SMART CROPS MONITORING SYSTEM USING IOT

Project report submitted in partial fulfillment of the requirement for the degree of

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

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DECLARATION BY THE SCHOLAR

I hereby declare that the work reported in the B-Tech thesis entitled **"SMART CROPS MONITORING SYSTEM USING IoT"** submitted at **Jaypee University of Information Technology, Solan, India,** is an authentic record of my work carried out under the supervision of **Dr. Rajiv Kumar**. I have not submitted this work elsewhere for any other degree or diploma.

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CERTIFICATE

This is to certify that the work reported in the B.Tech project report entitled **"SMART CROPS MONITORING SYSTEM USING IoT"** which is being submitted by **Karmanya Sharma(151085), Nikhil K.Shandelya (151037) and Rohan (151083)** in fulfillment for the award of Bachelor of Technology in Electronics and Communication Engineering by the Jaypee University of Information Technology, is the record of candidate's own work carried out by him/her under my supervision. This work is original and has not been submitted partially or fully anywhere else for any other degree or diploma.

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LIST OF ABBREVIATIONS

IoT	Internet of Things
IEEE	Institute of Electrical and Electronics Enginners
NEST	Novell Embedded Systems Technology
RFID	Radio-repeat unmistakable verification
TWI	Two Wire Interface
GPS	Global Positioning System
ITDM	Intelligent time division multiplexer
STK	Systems Tool Kit
AI	Artificial Intelligence
WSN	Wireless Sensor Network
IDE	Integrated Development Environment
USB	Universal Serial Bus
PWM	Pulse Width Modulation
SPI	Serial Peripheral Interface
AREF	Analog REFerence
PC	Personal computer
NTC	Negative Temperature Coefficent
ESP	Espressif modules
TCP	Transmission Control Protocol
IP	Internet Protocol
SDK	Software Development Kit

RTOS	Real- Time operating system
GCC	GNU Compiler collection
TTL	Time to live
V2X	Vehicle-to-everything communication
DC	Direct current
PWM	Pulse Width Modulation
IC	Integrated circuit
DIP	Dual in-line package
CPU	Central planning units

LIST OF FIGURES

ABSTRACT

The following project presents the use of the concept of Internet of Things in monitoring the crops and using it in other agricultural purposes. The field of agriculture has always demanded high standards of resources, professionalism and effort. Today majority of the world depends on agriculture for food consumption, economic growth, trade and employment. It also comes with various set of challenges for the agriculturists. Various agriculturists, famers, and scientists across the globe believe in formulating different plans and ideas to deal with these challenges.

The basic aim in this field is to maximize the yield by intelligent and efficient use of the available resources which are generally limited and scarce costly. Hence it becomes really important to use them significantly. There are many factors which affect the crops, including weather and climatic conditions, lay of the land, soil parameters, etc. These factors increase the complexity of this field and demand innovative ideas to tackle it.

The use of technology in various spectrums is often recommended in order to reduce the complexities get better results. It is used as a tool to balance and make proper adjustments in order to meet certain objectives. The use of science and technology in agricultural practices has yielded great results and helped the mankind in a significant way.

The advent of computers and electronics have completely changed the dynamics of this domain. The sudden increase in this usage of computers and electronics devices like PCs, smartphones, tablets etc. have resulted in huge increase in the potential of exploiting it for various purposes. The skyrocketing popularity of internet and its growing connectivity in different rural parts across the world only helps this potential. Hence the concept of Internet of things has gained huge popularity.

Today, the Internet of Things is the most explored concept in the domain of electronics. It consists of various electronic or other devices used in day to day lives interconnected with each other through an internet connection. The various devices can be monitored and

regulated through the internet without any physical contact over a device through some application. The user can achieve this from any part of the world, the only requirement being an internet connection.

The proposed model consists of a microcontroller, sensors like soil moisture sensor, humidity sensor, temperature sensor, and a motor representing a water pump. The microcontroller moderates all the parameters sensed by the various sensors and sends the data to the user application. The user can take necessary action if needed, such as switching on the motor pump through the application.

Hence the model helps in better handling of the crops under consideration. The user gets a better understanding of the various conditions of his field and can control them over his device from anywhere in the world.

CHAPTER 1
ELECTRONICS IN AGRICULTURE

INTRODUCTION

In the following project report, we suggest creating a system in a perfect world watering rustic yields subject to Internet of Things. The project intends to structure an IoT system using center point sensors in the yield field with data the board by methods for a mobile phone or any electronic device.

1.1 APPLICATIONS OF ELECTRONICS IN AGRICULTURE

Various fragments are gear, any electronic device using internet, and flexible application. The principle part was organized and executed in control box hardware related with accumulate data on the harvests. Soil moistness sensors are used to screen the field, interfacing with the control box[8]. The next part is an electronic app that was arranged and realized to control the nuances of yield data and field information. This part associated data mining to analyze the data for foreseeing sensible temperature, moisture, and soil clamminess for perfect future organization of yields advancement. The last section is primarily used to control of providing water to field with an adaptable application in a mobile phone[3]. The licenses are modified or manually used by the customer.The customized control uses data from soil clamminess sensors for watering[1]. In any case, the customer can settle on providing water to the yields in the pragmatic control mode. The system can send admonitions through LINE API for the LINE application. The results exhibited the execution to be useful in cultivating[3]. The moistness substance of the earth was kept up appropriately for vegetable improvement, diminishing costs and extending cultivating productivity[4]. Also, the report addresses doing cultivation through modernized improvement.

Figure 1.1 Farmer in crops field with modern electronics[1]

1.2 USE OF IoT IN AGRICULTURE:

Cutting edge innovations can convey advantages to most of individuals. During ongoing times, the Internet of things (IoTs) has started to assume a noteworthy job in day to day lives, stretching out our observations and capacity to alter the earth around us[3]. Especially the agro-mechanical and natural fields. What's more, it can give data to the last client/customer about the starting point and properties of the item (Talavera et al., 2017). In this way, this paper plans to apply IoTs for PC supported improvement of agribusiness.

In such advancement of agribusiness, introducing a Wireless Sensor Network (WSN) in the field has improved viability and effectiveness of the ranchers[22] . WSN helps in assessing field factors, for example, soil quality, climatic conditions, and biomass of plants or creatures[9]. It can likewise be utilized to survey and control factors, for example, temperature, moistness, vibrations, or stuns amid item transport (Pang et al., 2015). In addition, WSN can be utilized to screen and control factors that impact crop development[21]. This can be likewise be utilized to decide ideal month for reaping, the

rancher is progressively appropriate for various different weather states, distinguish ailments, reign hardware, and so on., (Ndzi et al., 2014). In this examination, we center around information comprising of temperature, mugginess, and soil dampness in the harvest fields[2]. So as to build up a legitimate framework, we require information stockpiling and a way to deal with find learning from amassed information, and collaborations with the client[1]. A database framework will be planned and actualized as an online application. The put away information will be utilized for basic leadership to sway programmed watering of harvests. The farming information will be examined to streamline and alter the earth around, and to anticipate the water need of harvests later on.

Figure1.2 Smart farming[3]

Information connected in horticulture to find learning .Affiliation rules approach has been for the most part used to find fascinating relations between factors with regards to expansive databases[2]. It dissects and set up shrouded connections among the properties of rural

information, supporting logical basic leadership. Accordingly, the agribusiness information examination using affiliation thus utilizing the calculation in the general guidelines obtaining, while direct relapse was connected to demonstrate the connections between a few information factors and a result variable[4]. What's more, this work planned to structure and execute a WSN framework for sensors in the harvest field, alongside information the executives interfaced with the client through a cell phone[7]. This framework bolsters blended harvest cultivating and help ranchers that have whenever and anyplace availability with the framework.

1.3 COMPUTER USEFULLNESS IN AGRICULTURE THROUGH INTERNET

Through PC application animal are solely track along these lines, no slips will be happen anyway in case it is done by an individual now and again incorrectly goof can be happen .Information, for instance, soundness of the animal, milk age, conceptive information[9]. These sorts of information are known as group recording. This group recording are secured in PC.

Through social event and individual to individual correspondence site farmers can get partner with various pros and exchange their points of view and various nuances[8]. Farmers can get a lot of information on grouping of agribusiness subjects by surfing. Farmers can get interface outside customer which can improve their thing and augmentation their creation limit[6] .Farmer can get information as for esteem, atmosphere, temperature, etc.

Similarly, keeping cash related record, creation record, electronic banking, Buy required resources through web, etc[5]. The proportion of water sprinkled in a considerable lot is moreover robotized.

As far as possible in developing and animal cultivating has increase in light of usage of PC in agribusiness field .There are less adversities in view of work are checked by PC. By using PC in standard field like agrarian field we can manufacture the gainfulness and point of confinement the error happen.

1.4 CHALLENGES

The cultivating business has always experienced slower improvement stood out from various divisions, generally in perspective on sustenance lacks and desiring issues in specific zones of our planet. These are normally related to the appointment and imbalance of developing, environment changes, urban effects, industrialization systems and utilization of manufactured creations, similarly as substitution of little farms by mechanical estates[1]. Private farmers still win in making key harvests, for instance, wheat, rice and maize, in spite of the way that they get lower returns, generally in view of the lacking store system and nonattendance of a real market affiliation[2]. As often as possible in the midst of the transportation, bearers are not set up to keep the right temperatures. They moreover reroute vehicles because of abrupt events[4]. The opportunity to see the consistent conditions inside naval force transport and applying atmosphere desires can result in a basic impact on the sustenance business and farmers benefits.

