ECE – 399(B02)

Design Project I

Team Name: The Weathermen

Real Time Weather Monitoring Station

Submitted To:

Ali Dehghanian

Prepared By:

Lawrence Chan, Mclain De Jesus, Brett Dionello

Nikhil Sharma, Logan Winter

Table of Contents

LITERATURE REVIEW 4

REQUIREMENT SPECIFICATION 10

REFERENCES 15

APPENDICIES 17

APPENDIX 1: PROJECT CHARTER 17

APPENDIX 2: PROJECT TIMELINE 21

EXECUATIVE SUMMARY

This technical report explores the implementation and performance of an Internet of Things (IoT) weather monitoring station for use on seaweed farms, designed to collect and disseminate real-time meteorological data. The system integrates a network of sensors measuring temperature, humidity, atmospheric pressure, wind speed, and precipitation, all connected to a centralized data hub. Utilizing Lora-WAN and an MQTT based database to allow for long range communication and display of the data to a remote terminal. The user interface provides a web-based dashboard and mobile applications, offering consumers intuitive access to real-time weather information. This IoT weather monitoring station's strength lies in its resilience to environmental conditions, data accuracy, and user-centric design. Future developments include ideas such as machine learning integration for advanced prediction, sensor capability expansion, and system longevity.

INTRODUCTION

Weather monitoring is a vital component to many different industries and areas of study. Being able to accurately determine present ambient environmental condition is critical for industries such as fire protection, agriculture, and ocean monitoring. Additionally, the ability to not only give real time weather data but also be able to recall historical data can allow companies - and individuals - to determine trends in the weather pattern. This weather prediction can allow people to prepare for incoming hazardous weather conditions and in turn saving companies both time, and money. Present methods of weather monitoring require an on-site operator to take measurements from various sensors. This can prove costly not only from labour expenses required to complete measurements, but also the potential to miss measurements signalling to catastrophic weather conditions. It is precisely this challenge that many seaweed farms are faced with.

Seaweed or seaweed byproducts are used for many medicinal, and chemical purposes as well as provides to the culinary industry –especially in coastal areas. Furthermore, many fishers rely on seaweed farming during their off season to boost the economic prosperity of the surrounding areas especially while fish populations are scarce. The ability to predict the weather and have constant real time data of the ambient weather is vital to seaweed farms, especially when it comes to preparing the seaweed for selling. However, these farms are not hugely profitable and therefore lead to very tight budgets [1] of which little actually goes to weather monitoring.

This project will attempt to solve the issue of a cheaper remote real time weather monitoring for seaweed farms. Utilizing the IoT (Internet of Things) capabilities of the ESP-32 microcontroller as well as the LoRa communication protocols, data from a remote weather station can be monitored directly from a mobile platform such as a laptop, or phone. Crucially, the remote weather station will collect data for substantial amounts of time as well as being able to store obtained data without the need for a direct internet connection. The data collected will be the ambient temperature, humidity, pressure, wind speed, wind direction, and rain volume (if any). To ensure longevity of the data collection a solar panel may be installed on the remote unit to ensure the sensors can stay powered for large periods of time. The historical data will be collected on an HTTPS server and can be connected to other weather databases to compare and create predictions about upcoming weather patterns.

LITERATURE REVIEW

The current method of weather monitoring employed by most seaweed farms is using a simple configuration with limited monitoring capabilities. Often only temperature, humidity, wind speed, and wind direction are measured [2], and measurements are recorded manually. One benefit of this system is that it is a cheap solution for most farmers to employ. This is highly beneficial because seaweed farming is a costly profession between buying land and equipment being able to save costs on a simple weather monitoring station goes a long way [1]. Additionally, due to the simplicity of the overall monitoring system maintenance is easy and does not require any expertise in electrical or mechanical systems. However, because measurements are not automatically taken many abnormal weather events may not be captured which can lead to damage to the farm. Another potential drawback to the current system is that the measurements are not always accurate. On the contrary, extreme accuracy is not required as most farmers are using the gathered data for preventative measures; hence why this monitoring system has persisted throughout the years [3], [4].

