A Project Report on

Iot Based Smart Irrigation System

Submitted in partial fulfillment of the requirements for the award of the degree of

Bachelor of Engineering

in

Information Technology

by

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Approval Sheet

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CERTIFICATE

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Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, We have adequately cited and referenced the original sources. We also declare that We have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Abstract

Automation is the modest and newest way to do things rather than doing it in a traditional way, where human beings are replaced by automatic machines to improve the yield. As we all know that India is known as the agricultural country and ranks second worldwide in farm output. At present time, farmers are manually irrigating the land at a regular interval. This traditional approach sometimes consumes more water or sometimes the water reaches late due to which the crops get dried or corrupted. By using smart farming system this problem can be solved. To ensure the proper usage of water efficiently we need to establish a system that automates the irrigation process. We have designed IoT based automated irrigation system suitable for the Indian scenarios using the advanced technology of Internet of Things and embedded technology. With the help of sensors such as moisture, temperature and light levels our system will deliver optimal amount of water to the plants. Additionally the farmers will be able to monitor the progress, growth and parameters.

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IoT:	Internet of Things
UI:	User Interface
IEEE:	Institute of Electrical and Electronics Engine
HTTP:	Hyper Text Transfer Protocol
WiFi:	Wireless Fidelity
GSM:	Global System for Mobile communication
SDLC:	Software Development Life Cycle

Chapter 1

Introduction

Water is a vital resource for living creatures, each living creature uses water 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 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. Technology advancement has played an important role in solving the insufficiency of water, techniques like drip irrigation system, sprinkler systems, automated irrigation systems, network based systems which work on automation of irrigation. 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.

India's major source of earning is through agriculture and agriculture has also made a big impact on India's economy. On an average, 80 percent of fresh water is withdrawn from river and groundwater, which is used to produce food and other agricultural products. It is known that water is a vital resource for any living creatures, each living creature uses water as per its desires, because of this there is an importance of water in our lives, so it is highly necessary to use this resource as effectively and efficiently as possible. There are several sectors that come under water consumption; the biggest sector is the agricultural sector which consumes around 70 percent of water.

To ensure proper usage of water our system works on the basis of predefined values in the program, where system checks the amount of water required by a plant. If the moisture level is less than the predefined amount of water needed by the plant, then the program automates the flow of water from the pump unless a threshold value is reached. This ensures that crop has been provided optimum amount of water without any manual labour or wastage. This improves efficiency of water usage, reduced cost of irrigation water and results in intelligent irrigation. This project will be a proof of concept based on a single plant, however such a system can be expanded to massive farmlands as well with appropriate up-sizing of hardware. All hardware components for this project are locally available.

The main components used to build the system are as follows:

a) Sensor Based Automatic Irrigation System

Sensors such as soil moisture, temperature, luminosity and humidity sensors are used to determine the appropriate schedule for irrigation. The sensors are integrated to an Arduino-Uno board and based on the received data the pump is operated in terms of turning it on when the soil moisture level is less than a defined value.

b) Internet of Things (IoT)

Internet of things is the inter-networking of physical devices, interacting with each other to collect, control and exchange data. This system is in accordance with collecting real time values from the sensors with the objective of automating irrigation on comparison with the threshold values. Prototype here developed is programmed to store data on Cloud at an interval of 25 seconds, that is, after every sensor reading iteration. Analysis of this data stored can be used to evaluate the water usage per day, per week or per year even.

c) Wi-Fi Technology

Wi-Fi technology is used to send sensors generated or collected data to the cloud to keep track of the field status using sensors.Wi-Fi technology is used to update our soil parameters to the cloud to keep track of the field status using sensors. The novelty about our project is the use of the luminosity sensor that senses the light intensity of the surrounding environment and can provide artificial light in case of low intensity, this gives us an upper hand on areas with low sunlight. We have also used thingspeak as a platform to store all the data of the sensors, this is then processed and summarised as to how much more beneficial our system is in terms of water management. The temperature sensor plays an important role in watering the plant as the plants are watered comparatively more when the temperature is higher such that there is a compensation for the high evaporation that occurs. Lastly, we have collected previous years data for the ground nut plant and are currently comparing the monthly data we obtain to it and then come to a conclusion on how much water we have saved.

1.1 Problem Defination

The typical irrigation system may operate on a timer or schedule. A more advanced system might use sensors to determine if it is raining to prevent watering. These systems are still inefficient though because there are better times to water than others. They can also potentially over-water a lawn if the irrigation system waters during one part of the day and then there is rainfall in another part of the day.

Potential Solution: The Smart Irrigation system could add feed forward control instead of the typical feedback control. Through an interface to weather data, calibrated to the location where it is installed, the smart irrigation system can determine the best days to water during the course of a week. It could also determine total water volume / rain fall to prevent over-watering. The controller program and settings can be defined and/or modified through a web interface.

Challenges: The anticipated challenges for this project would be finding a way to interface to weather forecast information to the control unit. It might also be difficult to capture the rainfall volume.

1.2 Our Objectives

1)Our goal in this project is to help the user with their plant by using efficient methods for watering plant, decreasing the work load for the user on a day to day basis, periodically updating the status of soil parameters and any malfunctioning of the mechanical systems like pumps/motors.

2)To save water in the water consumption for irrigation.Creating a water control system for the irrigation of cities, parks, golf, agriculture, large hydraulic lines.

3)The purpose of developing this project is create an automated plant watering system. This project will be a proof of concept based on a single plant, however such a system can be expanded to massive farmlands as well with appropriate upsizing of hardware.

Chapter 2

Literature Review

There have been many studies done on the area of smart irrigation system to provide an easy and efficient method to automate the irrigation process. The different studies done are aimed towards irrigation its inefficient water consumption, absence of remote farm monitoring and lack of useful inference. In this paper we figure out an efficient method to integrate sensors with Arduino and come up with an automated irrigation system. The following are a few studies that we have referred to.

1. Rajalakshmi.P and Mrs.S. Devi Mahalakshmi developed a system using sensors to monitor the crops. The use of wireless transmission of sensor data from the field and storing it on a database along with control through mobile application proposed a proof of concept to automate the irrigation system. In their system the use of NRF24L01 for wireless transfer of data is different from our system where data is transferred through our Wi-Fi module ESP8266 and then uploaded to cloud.

2. Joaqun Gutirrezet. al developed an automated irrigation using solar power for organic that are geographically isolated. Their work on internet controlled duplex communication system holds a good decision making concept for adaptation to several different scenarios. The internet link is provided where access through mobile devices are established. Our system concentrates on cloud storage and GSM technology to water the crops efficiently.

3. Jia Uddin et. al proposed a system for automated Irrigation System that involves two levels of decision making to turn the motor ON/OFF. The micro-controller has the threshold values embedded in it called secure and insecure values which are 0cm and 10cm to turn the motor ON or OFF respectively. If the sensor values reach a mid level, the farmer or the user has to make the decision accordingly. This decision is made using a decoder to read the message sent by the owner to turn the motor ON or OFF. The entire system is driven using solar power to overcome the use of electricity as an alternative.

To overcome the drawback of too many decision makers, the threshold values can be made to be operated on different water content levels implemented in our proposed system. This involves coding on the basis of trail and error procedures to build up on moisture levels.

4. R. Suresh et. al proposed a system for automatic Irrigation prototype wherein the sensor nodes sends sensed values to the micro-controller that operates the solenoid valve. This micro-controller is interfaced to a mobile phone that is in auto answering mode to activate the buzzer that then switches off the motor by sending this activation signal to the micro-controller. This system is based on micro-controller application that results in lower power consumption.

The above system involves interfacing of two communicating devices to turn the motor on and off which can be simplified by letting only the micro-controller turn the motor ON or OFF based on the levels of moisture content and decision embedded in the code as implemented in our system.

Sr.No	Name	Merits	Demerits
1	Rajalakshmi.P and Mrs.S.Devi Mahalakshmi	First to introduce the concept storing sensor data to database.	Data transmission is not secure,data can lose in between transmission.
2	Jia Uddin	The entire system is driven using solar power to overcome the use of electricity.	Involves two levels of decision making to turn the motor ON/OFF.
3	R.Suresh	This system is based on microcontroller application that results in lower power consumption.	Involves interfacing of two communicating devices to turn the motor on and off.

Table 2.1: Literature Review Table

Water scarcity has a huge impact on food production. Without water people do not have a means of watering their crops and, therefore, to provide food for the fast growing population. According to the International Water Management Institute, agriculture, which accounts for about 70% of global water withdrawals, is constantly competing with domestic, industrial and environmental uses for a scarce water supply. In attempts to fix this ever growing problem, many have tried to form more effective methods of water management.

One such method is irrigation management. Irrigation is a method of transporting water to crops in order to maximize the amount of crops produced. Many of the irrigation systems in place do not use the water in the most efficient way. This causes more water then necessary to be used or for there not to be enough water to ensure healthy crops. According to the World Bank, irrigation management works to upgrade and maintain irrigation systems, such as groundwater irrigation, that are already in place and expands the areas of irrigation to increase the amount of crops being produced.

Population growth is increasing the demand for water in India, especially for agricultural purposes. Yet, the government of India has not included an assessment of water needs for an expanding population into its development strategy. The leading obstacle to such an assessment is lack of quality data. In fact, the latest data comes from the 1981 Census. A government official proposes to transform climate and water balance synthesis into crop regions as a means to evaluate the national or macro level effects on agriculture. Rice is the dominant crop of the eastern and coastal regions of India which have a humid and rainy climate. The acute to marginally dry crop regions grow jowar, maize, bajra, and ragi and face a water shortage. In dry north western India, developed irrigation systems sustain the wheat crop. Agricultural water needs depend on sufficient monsoon rain and/or irrigation. India has 5 microclimates: per humid, humid, dry, semiarid, and arid regions. 40.7

Water scarcity involves water stress, water shortage or deficits, and water crisis. This may be due to both nature and humans. Main factors that contribute to this issue include poor management of resources, lack of government attention, and man-made waste. [1]18 percent of the worlds population which resides in India only has access to 4 percent of usable water sources. Official data in the past decade depicts how annual per capita availability of water in the country has plummeted significantly with 163 million Indians lacking access to safe drinking water. [2] [3]

Water sources are contaminated with both biological and chemical pollutants. 21% of the countrys diseases are water-related with only 33% of the country having access to traditional sanitation.[4] Excessive use of groundwater for irrigation in agriculture has also caused a strain in the resource. As India is one of the top agriculture producers in the world, the consumption of water for land and crops is also one the highest. The results of the widespread use of ineffective techniques used for irrigation aligned with mismanagement are few of the reasons for the water deficit. [5] A significant portion of water used for industrial and domestic purposes is waste when returned to the streams. The demand for freshwater is increasing with the growing population, but the decreasing amount of supply fails to meet the needs of the people.[6]

The increased amount of solid wastes in water systems such as lakes, canals and rivers also heavily pollute the water. To combat this problem, the government issued the Ganga Action Plan issued in 1984 to clean up the Ganges River. However, much of the river remains polluted with a high coliform count at many places. This is largely due to lack of maintenance of the facilities as well inadequate fees for service. [7] Due to this issue, urgent need for safe drinking water is 70.1% of the households in urban areas. 18.7% in rural received organized pipe water supply and others have to depend on surface and ground water which is untreated.[6]

The history of Agriculture in India dates back to Indus Valley Civilization Era and even before that in some parts of Southern India. India ranks second worldwide in farm outputs. As per 2018, Agriculture employed 50% of the Indian work force and contributed 17-18% to countrys GDP.

