**APPROVAL**

This Research based Project titled **“DATA MINING ON HOME FORESTATION USING IOT**”, submitted by Tanveer Hoqueto the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering (BSc) and approved as to its style and contents.

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# DECLARATION

We hereby declare that this project has been done by us under the supervision of **Ms. ZERIN NASRIN TUMPA,** Senior Lecturer**, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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"*I had to be successful to justify my parents’ sacrifice for me*"

.

# ABSTRACT

This paper automates plant monitoring, data collection and smart gardening using IoT. Home forestation such as gardening in rooftop, balcony, living room has now a days become common in urban areas, because there are less land resources to plant trees. Also, it increases interior beauty of a house. In urban areas trees are decreasing day by day at an alarming rate. At the same time, the population is increasing inversely proportional to trees. As a result, the air is polluted at a massive rate in urban areas. Home forestation or gardening is a smart solution to this life-threatening problem. In urban areas, people lead busy life. They have less time to do gardening with proper knowledge. A plant needs 4 basic elements to grow such as: Light, Humidity, Temperature, Soil moisture. Every plant requires different environment variables. The motive of this research is to conduct data mining on these four elements in home environment to analyze the environment requirements for the survival of each plants based on Plant taxonomy. In future, it will help me to make a smart platform “Eco Friend” which will suggest users the plants that are best for his home environment. The data will be collected using IoT including the device Nodemcu, Sensors and later analyzed with Data mining tools.

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# Chapter 1

# INTRODUCTION

## Introduction

An indoor garden is often either sophisticated or straightforward as somebody wants. One can pay hundreds of thousands of moneys to create a garden, or even pay a bit. horticulture could be a fun and relaxing way to get connected with nature. Gardening is an activity that’s smart for both the mind and body at a similar time. It may be enjoyed and practiced by individuals of any ages. It’s easy, grab your tools and get in the dirt! Is it really that much easy?

IoT (Internet of Things) is usually stated as internet of Objects, since IoT can rework anything-including ourselves. This bold statement is given by considering the impact of web on education, business, communication, science and humanity, etc. Kelvin Ahston used the term IoT first in 1998, that currently has additional and additional developed. All tale of human history the foremost powerful and vital creation is that the internet. The integrated and a part of future web is IoT. within the field of business, human process, info and communication, the things are expected to become active participants by using IoT. They have to be enabled so as to be able to move with the surroundings themselves by reworking and exchanging the data and knowledge detected regarding the environment. It reacts mechanically to the real-world events and is influenced by the processes that make services and trigger actions with or while not human intervention.



Figure 1.: Home Gardening

The planned system is intended and enforced employing a low-priced Mastercard sized Nodemcu, that is controlled through internet under the windows environment. The smart device collects home environment data and sends the info to server. It logs the info and stores them as data. Later they're classified using data processing tools. The complete platform is developed to gather the desired information of a future device. The device can observe home environment, collect and analyze information, send this to server, the server can respond according the matched criteria of the surroundings and return range of variables for a specific plant and environment.

All garden parameters like humidity, temperature, soil moisture, light intensity is tracked by the system and this data is uploaded in the cloud.

Eco Friend (the device itself) incessantly monitors the conditions of the garden and collects each amendment of information that need immediate actions for the garden and advise the user.

## Motivation

Plants are essential for life in earth. None of our basic functions from breathing to eating to drinking would be possible without plants. Plants not only act as food sources but also release oxygen and help maintain the water table. The simple fact of the matter is that without plants we cannot survive.

In today’s busy world, we always have little time to know every detailed information. But lack of information could spoil a perfectly planned decision. My roommate has 3 plants. 2 of them are already dead and another is about to die. Why that might have happened? Because he went to a local nursery plant shop, there he found three trees that had cool color flowers, leaves were beautiful. He asked himself how much would they suite the beauty of his balcony, and he found out they would quite an impression. They really were beautiful at first. He used to care for them, nurture them, water them. But after some time, he got himself busy with daily life. About a matter of time, these plants faced their destiny, and gets rotten. What if he knew, which plants was best for his environment? Which plants needed less nurture and attention. Maybe that could save his money and time. So, this device helps to learn more about the environment that a tree can survive, and then generate a database. Using the database, a user can learn which plants suits the criteria of his home environment and necessity (based on purpose, e.g. vegetable plants, flower plants, medicinal herbs, leaflet plants.

## 1.3 Rationale of the Study

There are so many projects on IoT is undergoing right now to make smart garden, which involves in smart watering and lighting systems. They use advanced technique and method using IoT devices and android platform to make user friendly gardening.

By this research, the gardening is taken to a whole new level by implying data mining techniques on home environment.

## Research Questions

These are few research questions regarding my research topic

* Does gardening needs to computer supervision rather than basic gardening knowledge?
* Can smart gardening reduce tree death rate?
* Accuracy of the data collected is up to the standard?
* How much adaption is possible in the variation of plants?

