running VNC Server) from another computer or mobile device (running VNC Viewer). VNC Viewer transmits the keyboard and either mouse or touch events to VNC Server, and receives updates to the screen in return.

You will see the desktop of the Raspberry Pi inside a window on your computer or mobile device. You'll be able to control it as though you were working on the Raspberry Pi itself.

VNC Connect from RealVNC is included with Raspbian. It consists of both VNC Server, which allows you to control your Raspberry Pi remotely, and VNC Viewer, which allows you to control desktop computers remotely from your Raspberry Pi should you want to.

You must enable VNC Server before you can use it: instructions for this are given below. By default, VNC Server gives you remote access to the graphical desktop that is running on your Raspberry Pi, as though you were sitting in front of it.

However, you can also use VNC Server to gain graphical remote access to your Raspberry Pi.

Fig: 4.34: VNC viewer desktop

4.5 Planning Model

In this "SMART IRRIGATION SYSTEM USING IoT" the planning model used is "ITERATIVE WATERFALL MODEL". In a practical software development project, the classical waterfall model is hard to use. So, Iterative waterfall model can be thought of as incorporating the necessary changes to the classical waterfall model to make it usable in practical software development projects. It is almost same as the classical waterfall model except some changes are made to increase the efficiency of the software development. The iterative waterfall model provides feedback paths from every phase to its preceding phases, which is the main difference from the classical waterfall model.

When errors are detected at some later phase, these feedback paths allow correcting errors committed by programmers during some phase. The feedback paths allow the phase to be reworked in which errors are committed and these changes are reflected in the later phases. But, there is no feedback path to the stage – feasibility study, because once a project has been taken, does not give up the project easily. It is good to detect errors in the same phase in which they are committed. It reduces the effort and time required to correct the errors.

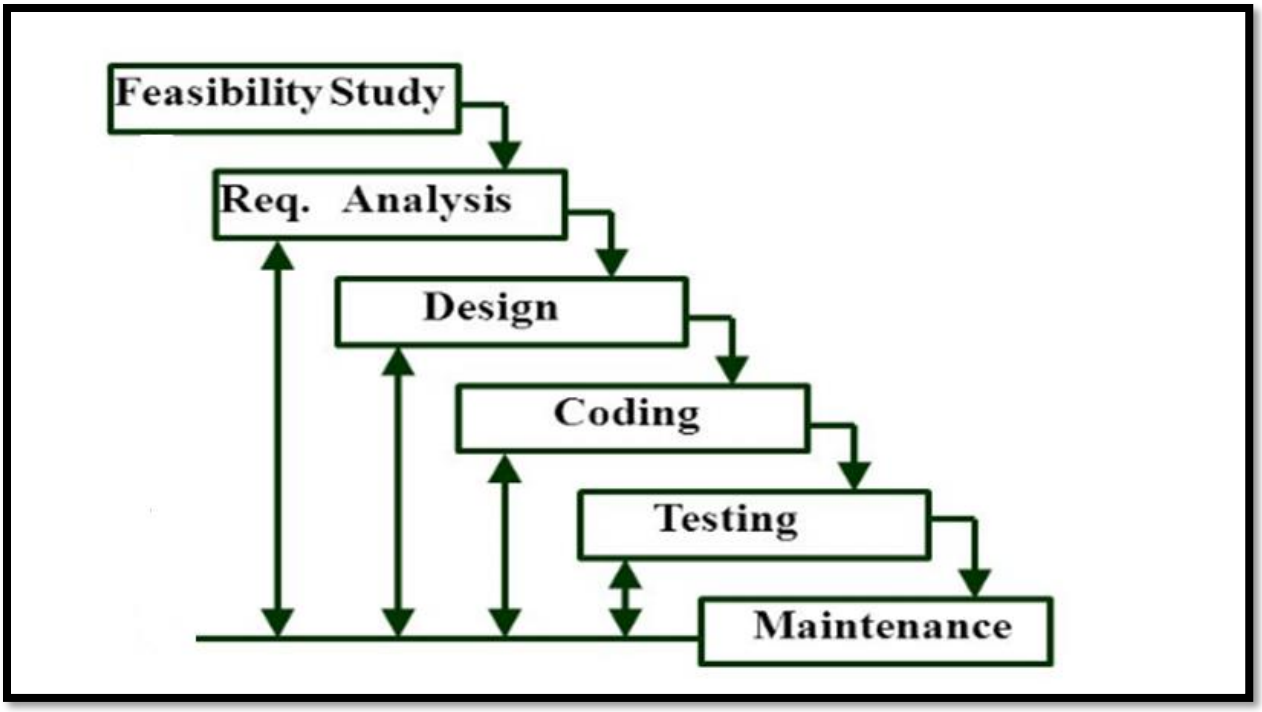


Fig 4.35: Iterative waterfall model

CHAPTER 5

DESIGN

5.1 Introduction

The unified modeling language allows the software engineer to express an analysis model using the modeling notation that is governed by a set of syntactic semantic and pragmatic rules. A UML System is represented using five different views that describe the system from distinctly different perspective.

UML is specifically constructed through two different domains, they are:

UML Analysis modeling, this focuses on the user model and structural model views of the system.

UML design modeling, which focuses on the behavioral modeling, implementation modeling and environmental model views.

Why Use UML in projects?

As the strategic value of software increases for many companies, the industry looks for techniques to automate the production of software and to improve quality and reduce cost and time-to-market. These include component technology, visual programming, patterns and frameworks. Businesses also seek techniques to manage the complexity of systems as they increase in scope and scale. In particular, they recognize the need to solve recurring architectural problems, such as physical distribution, concurrency, replication, security, load balancing and fault tolerance. Additionally, the development for the World Wide Web, while making some things simpler, has exacerbated these architectural problems. The Unified Modeling Language (UML) was designed to respond to these needs.