In 2016. Agriculture and allied sectors like animal husbandry, forestry and fisheries accounted for 15.4% of the GDP (gross domestic product) with about 31 % of the workforce in 2014. India ranks first globally with highest net cropped area followed by US and China. The economic contribution of agriculture to Indias GDP is steadily declining with the countrys broad-based economic growth. Still, agriculture is demographically the broadest economic sector and plays a significant role in the overall socio-economic fabric of India.

India exported 3%8 billion worth of agricultural products in 2013, making it the seventh largest agricultural exporter worldwide and the sixth largest net exporter. Most of its agriculture exports serve developing and least developed nations. Indian agricultural/horticultural and processed foods are exported to more than 120 countries, primarily in the Middle East, Southeast Asia, SAARC countries, the European Union and the United States. India is an agricultural country. India ranks second worldwide in farm output. At present, farmer manually irrigates land at regular interval. This process sometimes consumes more water or sometimes the water reaches late due to which the crops get dried. [8] The newer scenario of decreasing water tables, drying up of rivers and tanks, unpredictable environment present an urgent need of proper utilization of water. To cope up with this use of moisture sensor at suitable locations for monitoring of crops is implemented in. An algorithm developed with threshold values of temperature and soil moisture can be programmed into an Arduido-based gateway to control water quantity. A remote sensing and control irrigation system using distributed wireless sensor network to maximize the productivity with minimal use of water was developed by Y. Kim. [9] Cloud storage is a cloud computing model in which data is stored on remote servers accessed from the Internet, or cloud. It is maintained, operated and managed by a cloud storage service provider on storage servers that are built on virtualization techniques. Cloud storage is also known as utility storage a term subject to differentiation based on actual implementation and service delivery. India has recently achieved 100 % rural electrification. Hence we have no issues when it comes to powering our projects. Herein we introduce automatic plant watering system, which is considered as one of the most commonly used and the most benecial automated systems nowadays, which help people in their daily activities by reducing or completely replacing their effort. This system uses sensor technology along with microcontroller and other electronics in order to behave like smart switching system which senses soil moisture level and irrigates the plant if necessary. Purpose of this work is to show how someone can easily make own and cheap automatic plant watering system by connecting certain electronic components and other materials required. [10][11]

Chapter 3

Analysis

3.1 System Analysis

System Analysis is the detailed study of the various operations performed by the system and their relationships within and outside the system. Analysis is the process of breaking something into its parts so that the whole may be understood. System analysis is concerned with becoming aware of the problem, identifying the relevant and most decisional variables, analyzing and synthesizing the various factors and determining an optimal or at least a satisfactory solution. During this a problem is identified, alternate system solutions are studied and recommendations are made about committing the resources used to design the system

3.2 Feasibility Report

A feasibility analysis usually involves a through assessment of the operational(need), financial and technical aspects of a proposal. Feasibility study is the test of the system proposal made to identify whether the user needs may be satisfied using the current software and hardware technologies, whether the system will be cost effective from a business point of view and whether it can be developed with the given budgetary constraints. A feasibility study should be relatively cheap and done at the earliest possible time. Depending on the study, the decision is made whether to go ahead with a more detailed analysis. When a new project is proposed, it normally goes through feasibility assessment. Feasibility study is carried out to determine whether the proposed system is possible to develop with available resources and what should be the cost consideration. Facts considered in the feasibility analysis were. Technical Feasibility Economic Feasibility Behavioral Feasibility In this phase,we study feasibility of all proposed systems,and pick the best feasible solu- tion for the problem.The feasibility is studied based on three main factors as follows.

3.2.1 Technical Feasibility

Technical Feasibility deals with the hardware as well as software requirements. Technology is not a constraint to type system development. We have to find out whether the necessary technology, the proposed equipment have the capacity to hold the data, which is used in the project, should be checked to carry out this technical feasibility. The technical feasibility issues usually raised during the feasibility stage of investigation includes these The hardware required is Arduino Uno ,Three sensors , WiFi module. The cloud data can be accessed through any operating system. The system can be expanded. Our project is technically feasible because, all the technology needed for our project is readily available.

3.2.2 Economic Feasibility

This feasibility study present tangible and intangible benefits from the prefect by comparing the development and operational cost. The technique of cost benefit analysis is often used as a basis for assessing economic feasibility. This system needs some more initial investment than the existing system, but it can be justifiable that it will improve quality of service. Thus feasibility study should center along the following points: Improvement resulting over the existing method in terms of accuracy, timeliness. Cost comparison. Estimate on the life expectancy of the hardware. Overall objective. Our project is economically feasible. It does not require much cost to be involved in the overall process. The overall objectives are in easing out the requirement processes.

3.2.3 Behavioral Feasibility

This analysis involves how it will work when it is installed and the assessment of political and managerial environment in which it is implemented. People are inherently resistant to change and computers have been known to facilitate change. The method of processing are completely accepted by the clients since they can meet all user requirements. The clients have been involved in the planning and development of the system. The proposed system will not cause any problem under any circumstances. Our project is operationally feasible because the time requirements and personnel require-ments are satisfied.

Chapter 4

Modeling

4.1 Importance of Modeling

A model is an abstract representation of a system constructed to understand the system prior to building or modifying it. The use of Visual Notation to represent a system provide the landing, maintenance. fa- miliarity simplification and communication among the project teams. 1. Modeling gives better understanding of the system which we are developing. 2. It also helps in describing the structure or behavior of the system. 3. The important aspect of modeling is that it allows us to experiment by exploring mul- tiple solution for the system. 4. The main aspect of modeling is abstraction which is very useful. for managing complexity of the system

4.2 Four principles of modeling say

The choice of what models to create has a profound influence on how a problem is attacked. And how at solution is shaped: It means choose your model well. The right models will brilliantly illuminate the most wicked development problems. The wrong models will mislead you, causing you to focus on irrelevant issues. No single model is sufficient every non trivial system is best approached through a small set of nearly independent models. To understand the architecture of the system, you need multiple interlocking views such as use case views, design views. process views, implemen- tation views and development views. 8Each of these views may have structural as well as behavioral aspects. Together these views represent a system.

4.3 Principles of Modeling

1. According to first principal, the choice of models affects how a problem is tackled. 2. Second principle of modeling states that every model may expressed at different levels of abstraction. 3. The principle is effective models are connected to reality. 4. According to fourth principle of modeling no single model is sufficient to describe non trivial system.

4.4 Plan of Action

4.4.1 Software Development Life Cycle

We have chosen the Waterfall model to proceed with our project as it is suitable for our usecase.

The Waterfall Model was first Process Model to be introduced. It is very simple to understand and use. In a Waterfall model, each phase must be completed before the next phase can begin and there is no overlapping in the phases. Waterfall model is the earliest SDLC approach that was used for software development.

In The Waterfall approach, the whole process of software development is divided into separate phases. The outcome of one phase acts as the input for the next phase sequentially. This means that any phase in the development process begins only if the previous phase is complete. The waterfall model is a sequential design process in which progress is seen as flowing steadily downwards (like a waterfall) through the phases of Conception, Initiation, Analysis, Design, Construction, Testing, Production/Implementation and Maintenance.

As the Waterfall Model illustrates the software development process in a linear sequential flow; hence it is also referred to as a Linear-Sequential Life Cycle Model.

REQUIREMENTS

The first phase involves understanding what need to be design and what is its function, purpose etc. Here, the specifications of the input and output or the final product are studied and marked.

SYSTEM DESIGN

The requirement specifications from first phase are studied in this phase and system design is prepared. System Design helps in specifying hardware and system requirements and also helps in defining overall system architecture. The software code to be written in the next stage is created now.

IMPLEMENTATION

With inputs from system design, the system is first developed in small programs called units, which are integrated in the next phase. Each unit is developed and tested for its functionality which is referred to as Unit Testing.

INTEGRATION AND TESTING

All the units developed in the implementation phase are integrated into a system after testing of each unit. The software designed, needs to go through constant software testing to find out if there are any flaw or errors. Testing is done so that the client does not face any problem during the installation of the software.

DEPLOYMENT OF SYSTEM

Once the functional and non-functional testing is done, the product is deployed in the customer environment or released into the market.

MAINTENANCE

This step occurs after installation and involves making modifications to the system or an individual component to alter attributes or improve performance. These modifications arise either due to change requests initiated by the customer, or defects uncovered during live use of the system. Client is provided with regular maintenance and support for the developed software.

All these phases are cascaded to each other in which progress is seen as flowing steadily downwards (like a waterfall) through the phases. The next phase is started only after the defined set of goals are achieved for previous phase and it is signed off, so the name Waterfall Model.

4.4.2 Advantages of Waterfall Model

The advantage of waterfall development is that it allows for departmentalization and control. A schedule can be set with deadlines for each stage of development and a product can proceed through the development process model phases one by one. The waterfall model progresses through easily understandable and explainable phases and thus it is easy to use. It is easy to manage due to the rigidity of the model each phase has specific deliverables and a review process. In this model, phases are processed and completed one at a time and they do not overlap. Waterfall model works well for smaller projects where requirements are very well understood.

4.4.3 Disadvantages of Waterfall Model

It is difficult to estimate time and cost for each phase of the development process. Once an application is in the testing stage, it is very difficult to go back and change something that was not well-thought out in the concept stage. Not a good model for complex and object-oriented projects. Not suitable for the projects where requirements are at a moderate to high risk of changing.