## 1.5 Expected Output

1. Analyze experimental environment
   1. The device will gather the information based on room environment
      1. Light intensity
      2. Temperature
      3. Humidity
   2. It will also get the information based on plants
      1. Soil moisture
   3. Collect and format data
   4. Send data to the server
   5. The server will do the following
      1. Save the requested data
      2. Notice any unwanted occurances
   6. Scrapping the database
      1. Get plants upper and lower threshold limit of environment variables
2. Analyze user environment
   1. We will get the information based on room environment
      1. Light intensity
      2. Temperature
      3. Humidity
3. Interact with user
   1. Maintain
      1. Automatic water system
      2. Automatic lighting system
      3. Notify user about the tree

## 1.6 Report Layout

**Chapter 1: Introduction**

In this chapter, we have discussed the motivation, objectives and the expected outcome of the project. Moreover, research questions and expected outcomes also been discussed based on the project. Later followed by the report layout.

**Chapter 2: Background**

We discuss the background circumstances and hardware details of our project. We also talk about the related work, comparative studies, scope of the problem and challenges of the project.

**Chapter 3: Research method**

In this chapter, we discussed the requirements like the use case model of the project and their descriptions, the logical data model and the design requirements.

**Chapter 4: Experimental results and discussion** in this chapter, we discussed all the designs of the research with proper descriptions. We also discussed about individual result descriptions.

**Chapter 5: Conclusion and Future Scope** We discussed the conclusion and the scope for further developments which can make a vast sector for this system.

# Chapter 2

# BACKGROUND

## 2.1 Introduction

As per the growing rate of population with spontaneous consumption of resources, creates in the need for the managing the available resources at its best. So, a need was felt to manage the outflow of the two major resources i.e. water and electricity and to formulate out, that’s how it can be protected from getting wasted and could be utilized at its best.

As during the survey study, it was found that (Dhaka, in Bangladesh) the practices were manual and a major portion of resources was wasted due to slothful and unconcerned behavior leading to the death of trees and unwanted operation of the lights.

So, using modern technology, and statistical, survey-based study it was found that that major portion of the resources (water and Electricity) could be managed out and preserved by managing their controlled flow in an allocated area.

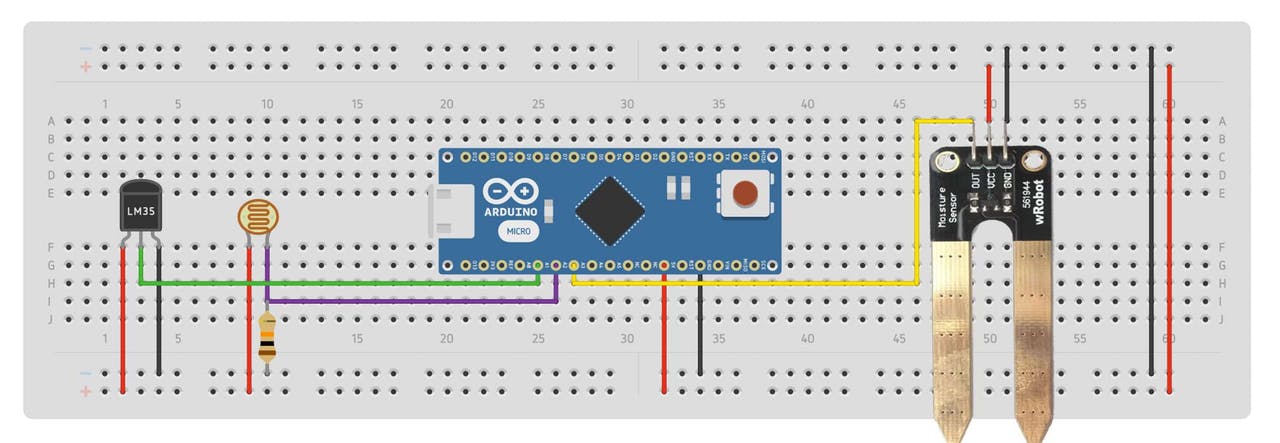
## 2.2 Related Works

There are lots of works on IoT devices regarding smart plant monitoring system. There are logs to classify the environment required to plant

**Plant Monitoring System by Ryan Gill**

Real time plant monitoring system to view temperature, light exposure and moisture. He started off by loading the MKR1000 with the Standard Firmata Wi-Fi sketch. This allowed him to communicate with the board using Johnny-Five.

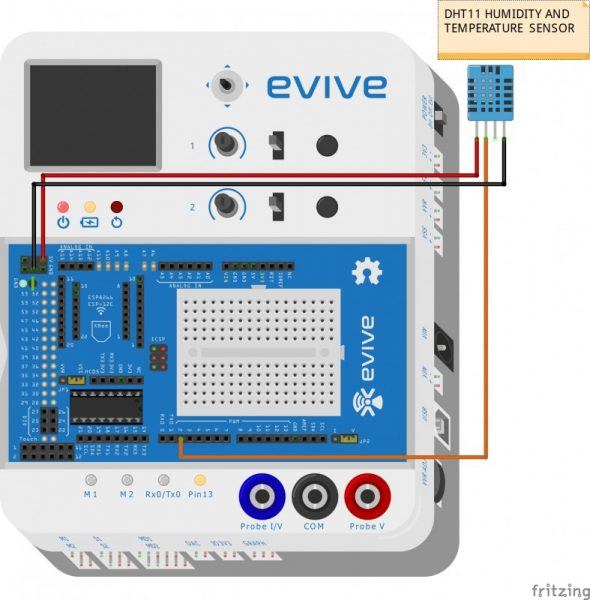
Below is a schematic of the circuit he built for his system..