Man-made mental ability and new advancements make a remarkable mix of electronic structures transversely over agribusiness, primarily through data sharing. Data streams in from different sources — field-based sensors, aeronautical sources and biological data, similarly as remote recognizing data starting from various satellites. At a comparable moment, data scattering causes its own one of a kind amazing troubles. In case we put these issues aside, there are colossal central focuses to sharing data in the cultivating industry. Nowadays, various farmers who share data with their bank or protection organization get lower advance expenses or rewards[10]. Along these lines, the essential fixation for IoT in agribusiness should be straightforwardness and control over data use. Nevertheless, to achieve this, it is fundamental to accumulate the right supervision from industry, government and experts[13].

For example, to warrant the precision developing thought, single agriculture organizations should store logs with information about equipment, showing that it is outstanding and working accurately.

1.5 PROBLEM STATEMENT

The objective of this proposed model is to monitor different parameters related to the crops under observation through wireless connectivity on an electronic device. These parameters include air humidity, atmospheric temperature, soil moisture. The model is also required to take necessary actions like turning on or turning off the water pump when required or when desired through an instruction given by the user over the electronic device.

1.6 OBJECTIVE

The aim is to build a model which is capable of handling various information about the crops under consideration and undertake required commands of the user, for a better management of the crops and the resources. Hence providing the agriculturists across various domains a robust and useful capability. Also promoting research and further exploration in the field of use of electronics and internet technology in agriculture.

1.7 ORGANISATION OF REPORT

Chapter 1: It briefly describes the proposed project, how electronics and Internet of Things is used in monitoring the crops and watering the crops when required. There was a small introduction to Internet of Things and how it can be used in the field of agriculture. The challenges incurred in using IoT in agriculture were discussed. The problem statement of the project and the objective has been defined.

Chapter 2: It is the literature report. It consists of the various analysis and their approaches done by different analysts.

Chapter 3: It gives more insight about the Internet of Things, its history, characteristics, how it controls and manages the information, its scope, uses and applications in different fields like agriculture, medical, home automation, transportation and some of the benefits of it

.

Chapter 4: It describes the various components used in the project, there specifications and their working in detail.

Chapter 5: It describes the working of the model in detail with the help of a flow chart and block diagram.

Chapter 6: The observations and analysis of the readings generated is done. It also consists the conclusion.

CHAPTER 2

LITERATURE SURVEY

PCs and Electronics in Agriculture gives overall incorporation of advances in the utilization of PC gear, programming and electronic instrumentation and control structures to cultivation, officer administration and related endeavors[1]. The[2] last fuse agribusiness (in the two its sustenance and merriment points of view), woods things, aquaculture, animal/trained creatures science, veterinary medicine and sustenance dealing with.

The journal conveys special papers, reviews, applications notes and book overviews on topics including modernized decision helps identifying with any piece of the recently referenced endeavors; electronic checking or control of any piece of tamed creatures/crop creation (for instance soil and water, condition, advancement, prosperity, waste things) and post-accumulate errands[2]. A structure using sensors that screen exceptional conditions like stickiness, etc., the processor close by IC-S8817BS and remote handset module with zigbee show is used, field condition is sent to the farmer through convenient texts and email from the masters[3]. With this structure Sensor center dissatisfaction likewise, essentialness viability are supervised. Zigbee advancement is used which now and again need in extent of correspondence[18] . A system is proposed for astute agribusiness nursery checking system subject to Zigbee advancement[7]. The structure performs data acquisition, dealing with, transmission and social affair limits[16]. The purpose of their investigations is to make sense of it nursery condition system, where the of efficency of system for managing domain additionally, decrease the money and developing expense and besides save imperativeness[9]. IOT advancement here relies upon the BS structure andcc2530 used like planning chip to work for remote sensor center and coordinator[17]. The gateway has Linux working go about as focus[11]. When all is said in done the structure makes sense of it remote adroit checking and control of nursery and besides changes regular ingrain advancement to remote, moreover decreases work price[16] .A system is proposed for plant advancement which can be checked using warm imaging framework. Here the water framework temperature dissemination estimation (ITDM) technique has been recommended[14]. Ceaselessly the warm pictures including both low and high temperature ITDM values gives better water framework.

dissection of plant and animal material)[22]. For temperatures which are uncommonly close in run, warm imaging prompts off kilter information with the objective that the things can transform into indifferenciable[27].A method to survey the usage of remote sensor orchestrate used in automating water framework and data are sent to the web server through remote correspondence[21].

The sensors are used to distinguish the temperature, sogginess, moistness for collect watching[18]. The water framework is automated when the sensor scrutinizing goes underneath the breaking point regards[22]. The farmer is routinely recommended with the field conditions. It similarly cleared up that in nurseries, light power control can similarly be automated in extension to water framework[12]. Here, the desire for reap water need isn't that much desired[20].

Movement of Knowledge Sharing System for Developing Application, proposes a technique where the information identified with the developing field can be shared utilizing the Knowledge sharing structure[13]. The rule subject of the examination is to plan a technique to share the information and it additionally fuses obtaining of developing information. The procedure fuses information amassing by two methods[12]. Beginning one is the altered regular information gathering by a sensor, and second technique is the polished information gathering by a rancher[17]. Ideal plan of sun arranged controlled warm control water structure framework for improvement of green vegetable plants in Rural India, proposes approach considered warm reason that displays as a reaction for water structure control so as to develop the vegetable plants[18] . Awe inspiring Farming Framework Using Sensors for Agricultural Task Mechanization, proposes a novel system that joins awe inspiring separating framework and sharp irrigator structure which is outright known as sharp creating system[19].

The current procedure and a champion among the most settled courses in agribusiness is the manual procedure for checking the parameters[16]. In this procedure the ranchers they themselves avow the majority of the parameters and figure the readings[17]. It spins around influencing contraptions and gadgets to manage, to show up similarly, alert the clients utilizing the benefits of a remote sensor coordinate structure[27]. It goes for making developing sharp utilizing computerization and IoT movements[29]. The including highlights

are astonishing GPS based remote controlled robot to perform assignments like weeding, showering, sogginess perceiving, human zone and keeping watchfulness[23]. The cloud figuring gadgets that can make an entire enlisting structure from sensors to contraptions that watch information from green field pictures and from human entertainers on the ground and unequivocally feed the information into the vaults near to the zone as GPS coordinates[28].This suspected proposes a novel methodology for awe inspiring creating by partner a sharp distinctive framework and wonderful irrigator structure through remote correspondence technology[22].It proposes a low cost and fit remote sensor sort out methodology to get the dirt soaked quality and temperature from different locale of homestead and as shown by the need of accumulate controller to take the choice whether the water system is empowered or not[29].

CHAPTER 3
INTERNET OF THINGS AND ITS APPLICATIONS

In this chapter we all get to know about what is IoT, history of Internet of Things, applications for various IoT devices, various trends and characteristics of IoT's, benefits of IoT, numerous things that our being connected to internet can do. We will also look forward about our problem statement and objective of our report.

3.1 Introduction

It is the thought that interfaces the various electronic devices and allows to talk among themselves on web. This is goliath arrangement consisting all related contraptions – all of which collect and offer information on there utilization conditions where it is worked. In this way, all of your devices will pick up from the experience of various contraptions, equally to individuals work. IoT is trying to broaden the dependence in human-i.e interface, contribute and cooperate to get things done.

3.1.1 What is IoT?

The Internet of things (IoT) caters to development using all accessibility into physical devices and differing objects. The contraptions moves using help of internet which further can be seen along these lines making it proficient to utilize them.

The importance of the Internet of things has progressed as a result of association of various advances, steady tests and introduced structures[21]. Old time embedded structures, remote sensor frameworks, control systems, motorization (tallying home and building telemechanics), and others all add to engaging the Internet of things[23]. In the purchaser publicize, IoT advancement similarises with things identifying with possibility "splendid home", covering contraptions and machines, (for instance, lighting establishments, indoor controllers, home security structures)providing assistance no less than any ordinary organic frameworks, and thus in turning constrained by methods for devices connected in the midst of that condition, for instance, cellphone and astute speaker[25].

The IoT thought which shoot like gone up against unquestionable examination, especially as for insurance and issues which are almost similar to these contraptions with objective of unavoidable proximity.

Figure 3.1 Internet of things[21]

3.1.2 History of Internet of things

The possibility of an arrangement of astute devices was analyzed as in front of treat machine at Carnegie Mellon University transforming into the essential Internet-related apparatus, prepared to report its stock and whether as of late stacked refreshments were cold or not[28]. Mark 1991 paper on ubiquitous figuring, "The Computer of latest generation", similarly as educational scenes. Raji delineated the deliberation in IEEE Spectrum as "(moving) little packages of data to an extensive course of action of center points, so as to arrange and robotize each and every thing from house mechanical assemblies to entire manufacturing

plants game". This ground got power when Bill Joy envisioned device to-device correspondence as a bit of his "Six Webs" structure, presented at the World Economic Forum at Davos in 1999[26].