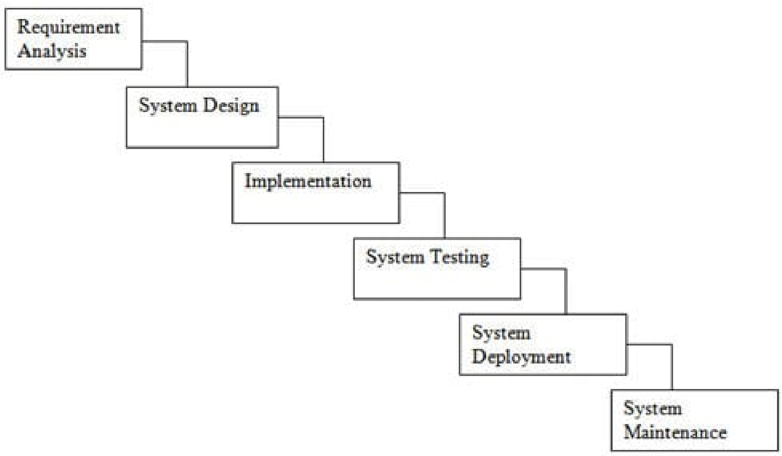


Figure 4.1: Waterfall Model

4.4.4 Gantt Chart

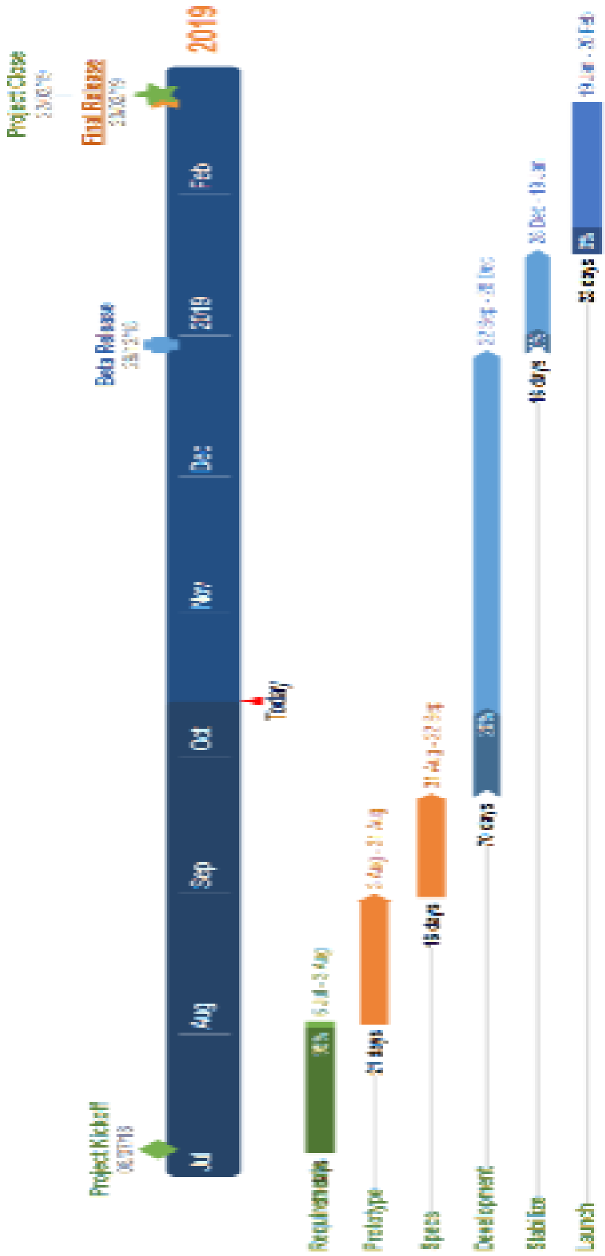


Figure 4.2: Gantt Chart

Chapter 5

List of Components

5.1 Arduino Uno board

Arduino is an open-source prototyping platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. We can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so we use the Arduino programming language (based on wiring), and the Arduino Software(IDE), based on Processing.

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

5.1.1 What's on the board?

There are many varieties of Arduino boards (explained below) that can be used for different purposes. Some boards look a bit different from the one below, but most Arduinos have the majority of these components in common

5.1.2 Power (USB / Barrel Jack)

Every Arduino board needs a way to be connected to a power source. The Arduino UNO can be powered from a USB cable coming from your computer or a wall power supply (like this) that is terminated in a barrel jack. The USB connection is also how you will load code onto your Arduino board.

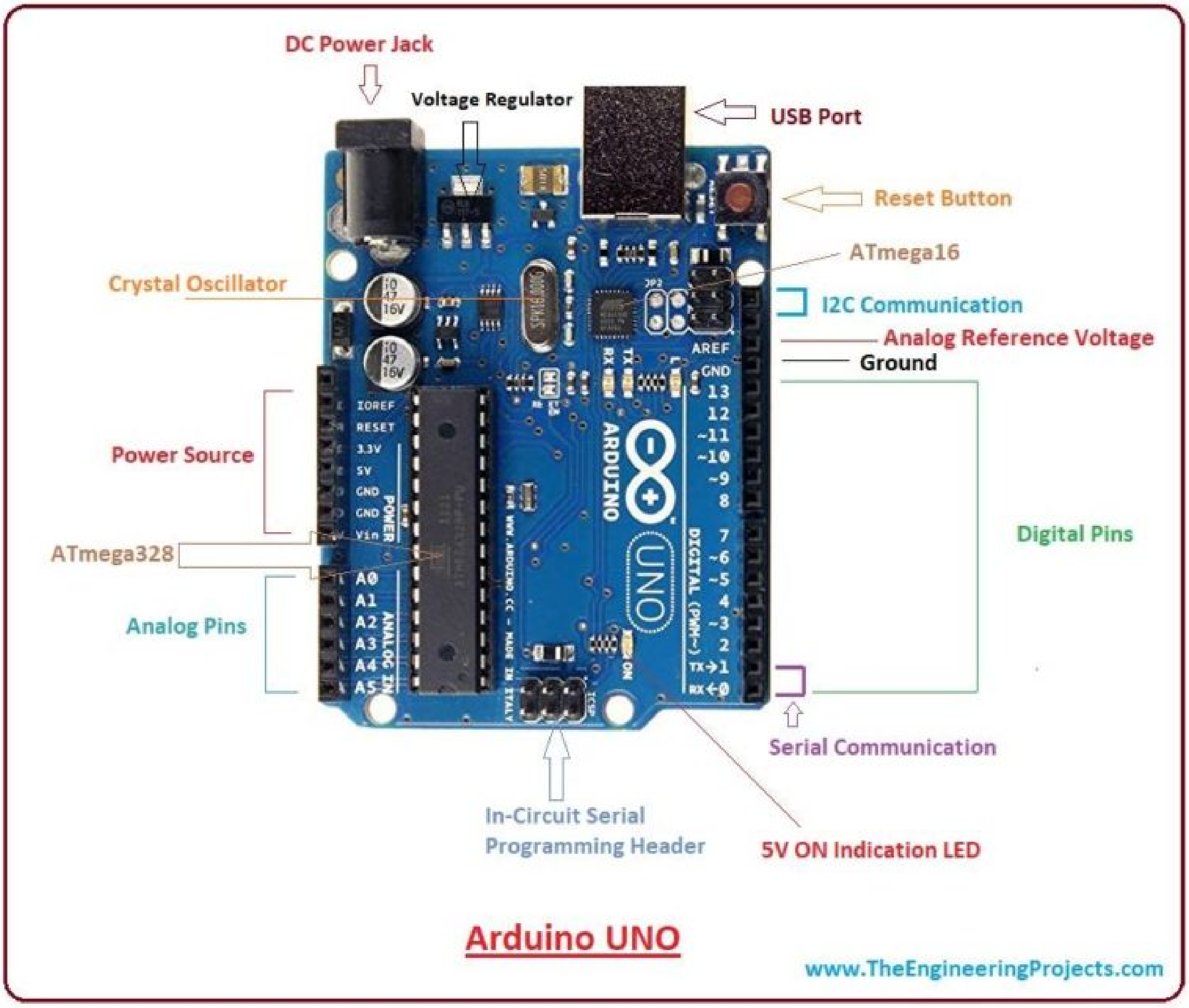


Figure 5.1: Arduino Uno Board

5.1.3 What Does it Do?

The Arduino hardware and software was designed for artists, designers, hobbyists, hackers, newbies, and anyone interested in creating interactive objects or environments. Arduino can interact with buttons, LEDs, motors, speakers, GPS units, cameras, the internet, and even your smart-phone or your TV! This flexibility combined with the fact that the Arduino software is free, the hardware boards are pretty cheap, and both the software and hardware are easy to learn has led to a large community of users who have contributed code and released instructions for a huge variety of Arduino-based projects.

5.1.4 Pins (5V, 3.3V, GND, Analog, Digital, PWM, AREF)

The pins on your Arduino are the places where you connect wires to construct a circuit (probably in conjuction with a breadboard and some wire. They usually have black plastic headers that allow you to just plug a wire right into the board. The Arduino has several different kinds of pins, each of which is labeled on the board and used for different functions.

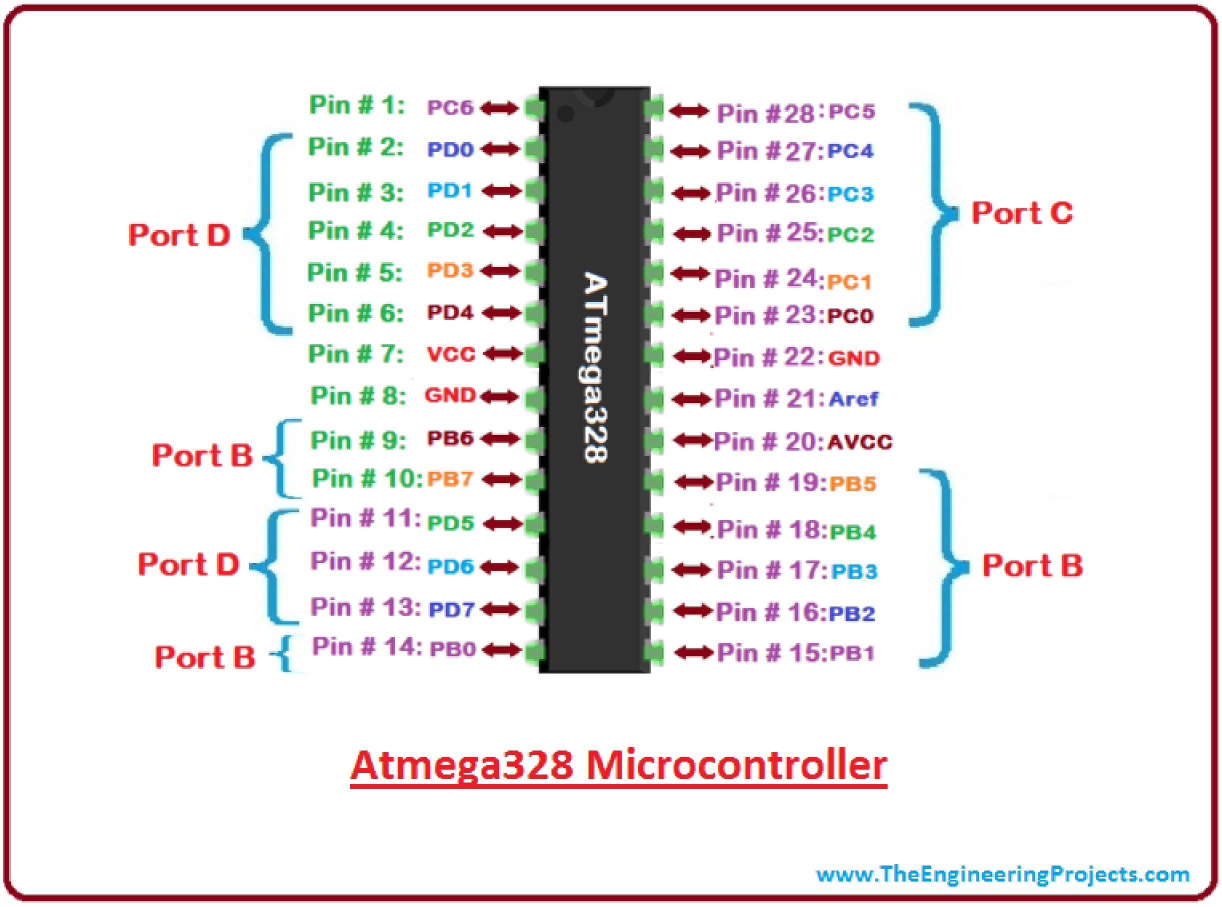


Figure 5.2: Arduino Uno Board pins

GND (3)

Short for Ground. There are several GND pins on the Arduino, any of which can be used to ground your circuit.

