LAWN SPRINKLER AUTOMATION

A report submitted in partial fulfillment of the requirements for the award of the degree of

B.Tech.

in

Computer Science Engineering

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CERTIFICATE

This is to certify that the project report entitled **"LAWN SPRINKLER AUTOMATION"** being submitted by **"Vyamesh Kumar Mishra, Ashutosh Sharma, Shivam Maggu and Tarun Bhatt "** in partial fulfillment for the award of the Degree of Bachelor of Technology in Computer Science and Engineering to the DIT University, is a record of bona fide work carried out by them under my guidance and supervision.

The results embodied in this project report have not been submitted to any other University or Institute for the award of any Degree or Diploma.

Mr. Sarvesh Chandra Shukla

Assistant Professor

Department of Computer Science Science

Dr. Anil K. Gupta

Head of Department

Department of Computer

CANDIDATES' DECLARATION

We hereby certify that the work, which is being presented in the project report, entitled **Lawn Sprinkler Automation Report**, in partial fulfillment of the requirement for the award of the Degree of **Bachelor of Technology** and submitted to the institution is an authentic record of our own work carried out during the period *February-2018* to *April-2018* under the supervision of Mr. Sarvesh Chandra Shukla.

Date: 14/04/2018 Signature of the Candidates

This is to certify that the above statement made by the candidate is correct to the best of our knowledge.

Date: 14/04/2018 Signature(s) of the Supervisor(s)

Abstract

Can we automatically water the plants when we are going out on vacation or do we need to bother our neighbours? Water affects plants' growth and production. So how do we really know if the soil needs to be watered? Can we manually water the plants from a remote location?

If you're tired of maintaining a constant vigil over your lawn and manually moving a sprinkler from the front yard to the backyard in an effort to keep your grass green, you may want to consider installing an automatic irrigation system. While it may seem that having a sprinkler system that turns on automatically would use more water, an efficient system may actually help you conserve water by allowing you to customize the amount you need in certain areas.

Plus, the automation this project provides in smart in itself. Automated features decide when it's been raining too much or too little, then adjust the amount of water your landscaping gets. That lowers the worry quotient for you, heads off costly over-watering, and makes the whole system almost maintenance-free.

Having a beautiful lawn that displays green grass and healthy vegetation can improve the value of your property, enhance the attractive appearance of your home and create a comfortable atmosphere when you and your family are playing or socializing outside.

Because rainfall can be inconsistent, the most effective way to maintain the quality of your lawn is to use an automatic sprinkler system. Understanding how to install a sprinkler system and knowing the average cost can help you to develop a thriving landscape.

Using an automatic sprinkler system to irrigate your lawn has many benefits: Less Stress, More Efficiency, More sense.

Acknowledgement

It is to announce with great satisfaction and feeling of achievement that we have completed our Project entitled "**LAWN SPRINKLER AUTOMATION**". We take this golden opportunity to acknowledge each and every one who has contributed towards our work and motivated us throughout the project.

We express our sincere gratitude towards **Mr. Sarvesh Chandra Shukla** Sir, Assistant Professor, Department of Computer Science and Engineering, DIT University, Dehradun; for his able guidance, creative suggestions and valuable support throughout the duration of the project.

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ABBREVIATIONS

DHT:	Digital Humidity and Temperature
IDE:	Integrated Development Environment
USB:	Universal Serial Bus
NTC:	Negative Temperature Coefficient
IC:	Integrated Circuit
DC:	Direct Current
ADT:	Android Development Tools
URL:	Uniform Resource Locator
UI:	User Interface
IoT:	Internet of Things
HTTP:	Hyper Text Transfer Protocol
API:	Application Program Interface
Wi-Fi:	Wireless Fidelity
ESP:	Electronic Stability Program
TCP/IP:	Transmission Control Protocol/Internet Protocol
RISC:	Reduced Instruction Set Computer
IEEE:	Institute Of Electrical and Electronics engineers

CHAPTER1: INTRODUCTION

1.1 Problem Statement

Can we automatically water the plants when we are going out on vacation or do we need to bother our neighbors?

Plants are precious and sensitive creations that may get destroyed by lack of water as well as by excess of it. Water affects their growth and production. So how do we really know if the soil needs to be watered?

Water is a significant resource that needs to be saved. By monitoring certain conditions can we control the amount of water fed to our lawns to omit wastage?

Can we save time on manual irrigation and reduce manual labor?

Can we manually water the plants at the click of a button?

1.2Purpose

The main purpose of Lawn Sprinkler Automation is to reduce or eradicate any manual or human intervention while watering the plants. Moreover, with the help of this project, water wastage can be prevented and the plants will get irrigated whenever required and to the extent required.

If someone sees that the sensors are not functioning properly and that the plants are not being watered at the required interval, you can override the system using a virtual button on the android application connected to the Arduino system.

1.3Motivation

Many would ask why you choose this project; what pushed you or motivated you to go for this particular agenda. So, an answer to all those questions would be first and foremost ‘to save water’. In this fast-moving modern era, the world is facing global warming and many people are turning a blind eye to the water problem that has hit the planet. Many countries are facing water deficiency. South Africa being the most recent victim and not to forget the drought affected part of India, i.e. Maharashtra. So, in order to minimize water wastage even by a very small margin, we decided to opt for the project and make efforts from our end to the cause of saving water. Moreover, this project would automate the gardening process as well as the irrigation industry system if used on high scale. We can also connect it to internet of plants, i.e. for different plants, different temperature, humidity level and moisture level can be set at which will be most advantageous to the plants.

1.4Why is the topic chosen?

This project not only saves water but also provides the optimum amount of moisture for plants to grow.

It can be implemented in household lawns to provide convenience of automated water irrigation.

1.5Objective and scope of the project:

The primary objective of the project is to minimize water wastage.

Moreover, it will be a help to not only the farmers but also to the people who love a garden in their backyard.

It will facilitate the agricultural industry and save time and money wasted on manual labour.