Simply, systems design refers to the process of defining the architecture, components, modules, interfaces and data for a system to satisfy specified requirements which can be done easily through UML diagrams.

In this project four basic UML diagrams have been explained

1. Class Diagram
2. Use Case Diagram
3. Sequence Diagram
4. Activity Diagram
5. Collaboration Diagram
6. Deployment Diagram
7. State Chart Diagram
8. Component Diagram

Class Diagram

In software engineering, a class diagram in the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, and the relationships between the classes

This is one of the most important of the diagrams in development. The diagram breaks the class into three layers. One has the name, the second describes its attributes and the third its methods. A padlock to left of the name represents the private attributes. The relationships are drawn between the classes. Developers use the Class Diagram to develop the classes. Analyses use it to show the details of the system. Architects look at class diagrams to see if any class has too many functions and see if they are required to be split.

Use Case Diagram

In software engineering, a use case diagram in the Unified Modeling Language (UML) is a type of behavioral diagram defined by and created from a Use case analysis. Its purpose is to present by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases. The main purpose of a use case

diagram is to show what system can be depicted. Use cases are used during requirements elicitation and analysis to represent the functionality of the system. Use cases focus on the behavior of the system from the external point of view. The actors are outside the boundary of the system, whereas the use cases are inside the boundary of the system.

Sequence Diagram

A sequence diagram in Unified Modeling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. Sequence Diagrams are sometimes called Event-trace diagrams, event scenarios, and timing diagrams.

Activity Diagram

Activity diagrams are a loosely defined diagram technique for showing workflows of stepwise activities and actions, with support for choice, iteration and concurrency. In the Unified Modeling Language, activity diagrams can be used to describe the business and operational step-by-step workflows of components in a system. An activity diagram shows the overall flow of control.

Collaboration Diagram

A Communication diagram models the interactions between objects or parts in terms of sequenced messages. Communication diagrams represent a combination of information taken from Class, Sequence, and Use Case Diagrams describing both the static structure and dynamic behavior of a system.

Deployment Diagram

A deployment diagram in the Unified Modeling Language models the physical deployment of artifacts on nodes. To describe a web site, for example, a deployment diagram would show what hardware components (“nodes”) exist (e.g., a web server, an application server, and a database server), what software components (“artifacts”) run on

each node (e.g., web application, database), and how the different pieces are connected (e.g., JDBC, REST, RMI).

State Chart Diagram

A state diagram is a type of diagram used in computer science and related fields to describe the behavior of systems. State diagrams require that the system described is composed of a finite number of states; sometimes, this is indeed the case, while at other times this is a reasonable abstraction. Many forms of state diagrams exist, which differ slightly and have different semantics.

Component Diagram

In the Unified Modeling Language, a component diagram depicts how components are wired together to form larger components and or software systems. They are used to illustrate the structure of arbitrarily complex systems.

