Analysis of smart agriculture based on IOT

A Thesis Report Submitted By

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In Partial Fulfillment of the Requirements for the Award of
Bachelor of Computer Science and Engineering

Department of Computer Science and Engineering

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IUBAT– International University of Business Agriculture and Technology

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Letter of Submission

March 15, 2021

Chairman

Practicum and Placement Committee College of Engineering and Technology (CEAT)

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Subject: Letter of Transmittal

Dear Sir,

With due respect, this is our pleasure to present our thesis report entitled― "Analysis of smart agriculture based on IoT", we have prepared this report as partial fulfillment of the thesis I have tried my level best to prepare this project to the required standard.

It was certainly a great opportunity to work on this paper to actualize our theoretical knowledge in the practical arena. Now, we are looking forward or your kind appraisal regarding this thesis report. We will remain deeply grateful to you if you kindly go through this report and evaluate my performance. I hope that you would find the report comprehensive and competent augmented.

Sincerely yours,

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Most. Nusrat Jahan
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Sincerely yours,

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Supervisor's Declaration

This is to certify that Thesis report on "Analysis of smart agriculture based on IoT" has been carried out by Most. Nusrat Jahan, ID: 17203084 and Rezvi Ahmed Tanim, ID: 17203099 of IUBAT-International University of Business Agriculture and Technology as a partial fulfillment of the requirement of Thesis course. The report has been prepared under my guidance and is a record of the bona fide work carried out successfully. To the best of my knowledge and as per his declaration, no part soft his report has been submitted anywhere for any degree, diploma or certificate.

Now they are permitted to submit the report. I wish they are all success in his future endeavors.

Thesis Supervisor

____

M.M.Rakibul Hasan
Senior Lecturer, Department of Computer Science and Engineering
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Student's Declaration

I am Rezvi Ahmed Tanim and my partner, M.M.Rakibul Hasan , Senior Lecturer, we are student of IUBAT– International University of Business Agriculture and Technology, declaring that this project paper on the stated topic has only been prepared for the fulfillment of "Course Name" as the partial fulfillment of―Bachelor of Computer Science and Engineering degree.

It has not been prepared for any other purposes, rewards, or presentation.

Sincerely yours,

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Sincerely yours,

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Program: BCSE

Author's Declaration

On behalf of the Department of Computer Science and Engineering of International University of Business Agriculture and Technology, we the undersigned certify that this Thesis Report **"**Analysis of smart agriculture based on IoT**"** for the award for the bachelor of Computer Science and Engineering (BCSE) degree was duly presented by Most. Nusrat Jahan ID: 17203084 and Rezvi Ahmed Tanim ID: 17203099 and accepted by the department.

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Acknowledgement

In the name of Allah who is the most merciful and the most graceful, it's our pleasure to take this occasion to thank a few people, who have, assisted, encouraged, directed and supported us throughout our Thesis program.

Firstly, we want to thank our family, who has endowed their immeasurable-innumerable support and encouragement to attain this exquisite event of my life.

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Sincerely,

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Abstract

The Internet of Things (IoT) is a new technology that will continue to grow in importance in the near future. It functions as a shared network with an internet connection between items and things. IoT aids farmers in resolving the most pressing issues they confront. Due to a large population and a lack of rain, farmers in Bangladesh rely on agriculture as their primary source of income. Water, food, crops, and other necessities of life are in short supply, and we're having trouble keeping them that way. We have an idea for a project that uses IoT and a low-cost system to analyze soil factors in agriculture, such as soil condition, temperature, and humidity, in order to address these issues. We do a project we called it analysis of smart agriculture based on IoT. Now a day's Dhaka city get warmer day by day and the reason is less tree and we face some problem of fresh food. we need daily ate some vegetable and if we get refresh vegetable in our rooftop that time our health will be good and we get some refresh environment. Many of us we don't know what the procedure of proper agriculture. So, in this project every one can do its easy and what time it's needed of drink temperature its tell us our project by message. And we are going to implement this Dhaka cities roof top building. This ESP8266 Wi-Fi module, Arduino MCU microcontroller, GSM, and sensors are all used in this system on the Arduino platform. The system uses GSM to send data to a user's mobile phone through SMS.

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Chapter 1

Introduction

1.1 Introduction

Bangladesh is an agricultural country blessed with a lot of fertile land having three cropping seasons. It means we can use our land throughout the year for the purpose of cultivation which covers a major part of our GDP as well as one of our basic needs, food which is one of the most primary concerns for the people worldwide. Food cannot be substituted, and the only way to improve food supply is through better farming practices. We need to find ways to make agriculture easier, faster, and more digital in order to meet our food production needs. In the past, farming employed more than 60% of the total number of people employed in the United States. With the passage of time, we now have a clearer picture of the current situation. In our country, farming is not an easy task, and farmers don't make enough money from it, thus people are more concentrated in cities. Statistics from the recent decade reveal that the growth rate of Bangladeshi farmers has decreased, which has contributed to a decline in the country's rice production. In this case, we've come up with a way to make farming a more manageable endeavour. Even if they are not there in the field, people may easily keep tabs on the progress of the growing process. We are living in the modern era where everything is getting digitized and farming is not exceptional among them but here, we are proposing something very exceptional which can farm itself and can give all kinds of information which is very essential for a farmer. It is not just a machine or robot, it itself is a farmer. First of all, we must mention that countries like U.S., China, and Japan are already spending a lot of money and time to make farming a lot easier though they don't have the fertile land like Bangladesh. Libin, Zhang, et al. [1] have mentioned in their article about the various kinds of robots like grafting robot, transplanting robot, spraying robot, mowing robot and various harvesting robots which are being used in China for the purpose of agriculture. Moreover, Yaghoubi, Sajjad, et al. [2] also showed in their research how fast the use of agricultural robot is growing every year and around 13% of the total industrial robot is belonged to the agricultural sector. As we can see, developed countries are using automation system for the increased efficiency of their crops whereas developing country like ours are way behind these automated systems. Therefore, we have become inspired to do such project.

40% of the planet's land is used to grow crops and 85% of its freshwater is drained away in the process. It is vital to regulate this chosen watering system. Soil health can be taken into account, allowing farmers to exert greater command and management over their land. With the Internet of Things (IoT), farmers are able to devote more time and attention to farms that are further distant from where they live. The development of the Internet of Things (IoT) would pave the way for innovative approaches to agricultural production that would maximize yields while minimizing costs. Sensors utilized in this project include LM35 temperature sensors, DHT11 humidity sensors, and soil sensors for determining whether or not the soil is dry or wet, and supplying water if necessary. The cloud database manages and stores the data collected by the different sensors. SMS transports the collected data to the user's mobile phone using GSM. The GPRS feature of a GSM module gives long-distance advice. LED display for soil status, temperature, and humidity values. Any microcontroller can benefit from the improved network approach provided by the Wi-Fi module's unified TCP/IP protocol and self-contained socket. It's easy to get started using Arduino UNO, an open-source microcontroller. Internet of Things (IoT) plays a significant role in agricultural technology development to fulfil farmers' rights. This data may be accessed at any time and from any location thanks to the Internet of Things (IoT).

