ENVIRONMENTAL IMPACT OF CONVENTIONAL FUEL BASED VEHICLES: A CASE STUDY FOR PALTAN AREA

A Project report is submitted in partial fulfillment of the requirements for the award of Degree of Bachelor of Science in Electrical and Electronic Engineering.

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DECLARATION

I hereby declare that this project "**Environmental Impact of Conventional Fuel Based Vehicles: A Case Study for Paltan Area**" represents my own work which has been done in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering, and has not been previously included in a thesis or dissertation submitted to this or any other institution for a degree, diploma or other qualifications. I have attempted to identify all the risks related to this research that may arise in conducting this research, obtained the relevant ethical and/or safety approval (where applicable), and acknowledged my obligations and the rights of the participants.

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APPROVAL

The project entitled **"Environmental Impact of Conventional Fuel Based Vehicles: A Case Study for Paltan Area"** submitted by **Shadia Selim (ID:191-33-4916)** has been done under my supervision and accepted as satisfactory in partial fulfillment of the requirements for the degree of **Bachelor of Science in Electrical and Electronic Engineering** in **September, 2023.**

Signed

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Dedicated

To

My Parents and Supervisor

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LIST OF ABBREVIATIONS

IoT	Internet of Things
ISO	International Organization for Standardization
NIST	National Institute of Standards and Technology
AQI	Air Quality Index
HC	Hydro Carbon
MQTT	Message Queuing Telemetry Transport
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
RFID	Radio-Frequency IDentification
EPA	Environmental Protection Agency
LCD	Liquid Crystal Display

LIST OF SYMBOLS

Symbol	*Name of the symbol*
µm	Micrometre
%	Percentage
C	Celsius
-	Hyphen

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First of all, I want to give thanks to **Almighty Allah**. With his blessing I am able to complete our work with best effort.

I want to pay my utmost respect to my Supervisor **Mr. Jahedul Islam, Lecturer** of the **Department of EEE, Daffodil International University** for who has given me the chance to work on an impactful idea and taken care of every issue of development of this concept. Then I would like to take this opportunity to express gratitude to my supervisor for being dedicated in supporting, motivating and guiding me throughout this project. This project can't be done without his useful advice and help. Also thank him very much for giving me the opportunity to work with this project.

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ABSTRACT

Bangladesh is a rapidly growing country with a large population. This has led to an increase in the number of vehicles on the road, especially in the capital city of Dhaka. Paltan is a very crowded and busy area in Dhaka, and the majority of vehicles in this area run on conventional fuel. The goal of this research is to target these conventional fuel-based vehicles and the emissions that they produce which are polluntants. We aim to investigate how these pollutants affect the environment and on the health of individuals. To measure this impact, we will first need to develop a project that will allow us to monitor vehicle emissions and their concentration. IoT-based monitoring projects are ideal for this purpose. The main emissions from vehicles are carbon dioxide (CO_2), carbon monoxide (CO), particulate matter (PM), sulfur oxides (SOx), and hydrocarbons (HC). CO_2 and CO are the two main pollutants emitted by vehicles, and they contribute to air pollution. In this IoT project, we will store and analyze our data on ThingSpeak, which is an IoT analytical cloud platform. We will use an ESP32 module, gas sensors such as MQ-9 and MQ-135, and a humidity and temperature sensor (DHT11) to collect data on vehicle emissions. The key findings of the project will be compared with the Air Quality Index (AQI) for Bangladesh. This will allow us to assess the current condition of the environment in Paltan, Dhaka.

We believe that this project will provide valuable insights into how automobile emissions affect the environment and people's health. The results of the project will be used to develop strategies to reduce and creation of plans regarding vehicle emissions. Also, enhance air quality in Paltan, Dhaka.

Keywords: Conventional Fuel, Vehicle Emissions, IoT, Air Pollution, ThingSpeak, CO2, CO, Environment Impact, Paltan

CHAPTER 1
INTRODUCTION

1.1 Motivation

The notion of the global environment embraces the intricate and linked web of ecological systems, biological diversity, and natural resources that sustain life on Earth. The complex bond between traditional fuel-based vehicles and the environment has a lot of negative repercussions in today's world. Conventional fuel-based vehicles, such as those that run on petrol or diesel, when they are working, they emit a large amount of atmospheric greenhouse gases (GHGs), with carbon dioxide (CO_2) representing the predominant one. These emissions play a key role in the greenhouse effect's increased intensity, global warming and following climate change. The global volume of CO_2 emissions from the transportation industry is widely acknowledged. Oil, coal, and natural gas, which are all limited fossil fuel resources which are subject to depletion, have been utilized to power traditional automobiles. And Vehicle emissions, which discharge a variety of pollutants into the environment, are the cause of air pollution. These pollutants include particulate matter (PM), NOx, SOx, CO and volatile organic compounds (VOCs). Smog formation, deterioration of air quality, and a negative effect on human health are all caused by these pollutants. The WHO's most challenging 2021 air quality guideline levels were not being fulfilled where 99% of people inhabited and in 2019, approximately 4 million deaths were caused by exposure to outdoor air pollution consisting of fine particles, with the highest death rates recorded in East Asia and Central Europe [1]. This project's objective is to offer a monitoring system for vehicular pollution that uses the Internet of Things (IoT) for a particular area in Dhaka city which can identify the vehicle emissions that are polluting city roadways environment as well as measure different kinds of contaminants and their concentration up in the atmosphere (CO, CO_2, NH3, S, C6H6). And this project will collect the most real-time physical data by including wireless gas sensors. So, today, these concerns lead to this work here.

1.2 Problem Statement

Light-duty automobile emissions are rising by about eight percent annually in recent years, and traditional fuel-based in 2021, cars and vans contributed to around 8% of the planet's direct CO_2 emissions [2]. In December 2015, the United Nations Framework Convention on Climate Change (UNFCCC) held its 21st Conference of the Parties (COP21) where the Paris Agreement, a worldwide agreement to combat climate change, was adopted by 196 countries. It became operational on November 4, 2016.

The Paris Agreement's key goals are to pursue efforts to hold temperature rises. The goal is to limit the increase in temperature to 1.5 degrees Celsius and keep global warming well below 2 degrees Celsius from pre-industrial levels. To safeguard human health from the harmful effects of air pollution, guidelines are provided by WHO (World Health Organization) for air quality. These guidelines clarify limits and recommendations for various contaminants, including PM2.5, PM10, NO2, SO2, O3, CO and others [3].

1.2.1 Conventional Fuel Types Used for Vehicle

The most widely utilized automobile fuels are gasoline (petrol), diesel, bio-diesel, ethanol, LPG and CNG [4].

Petrol (Gasoline): The most frequently utilized fuel for automobiles worldwide which is produced from crude oil by refining procedures and utilized in internal combustion engines that run on petrol. It is mostly used for bikes and personal 4-wheelers. It is hazardous and the gases produced when fuel evaporates. And the substances made when petrol burns are CO, NOx, PM, HC which generate air pollution. When petrol is consumed, CO_2, a greenhouse gas, is also created. [5].

Diesel: Diesel engines, which are prevalent in many trucks, buses, and certain cars, often run on diesel fuel. Although it also comes from crude oil, diesel fuel is more energy dense than petrol and offers better fuel economy. Diesel engine emission leads to the the creation of ozone at ground level and diesel pollutants are NOx, CO, CO_2,
GHGs and toxic air [6].

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Bio-diesel: In diesel engines, it can be combined with or used in place of petroleum diesel and which is made from recycled cooking oils, animal fats, or vegetable oils. It is biodegradable and lowers greenhouse gas emissions. According to a study, burning biodiesel produces more nitrous oxide (NOx) but less PM, CO and HC emissions. When compared to regular diesel, using a blend of 20% biodiesel (B20) results in a 7% increase in HC and a 10% increase in CO emissions, while not decreasing PM levels under current circumstances [7]. Vehicles with diesel engines can run on biodiesel. Additionally permitted to run on biodiesel are vans, trucks, and SUVs with particular construction.

Ethanol: The U.S. government believes that utilizing and manufacturing biofuels has less of an impact on the environment than using fuels that originate from fossil fuels. Pure ethanol and biodiesel are both biodegradable and harmless [8]. A renewable fuel, ethanol is produced from plant-based materials such as corn, sugarcane, or cellulosic feedstocks. In order to make ethanol-gasoline blends for Petrol is often blended with either E10 (10% ethanol, 90% petrol) or E85 (85% ethanol, 15% petrol When compared to regular petrol, ethanol and ethanol-gasoline blends burn more efficiently and have higher octane ratings. However, they also generate additional evaporative emissions from fuel tanks and dispensing machinery. These emissions contribute to the formation of harmful smog and ground-level ozone. Furthermore, the burning of biofuels releases a greenhouse gas called carbon dioxide (CO_2). Using biofuels has a different impact on net CO_2 emissions depending on how they are made [8]. It is mostly utilized in racing automobiles. Additionally, it is diluted with petrol for use in currently available on-road cars.

LPG (Liquefied Petroleum Gas): LPG, usually referred to as propane or auto-gas, is a byproduct of the processing of natural gas and the refining of petroleum. LPG, is made from another two natural gas liquids are named propane (C_3H_8) and butane (C_4H_{10}), and they can also be combined. LPG emits less carbon dioxide than both diesel and gasoline. Traveling one mile typically produces around 319 grams of CO_2 emissions. However, burning a single gallon of LPG results in a much larger output of 12.52 pounds (5,680 grams) of CO_2. While using LPG can offer environmental benefits, it's crucial to consider the source of the fuel to fully understand its impact on climate change [9]. Light-duty biofuel automobiles can use it.

CNG (Compressed Natural Gas): Compressed natural gas (CNG) predominantly comprises methane (CH_4). This fuel gas is compressed to less than 1% of its volume at regular atmospheric pressure. When burned, compressed natural gas (CNG) produces a lot fewer contaminants directly than petrol or oil, such as UHC, CO, NOX, SOx and PM [10]. In passenger cars, it is commonly employed. CNG can be used to power vehicles like the BMW 3 Series (E36) and Audi A5 2,0 TFSI CNG. In addition, vehicles including vans, buses, trucks, and more may run on CNG.

1.2.2 ICEs (Internal Combustion Engines) and their Drawbacks

An internal combustion engine is a type of engine that combusts fuel. For example, we can mention petrol or oil, diesel together with air inside the engine to produce hot gases that can move pistons or do other tasks as they expand. There are mainly two types: Gasoline Engine and Diesel Engine.

Drawbacks: Due to the combustion process and characteristics of the fuels used in internal combustion engines are the main causes of air pollution. As we know ICE depends on regulated ignition to produce power by burning fuel and this combustion process is not perfect every time. As a result, due to this incomplete combustion CO_2, CO, unburned hydrocarbons (HC) and PM release as air pollutant. Atoms of carbon and hydrogen are present in fuels used in internal combustion engines, such as petrol and diesel and these fuels react with oxygen during combustion to yield energy. Also, it releases CO_2 and water vapor. The fuels do have impurities and additives. So, when they burned, may produce pollutants. And the nitrogen in the air (from both ambient air and within the fuel) combines with oxygen during combustion to generate nitrogen oxides (NOx), chiefly nitrogen dioxide (NO_2) and air quality and human health are negatively affected by ground-level ozone (O_3) and smog. These harmful pollutants are produced due to NOx emissions. Fine particles which also referred to as particulate matter (PM), are produced during combustion in internal combustion engines. These particles can either be produced directly in the atmosphere (primary PM) or through intricate chemical processes (secondary PM). We know PM is made up of metals, soot, hydrocarbons, and other dangerous elements. Also, during the combustion of internal combustion engines, these emit volatile organic compounds (VOCs). VOCs are carbon-based substances which are easily

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evaporative and react in the environment to produce ground-level ozone, which contributes to air pollution and the development of smog.

1.2.3 Adverse Effects of Environmental Conditions in Bangladesh due to Vehicle Emission

Bangladesh, particularly in the city of Dhaka, is inundated with a vast number of cars, buses, motorbikes, vans, trucks, and rickshaws. The increase in traffic and prolonged idling caused by more vehicles on the road results in increased emissions. Due to old, poorly maintained, and polluting automobiles make up a sizable component of the city of Dhaka's vehicle sector and many of these produce greater amounts of pollutants like CO, NOx and PM since they do not follow tight emission requirements. Also due to the use of adulterated fuel in combustion could trigger some cars to burn more slowly and produce more emissions which increased the levels of pollutants in the exhaust gases. Although Bangladesh has emission limits, effective enforcement and frequent vehicle inspections are frequently absent. Because of this, many vehicles with excessive pollution levels are still on the road and not properly regulated or maintained. And Dhaka experiences heavy traffic jams that cause long standing still and stop-and-go periods. These circumstances lead to higher fuel use and emissions, which worsen the already poor air quality.

Global Warming & Climate Change: One of the leading causes of greenhouse gas emissions that contribute to climate change is the emissions produced by vehicles. The transportation sector is accountable for around 14% of all global CO2 emissions. The release of human-made gases, such as methane, CO2, and nitrous oxide, into the environment is a significant factor that contributes to the atmosphere of global warming [11]. Highway vehicles contribute 1.4 billion tons of GHGs annually. Each gallon of gasoline emits 20 pounds of GHG, and regular vehicles emit 5-9 tons of GHG per year [12]. The impact of vehicle emissions on ozone levels is indirect as they affect air quality and the production of ozone in the lower atmosphere. However, they do not directly harm the ozone layer. When vehicle emissions, specifically nitrogen oxides (NOx) and volatile organic compounds (VOCs), react with sunlight, ground-level ozone, also known as tropospheric ozone or smog, is created.

Air Pollution & Health Risk: Bangladesh has been designated as the worldwide most polluted nation in 2018 by the Swiss-based air quality technology business IQAir. In recent years, Bangladesh and its capital, Dhaka city, have frequently made headlines for being among the world's most polluted locations. The IQAir 2021 World Air Quality Report has revealed that Bangladesh's average PM2.5 concentration stands at 76.9 µg/m3, which is 15 times more than the WHO recommendation. Dhaka, the capital of Bangladesh, ranked second in the list of the most polluted regional capital cities worldwide, with an annual average PM2.5 concentration of 78.1 g/m. The only city ahead of Dhaka was New Delhi, the capital of neighboring country India [13]. Pollutants discharged by conventional automobiles are one of the impactful reasons and they emit CO, PM, NOx, VOCs and these pollutants contribute to smog formation also, poor air quality. According to UN environment programme (UNEP), Air pollution is a significant global health concern, as it is responsible for one in nine deaths worldwide. In 2019, exposure to PM2.5 reduced the average lifespan worldwide by nearly one year [1].

PM2.5 air pollution is linked to several fatal conditions such as stroke, heart disease, lung disease, pneumonia, and cancer. Moreover, it can negatively impact children's cognitive development, deteriorate mental health, and even cause diabetes and other illnesses. It is crucial to monitor and reduce the levels of fine particles in the air to prevent these harmful effects [1].

1.3 Aims

Did you know that Dhaka is the ninth-largest city in the world and ranks seventh in terms of population density? With over 22.4 million people, it's considered a megacity with a population of 10.2 million. It's also widely believed to be the most densely populated built-up urban region in the world and for this large scale of population it is nearly 57.5 million motor cars, of which more than 20 million are in Dhaka, according to the BRTA, which registers vehicles in the nation. That means one car for each city resident. The number of people who own multiple vehicles is not known to the BRTA [14]. Considering the size of the population, there is a large scale of conventional fuel-based vehicles which emit a large scale of CO2, CO, NOx, SOx, PM, VOCs. It is unfortunate to note that Bangladesh is currently the country with the highest levels of air pollution globally. This dire situation has resulted in a significant reduction in the life expectancy of an average Bangladeshi by 6.7 years, with vehicle emissions being the

primary contributor to this issue. A recent study by the Energy Policy Institute at the University of Chicago, known as the Air Quality Life Index (AQLI), reveals that areas with the highest pollution levels in Bangladesh experience a further decrease in life expectancy by 8.1 years. This has been the case since 2018, and we hope that measures will be taken to address this pressing matter [13]. A densely inhabited region of Dhaka called Paltan has a high vehicle density as a result. Additionally, this experiment will be carried out there to measure the conventional fuel-based vehicle emissions. Therefore, the aims will be:

Aim 1: I am working on a project to monitor and identify air pollutants such as CO_2, CO, ammonia (NH_3), sulfur (S), and benzene (C_6H_6) that are emitted from vehicles. The aim is to keep track of air quality in real-time. The project will be based in Paltan, Dhaka, Bangladesh.

Aim 2: The temperature and humidity will be measured in real time for this project.

Aim 3: The information gathered will be put to use and contrasted with earlier and more recent information that is already on websites.

1.4 Brief Methodology

The project will be made with the assistance of the IoT (Internet of Things). Real-time monitoring and administration of devices is made feasible by IoT, leading to improved operations, resource management, and process automation. Weather patterns, water quality, and air quality are just a few examples of environmental aspects that can be monitored and collected data on using IoT devices. IoT generates massive amounts of data that can be studied to draw valuable conclusions. To analyze the data, we'll be utilizing MathWorks (ThingSpeak), Arduino IDE, the ESP32 module, as well as the DHT11 temperature and humidity sensor, MQ-9 gas sensor, and MQ-135 gas sensor.

1.5 Gantt Chart
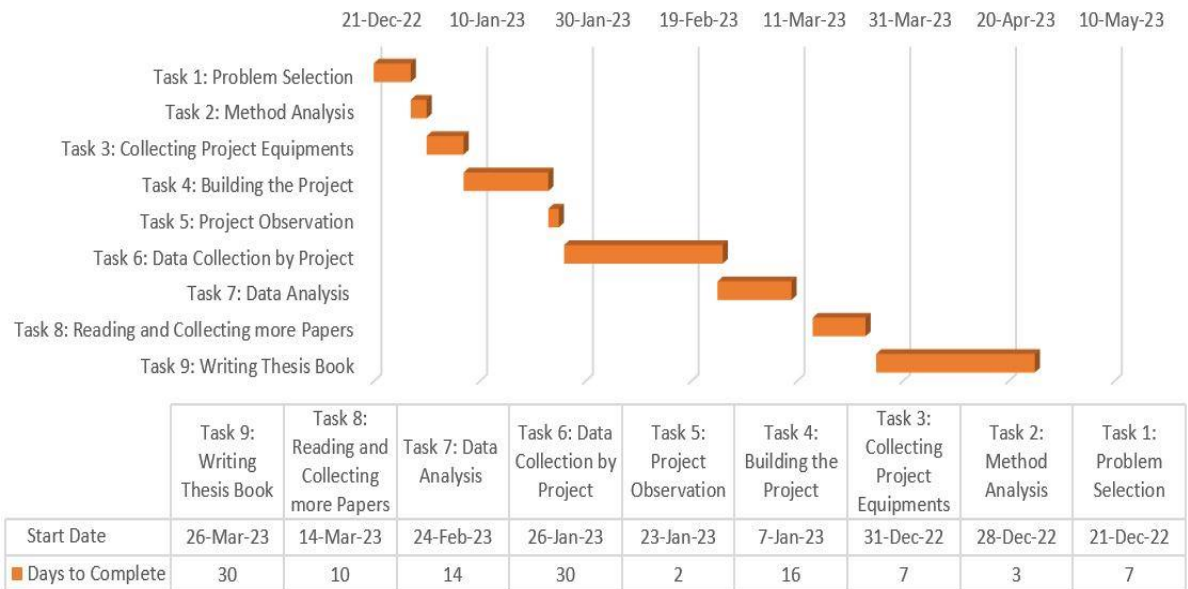
Figure 1.1: Gantt Chart

1.6 Structure of the Report

Chapter 2: Literature Review on Conventional Fuel Based Vehicle emissions Impact and IoT Based Monitoring Projects

Chapter 3: IoT Project Design and Applied Methods

Chapter 4: Result and Discussion.

Chapter 5: Project Management

Chapter 6: Impact Assessment of the Project

Chapter 7: Conclusion

CHAPTER 2
LITERATURE REVIEW ON CONVENTIONAL FUEL BASED VEHICLE EMISSIONS IMPACT AND IOT BASED MONITORING PROJECTS

2.1 Introduction

In this chapter, we will thoroughly discuss about the related research work of conventional fuel- based vehicle emission and their impact on our environment and daily life. Also, about the technology which is called Internet of Things (IoT) and its air quality monitoring system in the existing articles in recent times.

2.2 Related Research Works

A recent study published in Science Advances by K. Vohra et al. [15] revealed that air pollution has caused approximately 24,000 premature deaths in Dhaka between 2005 and 2018. The study also found that among the 46 cities examined, Dhaka has had the highest increase in premature deaths. Most of the top 15 most polluted cities in the world are located in Asia. And polluted vehicle emission is one of the biggest reasons for air pollution.
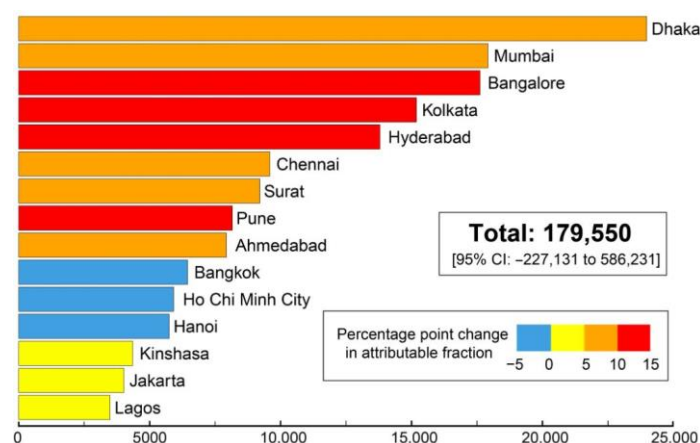
Figure 2.1: Increase in Premature Deaths from 2005 to 2018 (Source: [15])

In article [16], we shall now delve into the chemical composition of the primary pollutants discharged by diesel engines, namely CO, HC, PM, and NOx. Diesel engines, when used in vehicles, give rise to incomplete combustion and unburned fuel, thereby leading to the emission of CO and HC. Similarly, NOx emissions occur when combustion temperatures exceed 1,600 C. The minute particles produced from partially burned fuel, partially burned lubrication oil, fuel oil and cylinder lube oil ash content, sulfates, and water, result in PM emissions. Therefore, the environment and human health are negatively impacted by these pollution discharges.

This work [17] offers, a system design that provides a remedy for finding automobiles that pollute the environment by using Internet of Things (IoT). A low-cost solution that makes use of gas sensors and RFID (Radio Frequency Identification) which measures real-time pollution levels from specific vehicles. The sensor reads data simultaneously with RFID readers. In this project, small number of places with a typically large volume of traffic may be chosen to be watched. The RFID readers in this framework are positioned with a predetermined, close spacing between them on either side of a road for each monitored site. Each moving car on the road has a passive RFID tag attached to it. On the side of the road are sensor nodes made up of petrol sensors. A distinctive IP address or a distinctive can be used to identify and address the sensor nodes. This is how this project works and detect air pollutants discharged from the vehicle engines.

Another study [18], uses a Raspberry Pi embedded system in a Cloud Server to monitor and manage pollution caused by carbon dioxide emissions from vehicles. In this project the sensors are used for temperature, humidity, and carbon dioxide detect. Along with the sensors, data that is sensed is transmitted to the Raspberry Pi. The Raspberry Pi is programmed with Python to securely transfer the data to a remote server using the IPV6 connection protocol. All the information is collected and stored in appropriate tables in the preset database by the remote server. Users can access the database's history and current atmosphere status and monitor it using portable devices such as PDAs, smartphones, and PCs for assistance in this project.