5V (4) and 3.3V (5)

As you might guess, the 5V pin supplies 5 volts of power, and the 3.3V pin supplies 3.3 volts of power. Most of the simple components used with the Arduino run happily off of 5 or 3.3 volts.

Analog (6)

The area of pins under the Analog In label (A0 through A5 on the UNO) are Analog In pins. These pins can read the signal from an analog sensor (like a temperature sensor) and convert it into a digital value that we can read.

Digital (7)

Across from the analog pins are the digital pins (0 through 13 on the UNO). These pins can be used for both digital input (like telling if a button is pushed) and digital output (like powering an LED).

PWM (8)

You may have noticed the tilde ( ) next to some of the digital pins (3, 5, 6, 9, 10, and 11 on the UNO). These pins act as normal digital pins, but can also be used for something called Pulse-Width Modulation (PWM). We have a tutorial on PWM, but for now, think of these pins as being able to simulate analog output (like fading an LED in and out).

AREF (9)

Stands for Analog Reference. Most of the time you can leave this pin alone. It is sometimes used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins.

FEATURES	SPECIFICATIONS
Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage(recommended)	7-12V
Input Voltage(limits)	6-20V
Digital I/O Pins	14
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	3 KB (ATmega328)of which 0.5 KB used by boot loader
SRAM	2 KB(ATmega328)
EEPROM	1KB(ATmega328)
Clock Speed	16 MHz

Table 5.1: Arduino Uno Board Specifications

5.1.5 Reset Button

Just like the original Nintendo, the Arduino has a reset button (10). Pushing it will temporarily connect the reset pin to ground and restart any code that is loaded on the Arduino. This can be very useful if your code doesnt repeat, but you want to test it multiple times. Unlike the original Nintendo however, blowing on the Arduino doesnt usually fix any problems.

5.1.6 Power LED Indicator

Just beneath and to the right of the word UNO on your circuit board, theres a tiny LED next to the word ON (11). This LED should light up whenever you plug your Arduino into a power source. If this light doesnt turn on, theres a good chance something is wrong. Time to re-check your circuit!

5.1.7 TX RX LEDs

TX is short for transmit, RX is short for receive. These markings appear quite a bit in electronics to indicate the pins responsible for serial communication. In our case, there are two places on the Arduino UNO where TX and RX appear once by digital pins 0 and 1, and a second time next to the TX and RX indicator LEDs (12). These LEDs will give us some nice visual indications whenever our Arduino is receiving or transmitting data (like when were loading a new program onto the board).

5.1.8 Main IC

The black thing with all the metal legs is an IC, or Integrated Circuit (13). Think of it as the brains of our Arduino. The main IC on the Arduino is slightly different from board type to board type, but is usually from the A Tmega line of ICs from the ATMEL company. This can be important, as you may need to know the IC type (along with your board type) before loading up a new program from the Arduino software. This information can usually be found in writing on the top side of the IC. If you want to know more about the difference between various ICs, reading the datasheets is often a good idea.

5.1.9 Voltage Regulator

The voltage regulator (14) is not actually something you can (or should) interact with on the Arduino. But it is potentially useful to know that it is there and what its for. The voltage regulator does exactly what it says it controls the amount of voltage that is let into the Arduino board. Think of it as a kind of gatekeeper; it will turn away an extra voltage that might harm the circuit. Of course, it has its limits, so dont hook up your Arduino to anything greater than 20 volts.

5.1.10 The Arduino Family

Arduino makes several different boards, each with different capabilities. In addition, part of being open source hardware means that others can modify and produce derivatives of Arduino boards that provide even more form factors and functionality

5.1.11 Arduino IDE

The Arduino Software is an open source software that can be downloaded from the Arduino website, this is used to write codes and upload it on to the board. The Arduino software supports Windows, Linux, and Mac etc and is written in Java. All sensors and actuators are controlled by varying the code.

5.2 Descriptopn Of ATMEGA 328P Micro Cntroller

The ATmega48PA/88PA/168PA/328P is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega48PA/88PA/168PA/328P achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed The ATmega48PA/88PA/168PA/328P provides the following features: 4K/8K bytes of In-System Programmable Flash with Read-While-Write capabilities, 256/512/512/1K bytes EEPROM, 512/1K/1K/2K bytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, a byte-oriented 2-wire Serial Interface, an SPI serial port, a 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages), a programmable Watchdog Timer with internal Oscillator, and five software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, USART, 2-wire Serial Interface, SPI port, and interrupt system to continue functioning.

The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low power consumption. The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle.

The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning. The Power-down mode saves the RAM contents but freezes the oscillator, disabling all other chip functions until the next interrupt or hardware reset.The device is manufactured using Atmels high density non-volatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed In-System through an SPI serial interface, by a conventional non-volatile memory programmer, or by an On-chip Boot program running on the AVR core. The Boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega48PA/88PA/168PA/328P is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications. The Boot program can use any interface to download the application program in the Application Flash memory. This allows very fast start-up combined with low power consumption.

Figure 5.3: ATMEGA328PAU

Even though there are separate addressing schemes and optimized opcodes for register file and I/O register access, all can still be addressed and manipulated as if they were in SRAM. In the ATMEGA variant, the working register file is not mapped into the data address space; as such, it is not possible to treat any of the ATMEGA's working registers as though they were SRAM.

5.3 Sensors

5.3.1 Soil MOisture Sensor

A soil moisture sensor measures the amount of moisture content present in the soil, this is of great importance for the irrigation system.Although soil water status can be determined by direct (soil sampling) and indirect (soil moisture sensing) methods, direct methods of monitoring soil moisture are not commonly used for irrigation scheduling because they are intrusive and labor intensive and cannot provide immediate feedback. Soil moisture probes can be permanently installed at representative points in an agricultural field to provide repeated moisture readings over time that can be used for irrigation management. Special care is needed when using soil moisture devices in coarse soils since most devices require close contact with the soil matrix that is sometimes difficult to achieve in these soils.

Soil moisture is an important component in the atmospheric water cycle, both on a small agricultural scale and in large-scale modelling of land/atmosphere interaction. Vegetation and crops always depend more on the moisture available at root level than on precipitation occurrence. Water budgeting for irrigation planning, as well as the actual scheduling of irrigation action, requires local soil moisture information. Knowledge of the degree of soil wetness helps to forecast the risk of flash floods, or the occurrence of fog.

Soil water content is an expression of the mass or volume of water in the soil, while the soil water potential is an expression of the soil water energy status. The relation between content and potential is not universal and depends on the characteristics of the local soil, such as soil density and soil texture.

Measuring soil moisture is very important in agriculture to help farmer for managing the irrigation system. Soil moisture sensor is one who solves this. This sensor measures the content of water. Soil moisture sensor uses the capacitance to measure the water content of soil. It is easy to use this sensor. Simply insert this rugged sensor into the soil to be tested, and the volumetric water content of the soil is reported in percent. Soil moisture sensors measure the volumetric water content in soil.

Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, or electric conductivity. Reflected microwave radiation is affected by the soil moisture and is used for remote sensing inhydrology and agriculture. Portable probe instruments can be used by farmers or gardeners.

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

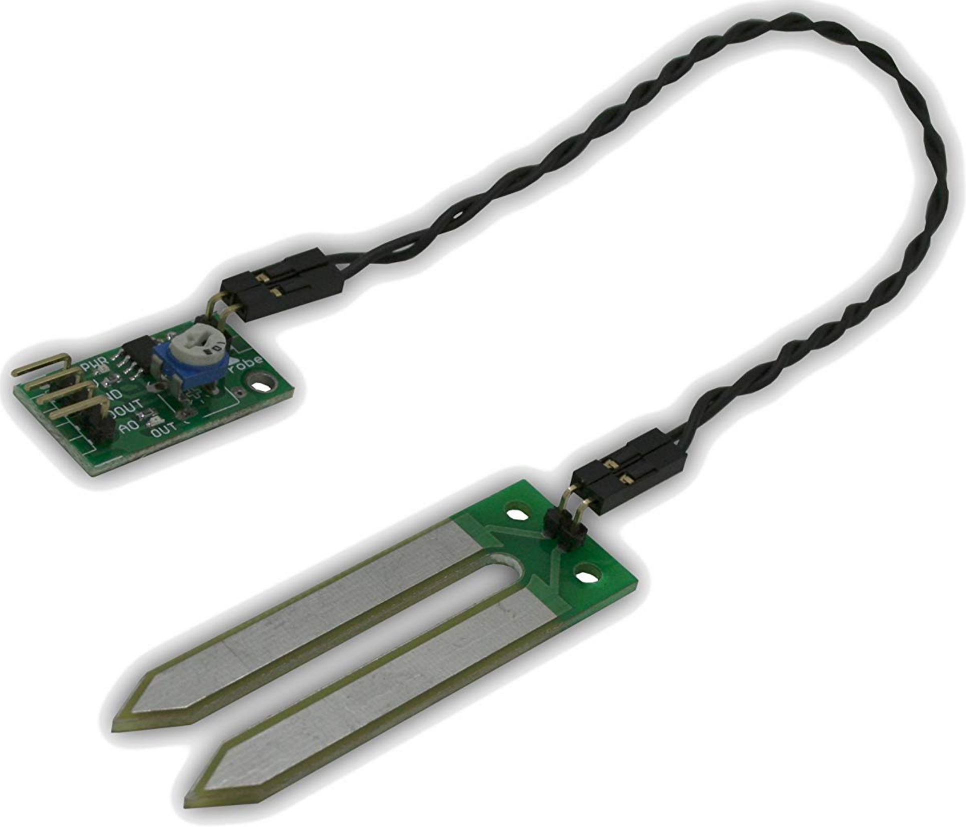


Figure 5.4: soil moisture sensor

5.3.2 Temperature Sensor

The LM35 is an integrated circuit temperature device with an output that is linearly proportional to the Centigrade temperature. The LM35 device does not require any external calibration or trimming to provide accuracy of 14C and 3/4 C at room temperature and externally respectively. The temperature sensor used to measure the temperature at the field is LM35. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade).The LM35 does not require any external calibration or trimming to provide typical accuracies of degree C at room temperature and degree C over a full -55 to +150C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35s low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy.