The articulation "Web of things" was likely composed by Kevin Ashton of Procter and Gamble, anyway he slants toward the articulation "Web for things"[22]. By then, he saw Radio-repeat unmistakable verification (RFID) as essential to the Internet of things, which would empower PCs to manage every single individual thing.

An investigation article referencing the Internet of Things was submitted to the get-together for Nordic Researchers[29] .University of Technology and even more eagerly arranges the bleeding edge one, for instance the data module placemnt for implementing sharp, related objects. Characterizing this Internet of things as "essentially the point in time when more 'things or articles' were related with the Internet than people", Cisco Systems evaluated that the IoT was "imagined"[20] .

3.2 Applications for various IoT devices

Customer applications

A creating section of IoT contraptions are made for purchaser ply,embracing related vehicles, home automation, wearable advancement (as a noteworthy part of Internet of Wearable Things (IoWT), related prosperity, added with mechanical assemblies and also includes watching capacities.

Mechanical Uses
Principle article: Industrial Internet of Things
Assembling

The IoT can comprehend reliable joining of various collecting devices furnished with recognizing, recognizing confirmation, getting ready, correspondence, actuation, and frameworks organization limits.

Horticulture

There are different IoT applications in cultivating, for instance, precipitation, clamminess, wind speed, bug infiltration, and soil content[28]. The information can be additionally used for developing systems, take taught decisions to improve quality and sum, limit peril, and decrease effort required to regulate crops. For example, farmers would now have the capacity to screen soil temperature and soddenness from far away, and even apply IoT –information for exact use readiness Codes.

3.3 Various trends and characteristics of IoT's

The IoT's major tremendous example of late is the perilous advancement of contraptions related and compelled by the Internet[26]. The IoT makes ways for progressively clear blend of the physical world into PC based systems, realizing capability updates, fiscal favourable circumstances, and diminished human exertions[28].

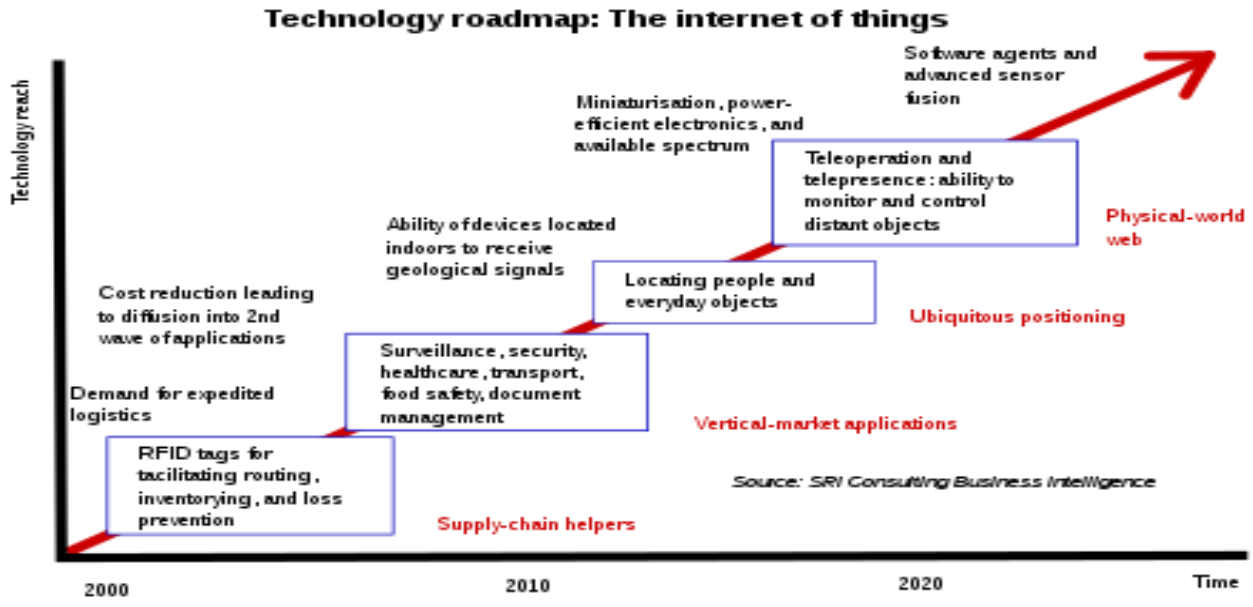

Figure 3.2 Internet of things roadmap[29]

3.4 Benefits of IoT

As it empowers instruments which can be used by direction of remote over the web, in this way it made opportunities to direct interface and organize the physical world to the PC based systems using sensors and web. Connection of the different introduced contraptions will result in robotization in pretty much , moreover enabling pushed applications. It has helped in achieving better precision, viability and money related preferred standpoint with decreased human intervention. It wraps developments, for instance, sagacious structures, astute homes, shrewd transportation and splendid urban networks. The noteworthy points of interest of this :

Enhanced Customer Commitment – The use of this helps in improving user's experience using means of modernizing this deed. For instance any issue in the vehicle will be normally recognized by the sensors. The driver, similarly as the maker, will be educated about it. Till the time driver accomplishes this organization place, and maker guarantee that broken element is situated in organization place.

Particular Optimization – It has helped in making it new headways and improving it. This maker helps to accumulate information which is totally unique from vehicle sensors and examine them to improve their arrangement which creates altogether increasingly capable.
Decreased Waste – Our present encounters are shallow, yet IoT gives progressing information provoking effective essential authority and the leading body of advantages.

3.5 Numerous things with internet connection

3.5.1 Gathering and Sending Information

This suggests sensors. Sensors can be categorized into temperature sensors, development sensors, moistness sensors, air quality sensors, light sensors, etc[24]. This equipment close by an affiliation, empower us to normally assemble information from the earth which, in this manner, empowers us to settle on logically clever decisions.

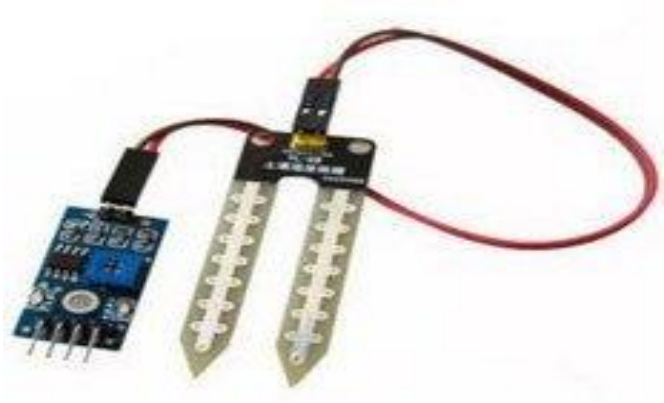

Figure 3.3 Soil moisture sensor[24]

3.5.2 Accepting and Acting on Information

The certifiable power of the Internet of Things develops when things can do both of the previously mentioned. Things that accumulate information and send it, yet furthermore get information and follow up on it.

3.5.3 Doing Both

We ought to quickly come back to the developing point of reference[28]. The sensors can assemble information about the earth soddenness to exhort the farmer the sum to water the harvests, yet you don't generally require the farmer[16]. Or maybe, the water framework structure can thusly turn on as required, in perspective on how much clamminess is in the soil.

Figure 3.4 Irrigation system[26]

CHAPTER 4
DESCRIPTION OF COMPONENTS

INTRODUCTION

The Smart Crops monitoring system being developed uses different electronic devices, sensors and other electric components. Different sensors are used in order to measure the soil parameters like moisture, humidity and temperature. A motor for operating the water pump and a motor driver is used. The microcontroller coordinates all the processes being carried out.

The specifications and working of various devices being used in this model are discussed below.

4.1 Ardunio UNO microcontroller

Figure 4.1 Arduino UNO[11]

The Arduino UNO is the most widely used hobby board or microcontroller used for various basic electronic projects and is developed by Arduino.cc. The arduino is equipped with simple, straightforward input/output pins11]. It consists of 14 digital and 6 analog input/output pins[15]. The microcontroller can be programmed with the help of Arduino IDE (Integrated Development Environment) by connecting it through a USB cable. Arduino can be given a powe supply from the USB port or a outside power supply of 5 to 20 Volts[18]. Some other variants of this microcontroller Arduino Nano and Leonardo. It is an open-sourced board.

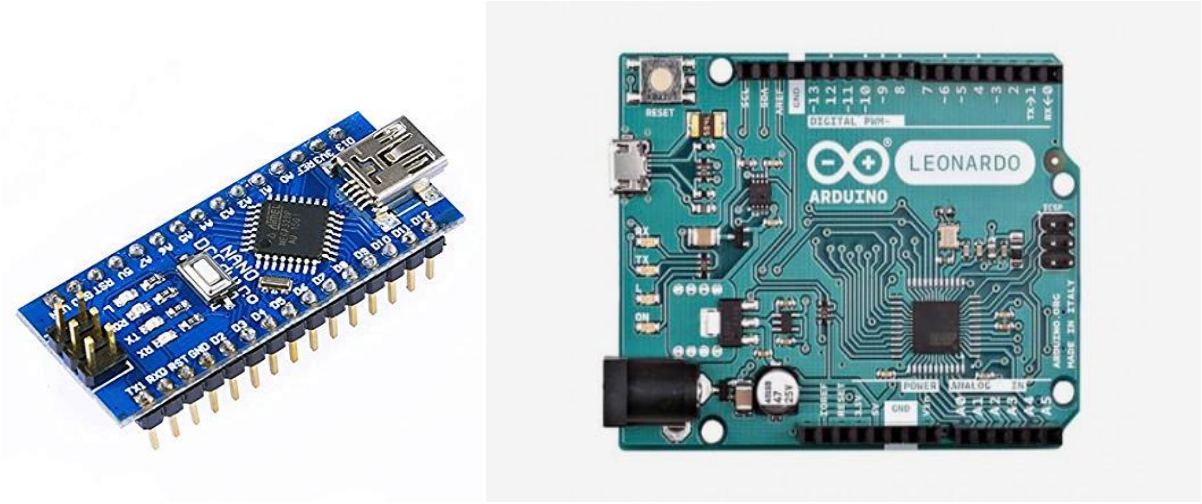

Figure 4.2 (a) Arduino Nano **(b)** Arduino Leonardo[12]

4.1.1 Pin

- **VIN :** This pin is used when arduino is powered with the help of an external power supply rather than a USB cable. The power supply is given on this pin. Generally 5 Volts is the preferred supply for arduino.