In another study [19], air quality was measured using the MQ135 sensor, while carbon monoxide (CO) was measured using the MQ7 sensor. The data collected from both sensors were obtained through an IoT system utilizing platforms such as Thingspeak or Cayenne. To create this IoT kit, the Arduino Uno microcontroller, MQ135, MQ7, ESP-01 Wi-Fi Module, a 9-volt battery, and a LM7805 regulator were utilized. The purpose of this study is to raise

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awareness among the public and government officials about the harmful effects of air pollution on human health. Real-time data from the Thingspeak website was analyzed using machine learning techniques. Here is the projects circuit diagram in Figure 2.1 [19].
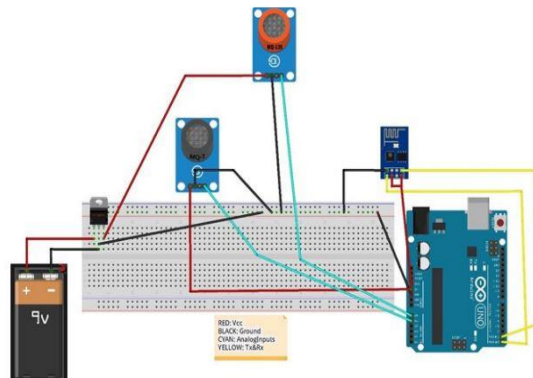
Figure 2.2: Utilize an IoT technology, MQ135, and MQ7 to monitor air quality with machine learning analysis. (Source: [19])

A study published by Dhingra, Swati, et al. [20], introduce the revolutionary three-phase air pollution monitoring system that utilizes an advanced IoT kit that comes equipped with high-tech gas sensors (MQ-7, MQ-2, MQ-135), the cutting-edge Arduino IDE (Integrated Development Environment), and a top-of-the-line Wi-Fi module. The gas sensors accurately gather information from the air and transmit it to the Arduino IDE, which in turn utilizes the Wi-Fi module to send the data to the cloud. Additionally, an IoT-Mobair Android app is available, allowing users to access relevant cloud-based air quality data on-the-go. During travel, users can view the projected pollution level for their entire route and receive an immediate warning if the predicted pollution level exceeds safe limits. This solution is second to none, comparable to none other than Google Traffic or the Google Maps Navigation application. Furthermore, future air quality index (AQI) levels can be accurately predicted using air quality data, making it the ultimate solution for all your air pollution monitoring needs.

2.3 Compare and Contrast

Table 2.1: Compare and contrast of related research works (IoT Based Monitoring Projects)

Study	Vehicular pollution monitoring using IoT [17]	IoT based smart system for controlling CO_2 emission [18]	IOT based air quality monitoring system using MQ135 and MQ7 with machine learning analysis [19]	Internet of Things mobile–air pollution monitoring system (IoT-Mobair) [20]
Objectives	According to this study, one solution to tackle the problem of vehicles emitting pollutants beyond a certain level is to utilize the Internet of Things (IoT) technology to track them and monitoring air pollution on highways.	The main goal of this research is to utilize IoT technology to measure the amount of CO_2 emissions that come from factories, public transportation systems, and forest fires. This will be done by using a CO2-sensitive device called Raspberry Pi.	Real-time independent system for monitoring air quality. On a webpage, display the PPM of the air quality.	Provide recommendations for a three-phase air pollution monitoring system.
Methodology	The RFID readers are positioned with a fixed little distance between them on	Sensing Control Module, Data-semantic-storage module, Data-semantic-storage	The gas sensors gather data with the assistance of the microcontroller and transmit it through ESP-	The gas sensors gather air information and transmit it to the Arduino IDE, which utilizes the Wi-Fi module to send data to the

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	either side of a road for each monitored location.	module, Data-semantic-storage module	01 to various websites, including Thingspeak.	cloud. Additionally, the IDE is compatible with the IoT-Mobair Android app, which provides users with relevant cloud-based air quality data.
Hardware Requirements	RFID readers, RFID tags, Arduino Uno, Gas sensors: (MQ series)	Raspberry Pi, MG811, DHT22	Arduino Uno, MQ135, MQ7, ESP-01 Wi-Fi Module, a 9 Volts Battery, a LM7805 Regulator	Gas sensors: MQ-135, MQ-2, MQ-7 Wi-Fi module: ESP8266 Arduino IDE
Tools and Technology	GPRS	Python, IPV6 (Connection Protocol)	Thingspeak, ML (Machine Learning)	Ubidots
Measured Elements	CO, SOx	CO_2, Temperature, Humidity	CO, CO_2, NH4, smoke	CO, CO_2, CH4, Acetone, alcohol, Formaldehyde
Research Gap	The challenge of locating the specific car that actually pollutes arises in this situation because there are many vehicles vying for space.	The suggested model solely detects carbon dioxide emissions. However, there are numerous toxic gases that impair the ecosystem, such as nitrous oxide, carbon monoxide, and methane.	For the purpose of identifying pollutants from factories and cars, a PM2.5 laser dust sensor will be helpful.	One way to enhance system performance and reduce compute complexity is by using fog computing instead of cloud computing.

2.4 Summary

In the end, although obstacles still exist, IoT-based air quality monitoring devices are a crucial step in the fight against vehicle pollution. These include data accuracy and sensor calibration issues, data privacy and security, and ensuring that data is accessible to all societal groups. In conclusion, serious environmental and health problems are associated with vehicular pollution, necessitating efficient monitoring and mitigation measures. A feasible choice is IoT-based air quality monitoring, which provides communities and cities with data-driven insights to fight pollution, improve urban environments, and support sustainable mobility systems.

CHAPTER 3

IOT PROJECT DESIGN AND APPLIED METHODS

3.1 Introduction

Throughout this chapter, we'll delve into the various methodologies and tools involved in developing an IoT project that's specifically engineered to identify emissions emanating from vehicles that run on traditional fuel sources.

3.2 Applied Method

These days, vehicle emissions are a major concern. In terms of automobile emissions, the environment becomes more and more contaminated. The standard fuel burns in the engines and releases a variety of unburned particles, including HC, CO2, CO, PM, NOx, and SOx. We will create an IoT environment monitoring project to find them and measure them in PPM (Parts Per Million).

To start this project, we'll use ThingSpeak, the Arduino IDE (for coding), the ESP32 microcontroller module, the DHT11, MQ9, and MQ135 sensors. We will gather data from the roadside in Paltan, Dhaka, Bangladesh, for 30 minutes twice daily as part of the Internet of Things initiative. The event will take place between (11:00 to11:30) am and (5:00 to 5:30) pm for about 10 days.

My data indicates that buses, private cars, microbuses, cngs, motorbikes, ambulances, and pickup vans are the predominant vehicles in this specific location. The most common vehicles here are buses and private cars. In order to compare the air quality of Paltan with the AQI standard and its effects on the environment, the emissions from them will be measured here as part of this research. The data will then be compared with AQI.

3.3 Details of the Components

For this project, we utilized two breadboards and jumper wires to connect the sensors and module on the breadboard. We utilized one ESP32 microcontroller module, one DHT11 sensor to monitor real-time humidity and temperature, and one MQ-9 and one MQ-135 gas sensors to measure the elements emitted from vehicles. Below is a detailed list of the main components used.

ESP32 Module

This is a microcontroller module that's perfect for Internet of Things (IoT) applications. It's called the ESP32 and it's designed to be versatile and powerful. The ESP32 comes with a dual-core processor, Wi-Fi and Bluetooth connectivity, RF balun, filters, low noise receive amplifier, power amplifier, plenty of GPIO pins (36), a CPU frequency of 160 MHz, a 32-bit architecture, 16 MB of Flash memory, 18 ADC pins, and multiple built-in peripherals. The ESP32 was created and developed by Espressif Systems, a company based in Shanghai, China. It's manufactured by TSMC using their 40 nm process and operates at a voltage of 3.3V. The ESP32 is a successor to the previous microcontroller model called ESP8266.
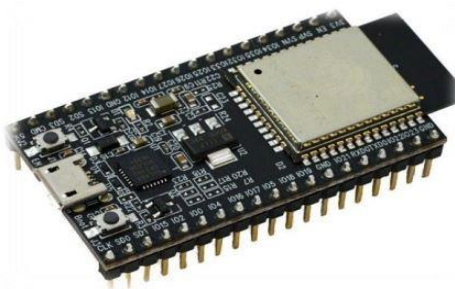
Figure 3.1: ESP32 Module

DHT11

A digital sensor that measures temperature and humidity is widely used due to its cost-effectiveness. It offers a digital output interface that makes it easy to connect to microcontrollers or development boards, designed to operate with low power consumption which requires a supply voltage of 3.3V to 5V. VCC (power supply), GND (ground), and DATA (digital data output) are its three pins. The DHT11 sensor is highly capable of accurately measuring temperatures within a range of 0°C to 50°C (32°F to 122°F) with a precision of 2°C. It can also measure relative humidity within the range of 20% to 90% with a precision of 5%.
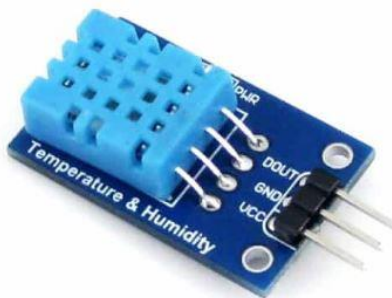
Figure 3.2: DHT11 Temperature & Humidity Sensor

MQ-9

MQ-9 sensor detects CO (Carbon Monoxide) /Combustible gas in air (in ppm). MQ-9 sensor operates on the principle of a tin dioxide (SnO_2) semiconductor sensing element, which changes its electrical resistance in the presence of combustible gases. The method utilized by this device for CO detection involves detecting high and low temperature cycles when the temperature is low and heated by 1.5V. Additionally, it boasts remarkable sensitivity to methane, propane, and LPG. The device is equipped with four pins, namely VCC, GND, DO (Digital Output), and AO (Analog Output). It is widely used, reasonably inexpensive, and suitable for a range of applications.
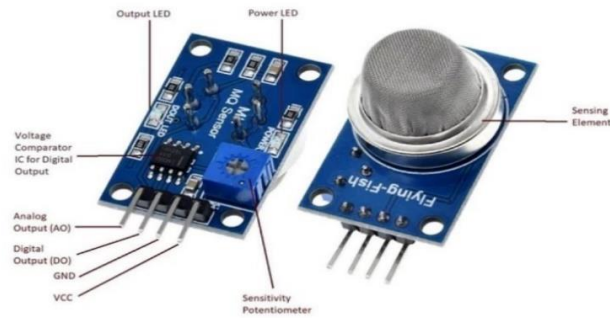
Figure 3.3: MQ-9 Gas Sensor

MQ-135

The MQ-135 gas sensor has the capability of detecting hazardous gases and smoke present in the air. These include Ammonia (NH3), Sulfur (S), Benzene (C6H6), and CO2. Its operating voltage is 2.5V to 5V, power consumption 150mA and it requires some pre heating for giving an accurate result. Four pins are on it. VCC, GND, DO (digital output), and AO (analogue output) are the pins. It is popular, cheaply priced, and appropriate for a variety of uses.
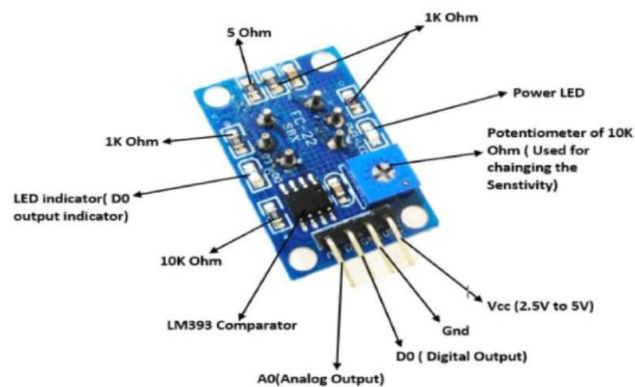

Figure 3.4: MQ-135 Gas Sensor

3.4 Design Specifications of IoT-Based Environment Monitoring System

The design of an IoT-based environmental monitoring system for Paltan, Dhaka, requires the specification of the project's main block diagram. The main target of the project is to assess the environmental impact of traditional fuel-based vehicle emissions in the area.

In this section we will illustrate the system's architecture, including the sensors, actuators, communication modules, and data storage. The sensors that will collect data on a variety of environmental parameters, such as air quality, humidity and temperature. The communication module which is ESP32 microcontroller here will be used to transmit data to a central server. And it is ThingSpeak platform and here data will be stored and analyzed.

Now the proposed block diagram illustrates the system's data flow. The data collected by the sensors which are DHT11, MQ-9 and MQ-135 will be transmitted to the actuators, which will then take action based on the data. The data will also be transmitted to the central server, where it will be stored and analyzed. The analysis of the data will be used to identify trends and patterns in the environmental data. This information will be used to inform decision-making about the management of the environment in Paltan, Dhaka.

This block diagram's information is essential for the development, implementation, and operation of the system.
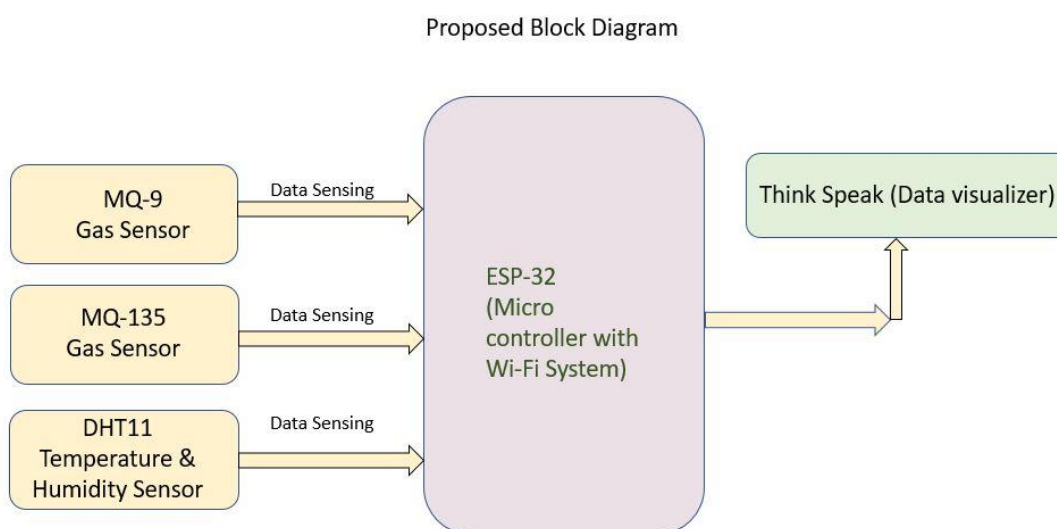
Figure 3.5: Block Diagram of IoT-Based Environment Monitoring System

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3.4.1 Arduino IDE & ThingSpeak

To run the IoT-based environmental monitoring system successfully, a program needs to be coded. The Arduino IDE is used to write the codes, and ThingSpeak is used to visualize the data collected from the sensors. And these two are the main platform to meet the project operation.

The Arduino IDE is an open-source integrated development environment (IDE) for writing and uploading programs to Arduino boards. It is a free and easy-to-use IDE that is available for Windows, macOS, and Linux.

A web-based platform called ThingSpeak enables users to gather, store, and visualize sensor data. A drag-and-drop user interface, a built-in library of sensors, and a robust API are just a few of the features that make using ThingSpeak simple. ThingSpeak is a free service that is accessible from everywhere in the world and is simple to use [21].

The Arduino IDE and ThingSpeak are both essential tools for developing and running an IoT-based environmental monitoring system. The Arduino IDE is used to write the code that will collect data from the sensors, and ThingSpeak is used to visualize the data and make it accessible to users.

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Figure 3.6: Code interface in Arduino IDE

The code in figure 3.6 is written in the Arduino programming language. It uses the ThingSpeak library to connect to the ThingSpeak platform and send data to the channel. The DHT library is used to read temperature and humidity data from the DHT sensor.

The code first initializes the serial monitor and the ThingSpeak client. Then, it initializes the DHT sensor. In the loop, the code reads temperature and humidity data from the sensor and writes it to ThingSpeak. The data is also printed to the serial monitor. And in Arduino IDE we have libraries for the gas sensors which are MQ-135 and MQ-9. And by including them we can get the data from these gas sensors. As like DHT11 sensor, they also show data in the serial monitor section and also in ThingSpeak.

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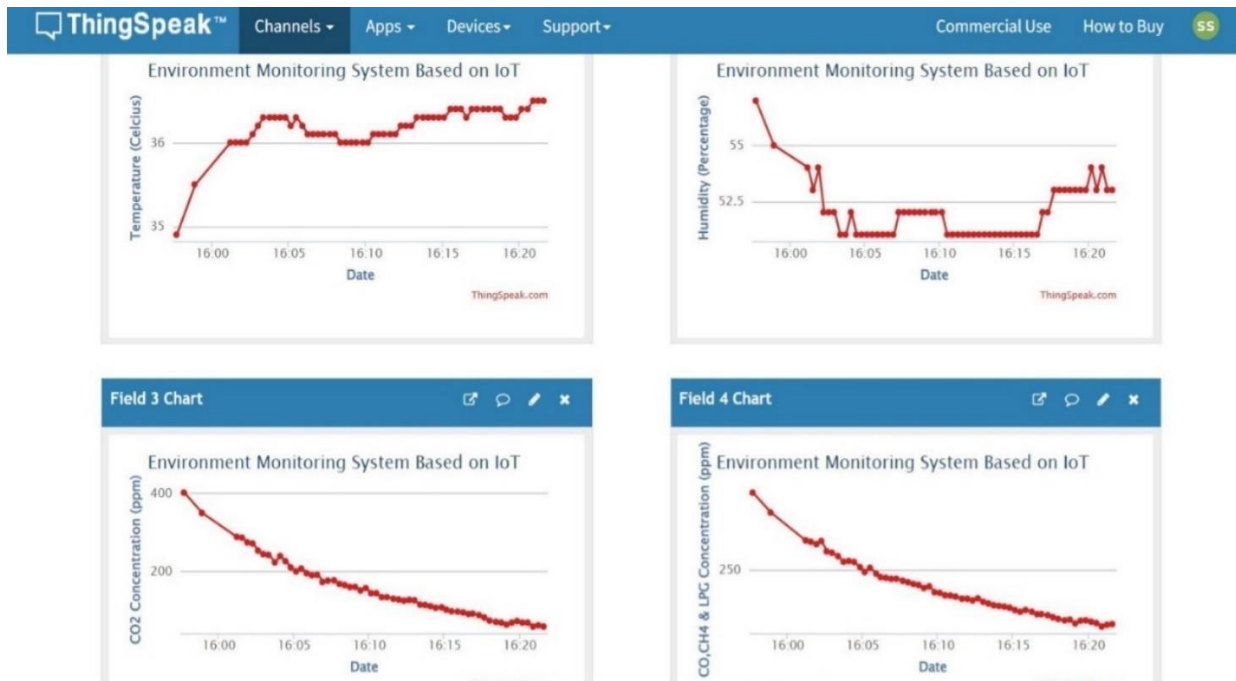
Figure 3.7: Data Visualization on ThingSpeak

Here in figure 3.8, we can see ThingSpeak is an IoT analytics platform that allows users to collect, visualize, and analyze real-time data from sensors. The data collected here from a variety of sensors, including temperature & humidity in C & % from DHT11 sensor, CO2 concentration in ppm from the gas sensor which is MQ-135, and CO, CH4, and LPG concentration in ppm from the gas sensor which is MQ-9. A range of tools for data visualization and analysis are available through ThingSpeak. Users can utilize MATLAB to carry out more complicated analysis as well as to produce graphs, charts, and maps to visualize the data.

3.5 System Analysis of IoT-Based Environment Monitoring System

The system may gather information from several sensors, giving it access to a thorough picture of the surroundings. It can be used to continuously monitor environmental variables and provide potential issues with early notice.

But there are some of the risks associated with an IoT-based environmental monitoring system:

- The system could be used to collect sensitive data about the environment.

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- The system could be used to disrupt or manipulate environmental data.

- The system could be used to attack critical infrastructure.

The system analysis should carefully consider the strengths, weaknesses, and risks of an IoT-based environmental monitoring system before it is implemented. This will help to ensure that the system is successful and that it does not pose any unnecessary risks.

3.6 Experimental Setup of IoT-Based Environment Monitoring System

The experimental setup of the IoT-based environment monitoring system is typically consisted of the following components:

- Sensors & Microcontroller Names: DHT11, MQ-9, MQ-135, ESP32 Module

- Sensor Work: The sensors collect data about the environment, such as temperature, humidity, CO2 concentration, and CO, CH4, and LPG concentration.

- Microcontroller Responsibility: The microcontroller is responsible for processing the data from the sensors and transmitting it to the cloud.

- Internet connection: The internet connection is used to transmit the data from the microcontroller to the cloud.

- Cloud platform (Arduino IDE & ThingSpeak): The cloud platform stores the data from the sensors and provides a platform for visualizing and analyzing the data both in Arduino IDE's serial monitor and on ThingSpeak.

This experimental setup can be configured to monitor a variety of environmental conditions. And it is used for a particular area in Dhaka which is Paltan. In figure 3.9 & figure 3.10 we can see the experimental setup for both hardware and software part.

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Figure 3.8: Experimental Setup of IoT-Based Environment Monitoring System Project (Hardware Part)

Figure 3.9: Experimental Setup of IoT-Based Environment Monitoring System Project (Software Part)

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3.7 Summary

In short, we can say that in this IoT-based environment monitoring system project we have visualized data by using the technology which is ThingSpeak and it makes this work simpler to comprehend and analyze. The hardware and software part are the core of this project. As without the help of the microcontroller and sensors it is impossible to understand the environmental condition.

CHAPTER 4
RESULTS AND DISCUSSIONS

4.1 Results & Observations

The primary objective of the project was to comprehend and evaluate the environment impact of conventional fuel-based vehicles as a result of their emissions. The study was conducted in Paltan, Dhaka, as a case study. So, after making this IoT-based environment monitoring system project we were able to get the data of vehicle emissions for that particular area. And also, we got the real time the temperature and humidity for that place. The data is stored in ThingSpeak which is an IoT analytics platform. Then from ThingSpeak cloud platform we have downloaded the data in CSV form and analyze the data in 2D graphical chart.

	A	B	C	D	E	F
1	DATE	TIME (Dhaka)	Temperature C (Field 1)	Humidity % (Field 2)	CO2 Concentration PPM (Field 3)	CO, CH4 & LPG Concentration PPM (Field 4)
2	2023-06-11	14:58:50	27.6	75	206	2031
3	2023-06-11	14:59:08	27.5	75	206	2030
4	2023-06-11	14:59:26	27.5	75	203	2037
5	2023-06-11	14:59:43	27.5	76	205	2027
6	2023-06-11	15:00:01	27.5	76	206	2021
7	2023-06-11	15:00:16	27.4	76	204	2017
8	2023-06-11	15:00:34	27.5	77	205	2023
9	2023-06-11	15:00:52	27.4	77	203	2018
10	2023-06-11	15:01:10	27.4	77	202	2014
11	2023-06-11	15:01:28	27.4	77	206	2005
12	2023-06-11	15:01:46	27.4	77	202	2016
13	2023-06-11	15:02:04	27.4	78	208	2013
14	2023-06-11	15:02:22	27.4	78	207	2005
15	2023-06-11	15:02:39	27.4	78	207	2006
16	2023-06-11	15:02:57	27.5	78	208	2003
17	2023-06-11	15:03:12	27.5	78	208	2003
18	2023-06-11	15:03:30	27.5	78	231	1993
19	2023-06-11	15:03:48	27.5	78	219	1985
20	2023-06-11	15:04:06	27.5	77	252	1984

Figure 4.1: Data Input in Excel from ThingSpeak Cloud Platform

Now, we will analyze this data separately. As we have collected the data two times in a day in Paltan, Dhaka. The first data is collected between 10:00 AM to 02:00 PM (10:00 to 14:00) and the second data is collected between 03:00 PM to 06:00PM (15:00 to 18:00) for 7 days.