The device is used with single power supplies, or with plus and minus supplies. As the LM35 device draws only 60 A from the supply, it has very low self-heating of less than 0.1C in still air. **Features**

1. Calibrated Directly in Celsius (Centigrade)
2. Linear + 10-mV/C Scale Factor
3. 0.5C Ensured Accuracy (at 25C)
4. Rated for Full 55C to 150C Range
5. Suitable for Remote Applications
6. Low-Cost Due to Wafer-Level Trimming
7. Operates from 4 V to 30 V
8. Less than 60-A Current Drain
9. Low Self-Heating, 0.08C in Still Air
10. Non-Linearity Only C Typical
11. Low-Impedance Output, 0.1 for 1-mA Load

Figure 5.5: Temperature sensor1

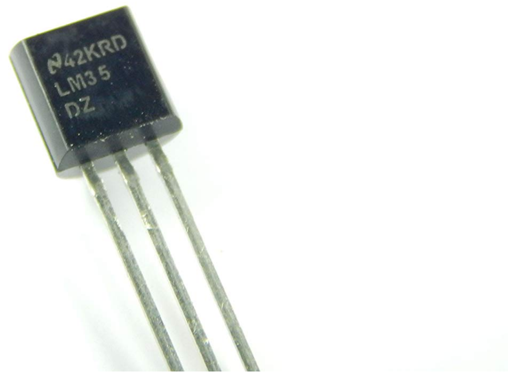


Figure 5.6: Temperature sensor2

5.4 Luminosity Sensor

The LDR sensor is a photo resistor whose resistant works on EMR. These are made up of semiconductor materials having high resistance sensitivity to light.

This system works by sensing the intensity of light in its environment. The sensor that can be used to detect light is an LDR. It's inexpensive, and you can buy it from any local electronics store or online.

The LDR gives out an analog voltage when connected to VCC (5V), which varies in magnitude in direct proportion to the input light intensity on it. That is, the greater the intensity of light, the greater the corresponding voltage from the LDR will be. Since the LDR gives out an analog voltage, it is connected to the analog input pin on the Arduino. The Arduino, with its built-in ADC (analog-to-digital converter), then converts the analog voltage (from 0-5V) into a digital value in the range of (0-1023). When there is sufficient light in its environment or on its surface, the converted digital values read from the LDR through the Arduino will be in the range of 800-1023.

Furthermore, we then program the Arduino to turn on a relay. Correspondingly, turn on an appliance (light bulb), when the light intensity is low (this can be done by covering the surface of the LDR with any object), that is, when the digital values read are in a higher range than usual. One leg of the LDR is connected to VCC (5V) on the Arduino, and the other to the analog pin 0 on the Arduino. A 100K resistor is also connected to the same leg and grounded.

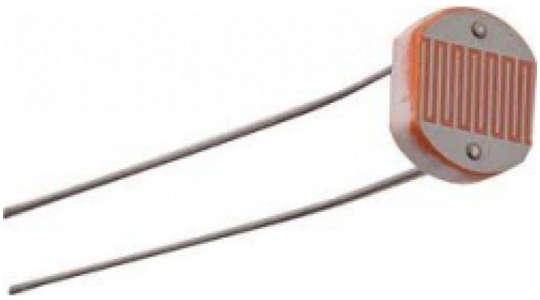


Figure 5.7: Luminosity sensor

5.5 Relay and pump

The relay turn on and off the pump according to the moisture level of the soil. It is controlled by interfacing it to a micro-controller, in this case the Arduino-uno. The pump is triggered on and off by the relay.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 water pump which is connected to a H-Bridge.

The pumping of water is a basic and practical technique, far more practical than scooping it up with one's hands or lifting it in a hand-held bucket. This is true whether the water is drawn from a fresh source, moved to a needed location, purified, or used for irrigation, washing, or sewage treatment, or for evacuating water from an undesirable location. Regardless of the outcome, the energy required to pump water is an extremely demanding component of water consumption. All other processes depend or benefit either from water descending from a higher elevation or some pressurized plumbing system.

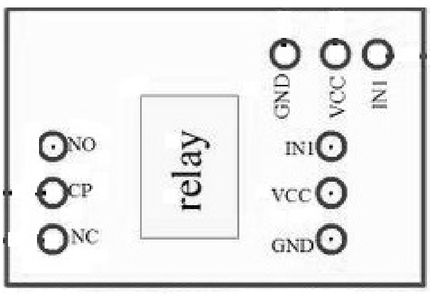


Figure 5.8: Relay Pins Structure

Figure 5.9: Submersible Mini Water Pump

Specifications:
Operating range: 3.0 - 12.0 Volts
Nominal Voltage: 12
No Load Speed: 5600 rpm
No Load Current: 0.022 A Max.
Efficiency Speed: 4906 rpm Max.
Efficiency Current: 0.16 -0.23 A Max.
Efficiency Torque: 21.1 g.cm
Stall Torque: 170 g.cm
Stall Current: 1.1 - 1.5 A
Body Diameter: 24.4 mm
Body Length: 32.5 mm
Shaft Diameter: 2 mm
Shaft Length: 10.5 mm
Weight: 50 grams
Contacts: 2mm x 3.9mm
End Play: 0.05 0.45mm
Operating Temperature: -10C 60C

5.6 Wi-Fi Module

The ESP8266 is a low cost Wi-Fi module which adds functionality to the existing Arduino-uno via the UART serial connection. This module is reprogrammed in such a way that the data from the sensors are transmitted to the cloud storage provide by cloud every 25 seconds.

The Arduino Uno WiFi is an Arduino Uno with an integrated WiFi module. The board is based on the ATmega328P with an ESP8266 WiFi Module integrated. The ESP8266 WiFi Module is a self contained SoC with integrated TCP/IP protocol stack that can give access to your WiFi network (or the device can act as an access point). One useful feature of Uno WiFi is support for OTA (over-the-air) programming, either for transfer of Arduino sketches or WiFi firmware.The Arduino Uno WiFi is programmed using the Arduino Software (IDE)

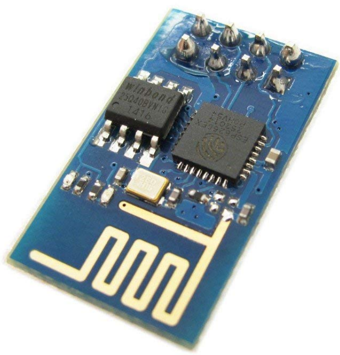


Figure 5.10: WiFi Module

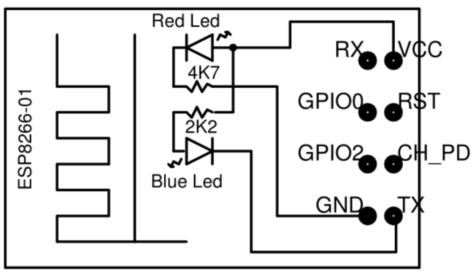


Figure 5.11: WiFi Pins Structure

5.7 Major Software Required

5.7.1 Arduino Software (IDE)

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. This software can be used with any Arduino board.

Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students with or without a background in electronics and programming.Arduino is an open-source prototyping platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a message - and turn it into an output - activating a motor, turning on an LED, publishing something online and many more.You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Inexpensive

Arduino boards are relatively inexpensive compared to other microcontroller platforms.

Cross-platform - The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.

Simple, clear programming environment

The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well.

Open source and extensible hardware

The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it.

Open source and extensible software

The Arduino software is published as open source tool and the language can be expanded through C++ libraries.

5.7.2 How to use Arduino IDE Tool

Steps for using Arduino IDE:

Step 1: Get an Arduino board and USB cable

In this tutorial, we assume you're using an Arduino Uno You also need a standard USB cable (A plug to B plug): the kind you would connect to a USB printer, for example.

Step 2 : Download the Arduino environment

(https://www.arduino.cc/en/Main/Software) Get the latest version from the download page. When the download finishes, unzip the downloaded file. Make sure to preserve the folder structure. Double-click the folder to open it. There should be a few files and sub-folders inside.

Step 3 : Connect the board

The Arduino Uno, Mega, Duemilanove and Arduino Nano automatically draw power from either the USB connection to the computer or an external power supply. If you're using an Arduino Diecimila, you'll need to make sure that the board is configured to draw power from the USB connection. The power source is selected with a jumper, a small piece of plastic that fits onto two of the three pins between the USB and power jacks. Check that it's on the two pins closest to the USB port. Connect the Arduino board to your computer using the USB cable. The green power LED (labelled PWR) should go on.

Step 4 : Install the drivers

Installing drivers for the Arduino Uno or Arduino Mega 2560 with Windows7, Vista, or XP

Step 5: Launch the Arduino application

Double-click the Arduino application. (Note: if the Arduino software loads in the wrong language, you can change it in the preferences dialog. See the environment page for details.