CHAPTER2: METHODOLOGY AND WORKING

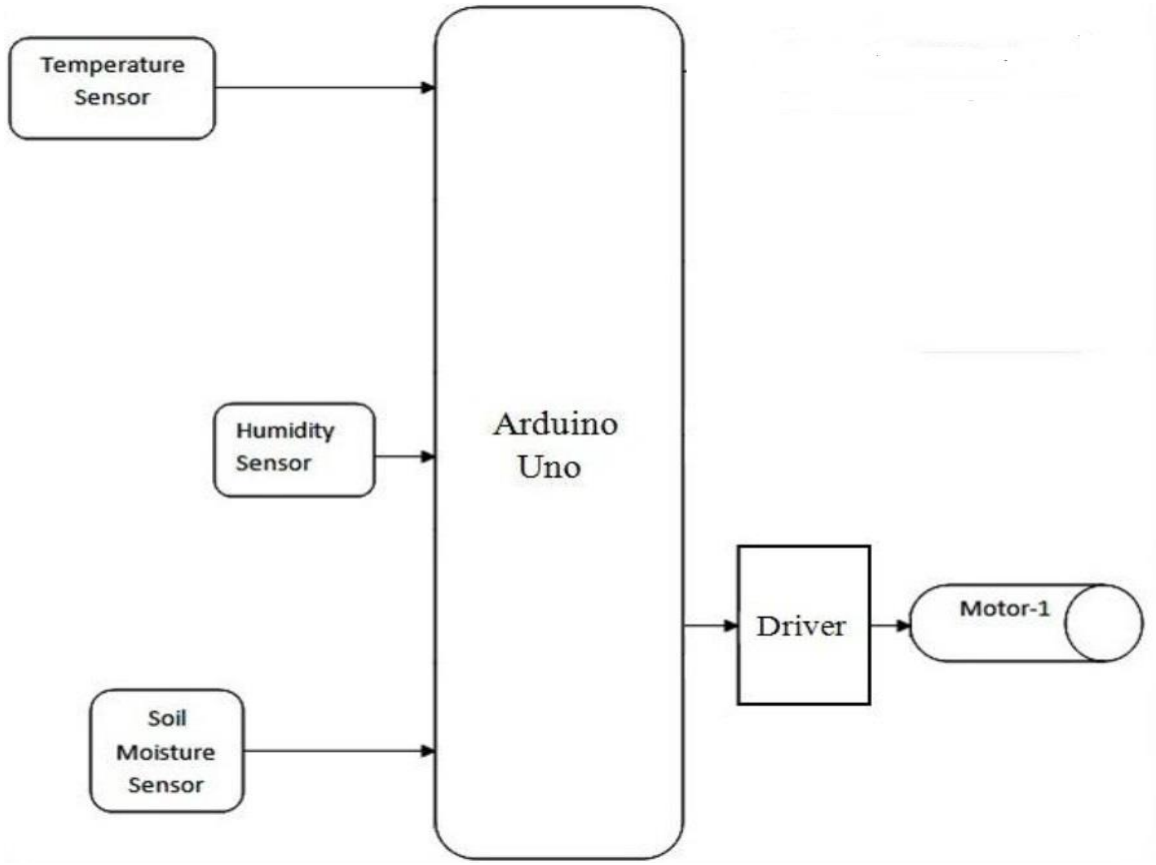
2.1 Methodology:

Irrigation automation using Arduino is a prototype of how we can automate the agricultural industry for watering the plantation. The automated irrigation will be done based on the Arduino microcontroller integrated with the temperature, humidity and moisture sensors.

Once the sensors conclude that the water level is low in the soil and the temperature is getting high, with certain feasible algorithms, it will send a signal to the Arduino, which will activate the water pump.

A smartphone also comes in handy in case you want to receive notification and want to water the plants at the push of a digital button just in case you feel that there is something wrong with the sensors or system and that the plants are not being watered at required time intervals or whenever necessary.

2.2 SYSTEM BLOCK DIAGRAM



The working of the system is such that input is provided by the 2 sensors that is the temperature and humidity sensor (DHT 11) and the moisture sensor(FC-28) which will measure the water level in the soil. If the moisture level is low and the temperature is higher than the threshold value, then the motor will go on, thereby watering the plants or lawn grass. Here at least two of the conditions need to be met for the system to go on, else no action will be performed unless the virtual button of the android application is pressed.

CHAPTER 3: HARDWARE/SOFTWARE REQUIREMENTS

3.1Hardware Needed:

- **Arduino**

  Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

  Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analogue input/output (I/O) pins that may be interfaced to various expansion boards and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++.

  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).

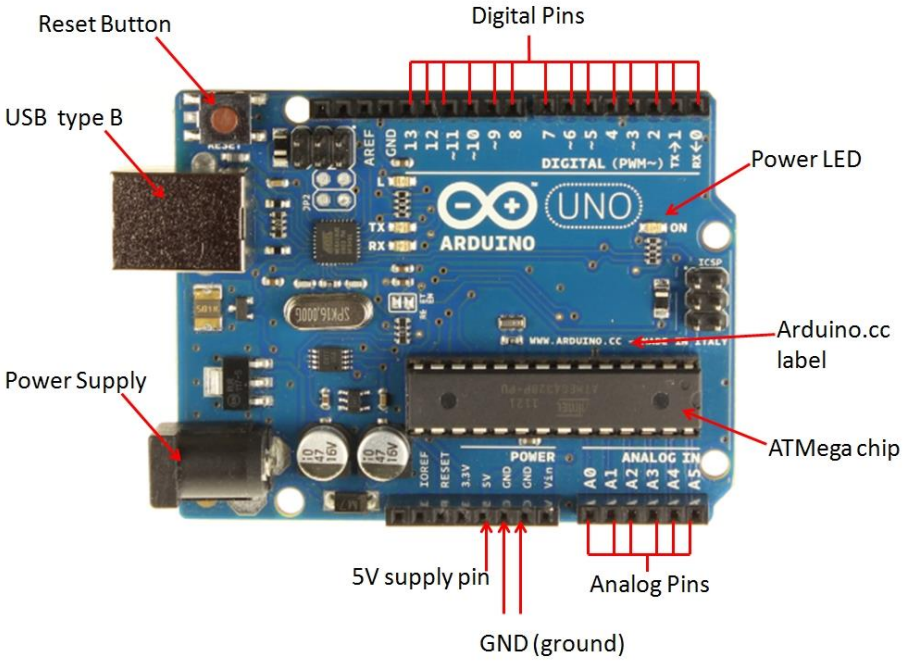


Figure 3.1
Arduino UNO

- **Soil moisture sensor**
  The soil moisture sensor used is **FC-28.**

  This sensor measures the volumetric content of water in soil and gives us the moisture level. The sensor gives us both analog and digital output.

  The soil moisture sensor consists of two probes that are used to measure the volumetric content of water. The two probes allow the current to pass through the soil, which gives the resistance value to measure the moisture value.