4.1.1 First Slot Data Collection and Graphical Representation

Table 4.1: Temperature Data Collected Between 10:00 to 14:00

DATE	TIME (Dhaka)	Temperature (C)
2023-06-13	12:02:31	30.8
2023-06-13	12:02:52	31.1
2023-06-13	12:03:13	31.1
2023-06-13	12:03:36	31.1
2023-06-13	12:03:57	31.1
2023-06-13	12:04:18	31.1
2023-06-13	12:04:40	31.1
2023-06-13	12:05:01	31.1
2023-06-13	12:05:23	31.2
2023-06-13	12:05:44	31.2
2023-06-13	12:06:06	31.2
2023-06-13	12:06:27	31.2
2023-06-13	12:06:48	31.2
2023-06-13	12:07:10	31.2
2023-06-13	12:07:31	31.2
2023-06-13	12:07:53	31.2
2023-06-13	12:08:14	31.2
2023-06-13	12:08:35	31.2
2023-06-13	12:08:57	31.2
2023-06-13	12:09:19	31.2
2023-06-13	12:09:40	31.2
2023-06-13	12:10:02	31.3
2023-06-13	12:10:23	31.3
2023-06-13	12:10:44	31.2
2023-06-13	12:11:06	31.3
2023-06-13	12:11:27	31.2
2023-06-13	12:11:49	31.2
2023-06-13	12:12:10	31.2
2023-06-13	12:12:31	31.2
2023-06-13	12:12:53	31.3
2023-06-13	12:13:14	31.2
2023-06-13	12:13:36	31.3
2023-06-13	12:13:57	31.3
2023-06-13	12:14:19	31.3
2023-06-13	12:14:40	31.4
2023-06-13	12:15:01	31.4
2023-06-13	12:15:23	31.4
2023-06-13	12:15:45	31.4
2023-06-13	12:16:06	31.4

2023-06-13	12:16:27	31.4
2023-06-13	12:16:49	31.4
2023-06-13	12:17:10	31.4
2023-06-13	12:17:32	31.4
2023-06-13	12:17:53	31.3
2023-06-13	12:18:15	31.3
2023-06-13	12:18:36	31.4
2023-06-13	12:18:58	31.4
2023-06-13	12:19:19	31.4
2023-06-13	12:19:40	31.4
2023-06-13	12:20:02	31.4
2023-06-13	12:20:23	31.4
2023-06-13	12:20:44	31.4
2023-06-13	12:21:06	31.5
2023-06-13	12:21:27	31.5
2023-06-13	12:21:49	31.5
2023-06-13	12:22:10	31.5
2023-06-13	12:22:32	31.5
2023-06-13	12:22:53	31.5
2023-06-13	12:23:15	31.5
2023-06-13	12:23:36	31.5
2023-06-13	12:23:58	31.5
2023-06-13	12:24:19	31.5
2023-06-13	12:24:41	31.5
2023-06-13	12:25:02	31.5
2023-06-13	12:25:23	31.5
2023-06-13	12:25:45	31.5
2023-06-13	12:26:07	31.5
2023-06-13	12:26:28	31.5
2023-06-13	12:26:49	31.5
2023-06-13	12:27:11	31.5
2023-06-13	12:27:32	31.5
2023-06-13	12:27:53	31.5
2023-06-13	12:28:15	31.5
2023-06-13	12:28:36	31.5
2023-06-13	12:28:58	31.5
2023-06-13	12:29:19	31.5
2023-06-13	12:29:41	31.5
2023-06-13	12:30:02	31.5
2023-06-13	12:30:23	31.5
2023-06-13	12:30:45	31.5
2023-06-13	12:31:06	31.5
2023-06-13	12:31:28	31.5
2023-06-13	12:31:50	31.5
2023-06-13	12:32:11	31.5
2023-06-13	12:32:32	31.5

2023-06-13	12:32:54	31.5
2023-06-13	12:33:15	31.5
2023-06-13	12:33:36	31.5
2023-06-13	12:33:58	31.5
2023-06-13	12:34:19	31.5
2023-06-13	12:34:41	31.5
2023-06-13	12:35:02	31.5
2023-06-13	12:35:24	31.5
2023-06-13	12:35:45	31.5
2023-06-13	12:36:06	31.5
2023-06-13	12:36:28	31.5
2023-06-13	12:36:50	31.5
2023-06-13	12:37:11	31.5
2023-06-13	12:37:33	31.5
2023-06-13	12:37:54	31.4
2023-06-13	12:38:15	31.5
2023-06-13	12:38:37	31.5
2023-06-13	12:38:58	31.5
2023-06-13	12:39:20	31.5
2023-06-14	10:46:48	30.9
2023-06-14	10:47:10	32.3
2023-06-14	10:47:34	32.7
2023-06-14	10:47:55	33
2023-06-14	10:48:17	33.3
2023-06-14	10:48:38	33.4
2023-06-14	10:48:59	33.5
2023-06-14	10:49:21	33.7
2023-06-14	10:50:29	33.8
2023-06-14	10:50:50	33.9
2023-06-14	10:51:13	33.9
2023-06-14	10:51:37	34
2023-06-14	10:51:59	34.1
2023-06-14	10:52:20	34.2
2023-06-14	10:53:12	34.2
2023-06-14	10:53:33	34.3
2023-06-14	10:53:55	34.4
2023-06-14	10:54:16	34.5
2023-06-14	10:54:37	34.5
2023-06-14	10:54:59	34.5
2023-06-14	10:55:20	34.5
2023-06-14	10:55:41	34.5
2023-06-14	10:56:03	34.6
2023-06-14	10:56:24	34.6
2023-06-14	10:56:46	34.6
2023-06-14	10:57:07	34.7
2023-06-14	10:57:28	34.7

29

2023-06-14	10:57:50	34.7
2023-06-14	10:58:11	34.8
2023-06-14	10:58:33	34.9
2023-06-14	10:58:54	34.9
2023-06-14	10:59:15	35
2023-06-14	10:59:38	35
2023-06-14	10:59:59	35.1
2023-06-14	11:00:23	35.1
2023-06-14	11:00:44	35.1
2023-06-14	11:01:06	35.1
2023-06-14	11:01:27	35.1
2023-06-14	11:01:48	35
2023-06-14	11:02:10	35
2023-06-14	11:02:31	35
2023-06-14	11:02:53	35
2023-06-14	11:03:14	35
2023-06-14	11:03:35	35
2023-06-14	11:03:57	35
2023-06-14	11:04:18	35.1
2023-06-14	11:04:39	35.1
2023-06-14	11:05:01	35.1
2023-06-14	11:05:22	35.1
2023-06-14	11:05:44	35.2
2023-06-14	11:06:05	35.2
2023-06-14	11:06:26	35.3
2023-06-14	11:06:48	35.3
2023-06-14	11:07:09	35.4
2023-06-14	11:07:30	35.4
2023-06-14	11:07:52	35.5
2023-06-14	11:08:14	35.5
2023-06-14	11:08:35	35.5
2023-06-14	11:08:56	35.6
2023-06-14	11:09:18	35.6
2023-06-14	11:09:39	35.7
2023-06-14	11:10:00	35.7
2023-06-14	11:10:22	35.7
2023-06-14	11:10:43	35.8
2023-06-14	11:11:04	35.9
2023-06-14	11:11:26	35.9
2023-06-14	11:11:47	35.8
2023-06-14	11:12:09	34.7
2023-06-15	12:05:20	31.3
2023-06-15	12:05:41	31.5
2023-06-15	12:06:03	31.6
2023-06-15	12:06:24	31.7
2023-06-15	12:06:46	31.8

2023-06-15	12:07:09	31.8
2023-06-15	12:07:31	31.9
2023-06-15	12:08:19	31.9
2023-06-15	12:08:42	32
2023-06-15	12:09:04	32.1
2023-06-15	12:09:26	32.1
2023-06-15	12:09:51	32.2
2023-06-15	12:10:13	32.3
2023-06-15	12:10:35	32.3
2023-06-15	12:11:00	32.4
2023-06-15	12:11:25	32.5
2023-06-15	12:11:47	32.6
2023-06-15	12:12:08	32.6
2023-06-15	12:12:31	32.7
2023-06-15	12:12:52	32.7
2023-06-15	12:13:14	32.6
2023-06-15	12:13:35	32.5
2023-06-15	12:13:57	32.5
2023-06-15	12:14:18	32.5
2023-06-15	12:14:40	32.6
2023-06-15	12:15:01	32.6
2023-06-15	12:15:22	32.7
2023-06-15	12:15:44	32.8
2023-06-15	12:16:05	32.8
2023-06-15	12:16:27	32.9
2023-06-15	12:16:48	32.9
2023-06-15	12:17:10	32.9
2023-06-15	12:17:31	32.8
2023-06-15	12:17:53	32.8
2023-06-15	12:18:37	32.9
2023-06-15	12:18:58	32.9
2023-06-15	12:19:43	33
2023-06-15	12:20:04	33.1
2023-06-15	12:20:49	33.1
2023-06-15	12:21:10	33.2
2023-06-15	12:21:32	33.2
2023-06-15	12:21:53	33.2
2023-06-15	12:22:15	33.2
2023-06-15	12:22:36	33
2023-06-15	12:22:58	33
2023-06-15	12:23:19	33
2023-06-15	12:23:40	32.9
2023-06-15	12:24:02	32.9
2023-06-15	12:24:23	33
2023-06-15	12:24:44	33
2023-06-15	12:25:06	33

2023-06-15	12:25:27	33
2023-06-15	12:25:48	33
2023-06-15	12:26:10	32.9
2023-06-15	12:26:32	32.9
2023-06-15	12:26:53	32.9
2023-06-15	12:27:15	32.8
2023-06-15	12:27:36	32.8
2023-06-15	12:27:58	32.8
2023-06-15	12:28:19	32.8
2023-06-15	12:28:41	32.9
2023-06-15	12:29:02	33
2023-06-15	12:29:23	33
2023-06-15	12:29:45	33.1
2023-06-15	12:30:06	33.2
2023-06-15	12:30:27	33.3
2023-06-15	12:30:49	33.3
2023-06-15	12:31:10	33.4
2023-06-15	12:31:32	33.4
2023-06-15	12:31:53	33.5
2023-06-15	12:32:15	33.5
2023-06-15	12:32:36	33.5
2023-06-15	12:32:57	33.6
2023-06-15	12:33:19	33.5
2023-06-15	12:33:40	33.5
2023-06-15	12:34:02	33.5
2023-06-15	12:34:23	33.6
2023-06-15	12:34:45	33.6
2023-06-15	12:35:06	33.5
2023-06-15	12:35:27	33.4
2023-06-15	12:35:49	33.4
2023-06-15	12:36:10	33.4
2023-06-15	12:36:31	33.4
2023-06-15	12:36:53	33.4
2023-06-15	12:37:14	33.4
2023-06-15	12:37:36	33.3
2023-06-15	12:37:58	33.2
2023-06-15	12:38:20	33.3
2023-06-15	12:38:41	33.3
2023-06-15	12:39:03	33.4
2023-06-15	12:39:24	33.4
2023-06-15	12:39:45	33.3
2023-06-15	12:40:07	33.3
2023-06-15	12:40:28	33.4
2023-06-15	12:40:50	33.4
2023-06-15	12:41:12	33.4
2023-06-15	12:41:33	33.5

2023-06-15	12:41:54	33.5
2023-06-15	12:42:16	33.6
2023-06-15	12:42:37	33.6
2023-06-15	12:42:58	33.7
2023-06-15	12:43:20	33.7
2023-06-15	12:43:41	33.7
2023-06-15	12:44:03	33.6
2023-06-15	12:44:24	33.6
2023-06-15	12:44:46	33.6
2023-06-15	12:45:30	33.6
2023-06-17	10:58:24	31.1
2023-06-17	10:58:45	30.8
2023-06-17	10:59:06	30.5
2023-06-17	10:59:28	30.3
2023-06-17	10:59:49	30.1
2023-06-17	11:00:11	30
2023-06-17	11:00:32	29.8
2023-06-17	11:00:53	29.7
2023-06-17	11:01:15	29.6
2023-06-17	11:01:36	29.5
2023-06-17	11:01:57	29.4
2023-06-17	11:02:19	29.2
2023-06-17	11:02:40	29.1
2023-06-17	11:03:02	29.1
2023-06-17	11:03:23	29
2023-06-17	11:03:44	28.9
2023-06-17	11:04:06	28.8
2023-06-17	11:04:27	28.7
2023-06-17	11:04:49	28.7
2023-06-17	11:05:10	28.6
2023-06-17	11:05:31	28.6
2023-06-17	11:05:52	28.5
2023-06-17	11:06:14	28.4
2023-06-17	11:06:35	28.4
2023-06-17	11:06:57	28.3
2023-06-17	11:07:18	28.3
2023-06-17	11:07:39	28.3
2023-06-17	11:08:01	28.9
2023-06-17	11:08:22	29.8
2023-06-17	11:08:43	30.7
2023-06-17	11:09:05	31.4
2023-06-17	11:09:26	32
2023-06-17	11:09:47	32.4
2023-06-17	11:10:09	32.9
2023-06-17	11:10:30	33.2
2023-06-17	11:10:51	33.4

2023-06-17	11:11:13	33.6
2023-06-17	11:11:34	33.8
2023-06-17	11:11:56	33.9
2023-06-17	11:12:17	34.1
2023-06-17	11:12:39	34.2
2023-06-17	11:13:00	34.2
2023-06-17	11:13:21	34.2
2023-06-17	11:13:43	34.2
2023-06-17	11:14:04	34.2
2023-06-17	11:14:25	34.1
2023-06-17	11:14:47	34.1
2023-06-17	11:15:08	34.1
2023-06-17	11:15:30	34.1
2023-06-17	11:15:51	34.1
2023-06-17	11:16:12	34.1
2023-06-17	11:16:34	34.1
2023-06-17	11:16:55	34.1
2023-06-17	11:17:16	34.1
2023-06-17	11:17:38	34
2023-06-17	11:17:59	34.1
2023-06-17	11:18:20	34.1
2023-06-17	11:18:42	34.1
2023-06-17	11:19:03	34.1
2023-06-17	11:19:25	34.1
2023-06-17	11:19:46	34.1
2023-06-17	11:20:08	34.2
2023-06-17	11:20:29	34.2
2023-06-17	11:20:50	34.2
2023-06-17	11:21:12	34.2
2023-06-17	11:21:33	34.2
2023-06-17	11:21:55	34.3
2023-06-17	11:22:16	34.3
2023-06-17	11:22:37	34.3
2023-06-17	11:22:59	34.4
2023-06-17	11:23:20	34.4
2023-06-17	11:23:41	34.5
2023-06-17	11:24:03	34.6
2023-06-17	11:24:24	34.8
2023-06-17	11:24:46	35.1
2023-06-17	11:25:07	35.2
2023-06-17	11:25:28	35.3
2023-06-17	11:25:50	35.5
2023-06-17	11:26:11	35.6
2023-06-17	11:26:33	35.7
2023-06-17	11:26:54	35.7
2023-06-17	11:27:15	35.7

2023-06-17	11:27:37	35.7
2023-06-17	11:27:58	35.7
2023-06-17	11:28:20	35.7
2023-06-17	11:28:41	35.7
2023-06-17	11:29:02	35.7
2023-06-17	11:29:24	35.7
2023-06-17	11:29:45	35.7
2023-06-17	11:30:06	35.7
2023-06-17	11:30:28	35.6
2023-06-17	11:30:49	35.5
2023-06-17	11:31:10	35.5
2023-06-17	11:31:32	35.4
2023-06-17	11:31:53	35.4
2023-06-17	11:32:15	35.4
2023-06-17	11:32:36	35.3
2023-06-17	11:32:57	35.4
2023-06-17	11:33:19	35.4
2023-06-17	11:33:40	35.4
2023-06-19	12:49:53	29.1
2023-06-19	12:50:16	29.1
2023-06-19	12:50:38	29.1
2023-06-19	12:50:59	28.9
2023-06-19	12:51:20	28.9
2023-06-19	12:51:42	28.8
2023-06-19	12:52:03	28.6
2023-06-19	12:52:25	28.8
2023-06-19	12:52:46	29.4
2023-06-19	12:53:08	30
2023-06-19	12:53:29	30.5
2023-06-19	12:53:51	31
2023-06-19	12:54:12	31.4
2023-06-19	12:54:34	31.7
2023-06-19	12:54:55	31.9
2023-06-19	12:55:16	32.2
2023-06-19	12:55:38	32.4
2023-06-19	12:56:00	32.7
2023-06-19	12:56:21	33.1
2023-06-19	12:56:42	33.4
2023-06-19	12:57:04	33.6
2023-06-19	12:57:25	33.8
2023-06-19	12:57:46	33.9
2023-06-19	12:58:08	33.8
2023-06-19	12:58:29	33.9
2023-06-19	12:58:50	34
2023-06-19	12:59:12	34
2023-06-19	12:59:33	34.1

2023-06-19	12:59:54	34.1
2023-06-19	13:00:16	34.2
2023-06-19	13:00:37	34.3
2023-06-19	13:00:59	34.3
2023-06-19	13:01:21	34.3
2023-06-19	13:01:42	34.3
2023-06-19	13:02:04	34.4
2023-06-19	13:02:25	34.5
2023-06-19	13:02:47	34.5
2023-06-19	13:03:08	34.6
2023-06-19	13:03:29	34.6
2023-06-19	13:03:51	34.6
2023-06-19	13:04:12	34.6
2023-06-19	13:04:34	34.6
2023-06-19	13:04:55	34.6
2023-06-19	13:05:16	34.5
2023-06-19	13:05:38	34.5
2023-06-19	13:06:00	34.5
2023-06-19	13:06:21	34.5
2023-06-19	13:06:43	34.4
2023-06-19	13:07:04	34.4
2023-06-19	13:07:25	34.5
2023-06-19	13:07:47	34.4
2023-06-19	13:08:08	34.4
2023-06-19	13:08:29	34.4
2023-06-19	13:08:51	34.3
2023-06-19	13:09:12	34.3
2023-06-19	13:09:34	34.2
2023-06-19	13:09:55	34.2
2023-06-19	13:10:17	34.2
2023-06-19	13:10:38	34.1
2023-06-19	13:11:00	34.1
2023-06-19	13:11:21	33.5
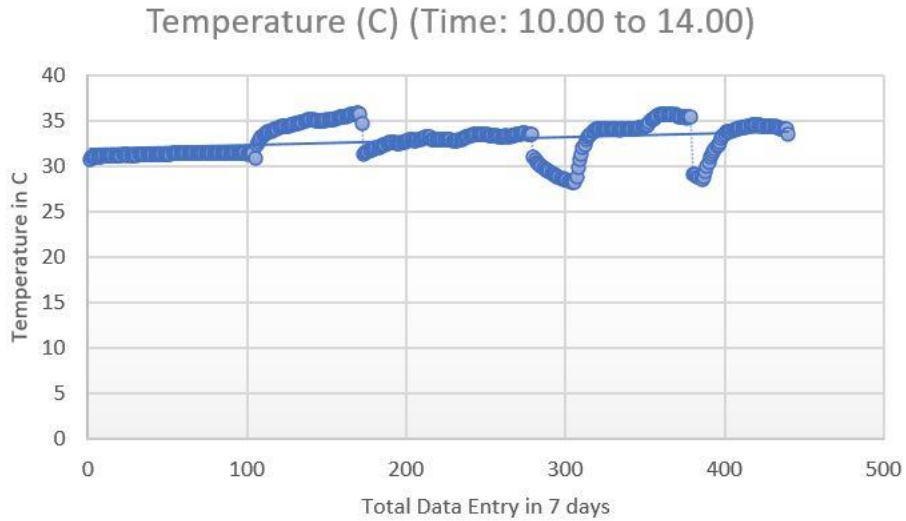
Figure 4.2: Graphical Representation of Temperature in C for First Slot (Paltan, Dhaka) (Data Collected by DHT11)

Table 4.2: Humidity Data Collected Between 10:00 to 14:00

DATE	TIME (Dhaka)	Humidity (%)
2023-06-13	12:02:31	76
2023-06-13	12:02:52	75
2023-06-13	12:03:13	75
2023-06-13	12:03:36	75
2023-06-13	12:03:57	75
2023-06-13	12:04:18	75
2023-06-13	12:04:40	75
2023-06-13	12:05:01	75
2023-06-13	12:05:23	75
2023-06-13	12:05:44	75
2023-06-13	12:06:06	75
2023-06-13	12:06:27	75
2023-06-13	12:06:48	75
2023-06-13	12:07:10	75
2023-06-13	12:07:31	75
2023-06-13	12:07:53	75
2023-06-13	12:08:14	74
2023-06-13	12:08:35	74
2023-06-13	12:08:57	74
2023-06-13	12:09:19	74
2023-06-13	12:09:40	74

37

2023-06-13	12:10:02	74
2023-06-13	12:10:23	74
2023-06-13	12:10:44	74
2023-06-13	12:11:06	74
2023-06-13	12:11:27	74
2023-06-13	12:11:49	74
2023-06-13	12:12:10	74
2023-06-13	12:12:31	74
2023-06-13	12:12:53	74
2023-06-13	12:13:14	74
2023-06-13	12:13:36	74
2023-06-13	12:13:57	74
2023-06-13	12:14:19	74
2023-06-13	12:14:40	73
2023-06-13	12:15:01	73
2023-06-13	12:15:23	73
2023-06-13	12:15:45	73
2023-06-13	12:16:06	73
2023-06-13	12:16:27	73
2023-06-13	12:16:49	73
2023-06-13	12:17:10	73
2023-06-13	12:17:32	73
2023-06-13	12:17:53	73
2023-06-13	12:18:15	74
2023-06-13	12:18:36	74
2023-06-13	12:18:58	74
2023-06-13	12:19:19	74
2023-06-13	12:19:40	74
2023-06-13	12:20:02	74
2023-06-13	12:20:23	74
2023-06-13	12:20:44	74
2023-06-13	12:21:06	74
2023-06-13	12:21:27	74
2023-06-13	12:21:49	74
2023-06-13	12:22:10	73
2023-06-13	12:22:32	73
2023-06-13	12:22:53	73
2023-06-13	12:23:15	73
2023-06-13	12:23:36	73
2023-06-13	12:23:58	73
2023-06-13	12:24:19	73
2023-06-13	12:24:41	73
2023-06-13	12:25:02	73
2023-06-13	12:25:23	73
2023-06-13	12:25:45	73
2023-06-13	12:26:07	73

2023-06-13	12:26:28	73
2023-06-13	12:26:49	73
2023-06-13	12:27:11	74
2023-06-13	12:27:32	74
2023-06-13	12:27:53	74
2023-06-13	12:28:15	73
2023-06-13	12:28:36	74
2023-06-13	12:28:58	73
2023-06-13	12:29:19	73
2023-06-13	12:29:41	73
2023-06-13	12:30:02	73
2023-06-13	12:30:23	73
2023-06-13	12:30:45	73
2023-06-13	12:31:06	73
2023-06-13	12:31:28	73
2023-06-13	12:31:50	73
2023-06-13	12:32:11	73
2023-06-13	12:32:32	73
2023-06-13	12:32:54	73
2023-06-13	12:33:15	72
2023-06-13	12:33:36	72
2023-06-13	12:33:58	72
2023-06-13	12:34:19	72
2023-06-13	12:34:41	72
2023-06-13	12:35:02	72
2023-06-13	12:35:24	73
2023-06-13	12:35:45	73
2023-06-13	12:36:06	72
2023-06-13	12:36:28	73
2023-06-13	12:36:50	73
2023-06-13	12:37:11	73
2023-06-13	12:37:33	73
2023-06-13	12:37:54	73
2023-06-13	12:38:15	73
2023-06-13	12:38:37	73
2023-06-13	12:38:58	73
2023-06-13	12:39:20	73
2023-06-14	10:46:48	82
2023-06-14	10:47:10	74
2023-06-14	10:47:34	72
2023-06-14	10:47:55	71
2023-06-14	10:48:17	69
2023-06-14	10:48:38	68
2023-06-14	10:48:59	66
2023-06-14	10:49:21	66
2023-06-14	10:50:29	64