**Plant Monitoring System by STEMpedia**

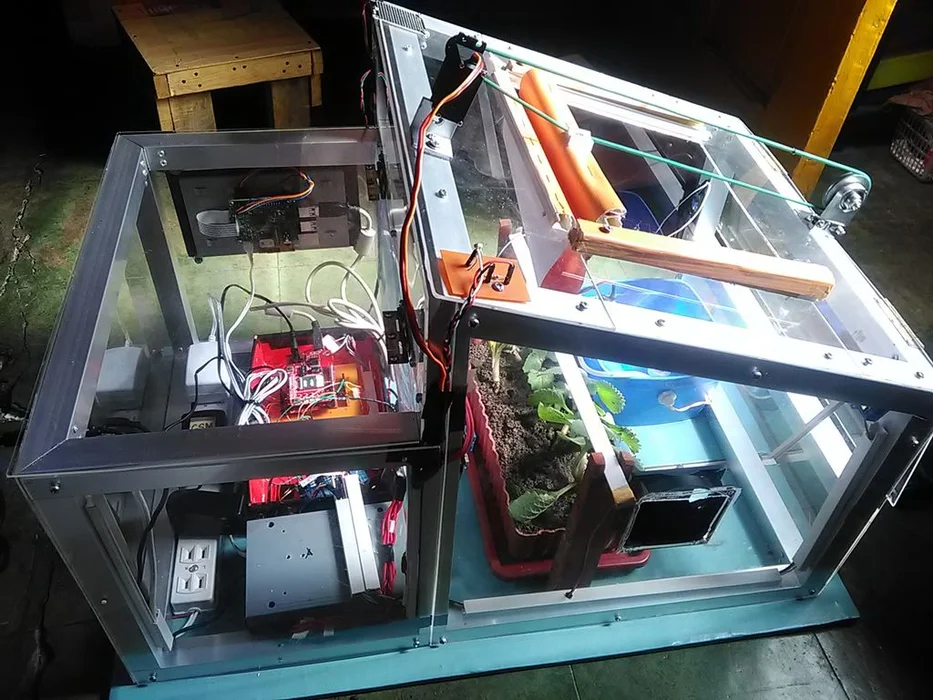
This project demonstrates how to track parameters like moisture of the soil, sunlight, humidity, and temperature of the plant environment and display it on evive display.

Monitoring plant health is very important for their fast growth. In this busy world, people usually forget to water their plants which leads to bad growth and health of their plants. For ensuring complete development of plants it is necessary to develop proper surrounding conditions in which plants grow. We are now going to make a small DIY Plant Monitoring system whose data will be displayed on the evive screen. The evive screen will display the following data:



**Automated Plant monitoring System by TUPT**

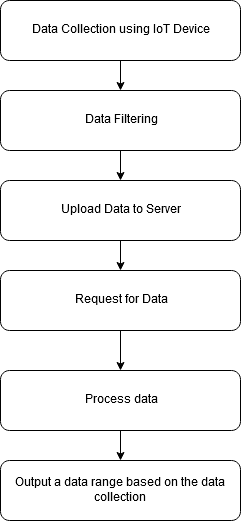
He decided to make a project which would help people see the importance of technology on our environment and with their lives. He came up with researching the projects that students have done using the Arduino. But he thought of making something that is existing but not most students have done improving it, so he decided to make an Automated Plant Monitoring System. This project is divided into two groups, the first group is in charge of nursing the plant meaning they will operate the sensors by using the website buttons upon monitoring the plant's status while the second group monitors the plant's status automatically, meaning they would just monitor by viewing on what has been displayed on the LCD TFT and let the raspberry pi do the secondary components do the tasks. Our major components for this project was the Gizduino and Raspberry Pi 3. Since plant owners are still doing the manual process of monitoring their plants for it to grow, by applying technology and some knowledge that he learn from school and researching what kind of materials or components should he use, it will be possible to make their monitoring easier and faster.



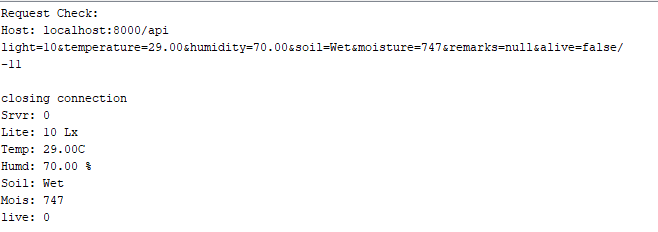
**Smart Plant Monitoring system by Sreeram Sadasivam**

Plant monitoring is seen as one of the most important tasks in any farming or agriculture-based environment. With the inception of Ambient Intelligent systems, there have been a rise in ambient intelligent based devices-Smart Homes and other similar technologies involving RFID has evolved over the past few years. Integration of such an ambient intelligent system with plant monitoring makes farming easier. In this paper, we discuss about the implementation of a smart plant monitoring system which makes use of the concept ambient intelligence with the use of .Net Gadgeteer which, proactively handles the plant monitoring system. The given implementation works along with a cloud-based server and a mobile based device (ideally Android/iOS device) which helps the user to control and see the status of the plant which is being monitored by the hardware device. The given circuitry detects changes in the moisture, temperature and light conditions in and around the plant, and performs a machine-based curation on the plant by providing necessary irrigation and illumination for the plant. Machine curation is also integrated with active weather forecasting systems which are deployed in the cloud-based server using which advanced machine curation is performed. For user-based curation, the Android device provides user an option to override a machine curated operation.