5.2 UML Diagrams

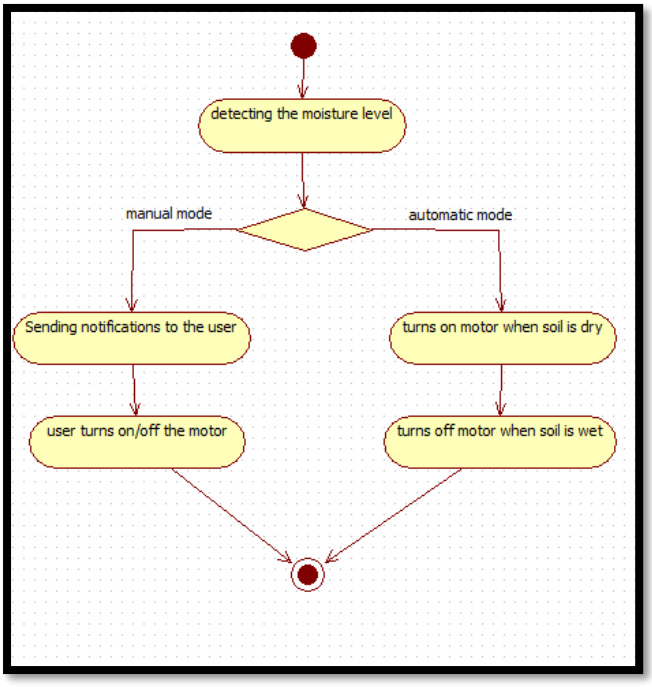


Fig 5.1: Activity Diagram

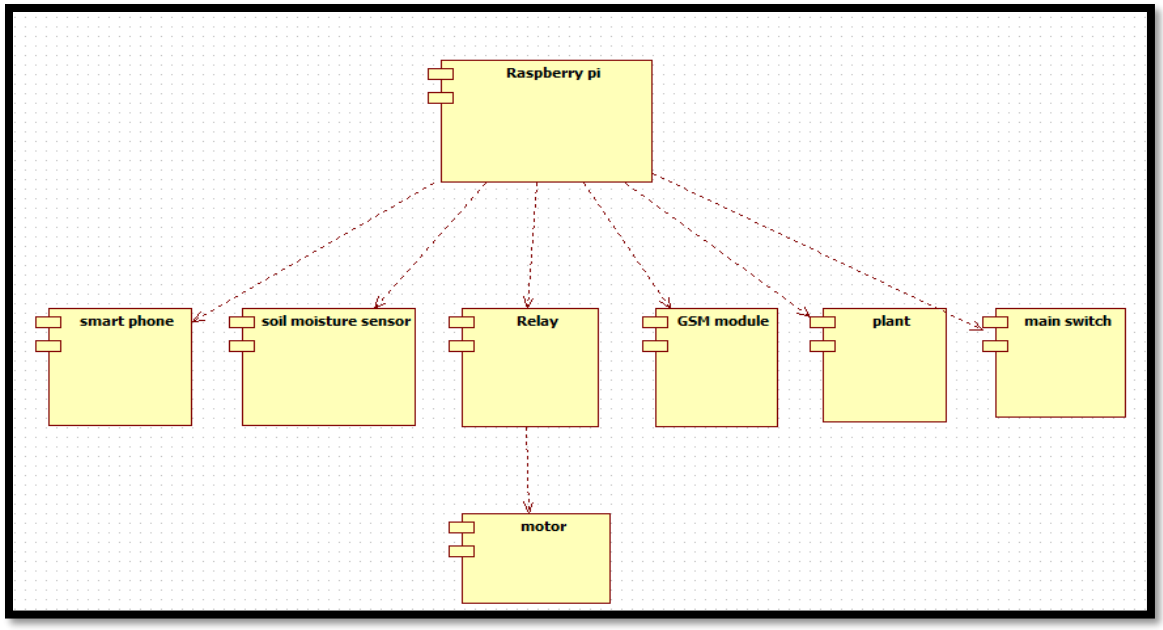


Fig 5.2: Component Diagram

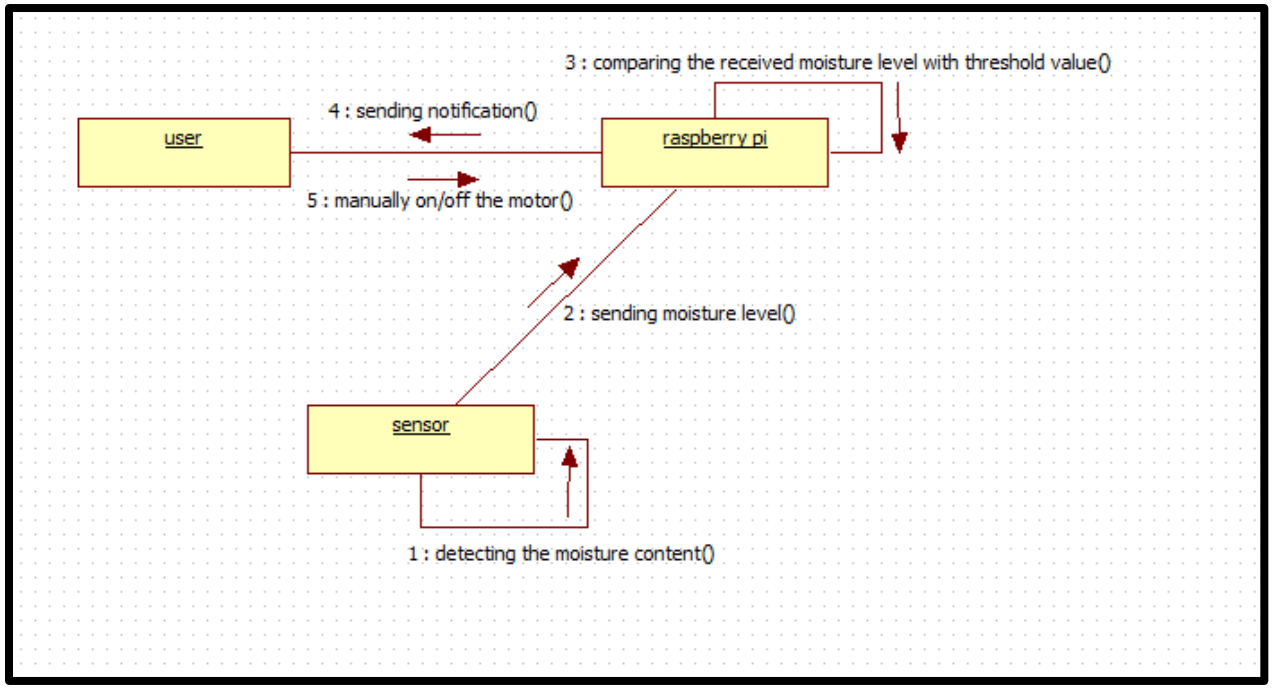


Fig 5.3: Collaboration Diagram

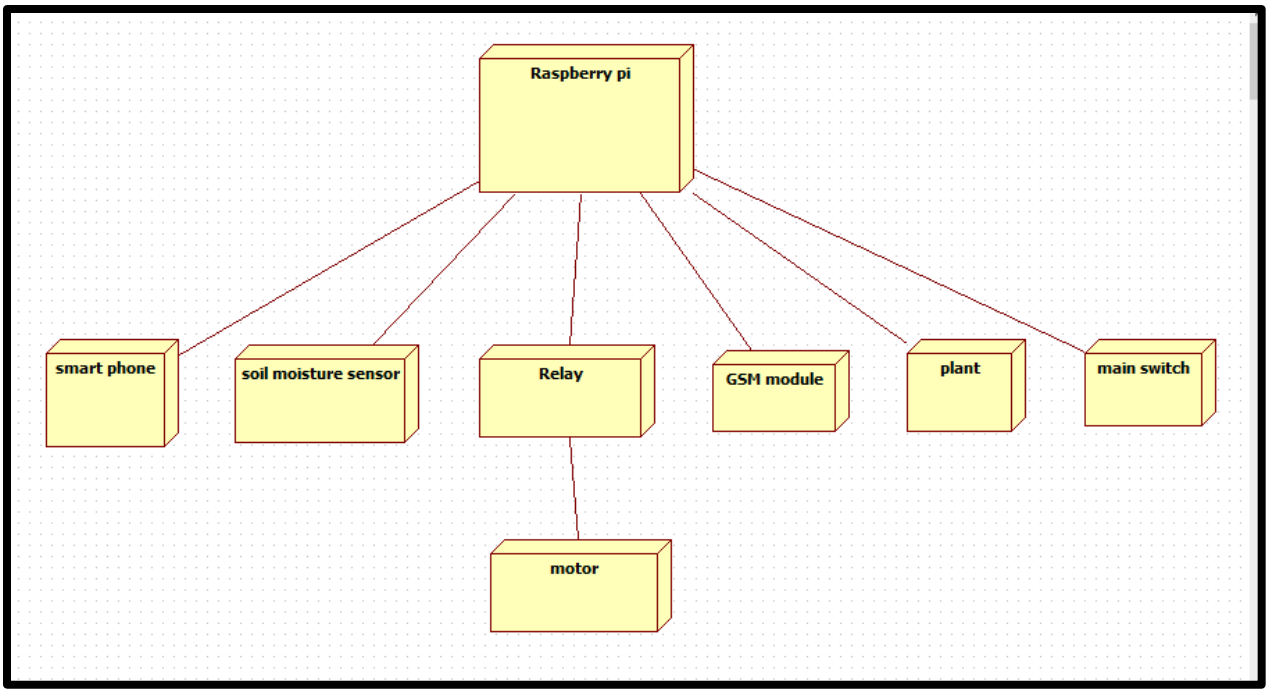


Fig 5.4: Deployment Diagram

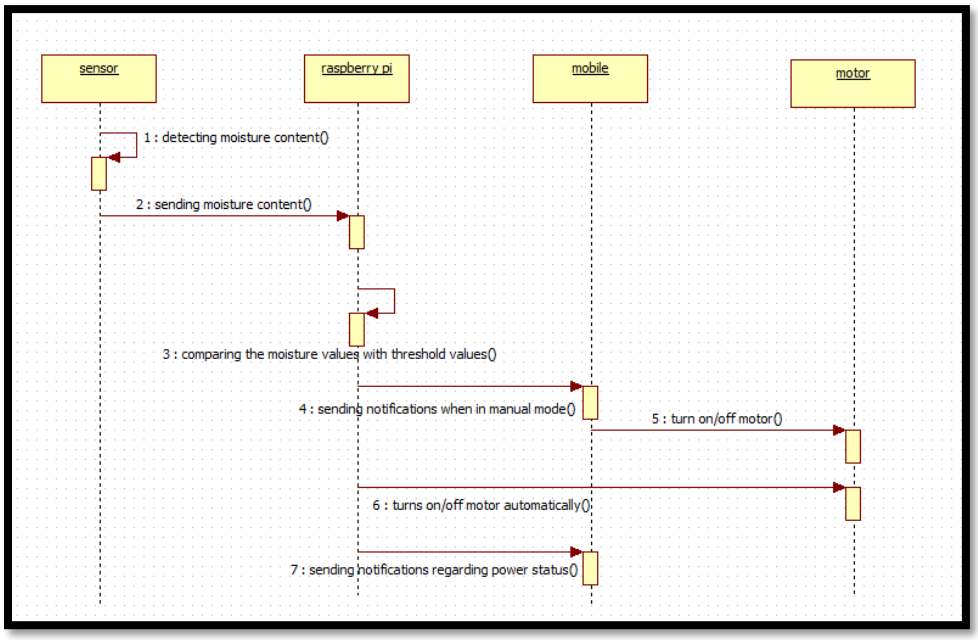


Fig 5.5: Sequence Diagram

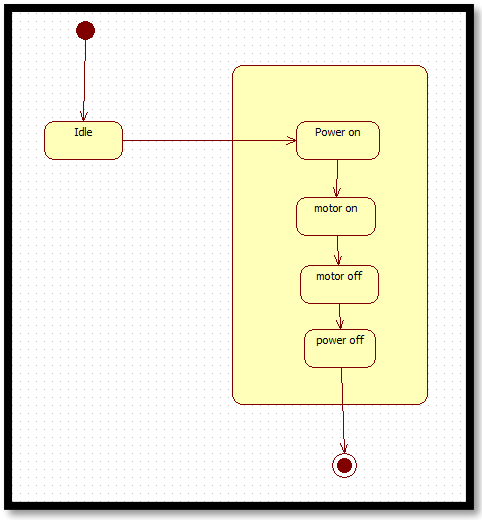


Fig 5.6: State Chart Diagram

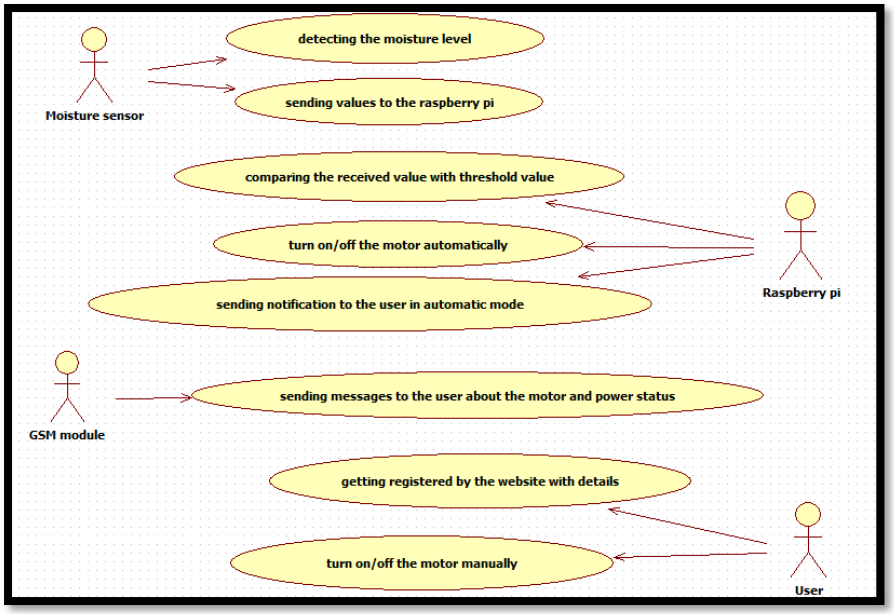


Fig 5.7: Use Case Diagram