1.2 Related Work

IoT-enabled monitoring of soil characteristics with the use of an IoT-enabled motor. It's been utilized for Monitoring and adjusting environmental conditions on crops in real-time, from planting through harvest [1]. Soil moisture level, soil temperature, and soil humidity can be monitored using the internet of things and sensors [2]. Pest management can also be monitored using the internet of things and sensors. Used semi-automated and automated irrigation concepts to maintain water levels in agriculture fields and replace traditional methods. Predicting future agricultural harvests by using neural networks for soil improvement and management [4]. It was used for crop field monitoring and irrigation automation, as well as sending data to a mobile application through GSM via the Internet of Things (IoT). The Internet of Things (IoT) was used in agriculture to improve resource use and eliminate the need for human labour. Automated agricultural procedures were made possible by smart gadgets and a wireless sensor network (WSN). Regulating the agricultural field using IoT, and transferring collected data over GSM to a user's mobile phone without any contact between humans or computers.

1.3 Major crops of Bangladesh:

More than 80 different kinds of crops are currently grown in Bangladesh. The main crop of our country is rice which has over 25 verities and is grown all year round. Around 76 percents of total crop production is covered by rice. Other types of crops are mainly potato, jute, wheat, maze etc. The table below shows the crop production from the year of 2014 to 2017.

Major crops	Area (Million ha)	% of cropped area	Production(Million tons)
Rice	11.42	70.62	33.83
Wheat	0.42	2.60	1.25
Maize	0.31	1.92	2.17
Pulses	0.71	4.39	0.77
Oilseeds	0.76	4.70	0.89
Spices	0.51	3.15	2.98
Potato	0.44	2.72	8.60
Vegetables	0.77	4.76	13.22
Other crops	0.83	5.15	13.20
Total	**16.17**	**100**	**76.91**

Figure 1.1: Major crops of Bangladesh

Crops are grown in three cropping seasons during a year which are known as Rabi (Dry season), Kharif-I and Kharif-II. Production of rice dominates the cropping pattern. Wheat, potato, sugarcane, pulses are the crops of Rabi season. In Kharif-I, jute and Boro rice is cultivated whereas Aman rice is cultivated in Khalif-II. Different crops are grown in different places of the country according to the types of soil, flooding condition and rainfall.

1:4 Employments in Agriculture

With the improvement of socio-economic condition, the people of our country have shifted their job to the town especially to the capital. Therefore, the employment rate in agricultural sector has decreased a lot. 47.48% of the total workable population was involved in agriculture as the record shows in the year of 2010 whereas; it was more than 65% in the year of 1991.

Bangladesh’s BD: Percentage of Male Employment in Agriculture was 31.941 percent in December 2018, according to the ILO's Modeled ILO Estimate. This represents a reduction of

32.472 percent from the previous month's figure. It is estimated that between December 1991 and December 2018, the percentage of men employed in agriculture in Bangladesh was 47.122 percent on average, based on 28 observations. At 64.068 per cent in 1991 and 31.941 percent in 2018, the data set an all-time high and record low. Only a small percentage of Bangladesh's male population works in agriculture, according to a model of the International Labor Organization (ILO). Table BD of the World Bank Global Database is where the data can be found. WDI: Workplace Dynamics Index. People of working age who were engaged in any activity to create goods or provide services for pay or profit, whether they were at work during the reference period or not because of a brief absence from a job, or because of a working-time agreement, are considered to be in the workforce. Agricultural activities include farming, hunting, forestry, and fishing, for example. 1 (ISIC 2) or categories A-B (ISIC 3) or category A (ISIC 4).; International Labour Organization, ILOSTAT database. Data retrieved in April 2019. Weighted average;

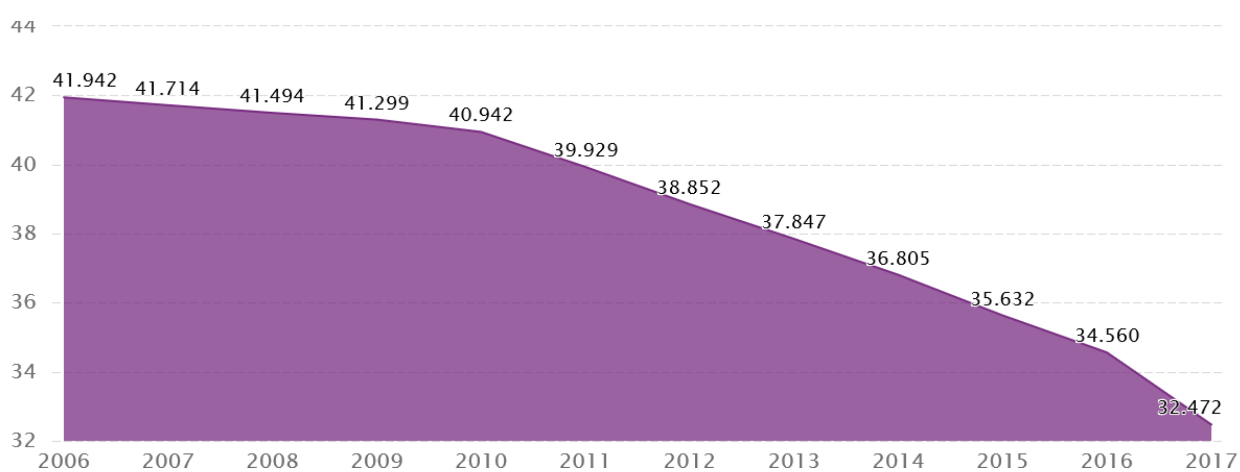


Figure 1.2: Employment in Agriculture

1.5 IOT

Internet is all around us every day. Internet is basically a network of devices, and they are all part of the same network. So, IoT or internet of things means a network of internet-connected objects able to collect and exchange data using embedded sensors and devices. It basically means that a device with an ip address anywhere in the world can be connected to any other device with an ip address, anywhere in the world using the interconnected network of networks also called the internet.

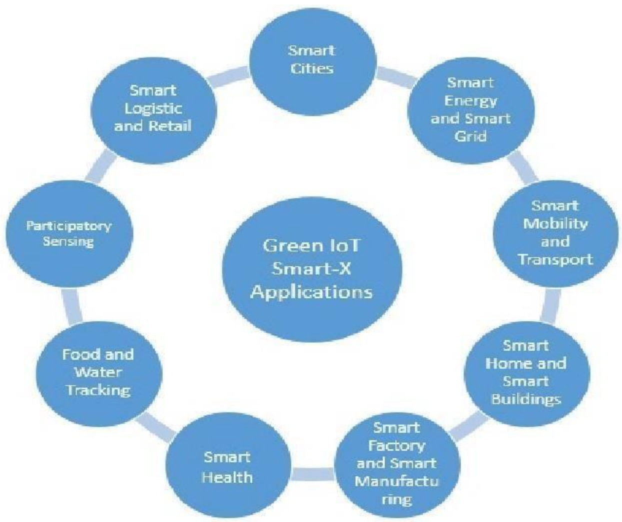


Figure 1.3: IOT Application

IoT devices are a part of the larger concept of home automation, also known as domestic. Large smart home systems utilize a main hub or controller to provide users with a central control for all of their devices. These devices can include lighting, heating and air conditioning, media and security systems. And, that is where our automated farming machine with IoT comes in. Anyone from anywhere with the ip address of the device in our case the raspberry can access the information in it. They can monitor the sensors, view live streaming through the camera connected to the device, give commands to the motors and change settings as they like.