  When there is water, the soil will conduct more electricity, which means that there will be less resistance. Dry soil conducts electricity poorly, so when there is less water, then the soil will conduct less electricity, which means that there will be more resistance. It measures the dielectric constant of soil between the 2 leads and gives reading between 0-1023.

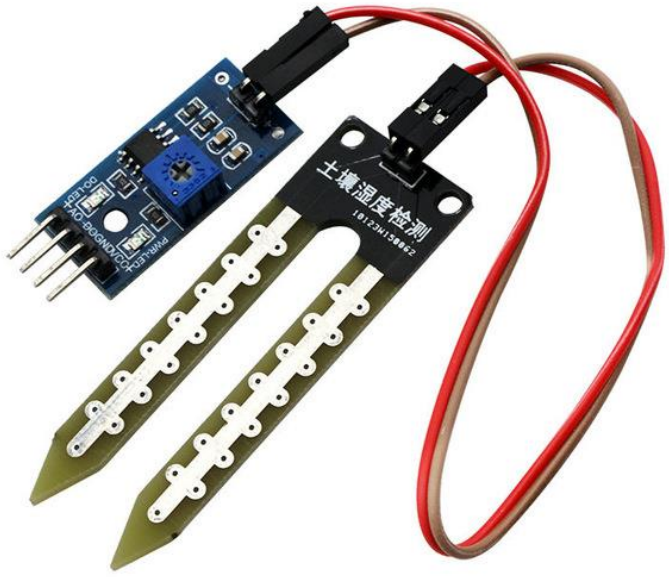


Figure 3.2
Moisture sensor **FC-28**

- **Temperature and humidity sensor**

  It features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component offering excellent quality, fast response, anti-interference ability and cost-effectiveness.

  DHT 11 consists of a humidity sensing component, a NTC temperature sensor (or thermistor) and an IC on the back side of the sensor.

  For measuring humidity, it uses the humidity sensing component which has two electrodes with moisture holding substrate between them. So as the humidity changes, the conductivity of the substrate changes or the resistance between these electrodes changes. This change in resistance is measured and processed by the IC which makes it ready to be read by a microcontroller.

  On the other hand, for measuring temperature these sensors use a NTC temperature sensor or a thermistor.

  A thermistor is a variable resistor that changes its resistance with change of the temperature. These sensors are made by sintering of semi-conductive materials such as ceramics or polymers so as to provide larger changes in the resistance with just small changes in temperature. The term "NTC" means "Negative Temperature Coefficient", which means that the resistance decreases with increase of the temperature.

Figure 3.3
Humidity and temperature sensor DHT 11

- **Water pump**
  DC 3-6V Micro Submersible Mini Water Pump.
  The water pump as its name suggests is used to pump water. When the sensors provide in the values to the program, the latter decides whether to turn the motor on or off depending upon the values and the programming.
  If the readings indicate that the water level is low and temperature is high, for example, the motor is turned on. In this system, you can turn on/off the motor using the manual override virtual button in the android application.

Figure 3.4
Water Pump

- **Pump controller**
  It is a small circuit made of transistor and resistor connected to motor and Arduino.
- **Transistor**
  A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. It is composed of semiconductor material usually with at least three terminals i.e. for connection to an external circuit. A voltage or current applied to one of the pair of the transistor's terminal changes the current flowing through another pair of terminals. A transistor can amplify a signal found embedded in integrated circuits.

Figure 3.5
Transistor

- **Resister**
  A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines.

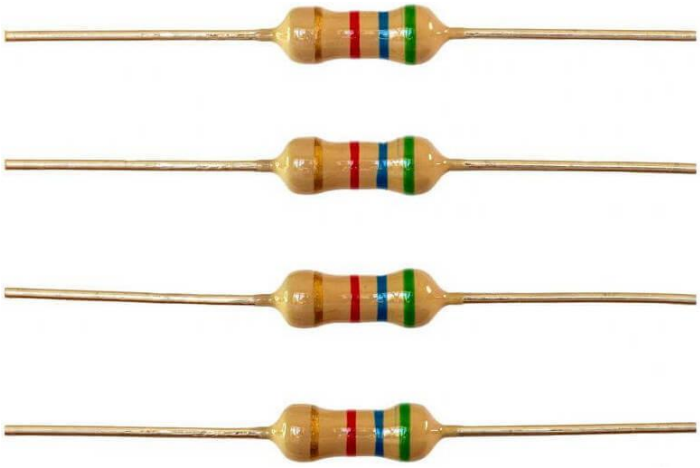


Figure 3.6
Resistors

- **Drip irrigation kit (feeder, connection pipe)**
  This is used to connect the pump to the plant(s) to supply water from feeder.
  The can be of different model depending upon the utility and like of the user.

Figure 3.7
Drip Irrigation kit

- **Jumper cables and wires**
  These are used for making connections.

Figure 3.8
Jumper Cables

- **Breadboard and LED's**
  The Bread board is where all the connections of the sensors, Arduino uno, jumber cables and all other physical connections are done.

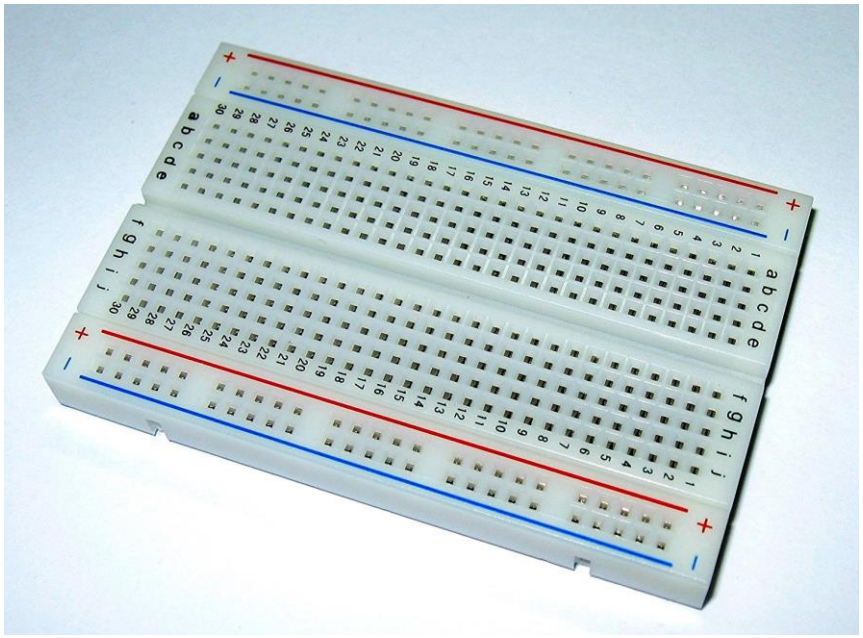


Figure 3.9
Breadboard

The LEDs are used to show which side of the system is on/off and when this happens.