- **LED :** There is a LED which is controlled by the digital pin numbered 13. When the pin is HIGH the LED is turned on, and when pin is LOW, the LED is turned off.

- **5V**: The 5 Volts pin gives an output voltage supply of 5 volts from the on-board controller. It is generally used to power electronic devices such as sensors which work on low voltage.

- **3V3 :** The 3V3 pin gives an output voltage supply of 3.3 volts from the controller on-board. It can draw a maximum current of 50 miliamperes.

- **IOREF :** This stick on the board gives the voltage reference on which the microcontroller operates.

- **Reset** : The Reset button on the microcontroller resets the board and the microcontroller starts over and execute the commands again.

Figure 4.3 Arduino UNO[16]

4.1.2 Special Pin Functions

All of the 14 modernized pins and 6 Analog Pins can be used as input or output pins using functions like pin Mode(),digital Write(), and digital Read() limits. They operate on 5 volts. Each pin can give or get 20 mA as endorsed working condition and has an inside resistor (separated as per usual) of 20-50k ohm[17]. A cutoff of 40 miliamperes is the regard that must not be outperformed on any I/O stick to dodge unending mischief to the microcontroller.[19] Usually most of the electronic devices like sensors, LEDs use digital input or give output in digital format hence there are more digital pins on the board than analog pins.

Some of the pins are used to carry out very specialized operations. They are discussed in brief:

- **UART**: The pin 0 is used to receive TTL data and pin 1 is used to transmit TTL data. They are denoted by RX and TX respectively.

- **External Interrupts** : Pins 2 and 3 are used to handle external interrupt. They can trigger or stop a process to deal with the interrupt.

- **PWM** : Pins 3, 5, 6, 9, 10 and 11 are used for PWM.

- **SPI** : These are pins 10, 11, 12, 13. The pins help SPI correspondence utilizing the SPIlibrary.k

- **TWI** : The analog pins numbered 4 and 5 are used for supporting the TWI communication.

4.1.3 Communication Process

The Arduino/Genuino Uno has various working environments for chatting with a PC, another Arduino/Genuino board, or particular microcontrollers. The ATmega328 gives UART TTL (5V) progressive correspondence, which is accessible on edge pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this progressive correspondence over USB and shows up as a virtual com port to programming on the PC. The 16U2 firmware utilizes the standard USB COM drivers, and no other driver is needed[29]. Regardless, Windows need .inf record. The Arduino Software (IDE) uses a progressive screen which engages basic printed information to be sent to and from the board. The reciever and transmitter LEDs on the board will turn on when information is being transmitted by techniques for the USB-to-back to back chip and USB association with the PC[13]. A Software Serial library allows continuous correspondence on any of the board's automated pins.

4.2 DHT11 Humidity Sensor

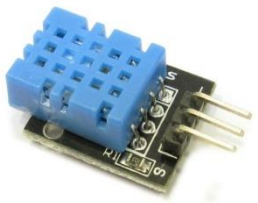

Figure 4.4 DHT11 Sensor[22]

The DHT11 sogginess and temperature sensor makes it really easy to add dampness and temperature data to your DIY equipment adventures. It's optimal for remote atmosphere stations, home environmental control systems, and residence or greenery walled in area watching structures[22].

This sensor gauges relative clamminess. Relative sogginess is the proportion of moisture in air versus the submersion reason for moisture in air[20]. At the submersion point, moisture starts to combine and gather on surfaces.

The soaking point changes with air temperature. Cold air can hold less moisture before it ends up immersed, and vacationer can hold more moisture before it winds up sprinkled

Formula

Relative Humidity = (Partial Preassure of water vapour/ Saturation vapour preassure)*100

4.2.1 Working of DHT11 Sensor

The DHT11 recognizes water vapors by surveying the electrical limitation between two cathodes. The stickiness perceiving part is a clamminess holding substrate with anodes related with the surface[17]. Precisely when water vapors is eaten up by the substrate, particles are discharged by the substrate which broadens the conductivity between the cathodes. The alteration in obstruction between the two cathodes is contrasting with the

relative dampness[13]. Higher relative wetness diminishes the hindrance between the anodes, while lower relative stickiness broadens the opposition between the cathodes.

The DHT11 measures temperature with a surface mounted NTC temperature sensor (thermistor) united with the unit. An IC mounted on the back of the unit changes over the impediment estimation to relative soddenness. It comparably stores the game plan coefficients, and controls the information signal transmission between the DHT11 and the Arduino .

4.3 Soil Moisture sensor

Soil moisture sensors measure the volumetric water content in soil. Since the estimation of soil wetness requires evacuating, drying, and weighting of a model, soil dampness sensors measure the volumetric water content by proposition by other properties such as, electrical resistance, dielectric steady, or participation with neutrons, as an operator for the doused quality substance[24].

The connection between the purposeful property and soil doused state must be balanced and may move subordinate upon natural components, for instance, soil type, temperature, or electric conductivity[26]. Reflected microwave radiation is affected by the earth soddenness and is used for remote seeing in hydrology and creating. Steady test instruments can be used by farmers or plant stars[11].

Soil wetness sensors generally induce sensors that check volumetric water content. Another class of sensors measure another property of dampness in soils called water potential; these sensor are for the most part implied as soil water potential sensors and circuit tensiometers.

Figure 4.5 Soil moisture sensor [24]

4.3.1 Technology

Following is the most generally used technologies in a soil moisture sensor for obtaining the presence of volumetric content of the water in the soil.

- **Frequency domain Reflectometry :** In this technology, the working repeat of the flattering circuit is evaluated.

- **Time Domain Transmission and Time domain Reflectometry** : In this technology, the speed of the spread is assessed to obtain the volume of water.

- **Neutron Moisture Gauges :** The go between properties of water for nuetrons are utilized to measure the soil moiture.

- **Galvanic cell** : This technology used the voltage the earth produces to measure soil moisture, beacuse water goes about as an electrolyt. Galvanic cell is the concept from which this idea comes.

4.4 ESP8266 Wifi module

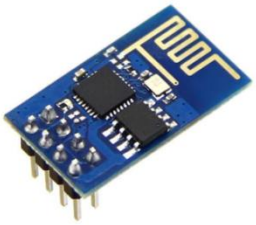

Figure 4.6 ESP8266[26]

It is a Wifi module which connects the arduino to a network or to internet.

The Arduino UNO board does not come with a built-in Wifi module unlike various other hobby boards[26]. Hence an external Wifi module is required to overcome this limitation. The ESP2866 is the most widely used Wifi module for providing Wifi capabilities to the microcontrollers due to its easy design and less complexity to program it.

The other Wifi modules of the ESP family are ESP8285 and ESP32.ESP825 comes with 1 MiB of natural gleam, mulling over single-chip contraptions fit for partner with Wi-Fi. The ESP32 is the new version of the two modules mentioned above[22].

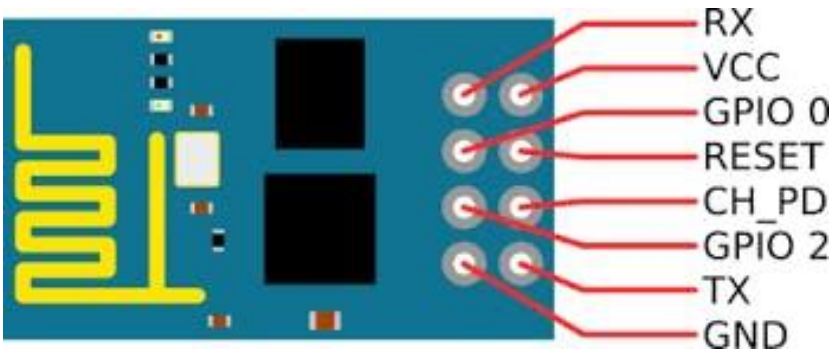

Figure4.7: Pin diagram of the ESP8266 Wi-Fi Module[26]

4.4.1 SDK's

The Software Development Kit (SDK) was launched in 2014, and removes the need of an alternate microcontroller[27]. There were many other versions of SDK.