2023-06-14	10:50:50	64
2023-06-14	10:51:13	64
2023-06-14	10:51:37	64
2023-06-14	10:51:59	63
2023-06-14	10:52:20	63
2023-06-14	10:53:12	62
2023-06-14	10:53:33	62
2023-06-14	10:53:55	62
2023-06-14	10:54:16	62
2023-06-14	10:54:37	62
2023-06-14	10:54:59	62
2023-06-14	10:55:20	61
2023-06-14	10:55:41	61
2023-06-14	10:56:03	61
2023-06-14	10:56:24	60
2023-06-14	10:56:46	60
2023-06-14	10:57:07	60
2023-06-14	10:57:28	60
2023-06-14	10:57:50	60
2023-06-14	10:58:11	60
2023-06-14	10:58:33	60
2023-06-14	10:58:54	60
2023-06-14	10:59:15	59
2023-06-14	10:59:38	59
2023-06-14	10:59:59	59
2023-06-14	11:00:23	59
2023-06-14	11:00:44	59
2023-06-14	11:01:06	59
2023-06-14	11:01:27	60
2023-06-14	11:01:48	60
2023-06-14	11:02:10	60
2023-06-14	11:02:31	59
2023-06-14	11:02:53	60
2023-06-14	11:03:14	60
2023-06-14	11:03:35	60
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2023-06-14	11:04:18	60
2023-06-14	11:04:39	60
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2023-06-14	11:05:22	60
2023-06-14	11:05:44	59
2023-06-14	11:06:05	60
2023-06-14	11:06:26	59
2023-06-14	11:06:48	59
2023-06-14	11:07:09	59
2023-06-14	11:07:30	59

2023-06-14	11:07:52	59
2023-06-14	11:08:14	58
2023-06-14	11:08:35	58
2023-06-14	11:08:56	58
2023-06-14	11:09:18	58
2023-06-14	11:09:39	58
2023-06-14	11:10:00	57
2023-06-14	11:10:22	57
2023-06-14	11:10:43	57
2023-06-14	11:11:04	57
2023-06-14	11:11:26	57
2023-06-14	11:11:47	45
2023-06-14	11:12:09	38
2023-06-15	12:05:20	71
2023-06-15	12:05:41	70
2023-06-15	12:06:03	69
2023-06-15	12:06:24	68
2023-06-15	12:06:46	68
2023-06-15	12:07:09	67
2023-06-15	12:07:31	67
2023-06-15	12:08:19	67
2023-06-15	12:08:42	67
2023-06-15	12:09:04	66
2023-06-15	12:09:26	65
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2023-06-15	12:10:35	65
2023-06-15	12:11:00	65
2023-06-15	12:11:25	64
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2023-06-15	12:12:08	64
2023-06-15	12:12:31	64
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2023-06-15	12:15:22	64
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2023-06-15	12:16:05	64
2023-06-15	12:16:27	64
2023-06-15	12:16:48	64
2023-06-15	12:17:10	64
2023-06-15	12:17:31	64

2023-06-15	12:17:53	64
2023-06-15	12:18:37	64
2023-06-15	12:18:58	64
2023-06-15	12:19:43	64
2023-06-15	12:20:04	64
2023-06-15	12:20:49	63
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2023-06-15	12:21:32	63
2023-06-15	12:21:53	63
2023-06-15	12:22:15	64
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2023-06-15	12:23:19	64
2023-06-15	12:23:40	64
2023-06-15	12:24:02	64
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2023-06-15	12:28:41	65
2023-06-15	12:29:02	65
2023-06-15	12:29:23	65
2023-06-15	12:29:45	64
2023-06-15	12:30:06	64
2023-06-15	12:30:27	64
2023-06-15	12:30:49	64
2023-06-15	12:31:10	64
2023-06-15	12:31:32	64
2023-06-15	12:31:53	63
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2023-06-15	12:32:36	63
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2023-06-15	12:33:19	63
2023-06-15	12:33:40	63
2023-06-15	12:34:02	63
2023-06-15	12:34:23	63
2023-06-15	12:34:45	63
2023-06-15	12:35:06	64

2023-06-15	12:35:27	64
2023-06-15	12:35:49	64
2023-06-15	12:36:10	64
2023-06-15	12:36:31	64
2023-06-15	12:36:53	64
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2023-06-15	12:37:58	65
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2023-06-15	12:39:03	64
2023-06-15	12:39:24	64
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2023-06-15	12:40:50	65
2023-06-15	12:41:12	64
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2023-06-15	12:41:54	64
2023-06-15	12:42:16	64
2023-06-15	12:42:37	64
2023-06-15	12:42:58	64
2023-06-15	12:43:20	64
2023-06-15	12:43:41	64
2023-06-15	12:44:03	64
2023-06-15	12:44:24	64
2023-06-15	12:44:46	64
2023-06-15	12:45:30	64
2023-06-17	10:58:24	66
2023-06-17	10:58:45	64
2023-06-17	10:59:06	63
2023-06-17	10:59:28	62
2023-06-17	10:59:49	61
2023-06-17	11:00:11	60
2023-06-17	11:00:32	59
2023-06-17	11:00:53	57
2023-06-17	11:01:15	56
2023-06-17	11:01:36	55
2023-06-17	11:01:57	54
2023-06-17	11:02:19	53
2023-06-17	11:02:40	52
2023-06-17	11:03:02	52
2023-06-17	11:03:23	51
2023-06-17	11:03:44	51
2023-06-17	11:04:06	50
2023-06-17	11:04:27	50

2023-06-17	11:04:49	49
2023-06-17	11:05:10	48
2023-06-17	11:05:31	47
2023-06-17	11:05:52	47
2023-06-17	11:06:14	47
2023-06-17	11:06:35	46
2023-06-17	11:06:57	46
2023-06-17	11:07:18	45
2023-06-17	11:07:39	58
2023-06-17	11:08:01	79
2023-06-17	11:08:22	83
2023-06-17	11:08:43	81
2023-06-17	11:09:05	77
2023-06-17	11:09:26	74
2023-06-17	11:09:47	72
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2023-06-17	11:10:30	69
2023-06-17	11:10:51	67
2023-06-17	11:11:13	66
2023-06-17	11:11:34	65
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2023-06-17	11:12:17	64
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2023-06-17	11:13:21	64
2023-06-17	11:13:43	64
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2023-06-17	11:14:25	64
2023-06-17	11:14:47	64
2023-06-17	11:15:08	64
2023-06-17	11:15:30	63
2023-06-17	11:15:51	64
2023-06-17	11:16:12	64
2023-06-17	11:16:34	64
2023-06-17	11:16:55	64
2023-06-17	11:17:16	63
2023-06-17	11:17:38	64
2023-06-17	11:17:59	63
2023-06-17	11:18:20	63
2023-06-17	11:18:42	63
2023-06-17	11:19:03	63
2023-06-17	11:19:25	64
2023-06-17	11:19:46	64
2023-06-17	11:20:08	64
2023-06-17	11:20:29	64
2023-06-17	11:20:50	64

2023-06-17	11:21:12	64
2023-06-17	11:21:33	63
2023-06-17	11:21:55	63
2023-06-17	11:22:16	63
2023-06-17	11:22:37	63
2023-06-17	11:22:59	63
2023-06-17	11:23:20	63
2023-06-17	11:23:41	63
2023-06-17	11:24:03	62
2023-06-17	11:24:24	61
2023-06-17	11:24:46	61
2023-06-17	11:25:07	60
2023-06-17	11:25:28	60
2023-06-17	11:25:50	60
2023-06-17	11:26:11	58
2023-06-17	11:26:33	59
2023-06-17	11:26:54	59
2023-06-17	11:27:15	59
2023-06-17	11:27:37	59
2023-06-17	11:27:58	58
2023-06-17	11:28:20	59
2023-06-17	11:28:41	59
2023-06-17	11:29:02	58
2023-06-17	11:29:24	58
2023-06-17	11:29:45	58
2023-06-17	11:30:06	58
2023-06-17	11:30:28	58
2023-06-17	11:30:49	59
2023-06-17	11:31:10	59
2023-06-17	11:31:32	59
2023-06-17	11:31:53	59
2023-06-17	11:32:15	60
2023-06-17	11:32:36	60
2023-06-17	11:32:57	60
2023-06-17	11:33:19	60
2023-06-17	11:33:40	60
2023-06-19	12:49:53	61
2023-06-19	12:50:16	64
2023-06-19	12:50:38	64
2023-06-19	12:50:59	55
2023-06-19	12:51:20	60
2023-06-19	12:51:42	58
2023-06-19	12:52:03	48
2023-06-19	12:52:25	69
2023-06-19	12:52:46	75
2023-06-19	12:53:08	76

45

2023-06-19	12:53:29	75
2023-06-19	12:53:51	74
2023-06-19	12:54:12	73
2023-06-19	12:54:34	71
2023-06-19	12:54:55	71
2023-06-19	12:55:16	70
2023-06-19	12:55:38	69
2023-06-19	12:56:00	68
2023-06-19	12:56:21	67
2023-06-19	12:56:42	66
2023-06-19	12:57:04	65
2023-06-19	12:57:25	63
2023-06-19	12:57:46	63
2023-06-19	12:58:08	62
2023-06-19	12:58:29	63
2023-06-19	12:58:50	63
2023-06-19	12:59:12	62
2023-06-19	12:59:33	61
2023-06-19	12:59:54	61
2023-06-19	13:00:16	61
2023-06-19	13:00:37	61
2023-06-19	13:00:59	60
2023-06-19	13:01:21	61
2023-06-19	13:01:42	61
2023-06-19	13:02:04	61
2023-06-19	13:02:25	61
2023-06-19	13:02:47	60
2023-06-19	13:03:08	60
2023-06-19	13:03:29	60
2023-06-19	13:03:51	60
2023-06-19	13:04:12	59
2023-06-19	13:04:34	59
2023-06-19	13:04:55	60
2023-06-19	13:05:16	60
2023-06-19	13:05:38	59
2023-06-19	13:06:00	61
2023-06-19	13:06:21	61
2023-06-19	13:06:43	60
2023-06-19	13:07:04	60
2023-06-19	13:07:25	61
2023-06-19	13:07:47	61
2023-06-19	13:08:08	62
2023-06-19	13:08:29	61
2023-06-19	13:08:51	61
2023-06-19	13:09:12	61
2023-06-19	13:09:34	61

2023-06-19	13:09:55	61
2023-06-19	13:10:17	61
2023-06-19	13:10:38	60
2023-06-19	13:11:00	61
2023-06-19	13:11:21	25
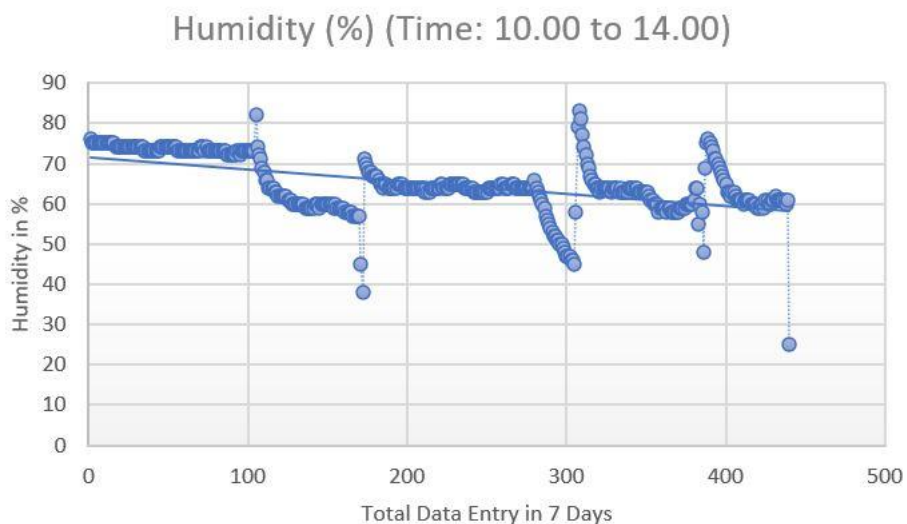
Figure 4.3: Graphical Representation of Humidity in % for First Slot (Paltan, Dhaka)
(Data Collected by DHT11)

Table 4.3: CO2 Data Collected Between 10:00 to 14:00

DATE	TIME (Dhaka)	CO2 Concentration (PPM)
2023-06-13	12:02:31	243
2023-06-13	12:02:52	235
2023-06-13	12:03:13	247
2023-06-13	12:03:36	239
2023-06-13	12:03:57	223
2023-06-13	12:04:18	220
2023-06-13	12:04:40	225
2023-06-13	12:05:01	227
2023-06-13	12:05:23	224
2023-06-13	12:05:44	227
2023-06-13	12:06:06	226
2023-06-13	12:06:27	232
2023-06-13	12:06:48	240

2023-06-13	12:07:10	242
2023-06-13	12:07:31	231
2023-06-13	12:07:53	240
2023-06-13	12:08:14	243
2023-06-13	12:08:35	247
2023-06-13	12:08:57	244
2023-06-13	12:09:19	256
2023-06-13	12:09:40	257
2023-06-13	12:10:02	254
2023-06-13	12:10:23	286
2023-06-13	12:10:44	257
2023-06-13	12:11:06	258
2023-06-13	12:11:27	261
2023-06-13	12:11:49	263
2023-06-13	12:12:10	275
2023-06-13	12:12:31	311
2023-06-13	12:12:53	250
2023-06-13	12:13:14	249
2023-06-13	12:13:36	256
2023-06-13	12:13:57	250
2023-06-13	12:14:19	242
2023-06-13	12:14:40	264
2023-06-13	12:15:01	240
2023-06-13	12:15:23	236
2023-06-13	12:15:45	240
2023-06-13	12:16:06	239
2023-06-13	12:16:27	238
2023-06-13	12:16:49	228
2023-06-13	12:17:10	230
2023-06-13	12:17:32	253
2023-06-13	12:17:53	245
2023-06-13	12:18:15	227
2023-06-13	12:18:36	240
2023-06-13	12:18:58	239
2023-06-13	12:19:19	233
2023-06-13	12:19:40	230
2023-06-13	12:20:02	240
2023-06-13	12:20:23	215
2023-06-13	12:20:44	214
2023-06-13	12:21:06	222
2023-06-13	12:21:27	217
2023-06-13	12:21:49	220
2023-06-13	12:22:10	208
2023-06-13	12:22:32	218
2023-06-13	12:22:53	189
2023-06-13	12:23:15	217

2023-06-13	12:23:36	218
2023-06-13	12:23:58	215
2023-06-13	12:24:19	219
2023-06-13	12:24:41	237
2023-06-13	12:25:02	218
2023-06-13	12:25:23	213
2023-06-13	12:25:45	222
2023-06-13	12:26:07	213
2023-06-13	12:26:28	212
2023-06-13	12:26:49	213
2023-06-13	12:27:11	213
2023-06-13	12:27:32	213
2023-06-13	12:27:53	208
2023-06-13	12:28:15	207
2023-06-13	12:28:36	207
2023-06-13	12:28:58	208
2023-06-13	12:29:19	208
2023-06-13	12:29:41	194
2023-06-13	12:30:02	207
2023-06-13	12:30:23	206
2023-06-13	12:30:45	208
2023-06-13	12:31:06	209
2023-06-13	12:31:28	213
2023-06-13	12:31:50	204
2023-06-13	12:32:11	208
2023-06-13	12:32:32	212
2023-06-13	12:32:54	218
2023-06-13	12:33:15	215
2023-06-13	12:33:36	217
2023-06-13	12:33:58	221
2023-06-13	12:34:19	214
2023-06-13	12:34:41	215
2023-06-13	12:35:02	223
2023-06-13	12:35:24	224
2023-06-13	12:35:45	207
2023-06-13	12:36:06	219
2023-06-13	12:36:28	218
2023-06-13	12:36:50	214
2023-06-13	12:37:11	214
2023-06-13	12:37:33	218
2023-06-13	12:37:54	219
2023-06-13	12:38:15	214
2023-06-13	12:38:37	221
2023-06-13	12:38:58	218
2023-06-13	12:39:20	219
2023-06-14	10:46:48	949

2023-06-14	10:47:10	759
2023-06-14	10:47:34	765
2023-06-14	10:47:55	905
2023-06-14	10:48:17	946
2023-06-14	10:48:38	673
2023-06-14	10:48:59	1456
2023-06-14	10:49:21	652
2023-06-14	10:50:29	1283
2023-06-14	10:50:50	1175
2023-06-14	10:51:13	647
2023-06-14	10:51:37	1295
2023-06-14	10:51:59	1277
2023-06-14	10:52:20	598
2023-06-14	10:53:12	1424
2023-06-14	10:53:33	1226
2023-06-14	10:53:55	1202
2023-06-14	10:54:16	1190
2023-06-14	10:54:37	762
2023-06-14	10:54:59	539
2023-06-14	10:55:20	506
2023-06-14	10:55:41	983
2023-06-14	10:56:03	853
2023-06-14	10:56:24	1168
2023-06-14	10:56:46	1163
2023-06-14	10:57:07	1135
2023-06-14	10:57:28	1136
2023-06-14	10:57:50	1134
2023-06-14	10:58:11	474
2023-06-14	10:58:33	438
2023-06-14	10:58:54	1162
2023-06-14	10:59:15	1104
2023-06-14	10:59:38	1098
2023-06-14	10:59:59	1088
2023-06-14	11:00:23	1074
2023-06-14	11:00:44	1055
2023-06-14	11:01:06	1054
2023-06-14	11:01:27	1045
2023-06-14	11:01:48	1039
2023-06-14	11:02:10	1022
2023-06-14	11:02:31	1003
2023-06-14	11:02:53	1002
2023-06-14	11:03:14	998
2023-06-14	11:03:35	991
2023-06-14	11:03:57	993
2023-06-14	11:04:18	994
2023-06-14	11:04:39	988

2023-06-14	11:05:01	990
2023-06-14	11:05:22	985
2023-06-14	11:05:44	974
2023-06-14	11:06:05	971
2023-06-14	11:06:26	971
2023-06-14	11:06:48	957
2023-06-14	11:07:09	944
2023-06-14	11:07:30	947
2023-06-14	11:07:52	941
2023-06-14	11:08:14	943
2023-06-14	11:08:35	912
2023-06-14	11:08:56	923
2023-06-14	11:09:18	926
2023-06-14	11:09:39	927
2023-06-14	11:10:00	927
2023-06-14	11:10:22	917
2023-06-14	11:10:43	915
2023-06-14	11:11:04	399
2023-06-14	11:11:26	327
2023-06-14	11:11:47	304
2023-06-14	11:12:09	273
2023-06-15	12:05:20	677
2023-06-15	12:05:41	492
2023-06-15	12:06:03	459
2023-06-15	12:06:24	443
2023-06-15	12:06:46	432
2023-06-15	12:07:09	447
2023-06-15	12:07:31	421
2023-06-15	12:08:19	553
2023-06-15	12:08:42	400
2023-06-15	12:09:04	383
2023-06-15	12:09:26	378
2023-06-15	12:09:51	354
2023-06-15	12:10:13	350
2023-06-15	12:10:35	256
2023-06-15	12:11:00	307
2023-06-15	12:11:25	317
2023-06-15	12:11:47	322
2023-06-15	12:12:08	304
2023-06-15	12:12:31	304
2023-06-15	12:12:52	298
2023-06-15	12:13:14	283
2023-06-15	12:13:35	284
2023-06-15	12:13:57	272
2023-06-15	12:14:18	283
2023-06-15	12:14:40	236

2023-06-15	12:15:01	272
2023-06-15	12:15:22	256
2023-06-15	12:15:44	256
2023-06-15	12:16:05	257
2023-06-15	12:16:27	305
2023-06-15	12:16:48	318
2023-06-15	12:17:10	318
2023-06-15	12:17:31	293
2023-06-15	12:17:53	315
2023-06-15	12:18:37	287
2023-06-15	12:18:58	311
2023-06-15	12:19:43	301
2023-06-15	12:20:04	307
2023-06-15	12:20:49	273
2023-06-15	12:21:10	272
2023-06-15	12:21:32	279
2023-06-15	12:21:53	281
2023-06-15	12:22:15	258
2023-06-15	12:22:36	291
2023-06-15	12:22:58	270
2023-06-15	12:23:19	285
2023-06-15	12:23:40	281
2023-06-15	12:24:02	267
2023-06-15	12:24:23	255
2023-06-15	12:24:44	267
2023-06-15	12:25:06	281
2023-06-15	12:25:27	270
2023-06-15	12:25:48	275
2023-06-15	12:26:10	256
2023-06-15	12:26:32	265
2023-06-15	12:26:53	263
2023-06-15	12:27:15	265
2023-06-15	12:27:36	247
2023-06-15	12:27:58	256
2023-06-15	12:28:19	250
2023-06-15	12:28:41	256
2023-06-15	12:29:02	243
2023-06-15	12:29:23	241
2023-06-15	12:29:45	240
2023-06-15	12:30:06	249
2023-06-15	12:30:27	257
2023-06-15	12:30:49	240
2023-06-15	12:31:10	242
2023-06-15	12:31:32	236
2023-06-15	12:31:53	235
2023-06-15	12:32:15	231

2023-06-15	12:32:36	230
2023-06-15	12:32:57	231
2023-06-15	12:33:19	225
2023-06-15	12:33:40	221
2023-06-15	12:34:02	190
2023-06-15	12:34:23	171
2023-06-15	12:34:45	162
2023-06-15	12:35:06	163
2023-06-15	12:35:27	157
2023-06-15	12:35:49	151
2023-06-15	12:36:10	154
2023-06-15	12:36:31	145
2023-06-15	12:36:53	148
2023-06-15	12:37:14	144
2023-06-15	12:37:36	141
2023-06-15	12:37:58	141
2023-06-15	12:38:20	144
2023-06-15	12:38:41	121
2023-06-15	12:39:03	143
2023-06-15	12:39:24	135
2023-06-15	12:39:45	128
2023-06-15	12:40:07	128
2023-06-15	12:40:28	133
2023-06-15	12:40:50	131
2023-06-15	12:41:12	131
2023-06-15	12:41:33	132
2023-06-15	12:41:54	128
2023-06-15	12:42:16	122
2023-06-15	12:42:37	124
2023-06-15	12:42:58	121
2023-06-15	12:43:20	115
2023-06-15	12:43:41	113
2023-06-15	12:44:03	112
2023-06-15	12:44:24	108
2023-06-15	12:44:46	107
2023-06-15	12:45:30	92
2023-06-17	10:58:24	791
2023-06-17	10:58:45	645
2023-06-17	10:59:06	637
2023-06-17	10:59:28	626
2023-06-17	10:59:49	622
2023-06-17	11:00:11	619
2023-06-17	11:00:32	610
2023-06-17	11:00:53	625
2023-06-17	11:01:15	609
2023-06-17	11:01:36	583

2023-06-17	11:01:57	545
2023-06-17	11:02:19	510
2023-06-17	11:02:40	496
2023-06-17	11:03:02	473
2023-06-17	11:03:23	455
2023-06-17	11:03:44	445
2023-06-17	11:04:06	432
2023-06-17	11:04:27	430
2023-06-17	11:04:49	403
2023-06-17	11:05:10	401
2023-06-17	11:05:31	390
2023-06-17	11:05:52	390
2023-06-17	11:06:14	381
2023-06-17	11:06:35	371
2023-06-17	11:06:57	359
2023-06-17	11:07:18	369
2023-06-17	11:07:39	432
2023-06-17	11:08:01	431
2023-06-17	11:08:22	430
2023-06-17	11:08:43	402
2023-06-17	11:09:05	400
2023-06-17	11:09:26	368
2023-06-17	11:09:47	372
2023-06-17	11:10:09	380
2023-06-17	11:10:30	375
2023-06-17	11:10:51	368
2023-06-17	11:11:13	366
2023-06-17	11:11:34	358
2023-06-17	11:11:56	342
2023-06-17	11:12:17	341
2023-06-17	11:12:39	346
2023-06-17	11:13:00	334
2023-06-17	11:13:21	318
2023-06-17	11:13:43	314
2023-06-17	11:14:04	301
2023-06-17	11:14:25	301
2023-06-17	11:14:47	304
2023-06-17	11:15:08	300
2023-06-17	11:15:30	287
2023-06-17	11:15:51	287
2023-06-17	11:16:12	285
2023-06-17	11:16:34	258
2023-06-17	11:16:55	273
2023-06-17	11:17:16	265
2023-06-17	11:17:38	239
2023-06-17	11:17:59	252