Satellite transmission is an alternative method for transmitting data from a weather station. By transmitting via satellite, the data is readily available and can be retrieved from virtually anywhere. This large coverage area is one major advantage for satellite communication. Furthermore, larger amounts of data can be sent meaning more readings can be taken allowing for more accurate long-term trends. Monitoring in this fashion is utilized in many fields such as in forest fire detection where accurate real time data is utilized frequently and must be accessed away from the physical monitoring station. Unfortunately, satellite transmission has some drawbacks especially for seaweed farmers. Firstly, the timing windows for transmission are very tight to be able to transmit the data (10 seconds every hour or so when used in fire detection). Should the transmission exceed the sending window, data being sent from other customers using the same satellite can become corrupt and thereby lead to penalties and fines. As well, corrupted data will not be viable nor hold any meaningful information that can be used. If the transmission is too small, then there may not be a suitable amount of time to transmit all the collected data [5]. Secondly, to transmit via satellite more hardware devices are required such as an antenna or satellite dish, a modem, an ISP (internet service provider) for a very rudimentary setup. For a more complex setup a more software-based solution can also work which require less hardware overall but more intricate software. Overall, the cost of such a station will increase as well as the expertise required to correct any malfunctions that may occur. Thirdly, during the transmission window the station overall will draw more power, and depending on the choice of power supply this may cause reduced lifespan of the monitoring station. Some solutions to offset this is to add a redundant backup power source or addition of an alternative power source such as a solar panel. However, both solutions require additional hardware and in turn additional cost. Due to unfeasible cost and larger power requirements, satellite communication would not be a viable option for seaweed farmers [6].

There are many existing IoT based weather monitoring solutions out there presently each with their own unique protocols and data management methodologies. One such technology that was widely popular utilizes Zigbee which is an IEEE standard for low power, wireless machine to machine (M2M) and IoT technology. Bluetooth and RFID both use ZigBee based protocols [7]. These systems are highly energy efficient and are often used for sensor networks. Unfortunately, however, while these technologies are energy efficient, they are extremely limited in their communication range. Typically, ZigBee protocols have a range of one hundred meters which is certainly not suitable for the remote monitoring station applications. Alternatively, Wi-Fi (wireless fidelity) modules are growing in popularity due to their efficient power use as well as long range communication as well as a larger bandwidth [8]. When implemented into a weather monitoring station data can be extracted over a larger range however due to power limitations often only basic data such as temperature, humidity, and wind speed are taken. On top of this many of these measurement devices and the devices used for implementing the ZigBee protocols are built to be used outdoors but are not as robust when it comes to withstanding the harsh environments of the ocean breeze. The salt content of ocean water can cause significantly more corrosion to devices which means weather stations that implement these IoT protocols would require more maintenance as well as require recalibration regularly [9].

REQUIREMENT SPECIFICATION

The proposed weather monitoring system will be comprised of two physical hardware devices: the end node and the gateway. The end node and gateway will both use LoRa RF communication on the 902-928MHz frequency band as per the North American standard. The device will also have the minimum capabilities of sending sensor data in 5-minute intervals from the node to the gateway. Data will then be sent via the MQTT protocol to an external database. The block diagram of the proposed system is depicted below in Figure 1.