1.6 Problem Statement

Manual irrigation system is simple and cheap but is more labor intensive and wastes water. As water is brought into the system manually, this requires high labor input, moreover it is important to check the systems regularly to improve the production and avoid water loss on the plantation. Due to water costs and increasing water demands, gardeners need to be concerned about conservation. So an automatic water irrigation system would be a great scope for solving this problem. An automatic water irrigation system can help the gardeners to water their plant automatically without any manual intervention. As a result, it saves the users time and labor.

1.7 Objective of the study

- Proper way to agriculture
- Uses of Sensor
- Save the environment
- Advertisement of this project
- Uses of this project
- To identify the crops/plants composition, input used, yield, income, fruit and vegetables consumption, occurrence of pests and diseases and use of bio -pesticides.

Chapter 2

Literature Review

Chapter 2 is an overview of Monitoring and uses of sensor using project smart agriculture. There is a pressing need for better management of water resources in light of the current situation, which includes declining groundwater levels, drying rivers and reservoirs, and an unpredictable environment. The use of temperature and moisture sensors for crop monitoring has been implemented in order to deal with this. A microcontroller-based gateway can be configured to control water quantity using an algorithm created using threshold values for temperature and soil moisture. Using photovoltaic panels and a cellular Internet interface, the system can be operated and monitored via a web page, and irrigation schedules may be set using a web page. Precision agriculture in greenhouses is now possible thanks to advancements in wireless sensor networks technology. Agriculture's productivity is dwindling, according to the results of recent studies. However, agricultural technology plays an essential role in increasing output while also lowering the need for additional manpower. Some of the research efforts are devoted to the benefit of farmers, who benefit from systems that use technology to increase agricultural productivity. Wireless sensor networks were used to develop an irrigation system that can be remotely monitored, controlled and monitored in the field, allowing for variable water rates, real-time monitoring and control of a precise linear move irrigation system, and maximizing productivity while minimizing water use. By employing the necessary software, the system described the design and instrumentation of variable rate irrigation, wireless sensor networks, and real-time in-field sensing and control. The entire system was built utilizing five in-field sensor stations that gather data and communicate it to the base station using GPS, where the necessary action was done for managing irrigation based on the information accessible in the system. Precision irrigation may be controlled remotely with this device, which offers a low-cost wireless alternative. Researchers used wireless sensor networks to gather data on soil-related characteristics like temperature and humidity. In order to extend the lifespan of the soil monitoring system, low-duty-cycle sensors were buried below the soil surface and connected to relay nodes using an effective communication protocol. The system was created with the use of a microcontroller, a UART interface, and sensors, and data was sent via hourly sampling and buffering, followed by transmission and verification of the received status messages. RF signals are attenuated when sensors are buried in the ground, therefore the system's cost was a major downside.

Chapter 3

Methodology

3.1 Strategy

- Our main goal is that help the farmer
- Another goal is that save the environment
- Advertisement of this project

3.2 Approach

We do a project we called it analysis of smart agriculture based on iot. Now a day's Dhaka city get warmer day by day and the reason is less tree and we face some problem of fresh food. we need daily ate some vegetable and if we get refresh vegetable in our rooftop that time our health will be good and we get some refresh environment. Many of us we don't know what the procedure of proper agriculture. So, in this project every one can do its easy and what time its needed of drink temperature its tell us our project by message.

3.3 System Hardware

Fig 4.shows the block diagram of System with Internet of Things. System Hardware mainly includes an Arduino Node MCU microcontroller chip, GSM module, sensors and Wi-Fi module.

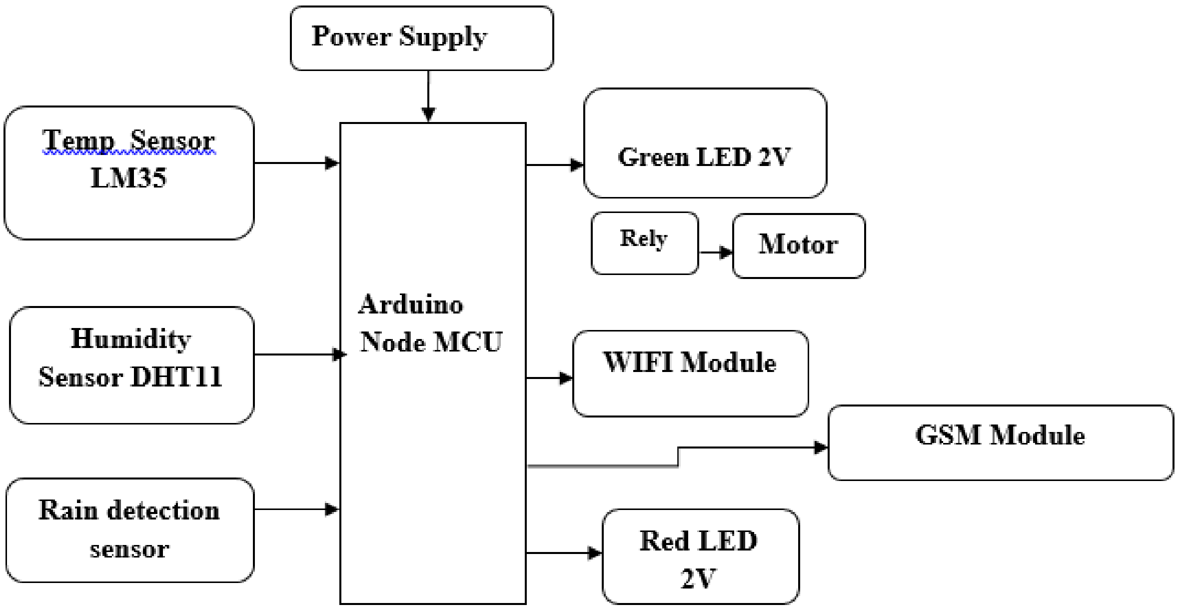


Figure 3.1: Block Diagram of the System

3.3.1 Arduino Node MCU, Microcontroller

- The ESP8266 Wi-Fi SoC is used in the well-known NodeMCU. Version 3 is based on the ESP-12E microcontroller (An ESP8266 based Wi-Fi module). With a few LUA script lines, you may prototype your Internet of Things (IoT) device with NodeMCU, an open-source firmware and development kit that can be programmed with the Arduino IDE.

Figure 3.2: Arduino Node MCU

- Note: In case you are looking for alternative NodeMCU compatible boards, here are some others:
- NodeMCU V2 Doit ESP12E (Narrow) - Narrow width, perfect for breadboard
- Wemos D1 Mini ESP8266 Dev Board - More compact
- As the width of this NodeMCU is 30mm, covering the entire holes on breadboard, so we do recommend getting the Base board for it to ease the protoyping. The base board comes with many extended header pins for the GPIO and also power line.
- Features:
- Open-source
- Interactive
- Programmable
- Low cost
- Simple
- Smart
- WiFi enabled
- Arduino-like hardware IO
- Advanced API for hardware IO, which can dramatically reduce the redundant work for configuring and manipulating hardware
- Code like Arduino, but interactively in Lua script
- Nodejs style network API
- Event-driven API for network applicaitons, which faciliates developers writing code running on a 5mm*5mm sized MCU in Nodejs style
- Greatly speed up your IoT application developing process

- Lowest cost WiFi
- Less than $2 WiFi MCU ESP8266 integrated and esay to prototyping development kit
- We provide the best platform for IoT application development at the lowest cost
- Input Voltage:
  - 3.3V via 3.3V pin
  - 5.0V via Vin or USB
- Specifications:
- The Development Kit based on ESP8266, integates GPIO, PWM, IIC, 1-Wire and ADC all in one board.
- Power your development in the fastest way combinating with NodeMCU Firmware!
- USB-TTL included, plug&play
- 10 GPIO, every GPIO can be PWM, I2C, 1-wire
- PCB antenna
- Documents:
- Schematic & PCB, Source Code, API Documents
- CH34X driver (Please ensure the board is plug in to computer USB port during driver installation)
  - Windows (V3.5 Mar2019)
  - Mac OS (V1.5 Mar2019)

The table below gives a description for each of the pins, along with their function.