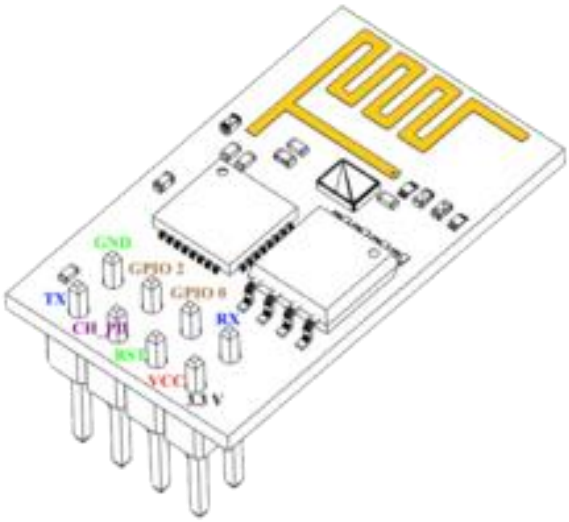

Figure 4.8 ESP-01 module pinout[27]

4.4.2 Air thinker modules

This module is made by Ai-Thinker. They are overall implied as "ESP-xx modules". These modules require some external parts, such as connectors and a 3.3V voltage supply. The NodeMCU with inbuilt USB-to-UART interface and a Micro-USB connector joined with a 3.3 volt control controller formally fused with the board is generally preferred during the testing period. After that, these fragments are not required and more affordable modules which are easier to control and more efficient are preferred.

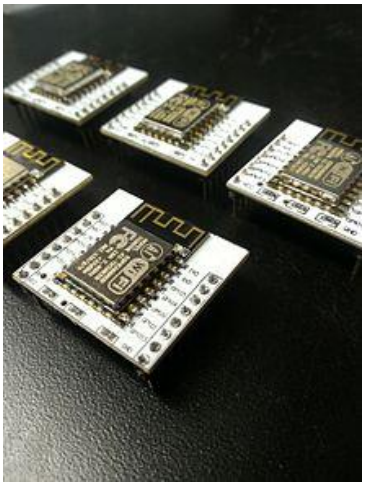

Figure 4.9 Ai-Thinker ESP8266 modules (ESP-12F, black color)[20]

4.5 Motor driver l298n

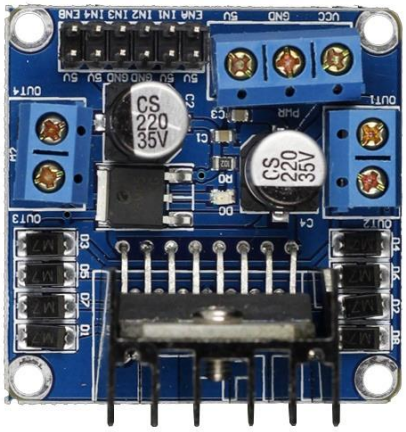

Figure 4.10 Motor driver l298n[18]

The L298N is a consolidated strong circuit in a 15-lead Multiwatt and PowerSO20 groups. The 5V DC motor cannot be directly connected to the arduino board. The motor requires high power to operate and the back current from the arduino can damage the board[18]. The

maximum current an arduino pin can sustain is 40mA. Moreover, the back emf from the motor may result in overheating of the board. The l298n has two terminals and can operate two motors at the same time. The direction of the rotation can also be easily varied.

4.5.1 Principle

The IN1 and IN2 are used to change the speed of motor, insist the rotational heading of the motor, and a short time later yield PWM beats for engaged terminals[17]. When IN1 and IN2 are 00 or 11, the motor is switched off. If IN1 is 0 and IN2 is 1, the motor A turns clockwise; if IN1 is 1 and IN2 is 0, the motor A turns counterclockwise. This is the control system for motor A. The control procedure for motor B is comparable to that for motor A.

ENA	IN1	IN2	The State of DC Motor A
0	X	X	Stop
1	0	0	Brake
1	0	1	Rotate Clockwise
1	1	0	Rotate Counterclockwise
1	1	1	Brake

Figure 4.11 Control mode and state of motor A[17]

4.5.2 Block diagram

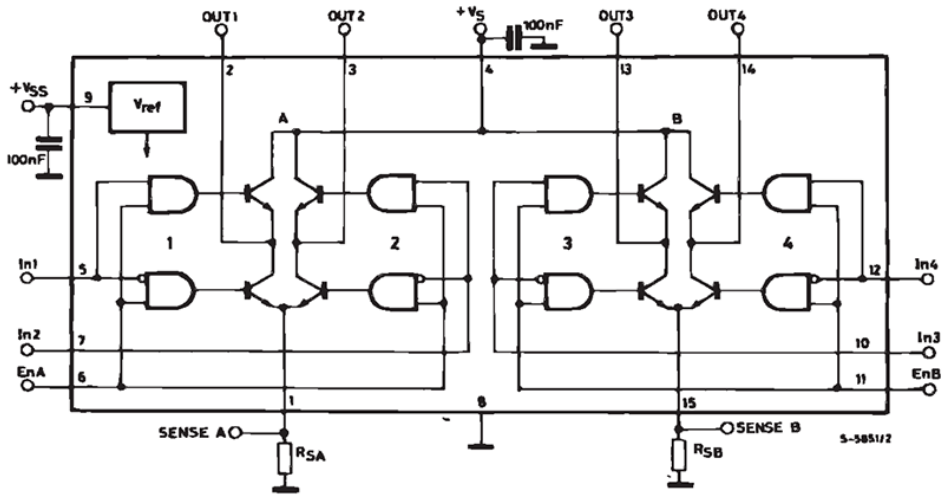

Figure 4.12 Block diagram representation[17]

4.6 Bread Board

A breadboard consists of interconnection of wires for basic circuits. It is commonly used for implementing simple circuits and small projects. It has different types of connections and the wires and other electronic devices can be inserted in the holes on it.

The one advantage of breadboard is that it can be used again and again as there is no soldering required. This makes it easy to use for making passing models and attempting various things with circuit structure. Thus, solderless breadboards are moreover outstanding with understudies and in imaginative guidance. The older breadboard types did not possess this property. A stripboard (Veroboard) and similar other such devices which can be used to produce semi-unchanging models, can just with noteworthy exertion can be used again.

Figure 4.13 Bread Board[7]

4.6.1 Specifications of bread board

A progressed solderless breadboard connection contains a punctured square of plastic with different tin plated phosphor bronze or nickel silver composite spring cuts under the gaps. The catches are much of the time called tie or contact centres.

CHAPTER 5
SMART CROPS MONITORING SYSTEM

INTRODUCTION

The proposed system is discussed in brief in the following chapter. The objective of the system is to manage the crops through internet with the help of a remote mobile application and initiate some commands through it. The working of the system is discussed in detail in the following sections with the help of flow charts and block diagrams.

5.1 PROPOSED MODEL

The model will monitor parameters like soil moisture, air humidity, temperature and precipitation levels. It consists of different sensors which will monitor these parameters. A microcontroller will be responsible for all these actions. The observations will be sent to a device through a Wi-Fi network on an android application or through SMS or E-mail. A command will be given through the device and action will be taken according to the command given.

In this case, we are giving a command to turn the motor pump on, when the moisture content in the soil is less than a certain desired value.The different readings will be read through the sensors and will be sent to the mobile where it can be monitored through an application. If the moisture content in soil is less than a desired value, a notification will be sent through the mobile to switch on the pump. The pump will work and water will be sprayed until the work is moisture content reaches the desired value.

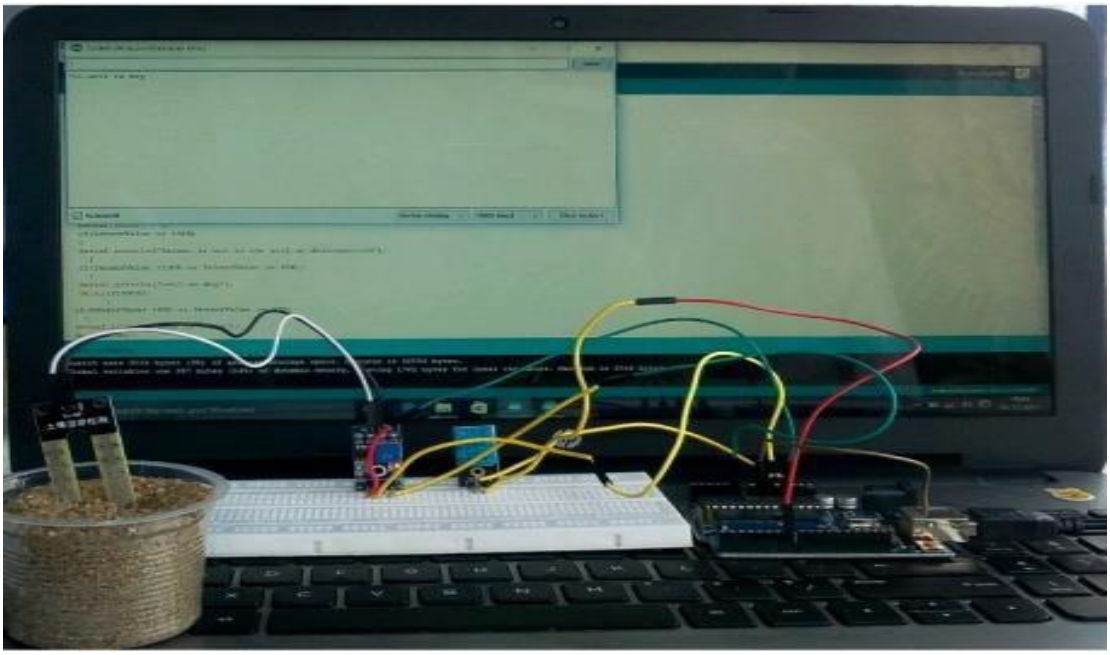

Figure 5.1 Proposed Model

5.2 WORKING

The soil moisture sensor is connected to an analog pin of the microcontroller arduino A0. The sensor will be sending the moisture content in the form of analog data to the microcontroller. DHT11 Humidity and temperature sensor is connected to the digital pin of the microcontroller, as the data sent by the DHT11 sensor is in digital format. The motor pump is connected to the arduino through the l298n motor driver. The l298n motor driver is used so that the arduino board does not get damaged due to the back current of the motor.