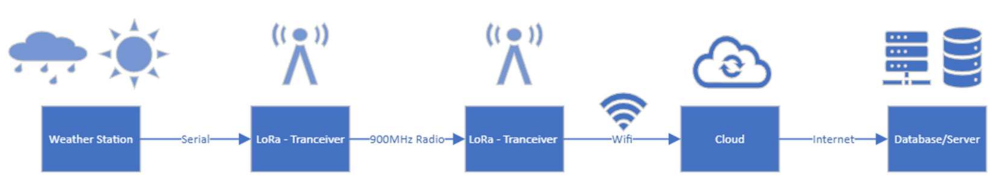

Figure 1: System block diagram

For the weather sensing there are six main categories that will be measured via specialized sensors. Temperature and humidity will be monitored using the DHT-11 temperature and humidity sensor. This is a relatively cheap device that is capable of measuring both temperature and humidity simultaneously with reasonable tolerances from 1-

5%. Actual market sensors can have more precision (with tolerances from 0.1-0.5% sometimes even lower) however tend to be more expensive as well.

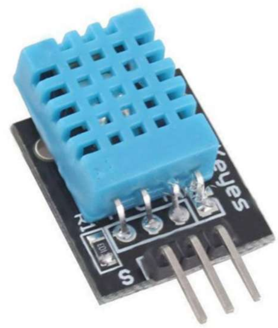

Figure 2: DHT-11 Temperature and humidity sensor

The next 3 devices measure, pressure, wind speed and direction, and rain. These devices were donated by FTS (Forestry Technology Services). FTS Develops weather monitoring sensors for forest fire detection applications. An analog electric barometer measures the pressure by utilizing MEMs (micro-electromechanical) technology a capacitive layer is built on an IC (integrated circuit) and as the pressure increases the capacitance of that layer fluctuates and outputs an analog signal that can be converted into a corresponding pressure. Figure 3 depicts the type of IC one would expect to find in an analog pressure sensor. The device from FTS is far more complicated, however due to copyright cannot be shown in this document.

Figure 3: Sample IC of a pressure sensor

Next, the wind speed and direction are measured using the same device. Wind is captured by three equidistant rotating cups, a reed (small, coiled wire) is spun by the motion of the cups closing a circuit which outputs a digital pulse each revolution. The revolution per second is counted and converted to a wind speed. The wind direction sits above the wind speed sensor and the wind pushes on a large fin which rotates the device to match the wind direction. A potentiometer is connected, and the resistance value of the potentiometer determines the wind direction. As seen in Figure 4, the three cups sit 120 degrees apart and below the wind direction rod and fin.

Figure 4: Wind speed and direction sensor

Lastly, the rain gauge is a rather simple device that collects rain through a funnel and into a tipping mechanism. The tipper has two sides which are each calibrated to hold 1.4 mL of rainwater. Once one side of the tipping mechanism is filled it tips and spills the water out. When the device tips a sensor detects the tipping motion and outputs a digital pulse indicating a tip has occurred. From these impulses the heaviness volume rate of the rain can be determined. It is paramount that this device remains level to have the tipping mechanism functioning as intended. A sample rain gauge as well as its stand is shown in Figure 5 below.

Figure 5: Rain gauge and internal tipper mechanism

All these sensors are connected to an end node which will function as a physical interface with the weather monitoring sensors; collecting and organizing the information gathered from the sensors into packets for transmission to the gateway. The node will monitor the surrounding area for conditions seen in **Error! Reference source not found.**. The sensors will make use of both serial communications and analog-to-digital conversion methods to report data. These packets will then transmit the raw data via LoRa RF communication to the gateway.

Table 1: Weather station sensor requirements.

Sensor	Resolution / Accuracy
Temperature	$0.1^{o}C$ / $\pm0.5^{o}C$
Humidity	1 % RH / ±5 %RH
Pressure	0.01 hPa / ±0.5hPa
Wind Speed	/
Wind Direction	1 degree / ±5 degrees
Rain Volume	0.1mm / ±5%

The gateway will take received data from the node and perform the necessary conversions to produce SI unit measurements from the analog data. Following acquisition, the data will be packaged in a JSON file format and sent to an external broker with the MQTT protocol over a Wi-Fi connection.