Pin Number	**Description**	**Function**
1	PC6	Reset
2	PD0	Digital Pin (RX)
3	PD1	Digital Pin (TX)
4	PD2	Digital Pin
5	PD3	Digital Pin (PWM)
6	PD4	Digital Pin
7	Vcc	Positive Voltage (Power)
8	GND	Ground
9	XTAL 1	Crystal Oscillator
10	XTAL 2	Crystal Oscillator
11	PD5	Digital Pin (PWM)
12	PD6	Digital Pin (PWM)
13	PD7	Digital Pin
14	PB0	Digital Pin
15	PB1	Digital Pin (PWM)
16	PB2	Digital Pin (PWM)
17	PB3	Digital Pin (PWM)
18	PB4	Digital Pin
19	PB5	Digital Pin
20	AVCC	Positive voltage for ADC (power)
21	AREF	Reference Voltage
22	GND	Ground
23	PC0	Analog Input
24	PC1	Analog Input
25	PC2	Analog Input
26	PC3	Analog Input
27	PC4	Analog Input
28	PC5	Analog Input

Table 3.1: Pin description

As previously stated, 20 of the pins are used as I/O ports. This means that they can be used as either an input or an output in the circuit. The software determines whether or not they're input or output. Six of the 14 digital pins on the board can be used to output PWM. Analog input/output is provided by six of the pins. The crystal oscillator is connected to two of the pins. The Arduino Node MCU chip needs a clock pulse from this source. A clock pulse is required for synchronization between the Atmega chip and a device it is linked to in order for communication to take place in a timely manner. Two of the pins, Vcc and GND, supply power to the chip, allowing it to function. In order to run, the Arduino Node MCU simply requires power from 1.8-5.5 Volts. An ADC (analogue-to-digital converter) is built into the Arduino Node MCU. An Arduino node MCU can't process analogue signals without this setting is present, hence it must be. The chip contains six analogue input pins because it features an ADC, which can decode analogue input. GND, AVCC and AREF are reserved for the ADC to function. The ADC's power supply, known as the AVCC, provides positive voltage. For the ADC to function, it requires its own power supply. The supplied ground is designated as GND. The ADC uses AREF as a voltage reference when converting an analogue signal to a digital one. The digital value of 1 will be assigned to analogue values above the reference voltage, while the digital value of 0 will be applied to analogue voltages below the reference voltage. In order to convert an analogue signal to its digital value, the Arduino Node MCU uses a 10-bit ADC. This means that it creates a 10-bit digital value. The AREF value is used to determine if a digital value is high or low. As a result, this digital value is a representation of an analogue signal; consequently, it is its digital counterpart value. The RESET pin is located at the very end of the board. An application can be restarted from the beginning. And that's all there is to an Arduino MCU chip's pinout.

3.3.2 GSM Module

Computers can communicate with GSM-GPRS systems using a GSM/GPRS module. In the majority of countries, the GSM architecture is utilized for mobile communication. As an expansion of the GSM standard, the Global Packet Radio Service (GPRS) provides a better data transmission rate. All of the components needed to connect the GSM/GPRS modem to a computer are included in the GSM/GPRS module, including the power supply and communication interfaces (RS-232, USB, etc). For computers to communicate with the GSM/GPRS network, the GSM/GPRS MODEM class of wireless MODEM devices is needed. SIM (Subscriber Identity Module) cards are required to connect to the network, just like mobile phones. IMEI (International Mobile Equipment Identity) numbers are used to identify them, too, just as they are on smartphones these days. For example, GSM/GPRS MODEMs can execute the following:

1. Receive, send or delete SMS messages in a SIM.
2. Read, add, search phonebook entries of the SIM.
3. Make, Receive, or reject a voice call.

Serial communication is used by the MODEM to communicate with the CPU or controller. The controller/processor sends these commands. After receiving a command, the MODEM responds by sending back a result. The processor/controller/computer can send several AT instructions provided by the MODEM to communicate with the GSM and GPRS cellular networks. It uses a user's mobile phone with a sim card to run. When the soil is dry and the motor is ON, it aids in the transfer of soil status to the user's mobile device.

3.3.3 Sensors

Soil Sensor

Soil water content can be measured with this device. Plant growth necessitates a constant supply of water. This device determines whether the soil is wet or dry, based on the demands of the growing season. To transmit current via soil, the sensor's two probes are put into the ground. It is easier for current to flow through the soil when it is moist, whereas it is more difficult when the soil is dry. The resistance valve is used to determine the state of the soil.

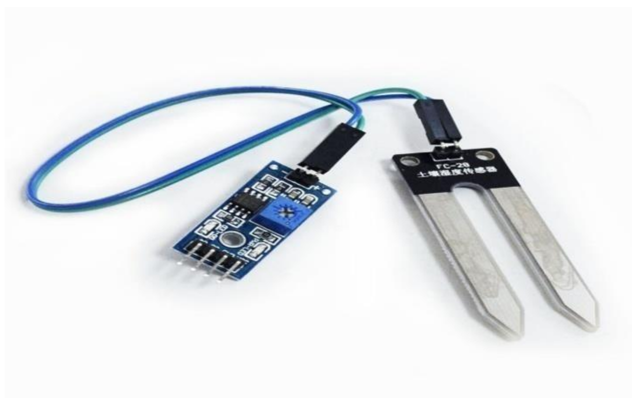


Figure 3.3: Soil sensor

Specifications

- Range: 0 to 45% volumetric water content in soil (capable of 0 to 100% VWC with alternate calibration)
- Accuracy: ±4% typical
- Typical Resolution: 0.1%
- Power: 3 mA @ 5VDC
- Operating temperature: –40°C to +60°C
- Dimensions: 8.9 cm × 1.8 cm × 0.7 cm (active sensor length 5 cm)

Temperature Sensor:

In order to accurately detect temperature, you can use a sensor like the LM35, which has an electrical output proportional to the temperature (in degrees Celsius). When compared to a thermistor, it provides a more accurate reading of temperature. The output voltage of this sensor is higher than that of thermocouples, hence it may not be necessary to amplify the output voltage. As the Celsius temperature increases, the LM35's output voltage increases as well. The conversion factor is.01V/°C.

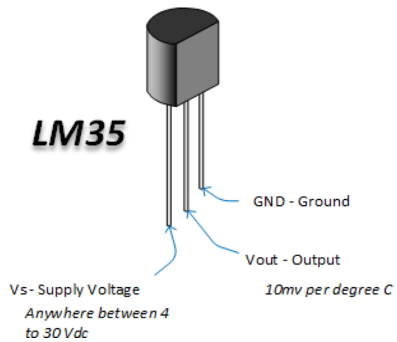


Figure 3.4: LM35 sensor

For temperatures ranging from 0°C to +100°C, the LM35 requires no external calibration and maintains precision of +/-0.4°C at ambient temperature. Besides its low self-heating capacity, this sensor requires only 60 micro amps from its power supply and has a low self-heating capacity This sensor is available in many various packages, such as the T0-46 metal can transistor-like package, the TO-92 plastic transistor-like package, and the 8-lead surface mount SO-8 tiny outline package, among others.