2023-06-17	11:18:20	257
2023-06-17	11:18:42	250
2023-06-17	11:19:03	253
2023-06-17	11:19:25	237
2023-06-17	11:19:46	247
2023-06-17	11:20:08	245
2023-06-17	11:20:29	246
2023-06-17	11:20:50	226
2023-06-17	11:21:12	234
2023-06-17	11:21:33	219
2023-06-17	11:21:55	222
2023-06-17	11:22:16	223
2023-06-17	11:22:37	225
2023-06-17	11:22:59	186
2023-06-17	11:23:20	208
2023-06-17	11:23:41	199
2023-06-17	11:24:03	203
2023-06-17	11:24:24	208
2023-06-17	11:24:46	204
2023-06-17	11:25:07	205
2023-06-17	11:25:28	201
2023-06-17	11:25:50	194
2023-06-17	11:26:11	195
2023-06-17	11:26:33	192
2023-06-17	11:26:54	179
2023-06-17	11:27:15	181
2023-06-17	11:27:37	195
2023-06-17	11:27:58	183
2023-06-17	11:28:20	185
2023-06-17	11:28:41	183
2023-06-17	11:29:02	182
2023-06-17	11:29:24	189
2023-06-17	11:29:45	176
2023-06-17	11:30:06	180
2023-06-17	11:30:28	174
2023-06-17	11:30:49	168
2023-06-17	11:31:10	176
2023-06-17	11:31:32	173
2023-06-17	11:31:53	166
2023-06-17	11:32:15	166
2023-06-17	11:32:36	151
2023-06-17	11:32:57	161
2023-06-17	11:33:19	146
2023-06-17	11:33:40	147
2023-06-19	12:49:53	492
2023-06-19	12:50:16	475

2023-06-19	12:50:38	462
2023-06-19	12:50:59	447
2023-06-19	12:51:20	439
2023-06-19	12:51:42	423
2023-06-19	12:52:03	448
2023-06-19	12:52:25	437
2023-06-19	12:52:46	432
2023-06-19	12:53:08	419
2023-06-19	12:53:29	415
2023-06-19	12:53:51	406
2023-06-19	12:54:12	399
2023-06-19	12:54:34	387
2023-06-19	12:54:55	385
2023-06-19	12:55:16	374
2023-06-19	12:55:38	369
2023-06-19	12:56:00	354
2023-06-19	12:56:21	353
2023-06-19	12:56:42	324
2023-06-19	12:57:04	335
2023-06-19	12:57:25	327
2023-06-19	12:57:46	308
2023-06-19	12:58:08	313
2023-06-19	12:58:29	313
2023-06-19	12:58:50	292
2023-06-19	12:59:12	295
2023-06-19	12:59:33	289
2023-06-19	12:59:54	265
2023-06-19	13:00:16	266
2023-06-19	13:00:37	265
2023-06-19	13:00:59	270
2023-06-19	13:01:21	258
2023-06-19	13:01:42	247
2023-06-19	13:02:04	229
2023-06-19	13:02:25	236
2023-06-19	13:02:47	231
2023-06-19	13:03:08	225
2023-06-19	13:03:29	224
2023-06-19	13:03:51	223
2023-06-19	13:04:12	218
2023-06-19	13:04:34	211
2023-06-19	13:04:55	208
2023-06-19	13:05:16	191
2023-06-19	13:05:38	208
2023-06-19	13:06:00	199
2023-06-19	13:06:21	192
2023-06-19	13:06:43	195

2023-06-19	13:07:04	193
2023-06-19	13:07:25	178
2023-06-19	13:07:47	176
2023-06-19	13:08:08	174
2023-06-19	13:08:29	172
2023-06-19	13:08:51	162
2023-06-19	13:09:12	173
2023-06-19	13:09:34	160
2023-06-19	13:09:55	160
2023-06-19	13:10:17	148
2023-06-19	13:10:38	147
2023-06-19	13:11:00	123
2023-06-19	13:11:21	128
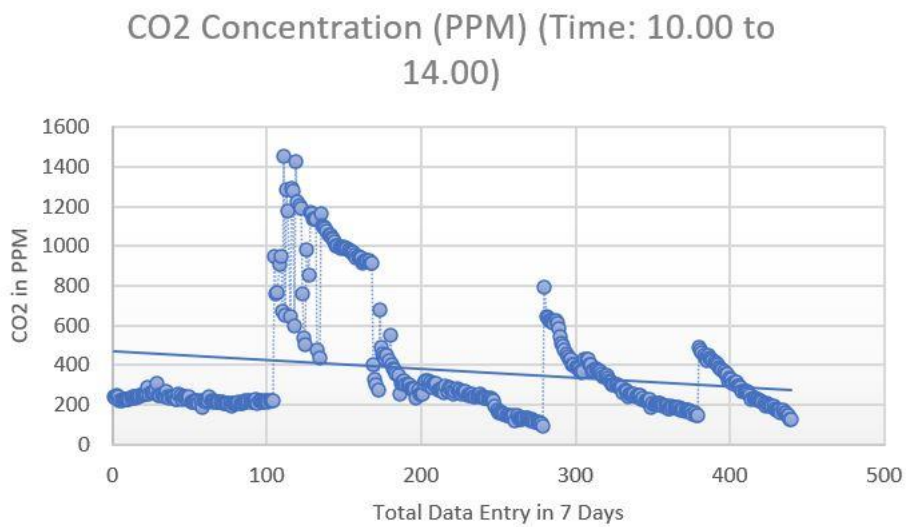
Figure 4.4: Graphical Representation of CO2 Concentration in PPM for First Slot (Paltan, Dhaka) (Data Collected by MQ-135)

Table 4.4: CO, CH4 & LPG Data Collected Between 10:00 to 14:00

DATE	TIME (Dhaka)	CO, CH4 & LPG Concentration (PPM)
2023-06-13	12:02:31	2549
2023-06-13	12:02:52	2523
2023-06-13	12:03:13	2508
2023-06-13	12:03:36	2483
2023-06-13	12:03:57	2463
2023-06-13	12:04:18	2449
2023-06-13	12:04:40	2438
2023-06-13	12:05:01	2414
2023-06-13	12:05:23	2400
2023-06-13	12:05:44	2385
2023-06-13	12:06:06	2380
2023-06-13	12:06:27	2274
2023-06-13	12:06:48	2348
2023-06-13	12:07:10	2321
2023-06-13	12:07:31	2314
2023-06-13	12:07:53	2307
2023-06-13	12:08:14	2297
2023-06-13	12:08:35	2282
2023-06-13	12:08:57	2282
2023-06-13	12:09:19	2261
2023-06-13	12:09:40	2215
2023-06-13	12:10:02	2237
2023-06-13	12:10:23	2230
2023-06-13	12:10:44	2222
2023-06-13	12:11:06	2224
2023-06-13	12:11:27	2203
2023-06-13	12:11:49	2188
2023-06-13	12:12:10	2184
2023-06-13	12:12:31	2181
2023-06-13	12:12:53	2164
2023-06-13	12:13:14	2155
2023-06-13	12:13:36	2146
2023-06-13	12:13:57	2137
2023-06-13	12:14:19	2135
2023-06-13	12:14:40	2036
2023-06-13	12:15:01	2149
2023-06-13	12:15:23	2113
2023-06-13	12:15:45	2107
2023-06-13	12:16:06	2107
2023-06-13	12:16:27	2096
2023-06-13	12:16:49	2101
2023-06-13	12:17:10	2095

2023-06-13	12:17:32	2064
2023-06-13	12:17:53	2085
2023-06-13	12:18:15	2074
2023-06-13	12:18:36	2056
2023-06-13	12:18:58	2066
2023-06-13	12:19:19	2058
2023-06-13	12:19:40	2092
2023-06-13	12:20:02	2063
2023-06-13	12:20:23	2053
2023-06-13	12:20:44	2039
2023-06-13	12:21:06	2053
2023-06-13	12:21:27	2033
2023-06-13	12:21:49	2017
2023-06-13	12:22:10	2025
2023-06-13	12:22:32	2021
2023-06-13	12:22:53	2012
2023-06-13	12:23:15	2005
2023-06-13	12:23:36	2010
2023-06-13	12:23:58	2014
2023-06-13	12:24:19	2004
2023-06-13	12:24:41	2002
2023-06-13	12:25:02	2001
2023-06-13	12:25:23	2000
2023-06-13	12:25:45	1997
2023-06-13	12:26:07	1994
2023-06-13	12:26:28	1985
2023-06-13	12:26:49	2013
2023-06-13	12:27:11	1985
2023-06-13	12:27:32	1977
2023-06-13	12:27:53	1970
2023-06-13	12:28:15	1978
2023-06-13	12:28:36	1968
2023-06-13	12:28:58	1999
2023-06-13	12:29:19	1955
2023-06-13	12:29:41	1963
2023-06-13	12:30:02	1959
2023-06-13	12:30:23	1958
2023-06-13	12:30:45	1968
2023-06-13	12:31:06	1955
2023-06-13	12:31:28	1942
2023-06-13	12:31:50	1947
2023-06-13	12:32:11	1941
2023-06-13	12:32:32	1935
2023-06-13	12:32:54	1921
2023-06-13	12:33:15	1885
2023-06-13	12:33:36	1923

2023-06-13	12:33:58	1921
2023-06-13	12:34:19	1923
2023-06-13	12:34:41	1925
2023-06-13	12:35:02	1922
2023-06-13	12:35:24	1925
2023-06-13	12:35:45	1916
2023-06-13	12:36:06	1911
2023-06-13	12:36:28	1917
2023-06-13	12:36:50	1921
2023-06-13	12:37:11	1916
2023-06-13	12:37:33	1919
2023-06-13	12:37:54	1913
2023-06-13	12:38:15	1914
2023-06-13	12:38:37	1906
2023-06-13	12:38:58	1904
2023-06-13	12:39:20	1908
2023-06-14	10:46:48	866
2023-06-14	10:47:10	918
2023-06-14	10:47:34	953
2023-06-14	10:47:55	1314
2023-06-14	10:48:17	1423
2023-06-14	10:48:38	876
2023-06-14	10:48:59	2629
2023-06-14	10:49:21	858
2023-06-14	10:50:29	1986
2023-06-14	10:50:50	2202
2023-06-14	10:51:13	1008
2023-06-14	10:51:37	2747
2023-06-14	10:51:59	2740
2023-06-14	10:52:20	1123
2023-06-14	10:53:12	2725
2023-06-14	10:53:33	2722
2023-06-14	10:53:55	2721
2023-06-14	10:54:16	2807
2023-06-14	10:54:37	1476
2023-06-14	10:54:59	1003
2023-06-14	10:55:20	782
2023-06-14	10:55:41	1803
2023-06-14	10:56:03	1869
2023-06-14	10:56:24	2703
2023-06-14	10:56:46	2700
2023-06-14	10:57:07	2698
2023-06-14	10:57:28	2686
2023-06-14	10:57:50	2691
2023-06-14	10:58:11	867
2023-06-14	10:58:33	732

2023-06-14	10:58:54	2690
2023-06-14	10:59:15	2688
2023-06-14	10:59:38	2694
2023-06-14	10:59:59	2680
2023-06-14	11:00:23	2688
2023-06-14	11:00:44	2677
2023-06-14	11:01:06	2673
2023-06-14	11:01:27	2672
2023-06-14	11:01:48	2670
2023-06-14	11:02:10	2663
2023-06-14	11:02:31	2655
2023-06-14	11:02:53	2649
2023-06-14	11:03:14	2653
2023-06-14	11:03:35	2633
2023-06-14	11:03:57	2656
2023-06-14	11:04:18	2835
2023-06-14	11:04:39	2657
2023-06-14	11:05:01	2653
2023-06-14	11:05:22	2651
2023-06-14	11:05:44	2646
2023-06-14	11:06:05	2650
2023-06-14	11:06:26	2650
2023-06-14	11:06:48	2631
2023-06-14	11:07:09	2629
2023-06-14	11:07:30	2630
2023-06-14	11:07:52	2630
2023-06-14	11:08:14	2490
2023-06-14	11:08:35	2622
2023-06-14	11:08:56	2618
2023-06-14	11:09:18	2614
2023-06-14	11:09:39	2610
2023-06-14	11:10:00	2604
2023-06-14	11:10:22	2608
2023-06-14	11:10:43	2615
2023-06-14	11:11:04	1323
2023-06-14	11:11:26	780
2023-06-14	11:11:47	652
2023-06-14	11:12:09	589
2023-06-15	12:05:20	642
2023-06-15	12:05:41	587
2023-06-15	12:06:03	560
2023-06-15	12:06:24	544
2023-06-15	12:06:46	530
2023-06-15	12:07:09	557
2023-06-15	12:07:31	523
2023-06-15	12:08:19	550

2023-06-15	12:08:42	496
2023-06-15	12:09:04	473
2023-06-15	12:09:26	470
2023-06-15	12:09:51	437
2023-06-15	12:10:13	427
2023-06-15	12:10:35	368
2023-06-15	12:11:00	419
2023-06-15	12:11:25	390
2023-06-15	12:11:47	400
2023-06-15	12:12:08	381
2023-06-15	12:12:31	375
2023-06-15	12:12:52	365
2023-06-15	12:13:14	350
2023-06-15	12:13:35	345
2023-06-15	12:13:57	333
2023-06-15	12:14:18	354
2023-06-15	12:14:40	309
2023-06-15	12:15:01	331
2023-06-15	12:15:22	320
2023-06-15	12:15:44	320
2023-06-15	12:16:05	320
2023-06-15	12:16:27	392
2023-06-15	12:16:48	405
2023-06-15	12:17:10	411
2023-06-15	12:17:31	397
2023-06-15	12:17:53	403
2023-06-15	12:18:37	379
2023-06-15	12:18:58	403
2023-06-15	12:19:43	400
2023-06-15	12:20:04	397
2023-06-15	12:20:49	361
2023-06-15	12:21:10	352
2023-06-15	12:21:32	363
2023-06-15	12:21:53	368
2023-06-15	12:22:15	336
2023-06-15	12:22:36	383
2023-06-15	12:22:58	368
2023-06-15	12:23:19	383
2023-06-15	12:23:40	370
2023-06-15	12:24:02	349
2023-06-15	12:24:23	347
2023-06-15	12:24:44	353
2023-06-15	12:25:06	372
2023-06-15	12:25:27	362
2023-06-15	12:25:48	378
2023-06-15	12:26:10	347

2023-06-15	12:26:32	352
2023-06-15	12:26:53	359
2023-06-15	12:27:15	355
2023-06-15	12:27:36	336
2023-06-15	12:27:58	343
2023-06-15	12:28:19	337
2023-06-15	12:28:41	342
2023-06-15	12:29:02	335
2023-06-15	12:29:23	335
2023-06-15	12:29:45	330
2023-06-15	12:30:06	335
2023-06-15	12:30:27	350
2023-06-15	12:30:49	326
2023-06-15	12:31:10	327
2023-06-15	12:31:32	321
2023-06-15	12:31:53	320
2023-06-15	12:32:15	317
2023-06-15	12:32:36	307
2023-06-15	12:32:57	318
2023-06-15	12:33:19	312
2023-06-15	12:33:40	307
2023-06-15	12:34:02	253
2023-06-15	12:34:23	227
2023-06-15	12:34:45	214
2023-06-15	12:35:06	209
2023-06-15	12:35:27	203
2023-06-15	12:35:49	204
2023-06-15	12:36:10	201
2023-06-15	12:36:31	195
2023-06-15	12:36:53	198
2023-06-15	12:37:14	192
2023-06-15	12:37:36	189
2023-06-15	12:37:58	187
2023-06-15	12:38:20	188
2023-06-15	12:38:41	173
2023-06-15	12:39:03	183
2023-06-15	12:39:24	176
2023-06-15	12:39:45	176
2023-06-15	12:40:07	175
2023-06-15	12:40:28	176
2023-06-15	12:40:50	176
2023-06-15	12:41:12	174
2023-06-15	12:41:33	175
2023-06-15	12:41:54	170
2023-06-15	12:42:16	165
2023-06-15	12:42:37	167

2023-06-15	12:42:58	160
2023-06-15	12:43:20	153
2023-06-15	12:43:41	151
2023-06-15	12:44:03	147
2023-06-15	12:44:24	144
2023-06-15	12:44:46	144
2023-06-15	12:45:30	137
2023-06-17	10:58:24	748
2023-06-17	10:58:45	717
2023-06-17	10:59:06	710
2023-06-17	10:59:28	704
2023-06-17	10:59:49	698
2023-06-17	11:00:11	695
2023-06-17	11:00:32	688
2023-06-17	11:00:53	720
2023-06-17	11:01:15	707
2023-06-17	11:01:36	672
2023-06-17	11:01:57	624
2023-06-17	11:02:19	589
2023-06-17	11:02:40	562
2023-06-17	11:03:02	535
2023-06-17	11:03:23	519
2023-06-17	11:03:44	496
2023-06-17	11:04:06	483
2023-06-17	11:04:27	482
2023-06-17	11:04:49	463
2023-06-17	11:05:10	453
2023-06-17	11:05:31	446
2023-06-17	11:05:52	437
2023-06-17	11:06:14	430
2023-06-17	11:06:35	418
2023-06-17	11:06:57	400
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2023-06-17	11:08:01	485
2023-06-17	11:08:22	478
2023-06-17	11:08:43	455
2023-06-17	11:09:05	448
2023-06-17	11:09:26	478
2023-06-17	11:09:47	427
2023-06-17	11:10:09	429
2023-06-17	11:10:30	421
2023-06-17	11:10:51	413
2023-06-17	11:11:13	407
2023-06-17	11:11:34	403
2023-06-17	11:11:56	388

2023-06-17	11:12:17	384
2023-06-17	11:12:39	384
2023-06-17	11:13:00	370
2023-06-17	11:13:21	361
2023-06-17	11:13:43	352
2023-06-17	11:14:04	342
2023-06-17	11:14:25	336
2023-06-17	11:14:47	341
2023-06-17	11:15:08	336
2023-06-17	11:15:30	327
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2023-06-17	11:16:12	322
2023-06-17	11:16:34	304
2023-06-17	11:16:55	311
2023-06-17	11:17:16	304
2023-06-17	11:17:38	323
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2023-06-17	11:18:20	295
2023-06-17	11:18:42	287
2023-06-17	11:19:03	287
2023-06-17	11:19:25	275
2023-06-17	11:19:46	283
2023-06-17	11:20:08	282
2023-06-17	11:20:29	286
2023-06-17	11:20:50	268
2023-06-17	11:21:12	269
2023-06-17	11:21:33	258
2023-06-17	11:21:55	261
2023-06-17	11:22:16	261
2023-06-17	11:22:37	261
2023-06-17	11:22:59	230
2023-06-17	11:23:20	242
2023-06-17	11:23:41	237
2023-06-17	11:24:03	240
2023-06-17	11:24:24	250
2023-06-17	11:24:46	245
2023-06-17	11:25:07	240
2023-06-17	11:25:28	239
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2023-06-17	11:26:54	223
2023-06-17	11:27:15	223
2023-06-17	11:27:37	228
2023-06-17	11:27:58	221
2023-06-17	11:28:20	221

2023-06-17	11:28:41	221
2023-06-17	11:29:02	217
2023-06-17	11:29:24	225
2023-06-17	11:29:45	215
2023-06-17	11:30:06	211
2023-06-17	11:30:28	208
2023-06-17	11:30:49	200
2023-06-17	11:31:10	211
2023-06-17	11:31:32	206
2023-06-17	11:31:53	199
2023-06-17	11:32:15	201
2023-06-17	11:32:36	192
2023-06-17	11:32:57	195
2023-06-17	11:33:19	181
2023-06-17	11:33:40	179
2023-06-19	12:49:53	567
2023-06-19	12:50:16	549
2023-06-19	12:50:38	529
2023-06-19	12:50:59	509
2023-06-19	12:51:20	497
2023-06-19	12:51:42	477
2023-06-19	12:52:03	500
2023-06-19	12:52:25	495
2023-06-19	12:52:46	481
2023-06-19	12:53:08	464
2023-06-19	12:53:29	463
2023-06-19	12:53:51	452
2023-06-19	12:54:12	430
2023-06-19	12:54:34	399
2023-06-19	12:54:55	365
2023-06-19	12:55:16	353
2023-06-19	12:55:38	342
2023-06-19	12:56:00	323
2023-06-19	12:56:21	318
2023-06-19	12:56:42	296
2023-06-19	12:57:04	299
2023-06-19	12:57:25	292
2023-06-19	12:57:46	280
2023-06-19	12:58:08	278
2023-06-19	12:58:29	311
2023-06-19	12:58:50	303
2023-06-19	12:59:12	305
2023-06-19	12:59:33	304
2023-06-19	12:59:54	283
2023-06-19	13:00:16	285
2023-06-19	13:00:37	282

2023-06-19	13:00:59	286
2023-06-19	13:01:21	288
2023-06-19	13:01:42	272
2023-06-19	13:02:04	258
2023-06-19	13:02:25	263
2023-06-19	13:02:47	257
2023-06-19	13:03:08	256
2023-06-19	13:03:29	254
2023-06-19	13:03:51	247
2023-06-19	13:04:12	242
2023-06-19	13:04:34	245
2023-06-19	13:04:55	239
2023-06-19	13:05:16	222
2023-06-19	13:05:38	239
2023-06-19	13:06:00	227
2023-06-19	13:06:21	220
2023-06-19	13:06:43	228
2023-06-19	13:07:04	224
2023-06-19	13:07:25	217
2023-06-19	13:07:47	203
2023-06-19	13:08:08	199
2023-06-19	13:08:29	198
2023-06-19	13:08:51	193
2023-06-19	13:09:12	203
2023-06-19	13:09:34	193
2023-06-19	13:09:55	190
2023-06-19	13:10:17	182
2023-06-19	13:10:38	181
2023-06-19	13:11:00	150
2023-06-19	13:11:21	156
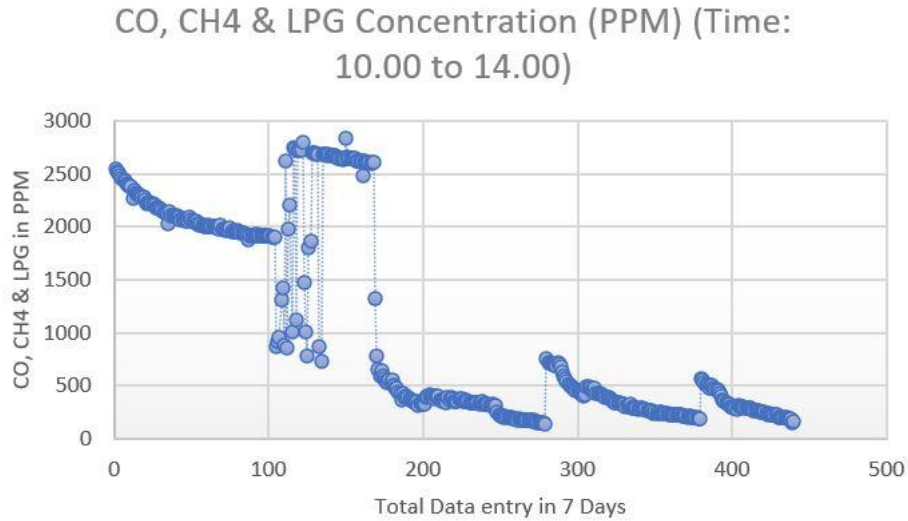
Figure 4.5: Graphical Representation of CO, CH4 & LPG Concentration in PPM for First Slot (Paltan, Dhaka) (Data Collected by MQ-9)