## 2.3 Research Summary



I have collected 1000’s of data from the IoT device.



Later uploaded on the PHP Server



The Data is processed and later using filtering and data mining techniques we get the desired range values



## 2.4 Scope of the Problem

This research-based project has tremendous scope in practical fields. Some examples are given below:

* Plant environment analysis
* Genetic transfusion of plants based on research data
* Predict plant’s survival based on environment
* Extend research on plants

## 2.5 Challenges

The proposed device should have the following challenges to overcome

* To operate in friendly environment
* To work with cheap device that is prone to error
* Irrelevant data
* Working with massive datasets and options
* Server response issues
* Heavy dataset leads to no result at all
* Needs premium materials
* Work on cross platform servers
* Low level programming for IoT leads to more errors

## 2.6 Hardware Requirements

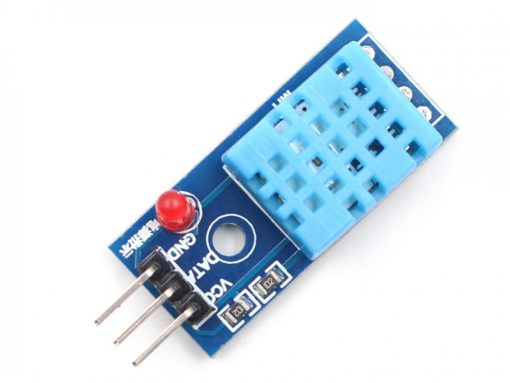
There were lots of parts and devices used to complete the device. Some of them finally came out with limitations. These were replaced or removed later. The final parts that makes the final device is as follows:

* + 1. **Nodemcu**



The NodeMCU is a development board that includes the favored ESP8266 Wi-Fi chip. as it seems, you'll be able to program the ESP8266 a bit like the other microcontroller. Its obvious advantage over the Arduino or PIC is that it will promptly connect with the web via Wi-Fi. However, the ESP8266 prison-breaking board has restricted pins though the chip itself contains a heap of output ports. The NodeMCU solves this drawback by that includes ten GPIO pins each capable of using PWM, I2C and 1-wire interface.**[[1]](#footnote-1)**

* + 1. **DHT11**

**[[2]](#footnote-2)**

DHT11 is a humidity and Temperature detecting sensor, that generates calibrated digital output. DHT11 are often interface with any microcontroller like Arduino, Raspberry Pi, etc. and find fast results. DHT11 may be a affordable humidity and temperature detector that provides high reliability and long stability.

It uses a capacitive humidity detector and a semiconductor to measure the encircling air, and outputs a digital signal on the data pin (no analog input pins needed). It’s terribly straightforward to use, and libraries and sample codes are accessible for Arduino and Raspberry Pi.

This module makes is simple to attach the DHT11 detector to an Arduino or microcontroller as includes the pull up resistance required to use the detector. solely 3 connections are needed to be created to use the detector – Vcc, Gnd and Output.

It has high reliability and glorious long stability, because of the exclusive digital signal acquisition technique and temperature sensing technology.

