Sense Weather

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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APPROVAL

This Project titled **"Sense Weather"**, submitted by **Md. Ibrahim Hossen**, ID No: **171-15-8607**, and **Md. Rifat Ahmed**, ID No: **171-15-8585** and **Uzzal Kumar Shimanto Roy**, ID No: **171-15-9163** to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on **28 January 2021**.

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DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Fahad Faisal, Assistant Professor, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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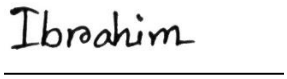

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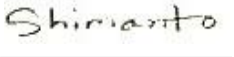

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Finally, we must acknowledge with due respect the constant support and patients of our parents.

ABSTRACT

This report on the IoT base project “Sense Weather” is made as a guide for the people who are doing the same kind of work. Teachers and students can have a look at this report before starting this type of project as a guideline. Discussions of this report will give a proper description of the current situation of the weather monitoring technology. Teachers can suggest this report paper to the students can take away effective information for their work save a lot of time. Because we talked about the requirements for this kind of project in-depth. Design and implementation processes are brought up perfectly with appropriate models and diagrams. So this report will save a lot of time for the students as they will enrich their knowledge about the sensors and connectors. Future developers can know a lot about Thingspeak in our project, which will highlight their project with great UI. So we think, by using this report, students can become more pro-active about their development projects. Teachers will be helped with the assistance of this report, among other tools, to begin a conversation and take the first step with their students about the expectations for the project assignments. Then relevant information is repeated in the summary section for the convenience of the teachers and students. In the future scope, we have given some great ideas from which future developers can take a notion and build their very own advanced project. An annotated reference list is included in this report paper for ease in finding other useful guidance and some more information if developers needed.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

There was a time when Bangladesh was called a temperate country in terms of climate. Back in the time, it was neither very warm nor very cold in this country. At present, Bangladesh is facing mostly very hot seasons. Rainfall has been reduced. It's a good thing that spring still comes to this country but winter does not have its scare that much anymore. Our country is an agricultural country. The majority of people in this country is depending on it. Here the weather is a basic parameter of our agricultural system. Every season plays a vital role for every crop. For example, you just can not grow Potatoes in the rainy season. So to know the weather update is very important for agriculture. From this thinking, we have tried to develop a basic weather monitoring and an analytic device named "Sense Weather". Our developed device can provide real-time weather update with parameters of temperature, humidity, light intensity, and gas detection. This data can be showed and analyzed on the cloud.

1.2 Motivation

Though we have an agricultural country we want to help our farmers to provide real-time weather parameters. With the flow of modernization, our agricultural sector is digitalizing from day today. Many of our young generation educated people are coming to this sector. They have new ideas and thinking. We have focused on these categories of farmers for developing our project.

In agriculture, the weather is a key factor. If we get real-time data rapidly and analytical reports this will help our farmers to take care of their crops.

1.3 Objective

- To help the people who are cultivating crops in a different season.
- Young people who want to enter the field of agriculture.
- To help the farmers to take the necessary steps in different local weather.
- Helping the cultivators with pest control.
- To take the right decision in using the right fertilizer at the right time.
- Partially help to increase the number of crops.

1.4 Expected Outcome

We have tried to develop a basic weather monitoring system named ” Sense Weather”. Our target is to collect data from the local environment and deploy them on the cloud then we have tried to show some analysis into the web in some graphical way. On the web, we have tried to show real-time data of some different parameters like temperature, humidity, light intensity, and bad gas detection.

In our developed device, we have tried to update these local weather parameters every 15 seconds. We have tried to help our farmers by providing real-time weather data with an analytical view. We are hoped our developed device “Sense Weather” will help our farmers in the agricultural sectors and it’s our main target and expected target.

CHAPTER 2
BACKGROUND

2.1 Introduction

Weather is the ultimate mystery to us humans. We always wanted to make friendship with the environment. For the majority of the time, weather monitoring was limited to the government and some organizations. People had to depend on them. They would sit in front of the TV or hear radio stations for the weather update. Farmers know very little about the weather but they spend hours in the fields. If they had known more about the weather they would have produced more crops. From plowing land, sawing seed, spreading fertilizer to harvesting the crops, they could do all these in an exact time and have a better harvesting season with greater profit if they had their own weather monitoring system. This is why are focusing on developing a weather monitoring system called “Sense Weather”, which is portable, cost-efficient, and less power consuming.

2.2 Similar Works Like “Sense Weather”

At the moment, a bunch of apps is present in app stores that monitor the weather. But almost all of them use mobile phone sensors to show the result. If a phone does not have high-quality sensors, then monitoring results are not accurate. Some of these apps also use Google’s API to monitor the result but Google shows an average weather forecast for an entire area. There are also some websites like Dark Sky that show the weather forecast but shows an average weather forecast for an entire area.

2.2.1 Dark Sky

Figure 2.1 shows an image of the Dark Sky website. It has some features like temperature, humidity, wind, visibility. It shows the data with a map of the current location.

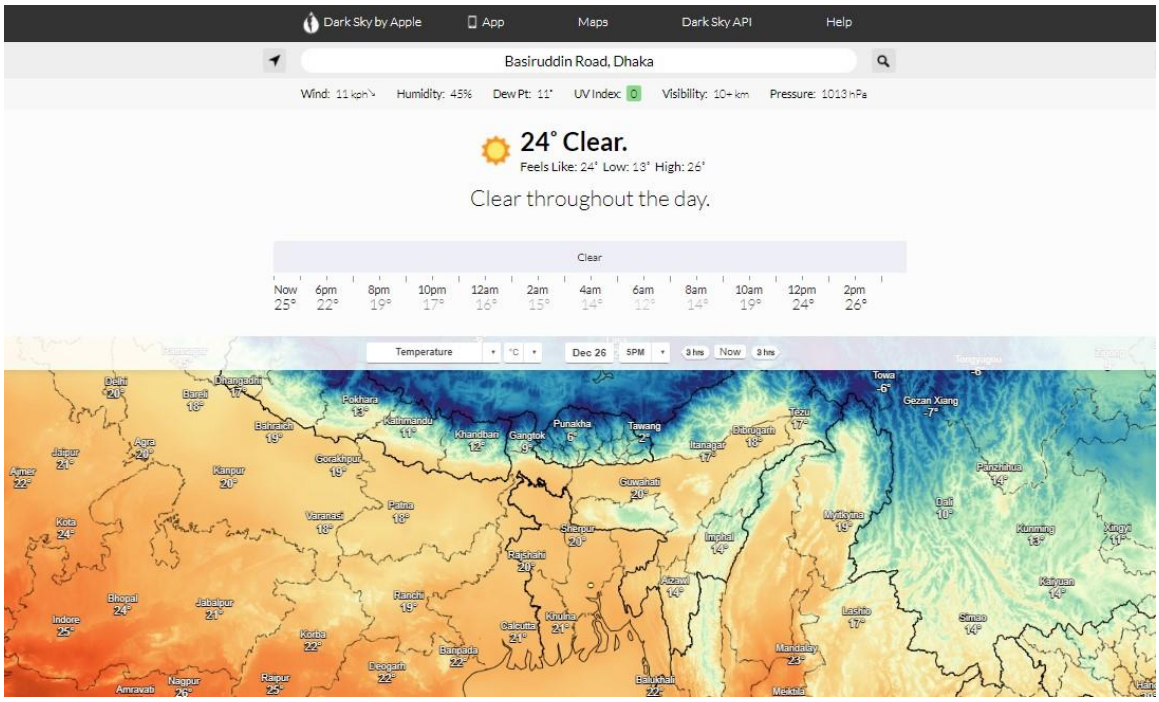

Figure 2.1: Dark Sky Weather Forecast [3]