4.1.2 Second Slot Data Collection and Graphical Representation

Table 4.5: Temperature Data Collected Between 15:00 to 18:00

DATE	TIME (Dhaka)	Temperature (C)
2023-06-11	14:58:50	27.6
2023-06-11	14:59:08	27.5
2023-06-11	14:59:26	27.5
2023-06-11	14:59:43	27.5
2023-06-11	15:00:01	27.5
2023-06-11	15:00:16	27.4
2023-06-11	15:00:34	27.5
2023-06-11	15:00:52	27.4
2023-06-11	15:01:10	27.4
2023-06-11	15:01:28	27.4
2023-06-11	15:01:46	27.4
2023-06-11	15:02:04	27.4
2023-06-11	15:02:22	27.4
2023-06-11	15:02:39	27.4
2023-06-11	15:02:57	27.5
2023-06-11	15:03:12	27.5
2023-06-11	15:03:30	27.5
2023-06-11	15:03:48	27.5
2023-06-11	15:04:06	27.5
2023-06-11	15:04:22	nan

2023-06-11	15:04:41	nan
2023-06-11	15:04:59	nan
2023-06-11	15:05:17	nan
2023-06-11	15:05:35	nan
2023-06-11	15:05:53	nan
2023-06-11	15:06:12	nan
2023-06-11	15:06:29	nan
2023-06-11	15:06:59	27.7
2023-06-11	15:07:17	27.7
2023-06-11	15:07:35	27.7
2023-06-11	15:08:23	27.7
2023-06-11	15:08:44	27.7
2023-06-11	15:09:05	27.7
2023-06-11	15:09:26	27.7
2023-06-11	15:09:47	27.8
2023-06-11	15:10:08	27.7
2023-06-11	15:10:29	27.8
2023-06-11	15:10:50	27.7
2023-06-11	15:11:11	27.7
2023-06-11	15:11:32	27.7
2023-06-11	15:11:53	27.8
2023-06-11	15:12:14	27.8
2023-06-11	15:12:35	27.8
2023-06-11	15:12:56	27.8
2023-06-11	15:13:17	27.8
2023-06-11	15:13:38	27.8
2023-06-11	15:13:59	27.8
2023-06-11	15:14:20	27.8
2023-06-11	15:14:41	27.8
2023-06-11	15:15:02	27.8
2023-06-11	15:15:23	27.8
2023-06-11	15:15:44	27.8
2023-06-11	15:16:05	27.8
2023-06-11	15:16:26	27.8
2023-06-11	15:16:48	27.8
2023-06-11	15:17:09	27.8
2023-06-11	15:17:30	27.8
2023-06-11	15:17:51	27.8
2023-06-11	15:18:12	27.8
2023-06-11	15:18:33	27.8
2023-06-11	15:18:54	27.9
2023-06-11	15:19:15	27.9
2023-06-11	15:19:36	27.8
2023-06-11	15:19:57	27.9
2023-06-11	15:20:18	27.8
2023-06-11	15:20:39	27.8

2023-06-11	15:21:00	27.7
2023-06-11	15:21:21	27.7
2023-06-11	15:21:42	27.6
2023-06-11	15:22:03	27.4
2023-06-11	15:22:24	27.3
2023-06-11	15:22:45	27.2
2023-06-11	15:23:07	27
2023-06-11	15:23:28	26.8
2023-06-11	15:23:48	26.7
2023-06-11	15:24:10	26.5
2023-06-11	15:24:31	26.4
2023-06-11	15:24:52	26.3
2023-06-11	15:25:13	26.2
2023-06-11	15:25:34	26.1
2023-06-11	15:25:55	26.1
2023-06-11	15:26:16	26.2
2023-06-11	15:26:37	26.2
2023-06-11	15:26:58	26.2
2023-06-11	15:27:19	26.2
2023-06-11	15:27:40	26.3
2023-06-11	15:28:01	26.3
2023-06-11	15:28:22	26.3
2023-06-11	15:28:43	26.4
2023-06-11	15:29:04	26.4
2023-06-11	15:29:25	26.4
2023-06-11	15:29:46	26.5
2023-06-11	15:30:07	26.6
2023-06-11	15:30:28	26.6
2023-06-11	15:30:49	26.7
2023-06-11	15:31:10	26.7
2023-06-11	15:31:31	26.8
2023-06-11	15:31:52	26.8
2023-06-11	15:32:13	26.8
2023-06-11	15:32:34	26.9
2023-06-11	15:32:55	26.9
2023-06-11	15:33:16	27
2023-06-11	15:33:37	27.1
2023-06-11	15:33:58	27.1
2023-06-11	15:34:19	27.1
2023-06-11	15:34:40	27.2
2023-06-11	15:35:01	27.2
2023-06-11	15:35:22	27.2
2023-06-11	15:35:43	27.3
2023-06-11	15:36:04	27.3
2023-06-11	15:36:25	27.4
2023-06-11	15:36:46	27.4

2023-06-11	15:37:07	27.4
2023-06-14	15:57:21	34.5
2023-06-14	15:57:42	34.9
2023-06-14	15:58:54	35.5
2023-06-14	16:01:12	36
2023-06-14	16:01:33	36
2023-06-14	16:01:55	36
2023-06-14	16:02:16	36
2023-06-14	16:02:38	36.1
2023-06-14	16:02:59	36.2
2023-06-14	16:03:21	36.3
2023-06-14	16:03:44	36.3
2023-06-14	16:04:06	36.3
2023-06-14	16:04:27	36.3
2023-06-14	16:04:49	36.3
2023-06-14	16:05:10	36.2
2023-06-14	16:05:31	36.3
2023-06-14	16:05:53	36.2
2023-06-14	16:06:14	36.1
2023-06-14	16:06:35	36.1
2023-06-14	16:06:57	36.1
2023-06-14	16:07:18	36.1
2023-06-14	16:07:40	36.1
2023-06-14	16:08:01	36.1
2023-06-14	16:08:22	36
2023-06-14	16:08:44	36
2023-06-14	16:09:05	36
2023-06-14	16:09:27	36
2023-06-14	16:09:48	36
2023-06-14	16:10:10	36
2023-06-14	16:10:31	36.1
2023-06-14	16:10:53	36.1
2023-06-14	16:11:14	36.1
2023-06-14	16:11:36	36.1
2023-06-14	16:11:57	36.1
2023-06-14	16:12:18	36.2
2023-06-14	16:12:40	36.2
2023-06-14	16:13:01	36.2
2023-06-14	16:13:22	36.3
2023-06-14	16:13:44	36.3
2023-06-14	16:14:05	36.3
2023-06-14	16:14:27	36.3
2023-06-14	16:14:48	36.3
2023-06-14	16:15:10	36.3
2023-06-14	16:15:31	36.4
2023-06-14	16:15:52	36.4

2023-06-14	16:16:14	36.4
2023-06-14	16:16:35	36.3
2023-06-14	16:16:56	36.4
2023-06-14	16:17:18	36.4
2023-06-14	16:17:42	36.4
2023-06-14	16:18:03	36.4
2023-06-14	16:18:25	36.4
2023-06-14	16:18:46	36.4
2023-06-14	16:19:08	36.3
2023-06-14	16:19:29	36.3
2023-06-14	16:19:50	36.3
2023-06-14	16:20:12	36.4
2023-06-14	16:20:33	36.4
2023-06-14	16:20:54	36.5
2023-06-14	16:21:16	36.5
2023-06-14	16:21:37	36.5
2023-06-14	16:21:58	36.6
2023-06-14	16:22:20	36.6
2023-06-14	16:22:41	36.6
2023-06-14	16:23:02	36.6
2023-06-14	16:23:24	36.6
2023-06-14	16:23:45	36.6
2023-06-14	16:24:07	36.7
2023-06-14	16:24:28	36.6
2023-06-14	16:24:50	36.6
2023-06-15	17:08:42	29.3
2023-06-15	17:09:04	30.6
2023-06-15	17:10:02	31
2023-06-15	17:10:23	31.8
2023-06-15	17:10:45	32.1
2023-06-15	17:11:06	32.3
2023-06-15	17:11:28	32.4
2023-06-15	17:11:49	32.6
2023-06-15	17:12:10	32.7
2023-06-15	17:12:32	32.8
2023-06-15	17:12:53	32.8
2023-06-15	17:13:16	32.9
2023-06-15	17:13:37	32.9
2023-06-15	17:13:59	32.9
2023-06-15	17:14:21	32.9
2023-06-15	17:14:42	32.9
2023-06-15	17:15:03	33
2023-06-15	17:15:25	32.9
2023-06-15	17:15:46	33
2023-06-15	17:16:07	33
2023-06-15	17:16:29	33.1

2023-06-15	17:16:50	33.1
2023-06-15	17:17:12	33.1
2023-06-15	17:17:33	33.1
2023-06-15	17:17:54	33
2023-06-15	17:18:16	33
2023-06-15	17:18:37	33
2023-06-15	17:18:59	33
2023-06-15	17:19:20	33
2023-06-15	17:19:42	33
2023-06-15	17:20:03	33
2023-06-15	17:20:25	32.9
2023-06-15	17:20:47	32.9
2023-06-15	17:21:08	32.9
2023-06-15	17:21:29	33
2023-06-15	17:21:50	33
2023-06-15	17:22:12	33.1
2023-06-15	17:22:34	33.1
2023-06-15	17:22:55	33.1
2023-06-15	17:23:17	33.1
2023-06-15	17:23:38	33.1
2023-06-15	17:23:59	33.2
2023-06-15	17:24:21	33.2
2023-06-15	17:24:42	33.2
2023-06-15	17:25:04	33.1
2023-06-15	17:25:25	33.1
2023-06-15	17:25:46	33
2023-06-15	17:26:08	33
2023-06-15	17:26:30	33
2023-06-15	17:26:51	33
2023-06-15	17:27:12	33
2023-06-15	17:27:34	33
2023-06-15	17:27:55	33
2023-06-15	17:28:16	33
2023-06-15	17:28:38	33
2023-06-15	17:28:59	33
2023-06-15	17:29:21	33.1
2023-06-15	17:29:42	33.1
2023-06-15	17:30:04	33.1
2023-06-15	17:30:25	33.1
2023-06-15	17:30:47	33.1
2023-06-15	17:31:09	33.1
2023-06-15	17:31:31	33.1
2023-06-15	17:31:52	33.1
2023-06-15	17:32:13	33.1
2023-06-15	17:32:35	33.1
2023-06-15	17:32:56	33.1

2023-06-15	17:33:17	33.1
2023-06-15	17:33:39	33.1
2023-06-15	17:34:00	33.1
2023-06-15	17:34:21	33.1
2023-06-15	17:34:43	33.1
2023-06-15	17:35:04	33.1
2023-06-15	17:35:26	33.1
2023-06-15	17:35:47	33.1
2023-06-15	17:36:09	33.1
2023-06-15	17:36:30	33.1
2023-06-15	17:36:52	33.1
2023-06-15	17:37:13	33.1
2023-06-15	17:37:34	33
2023-06-15	17:37:56	33
2023-06-15	17:38:17	33.1
2023-06-15	17:38:39	33
2023-06-15	17:39:00	33.1
2023-06-15	17:39:22	33
2023-06-15	17:39:43	33
2023-06-15	17:40:04	33
2023-06-15	17:40:29	33
2023-06-15	17:40:50	33
2023-06-15	17:41:12	33
2023-06-15	17:41:33	33
2023-06-15	17:41:54	33
2023-06-15	17:42:16	33
2023-06-15	17:42:37	33
2023-06-17	17:19:34	33
2023-06-17	17:19:55	33
2023-06-17	17:20:17	33.1
2023-06-17	17:20:38	33.2
2023-06-17	17:20:59	33.3
2023-06-17	17:21:21	33.4
2023-06-17	17:21:42	33.4
2023-06-17	17:22:04	33.5
2023-06-17	17:22:25	33.6
2023-06-17	17:22:46	33.6
2023-06-17	17:23:08	33.6
2023-06-17	17:23:29	33.7
2023-06-17	17:23:50	33.7
2023-06-17	17:24:12	33.7
2023-06-17	17:24:33	33.7
2023-06-17	17:24:55	33.7
2023-06-17	17:25:16	33.6
2023-06-17	17:25:37	33.6
2023-06-17	17:25:59	33.6

2023-06-17	17:26:20	33.5
2023-06-17	17:26:42	33.5
2023-06-17	17:27:03	33.5
2023-06-17	17:27:24	33.5
2023-06-17	17:27:46	33.5
2023-06-17	17:28:07	33.5
2023-06-17	17:28:29	33.5
2023-06-17	17:28:50	33.5
2023-06-17	17:29:12	33.5
2023-06-17	17:29:33	33.4
2023-06-17	17:29:54	33.4
2023-06-17	17:30:16	33.4
2023-06-17	17:30:37	33.4
2023-06-17	17:30:59	33.4
2023-06-17	17:31:39	33.4
2023-06-17	17:32:00	33.4
2023-06-17	17:32:22	33.4
2023-06-17	17:32:43	33.3
2023-06-17	17:33:04	33.3
2023-06-17	17:33:26	33.4
2023-06-17	17:33:47	33.4
2023-06-17	17:34:09	33.4
2023-06-17	17:34:30	33.4
2023-06-17	17:34:52	33.4
2023-06-17	17:35:13	33.4
2023-06-17	17:35:34	33.4
2023-06-17	17:39:10	33.4
2023-06-17	17:39:31	33.4
2023-06-17	17:39:53	33.4
2023-06-17	17:40:14	33.4
2023-06-17	17:40:35	33.3
2023-06-17	17:40:57	33.3
2023-06-17	17:41:18	33.3
2023-06-17	17:41:39	33.3
2023-06-17	17:42:01	33.4
2023-06-17	17:42:23	33.4
2023-06-17	17:42:44	33.4
2023-06-17	17:43:05	33.4
2023-06-17	17:43:27	33.5
2023-06-17	17:43:48	33.4
2023-06-17	17:44:09	33.5
2023-06-17	17:44:31	33.5
2023-06-17	17:44:52	33.5
2023-06-17	17:45:14	33.6
2023-06-17	17:45:35	33.6
2023-06-17	17:45:57	33.5

2023-06-17	17:46:18	33.5
2023-06-17	17:46:39	33.5
2023-06-17	17:47:01	33.4
2023-06-17	17:47:22	33.3
2023-06-17	17:47:43	33.3
2023-06-17	17:48:05	33.3
2023-06-17	17:48:26	33.3
2023-06-17	17:48:48	33.3
2023-06-17	17:49:09	33.4
2023-06-17	17:49:30	33.3
2023-06-17	17:49:52	33.3
2023-06-17	17:50:13	33.3
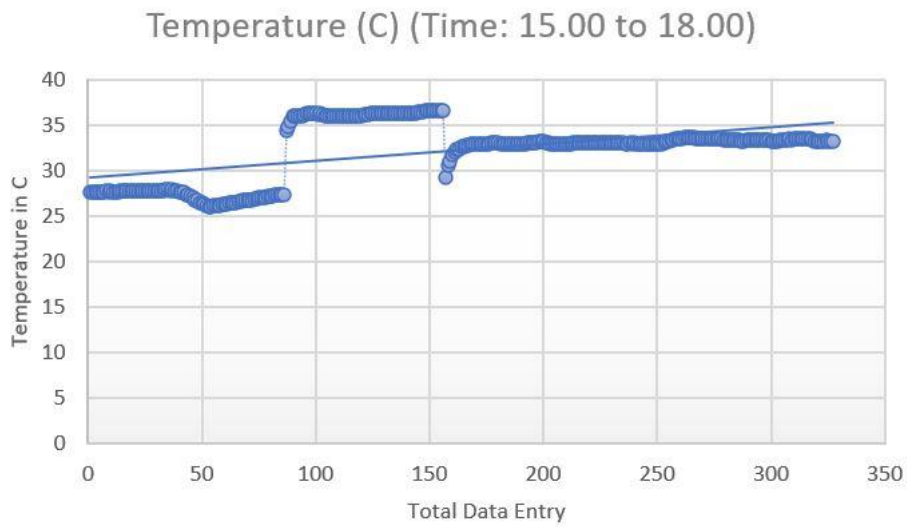
Figure 4.6: Graphical Representation of Temperature in C for Second Slot (Paltan, Dhaka) (Data Collected by DHT11)

Table 4.6: Humidity Data Collected Between 15:00 to 18:00

DATE	TIME (Dhaka)	Humidity (%)
2023-06-11	14:58:50	75
2023-06-11	14:59:08	75
2023-06-11	14:59:26	75
2023-06-11	14:59:43	76
2023-06-11	15:00:01	76
2023-06-11	15:00:16	76

2023-06-11	15:00:34	77
2023-06-11	15:00:52	77
2023-06-11	15:01:10	77
2023-06-11	15:01:28	77
2023-06-11	15:01:46	77
2023-06-11	15:02:04	78
2023-06-11	15:02:22	78
2023-06-11	15:02:39	78
2023-06-11	15:02:57	78
2023-06-11	15:03:12	78
2023-06-11	15:03:30	78
2023-06-11	15:03:48	78
2023-06-11	15:04:06	77
2023-06-11	15:04:22	nan
2023-06-11	15:04:41	nan
2023-06-11	15:04:59	nan
2023-06-11	15:05:17	nan
2023-06-11	15:05:35	nan
2023-06-11	15:05:53	nan
2023-06-11	15:06:12	nan
2023-06-11	15:06:29	nan
2023-06-11	15:06:59	78
2023-06-11	15:07:17	78
2023-06-11	15:07:35	78
2023-06-11	15:08:23	78
2023-06-11	15:08:44	78
2023-06-11	15:09:05	79
2023-06-11	15:09:26	79
2023-06-11	15:09:47	79
2023-06-11	15:10:08	79
2023-06-11	15:10:29	79
2023-06-11	15:10:50	79
2023-06-11	15:11:11	79
2023-06-11	15:11:32	79
2023-06-11	15:11:53	80
2023-06-11	15:12:14	80
2023-06-11	15:12:35	80
2023-06-11	15:12:56	80
2023-06-11	15:13:17	80
2023-06-11	15:13:38	80
2023-06-11	15:13:59	80
2023-06-11	15:14:20	80
2023-06-11	15:14:41	80
2023-06-11	15:15:02	81
2023-06-11	15:15:23	80
2023-06-11	15:15:44	80

2023-06-11	15:16:05	80
2023-06-11	15:16:26	80
2023-06-11	15:16:48	80
2023-06-11	15:17:09	80
2023-06-11	15:17:30	80
2023-06-11	15:17:51	80
2023-06-11	15:18:12	80
2023-06-11	15:18:33	80
2023-06-11	15:18:54	80
2023-06-11	15:19:15	80
2023-06-11	15:19:36	80
2023-06-11	15:19:57	80
2023-06-11	15:20:18	80
2023-06-11	15:20:39	79
2023-06-11	15:21:00	77
2023-06-11	15:21:21	75
2023-06-11	15:21:42	73
2023-06-11	15:22:03	72
2023-06-11	15:22:24	69
2023-06-11	15:22:45	65
2023-06-11	15:23:07	64
2023-06-11	15:23:28	62
2023-06-11	15:23:48	61
2023-06-11	15:24:10	59
2023-06-11	15:24:31	60
2023-06-11	15:24:52	59
2023-06-11	15:25:13	59
2023-06-11	15:25:34	60
2023-06-11	15:25:55	61
2023-06-11	15:26:16	62
2023-06-11	15:26:37	63
2023-06-11	15:26:58	63
2023-06-11	15:27:19	64
2023-06-11	15:27:40	65
2023-06-11	15:28:01	66
2023-06-11	15:28:22	67
2023-06-11	15:28:43	68
2023-06-11	15:29:04	69
2023-06-11	15:29:25	70
2023-06-11	15:29:46	71
2023-06-11	15:30:07	71
2023-06-11	15:30:28	71
2023-06-11	15:30:49	72
2023-06-11	15:31:10	72
2023-06-11	15:31:31	72
2023-06-11	15:31:52	72

2023-06-11	15:32:13	73
2023-06-11	15:32:34	73
2023-06-11	15:32:55	73
2023-06-11	15:33:16	73
2023-06-11	15:33:37	74
2023-06-11	15:33:58	74
2023-06-11	15:34:19	74
2023-06-11	15:34:40	74
2023-06-11	15:35:01	74
2023-06-11	15:35:22	75
2023-06-11	15:35:43	75
2023-06-11	15:36:04	76
2023-06-11	15:36:25	76
2023-06-11	15:36:46	76
2023-06-11	15:37:07	76
2023-06-14	15:57:21	59
2023-06-14	15:57:42	57
2023-06-14	15:58:54	55
2023-06-14	16:01:12	54
2023-06-14	16:01:33	53
2023-06-14	16:01:55	54
2023-06-14	16:02:16	52
2023-06-14	16:02:38	52
2023-06-14	16:02:59	52
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2023-06-14	16:05:53	51
2023-06-14	16:06:14	51
2023-06-14	16:06:35	51
2023-06-14	16:06:57	51
2023-06-14	16:07:18	52
2023-06-14	16:07:40	52
2023-06-14	16:08:01	52
2023-06-14	16:08:22	52
2023-06-14	16:08:44	52
2023-06-14	16:09:05	52
2023-06-14	16:09:27	52
2023-06-14	16:09:48	52
2023-06-14	16:10:10	52
2023-06-14	16:10:31	51
2023-06-14	16:10:53	51

2023-06-14	16:11:14	51
2023-06-14	16:11:36	51
2023-06-14	16:11:57	51
2023-06-14	16:12:18	51
2023-06-14	16:12:40	51
2023-06-14	16:13:01	51
2023-06-14	16:13:22	51
2023-06-14	16:13:44	51
2023-06-14	16:14:05	51
2023-06-14	16:14:27	51
2023-06-14	16:14:48	51
2023-06-14	16:15:10	51
2023-06-14	16:15:31	51
2023-06-14	16:15:52	51
2023-06-14	16:16:14	51
2023-06-14	16:16:35	51
2023-06-14	16:16:56	52
2023-06-14	16:17:18	52
2023-06-14	16:17:42	53
2023-06-14	16:18:03	53
2023-06-14	16:18:25	53
2023-06-14	16:18:46	53
2023-06-14	16:19:08	53
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2023-06-14	16:23:24	54
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2023-06-14	16:24:28	54
2023-06-14	16:24:50	54
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2023-06-15	17:09:04	81
2023-06-15	17:10:02	79
2023-06-15	17:10:23	74
2023-06-15	17:10:45	73
2023-06-15	17:11:06	72
2023-06-15	17:11:28	72

2023-06-15	17:11:49	71
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2023-06-15	17:12:53	70
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2023-06-15	17:18:37	69
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2023-06-15	17:19:42	69
2023-06-15	17:20:03	69
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2023-06-15	17:21:29	70
2023-06-15	17:21:50	70
2023-06-15	17:22:12	70
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2023-06-15	17:22:55	69
2023-06-15	17:23:17	69
2023-06-15	17:23:38	69
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2023-06-15	17:24:42	69
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2023-06-15	17:25:25	69
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2023-06-15	17:26:08	69
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2023-06-15	17:26:51	70
2023-06-15	17:27:12	70
2023-06-15	17:27:34	70
2023-06-15	17:27:55	70