5.3 Block Diagram

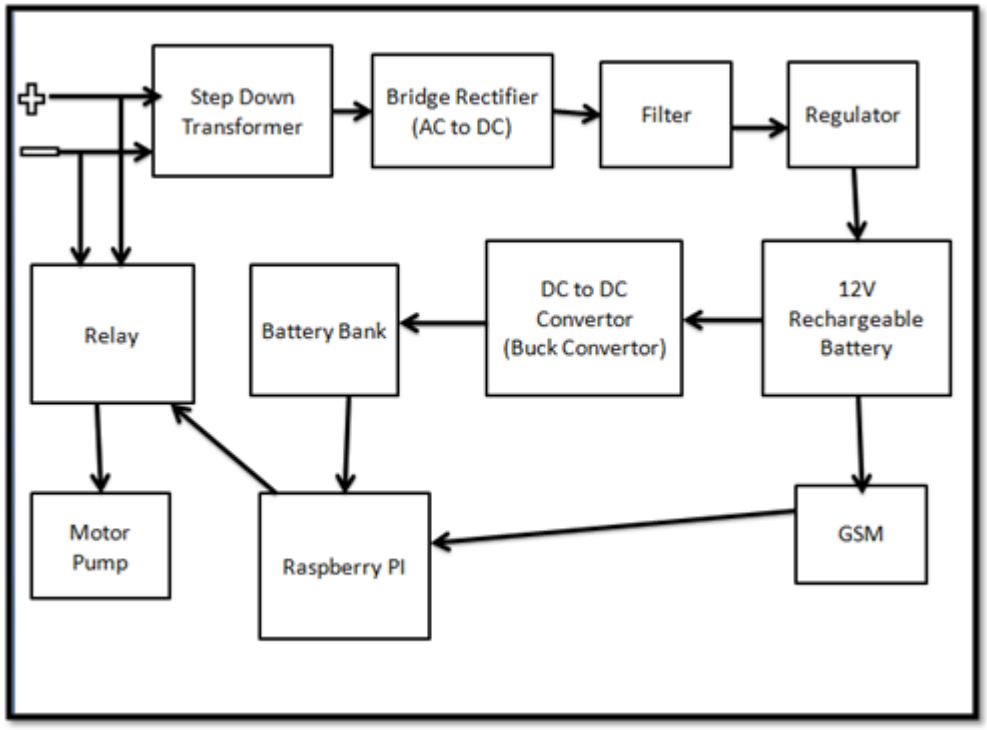


Fig 5.10: Block Diagram

230V Main supply is given to the Ac Motor Pump and to the step down transformer. The step down transformer converts the 230v ac current to 12v dc. But this dc is not pure. Using Bridge Rectifier the pulsating dc is converted to pure dc. The pure 12v dc is supplied to 12v rechargeable battery. It supplies power to the GSM Module even in case of power failure. The same 12v dc current is supplied to Buck