Figure 3.10
LEDs

- **Wifi Module ESP8266**

  The **ESP8266** is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability

  This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands.

  Processor: L106 32-bit RISC microprocessor core based on the Tensilica Xtensa Diamond Standard 106Micro running at 80 MHz[†]

  Memory:

  32 KiB instruction RAM; 32 KiB instruction cache RAM; 80 KiB user data RAM; 16 KiB ETS system data RAM

  External QSPI flash: up to 16 MiB is supported (512 KiB to 4 MiB typicall included)

  IEEE 802.11 b/g/n Wi-Fi

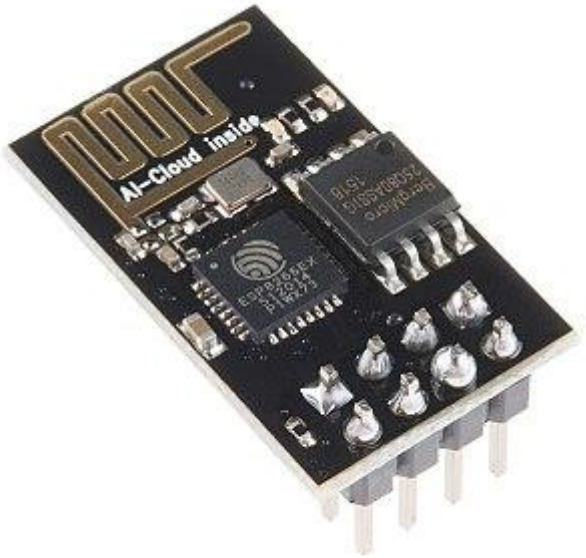


Figure 3.11
Wi-Fi Module ESP8266

- **Smartphone/Laptop**
  The smartphones and laptops are used to connect the Arduino system with the Android Application or the web application so that the user can know the plants are being irrigated and as well as to manually override the system using the virtual android application button.
  The laptop system is also used to run the Arduino IDE (so as to run the Arduino code).

Figure 3.12
Smartphones and laptops

2.2Software Needed:

- Arduino IDE
  The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.
  The Arduino IDE is the software where all the Arduino codes are written.

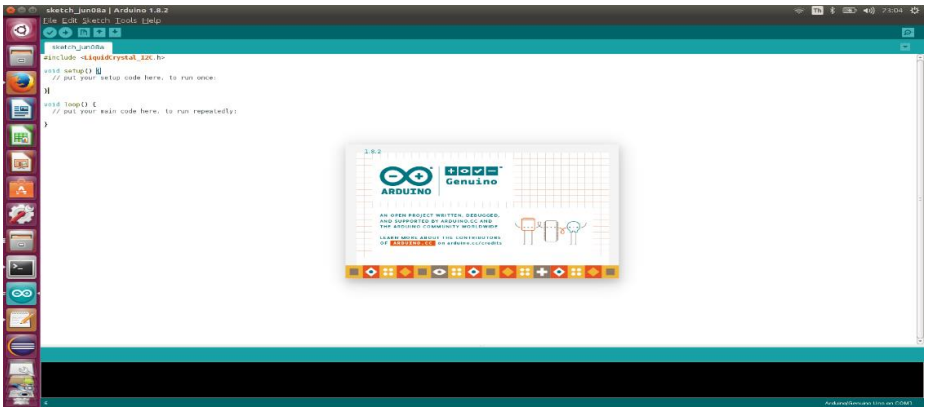


Figure 3.13

- Android studio

  Android Studio is the official integrated development environment (IDE) for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development. It is available for download on Windows, macOS and Linux based operating systems. It is a replacement for the Eclipse Android Development Tools (ADT) as primary IDE for native Android application development.

  The android application to be connected with Arduino is developed on Android studio only.

Figure 3.14 Android Studio

- Web Browser

  Web Browser is an application software that allows us to view and explore information on the web. User can request for any web page by just entering a URL into address bar. Web browser can show text, audio, video, animation and more. It is the responsibility of a web browser to interpret text and commands contained in the web page.

  We are using a web browser to open our web application that is also connected to the Arduino and shows the data received by the sensors.

Figure 3.15 Browser

Testing technology used:

Alpha Testing:

Alpha Testing is one of the most common software testing methods. Here the tests occur at the developers' site. They observe the users/clients and jot down the problems. This kind of testing is done when the project is about to reach its completion and upon the result of the test, changes can be made.

So, in order to make any changes or improvement to the project, we could use alpha testing. This test would allow us to know more about the requirements and how to design a friendlier user interface (UI).

CHAPTER 4: MORE ABOUT THE ANDROID APPLICATION

4.1 Introduction

The android app for the project provides us with a capability to check the current temperature, humidity and soil moisture conditions of the plant. It also provides a manual override for the water pump providing user with the ability to keep trace of the current readings and manually turn the sprinkling on and off, using his/her discretion over the automation algorithms.

4.2 Readings Channel

The readings are being sent to thingsspeak.com channel for processing, and the charts are being mirrored on the android app.

ThingSpeak is an open source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP protocol over the Internet or via a Local Area Network. ThingSpeak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates.