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2023-06-15	17:28:38	70
2023-06-15	17:28:59	69
2023-06-15	17:29:21	69
2023-06-15	17:29:42	69
2023-06-15	17:30:04	69
2023-06-15	17:30:25	70
2023-06-15	17:30:47	70
2023-06-15	17:31:09	70
2023-06-15	17:31:31	69
2023-06-15	17:31:52	69
2023-06-15	17:32:13	70
2023-06-15	17:32:35	69
2023-06-15	17:32:56	69
2023-06-15	17:33:17	69
2023-06-15	17:33:39	70
2023-06-15	17:34:00	70
2023-06-15	17:34:21	69
2023-06-15	17:34:43	70
2023-06-15	17:35:04	70
2023-06-15	17:35:26	69
2023-06-15	17:35:47	69
2023-06-15	17:36:09	69
2023-06-15	17:36:30	70
2023-06-15	17:36:52	70
2023-06-15	17:37:13	70
2023-06-15	17:37:34	69
2023-06-15	17:37:56	69
2023-06-15	17:38:17	70
2023-06-15	17:38:39	70
2023-06-15	17:39:00	70
2023-06-15	17:39:22	70
2023-06-15	17:39:43	70
2023-06-15	17:40:04	70
2023-06-15	17:40:29	70
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2023-06-15	17:41:33	70
2023-06-15	17:41:54	70
2023-06-15	17:42:16	70
2023-06-15	17:42:37	70
2023-06-17	17:19:34	61
2023-06-17	17:19:55	59
2023-06-17	17:20:17	58
2023-06-17	17:20:38	58
2023-06-17	17:20:59	57

2023-06-17	17:21:21	57
2023-06-17	17:21:42	57
2023-06-17	17:22:04	57
2023-06-17	17:22:25	56
2023-06-17	17:22:46	56
2023-06-17	17:23:08	55
2023-06-17	17:23:29	54
2023-06-17	17:23:50	54
2023-06-17	17:24:12	54
2023-06-17	17:24:33	55
2023-06-17	17:24:55	55
2023-06-17	17:25:16	55
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2023-06-17	17:26:20	54
2023-06-17	17:26:42	54
2023-06-17	17:27:03	54
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2023-06-17	17:30:59	55
2023-06-17	17:31:39	55
2023-06-17	17:32:00	55
2023-06-17	17:32:22	55
2023-06-17	17:32:43	55
2023-06-17	17:33:04	55
2023-06-17	17:33:26	55
2023-06-17	17:33:47	55
2023-06-17	17:34:09	55
2023-06-17	17:34:30	55
2023-06-17	17:34:52	55
2023-06-17	17:35:13	55
2023-06-17	17:35:34	55
2023-06-17	17:39:10	56
2023-06-17	17:39:31	56
2023-06-17	17:39:53	56
2023-06-17	17:40:14	56
2023-06-17	17:40:35	56
2023-06-17	17:40:57	57

2023-06-17	17:41:18	57
2023-06-17	17:41:39	57
2023-06-17	17:42:01	57
2023-06-17	17:42:23	57
2023-06-17	17:42:44	56
2023-06-17	17:43:05	56
2023-06-17	17:43:27	57
2023-06-17	17:43:48	56
2023-06-17	17:44:09	56
2023-06-17	17:44:31	56
2023-06-17	17:44:52	56
2023-06-17	17:45:14	56
2023-06-17	17:45:35	56
2023-06-17	17:45:57	56
2023-06-17	17:46:18	56
2023-06-17	17:46:39	57
2023-06-17	17:47:01	57
2023-06-17	17:47:22	59
2023-06-17	17:47:43	59
2023-06-17	17:48:05	58
2023-06-17	17:48:26	58
2023-06-17	17:48:48	58
2023-06-17	17:49:09	58
2023-06-17	17:49:30	58
2023-06-17	17:49:52	58
2023-06-17	17:50:13	56
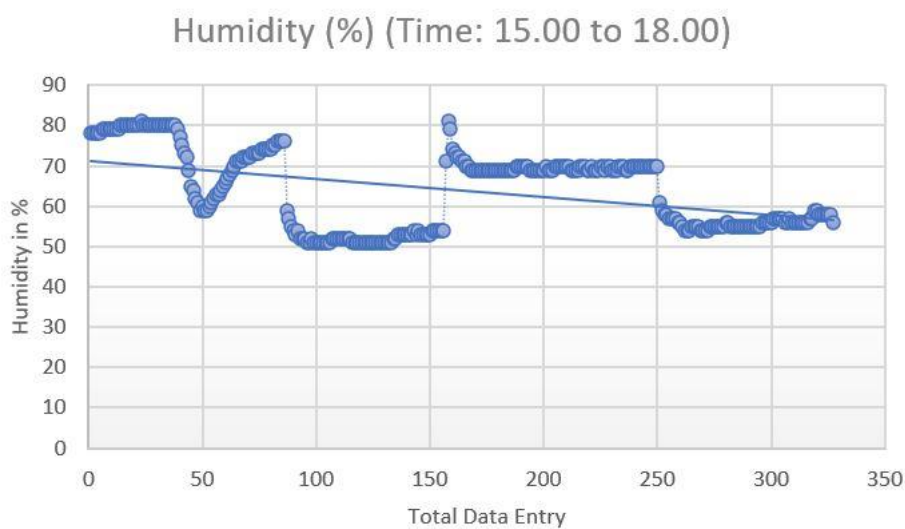
Figure 4.7: Graphical Representation of Humidity in % for Second Slot (Paltan, Dhaka)
(Data Collected by DHT11)

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Table 4.7: CO2 Data Collected Between 15:00 to 18:00

DATE	TIME (Dhaka)	CO2 Concentration (PPM)
2023-06-11	14:58:50	206
2023-06-11	14:59:08	206
2023-06-11	14:59:26	203
2023-06-11	14:59:43	205
2023-06-11	15:00:01	206
2023-06-11	15:00:16	204
2023-06-11	15:00:34	205
2023-06-11	15:00:52	203
2023-06-11	15:01:10	202
2023-06-11	15:01:28	206
2023-06-11	15:01:46	202
2023-06-11	15:02:04	208
2023-06-11	15:02:22	207
2023-06-11	15:02:39	207
2023-06-11	15:02:57	208
2023-06-11	15:03:12	208
2023-06-11	15:03:30	231
2023-06-11	15:03:48	219
2023-06-11	15:04:06	252
2023-06-11	15:04:22	211
2023-06-11	15:04:41	210
2023-06-11	15:04:59	208
2023-06-11	15:05:17	210
2023-06-11	15:05:35	217
2023-06-11	15:05:53	204
2023-06-11	15:06:12	207
2023-06-11	15:06:29	201
2023-06-11	15:06:59	227
2023-06-11	15:07:17	225
2023-06-11	15:07:35	222
2023-06-11	15:08:23	229
2023-06-11	15:08:44	235
2023-06-11	15:09:05	235
2023-06-11	15:09:26	250
2023-06-11	15:09:47	256
2023-06-11	15:10:08	257
2023-06-11	15:10:29	260

2023-06-11	15:10:50	261
2023-06-11	15:11:11	266
2023-06-11	15:11:32	265
2023-06-11	15:11:53	270
2023-06-11	15:12:14	267
2023-06-11	15:12:35	272
2023-06-11	15:12:56	272
2023-06-11	15:13:17	272
2023-06-11	15:13:38	277
2023-06-11	15:13:59	273
2023-06-11	15:14:20	273
2023-06-11	15:14:41	275
2023-06-11	15:15:02	279
2023-06-11	15:15:23	277
2023-06-11	15:15:44	274
2023-06-11	15:16:05	271
2023-06-11	15:16:26	251
2023-06-11	15:16:48	250
2023-06-11	15:17:09	253
2023-06-11	15:17:30	245
2023-06-11	15:17:51	244
2023-06-11	15:18:12	247
2023-06-11	15:18:33	254
2023-06-11	15:18:54	251
2023-06-11	15:19:15	251
2023-06-11	15:19:36	251
2023-06-11	15:19:57	254
2023-06-11	15:20:18	255
2023-06-11	15:20:39	252
2023-06-11	15:21:00	252
2023-06-11	15:21:21	255
2023-06-11	15:21:42	255
2023-06-11	15:22:03	255
2023-06-11	15:22:24	253
2023-06-11	15:22:45	257
2023-06-11	15:23:07	261
2023-06-11	15:23:28	243
2023-06-11	15:23:48	259
2023-06-11	15:24:10	259
2023-06-11	15:24:31	257
2023-06-11	15:24:52	258
2023-06-11	15:25:13	257
2023-06-11	15:25:34	259
2023-06-11	15:25:55	265
2023-06-11	15:26:16	268
2023-06-11	15:26:37	259

2023-06-11	15:26:58	256
2023-06-11	15:27:19	267
2023-06-11	15:27:40	270
2023-06-11	15:28:01	272
2023-06-11	15:28:22	267
2023-06-11	15:28:43	270
2023-06-11	15:29:04	258
2023-06-11	15:29:25	272
2023-06-11	15:29:46	273
2023-06-11	15:30:07	270
2023-06-11	15:30:28	270
2023-06-11	15:30:49	270
2023-06-11	15:31:10	271
2023-06-11	15:31:31	269
2023-06-11	15:31:52	267
2023-06-11	15:32:13	269
2023-06-11	15:32:34	266
2023-06-11	15:32:55	263
2023-06-11	15:33:16	271
2023-06-11	15:33:37	271
2023-06-11	15:33:58	270
2023-06-11	15:34:19	266
2023-06-11	15:34:40	262
2023-06-11	15:35:01	267
2023-06-11	15:35:22	272
2023-06-11	15:35:43	269
2023-06-11	15:36:04	266
2023-06-11	15:36:25	269
2023-06-11	15:36:46	272
2023-06-11	15:37:07	270
2023-06-14	15:57:21	413
2023-06-14	15:57:42	401
2023-06-14	15:58:54	349
2023-06-14	16:01:12	288
2023-06-14	16:01:33	286
2023-06-14	16:01:55	274
2023-06-14	16:02:16	271
2023-06-14	16:02:38	253
2023-06-14	16:02:59	244
2023-06-14	16:03:21	242
2023-06-14	16:03:44	223
2023-06-14	16:04:06	239
2023-06-14	16:04:27	226
2023-06-14	16:04:49	210
2023-06-14	16:05:10	200
2023-06-14	16:05:31	207

2023-06-14	16:05:53	195
2023-06-14	16:06:14	190
2023-06-14	16:06:35	191
2023-06-14	16:06:57	173
2023-06-14	16:07:18	176
2023-06-14	16:07:40	177
2023-06-14	16:08:01	168
2023-06-14	16:08:22	165
2023-06-14	16:08:44	160
2023-06-14	16:09:05	160
2023-06-14	16:09:27	151
2023-06-14	16:09:48	157
2023-06-14	16:10:10	144
2023-06-14	16:10:31	144
2023-06-14	16:10:53	134
2023-06-14	16:11:14	134
2023-06-14	16:11:36	130
2023-06-14	16:11:57	128
2023-06-14	16:12:18	125
2023-06-14	16:12:40	127
2023-06-14	16:13:01	126
2023-06-14	16:13:22	115
2023-06-14	16:13:44	114
2023-06-14	16:14:05	111
2023-06-14	16:14:27	107
2023-06-14	16:14:48	108
2023-06-14	16:15:10	102
2023-06-14	16:15:31	98
2023-06-14	16:15:52	97
2023-06-14	16:16:14	95
2023-06-14	16:16:35	91
2023-06-14	16:16:56	92
2023-06-14	16:17:18	88
2023-06-14	16:17:42	82
2023-06-14	16:18:03	74
2023-06-14	16:18:25	71
2023-06-14	16:18:46	69
2023-06-14	16:19:08	64
2023-06-14	16:19:29	69
2023-06-14	16:19:50	73
2023-06-14	16:20:12	69
2023-06-14	16:20:33	69
2023-06-14	16:20:54	59
2023-06-14	16:21:16	62
2023-06-14	16:21:37	59
2023-06-14	16:21:58	63

2023-06-14	16:22:20	50
2023-06-14	16:22:41	60
2023-06-14	16:23:02	51
2023-06-14	16:23:24	53
2023-06-14	16:23:45	50
2023-06-14	16:24:07	48
2023-06-14	16:24:28	48
2023-06-14	16:24:50	49
2023-06-15	17:08:42	372
2023-06-15	17:09:04	219
2023-06-15	17:10:02	298
2023-06-15	17:10:23	187
2023-06-15	17:10:45	189
2023-06-15	17:11:06	159
2023-06-15	17:11:28	144
2023-06-15	17:11:49	143
2023-06-15	17:12:10	136
2023-06-15	17:12:32	138
2023-06-15	17:12:53	131
2023-06-15	17:13:16	121
2023-06-15	17:13:37	119
2023-06-15	17:13:59	114
2023-06-15	17:14:21	99
2023-06-15	17:14:42	112
2023-06-15	17:15:03	108
2023-06-15	17:15:25	103
2023-06-15	17:15:46	101
2023-06-15	17:16:07	93
2023-06-15	17:16:29	83
2023-06-15	17:16:50	91
2023-06-15	17:17:12	87
2023-06-15	17:17:33	80
2023-06-15	17:17:54	80
2023-06-15	17:18:16	65
2023-06-15	17:18:37	64
2023-06-15	17:18:59	65
2023-06-15	17:19:20	66
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2023-06-15	17:23:17	39
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2023-06-15	17:23:59	35
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2023-06-15	17:24:42	41
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2023-06-15	17:25:25	43
2023-06-15	17:25:46	38
2023-06-15	17:26:08	45
2023-06-15	17:26:30	34
2023-06-15	17:26:51	31
2023-06-15	17:27:12	33
2023-06-15	17:27:34	34
2023-06-15	17:27:55	29
2023-06-15	17:28:16	29
2023-06-15	17:28:38	31
2023-06-15	17:28:59	25
2023-06-15	17:29:21	30
2023-06-15	17:29:42	27
2023-06-15	17:30:04	22
2023-06-15	17:30:25	24
2023-06-15	17:30:47	23
2023-06-15	17:31:09	22
2023-06-15	17:31:31	20
2023-06-15	17:31:52	22
2023-06-15	17:32:13	19
2023-06-15	17:32:35	22
2023-06-15	17:32:56	21
2023-06-15	17:33:17	19
2023-06-15	17:33:39	19
2023-06-15	17:34:00	17
2023-06-15	17:34:21	16
2023-06-15	17:34:43	16
2023-06-15	17:35:04	17
2023-06-15	17:35:26	17
2023-06-15	17:35:47	16
2023-06-15	17:36:09	17
2023-06-15	17:36:30	17
2023-06-15	17:36:52	16
2023-06-15	17:37:13	16
2023-06-15	17:37:34	16
2023-06-15	17:37:56	16
2023-06-15	17:38:17	17
2023-06-15	17:38:39	17
2023-06-15	17:39:00	14

2023-06-15	17:39:22	16
2023-06-15	17:39:43	16
2023-06-15	17:40:04	16
2023-06-15	17:40:29	16
2023-06-15	17:40:50	16
2023-06-15	17:41:12	19
2023-06-15	17:41:33	16
2023-06-15	17:41:54	21
2023-06-15	17:42:16	18
2023-06-15	17:42:37	0
2023-06-17	17:19:34	509
2023-06-17	17:19:55	369
2023-06-17	17:20:17	367
2023-06-17	17:20:38	343
2023-06-17	17:20:59	343
2023-06-17	17:21:21	304
2023-06-17	17:21:42	286
2023-06-17	17:22:04	258
2023-06-17	17:22:25	172
2023-06-17	17:22:46	212
2023-06-17	17:23:08	199
2023-06-17	17:23:29	188
2023-06-17	17:23:50	180
2023-06-17	17:24:12	177
2023-06-17	17:24:33	163
2023-06-17	17:24:55	137
2023-06-17	17:25:16	147
2023-06-17	17:25:37	131
2023-06-17	17:25:59	123
2023-06-17	17:26:20	131
2023-06-17	17:26:42	115
2023-06-17	17:27:03	109
2023-06-17	17:27:24	103
2023-06-17	17:27:46	102
2023-06-17	17:28:07	74
2023-06-17	17:28:29	95
2023-06-17	17:28:50	83
2023-06-17	17:29:12	83
2023-06-17	17:29:33	80
2023-06-17	17:29:54	64
2023-06-17	17:30:16	80
2023-06-17	17:30:37	76
2023-06-17	17:30:59	73
2023-06-17	17:31:39	149
2023-06-17	17:32:00	80
2023-06-17	17:32:22	74

2023-06-17	17:32:43	64
2023-06-17	17:33:04	70
2023-06-17	17:33:26	70
2023-06-17	17:33:47	17
2023-06-17	17:34:09	64
2023-06-17	17:34:30	61
2023-06-17	17:34:52	58
2023-06-17	17:35:13	61
2023-06-17	17:35:34	56
2023-06-17	17:39:10	149
2023-06-17	17:39:31	112
2023-06-17	17:39:53	86
2023-06-17	17:40:14	64
2023-06-17	17:40:35	54
2023-06-17	17:40:57	51
2023-06-17	17:41:18	51
2023-06-17	17:41:39	53
2023-06-17	17:42:01	48
2023-06-17	17:42:23	25
2023-06-17	17:42:44	48
2023-06-17	17:43:05	47
2023-06-17	17:43:27	47
2023-06-17	17:43:48	45
2023-06-17	17:44:09	38
2023-06-17	17:44:31	23
2023-06-17	17:44:52	40
2023-06-17	17:45:14	38
2023-06-17	17:45:35	38
2023-06-17	17:45:57	42
2023-06-17	17:46:18	35
2023-06-17	17:46:39	34
2023-06-17	17:47:01	39
2023-06-17	17:47:22	35
2023-06-17	17:47:43	36
2023-06-17	17:48:05	34
2023-06-17	17:48:26	34
2023-06-17	17:48:48	31
2023-06-17	17:49:09	31
2023-06-17	17:49:30	31
2023-06-17	17:49:52	27
2023-06-17	17:50:13	32
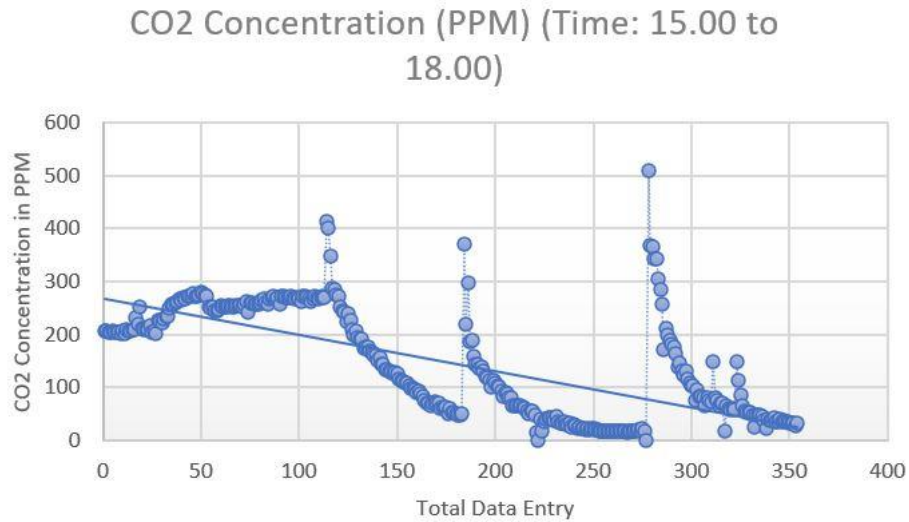
Figure 4.8: Graphical Representation of CO2 Concentration in PPM for Second Slot (Paltan, Dhaka) (Data Collected by MQ-135)

Table 4.8: CO, CH4 & LPG Data Collected Between 15:00 to 18:00

DATE	TIME (Dhaka)	CO, CH4 & LPG Concentration (PPM)
2023-06-11	14:58:50	2031
2023-06-11	14:59:08	2030
2023-06-11	14:59:26	2037
2023-06-11	14:59:43	2027
2023-06-11	15:00:01	2021
2023-06-11	15:00:16	2017
2023-06-11	15:00:34	2023
2023-06-11	15:00:52	2018
2023-06-11	15:01:10	2014
2023-06-11	15:01:28	2005
2023-06-11	15:01:46	2016
2023-06-11	15:02:04	2013
2023-06-11	15:02:22	2005
2023-06-11	15:02:39	2006
2023-06-11	15:02:57	2003
2023-06-11	15:03:12	2003
2023-06-11	15:03:30	1993
2023-06-11	15:03:48	1985
2023-06-11	15:04:06	1984
2023-06-11	15:04:22	1977
2023-06-11	15:04:41	1973
2023-06-11	15:04:59	1974
2023-06-11	15:05:17	1980

93

2023-06-11	15:05:35	1978
2023-06-11	15:05:53	1975
2023-06-11	15:06:12	1977
2023-06-11	15:06:29	1971
2023-06-11	15:06:59	1799
2023-06-11	15:07:17	2021
2023-06-11	15:07:35	2032
2023-06-11	15:08:23	2017
2023-06-11	15:08:44	2017
2023-06-11	15:09:05	2011
2023-06-11	15:09:26	2005
2023-06-11	15:09:47	2000
2023-06-11	15:10:08	1999
2023-06-11	15:10:29	2000
2023-06-11	15:10:50	1995
2023-06-11	15:11:11	1999
2023-06-11	15:11:32	1998
2023-06-11	15:11:53	1994
2023-06-11	15:12:14	1987
2023-06-11	15:12:35	1984
2023-06-11	15:12:56	1983
2023-06-11	15:13:17	1975
2023-06-11	15:13:38	1982
2023-06-11	15:13:59	1981
2023-06-11	15:14:20	1976
2023-06-11	15:14:41	1975
2023-06-11	15:15:02	1976
2023-06-11	15:15:23	1969
2023-06-11	15:15:44	1970
2023-06-11	15:16:05	1966
2023-06-11	15:16:26	1967
2023-06-11	15:16:48	1967
2023-06-11	15:17:09	1962
2023-06-11	15:17:30	1966
2023-06-11	15:17:51	1989
2023-06-11	15:18:12	1958
2023-06-11	15:18:33	1956
2023-06-11	15:18:54	1958
2023-06-11	15:19:15	1953
2023-06-11	15:19:36	1951
2023-06-11	15:19:57	1952
2023-06-11	15:20:18	1945
2023-06-11	15:20:39	1947
2023-06-11	15:21:00	1925
2023-06-11	15:21:21	1936
2023-06-11	15:21:42	1934

2023-06-11	15:22:03	1920
2023-06-11	15:22:24	1921
2023-06-11	15:22:45	1916
2023-06-11	15:23:07	1912
2023-06-11	15:23:28	1904
2023-06-11	15:23:48	1899
2023-06-11	15:24:10	1904
2023-06-11	15:24:31	1899
2023-06-11	15:24:52	1963
2023-06-11	15:25:13	1893
2023-06-11	15:25:34	1797
2023-06-11	15:25:55	1895
2023-06-11	15:26:16	1897
2023-06-11	15:26:37	1897
2023-06-11	15:26:58	1898
2023-06-11	15:27:19	1897
2023-06-11	15:27:40	1901
2023-06-11	15:28:01	1901
2023-06-11	15:28:22	1897
2023-06-11	15:28:43	1901
2023-06-11	15:29:04	1895
2023-06-11	15:29:25	1902
2023-06-11	15:29:46	1903
2023-06-11	15:30:07	1914
2023-06-11	15:30:28	1898
2023-06-11	15:30:49	1904
2023-06-11	15:31:10	1904
2023-06-11	15:31:31	1904
2023-06-11	15:31:52	1904
2023-06-11	15:32:13	1909
2023-06-11	15:32:34	1899
2023-06-11	15:32:55	1883
2023-06-11	15:33:16	1904
2023-06-11	15:33:37	1904
2023-06-11	15:33:58	1905
2023-06-11	15:34:19	1905
2023-06-11	15:34:40	1904
2023-06-11	15:35:01	1904
2023-06-11	15:35:22	1870
2023-06-11	15:35:43	1920
2023-06-11	15:36:04	1904
2023-06-11	15:36:25	1903
2023-06-11	15:36:46	1899
2023-06-11	15:37:07	1893
2023-06-14	15:57:21	491
2023-06-14	15:57:42	475