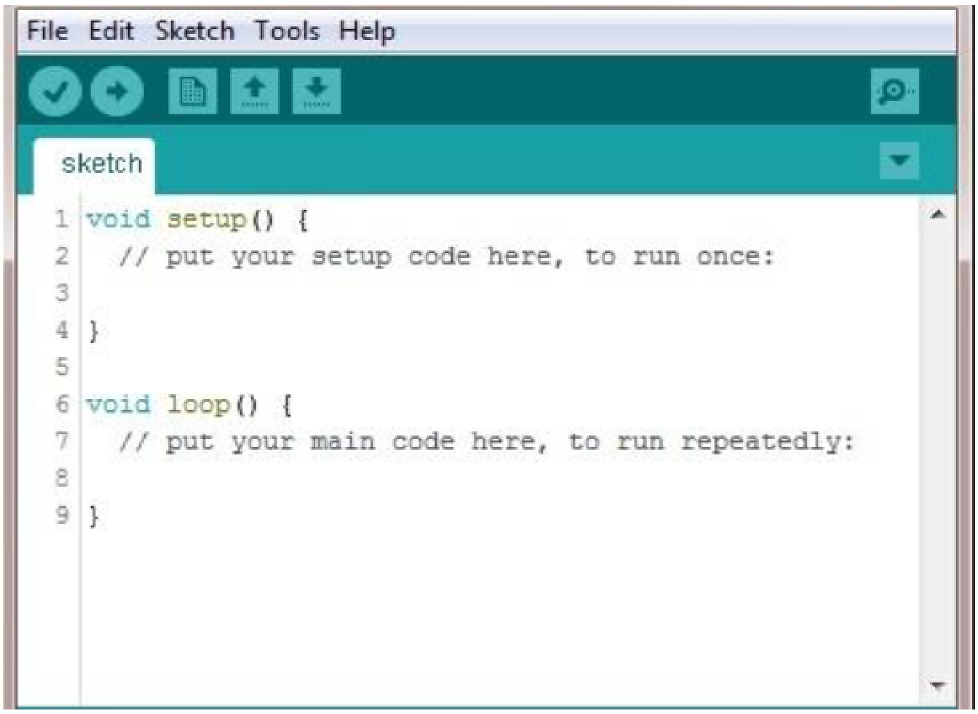


Figure 5.12: Arduino 1.6.12 Sketch Environment

Step 6: Open the blink

sketch: File - Open - iot1.ino

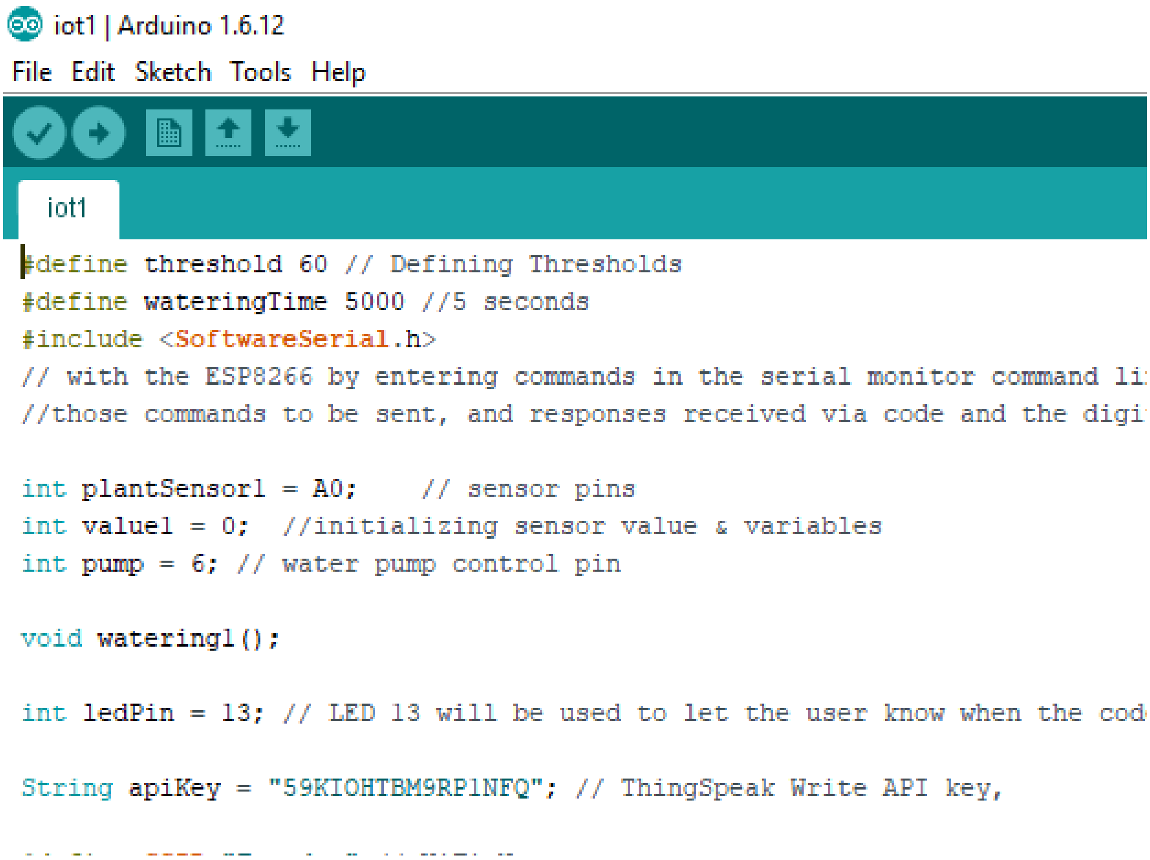


Figure 5.13: Arduino 1.6.12 Main Code Environment

Step 7: Select your board

You'll need to select the entry in the Tools ¿ Board menu that corresponds to your Arduino.

Step 8: Select your serial port

Select the serial device of the Arduino board from the Tools — Serial Port menu. This is likely to be COM3 or higher (COM1and COM2 are usually reserved for hardware serial ports). To find out, you can disconnect your Arduino board and re-open the menu;the entry that disappears should be the Arduino board. Reconnect the board and select that serial port.

Step 9 : Upload the program

Now, simply click the "Upload" button in the environment. Wait a few seconds - you should see the RX and TX leds on the board flashing. If the upload is successful, the message "Done uploading." will appear in the status bar.

Step10 : Run the Serial Monitor

Tools-Serial Monitor:

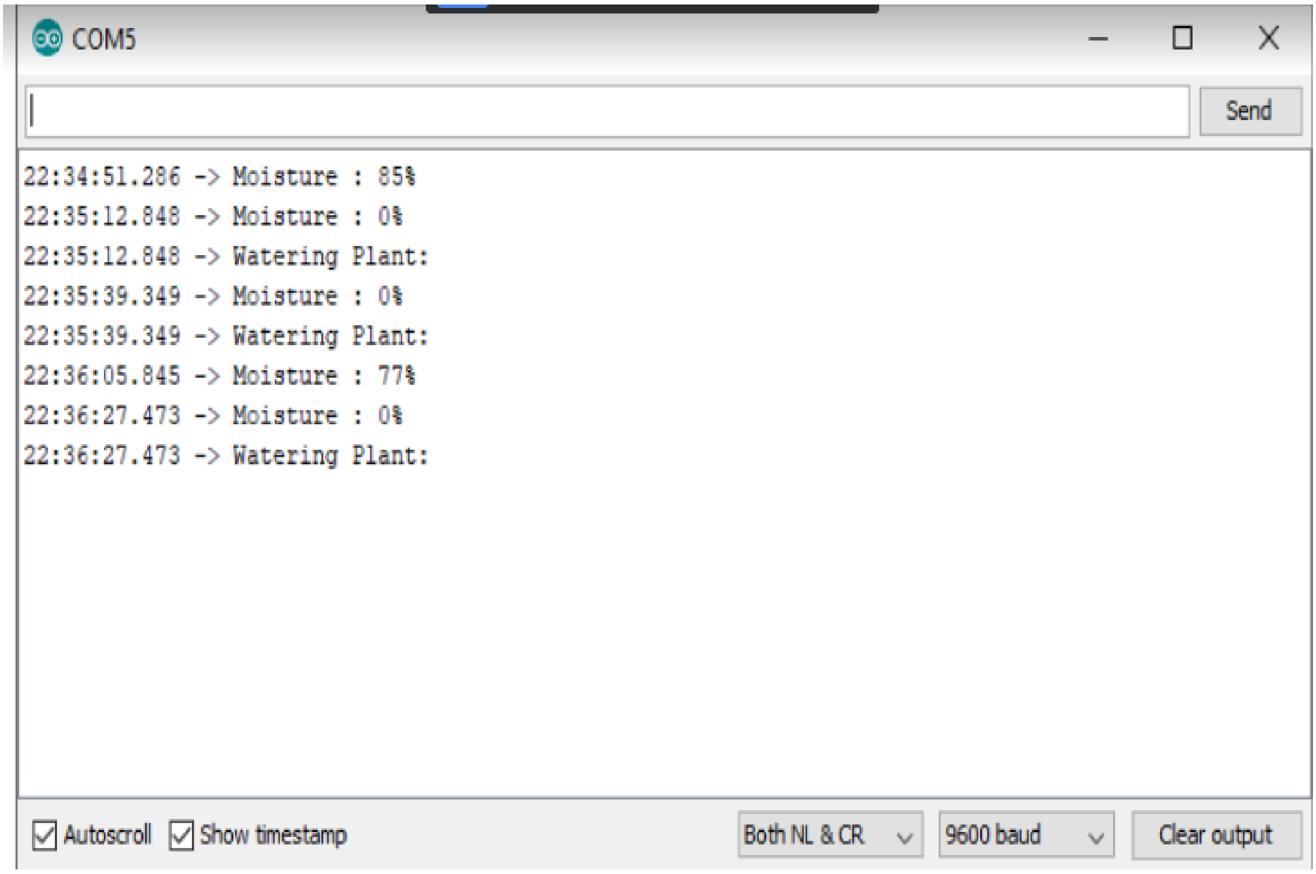


Figure 5.14: Arduino 1.6.12 Serial Monitor Output

5.8 Advantages

1) Relatively simple to design and install.

2) It is safest system and no manpower is required.

3) The system helps to farmer or gardener to work when irrigation is taking place, as only the area between the plants are wet.

4) Reduce soil erosion and nutrient leaching.

5) The system need smaller water sources, as it consumes less than half of the water.

6) Fertilizers can also be provided by using the system.

7) PH content of the soil is maintained Through the suggestions which helps for healthy plant growth.

Chapter 6

Implementation

In this section we are going to discuss about the different modules that makes the project whole.

6.1 Integration of Moisture, Temperature and Luminosity sensors with the Arduino Uno

The soil moisture sensor records the moisture level of the soil, when the soil moisture is below the defined value, the pump is turned on. The temperature sensor records the temperature of the environment, this needs to be incorporated retrieve the data in a digital form, according to how high the temperature is and the water through the pump is increased by 20ml to compensate for the loss of water through evaporation. the main function of the luminosity sensor is to send a signal in case there is an overly cloudy day such that artificial light can be used on certain crops to improve their growth. The Arduino board is powered by the laptop or an external adapter of 9V, Arduino IDE is used to edit, write and upload the code. Whenever the moisture is less the relay turns on and the pump is turned on for about 10-20 seconds. As only 1 UART is present in Arduino board second UART is emulated using software serial function, mySerial object is created and it inherits all the function of Serial object.

6.2 Send sensor data to the cloud

The sensors detect and measure changes in the parameters such as temperature, humidity, light and moisture content in the soil. These parameters are in electrical and numerical values. ESP8266 is Wi-Fi module that works with UART serial communication pin, via this, AT commands are sent to the Wi-Fi module, first at commands are to connect the Wi-Fi spot and later to send the data to internet using HTTP GET request. This allows the sensors, instruments and websites to communicate the data in cloud.