The sensors continuously monitor the data parameters and the microcontroller displays them after regular intervals. If the soil moisture is below a certain level which can affect the crops under consideration, the arduino will execute the condition mentioned in the if block of the code. As soon as the moisture level goes down, the motor pump will start and water will start flowing into the fields.

The moisture content of the soil will start increasing. The new moisture content will be regularly monitored and will be displayed along with other parameters. As soon as the moisture content reaches the desired value, the if condition which was being executed will

become false, and the motor pump will stop getting power and as result will be switched off, hence conserving the water and reducing the complexity of the watering system.

5.2.1 FLOW CHART

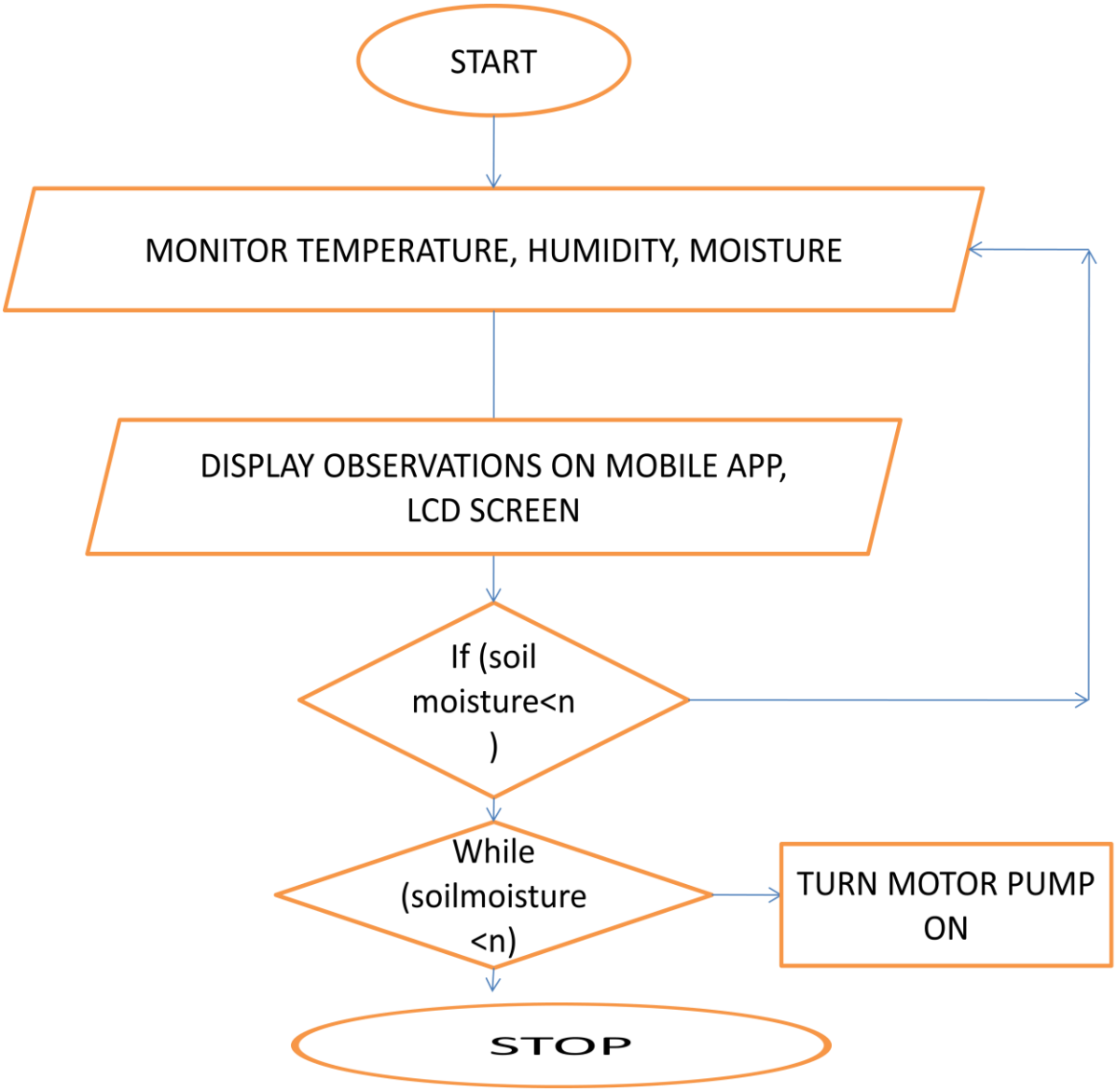

Figure5.2 Flow chart

5.2.2 BLOCK DIAGRAM

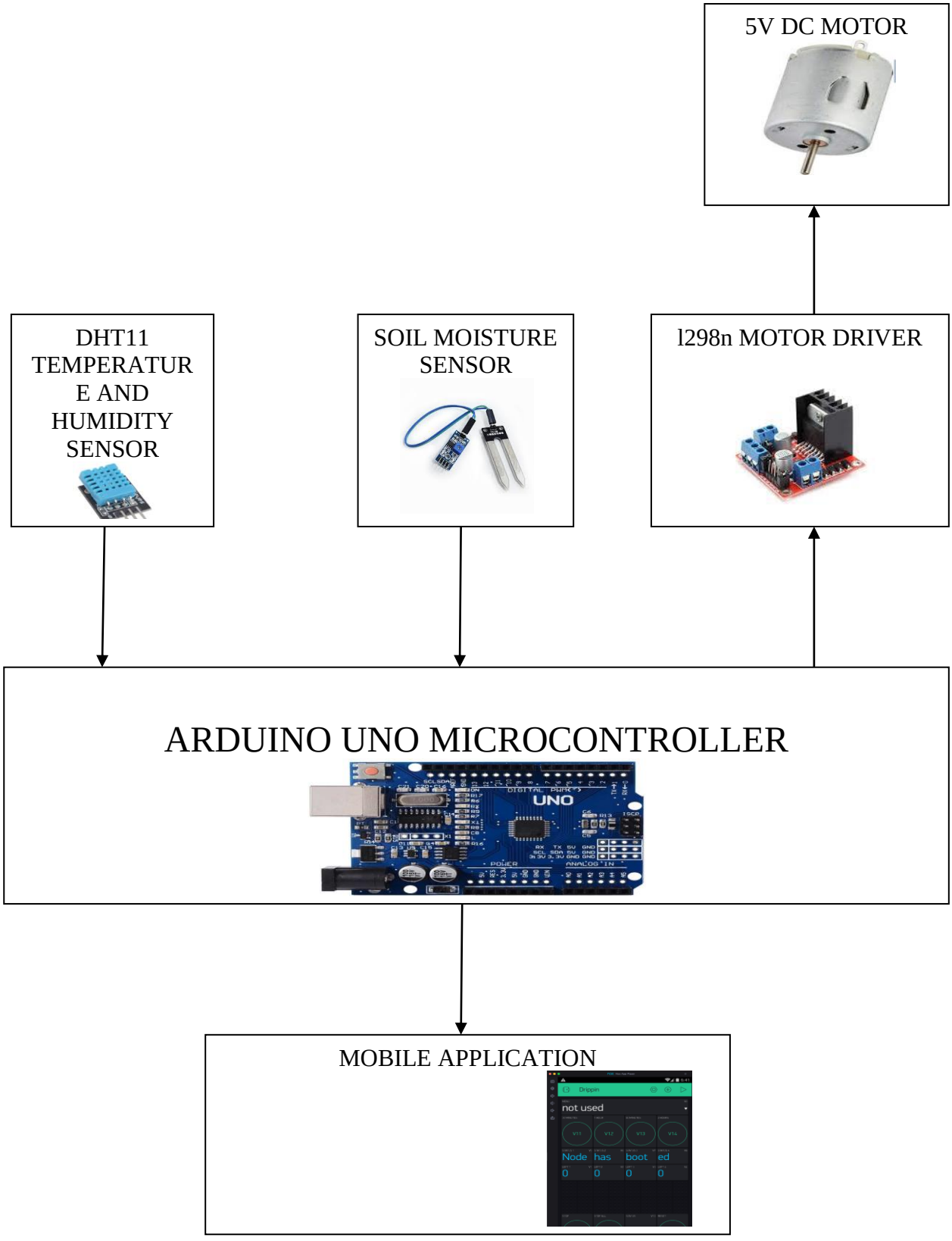

Figure 5.3 Block Diagram

CHAPTER 6
RESULTS AND CONCLUSION

INTRODUCTION

In this unit the observations of the system as appeared on the output screen is displayed below, the work done and the analysis of the observations is also discussed.