Specifications: -

Power Supply： 3.3~5.5V DC

Output： 4 pin single row

Measurement Range： Humidity 20-90%RH， Temperature 0~50℃

Accuracy： Humidity +-5%RH， Temperature +-2℃

Resolution： Humidity 1%RH， Temperature 1℃

Interchangeability： Fully Interchangeable

Long-Term Stability： <±1%RH/year

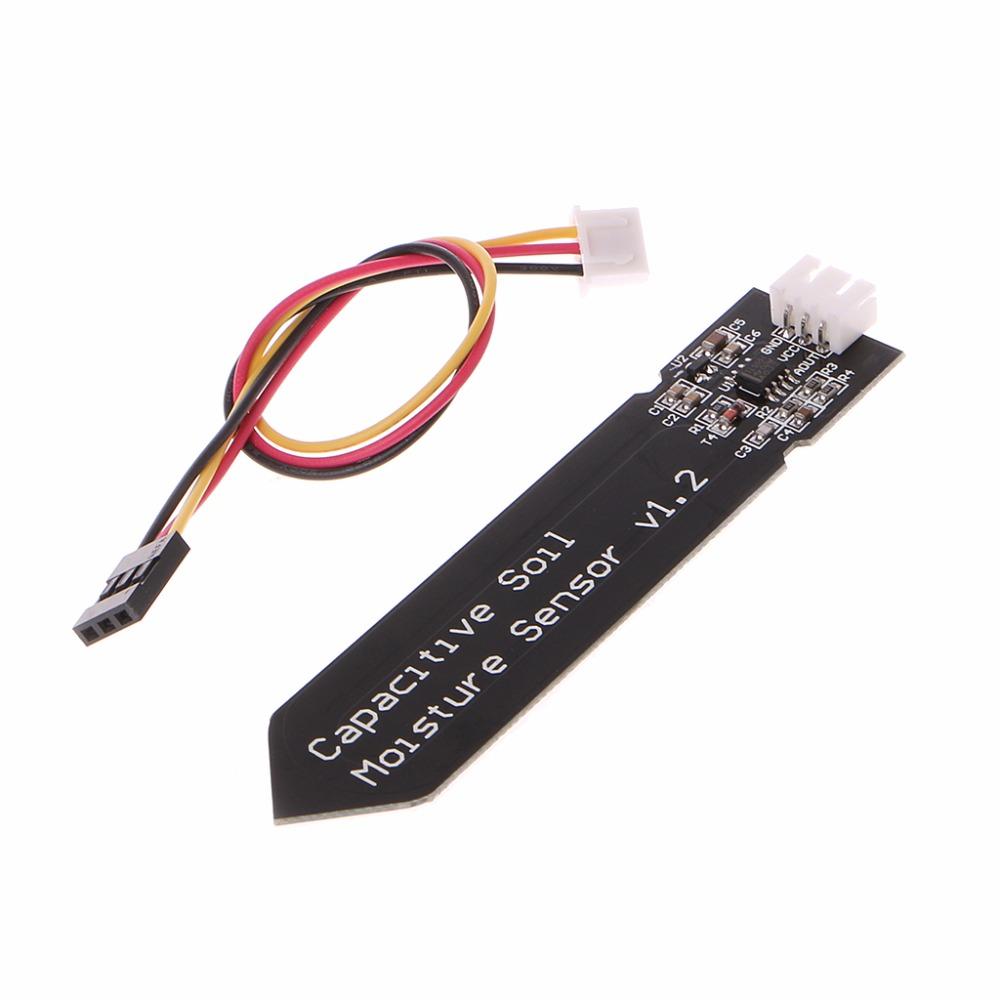
Pin Description: -

Pin 1: Power +ve (3.3VDC to 5.5VDC Max wrt. GND)

Pin 2: Serial Data Output

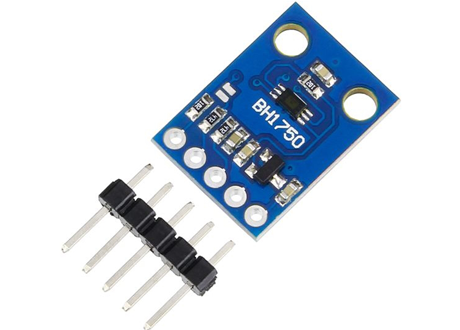
Pin 3: Power Ground or Power –ve

* + 1. **Capacitive Soil Moisture Sensor v1.2**

**[[3]](#footnote-3)**

soil moisture device measures soil moisture levels by electrical phenomenon sensing instead of resistive sensing like alternative sensors on the market. it's made from corrosion resistant material which provides it a wonderful service life. Insert it in to the soil around your plants and impress your friends with real-time soil moisture data! This module includes an on-board transformer which provides it an operative voltage vary of 3.3 ~ 5.5V. it's excellent for low-voltage MCUs, both 3.3V and 5V. For compatibility with a Raspberry Pi it'll need an ADC convertor. This soil moisture device is compatible with our 3-pin "Gravity" interface, which might be directly connected to the Gravity I/O enlargement shield.

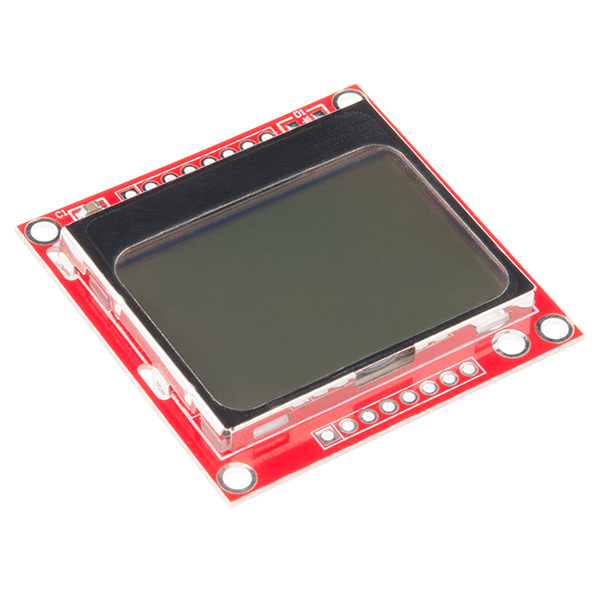
* + 1. **Digital Light intensity sensor module**

**[[4]](#footnote-4)**

BH1750FVI is a digital ambient light sensing element IC for I2 C bus interface. This IC is the best suited to get the ambient light information for adjusting liquid crystal display and keyboard backlight power of Mobile Phones. it's attainable to find wide selection at High resolution. It’s Spectral responsibility is roughly human eye response. This has terribly low source of illumination dependency like electric lamp, lamp, halogen Lamp, White LED. there's No need of any external elements and comes with 50Hz or 60Hz light noise reject function. it's attainable to pick two kind of I2C slave-address.