2.3 Comparative Studies

Dark Sky and some other weather forecasting websites provide a lot of features. But the question is, are they user friendly? If we think broadly the answer would be “no”. Yes, these websites provide us a lot of pieces of information but how much of them do we actually need? The data they are giving is not fully useful in our country. They are already giving us data on an average for the whole area and with that, they are not synchronizing the data in a very quick time. Whereas In our device “Sence Weather”, data is synchronizing every 15 seconds. We are providing only important weather data like temperature, humidity, gas sensor, and light intensity. The most important part is it not giving an average result for the forecast. It detects the exact result for the exact place.

2.4 Scope of The Problem

Some problems that might come up during development process of "Sense Weather" are –

- Choosing the perfect components for making the device.
- Connecting the wires to the right port.
- Combination of the sensors.
- Writing the code efficiently.
- Configuring Thingspeak.
- Fetching true data

2.5 Challenges

No project in the whole world is developed without facing any problems. Our project "Sense Weather" might as well face some challenges too. For example,

- Attractive design and useful features for users of every level.
- Making the device easy for customers to use and run.
- Making the device available for all.
- Making the setup easy to less complicated.
- Doing a proper advertisement for the system to be more popular.

CHAPTER 3

REQUIREMENT SPECIFICATION

3.1 “Sense Weather’s” BPM

BPM (Business Process Modeling) is one of the most important things to start a new business and to operate a running business. BPM in elaborate form is a way of making an observable picture of a functional process. We make this by using methods like flowcharts and BPMN. Easily speaking, BPM is a description of a companies function method. Although BPM is complex, this is a very effective way of handling the procedure of a business. To make our work easier we can use software for process modeling.

Next, we use BPM to measure the development of the project of a company and the work rate put in for the specific project. This becomes possible because through this method we can keep track of every step. For example, we can measure the difference in a function’s performance before and after installing an improvement to the project.

In our project, we worked with NodeMCU and some sensors to show our data on Thingspeak. In figure 3.1. our work process is been shown.

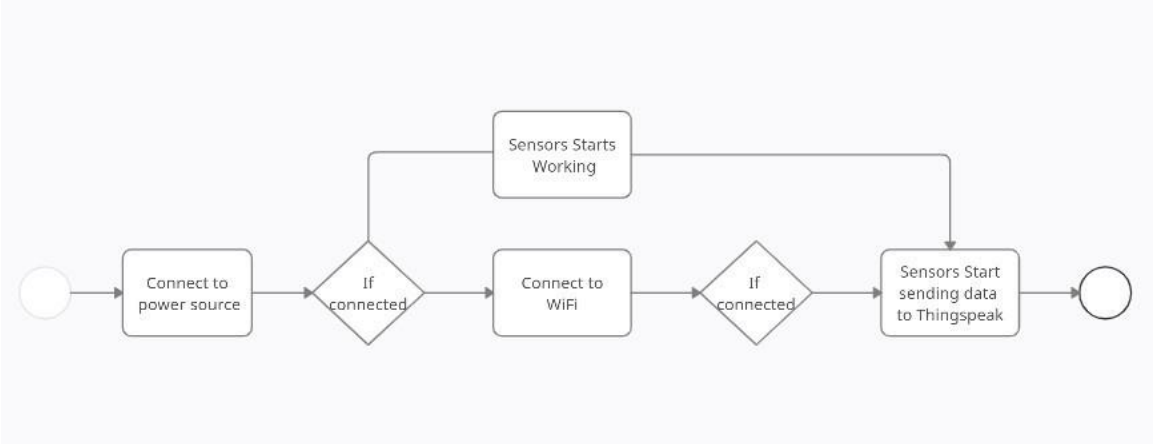

Figure 3.1: BPM of “Sense Weather”

3.2 System Development Life Cycle of "Sense Weather"

Systems Development Life Cycle (SDLC), is the stage where all the future planning occurs, after planning comes the developing stage, and then testing of the project happens. This process is also known to us as the Application Development Life Cycle. The concept of SDLC is applied to all the projects. It can be a hardware project or only a software project. Or it can be a mixture of both. For getting a perfect result for the proposed software every step of the system development life cycle should be followed and not overstepping one before another. To provide security and efficiency to the developing project we better maintain a strict obligation to follow the system development life cycle. Generally, there are six stages in SDLC. These are requirement analysis, design, development and testing, implementation, documentation, and evaluation.

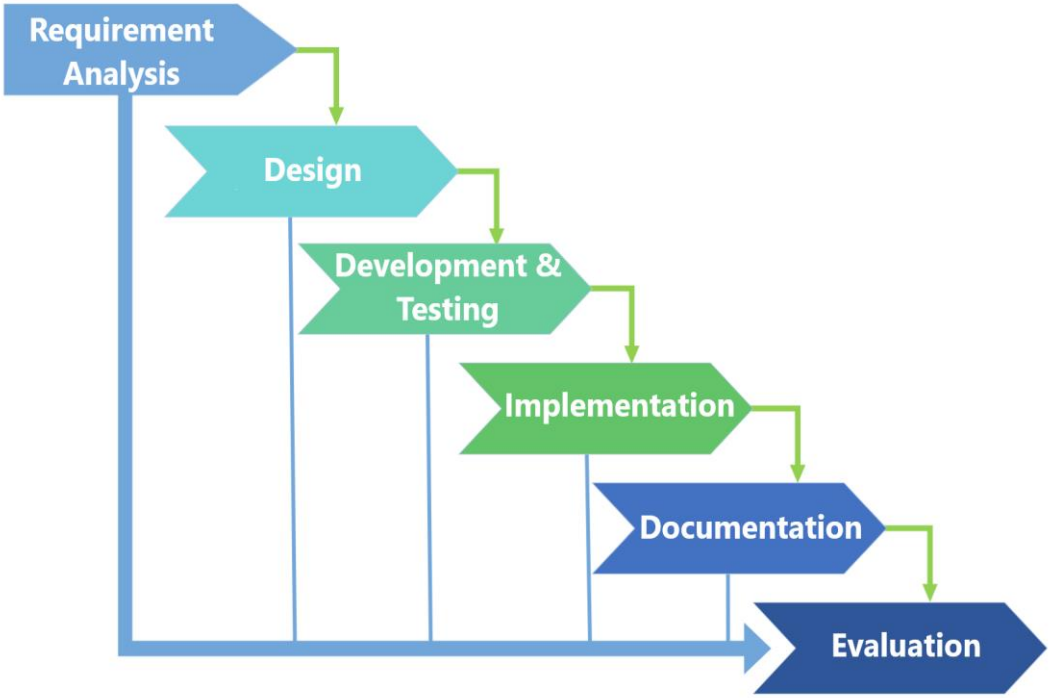

Figure 3.2: SDLC Model for "Sense Weather"

From the above figure 3.2, we can see that our project's model is very similar to the waterfall model of SDLC. Both of them have a step by step method. This means one stage has to be concluded before the next stage can begin and there is no overstepping in the stages. It is very simple to understand and use. For our project, first, we have to analyze all the requirements, then design the structure, develop the project, and start testing. And then start the implementation process. After implementation, we have to make the documentation, and then finally make a proper evaluation. Bellow, We are discussing all the processes one by one.