Pin Configuration

Pin Number	Pin Name	Description
1	Vcc	Input voltage is +5V for typical applications
2	Analog Out	There will be the increase in 10mV for raise of every 1°C. Can range from -1V(-55°C) to 6V(150°C)
3	Ground	Connected to ground terminal of the circuit

Humidity Sensor:

The digital signal output of this DHT11 Temperature and Humidity Sensor is calibrated, and it is capable of measuring both temperature and humidity. It has an 8-bit high-performance microcontroller embedded inside it. High levels of dependability and long-term stability are ensured by its technology. A resistive element and a wet NTC temperature sensor are included in this sensor. It features outstanding quality, fast reaction, anti-interference capability, and high performance.

The humidity calibration chamber of each DHT11 sensor is exceptionally accurate. We should refer to the OTP program memory's calibration coefficients as calibration coefficients because internal sensors are able to detect these signals. A single-wire serial interface is included for ease of use. Even the most demanding applications can benefit from the small size, low power, and signal transmission distance of up to 20 meters. This is a 4-pin single-row bundle. Special packages can be tailored to meet the needs of individual customers.

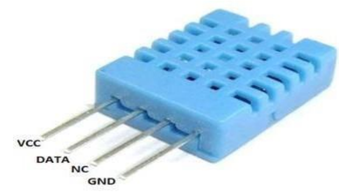


Figure 3.5: DHT11 sensors

Specification

- Supply Voltage: +5 V
- Temperature range :0-50 °C error of ± 2 °C
- Humidity :20-90% RH ± 5% RH error
- Interface: Digital

3.3.4 Wi-Fi Module

The ESP8266 WiFi Module is a self-contained SOC with an integrated TCP/IP protocol stack that can give any microcontroller access to our WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, we can simply hook this up to our Arduino device and get about as much WiFi-ability as a WiFi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost-effective board with a huge, and ever-growing, community.

This module has a powerful enough onboard processing and storage capability that allows it to be integrated with the sensors and other application-specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions and requires no external RF parts.

There is an almost limitless fountain of information available for the ESP8266, all of which has been provided by amazing community support. In the Documents section below we will find many resources to aid in using the ESP8266, even instructions on how to transform this module into an IoT (Internet of Things) solution!

Figure 3.6: ESP8266 Wi-Fi Module

Specification

- 802.11 b/g/n
- Wi-Fi Direct (P2P), soft-AP
- Integrated TCP/IP protocol stack
- Integrated TR switch, balun, LNA, power amplifier and matching network
- Integrated PLLs, regulators, DCXO and power management units
- +19.5dBm output power in 802.11b mode
- Power down leakage current of <10uA
- 1MB Flash Memory
- Integrated low power 32-bit CPU could be used as application processor
- SDIO 1.1 / 2.0, SPI, UART

- STBC, 1×1 MIMO, 2×1 MIMO
- A-MPDU & A-MSDU aggregation & 0.4ms guard interval
- Wake up and transmit packets in < 2ms
- Standby power consumption of < 1.0mW (DTIM3)

3.4 System Software

Collecting and reading the data from the sensors and controlling the various devices. Sensed data is collected from each sensor and sent to IoT, each reading is processed and graph is plotted in the Thing speak cloud. Fig 10. Shows the work Flow:

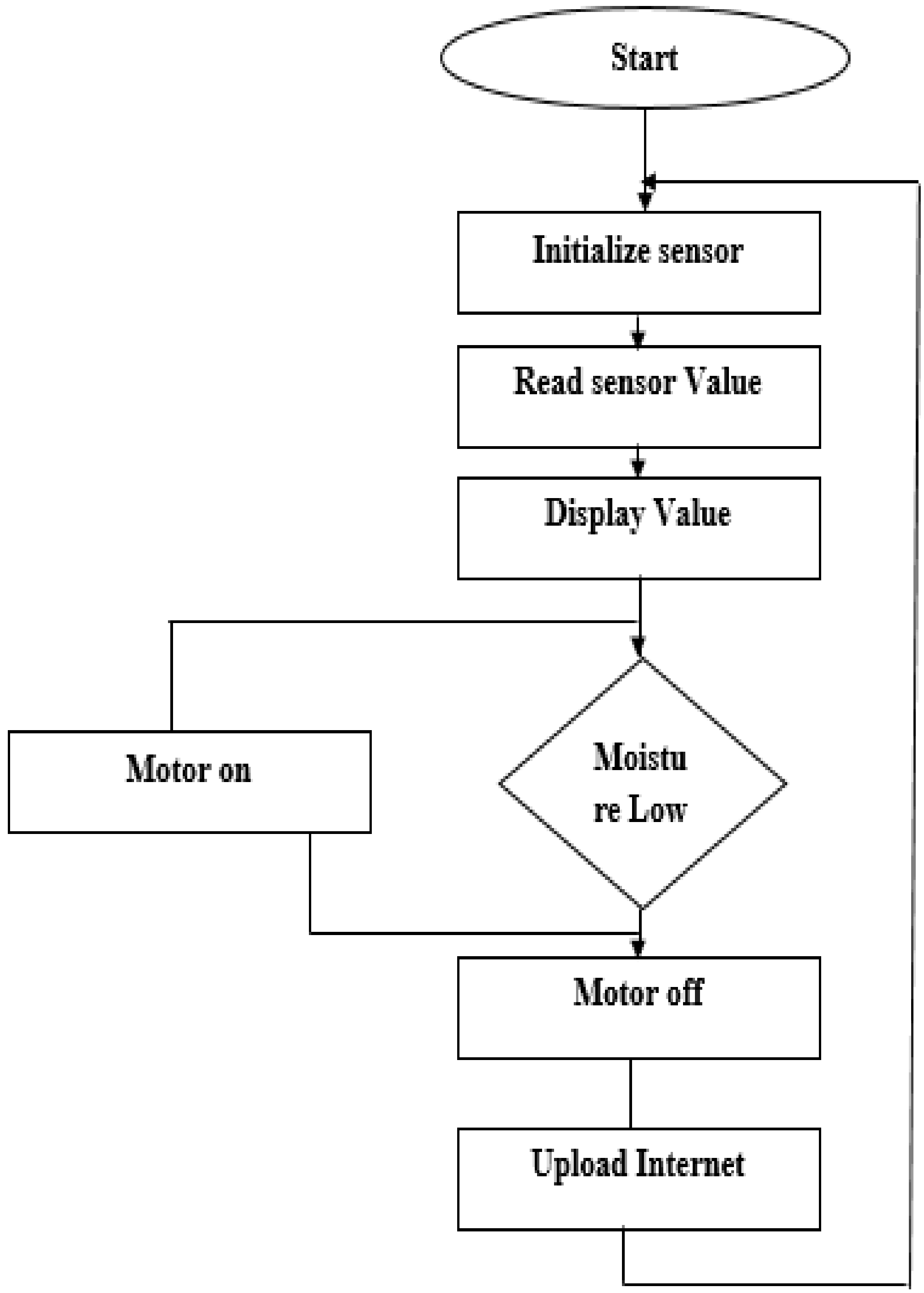


Figure 3.7: Work Flow of the System

Step 1: Process started.

Step 2: All the sensors are initialized using IoT.