Adjustable measuring result for influence of optical window. The influence of infrared is extremely little. it's application in mobile, LCD TV, NOTE PC, transportable game machine, photographic camera, Digital video camera, PDA, liquid crystal display, DIY projects, robotics projects, Arduino projects, Raspberry-Pi projects, Electrical or Electronic projects.

* + 1. **Nokia 5110 LCD Display**

[[5]](#footnote-5)

The Nokia 5110 is a basic graphic LCD screen for ample applications.

It was originally supposed to be used as a cellular phone screen.

This one is mounted on a straightforward to solder PCB.

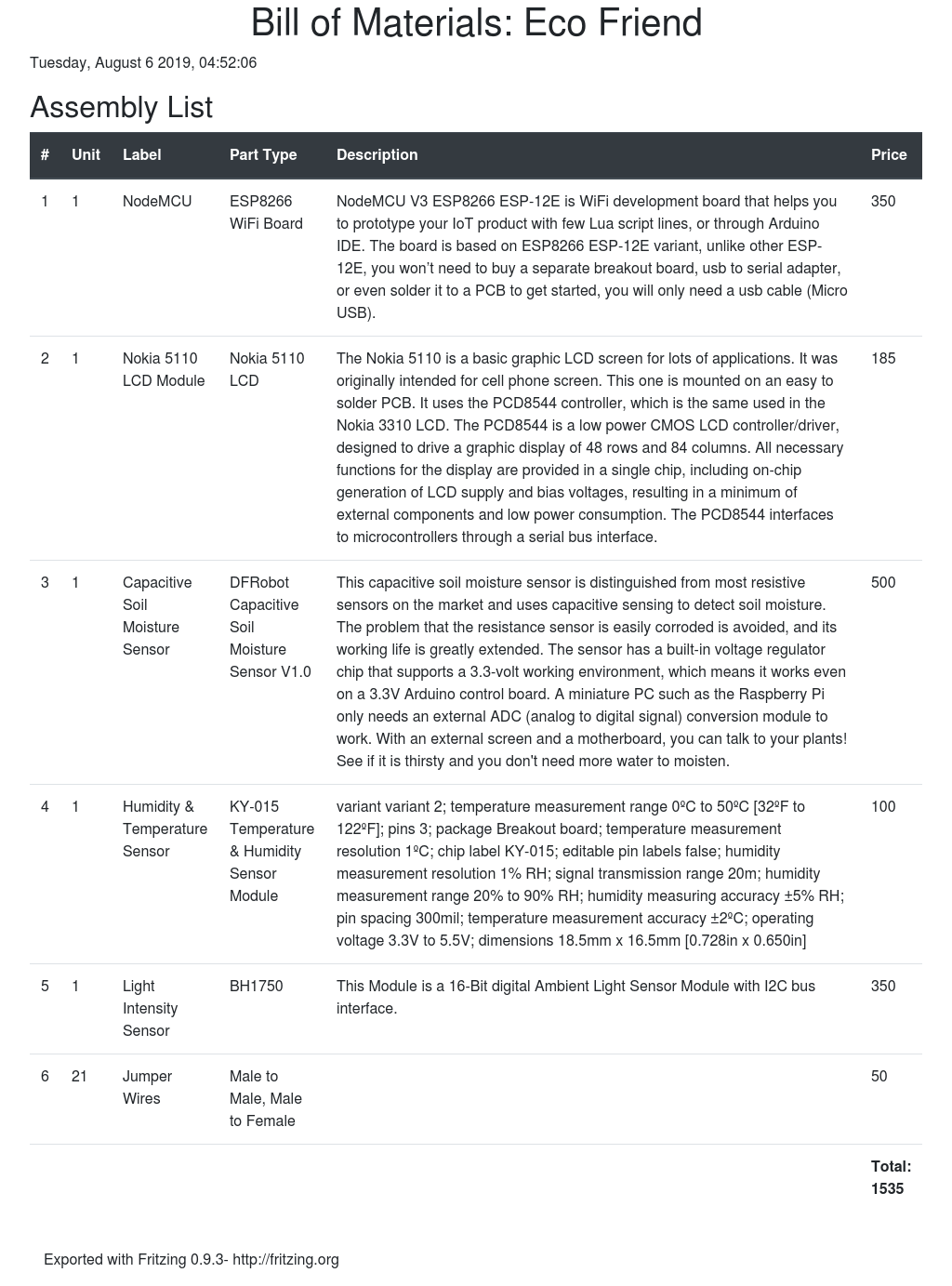
It uses the PCD8544 controller, that is the same utilized in the Nokia 3310 liquid crystal display.

The PCD8544 could be a low power CMOS LCD controller/driver, designed to drive a graphic display of forty-eight rows and eighty-four columns.

All necessary functions for the display are provided in an exceedingly} very single chip, in conjunction with on-chip generation of liquid crystal display offer and bias voltages, resulting in a minimum of external elements and low power consumption.