3.2.1 Requirement Analysis

This is the very first step of beginning development work on a project. This stage aims to see what is the cause of the problem. Or for a new project, it sorts out the user requirement and sets the objectives. Then tries to solve the problems. At this stage, the process requires a complete piece-by-piece demolition of the system. We do all this in order to investigate project goals, understanding what can be made. In this project named "Sense Weather", at first we tried to find out what is the shortage of the existing systems. Then we listed down we want to solve them and then how can we make it easy for the users to handle and use them.

Some requirements of this project are –

- This device should meet users' prerequisite requirements.
- The device must be small in size.
- The corrosion rate must be low.
- Development cost should be efficient.
- Response time must be fast.

3.2.2 Design

The second stage of any development project is designed. This is also one of the most important stages. Because user satisfaction would never come if they don't find the design attractive. People would even buy less effective software if they find the device's design eye-dazzling. Developer design the layout, structure, and architecture in this stage. The output of this stage can bring major success to the company. That is why companies value the system designers very high and pay them a lot.

3.2.3 Development and Testing

Undoughtly system development and testing are more important than it is thought off. This stage takes place after two very quick sessions and works with the users' desires and wants from the project. We also did some research before the implementation of the project and found some attributes that users want.

Our system generally highlights the most effective options of the proposed project in terms of:

- Quality
- Functionality
- Operability
- Serviceability
- Durability
- Convenience
- Price
- Values

At the start of developing a project, developers start with a variety of ideas. But only the feasible and convenient option for the users gets the chance for implementation.

The method of system testing happens before launching the project in the market. It is done with the users who are trusted and most likely to buy the product. For an example, we wish to raise our systems' users the subsequent questions:

- Are users fascinated by the device?
- Do they like the device's features?
- Is the design liked by the users?
- Is there any option they do not like?
- What more features would they want us to add?
- Is the device compatible with the alternate solution?
- Is the price for the device acceptable?

3.2.4 Implementation

The implementation phase no dought is one of the most important phases of the SDLC process. During implementation, we created the actual device. Implementation of the project was an exciting phase for us because our idea for the project became visible. We began building and coding in order to configure the NodeMCU. As the system "Sense weather" was designed properly and all the requirements were gathered accurately, the writing of the code was made very easy. We were better prepared to meet the requirements because the information was always up-front to us.

For example, in this project, we were aware that we are building a system that detects the weather. We knew we are detecting temperature, humidity, light intensity, and harmful gas. So we bought the sensors accordingly, set them up on the breadboard, and wrote specific codes to configure each sensor along with the microcontroller. After we had completed the setup and code, the next phase of the development process can begin.

3.2.5 Documentation

Documentation is necessary for every system. It is the shade term that surrounds all written documents and pieces of information addressing how a packaged product should be used. A system or device, Developed by a little group like us or an oversized group, need some connected "read me" document. Documentation should be recorded at every step of the development so that nothing is forgotten. Usually, documentation is created to clarify the system's operability, merging the projects related data, and answering the all-important queries that can be arising between the users and us.

We have to keep in mind that, documentation faults can lead to huge misery. This will create a hole between the desire of the users and developers. So, As developers, we should always pay extra attention to the quality of our documentation.

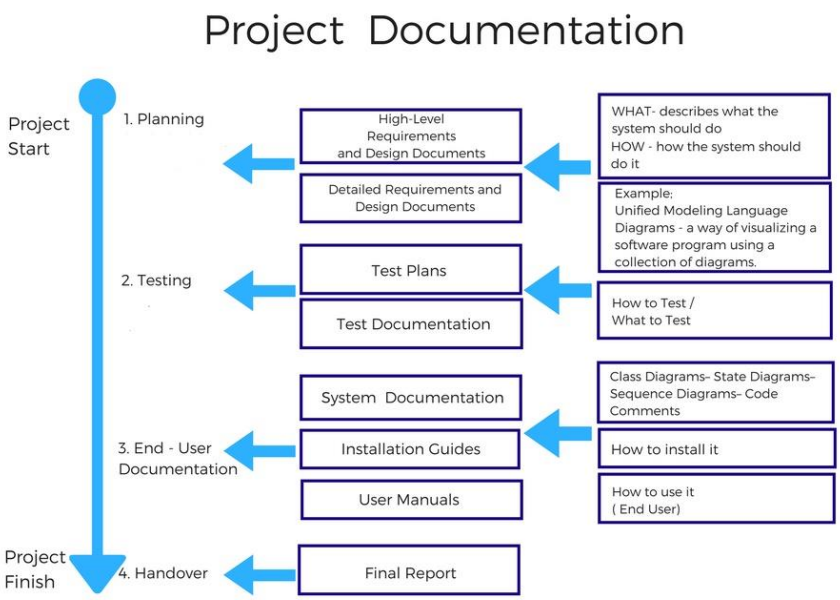

Figure 3.2.5: A View On Project Documentation

3.2.6 Evaluation

After the hard work of the developers comes the final stage which is called “Evaluation”. There is a tendency between developers to overlook this phase in the SDLC process. When developers start the evaluation process, a lot of error comes in front and they can start to solve then. This is why the system gets its sharpness, and gets faster. This brings huge improvement to the system.

The evaluation process finds out if the device is full filling the user's prerequisite demand. This is why the evaluation stage is crucial for customer satisfaction. That’s the reason we did our evaluation of the device named “Sense Weather” and was pretty happy with the result.

3.3 Sense Weather’s Use Case Modeling and Description

Use Case diagram is used to describe the relationship between the users and the systems. For a given scenario many types of use case models can be drawn. A use case model makes it easy for observers to understand the goal and workflow of the user and system. A use case diagram points out the interaction between the system and the users and how many ways the actions can be done by the actors. It is simply the workflow of a system. Bellow, we are giving the use case scenario for our system with an appropriate diagram.

Use Case Scenario: Exact weather forecast for an exact place is not available in our country. Google, Dark Sky by Apple, and other websites provide us weather forecasts but those are average of temperature, humidity, and other weather information and the synchronization time is long. So we have taken the task into our hands to build an IoT device name "Sense Weather" which will detect the information data for a specific place at the exact time. and continue to synchronize data in a few seconds continuously. Users would buy the device and then connect it to a power source. All the data will be shown in Thingspeak. Many users can see the weather information of a specific with one account in Thingspeak.