A cloud service, such as AWS or Azure will serve to provide MQTT routing from the gateway to an external database. This external database will collect and store the real-time data for trend analysis as well as compare the data from other weather stations that have uploaded their information to the database. Finally, this database will be the point from which the data can be retrieved and viewed on a simple mobile or computer application (app). The app will display the most recently collected data as well as the historical data from that given weather station. To use the app the device must also have an internet connection which will allow for data retrieval from the database.

Due to time and budgetary constraints, the scope of the project prototype will exclude the addition of a backup solar power supply module. Under longer term development the addition of a solar power supply would increase the longevity of the whole weather monitoring station; during the daytime, the battery supply would be able to recharge off the solar panel, or in case of a failure, the panel could act as a limited power supply. Furthermore, error checking of the data will not be included. The prototype will assume that the received values are correct. If there is any corruption of data during transmission the device and by extension the user would not be aware of it. Finally, the prototype will not feature any form of data security or encryption. Data security is not a necessary feature as having open-source weather data if beneficial to any user who would like to access the local weather data.

PROPOSED DESIGN

Before the design process began a tentative workflow diagram was built, as depicted in Figure 6. This diagram guided us on the overall breakdown for each main step during the data retrieval to data transmission process. Figure 6 shows the general flow of data and the logic behind each decision will be explored in this section.

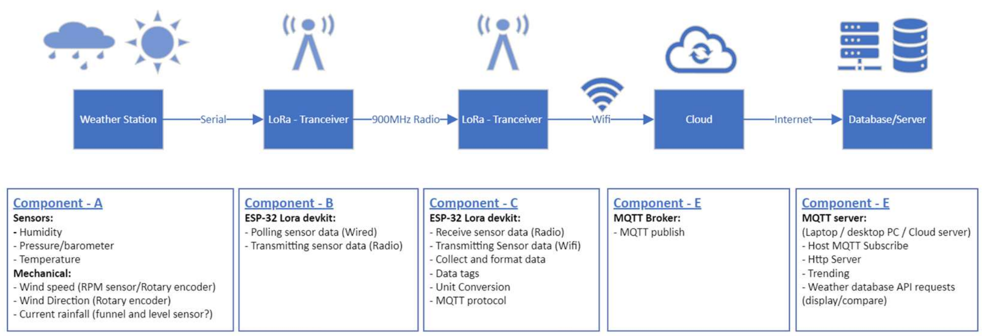

Figure 6: General Workflow Diagram

The initial design plan was to utilize 3D printed models for each sensor. That being designed the mechanical and electrical components for each measurement device. However, there were two reasons for not making the sensors. Firstly, 3D printing designs take time as well as can take many iterations to get them to a functional state. Both time and resources we did not have. The second reason is that Forest Technology Services reached out and allowed us to borrow some of their already functional sensors. These sensors allowed us to save both time and money as well as being able to have sensors in the prototype that are as durable as the main product line would be.

The next major design decision we faced was choosing a method of long-range data communication for the IOT functionality. One option was using an Arduino and utilizing an ESP8266 to get Wi-Fi functionality. The first problem with the Arduino solution is that with a purely Wi-Fi based solution the device would not be capable of transmitting over significantly long distances, plus that would also mean an internet connection would be required at the remote site, which brings additional cost to the customer. The other issue with using an Arduino with peripheral devices is that it would be more expensive to obtain the Arduino as well as the ESP8266. It was then decided to use the ESP32 with LoRa-WAN capabilities. The LoRa can communicate up to distances of 10km (much better than Wi-fi or Bluetooth being 45m and 30m respectively). Additionally, the LoRa was built into the ESP32 microcontroller meaning no additional components would be needed thus saving cost.

The next problem that was tackled was how to transmit and receive the data from the remote weather station to a remote display. Because the plan was already to use the ESP32 as a transmitter we chose to use the same device for the receiver. By doing this we save time on development of the receiver as most of the functional code can be transferred to the receiver, and the second ESP32 is already built to receive data from a LoRa based connection.