* + 1. **Jumper wires**

[[6]](#footnote-6) Jumper wires are merely wires that have connection pins at every end, permitting them to be used to connect 2 points to every other without soldering. Jumper wires are usually used with breadboards and alternative prototyping tools so as to create it simple to change a circuit as required. Fairly easy. In fact, it doesn’t get way more basic than jumper wires.

**Parts Bill**

## Software Requirements

The below softwares were used to complete the project:

* + 1. Arduino IDE
    2. Draw.io
    3. Fritzing
    4. PyCharm Professional
    5. PHPStorm
    6. Postman
    7. Git

# Chapter 3

# Research Methodology

## 3.1 Introduction

The automatic plant monitoring system has recently attracted tremendous interest due to the potential application in emerging technology. More importantly, this technique is used to enhance the performance of existing techniques or to develop and design new techniques for the growth of plants. The plant monitoring system is helpful for watering the plants and to monitor few parameters for growth of plants. This system is very used in few areas like nursery farms and in agriculture. In this system a mechanism is established to find the moisture content in the soil with the help of soil moisture sensor and depending upon the condition of the sensor the water is controlled. Another important parameter is by capturing the light, temperature and humidity of the environment by using NodeMCU, and processing the data by using data mining technique to analyze and determine the environment. This helps in providing the appropriate amount of water for plants so reduces some situations like mud cracks, water logging. This helps in irrigating the field even during night time, so does not require the user to switch ON the motor manually.

## 3.2 Research Subject and Instrumentation

**Subject:** Data mining on Home Forestation using IoT

**Instrumentation:**

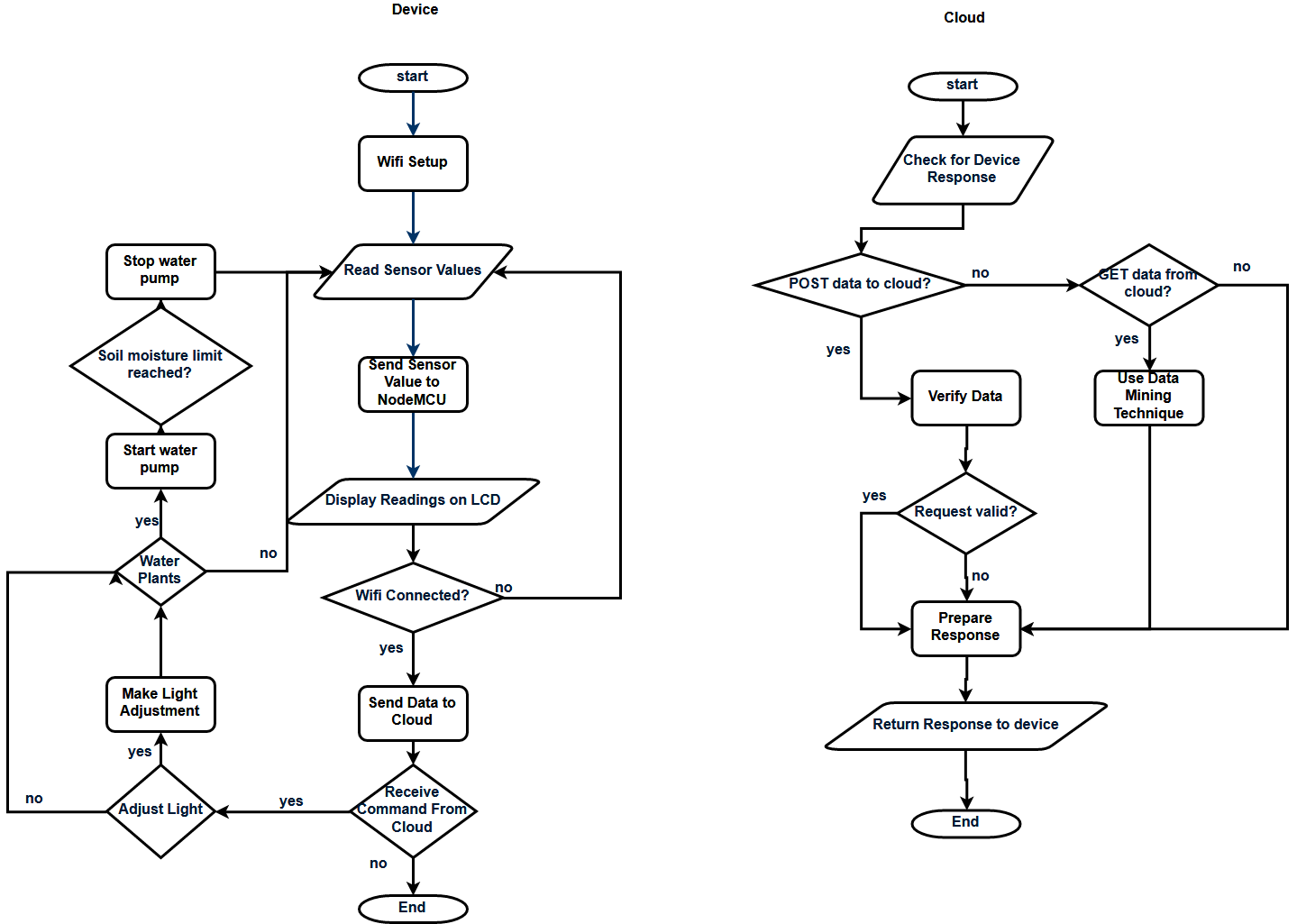
* NodeMCU
* DHT11
* Light Sensor Module
* Soil Moisture Sensor
* LCD
* Digital Meter
* Jump wires
* Python Server
* PHP Server