Modeling of The Use Case: In figure 3.3 we have shown a use case model for the above scenario.

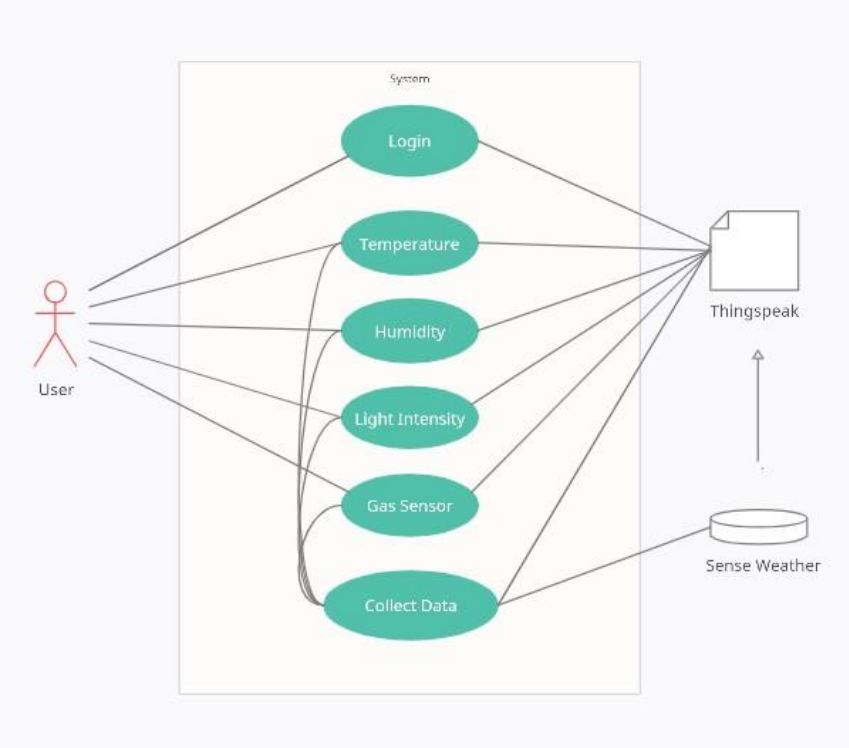

Figure 3.3: Sense Weather's Use Case Modeling

CHAPTER 4

DESIGN SPECIFICATION

4.1 Front-End

We have used ThingSpeak as our front-end purpose. It is an open-source Internet of Things Application and API to store and retrieve data from things using the HTTP and MQTT protocol over the Internet or via a Local Area Network. ThingSpeak helps us to receive real-time data from our developed device and store it on it. ThinkSpeak shows the data in analog and digital format which is received from the physical device.

4.2 Back-End

We have developed our device named" Sense Weather" using the NodeMCU ESP8266 microcontroller. NodeMCU is a low-cost open-source IoT platform. It initially included firmware that runs on the ESP8266 Wi-Fi SoC and hardware which was based on the ESP-12 module. Here we used Arduino IDE as the compiler. We have used C++ and Arduino Libraries for our background coding. The Arduino Integrated Development Environment is a cross-platform application. It uses C and C++ as the programming language. Arduino IDE compiles the code and deploys them to the microcontroller.

4.3 Implementation Requirements

To implement our project we have used Arduino IDE to compile the written code and upload them to the microcontroller. We have used some sensors for getting real-time weather data from the environment. Here we have used DHT22, MQ-135 Gas sensor, LDR sensor for measuring the basic weather parameter. We have used two breadboards to set up the instrument, use some connecting wires to connect them, and use a 5 v adapter to power them. Here we have also used a switch to turn on and off the device.

4.5 UX

UX means User Experience. But we did not launch our project in public so this time we don’t have any information

CHAPTER 5

IMPLEMENTATION AND TESTING

5.1 Implementation of The Physical Device

We have implemented our device with a NodeMCU ESP8266 microcontroller. It's a wifi-based microcontroller. Through the advantages of the ESP8266 module, our device sends real-time data to the cloud. So from anywhere and anytime, we can focus on basic weather parameters and their analysis. Our developed device runs with AC for this we have use 5v AC adapter to power up our device. Here we use a switch to on/off our device "Sense Weather". Sense Weather is a basic weather monitoring device. It reads data parameters from the environment and sends the desire data to our cloud server. We have used a DHT22 sensor for sensing temperature and humidity data. It's a digital sensor. We have also used the MQ-135 gas sensor. It's a dual output (analog output, and high/low digital output). We have used it to monitoring air quality. This sensor will detect if there is any harmful gas in the air. This MQ135 gas sensor has high sensitivity in ammonia, sulfide, benzene steam, smoke, and other harm full gas. This sensor is also sensitive to different types of Alcohol. We have used another analog sensor named the LDR sensor. It's used to check the light intensity of our desire location. All of the data is synchronized every 15 seconds later. Figure 5.1 will show the circuit diagram of Sense Weather and figure 5.1.1 will show the physical part of our device.