Finally, the data would be sent from the remote device to an MQTT (Message Queueing Telemetry Transport) server from which the data can be requested and pulled for display on a remote terminal. Amazon Web Services (AWS) was also considered in place of MQTT, however many members of the team had prior experience with MQTT thus allowing us to focus our time on the other aspects of the project. Furthermore, MQTT serves as a solid foundation for device-to-device communication. Figure 7 show a basic flow graph of how data is transmitted using MQTT as an intermediary to store the data which can be retrieved by a remote device.

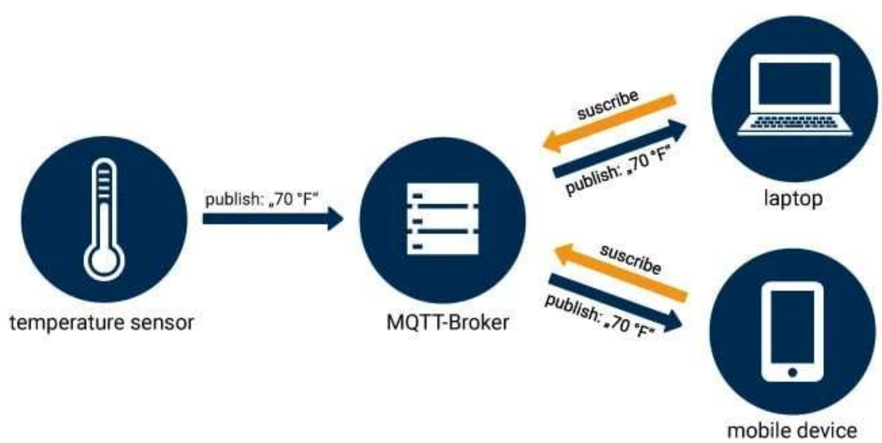

Figure 7: MQTT Basic Data Flow

To display the data retrieved from the MQTT server simple graphs were used as they allowed one to see the trends over time which can be used for preventative maintenance if needed.

EVALUATION

Each step of the evaluations process tested and verified various aspects of the design. The first part that was tested were the sensors. The simplest to test was the wind direction. Simply starting at the zero degree margin the test was to see how far off the device was after one full rotation. There was only a small miscalibration of about 2% which for this prototype was deemed acceptable. Next was wind speed, where the device was spun, and the speed read had to fall within a reasonable range which was about 10m/s which is the average speed of a human breathing out. Again, this test was not fully throughout however giving a reasonable accuracy to be able to determine if the measurements and code were functioning as intended. Next, the tip rate of the rain gauge was tested simply by applying an impulse. The faster the impulse the precipitation level increased as expected. The rain gauge for simplicity of the demonstration was averaged over one minuet, however in practice an average over one hour or more is suitable. Temperature and humidity were the final two to be tested and fell well within the 5% tolerance range as listed on the DHT datasheet. Simply placing your hand over the sensor was enough to increase both the temperature and humidity which was compared against a calibrated temperature and humidity meter.

The next part tested was the data transmission. This included creating a packet that contains the data as well as a cyclical redundancy check (CRC). The CRC allows the receiver to determine if the data packet has been corrupted or is invalid. This was done using a built-in function in the C++ library where an array containing the data was used where each element of the array corresponds to a different value being transmitted with the final index of the array being the CRC. The transmitted and received data packet was printed to the console to ensure that data transmission was in fact possible. We successfully were able to validate the functionality of the transmission between the ESP32 devices.

Lastly, testing was done to ensure that the data received by the remote terminal ESP32 could be requested from the MQTT server and displayed. For this we simply fed in some arbitrary values and were able to request data and display it graphically as shown in Figure 8 shown below.