Step 3: Sensor values are checked. Soil sensor gives soil Status whether soil dry/wet. DHT11 sensor gives the Humidity available in the environment. LM35 sensor gives the temperature reading.

Step 4: If the soil status is up to required level, motor remains off.

Step 5: If the soil status is dry then motor gets ON automatically.

Step 6: Initialize all the sensor values after completion of step 5.Process is completed and moves to original state.

Chapter 4

Result and Discussion

4.1 Results

In this analysis we can see that there will be detection for Dry and wet. We can also see that the chart of soil parameter sensor detect when its water needed and in this chart where we can see that there value will be there when its 50 that time it's indicate soil is dry when value will be 100 that time it shows wet. When its indicates It goes for a message to user. That time user take necessary step. The output can be analyzed in the Thing speak cloud, which is an open source IoT application. Thing speak gives the graphical notation of the values collected. Thing speak gives the real time data visualization.

Fig 11. shows displaying when soil is dry, corresponding graph for dry status of soil is plotted in chart 1a.

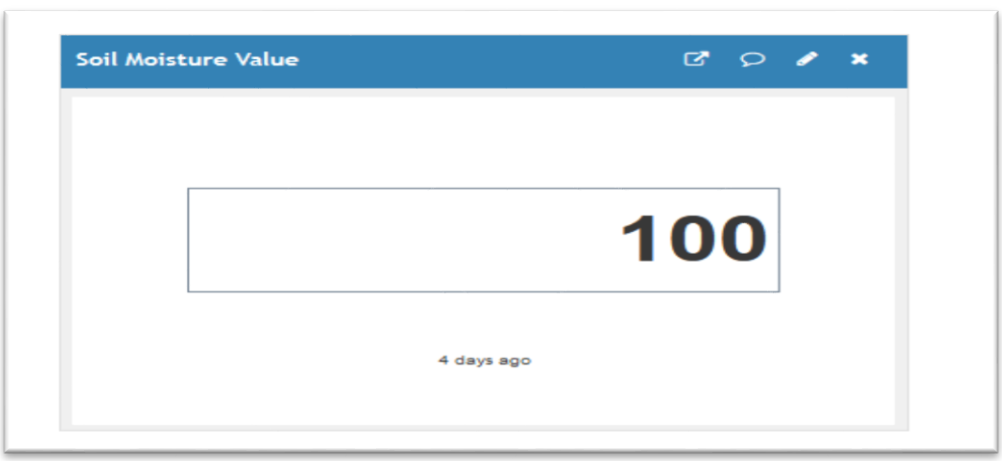


Figure 4.1: soil moisture value.

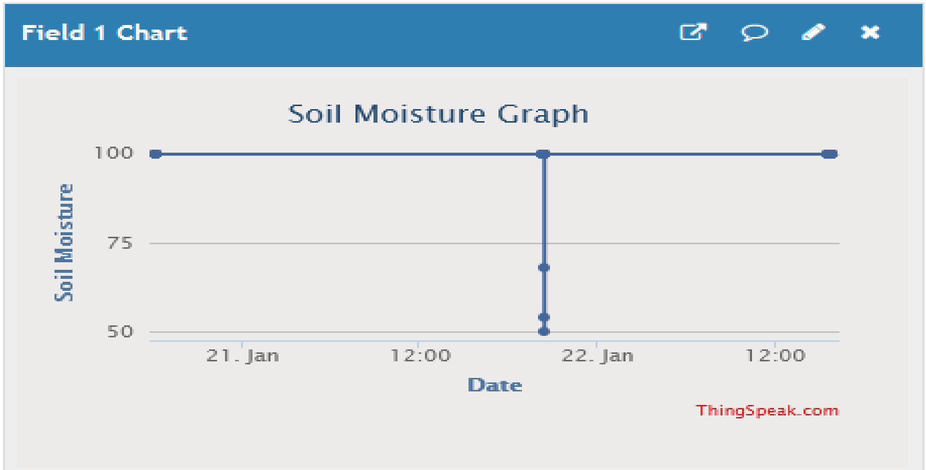


Table 4.1: Chart 1 Analysis of soil status, when dry.

The graph in chart 1a is plotted with soil status value v/s date by analyzing the soil status using IoT. It shows fixed value 100 when dry state.

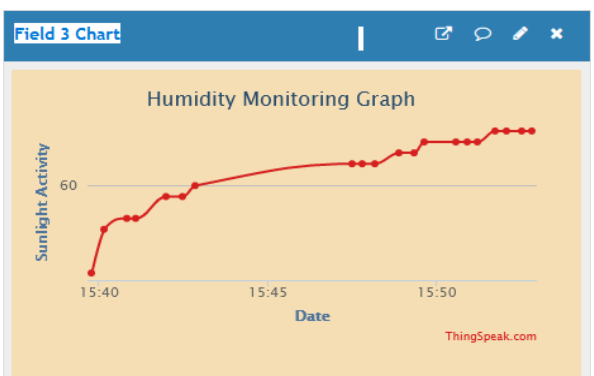


Figure 4.2.: Humidity Monitoring Graph

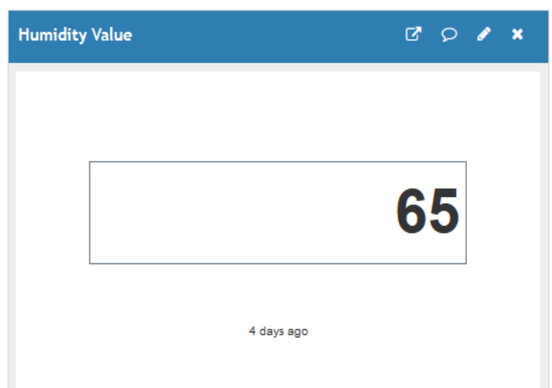
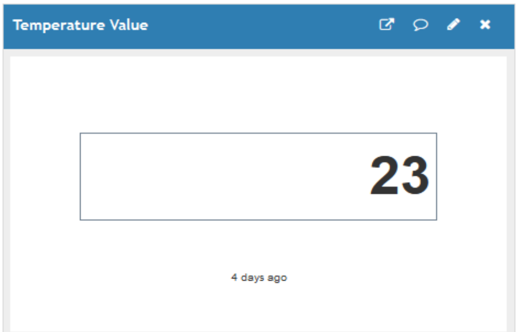


Table 4.2: Analysis of Humidity Value.

The graph in chart 2 is plotted with humidity value v/s date by analyzing the humidity value using IoT.



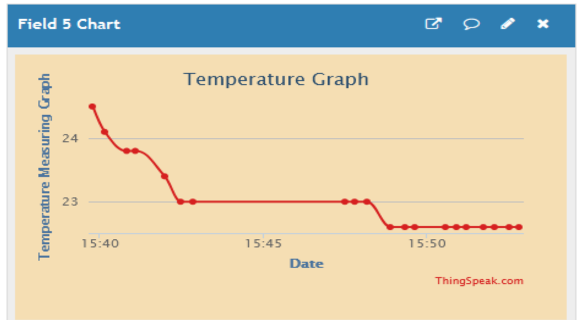


Table 4.3: Analysis of Temperature Value.

The graph in chart 3 is plotted with temperature value v/s date by analyzing the temperature value using IoT. Fig 4 .shows The Display of soil status when dry and motor started is sent to user mobile as message through GSM.