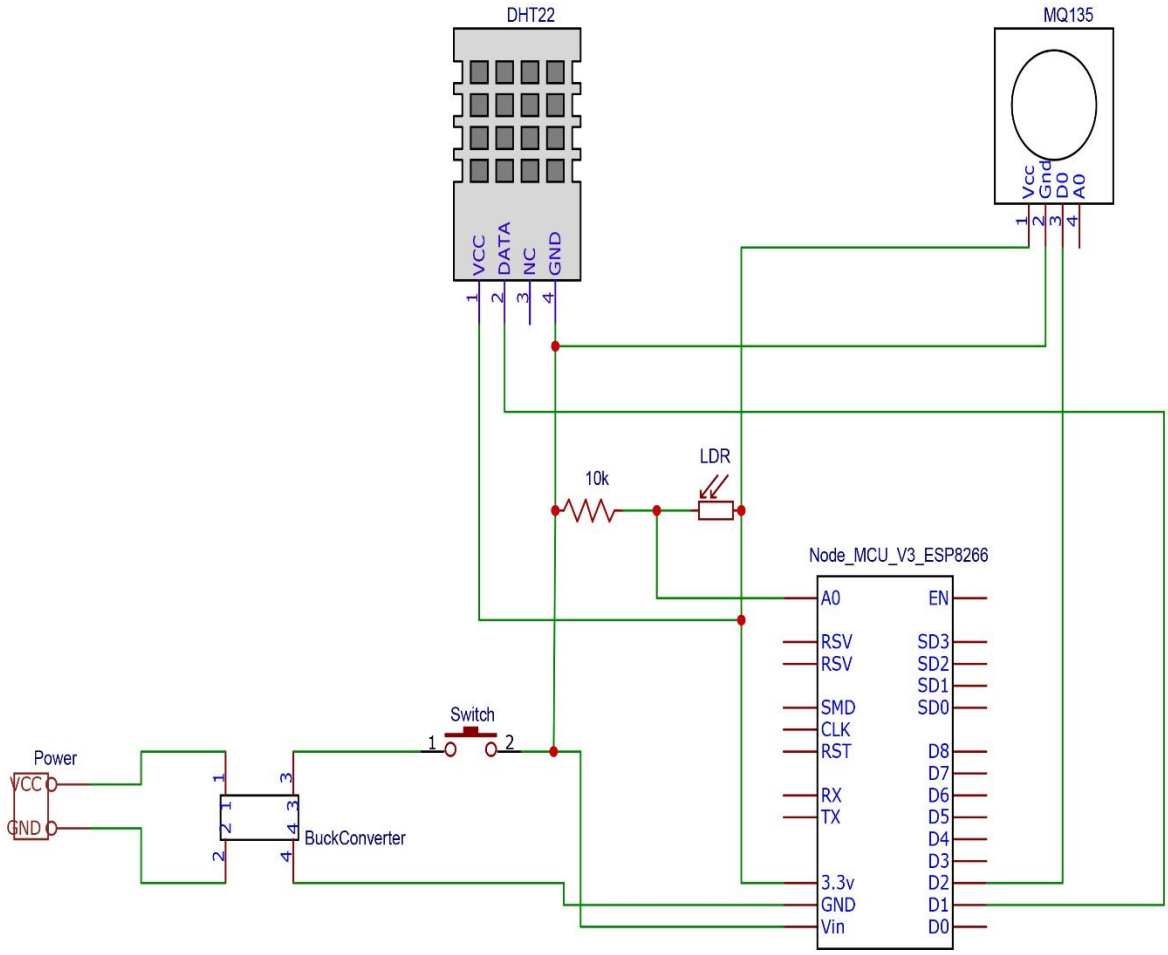

Figure 5.1: Circuit Diagram

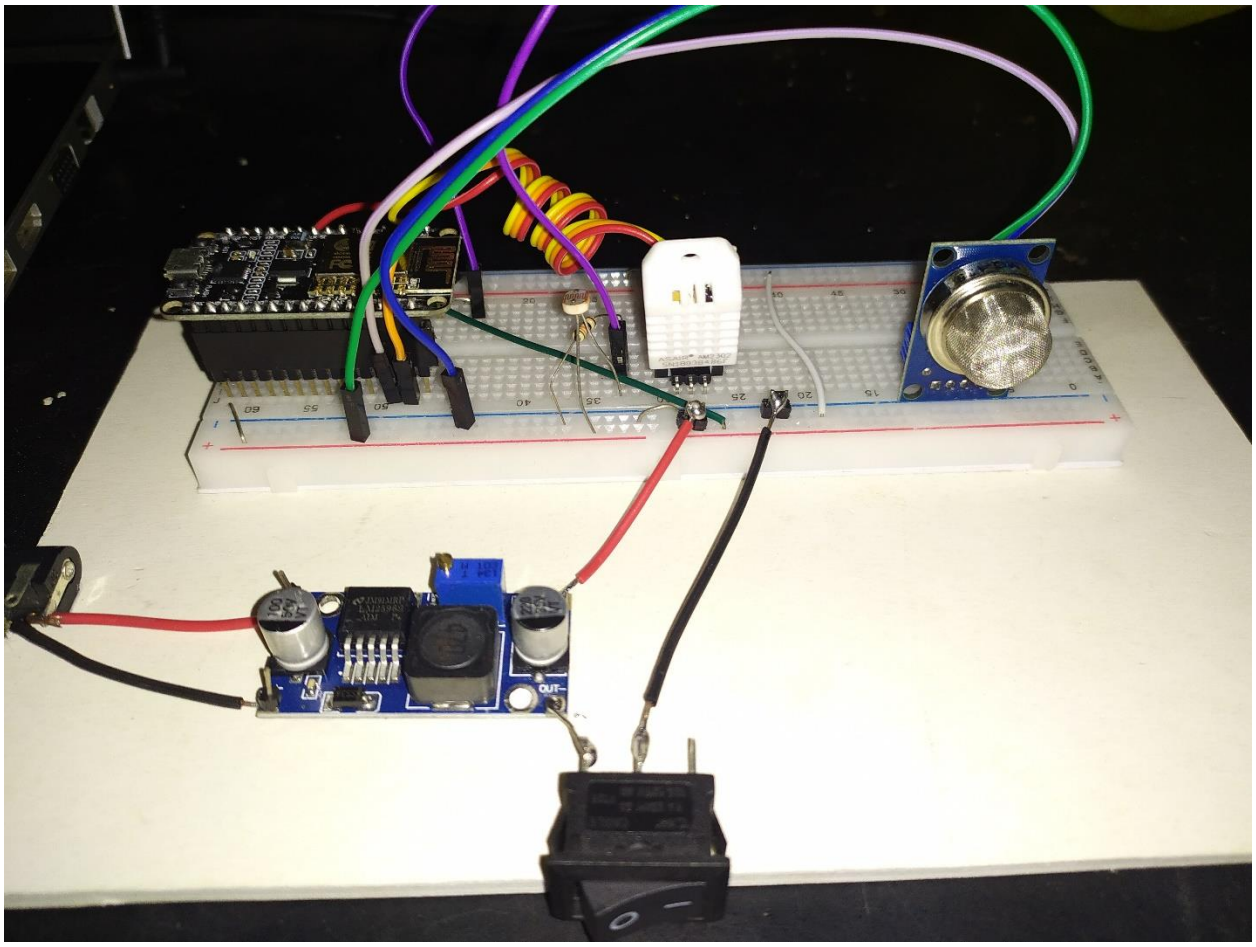

Figure 5.1.1: Physical View of Sense Weather

5.2 Implementation in ThingSpeak

Our device Sense Weather sends the collected data to the ThingSpeak through a WiFi connection. ThingSpeak is an open-source ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize, and analyze live data streams in the cloud. It can send data to ThingSpeak from your devices, create instant visualization of live data, and send alerts. ThingSpeak provides instant visualizations of data posted by your devices to ThingSpeak. With the ability to execute MATLAB® code in ThingSpeak can perform online analysis and processing of the data as it comes in. ThingSpeak is often used for prototyping and proof of concept IoT systems that require analytics. In the ThingSpeak website, we have created some fields to visualize our data which is collecting continuously from our physical device.

5.3 Home Page

We need to login sign in ThingSpeak then we will get our home page then select our desire channel. In figure 5.3 shows the Home Page.