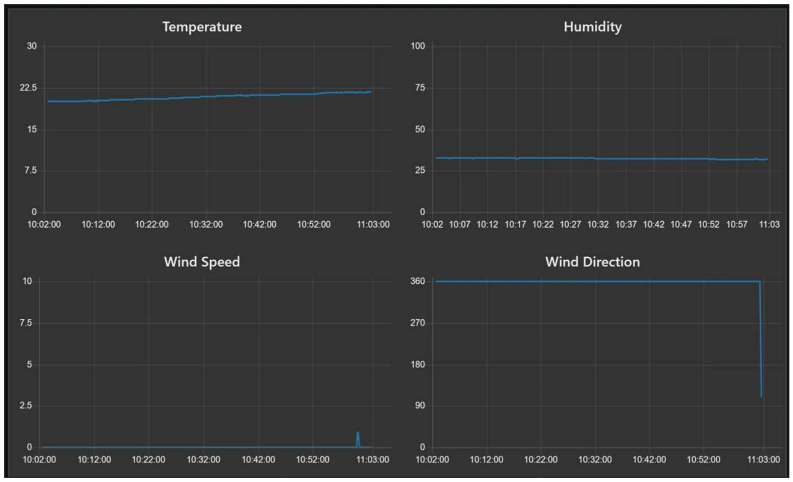

Figure 8: Received and Displayed Data from MQTT Server

The initial prototype serves more as a proof of concept and is therefore not fully suitable for commercial production. Some limitations that exist within this design stating from the mechanical components the devices must be properly calibrated and calibration procedures must be made up to ensure consistent results between different devices. As well, further development must be done to allow for the temperature to be able to read negative temperatures. In theory the device would never be using in conditions that are below zero as seaweed farming typically does not occur during these times. However, during autumn it is fully possible the temperature at night may dip below zero thus requiring those data points to be collected. Additionally, a proper stand that is also capable of withstanding harsh environments must also be developed for ease of set up and transportation. As well closer work with seaweed farmers may give more insight into what additional sensors and data, they may want to collect that would have to be integrated within the system (such as turbidity sensors, or pressure sensors). Electrically, device power is one issue that must be addressed. How the device will be powered at the remote site and additional backup power to ensure longevity and minimal losses of data. Further development on being able to display data on a cell phone by developing an app to easily check the health of the station as well as access all the data parameters. Furthermore, more testing should be done on transmission range and limitations as that testing was not able to be completed during this initial phase of development.

IMPACTS OF APPLICABLE CODES/ STANDARDS

There are many codes and standards that apply to weather monitoring as well as electronic devices for consumer goods, a few of which will be explored in this section.

There are many sections of regulation outlined by the World Meteorological Organization (WMO) who outline compliance standards for weather data collection and transmission in areas such as hydrology, technical regulations, quality management, and measurement accuracy. By using commercial devices from FTS, the measurement devices used are within the specifications outlined by the WMO. However, some of the calibration standards outlined by the WMO as well as the standards outlined by the GUM (Guide to Uncertainty Measurements) may not be met as this device is still a prototype so measurements may not meet the required degree of accuracy.

Consumer Electrical Standards must also be met. These standards outline the emmissions rate for comsumer devices as well as necessary safety preventions and protocols to ensure all electrical connections and transmissions will not cause damage to a consumer. MQTT is a known protocol and falls well within the bounds of the standards. Furthermore, by using a commercial microcontroller (ESP32) and not designing our own PCB we can ensure the electrical EMC specifications are met.

SOCIAL AND ETHICAL IMPLICATIONS

Often people express concern for data security, therefore, it is vital to have transparent data ownership policies are essential to ensure that individuals or communities providing the data are aware of how their information is used and protected. Currently, the prototype does not have any data security policies and all the data is available for public use and interpretation.