4.2 Data collection procedure Of rooftop

The primary and secondary data were used in the study. The extensive literature review, relevant documents/reports and secondary information were collected during the study. Primary data were collected from sample households using the semi-structured questionnaire. Data were sought on rooftop gardening like roof top size, uses of open space, species composition, materials used, yield of fruits and vegetables, income from RTG, management issues, fruits and vegetables consumption, training and support need assessment for rooftop gardening in the study area. Demographic and socio economic data were also collected from the respondents. All qualitative and quantitative data were collected in local terms and units and then converted into standard unit. The quantities of fruits and vegetables consumed by sample households in the last three days were collected and were divided by household size to obtain the intake per capita per day. In the case of calculating yearly household income from existing farming, all sorts of income earned from farming were taken into consideration with the perception of the interviewers. The primary data were collected from April to June 2016. Interviews were performed during daytime, with an average duration of about 30 minutes. Respondents were free to express their own view at each step of the interview. The whole study period was January-June, 2016.

4.3 Analysis

4.3.1 Potential spaces of rooftop in the selected household

Potential space on rooftops is an utmost important for improving or establishing the garden in the cities. In the study, results revealed that per household total rooftops space was recorded as 1916 sq. feet in Dhaka city areas. Of them average 1593 sq. feet was considered as potential space for gardening and 323 sq. feet was remained as open but presently the open space are being used in different purposes by the owner of the building. On the other hand, per household total rooftops space was recorded as 2190 sq. feet in Chittagong. Of them 1607 sq. feet was considered as potential space for gardening and 583 sq. feet was remained as open but presently the open space are being used in different purposes by the owner of the building (Table 4.3). Analysis results implied that the differences in the potential rooftop space per household was found to be significant at 10% level of probability ($F= 2.002^*$ and $p <.086$) among the location in Dhaka areas). But in the case of other areas in Dhaka and Chittagong it was found to be insignificant .(Table 4.2)

4.3.2 Current uses of residential rooftops in Dhaka city

Presently the rooftops of the residential buildings are being used for various purposes such as gardening, drying and washing clothes, playground for children, entertaining guest, passing pleasure time etc. In the study, results revealed that the highest percentages of the respondents are being used for gardening (87%), drying cloths (25.8%) and others (11.5%) irrespective of all areas in Dhaka city while it was 71% for gardening,42% for drying cloths and others (33%) in Chittagong city areas (Table 3.4). Islam (2004) reported that the rooftops of the residential buildings was used for drying (88%) and washing (45%) clothes, as playground for children (97%), for entertaining guests (20%), for cool air during the summer (64%), to sunbathe in the winter (33%). On most of the roofs, some form of pleasure garden exists (78%), sometimes there are fruit gardens (12%), and, less often, vegetable garden as well (8%).

Estimation of potential space on rooftop and use of open space in household

City /Metropolitan areas	Size of space on rooftop per household.(In sq.feet)			Used of open as % of each respondents		
Dhaka city	Total space	Open space	Potential space for RTG	For gardening	For drying cloths	Other
Mohammadpur	1950	325	1175	79	36	7
Mirpur	1950	338	1612	76	6	24
Gulshan	1806	256	1550	94	11	11
Uttara	2035	460	1575	90	35	10
Tejgaon	2075	200	1875	83	42	17
All	1916	323	1593	87.0	25.8	11.5
F-Value	1.863^{ns}	1.111^{ns}	1.210^{ns}			

Table 4.4: Estimation of potential space on rooftop and use of open space in the selected household

4.3.3 Water source used for current RTG's in Dhaka city

Water source is essential for providing irrigation to the user's plant. Irrigation can contribute to produce higher yield of plant. In the study, two main water sources (owned and rain water harvest) were observed. In the selected areas of Dhaka city, more than 90% respondents used owned source (owned supply water)

for irrigation to user's the plants. Irrespective of all selected areas of Chittagong, about 82 per cent respondents used owned source (owned supply water) for irrigation in the user's. About 23 percent respondent didn‟t provide irrigation but only 7 per cent used the conserved rain water for irrigation purpose .

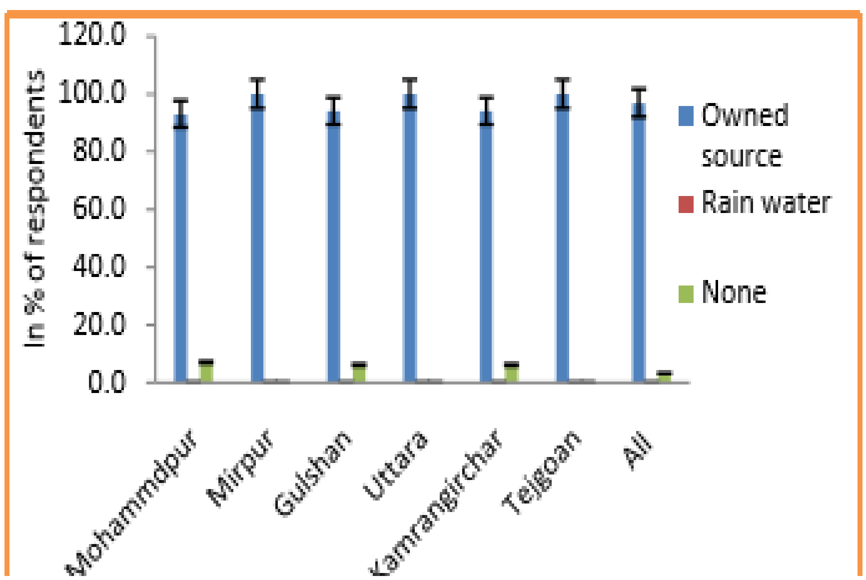


Figure 4.3: Respondents

4.3.4 Per household agricultural equipment owned

Agricultural equipment is one kind of household assets, generally used for growing agricultural produces that might ensure food security at household level. It can be seen from Figure 3.5 that the highest (76%) of the respondents owned water cane followed by hand sprayer (44%), hand hoe (40%) and secateurs (27%) irrespective of all locations in Dhaka city. It was reported that about 36% household owned hand hoe, 13% water cane, 11% secateurs and only 7% hand sprayer irrespective of all locations in Chittagong (Figure 3.6). Agriculture equipment owned by the households varied significantly across the respondents and locations