4.3 Manual Override

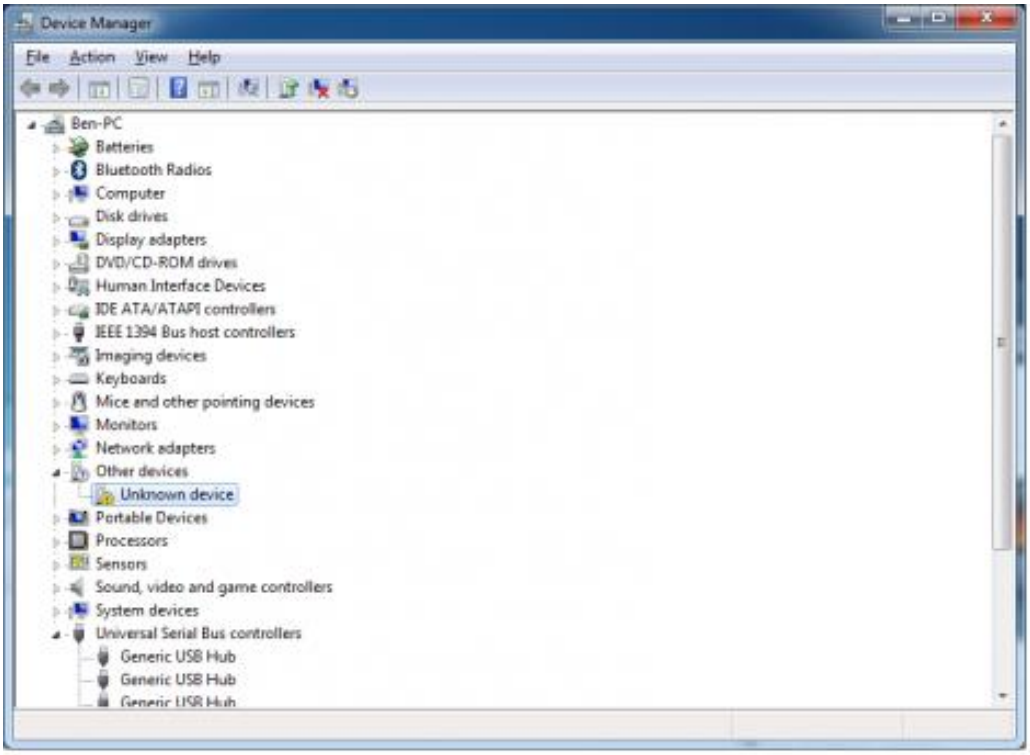
The Manual override feature of the app takes you to a web page over the internet that shows you the current status of the water pump attached to your Arduino guided Sprinkling System, and allows you to toggle the motor status on and off from any part of the world using IoT (Internet of Things) concepts.

CHAPTER 5: SYSTEM FEATURES

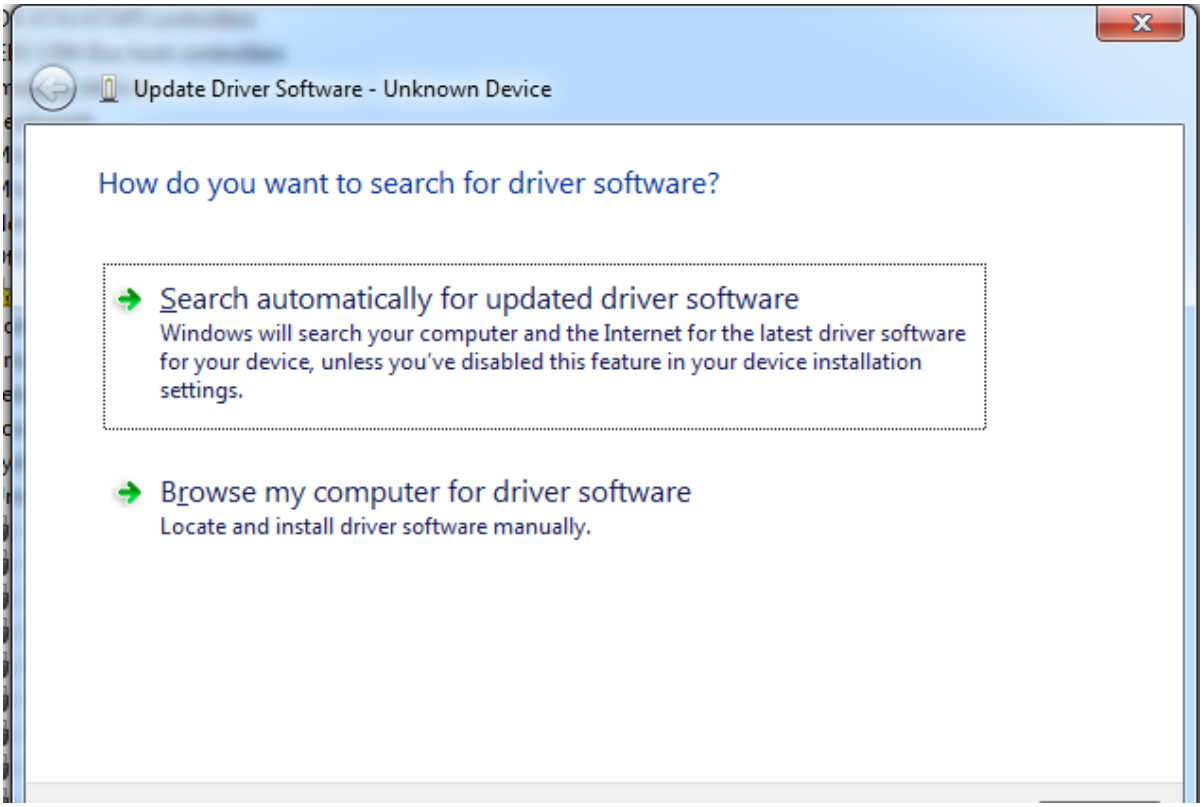
5.1 Configuration of Arduino IDE

Installing the Drivers for the Arduino Uno (from Arduino.cc)

- Plug in your board and wait for Windows to begin it's driver installation process
- After a few moments, the process will fail, despite its best efforts
- Click on the Start Menu, and open up the Control Panel
- While in the Control Panel, navigate to System and Security. Next, click on System
- Once the System window is up, open the Device Manager
- Look under Ports (COM & LPT). You should see an open port named "Arduino UNO (COMxx)". If there is no COM & LPT section, look under 'Other Devices' for 'Unknown Device'



- Right click on the "Arduino UNO (COMxx)" or "Unknown Device" port and choose the "Update Driver Software" option
- Next, choose the "Browse my computer for Driver software" option



- Finally, navigate to and select the Uno's driver file, named "ArduinoUNO.inf", located in the "Drivers" folder of the Arduino Software download (not the "FTDI USB Drivers" sub-directory). If you cannot see the .inf file, it is probably just hidden. You can select the 'drivers' folder with the 'search sub-folders' option selected instead.
- Windows will finish up the driver installation from there