The environmental footprint of the monitoring station, including the production, deployment, and eventual decommissioning of its components, is carefully considered. Sustainable practices are encouraged, and efforts are made to minimize any adverse environmental impact associated with the station. Social responsibility involves fostering public awareness and education regarding the benefits and potential risks of the IoT weather monitoring station. Transparent communication about the system's purpose, data usage, and security measures contributes to building trust within the community

Ethical considerations extend to the role of the monitoring station in emergency response situations. The system should be designed to prioritize public safety, providing timely and accurate information to support effective decision-making during extreme weather events.

CONCLUSION

Currently, seaweed farmers have struggled to find a cheap, durable, and reliable weather station for monitoring their farms. Our design utilizes robust sensors capable of withstanding difficult environmental conditions that come along with seaweed farming. The monitoring station is capable of monitoring precipitation levels, wind speed, wind direction, temperature, and humidity via a series of simple components. All the data is collected and transmitted using a ESP32 microcontroller that is capable of LoRa transmission. The data is then sent to another ESP32 receiver module which is a remote device with Wi-Fi access which will then send the data to an MQTT based server. From the server data can be pulled via a mobile device for viewing. There are many avenues for future development such as, increasing the battery life, implement additional sensors as needed, create a robust mounting system, or adding a predictive algorithm to predict when a major weather event may occur. Overall, this project could have a major impact on seaweed farming allowing farms to yield more and make more capital. Seaweed farms pay a vital role in many communities providing food and other medical uses and by being able to prepare for weather events the farms can continue to serve the community with minimal losses to their yield.

REFERENCES

[1] L. O. M. Aslan *et al.*, "Income of Seaweed Farming Households: A Case Study From Lemo of Indonesia," *IOP Conference Series: Earth and Environmental Science*, vol. 175, p. 012221, Jul. 2018.

[2] Mr. Dipak, V. Sose. "Weather Monitoring Station: A Review," Int. Journal of Engineering Research and Application Vol. 6, Issue 6, (Part -1) June 2016, pp.55-60 ISSN: 2248-9622.

[3] M. Kumari, A. Kumar, S. Singh, and S. Singh, "Multidisciplinary Real-Time Model for Smart Agriculture based on Weather Forecasting Using IoT, Machine Learning, Big Data and Cloud," Oct. 2021.

[4] I. A. Houghton *et al.*, "Performance statistics of a real-time Pacific Ocean Weather Sensor Network," *Journal of Atmospheric and Oceanic Technology*, vol. 38, no. 5, pp. 1047–1058, 2021.

[5] D. Roddy, *Satellite communications: [mobile services, digital television services, satellite-based internet, and ATM services]*. New York: McGraw-Hill, 2006.

[6] Satya Kalluri *et al.*, "Validation and Utility of Satellite Retrievals of Atmospheric Profiles in Detecting and Monitoring Significant Weather Events," *Bulletin of the American Meteorological Society*, vol. 103, no. 2, pp. E570–E590, Feb. 2022.

[7] K. A. Patil and N. R. Kale, "A model for smart agriculture using IoT," *2016 International Conference on Global Trends in Signal Processing, Information, and Communication (ICGTSPICC)*, Dec. 2016.

[8] C Girija, H Harshalatha, Andreanna Grace Shires, and H. P. Pushpalatha, "Internet of Things (IOT) based Weather Monitoring System," *International journal of engineering research and technology*, vol. 6, no. 13, Apr. 2018.

[9] R.-H. Ma, Y.-H. Wang, and C.-Y. Lee, "Wireless Remote Weather Monitoring System Based on MEMS Technologies," *Sensors*, vol. 11, no. 3, pp. 2715–2727, Mar. 2011.