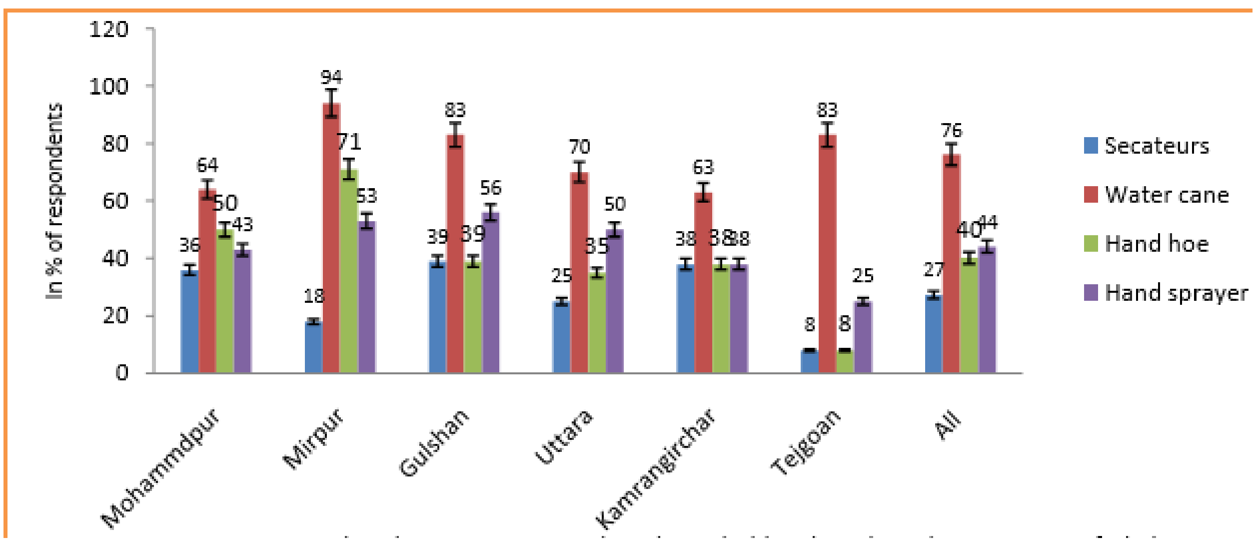


Figure 4.4: Agriculture Equipment owned

4.3.5 Some advantages and Key Findings of rooftop farming

Household size:

The average size of household (family) of the respondent was recorded as 5.4 and 5.3in Dhaka and Chittagong city, respectively which was found to be higher than national average (urban) implies that the family members can contribute to the RTG for sustainable food production.

Education of the respondents:

The average education level was recorded as the highest as graduate level in both Dhaka city and were found statistically significant indicated that an educated person can easily adopt the new technology.

Occupation of the respondents:

The highest percentages of the respondents were found as business man followed by retired person and housewives in both Dhaka and Chittagong city areas implied that these types of occupational people can contribute to the RTG by expending time and money.

Potential spaces of rooftop:

Average per household total rooftop space was recorded as 1916sq. feet, where potential space 1593sq. feet for gardening and open space 323sq. feet in Dhaka city areas but it was 2190 sq. feet, 1607 sq. feet and 583 sq. feet in Chittagong city areas, respectively. These figures indicated that there were huge potential for rooftop gardening in both city areas.

Current uses of residential rooftops:

The highest percentages of areas expressed by the respondents being used for gardening was 87%, drying cloths 25.8% and others11.5% in Dhaka city areas while it was 71%, 42%, and 33% in Chittagong city areas, respectively and that implied that there was scope for improving and re-designing the current RTG‟s.

Water source used:

About90% and 82% respondents used owned source (owned supply water) for irrigation to the RTG‟s in Dhaka and Chittagong city areas, respectively. Container used in the current RTG's: The highest 72% respondents used half plastic drum, 62.5% plastic pot, 59% earthen pot, 53% half-drum made by GI sheet, 51% plastic bucket, concrete made bed/drum and 41.6% plastic tray. In Chittagong areas, the highest 42% respondents used concrete made drum, 40% half-drum made by GI sheet, 31% plastic/earthen pot, 27% half plastic drum, 16% plastic bucket, 7% concrete made bed and 5% plastic tray. Per

4.3.6 Marketing of rooftop gardening products

There was no organized marketing system of rooftop gardens products in the study area. This might be due to limited production of the rooftop garden and that of consumed by the members of household. From this study it was found that rooftop garden production, income and self-use increases with the increasing size, investment and what purposes owner managed his garden. After ensuring available production of the gardens, the marketing system can be developed for sale their product

4.3.7 Responses to carry the inputs on the rooftop

Carry the input (soil, compost, fertilizer, container, seedling, sapling etc.) on the rooftop is important for successfully gardening. In the study, in Dhaka city areas about 90% of the respondents reported that they had no problem for carrying the input on their rooftop and other 10% respondents opined that it would be a problem if not carefully carry the input to the rooftop.

On the other hand, more than 52% respondents of Chittagong areas reported that they had no problem for carrying input to the rooftop (Figure 15).

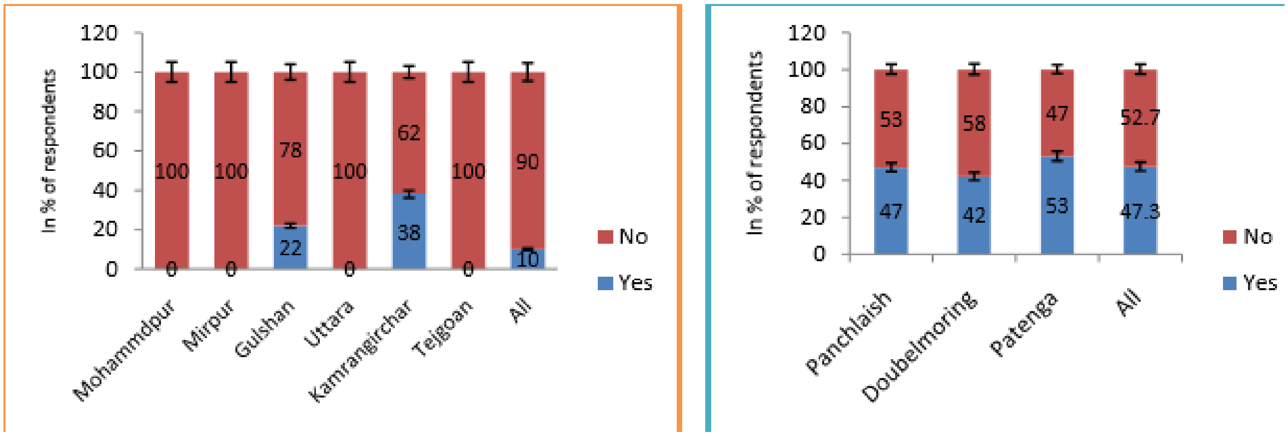


Figure 4.5: Responses carry input

Chapter 5

Conclusions

Improved technological know-how is required to boost crop output in countries like Bangladesh. By assessing soil parameters, it is suggested that IoT technology be used to improve crop yields and provide users with the convenience of knowing the status of their fields no matter where they are. If this machine works than many people inspire to became a farming person. It’s also a hobby we can say that if we implement something our rooftop, we will get environment and nice fresh vegetable and if the farmer is used in their works, they got some incredible result by short time in less amount of money. Farmers are those people who work day and night under the bright sun during summer, under cloud and rain during rainy season. They don't have any vacation. Each and every season they have to cultivate something. Question comes why they do it though they are not paid enough money? They do it just to make sufficient food for us. They do it for the people of their country. They do it out of responsibility and love towards their country. Now it is time for us to do something for those hard-working people because of whom we can eat at least three times a day and fulfill the need of our stomach. In our demo project, we are using the science and technology to make farming easier and enjoyable. As we all know farming is boring and monotonous and so lot of people are not interested in this profession. As a result, day by day the ratio of farmers in respect to total population is decreasing. Somehow, we have to attract people towards farming and we believe our machine can do that.

5.1 Limitations

1. This system cannot determine extra crops that are not available in our dataset. In our project we only use three sensors named Temperature, Soil Moisture and rainfall.
2. If we can add more extra sensors then our model accuracy could improve more.
3. The reason behind why we cannot add more sensors is the dataset. Our dataset value has only three parameters. We are using the manual system to input the arduino value into our website, no cloud databases are used here to check the sensor parameters value with the trained model to get crop result.

5.2 Future work

We have a plan to send requests on our web server from arduino directly. We will add more sensors to improve our system accuracy like pH sensors. Our dataset is only limited to few crops. In future we will improve our dataset.

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