**Software Requirements:**

* Arduino IDE
* PHPStorm
* Pycharm Professional
* Pandas Library
* Numpy Library
* Nokia 5110 LCD Library
* DHT11 Library
* BH1750 Library
* JSON Library
* NodeMCU Library
* Adafruit GFX Library
* REST API

## Data Collection Procedure

### Flowchart



### Diagram

### Circuit Diagram



## 3.4 Statistical Analysis

## 3.5 Implementation Requirements

To implement the experiment I mainly used IoT Device. For this I followed these steps:

1. **Data Collection:** Use of IoT device to draw the environment data for the server.
2. **Sorting and remove data:** After collecting data I have to sort the data and remove irrelevant data.
3. **Algorithms:** Applying different types of algorithms to evaluate the data.

# Chapter 4

# Experimental Results and Discussion

## 4.1 Introduction

For precise information, we have tried the best output possible. For this, we have chosen better algorithms as it is clearly explained in (Research methodology).

Our focus was to create a dataset where we will be able to implement algorithms and track records of environment and its impact on plants. We have also made it possible to know about barriers and possible outcomes of those barriers by this experiment.

## 4.2 Experimental Results

## 4.3 Descriptive Analysis

## 4.4 Summary

The automatic plant monitoring system has recently attracted tremendous interest due to the potential application in emerging technology. More importantly, this technique is used to enhance the performance of existing techniques or to develop and design new techniques for the growth of plants.

# Chapter 5: Summary, Conclusion, Recommendation and Implication for Future Research

## 5.1 Summary of the Study

The goal of our research is to build an advanced gardening support system called the Eco Friend. Eco Friend supports gardeners in making planting decisions. With increasing numbers of people in Bangladesh and increasing interest in healthy eating, home gardening is becoming more and more popular. How-ever, it is difficult for beginners to plan gardens because of the wide range of factors to consider, such as soil, weather, climate. Eco Friend supports decisions about what to plant where with data collected by sensors and organized in a database. The concept of Eco Friend is based on precision agriculture, which uses information technology to bring together data from multiple sources to support decisions associated with crop production. Eco Friend uses sensors to collect data in the real world that it then plots in a cloud database. Various models then forecast possible fertilizer needs, pest control needs, and yields. Growers carry out actions based on the forecasts and evaluate the results.SG allows growers to set their own goals. Growers might pursue yield, or particular vegetables, or a mix of flowers, herbs, and vegetables, or a balance of fragrant and beautiful plants. SG uses computer models to forecast the outcomes of management decisions, and the technology of Data Mining (AR) to show the grower the predicted results.

## 5.2 Conclusions

Analyzing and Datamining using IoT with the assistance of a NodeMCU controller helps to ease the foremost tedious job of farming for plant lovers who are in a very time of rush. this method monitors numerous garden parameters and store the data in details of garden through the device. It conjointly helps to unravel several problems occurring within the existing plant watering and farming system. It helps to avoid wasting water and utility bills. Plant observance and good farming mistreatment IoT with the assistance of the NodeMCU controller can bring a lot of convenience and luxury to individuals ‘s lives for taking care of their garden. The user will management and monitor the setting of the garden mistreatment internet application. The controller during this system (Raspberry Pi) provides associate economic and economical platform to implement the plant observance and good farming system mistreatment IOT. the most advantage of the good farming system is that the user will monitor the garden mistreatment the net from so much distances throughout leisure or whenever necessary.

## 5.3 Recommendations

I recommend,

* There must be work to understand how the device works.
* As the device is still not user friendly, more guidelines and precise information is required to use the device.
* Gardening should be encouraged amongst people.
* Raise awareness about tree plantation.

## 5.4 Implication for Further Study

* **Commercial field**: Addressing the operations that can be done with the device can help to create more innovative devices based on Home gardening system.
* **Potential Economic Growth**: Helping home gardening can result into more efficient and healthier citizen life. Which can result into potential economic growth.

Drawbacks

* pH sensor module high price (Approx 2k+)
* limited analog pin of NodeMCU
* Limited digital pin of NodeMCU
* Technical difficulties

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# Appendices

## Appendix A: Research Reflection

## Appendix B: Related Issues

1. https://www.teachmemicro.com/intro-nodemcu-arduino/ [↑](#footnote-ref-1)
2. https://happyec.in/product/dht11-temprature-and-humidity-sensor-module/ [↑](#footnote-ref-2)
3. https://wiki.dfrobot.com/Capacitive\_Soil\_Moisture\_Sensor\_SKU\_SEN0193 [↑](#footnote-ref-3)
4. https://robohaat.com/product/bh1750fvi-digital-light-intensity-sensor-module/ [↑](#footnote-ref-4)
5. https://www.sparkfun.com/products/10168 [↑](#footnote-ref-5)
6. http://blog.sparkfuneducation.com/what-is-jumper-wire [↑](#footnote-ref-6)