6.3 Design

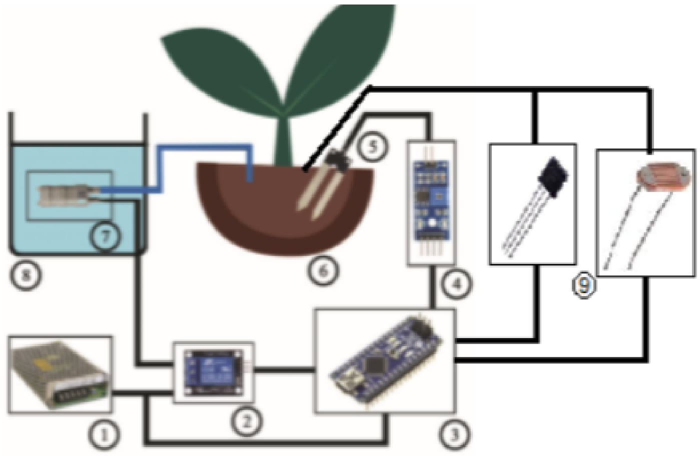


Figure 6.1: Design

1.Power Supply
2.Relay Module
3.Microcontroller (Arduino Uno)
4.Amplifier circuit as a part of Soil Moisture Sensor
5.Soil Moisture Probe
6.Plant
7.Water Pump
8.Watre Container
9.Temperature And Light Sensor

6.3.1 Circuit Design

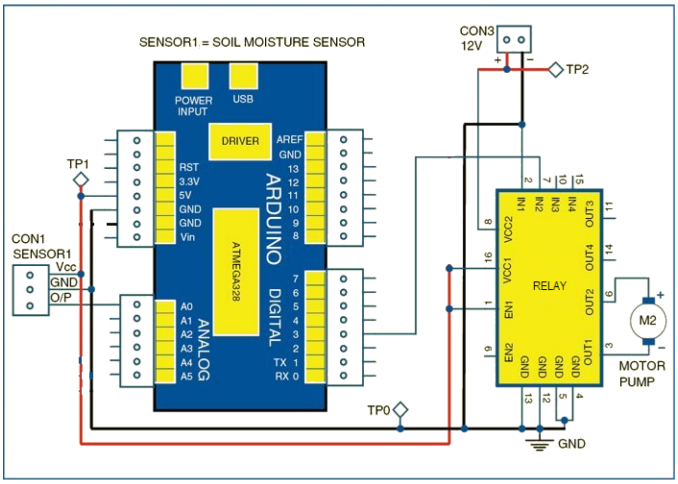


Figure 6.2: Circuit Design

6.3.2 Flow Chart

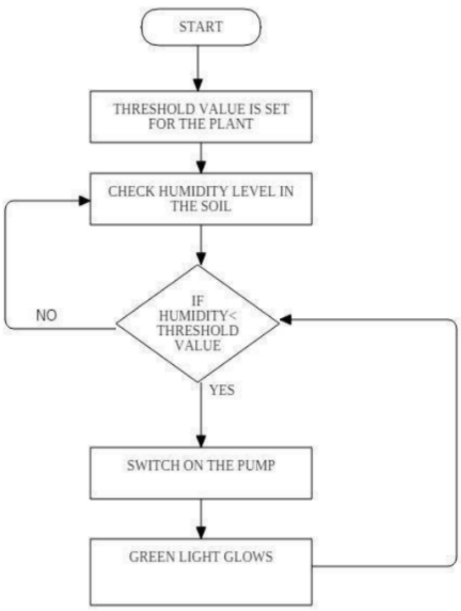


Figure 6.3: Flow Chart

6.3.3 Use Case

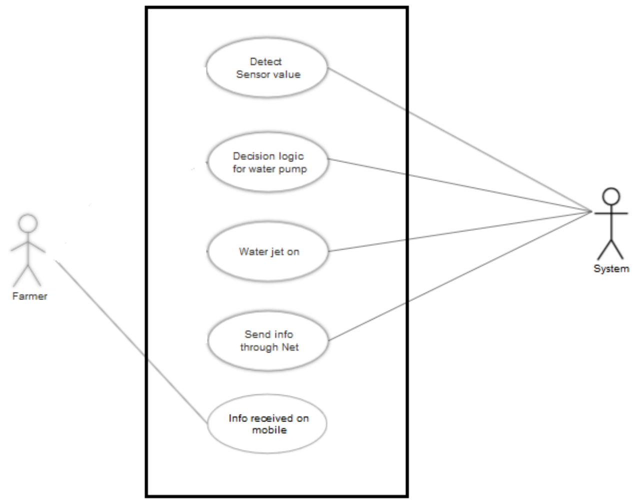


Figure 6.4: Use Case Diagram

6.3.4 Data Flow Diagram

Dfd level 0

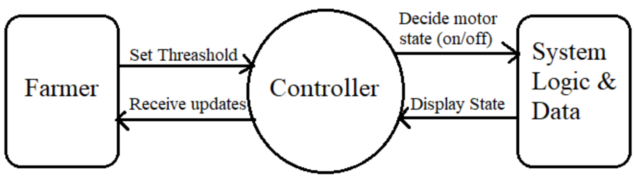


Figure 6.5: Dfd level 0

Dfd level 1

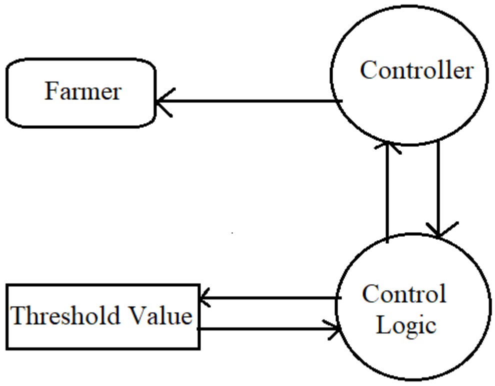


Figure 6.6: Dfd level 1

6.4 Pros and Cons

Pros:

1. Saving water
2. Saving Time
3. Saving manpower
4. Optimal water supply to plant/crop
5. Automatic Operation

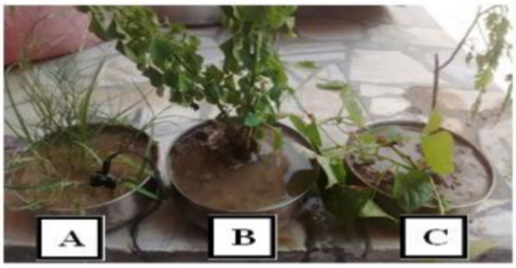
Cons:

1. Currently needs internet connection to monitor the status of Moisture.
2. Needs reliable electricity supply.

Chapter 7

Result

Out of all necessities for farming, irrigation has the most important role to play that is why investigator has concentrated over water retention by soil. For this soil moisture sensor has been used. For the successful implementation to get fruitful results investigator has done series of testing experiments using soil moisture sensor. In the testing, set of three different soils and plant combinations were taken say A, B and C as shown in Fig.8.1



Three Different Soil and Plant Combinations A, B and C.


Soil and Plant Combination A (Without Water).

Figure 7.1: Test Case 1

Plant A with first type of soil and plant was exposed to three different water levels i.e., low water content, normal water content and excess water content. It was observed during experiment that sensor was smart enough to detect the water level and information was sent through controller which was received on farmers cell phone and the necessary action was also performed like;

(i) If the water level was below the predefined limit (without water) then water pump automatically switched ON until it reached to the required level shown in Fig.8.1 (ii) If the water level was up to the predefined limit (average water) then it remained in passive mode shown in Fig.8.2

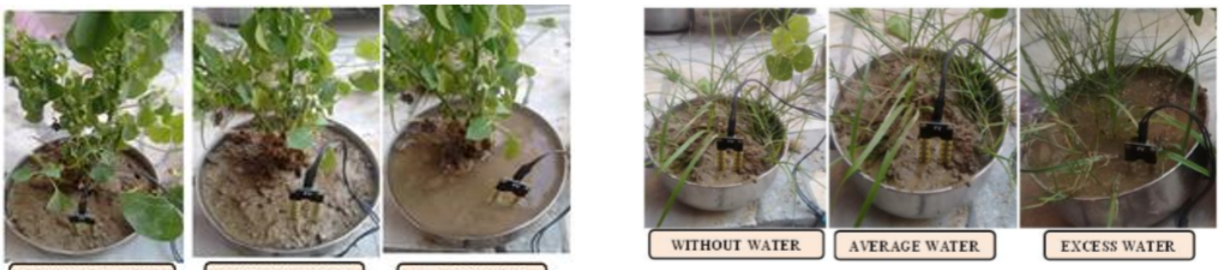
(iii) If the water level was above the predefined limit (excess water) then water pump automatically switched OFF shown in Fig. 8.2. In order to test the compatibility of sensor with different soil and plant combinations, investigator used it with combination B, which was the second combination of plant and soil as shown in Fig.8.3

The same results as in combination A were found to be true. For the confirmation of the results obtained with A and B, third and last combination of soil and plant i.e., C, was used as shown in Fig. 8.3 The results found with combinations A and B were repeated hence it

Soil and Plant Combination

Soil and Plant Combination C (Excess Water)

Figure 7.2: Test Case 2



Soil and Plant Combination B

Soil and Plant Combinations C

Figure 7.3: Test Case 3

was confirmed that sensor was sensitive enough to produce the same results with different soils and different plants combinations using different water level conditions.

The second type of testing was done to check the range of the ESP266 WiFi Chip through different obstacles. The following table details our findings.

Soil Moisture Sensor,Temperature Sensor,Luminosity Sensor outputs are dispayed in fig 7.4,fig 7.5,fig 7.6 respectively which are obtained from thingspeak server. This sensors data are sent to Thingspeak server Through WiFi module,also specifying the time at which data is sent.