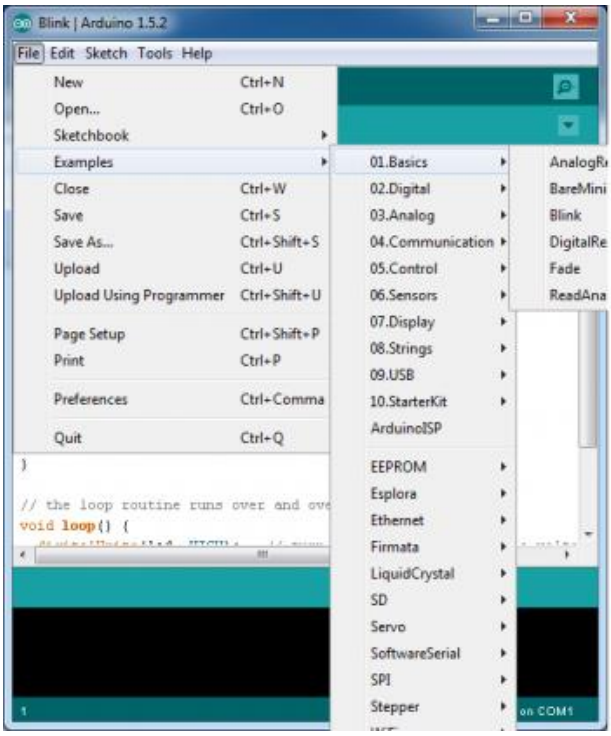
For earlier versions of the Arduino boards (e.g.Arduino Duemilanove, Nano, or Diecimila) check out this page for specific directions.

Launch and Blink!

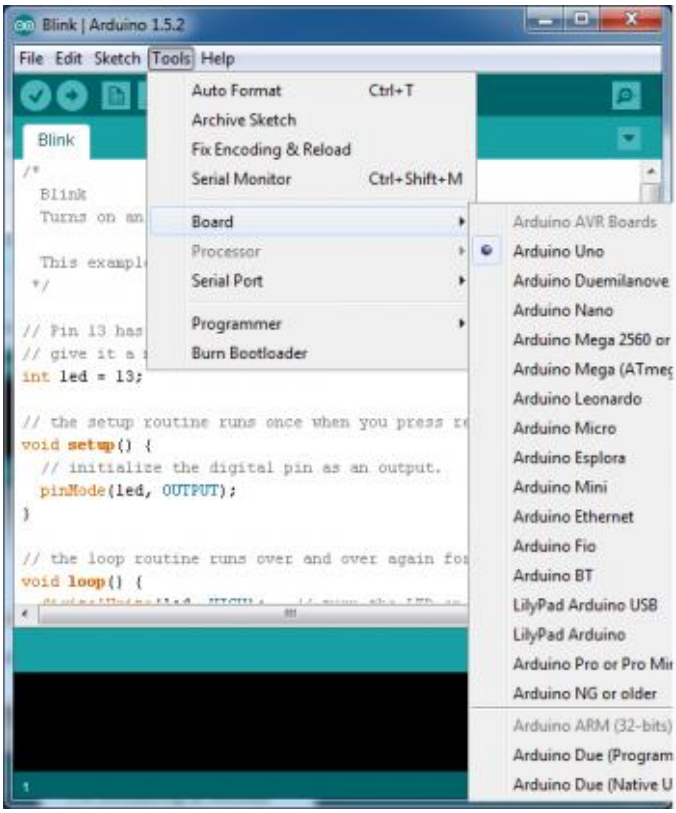
After following the appropriate steps for your software install, we are now ready to test your first program with your Arduino board!

- Launch the Arduino application
- If you disconnected your board, plug it back in

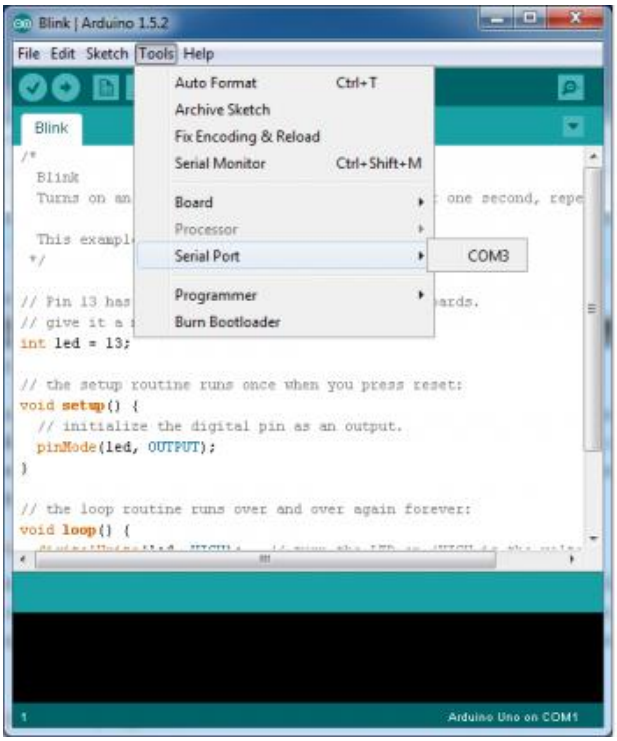
- Open the Blink example sketch by going to: File > Examples > 1.Basics > Blink



- Select the type of Arduino board you're using: Tools > Board > your board type



- Select the serial/COM port that your Arduino is attached to: Tools > Port > COMxx



- If you're not sure which serial device is your Arduino, take a look at the available ports, then unplug your Arduino and look again. The one that disappeared is your Arduino.
- With your Arduino board connected, and the Blink sketch open, press the 'Upload' button

- After a second, you should see some LEDs flashing on your Arduino, followed by the message 'Done Uploading' in the status bar of the Blink sketch.
- If everything worked, the onboard LED on your Arduino should now be blinking! You just programmed your first Arduino!

5.2 Configuration of Sensors and Motors

5.2.1 Soil Moisture Sensor (FC-28)

It is a two legged device that measures the dielectric constant of soil, and gives readings, between 0 to 1023. These readings can be mapped using mapping functions in our Arduino code sketch.

5.2.2 Temperature and Humidity Sensor (DHT 11)

- The capacitive humidity sensor is made up of two electrodes, and moisture holding substrate between them. The substrate is a non-conducting polymer film and holds the moisture present in the air.
- With humidity change the conductivity of substrate changes or the resistance between electrode changes. This change is measured and processed by IC along with temperature changes and output on screen. It gives relative humidity as output in percentage.
- The temperature sensor uses a thermistor. It is a variable resistor that changes it's resistance with change in temperature.
- Material used for such a resistor has large change in resistance for a small temperature change.

5.2.3 Configuration of Wi-Fi Module ESP 8266

Let's take a moment to create an endpoint we can send some data to in our test.