Convertor to convert the 12v dc to 5v dc. This is supplied to battery bank which supplies the current to raspberry pi 3 even in case of power loss.

The soil moisture sensor senses the moisture content in the soil and sends the information to the raspberry pi through GPIO pins. Raspberry pi sends the signal to relay module either to turn on or off the motor based upon the moisture content.

5.4 Detailed View of Connections

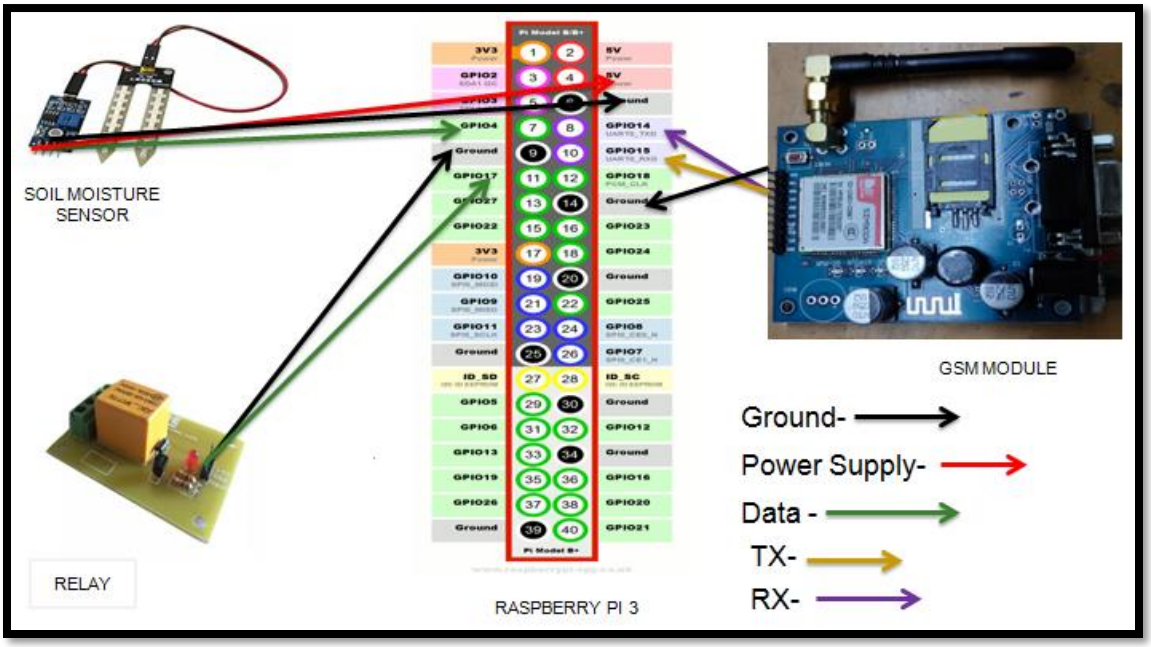
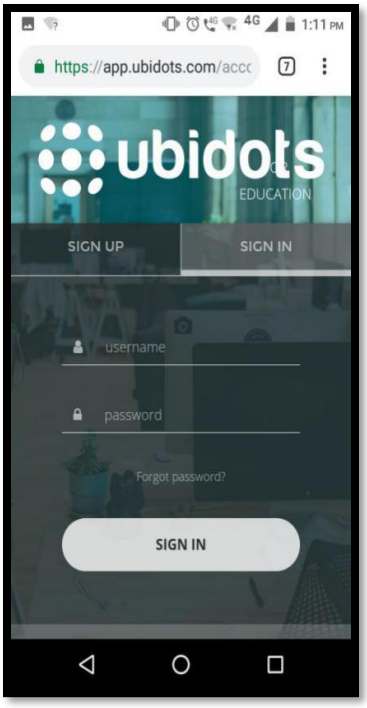