fig 7.7 is showing how much water is pumped and at which time

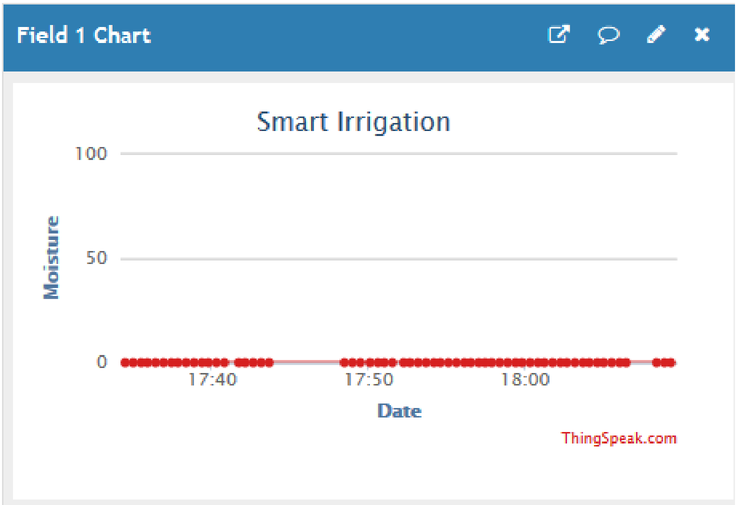


Figure 7.4: Moisture Sensor Output

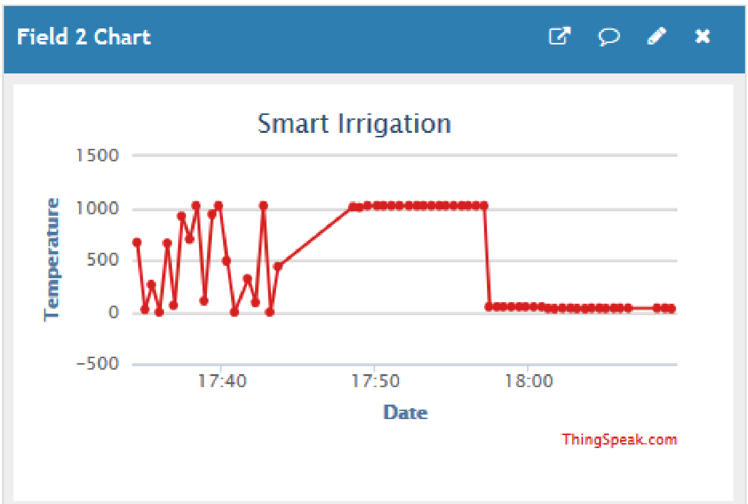


Figure 7.5: Temperature Sensor Output

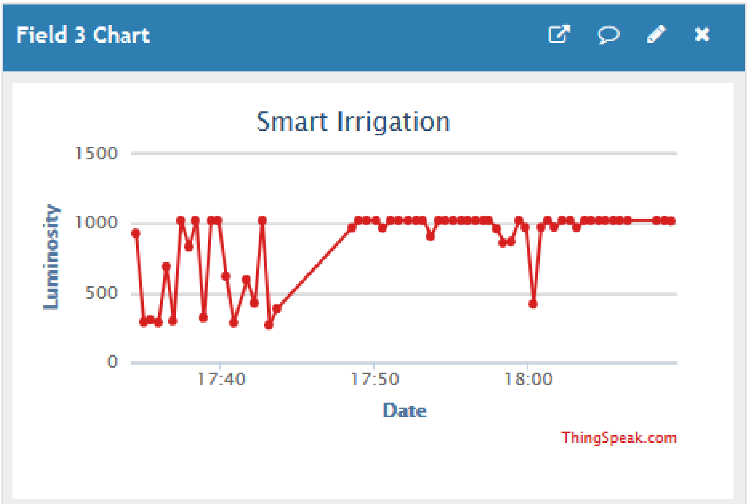


Figure 7.6: Luminosity Sensor Output

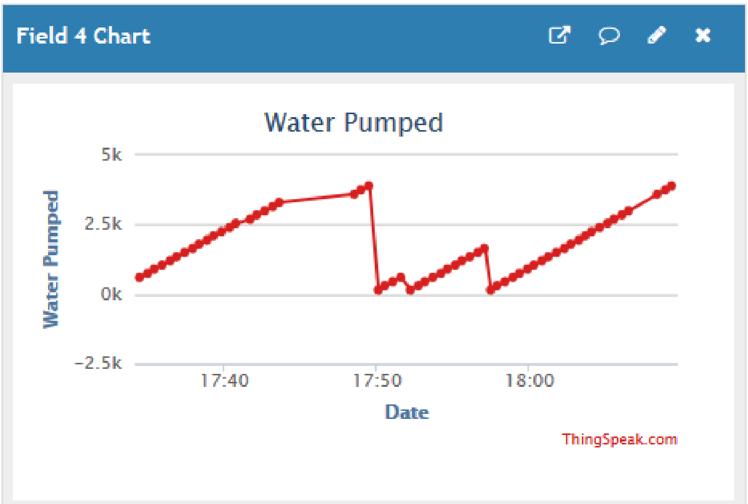


Figure 7.7: Water Pump Output

Chapter 8

Conclusion and Future Scope

8.1 Conclusion

The developed system is simple and cost effective than most other systems present in the market. It measures different soil conditions. It includes measurement of soil moisture. System uses wireless module for the data transfer, communication purpose. So it can be used in open fields as well as inside greenhouse as the range of wireless module is up to 25m with / without different obstacles like trees, benches, walls, cupboard, magnet, etc. With the use of wireless module, system becomes flexible, robust, etc. Sensors can be placed anywhere in the field and if there is need of relocation then it can be easily done. System is also tested for different temperature and it is found that all the sensors work with minimum deviation in output. With the use of drip irrigation, water is provided directly to the roots of the crop. Thus wastage of water is minimized and water resources are optimized to obtain better crop yield. This system is advantageous to farmers as it not only saves water but also helps farmers in fighting the diseases. Thus it will increase the yield of the crop.

8.2 Future Scope

1. The automated irrigation system is more viable, and can manage irrigation water supply more effectively. It helps to optimize the use of water for irrigation purpose. The water consumption will be reduced with the implementation of soil-moisture based automated irrigation system

2. The technique can be used for application of accurate amount of fertilizer, water, pesticide etc. to enhance productivity and excellence.

3. Alarm System can be used to alert the Farmer/Land Owner in case of any Unusual activities on the field.

4. Providing Different types of Irrigation according to crops.

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Appendices

Arduino-1.6.12 IDE code:

define threshold 60 // Defining Thresholds
define wateringTime 5000 //5 seconds
include ¡SoftwareSerial.h¿
int plantSensor1 = A0; // sensor pins
int value1 = 0; //initializing sensor value variables
int pump = 6; // water pump control pin
void watering1();
int ledPin = 13; // LED 13 will be used to let the user know when the code has looped back again.
int tempval; //to store temperature value
int tempPin = 2; //temp sensor connection
int lumval; //to store luminosity value
int lumPin = 4; //luminosity sensor connection
int t; // for counting pump on off
int waterpumped; //to store amount of water pumped
String apiKey = ”UMXY0NJNKH173S0J”; // ThingSpeak Write API key,
define SSID ”Freedom” // WiFi Name
define PASS ”qwerty123”// WiFi password
SoftwareSerial SoftSer(9, 8); // Everywhere from here on when you see SoftSer, it is being used as a command
void setup()
pinMode(ledPin, OUTPUT);
pinMode(pump, OUTPUT);
digitalWrite(pump, HIGH); //pump off at initial
// Begins serial communication at a baud of 9600.
Serial.begin(9600);
// Begins software serial communication at a baud of 9600.
SoftSer.begin(9600);
void loop()
// Connecting to your internet source————*
String join=”AT+CWJAP=”̈; // Join accesspoint
join+=SSID;
join+=”,”̈;
join+=PASS;
join+=””̈;
SoftSer.println(join);
delay(5000);

```
// blink LED on board
digitalWrite(ledPin, HIGH);
delay(200);
digitalWrite(ledPin, LOW);
//luminosity read  dusplay
lumval = analogRead(lumPin);
Serial.print(”Luminosity : ”);
Serial.println(lumval);
delay(1000);
//temperature, read, convert voltage to celsius  display
tempval = analogRead(tempPin);
float mv = ( tempval/1024.0)*500;
float cel = mv/10;
Serial.print(”Temperature : ”);
Serial.print(cel);
Serial.print(”*C”);
Serial.println();
delay(1000);
//moisture sensor, read, map value in percentage  display
value1= analogRead(plantSensor1);
value1 = map(value1,1023,74,0,100);
Serial.print(”Moisture : ”);
Serial.print(value1);
Serial.println(”
if(value1 ¡= threshold)
watering1(); //control watering operations
++t; //count number of times pump started  store in t
waterpumped = t * 150; //no of times pump strted x 150 ml
Serial.print(”Water pumped so far : ”);
Serial.print(waterpumped);
Serial.print(” Millilitres”);
Serial.println();
// TCP connection
String cmd = ”AT+CIPSTART=T̈CP,̈”;
cmd += ”184.106.153.149”; // api.thingspeak.com
cmd += ”,80”;
SoftSer.println(cmd);
if (SoftSer.find(”Error”))
Serial.println(”AT+CIPSTART error”);
return;
String getStr = ”GET /update?api_key = ”;
getStr += apiKey;
getStr += ”field1=”;
getStr += String(value1);
getStr += ”field2=”;
getStr += String(cel);
getStr += ”field3=”;
```

```
getStr += String(lumval);
getStr += "field4=";
getStr += String(waterpumped);
getStr += " ◦ ◦ ";
// send data length
cmd = "AT+CIPSEND=";
cmd += String(getStr.length());
SoftSer.println(cmd);
SoftSer.print(getStr); // Send data.
SoftSer.println("AT+RST"); //restart wifi chip, helps with reliability
delay(15000);
//plant watering
void watering1()
Serial.println("Watering Plant:");
digitalWrite(pump, LOW); //Pump onn
delay(wateringTime); //Watering Time
digitalWrite(pump, HIGH); //Pump off
```

Appendix A:XML Code of data feed


```
-<channel>
    <id type="integer">719819</id>
    <name>Smart Irrigation</name>
    <latitude type="decimal">0.0</latitude>
    <longitude type="decimal">0.0</longitude>
    <field1>Moisture</field1>
    <field2>Temperature</field2>
    <field3>Luminosity</field3>
    <field4>Water Pumped</field4>
    <created-at type="dateTime">2019-03-05T04:41:37Z</created-at>
    <updated-at type="dateTime">2019-03-05T12:01:46Z</updated-at>
    <last-entry-id type="integer">201</last-entry-id>
  -<feeds type="array">
    -<feed>
        <created-at type="dateTime">2019-03-05T06:21:22Z</created-at>
        <entry-id type="integer">102</entry-id>
        <field1>0</field1>
        <field2>909</field2>
        <field3>881</field3>
        <field4 nil="true"/>
     </feed>
    -<feed>
        <created-at type="dateTime">2019-03-05T06:21:49Z</created-at>
        <entry-id type="integer">103</entry-id>
        <field1>0</field1>
        <field2>110</field2>
        <field3>496</field3>
        <field4 nil="true"/>
     </feed>
```

```
−<feed>
    <created-at type="dateTime">2019-03-05T12:01:46Z</created-at>
    <entry-id type="integer">137</entry-id>
    <field1>0</field1>
    <field2>141</field2>
    <field3>284</field3>
    <field4 nil="true"/>
  </feed>
−<feed>
    <created-at type="dateTime">2019-03-05T12:02:15Z</created-at>
    <entry-id type="integer">138</entry-id>
    <field1>0</field1>
    <field2>966</field2>
    <field3>1023</field3>
    <field4 nil="true"/>
  </feed>
−<feed>
    <created-at type="dateTime">2019-03-05T12:03:02Z</created-at>
    <entry-id type="integer">139</entry-id>
    <field1>0</field1>
    <field2>0</field2>
    <field3>383</field3>
    <field4>150</field4>
  </feed>
−<feed>
    <created-at type="dateTime">2019-03-05T12:03:31Z</created-at>
    <entry-id type="integer">140</entry-id>
    <field1>0</field1>
    <field2>0</field2>
    <field3>381</field3>
    <field4>300</field4>
  </feed>
−<feed>
```

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