2023-06-14	15:58:54	417
2023-06-14	16:01:12	336
2023-06-14	16:01:33	332
2023-06-14	16:01:55	325
2023-06-14	16:02:16	334
2023-06-14	16:02:38	304
2023-06-14	16:02:59	300
2023-06-14	16:03:21	290
2023-06-14	16:03:44	274
2023-06-14	16:04:06	276
2023-06-14	16:04:27	273
2023-06-14	16:04:49	258
2023-06-14	16:05:10	244
2023-06-14	16:05:31	256
2023-06-14	16:05:53	239
2023-06-14	16:06:14	229
2023-06-14	16:06:35	227
2023-06-14	16:06:57	224
2023-06-14	16:07:18	224
2023-06-14	16:07:40	218
2023-06-14	16:08:01	214
2023-06-14	16:08:22	209
2023-06-14	16:08:44	206
2023-06-14	16:09:05	197
2023-06-14	16:09:27	202
2023-06-14	16:09:48	185
2023-06-14	16:10:10	183
2023-06-14	16:10:31	176
2023-06-14	16:10:53	175
2023-06-14	16:11:14	172
2023-06-14	16:11:36	166
2023-06-14	16:11:57	166
2023-06-14	16:12:18	161
2023-06-14	16:12:40	167
2023-06-14	16:13:01	157
2023-06-14	16:13:22	152
2023-06-14	16:13:44	147
2023-06-14	16:14:05	145
2023-06-14	16:14:27	143
2023-06-14	16:14:48	140
2023-06-14	16:15:10	133
2023-06-14	16:15:31	128
2023-06-14	16:15:52	133
2023-06-14	16:16:14	128
2023-06-14	16:16:35	121
2023-06-14	16:16:56	121

2023-06-14	16:17:18	118
2023-06-14	16:17:42	112
2023-06-14	16:18:03	107
2023-06-14	16:18:25	103
2023-06-14	16:18:46	105
2023-06-14	16:19:08	94
2023-06-14	16:19:29	102
2023-06-14	16:19:50	103
2023-06-14	16:20:12	99
2023-06-14	16:20:33	95
2023-06-14	16:20:54	85
2023-06-14	16:21:16	90
2023-06-14	16:21:37	92
2023-06-14	16:21:58	91
2023-06-14	16:22:20	81
2023-06-14	16:22:41	82
2023-06-14	16:23:02	81
2023-06-14	16:23:24	81
2023-06-14	16:23:45	79
2023-06-14	16:24:07	77
2023-06-14	16:24:28	76
2023-06-14	16:24:50	77
2023-06-15	17:08:42	400
2023-06-15	17:09:04	293
2023-06-15	17:10:02	282
2023-06-15	17:10:23	247
2023-06-15	17:10:45	256
2023-06-15	17:11:06	211
2023-06-15	17:11:28	197
2023-06-15	17:11:49	192
2023-06-15	17:12:10	182
2023-06-15	17:12:32	186
2023-06-15	17:12:53	175
2023-06-15	17:13:16	164
2023-06-15	17:13:37	160
2023-06-15	17:13:59	153
2023-06-15	17:14:21	143
2023-06-15	17:14:42	153
2023-06-15	17:15:03	144
2023-06-15	17:15:25	142
2023-06-15	17:15:46	137
2023-06-15	17:16:07	128
2023-06-15	17:16:29	115
2023-06-15	17:16:50	121
2023-06-15	17:17:12	119
2023-06-15	17:17:33	113

2023-06-15	17:17:54	110
2023-06-15	17:18:16	96
2023-06-15	17:18:37	87
2023-06-15	17:18:59	86
2023-06-15	17:19:20	85
2023-06-15	17:19:42	85
2023-06-15	17:20:03	82
2023-06-15	17:20:25	80
2023-06-15	17:20:47	77
2023-06-15	17:21:08	71
2023-06-15	17:21:29	74
2023-06-15	17:21:50	72
2023-06-15	17:22:12	66
2023-06-15	17:22:34	53
2023-06-15	17:22:55	53
2023-06-15	17:23:17	61
2023-06-15	17:23:38	90
2023-06-15	17:23:59	53
2023-06-15	17:24:21	59
2023-06-15	17:24:42	59
2023-06-15	17:25:04	55
2023-06-15	17:25:25	56
2023-06-15	17:25:46	55
2023-06-15	17:26:08	54
2023-06-15	17:26:30	48
2023-06-15	17:26:51	48
2023-06-15	17:27:12	48
2023-06-15	17:27:34	48
2023-06-15	17:27:55	44
2023-06-15	17:28:16	45
2023-06-15	17:28:38	46
2023-06-15	17:28:59	43
2023-06-15	17:29:21	45
2023-06-15	17:29:42	43
2023-06-15	17:30:04	40
2023-06-15	17:30:25	38
2023-06-15	17:30:47	38
2023-06-15	17:31:09	37
2023-06-15	17:31:31	38
2023-06-15	17:31:52	37
2023-06-15	17:32:13	35
2023-06-15	17:32:35	36
2023-06-15	17:32:56	33
2023-06-15	17:33:17	34
2023-06-15	17:33:39	33
2023-06-15	17:34:00	33

2023-06-15	17:34:21	30
2023-06-15	17:34:43	33
2023-06-15	17:35:04	33
2023-06-15	17:35:26	34
2023-06-15	17:35:47	32
2023-06-15	17:36:09	32
2023-06-15	17:36:30	31
2023-06-15	17:36:52	32
2023-06-15	17:37:13	30
2023-06-15	17:37:34	32
2023-06-15	17:37:56	32
2023-06-15	17:38:17	34
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2023-06-15	17:39:00	31
2023-06-15	17:39:22	32
2023-06-15	17:39:43	35
2023-06-15	17:40:04	35
2023-06-15	17:40:29	35
2023-06-15	17:40:50	37
2023-06-15	17:41:12	38
2023-06-15	17:41:33	43
2023-06-15	17:41:54	42
2023-06-15	17:42:16	40
2023-06-15	17:42:37	41
2023-06-17	17:19:34	519
2023-06-17	17:19:55	469
2023-06-17	17:20:17	471
2023-06-17	17:20:38	454
2023-06-17	17:20:59	449
2023-06-17	17:21:21	398
2023-06-17	17:21:42	371
2023-06-17	17:22:04	336
2023-06-17	17:22:25	274
2023-06-17	17:22:46	283
2023-06-17	17:23:08	259
2023-06-17	17:23:29	245
2023-06-17	17:23:50	236
2023-06-17	17:24:12	221
2023-06-17	17:24:33	205
2023-06-17	17:24:55	183
2023-06-17	17:25:16	185
2023-06-17	17:25:37	170
2023-06-17	17:25:59	160
2023-06-17	17:26:20	157
2023-06-17	17:26:42	144
2023-06-17	17:27:03	139

2023-06-17	17:27:24	129
2023-06-17	17:27:46	127
2023-06-17	17:28:07	108
2023-06-17	17:28:29	113
2023-06-17	17:28:50	109
2023-06-17	17:29:12	104
2023-06-17	17:29:33	102
2023-06-17	17:29:54	90
2023-06-17	17:30:16	102
2023-06-17	17:30:37	99
2023-06-17	17:30:59	96
2023-06-17	17:31:39	122
2023-06-17	17:32:00	93
2023-06-17	17:32:22	91
2023-06-17	17:32:43	86
2023-06-17	17:33:04	91
2023-06-17	17:33:26	86
2023-06-17	17:33:47	64
2023-06-17	17:34:09	81
2023-06-17	17:34:30	80
2023-06-17	17:34:52	80
2023-06-17	17:35:13	77
2023-06-17	17:35:34	77
2023-06-17	17:39:10	112
2023-06-17	17:39:31	176
2023-06-17	17:39:53	126
2023-06-17	17:40:14	81
2023-06-17	17:40:35	75
2023-06-17	17:40:57	71
2023-06-17	17:41:18	69
2023-06-17	17:41:39	67
2023-06-17	17:42:01	65
2023-06-17	17:42:23	52
2023-06-17	17:42:44	63
2023-06-17	17:43:05	63
2023-06-17	17:43:27	62
2023-06-17	17:43:48	61
2023-06-17	17:44:09	59
2023-06-17	17:44:31	49
2023-06-17	17:44:52	58
2023-06-17	17:45:14	53
2023-06-17	17:45:35	55
2023-06-17	17:45:57	60
2023-06-17	17:46:18	54
2023-06-17	17:46:39	53
2023-06-17	17:47:01	54

| 2023-06-17	17:47:22	53
2023-06-17	17:47:43	52
2023-06-17	17:48:05	49
2023-06-17	17:48:26	49
2023-06-17	17:48:48	48
2023-06-17	17:49:09	48
2023-06-17	17:49:30	48
2023-06-17	17:49:52	47
2023-06-17	17:50:13	47
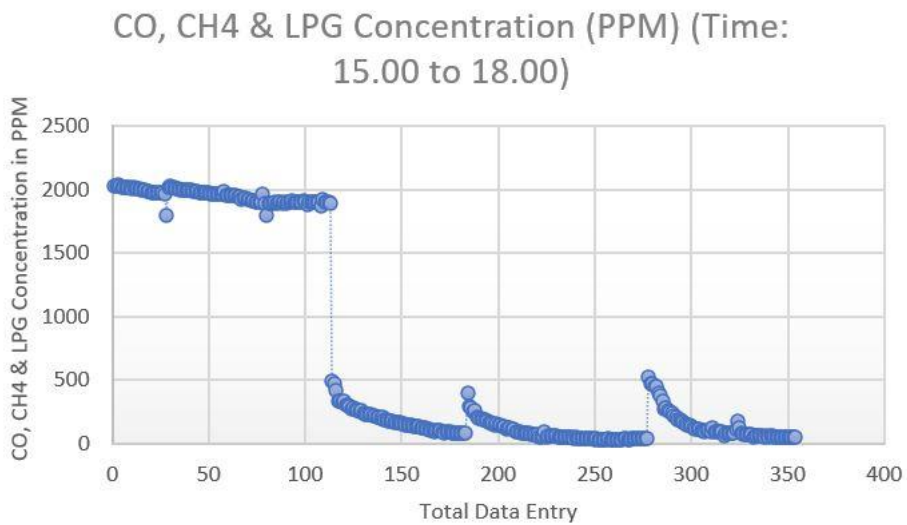
Figure 4.9: Graphical Representation of CO, CH4 & LPG Concentration in PPM for Second Slot (Paltan, Dhaka) (Data Collected by MQ-9)

4.2 Discussions

The air quality index (AQI) is a number that reflects the condition of the local air quality. The AQI in Bangladesh is determined using the current levels of 5 criterion pollutants: PM (PM10

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and PM2.5), NO2, CO, SO2, and O3 [22]. The air quality index (AQI) number indicates how clean or dirty the air is and what potential health effects there may be for the general public [22]. The AQI focuses on potential health impacts that could occur hours or days after breathing contaminated air [22]. The AQI is a single number between 0 and 500 PPM (Parts Per Million) that is determined by the pollutant concentrations that have been recorded in a specific location [22]. The larger the air pollution level and, thus, the bigger the public health issue, the higher the AQI. And in this project we have collected data for CO2, CO, CH4 & LPG in PPM. Here is the air quality index (AQI) for Bangladesh in table 4.9 [22].

Table 4.9: Air Quality Index (AQI) for Bangladesh (Source: [22])

AQI (Air Quality Index) Range (PPM)	Status
0-50	Good
51-100	Moderate
101-150	Unhealthy for sensitive groups
151-200	Unhealthy
201-300	Very Unhealthy
301-500	Hazardous

A comparison of Table 4.9 and the collected data reveals that the CO2 concentration trendline (Figure 4.4) the ranges between 200 and 600 parts per million (PPM). And this data is collected between the time 10:00 to 14:00 at Paltan, Dhaka which is considered very unhealthy and hazardous according to the Air Quality Index (AQI) for Bangladesh. This is consistent with the findings of previous studies, which have shown that CO2 levels in Dhaka can reach as high as 450 ppm during peak traffic hours. In figure 4.8 the CO2 concentration range is between 300 to 50 PPM and the concentration is dropped. This data is collected between the time 15:00 to 18:00 at Paltan, Dhaka.

Figure 4.5, on the other hand, depicts the concentrations of CO, CH4, and LPG in PPM. This graphical chart depicts a mixed concentration of these elements rather than for a single element. The concentration of CO is particularly high, reaching up to 100 ppm in some areas. This is well above the World Health Organization's (WHO) safe level of 10 ppm. The concentrations of CH4 and LPG are also high, reaching up to 50 ppm and 20 ppm, respectively. These levels are also considered to be unhealthy and hazardous. And this data is collected between the time 10:00 to 14:00 at Paltan, Dhaka. And in figure 4.9 the data is collected between the time 15:00 to 18:00 at Paltan, Dhaka. This time the range is between 100 to 500 PPM.

The high levels of CO, CH4, and LPG in Dhaka are a major cause for concern. These pollutants can have a number of negative health effects, including respiratory problems, heart disease, and cancer. They can also contribute to climate change.

In Figure 4.2 we can see the data is collected between the time 10:00 to 14:00 at Paltan, Dhaka. The temperature is between 30 to 35 degrees Celsius. As in Figure 4.6, we can see the temperature raised above 35 degrees Celsius, and this data is collected between the time 15:00 to 18:00 at Paltan, Dhaka.

Figure 4.3 shows the humidity levels in Paltan, Dhaka between 10:00 and 14:00. The humidity levels are mostly between 60% and 85%, with a peak of 88% at 12:00. This is to be expected, as these are the hottest hours of the day and the air is more saturated with water vapor.

Figure 4.7 shows the humidity levels in Paltan, Dhaka between 15:00 and 18:00. The humidity levels are lower in this time period, ranging from 58% to 70%. This is because the sun is setting and the air is cooler, so it can hold less water vapor.

It is important to note that these are just two snapshots of the humidity levels in Paltan, Dhaka. The humidity levels can vary significantly depending on the time of day, the season, and the weather conditions.

CHAPTER 5

PROJECT MANAGEMENT

5.1 Task and Milestones

Table 5.1: Real Achieved Total Task, Timing and Milestones

Task	Expected Days to Complete	Milestones
Task 1: Problem Selection	7	DONE
Task 2: Method Analysis	3	DONE
Task 3: Collecting Project Equipment	7	DONE
Task 4: Building the Project	16	DONE
Task 5: Project Observation	2	DONE
Task 6: Data Collection by Project	30	7 Days
Task 7: Data Analysis	14	DONE
Task 8: Reading and Collecting more Papers	10	DONE
Task 9: Writing Thesis Book	30	Took 45 Days
Task 10: Check plagiarism	4	DONE
Task 11: Again review	7	DONE
Task 12: Report submit	1	DONE

5.2 Resources and Cost Management for IoT-Based Environment Monitoring System Project

- First, we had to collect papers and print them out, which incurred some costs.

- The internet was used for research, which also incurred costs.

- Transportation costs were incurred to collect equipment and data.

- The project equipment itself also incurred costs.

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- Due to some problems in collecting data from sensors, we had to purchase additional sensors, which further increased costs.

- Finally, binding and printing costs were incurred.

5.3 Lesson Learned by the Project

From this technical project, I have learnt about various things. They are:

- The study looked into how to create an IoT-based system for monitoring the environment.
- The research also investigated the use of sensors and code to operate a microcontroller.
- The project showed how to use a cloud platform like ThingSpeak for data storage.
- The project demonstrated how to visualize gathered information and draw conclusions from it.
- The initiative looked at how automobile emissions affect the environment.
- The initiative investigated Paltan, a neighbour-hood in Dhaka.
- The initiative compared Bangladesh's Air Quality Index (AQI) to the air quality in Paltan, Dhaka.

CHAPTER 6
IMPACT ASSESSMENT OF THE PROJECT

6.1 Economical, Societal and Global Impact by IoT-Based Environment Monitoring System Project

Systems for monitoring the environment that rely on the Internet of Things (IoT) can assist to enhance air quality and minimize pollution, which can lower healthcare expenses and boost productivity. For instance, a study from the University of California, Berkeley concluded that healthcare expenditures and lost productivity from air pollution cost the American economy $1 trillion annually. IoT-based environmental monitoring systems can also promote energy and water efficiency, which can result in financial savings for organizations and governments. IoT-based technologies for monitoring the environment can help to raise people's standards of living globally.

6.2 Environmental and Ethical Issues

The quantity of energy that IoT consumes is one of the largest environmental problems. Despite being small and frequently battery-operated, IoT devices can nevertheless consume a lot of energy, especially if they are continually transferring data. Over time, this can result in a large increase in energy demand, which can also increase greenhouse gas emissions.

The amount of waste that IoT generates is another issue for the environment. The lifespans of IoT devices are frequently brief, and they are frequently not recycled or disposed of correctly. This can result in an accumulation of electronic garbage, which might contaminate the environment.

IoT raises various ethical issues that need to be taken into account. The most important issue is privacy. IoT devices gather a lot of information about individuals, and this information can be used to follow individuals' whereabouts, keep tabs on their activities, and even forecast their behaviour. This raises questions about who will have access to the data and how it would be used.

IoT security is another ethical issue. IoT devices are susceptible to hackers because they are frequently linked to the internet. By doing this, hackers might be able to steal data, interfere with business operations, or even hurt people directly.

Before creating and implementing IoT initiatives, it is crucial to thoroughly assess the environmental and ethical implications of IoT. We can contribute to ensuring that IoT is utilized in a way that is ethical and sustainable by taking these concerns into consideration.

6.3 Utilization of Existing Standards or Codes

- The Internet Protocol (IP), which serves as the foundation for the internet and the Internet of Things, is employed. Regardless of the brand or model, IP offers a common method for devices to communicate with one another.
- MQTT is a simple messaging protocol that works well with the Internet of Things. MQTT is simple to set up and utilizes little bandwidth, which is crucial for battery-powered devices.
- IEEE 802.15.4 is a wireless networking standard for low power. IoT devices frequently employ IEEE 802.15.4 because of how little electricity it uses [24].
- For Internet of Things (IoT) devices, ISO offers a number of security standards, including ISO/IEC 27011, "Information Security Management Systems for telecommunications organizations" [25].
- NIST offers several security recommendations for Internet of Things (IoT) devices, such as Special Publication 800-160, "Guidelines for Managing the Security of Information Systems" [26].

CHAPTER 7
CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

Bangladesh's urban regions experience significant air quality issues, particularly during the dry season (November to April), when PM concentrations routinely exceed the WHO guideline value by a factor of 7-8 [22]. To constantly monitor the air quality in Bangladesh's urban regions, the Clean Air and Sustainable Environment (CASE) Project of the Department of Environment has installed continuous air monitoring systems across the whole nation [22]. The globe is warming as a result of CO_2 emissions from vehicles trapping heat in the atmosphere. Globally, more extreme weather events, increasing sea levels, and changes in plant and animal life are already being felt as a result of climate change. The acute and long-term results of traffic-related air pollution include adverse health impacts such as asthma, eye irritation, lung problems, and effects on fertility. People who live in expanding cities are more likely to experience negative health effects [23]. So, in Conclusion, we can say that the IOT-Based environment monitoring system is a step forward to contribute a solution to the biggest threat which is environment impact due conventional vehicle emission and the created system is inexpensive, easy to use, and adaptable to any setting. The newly created system outperforms the current one in terms of accuracy and cost. And the main aims those are introduced in chapter 1 are also fulfilled.

7.2 New Skills and Experiences Learned

- Developing IoT-based projects.

- Learning to code in the Arduino IDE, cloud storage, including the IoT-based analytical platform ThingSpeak (MathWork) and MS Excel data analysis.

- Gaining knowledge of different types of microcontrollers, sensors, and their operations.

- Collecting data for days on the roadside to identify vehicle emissions elements and their concentration in parts per million (ppm).

- Analyzing the current environmental impact of vehicle emissions in Paltan, Dhaka.

- Determining the rate at which air pollution is rising due to these emissions.

- Investigating the rise in temperature in Dhaka city caused by vehicle emissions.

7.3 Future Recommendations

In order to lessen the environmental impact of transportation, the adoption of Internet of Things (IoT)-based monitoring systems for vehicle emissions is a viable strategy. Real-time data on car emissions collected by IoT systems can be used to pinpoint enforcement activities, identify regions with high pollution levels, and create emission-reduction plans. IoT systems can also be used to warn drivers when their cars are producing too much pollution. This can inspire them to maintain their cars properly and lower their emissions. IoT systems for monitoring vehicle emissions are still in their early stages, but they have the potential to make a big difference in air quality and public health. As the technology continues to develop and become more widely adopted, IoT systems will become increasingly important in reducing the environmental impact of transportation. The time when vehicles are stopped in traffic or waiting for someone, by turning off the engine we can reduce CO_2, CO, LPG, CH_4 emission. Because idling wastes fuel and pollutes the air. The EPA estimates that idling for 10 seconds wastes as much fuel as driving one mile. Also, Regular tune-ups and oil changes can keep this traditional fuel-based vehicles operating effectively and cut pollutants. According to the EPA, properly maintained vehicles release up to 40% fewer pollutants than poorly maintained vehicles. And to develop this monitoring project we can add LCD for real time display on the spot, can add one more sensor that tells the ozone layer status and PM2.5 laser dust sensor.

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APPENDIX A
TURNITIN REPORT

APPENDIX B
PROGRAM CODE

```
#include <WiFi.h>
#include <DHT.h>
#include <WiFiClient.h>
#include"ThingSpeak.h"
WiFiClient client;
int status=WL_IDLE_STATUS;
unsigned long myChannelNumber=2146435;
const char * myWriteAPIKey="NQBFGNIYHL4P02RF";
const char* ssid    = "EEE";
const char* password = "12345678";


#include "DHT.h"
#include "MQ135.h"
#define DPIN 4 //Pin to connect DHT11 sensor (GPIO number)
#define DTYPE DHT11 //Define DHT sensor type
#define MQ135PIN 35 //Pin to connect MQ135 sensor(GPIO number)
#define MQTYPE MQ135 //Define MQ sensor type
#define MQ9PIN 34 //Pin to connect MQ9 sensor(GPIO number)
DHT dht (DPIN,DTYPE);
void setup () {
 Serial.begin(115200);
 Serial.print("Connecting to ");
 Serial.println(ssid);
 WiFi.begin(ssid, password);
 while (WiFi.status() != WL_CONNECTED)
 Serial.print(".");
 Serial.println("");
 Serial.println("WiFi connected.");
```

```
Serial.println("IP address: ");
Serial.println(WiFi.localIP());
ThingSpeak.begin(client);
dht.begin();
 delay(5000);
 }
// Print local IP address and start web server
void loop () {
 delay (20000);
 float tc= dht.readTemperature();//Read temperature in C
 float hu= dht.readHumidity();//Read humidity in %
 //mq9
 float conductivity;
 conductivity = analogRead(34);
 Serial.print("LPG = ");
 Serial.print(conductivity);
 Serial.println("PPM\t");
 //delay(500);
 //mq  135
 float air_quality_mq135;
 air_quality_mq135 = analogRead(35);
 Serial.print("CO2 = ");
 Serial.print(air_quality_mq135);
 Serial.println("PPM\t");
 //MQ135 gasSensor2 = MQ135(MQ135PIN);
 //float air_quality_mq135 = gasSensor2.getPPM();
 //int gas = analogRead(MQ9PIN);
 //int conductivity = round(((float)gas/1023)*100);
 Serial.print ("Temp:");
 Serial.print (tc);
 Serial.print (" C,Hum:");
 Serial.print (hu);
 Serial.println (" %");
 Serial.print("Air Quality by MQ135: ");
```

```
Serial.print(air_quality_mq135);
Serial.println(" PPM");
Serial.print("Air Quality by MQ9: ");
Serial.print(conductivity);
Serial.println(" PPM");

//ThingSpeak

ThingSpeak.setField (1,tc);
ThingSpeak.setField (2,hu);
ThingSpeak.setField (3,air_quality_mq135);
ThingSpeak.setField (4,conductivity);
ThingSpeak.writeFields (myChannelNumber,myWriteAPIKey);
}
```