Fig 5.11: Detailed view of Connection

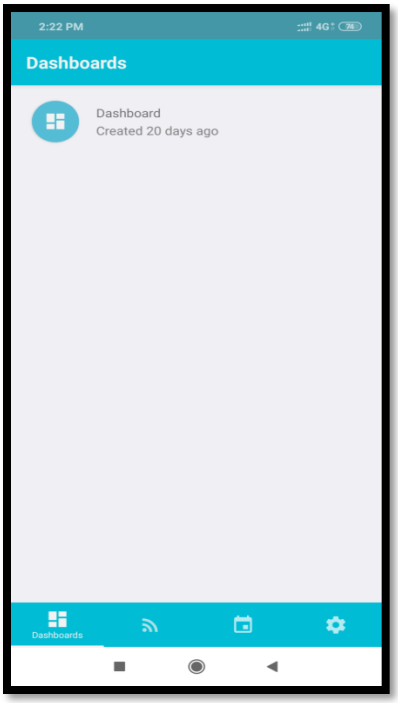
5.5 UI Screens

Screen 5.1: Home Page

Screen 5.2: Sign Up Page

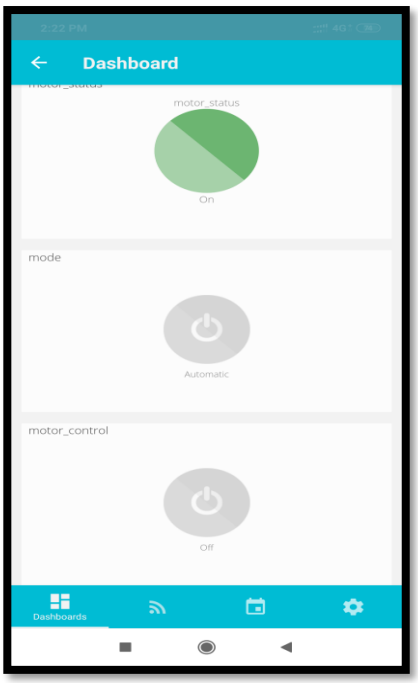


Screen 5.3: Sign In Page



Screen 5.4: Dashboard

Screen 5.5: Attributes



Screen 5.6: Attributes

CHAPTER 6

IMPLEMENTATION & RESULTS

6.1 Installing the RASPBIAN OS

Requirements for Installing Raspbian OS

- RASPBERRY PI 3: Single Board Computer.
- SD CARD: An 8GB class 4 SD card.
- DISPLAY: PC or TV.
- KEYBOARD & MOUSE: A standard USB keyboard and mouse.
- POWER SUPPLY: Use a 5V micro USB power supply to power your Raspberry Pi. Be careful that whatever power supply you use outputs at least 5V; insufficient power will cause Pi to behave unexpectedly.
- INTERNET CONNECTION: To update or download software, connect Raspberry Pi to the internet.

Steps to be followed while installing Raspbian OS

Step 1: DOWNLOAD RASPBIAN STRETCH LITE ZIP FILE.

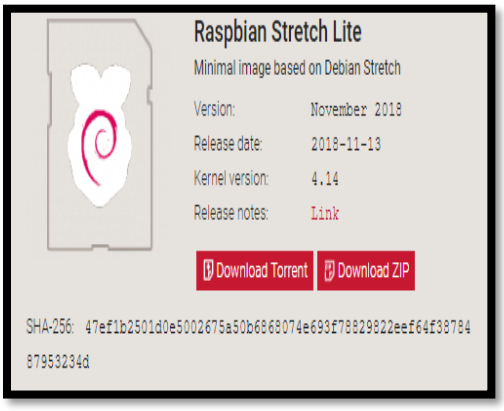


Fig 6.1: Raspbian Stretch Lite

Step 2: UNZIP THE ZIP FILE WE WILL GET AN IMAGE FILE.