6.1 WORK DONE

The two sensors (DHT11 humidity and temperature sensor and soil moisture sensor) were checked and tested. The microcontroller Arduino Uno was also tested by connecting it to the PC. The other components like DC motor, motor driver, and the bread board were joined together with connecting wires and the circuit was made. The arduino IDE program was developed and was compiled and debugged.

After the initial testing and code development, the program was uploaded to the board. The sensor readings were observed and verified. The motor was made to run when the soil moisture was below the desired value.

6.2 OBSERVATIONS

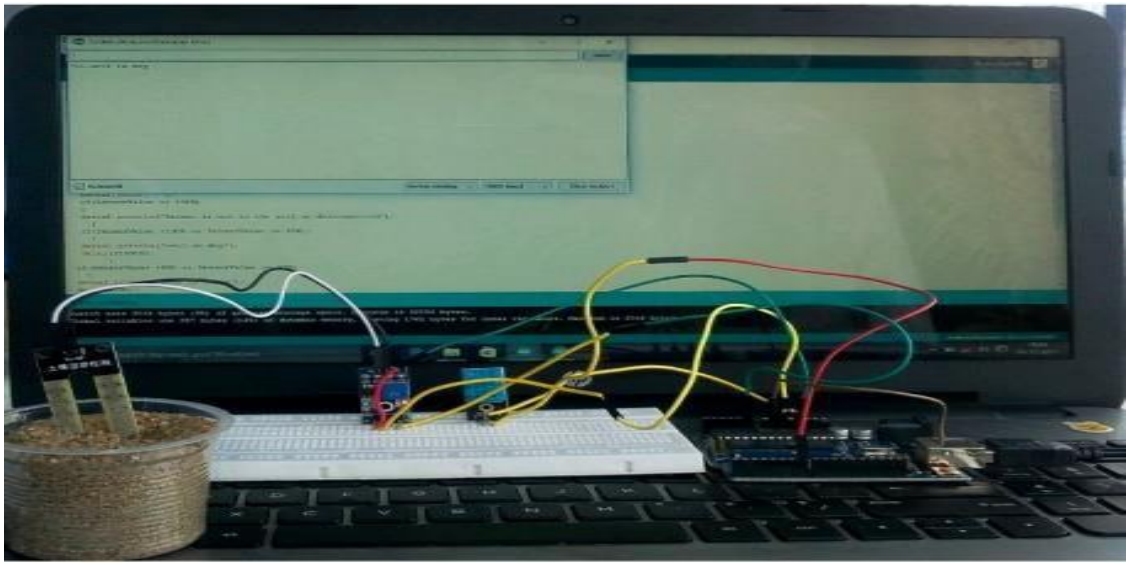

Figure 6.1 Output for dry soil

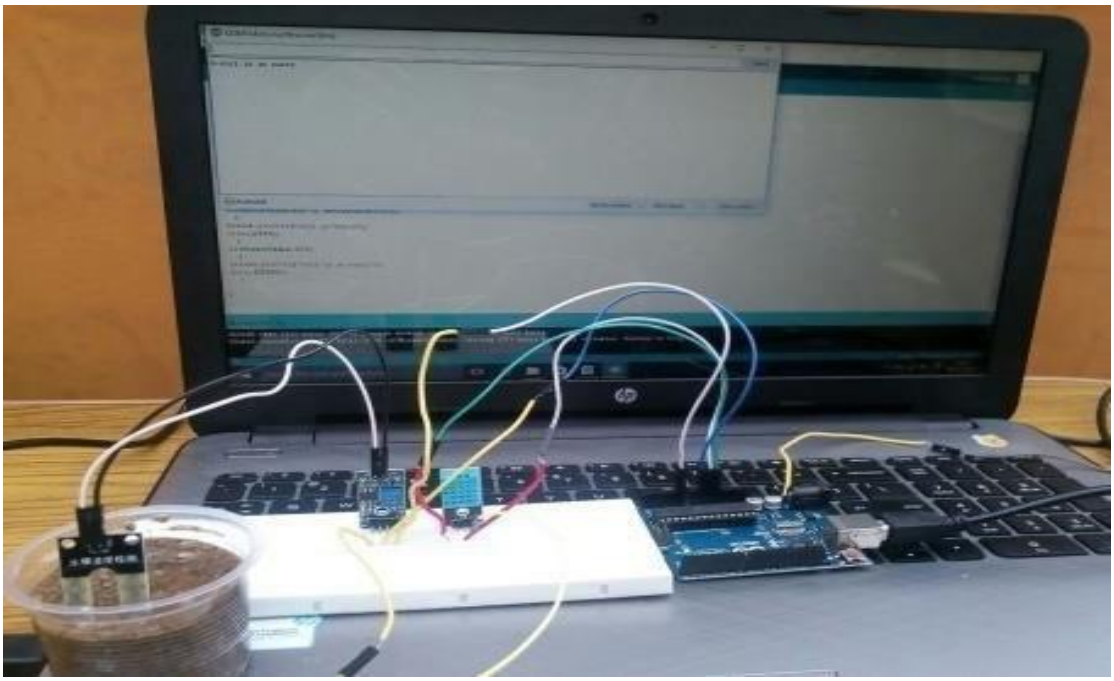

Figure 6.2 Output for wet soil

After the implementation of circuit the experiment was carried out in soil. Three values of the temperature, humidity, and moisture are shown on the serial monitor screen as test case 1 and test case 2 respectively. The observations are shown below.