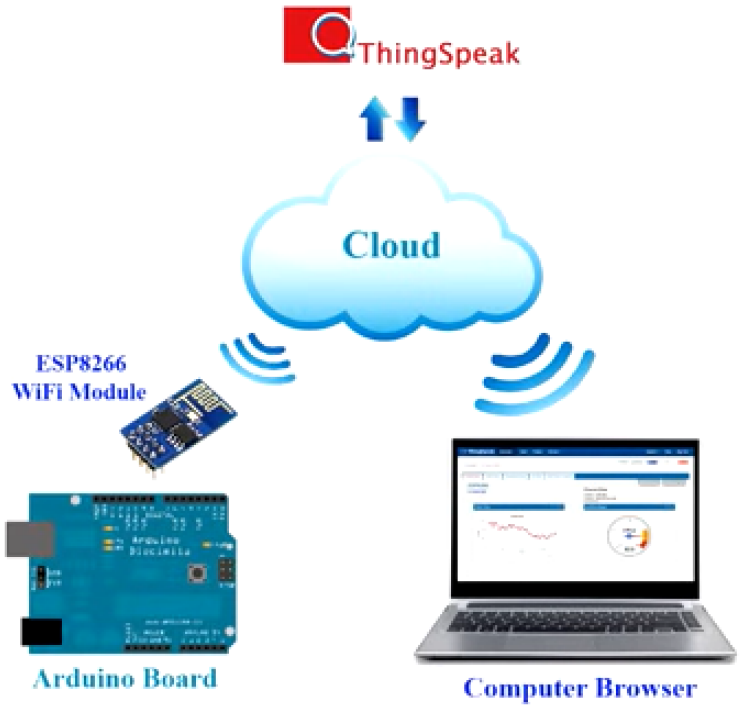
- Create an account on ThingSpeak https://thingspeak.com/
- Create a new channel with one field label
- Get the API Key

- Review the “Update a Channel Feed” Url

Once you have your channel and key you can simply make an HTTP request like:

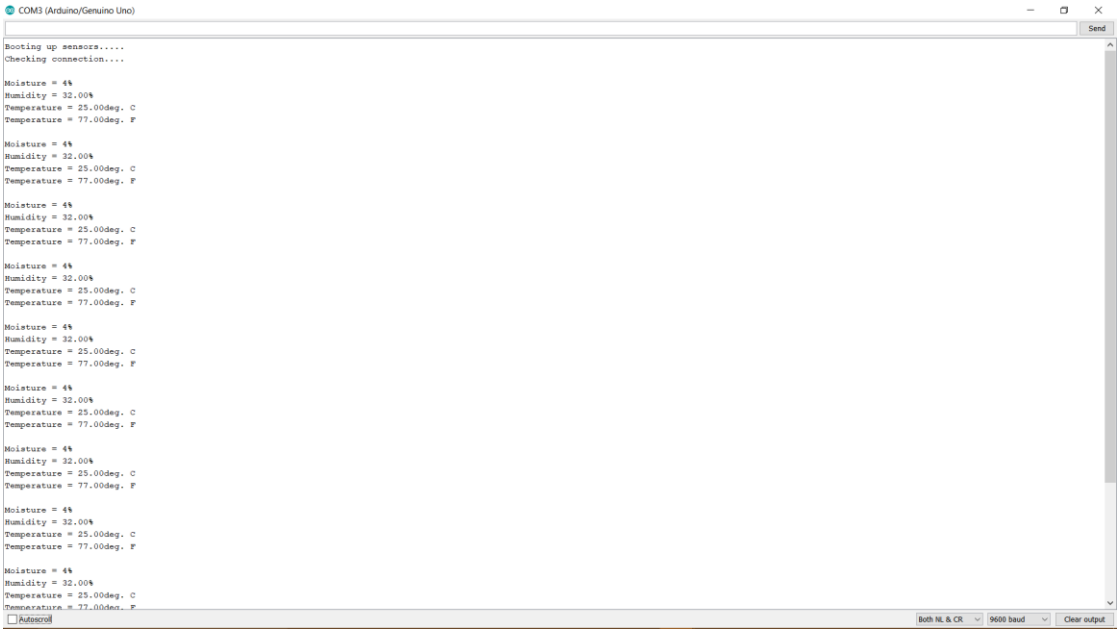
https://api.thingspeak.com/update?api_key=YOUR_KEY_HERE&field1=4 to send the value 4 into field1.

Try it in your browser, then review the data in the Private View of your channel.



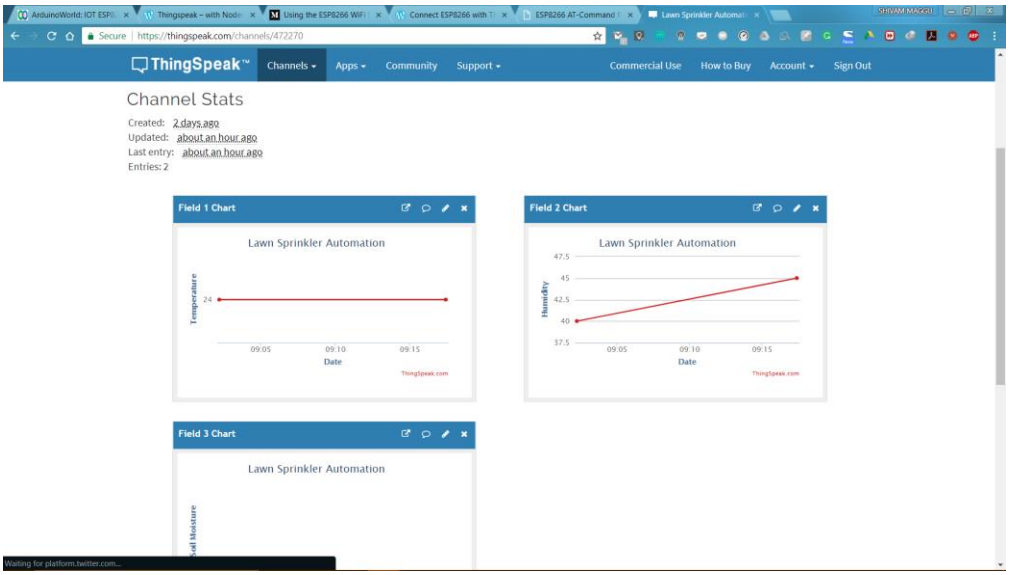
5.3 Configuration of Readings Channels and Display