APPENDICIES

Appendix 1: Project Charter

Part 1: Project Charter

Project Charter Template (ECE 399)			
Project Title	Real-Time Weather Monitoring for Seaweed Farms		
Project Manager (Team Leader) You may assign a different manager from the team member in each cycle.	Nikhil Sharma	Kick-off Meeting Date (First meeting)	Sept.20.2023
Project Sponsor (TA)	Ali Dehghanian	Project Manager Approval	Approved
Project Summary (Scope)	Build a real time weather monitioring station for seaweed farms utilizing IOT to transmit data		
Project Goals	-temperature, humidity, pressure, wind speed, wind direction, and rainfall detection -transmit data wirelessly to a phone or mobile app -compare to other weather databases to create predictions on upcoming weather changes or patterns		
Project Assumptions and Constraints. *Time and Budget are for Cost and Benefits Analysis.* *You must define scope boundaries.*	Time	3 months	
	Budget	$100	
	Scope (Inside)	Devices to collect data, transmit that data using IOT	
	Scope (Outside) Things to avoid	No extra sensors, no data security, range of data transmission will not have to exceed 20km.	
Milestones	Date	Milestone Description	
		Complete literature review and begin collecting components	
		Assemble components and simple data collection	
		Overall test of the system	
		presentation	
Project Risks		Project Main Requirements	

1. Delays in delivery of components 2. Higher costs than expected 3. Data corruption interference issues	1. IOT data trasmission 2. various weather data collected 3. stand alone device

Stakeholders (Sponsors, supervisors, clients)

Name	Role	Responsibility
Ali Dehghanian	client	Set project goals
Thomas Khizuk	Sponsor	Provide hardware support and act as an industry advisor

Project Team

Name	Role	Responsibility
Nikhil	Project manager	Oversee project goals are met and completed by the deadlines, and work with mclain on hardware and support sw where needed
Brett	Data transmission	Work with HW to get data transmission
Logan	Data transmission	Work with HW to get data transmission
Lawrence	Hardware/data transmission	Work with HW to get data transmission
Mclain	hardware	Build overall circuit and ensure hardware is working

Approval (must be approved by TA)

Title & Name: Seafarm weather monitoring – The Weather-men________________________ Date: Sept.20th.2023____________

Part 2: List the Main Prioritized Features for your Project

Instruction:

1. List the project features.
2. You may select from the dropdown list the Impact and Effort and final scores.
3. Assign feature dependency (In relation to other features). For Example, in the below list, Feature 2 is dependent on Feature 1.
4. You have to decide with the team the priority for each feature or task based on your analysis. You may give 1 for the first task. Note: Impact/Effort score is just one method to define priority; it gives an indication. You still need to estimate and decide the dependency of each feature. For example, some features are dependent on other features and need to be done earlier to do some other task.

No.	Feature Name (Task)	Impact (0-5)	Effort (0-5)	Score = Impact + Effort	Feature Dependency (add all dependant features No.)	Priority (Numerical)
1	Implement IoT code	4	5	9		1
2	Temprature sensing	3	4	7	1	2
3	Humidity Sensing	1	3	4		2
4	Atmospheric pressure sensing	4	5	9		3
5	Rain gauge	4	5	9		3
6	Wind speed	4	5	9		2
7	Wind direction	4	5	9		2
8	Database data comparison	4	5	9		4

Part 3: Create a Roadmap of your Features Delivery Plan

In this section, you need to create a timeline for the features that you listed in part 2. You may use the project timeline as in the sheet in below link:

https://docs.google.com/spreadsheets/d/1yWrmz02HhCERWl_TlvquT4Nr0zS_wKt3O0mSXgwPJVM/edit?usp=sharing

Note: You need to create a copy of the sheet in your own directory to make changes to the shared timeline document.

The table below is a tracker for your main project phases. Feel free to adjust it as you see it fits your project.

Project Milestones	Status	Related files	Notes
First Meeting and Project Charter	In progress	DONE	Initial Project
Define Project Scope and Features	In progress	DONE	Select the appropriate features
Launch Project (Implementation Phase)	Launched	LAUNCHED	Implement your project physically
Project Review and Performance Analysis	Not started	NOT STARTED	Your TA and Project Team should Approve the Project
Project Close	Not started	NOT STARTED	Prepare the project's Final demo.

Appendix 2: Project Timeline