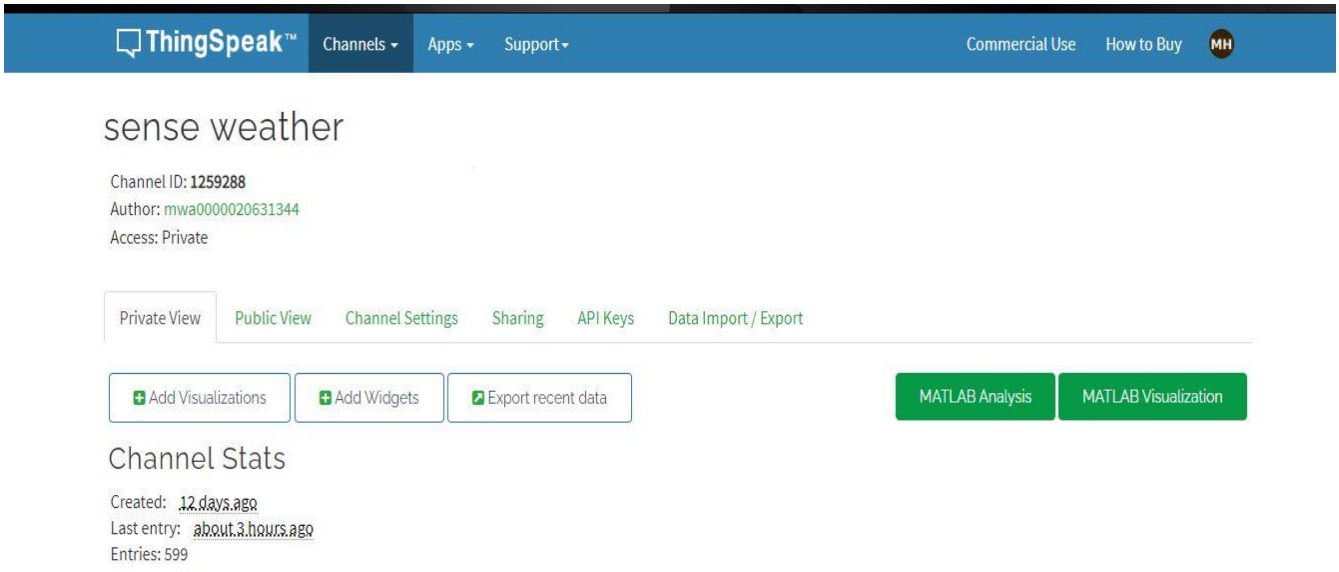

Figure 5.3: Home Page.

5.4 Temperature

In home page here shows the field of temperature in a digital format with an analytical graph. Figure 5.4 and 5.4.1 will show them.

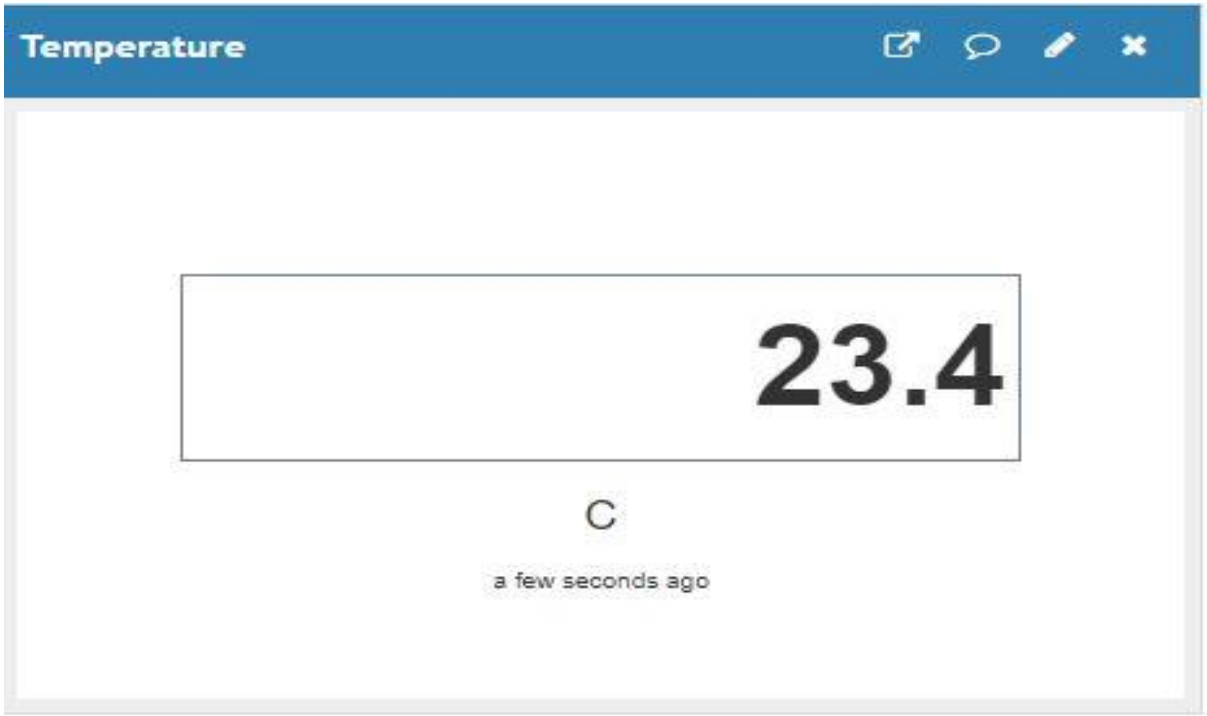

Figure 5.4 Temperature

Temperature Chart:

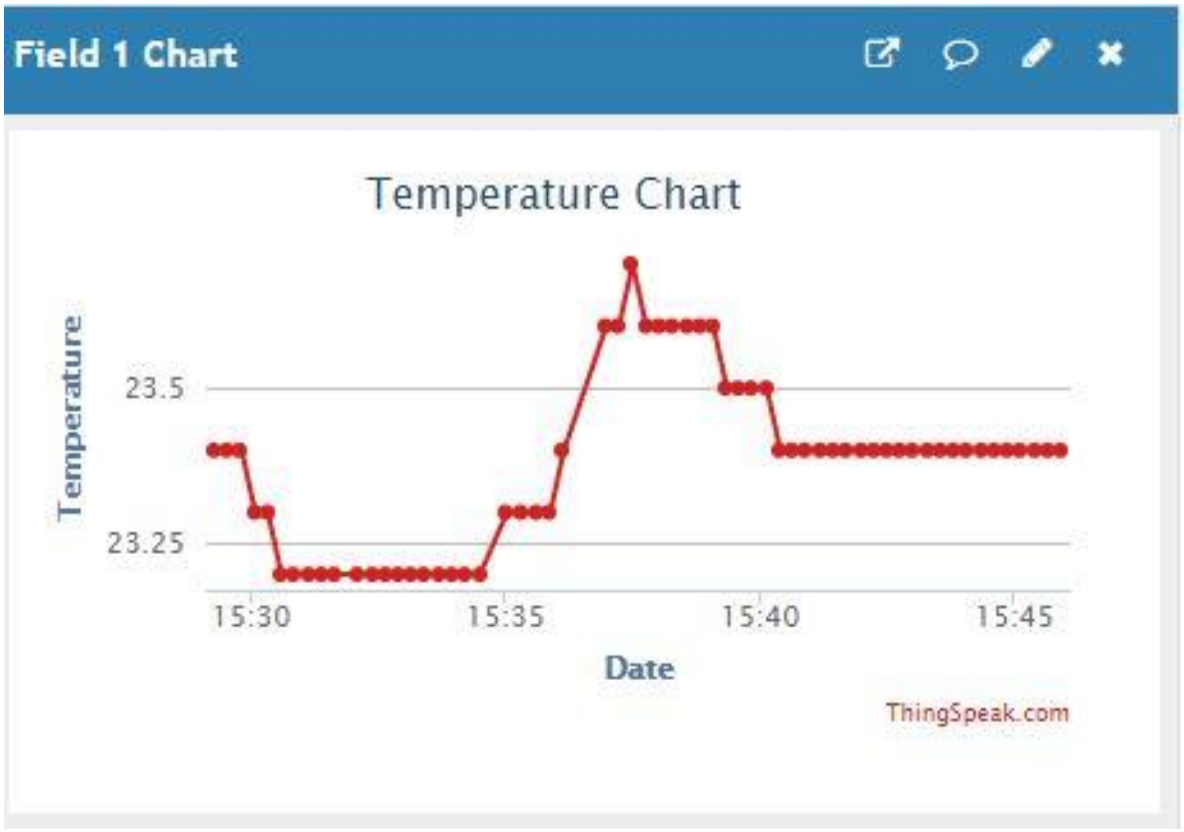

Figure 5.4.1: Temperature Chart

5.5 Humidity

In figure 5.5 and 5.5.1 shows the humidity with digital and chart view.

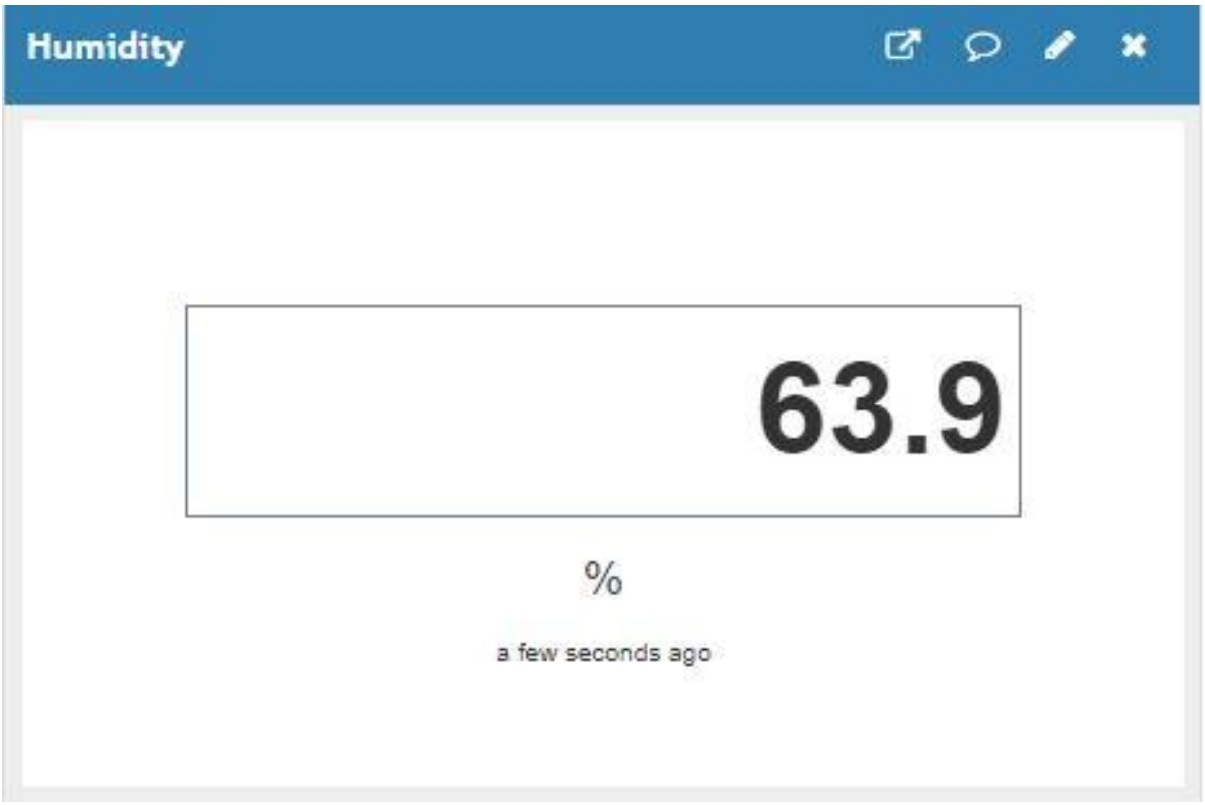

Figure 5.5: Humidity

Humidity Chart

Figure: 5.5.1 Humidity Chart

5.6 Air Quality

In figure 5.6 and 5.6.1 shows Air Quality. If there is a bad gas in the air then it will be red-colored. When there is no bad gas in the air then it will be light pink colored.

Figure 5.6: Bad Gas Detected

Figure 5.6.1: No Bad Gas Found

5.7 Light Intensity

Figure 5.7, 5.7.1, 5.7.2 will show the light intensity measurement from our ThingSpeak API.