- The readings from the sensors are scaled and made visible on the Arduino IDE ports

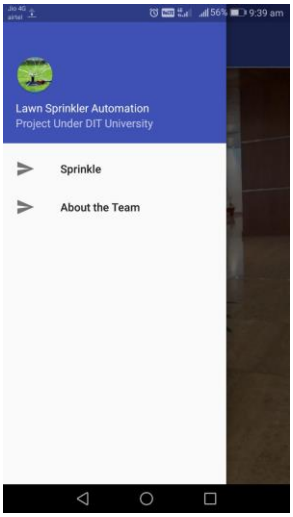


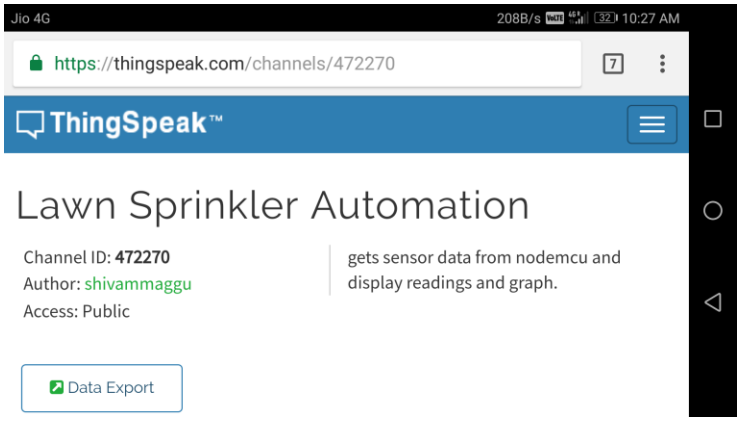
- The same readings are sent over to the web to the Thing-Speak channel set on public mode, or on private mode(login required) as per user's need, the readings are plotted and displayed in the forms of graphs.

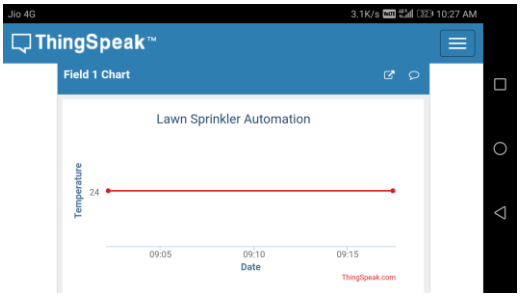
  A new reading in taken in every 15 seconds.

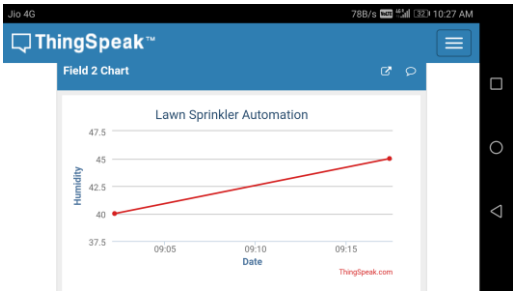


- The graphs of the Thing-Speak channel is mirrored to an Android app for display. The app is also provided with a web switch to toggle the Sprinkler status On and Off manually.









CHAPTER 6: SYSTEM ANALYSIS

6.1 FEASIBILITY STUDY

Feasibility of a new system means ensuring that the new system, which we are going to implement, is efficient and affordable.

Feasibility is measured on three globally accepted scales, as follows:

1. Technical Feasibility
2. Economic Feasibility
3. Operational Feasibility

The feasibility study for Lawn Sprinkler Automation is as follows:

6.1.1 Technical Feasibility

Technical Feasibility involves financial considerations to accommodate technical enhancements. It is mainly concerned with the study of function, performance, and constraints that may affect the ability to achieve the system.

Since the project is designed on Arduino, it is easy to write the code for the system working. Moreover, its application is efficient, easy and user-friendly to be understood by almost everyone. In case of any difficulty or sensor faults, the system can be overridden using the virtual key in the android application.

6.1.2 Economic Feasibility

Economic feasibility is concerned with comparing the development cost with the income/benefit derived from the developed system. Economic Feasibility is mainly concerned with the cost incurred in the implementation of the product. Since this project is developed using Arduino, some sensors and easily available android studio and Arduino IDE, not much capital is spent on it and is fairly affordable. Moreover, since the product is easy to use, no extra cost is required to train its users.

6.1.3 Operational Feasibility

An estimate should be made to how strong a reaction the users are likely the use of this product. The working of this project is easily understood by the general public and its users, and the user interface(UI) of the android application is also user-friendly, so be it a heavy smartphone user or a new one, he will not face any difficulty while using the system with the application. Hence the system as a whole is operationally feasible as well.

CHAPTER 7: CONCLUSION AND FUTURE WORK

7.1 What contribution would your project make?

Our project is a prototype and its full-scale model can be used in the University Campus Lawns, for those who love gardening in their backyards, for large scale irrigation, etc.

In near future, this can be implemented in household lawns and backyards to provide convenience of automated watering.

This automation could also be utilized for industrial purposes like in green houses.

It saves various crucial resources such as water, time, labor and money.

Moreover, an Internet of Plants can be woven in which plants can share data amongst each other. For further studies the data about various plants/crops can be collected in a single database, accessible for all.

7.2 Limitations

The only limitation to this project is that the electronic device and the wire may get damaged by the changes in whether (rain may damage the electronic boards). Therefore, the device must be well kept in a container or a secure place so that damages due to rain water can be prevented or reduced to the lowest for the system to work without any inconveniences for a greater period of time.

7.3 Conclusion

This project is a very good product for the daily use of any person who entertains gardening, for irrigating the lawns of colleges, or any institutions. Moreover, it can also be put to use on a greater scale for use in the agricultural industry.

It also helps to save unnecessary wastage of water while irrigating the plants. Therefore, it can be in some ways considered environment friendly.

From our side, this prototype of the projected idea is complete. Now to deploy in the actual market, the model needs to be developed with some minor changes to retain the sustainability of the product.

REFERENCES

[1] "An introduction to Arduino" https://www.arduino.cc/en/Guide/Introduction

[2] "Arduino Tutorials" https://www.arduino.cc/en/Tutorial/HomePage

[3] "Android Studio" https://developer.android.com/studio/index.html

[4] "Java T Point Android Tutorials" https://www.javatpoint.com/android-tutorial

[5] "Udacity Android Courses" https://in.udacity.com/courses/android

[6] "Thingspeak" https://thingspeak.com/channels/472270