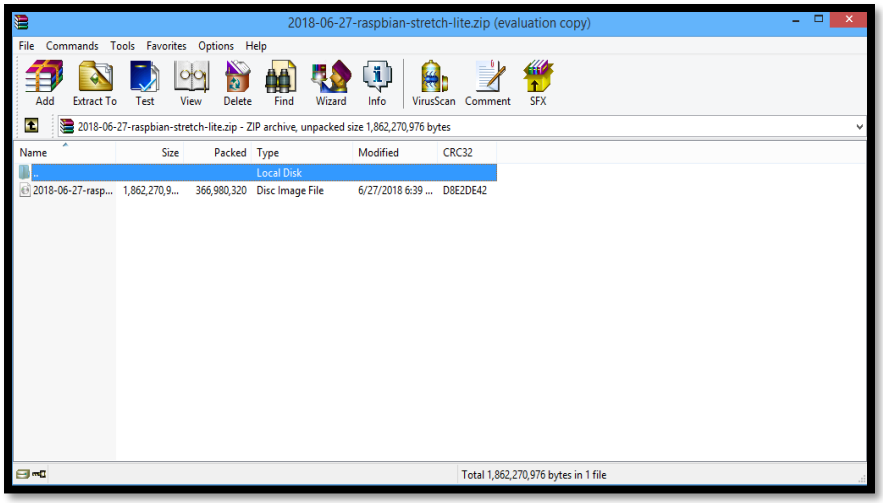


Fig 6.2: Unzip the file

Step 3: SELECT THE SD CARD TO FORMAT

Fig 6.3: Select SD Card

Step 4: FORMATTING THE SD CARD

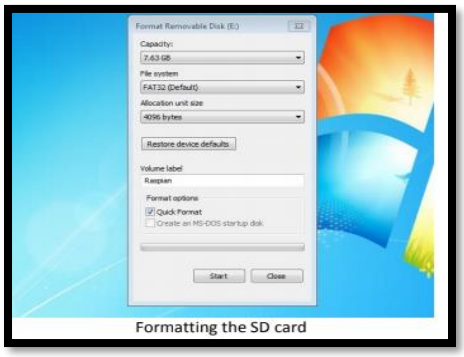


Fig 6.4: Format SD Card

Step 5: SELECT THE FILE TO WRITE

Fig 6.5: Select file to write

Step 6: WRITE THE FILE TO THE SD CARD

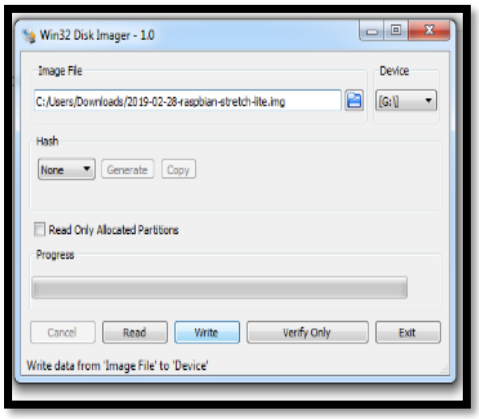


Fig 6.6: Write the file

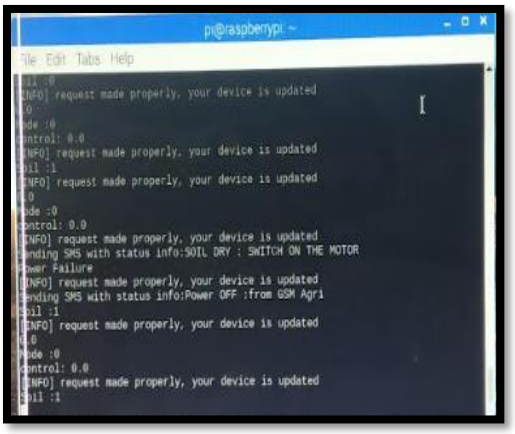
Step 7: WRITE SUCCESSFUL

Fig 6.7: Write Successful

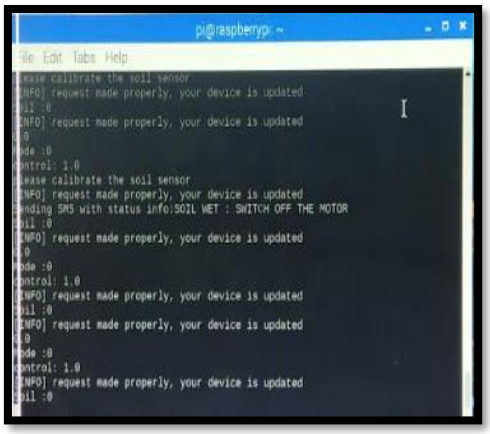
Step 8: WELCOME SCREEN

Fig 6.8: Welcome Screen

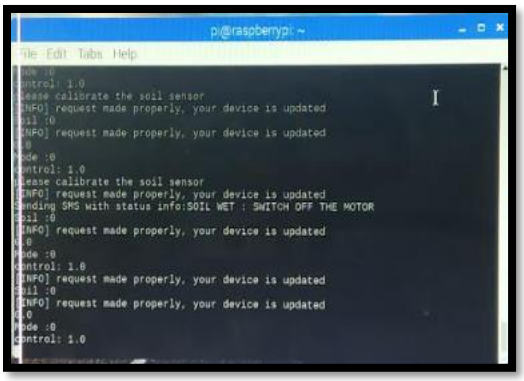
6.2 Execution



Screen 6.1: Execution

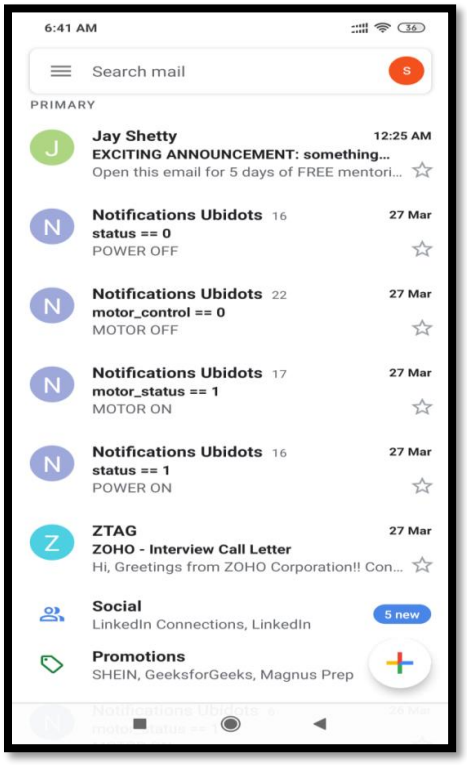


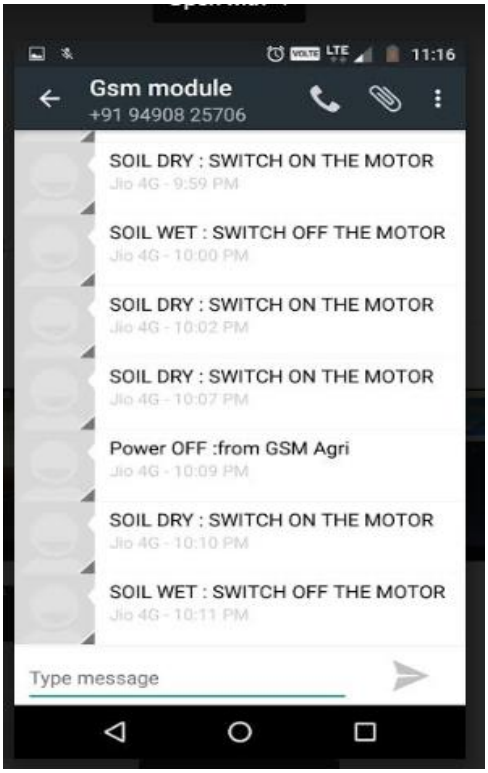
Screen 6.2: Execution



Screen 6.3: Execution

6.3 Results





Screen 6.4: Mails **Screen 6.5: Messages**

In the Screen 1 we could see that the user receives the emails acknowledging him/her when the motor is on/off and there is power loss.

From the Screen 2, we could say that the user will receive local SMS or text messages which can be checked offline even without the internet connectivity.

Steps:

- As soon as we open the app, the welcome page is shown that consists of a button named sign in. This button is redirected to ubidots website.
- The user needs to login by clicking on the sign up button if he/she has not registered for it yet. Otherwise if he/she has already have registered, user can directly login by clicking on the sign in button.
- Login credentials like registered username and password are to be entered by the user which will direct it to the user's dashboard.

- The dashboard usually consists of the status of attributes created by the user. We have five attributes for our project.
- **Moisture** attribute is used for checking the moisture level which might be dry/wet indicated by 1/0 respectively.
- **Status** attribute represents the power status of the mechanical setup.
- **Motor status** attribute is used to represent the on/off status of the motor.
- **Mode** attribute is used to operate either in automatic/manual modes.
- **Motor control** attribute is used to control the motor manually by turning it on/off.

CHAPTER 7

TESTING & VALIDATION

7.1 Introduction

The purpose testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, sub-assemblies, assemblies and/or a finished product. It is a process of exercising software with the intent of ensuring that the Software system meets its requirements and user expectations and does not fail in an unacceptable manner. There are various types of test. Each test type addresses a specific testing requirement.

7.2 Types of Testing Strategies used

- Unit Testing
- Integration Testing

7.2.1 Unit testing

Unit testing is a level of software testing where individual units/ components of a software are tested. The purpose is to validate that each unit of the software performs as designed. A unit is the smallest testable part of any software. It usually has one or a few inputs and usually a single output. In procedural programming, a unit may be an individual program, function, procedure, etc. In object-oriented programming, the smallest unit is a method, which may belong to a base/ super class, abstract class or derived/ child class. (Some treat a module of an application as a unit. This is to be discouraged as there will probably be many individual units within that module.) Unit testing frameworks, drivers, stubs, and mock/ fake objects are used to assist in unit testing.

Test cases

Test_case_id	Test_case_description	Expected result	Actual Result	Status
Test_case_001	Raspberry pi	Shows the status of network and power supply	Shows the status of network and power supply	Pass