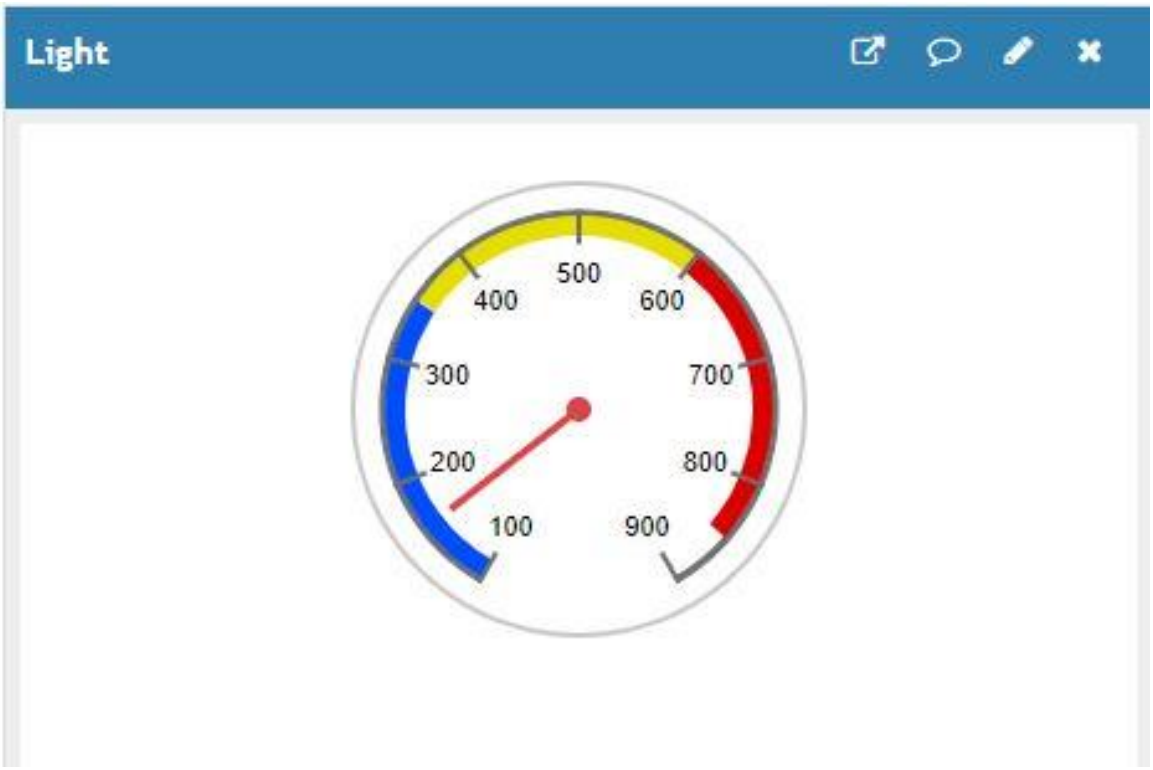

Figure 5.7: Light Intensity Is Normal

Figure 5.7.1: Light Intensity Is Medium

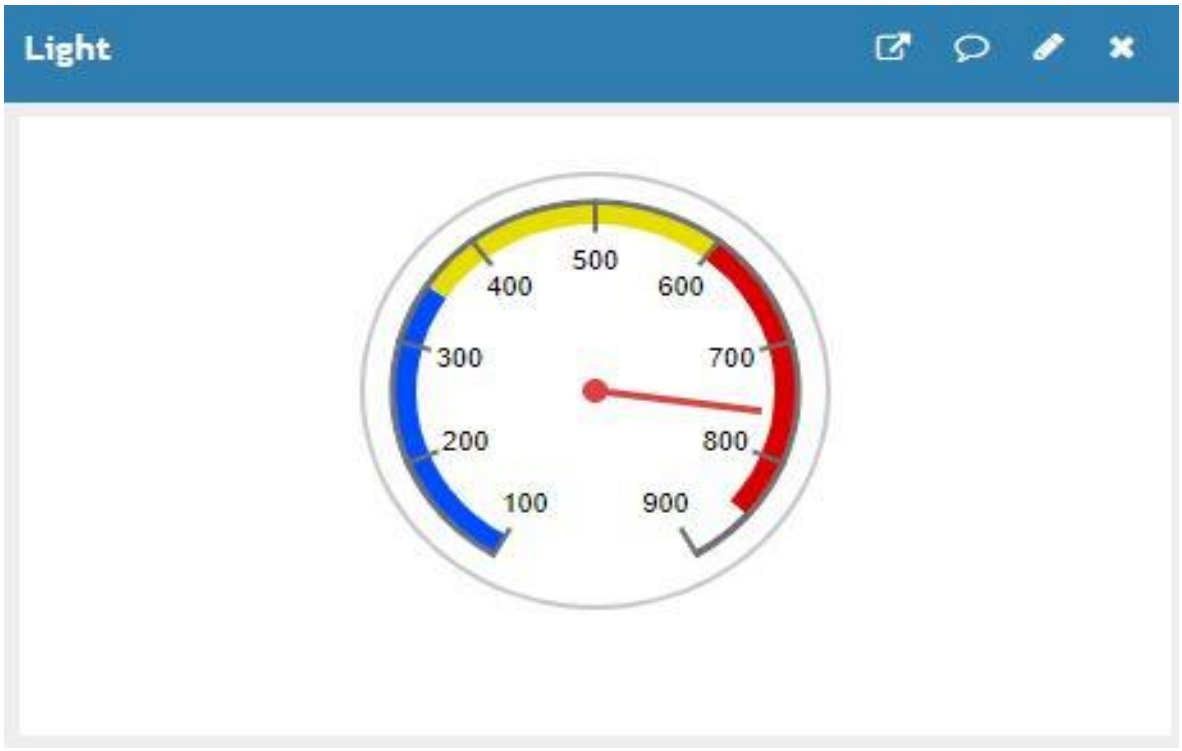

Figure 5.7.2: Light Intensity Is High

5.8 Implementation of Interactions

Implementation testing generally refers to the process of testing implementations of technical specifications. This process serves the dual purpose of verifying that the specification is implementable in practice and that implementations conform to the specification.

Table 5.8: Test Case Evaluation

Test Case	Test Input	Expected Outcome	Obtained Outcome	Pass / Fail	Tested On
1 . Temperature check	Temperature	Show Temperature	Successfully shows	Pass	25.12.2020
2 . Humidity check	Humidity	Show Humidity	Successfully shows	Pass	25.12.2020
3 . Air Quality check	Local Air	Light pink color circle	Successfully shows	Pass	25.12.2020
4 . Light Intensity	Sunlight	Show Intensity level	Successfully shows	Pass	25.12.2020
5 . Air quality	Ethanol	Red color circle	Successfully shows	Pass	26.12.2020
6 . Light Intensity	Torch Light	Show Intensity level	Successfully shows	Pass	27.12.2020
7 .Temperature check	Temperature	Show Temperature	Successfully shows	Pass	27.12.2020
8 . Humidity check	Humidity	Show Humidity	Successfully shows	Pass	27.12.2020

5.9 Test Results and Reports

Test reports should be created formally because test reports will give a view of the estimated results of day to day use. To write these test results we have tested our device Sense Weather many times and monitored the outcome. During the testing, we haven't face any unwanted situation to operate this device. Each of the times we have got the actual outcome from our developed device "Sense Weather". We have tested our device according to these basic parameters of testing which are given below-

- Functionality
- Regression
- Security
- Localization
- Disaster Recovery
- Performance
- Scalability
- Usability
- Installation/ Upgrade

According to the results of during testing time and from the experience of the use we can say that our implemented device named Sense Weather is production-ready, safe, and easy to operate for kind of user. We believe that our device will easily be accepted by the clients.

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

6.1 Discussion and Conclusion

The journey is to develop our project is a great experience. To develop this project named "Sense Weather" our learning approach is so long and hope it will help us to develop other projects in the future. During the time of development, we have done absolutely great teamwork. This experience helps us in any kind of teamwork in the future. The project which was developed by us, we will try to upgrade many features of this project in the future.

6.2 Scope for Further Developments

In the future, we can go in a variety of directions. But mainly we will try to upgrade some features like wind speed, visibility rate, dew point checker, etc. This will add more options to analyze more data and predict us for the next two days. In the future, we will try to develop our very own web application and our data will be shown there.

APPENDIX

Project Reflection

We had started our journey to develop this project named “Sense Weather”, a basic weather monitoring system from the Fall 2019 semester. During the development process, we have to spend lots of time to learn and implement. Everything was going great until March 2020. The world came to a stand-still due to COVID-19. During the three-four months lockdown period our work did not progress that much. As time was passing, COVID-19 became the new norm. Stores were opened and we bought our development tools and started working again with full force. After spending lots of time and hard work finally we have reached our goal and developed our project. We believe that our developed project “**Sense Weather**” will help the people who are wanting to enter the agricultural sectors and cultivate crops with modern technology. We will try to upgrade our project and try to connect with our users with more features in the future.

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