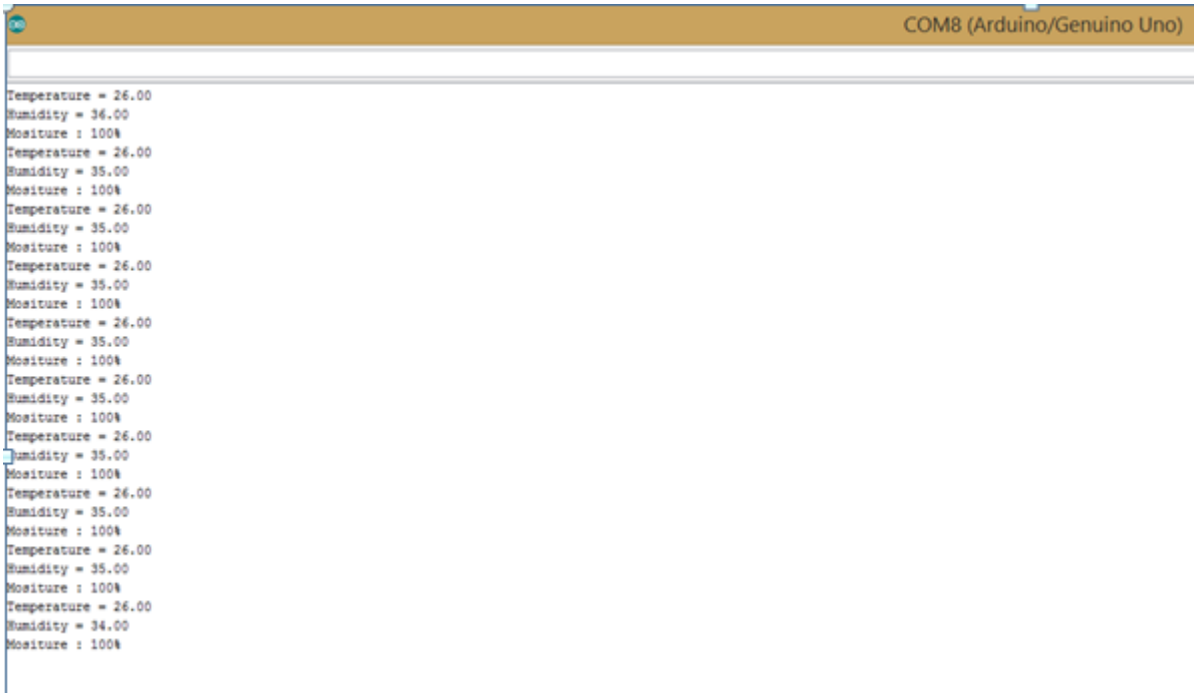

Figure 6.3 Test case-1

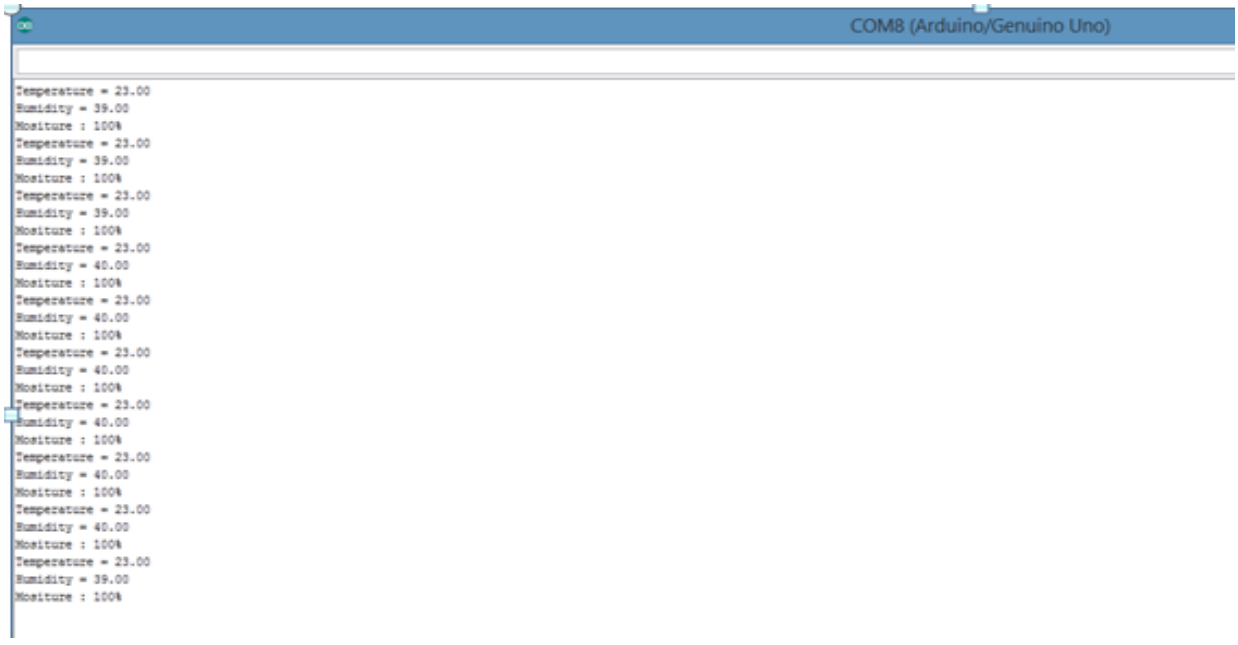

Figure 6.4 Test case-2

6.3 ANALYSIS AND DISCUSSION

The values of temperature, humidity and soil moisture are displayed in figure 6.3 and figure 6.4. The model was tested in different weather conditions and the observations were verified by the room temperature and humidity values during the time of testing. The model was found to be accurate and in a good working condition.

6.4 CONCLUSION

The above model gives a prototype of a smart crop monitoring system which can be used for small sized fields and polyhouses. The field can be divided into different sections which will have one such model each. The sensors can be varied depending on the size of the field or the requirements.

There are many challenges in the use of IoT for such purposes. More exploration, research and interest in this field, can slowly help in tackling these challenges and can improve the performance and working of these models.

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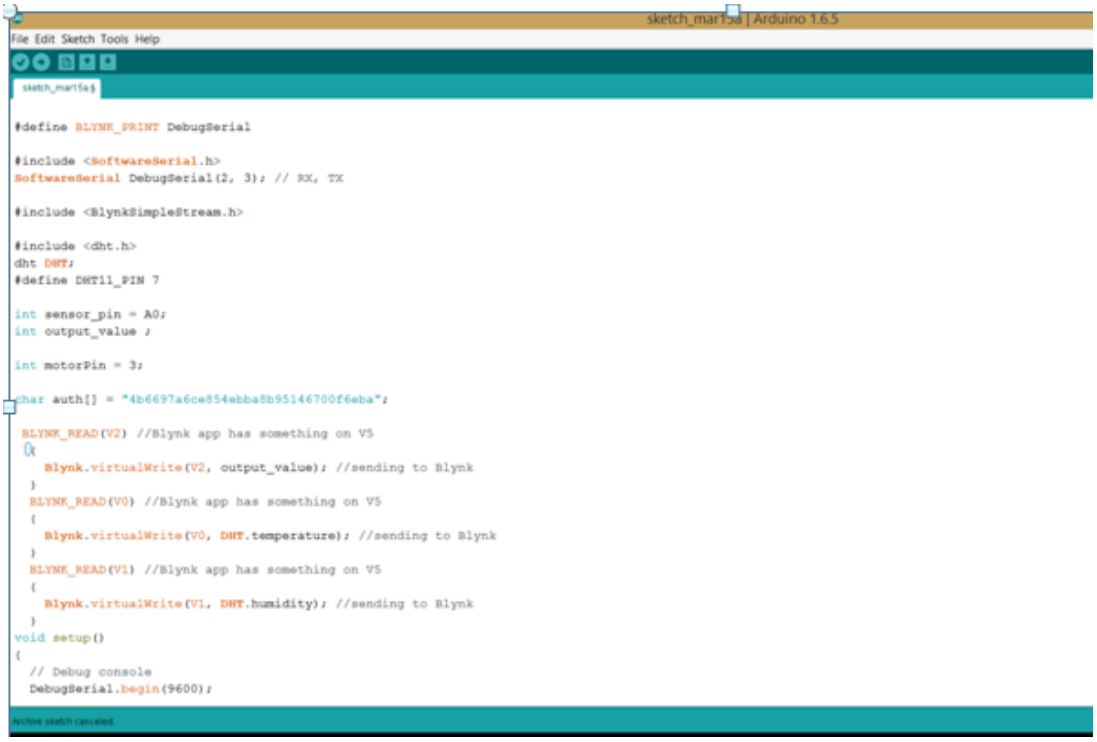
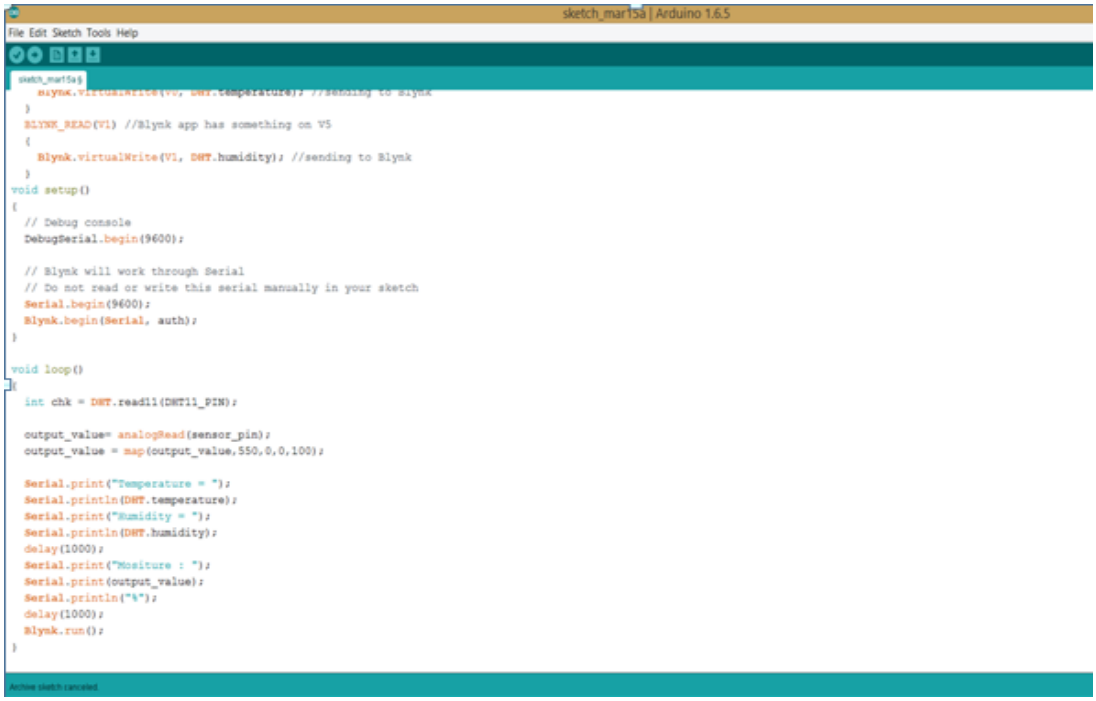
APPENDIX

PROGRAM



```
#define BLYNK_PRINT DebugSerial

#include <SoftwareSerial.h>
SoftwareSerial DebugSerial(2, 3); // RX, TX

#include <BlynkSimpleStream.h>

#include <dht.h>
dht DHT;
#define DHT11_PIN 7

int sensor_pin = A0;
int output_value ;

int motorPin = 3;

char auth[] = "4b6697a6ce854ebba8b95146700f6eba";

 BLYNK_READ(V2) //Blynk app has something on V5
 {
   Blynk.virtualWrite(V2, output_value); //sending to Blynk
 }
 BLYNK_READ(V0) //Blynk app has something on V5
 {
   Blynk.virtualWrite(V0, DHT.temperature); //sending to Blynk
 }
 BLYNK_READ(V1) //Blynk app has something on V5
 {
   Blynk.virtualWrite(V1, DHT.humidity); //sending to Blynk
 }
void setup()
{
  // Debug console
  DebugSerial.begin(9600);
```



```
  BLYNK_READ(V1) //Blynk app has something on V5
  {
    Blynk.virtualWrite(V1, DHT.humidity); //sending to Blynk
  }
void setup()
{
  // Debug console
  DebugSerial.begin(9600);

  // Blynk will work through Serial
  // Do not read or write this serial manually in your sketch
  Serial.begin(9600);
  Blynk.begin(Serial, auth);
}

void loop()
{
  int chk = DHT.read11(DHT11_PIN);

  output_value= analogRead(sensor_pin);
  output_value = map(output_value,550,0,0,100);

  Serial.print("Temperature = ");
  Serial.println(DHT.temperature);
  Serial.print("Humidity = ");
  Serial.println(DHT.humidity);
  delay(1000);
  Serial.print("Mositure : ");
  Serial.print(output_value);
  Serial.println("%");
  delay(1000);
  Blynk.run();
}
```