Test_case_002	GSM module	Outgoing calls can be made, power status and network status is shown.	Outgoing calls can be made, power status and network status is shown.	Pass
Test_case_003	Submersible water pump	Pumping water	Pumping water	Pass
Test_case_004	Relay	Switching on/off the pump	Switching on/off the pump	Pass
Test_case_005	Soil moisture sensor	Senses the moisture level	Senses the moisture level	Pass

7.2.2 Integration testing

Integration testing is a level of software testing where individual units are combined and tested as a group. The purpose of this level of testing is to expose faults in the interaction between integrated units. Test drivers and test stubs are used to assist in Integration Testing.

- **Integration testing:** Testing performed to expose defects in the interfaces and in the interactions between integrated components or systems. See also *c*omponent integration
  testing, system integration testing.
- **Component integration testing:** Testing performed to expose defects in the interfaces and interaction between integrated components.

Test Cases

Test_case _id	Test_case_description	Expected result	Actual Result	Status
Test_case _001	User sign in	Displaying the user login and password to register	Displays the user login and password	pass
Test_case _002	Displaying user's dashboard	User's current dashboard is displayed on screen after signing up	User's current dashboard is displayed on screen after user signs up	pass

Test_case _003	Displaying the attributes on dashboard	Current status is shown as attributes on screen	Current status is shown as attributes on screen	pass
Test_case _004	Checking the raspberry pi functionality	Updates in the status of attributes	Updated status of attributes	pass
Test_case _005	Checking the GSM module functionality	Receiving the text messages sent by GSM module	Text messages received from GSM module	pass
Test_case _006	Checking the working of sensor	Functionality of sensor is successful	Detects the moisture content (0/1) successfully	pass
Test_case	Checking the	Motor on/off	Autom	pass

_007	functionality of motor in automatic mode	modes function successfully	aticall y turns on/off the motor	
Test_case _008	Checking the functionality of motor in manual mode	Turning on/off the motor when controlled by user on dashboard	Turns on/off the motor when control led by user on dashbo ard succes sfully	pass

7.3 Summary

In this way we also completed the testing phase of the project and ensure that the system is ready to go live.

CONCLUSION

In this project, we successfully developed a system that can help in an automated irrigation system by analyzing the moisture level of the soil. The smart irrigation system proves to be a useful system as it automates and regulates the watering without any manual intervention. The primary applications for this project are for farmers and gardeners who do not have enough time to water crops/plants. The farmers are facing major problems in watering their agriculture fields. It is because they have no proper idea about when the current is available so that they can pump water. The moisture sensors measure the moisture level in the soil. If the moisture level is found to be below the desired level, the moisture sensor sends the signal to the raspberry pi and sends an alert message which alerts the Water Pump to turn ON and supply the water to respective plant. Also without visiting will get the status of the motor on mobile.

The system may be further extended for outdoor utilization. This can be done through using number of wireless sensors depending upon the field size.

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