Santa Clara University
DEPARTMENT of COMPUTER SCIENCE AND ENGINEERING

Date: June 6, 2021

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Nicaragua Weather Application

BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE

DEGREE OF

BACHELOR OF SCIENCE IN WEB DESIGN AND ENGINEERING

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Nicaragua Weather Application

by

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SENIOR DESIGN PROJECT REPORT

Submitted in partial fulfillment of the requirements
for the degree of
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Nicaragua Weather Application

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ABSTRACT

ASDENIC is an organization that partners with local farmers and citizens in northern Nicaragua to provide resources and information to ensure the safety of residents and optimize agricultural techniques. Currently, a singular, localized weather station collects useful information on patterns that can be used for indicators, yet the data requires manual processing and there is not a system in place to report the findings. The current method of information transfer is in person during weekly meetings which can be ineffective and inconsistent.

In continuation of a previous project focused on sharing water quality information, our mobile application acts as a platform for leaders to share valuable weather indicators with members of the community in real time instead of on a weekly basis. This allows community leaders to disseminate all relevant information with the community in a reliable and easy-to-digest manner. As an additional benefit, providing accessible information to community members reduces the need for large group gatherings, especially relevant during the COVID-19 pandemic.

ACKNOWLEDGEMENTS

We want to thank Allan Baez Morales and the Frugal Innovation Hub, Raul Diaz and ASDENIC, and our advisor Professor Angela Musurlian for helping us coordinate, plan, and develop the Nicaragua Weather Application. We're so grateful to have worked on this project and we could not have done it without your support.

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Chapter 1
Introduction

1.1 Background

ASDENIC is an organization that partners with local farmers and citizens in northern Nicaragua to provide resources and information to ensure the safety of residents and optimize agricultural techniques. Currently, a singular, localized weather station collects useful information on patterns that can be used for indicators, yet the data requires manual processing and there is not a system in place to report the findings. The current method of information transfer is through in-person meetings, which can be ineffective and inconsistent.

1.2 Motivation

In continuation of a previous project focused on sharing water quality information, our mobile application will act as a platform for leaders to share valuable weather indicators with members of the community in real time. This will allow community leaders to disseminate all relevant information with the community in a reliable and easy-to-digest manner. As an additional benefit, providing accessible information to community members will reduce the need for large group gatherings, especially relevant during the COVID-19 pandemic. In our process of developing and designing the application, we remained in constant contact with local community members to ensure their vision was brought to fruition.

1.3 Solution

Although the water quality portion of the application serves as a significant functionality of the larger project, we clarified the scope and requirements of our work to prioritize the development of the weather portion - focusing our efforts on the functionality of the weather application as opposed to improving the water side.

When analyzing the problem and developing a solution for ASDENIC, it was imperative that the application be simple, intuitive, and easy-to-use. After several meetings with our

main point of contact at ASDENIC, Raul, it became apparent that a web application would be necessary for administrators to view and upload weather reports and a mobile application would be required for general users to view current and past weather reports.

In our web implementation, we aimed to include several key functionalities to aid our users. The first key functionality was for administrators to pick and choose which weather indicators they would like to highlight in a report. Currently, the excel document outputted by the weather station contains a plethora of data, much too dense for any general user to decipher. With the ability to specify the date, time, and specific weather indicators to include in the report, administrators can more effectively convey information from the weather station to general users. Moreover, another key feature to include was the ability to post announcements with each report - enabling administrators to include additional insight from a given weather report and broadcast this information to all users. Lastly, it was mentioned that, although administrators mainly share information at two main times in a day, it would be necessary to enable administrators to post multiple reports and provide community members with more real-time accessibility to information. Subsequently, reports can be uploaded multiple times a day for adjustments to key weather conditions or announcements.

In our mobile implementation, our key goal was to provide an optimal experience in viewing current and past weather reports. We decided to keep a similar interface to the web application for viewing reports to promote consistency. Users are brought to a calendar-view and are able to choose specific dates to view, as well as all reports associated with that date. Additionally, a button to bring users to the most recent weather report was included to promote efficiency in a general user's primary use case. Lastly, messaging functionality was requested from our client, however, we decided to implement this via an external WhatsApp group; WhatsApp is one of the main methods of communication for members in the Nicaraguan area. The link to the WhatsApp group is highlighted at the bottom of the mobile application interface so that community members who have questions about weather information can contact administrators directly.

Chapter 2

Project Analysis

2.1 Requirements

Functional

- The system should support account sign-up and login features using a phone number and password as login credentials. This is necessary because not all users will have emails.
- The system should compile weather station reports forecasting using data from an excel spreadsheet to be posted by administrators. Administrators should be able to mark which of the given weather indicators should be published in each report. This allows ASDENIC to digitally distribute this information to the community.
- Weather reports should include specific weather information and measurements deemed necessary by administrators, such as temperature, humidity, wind speed, etc.
- Users should be able to view weather reports.
- General users and administrators can communicate via WhatsApp group messenger.
- The system should give administrative rights to certain users.
- In addition to regular user capabilities, administrators should be able to create and post weather reports.

Non-Functional

- The system displays information reliably and accurately.
- Administrators can easily post reports and share announcements with community members.
- Users can easily retrieve reports and contact administrators as needed.
- The user interface is easy to use and intuitive for Nicaraguan community members.

Design Constraints

- The user interface must be in Spanish that is specific to Northern Nicaragua.

- The application must be accessed via an Android application that can be downloaded from the Google Play Store.
- The interface design must integrate cohesively with the previously existing user interface.

2.2 Use Cases

Our use case diagram (Figure 2.1) demonstrates the actions users can take inside our application. The main users are regular users, primarily members of the community, and administrators, those working with ASDENIC.

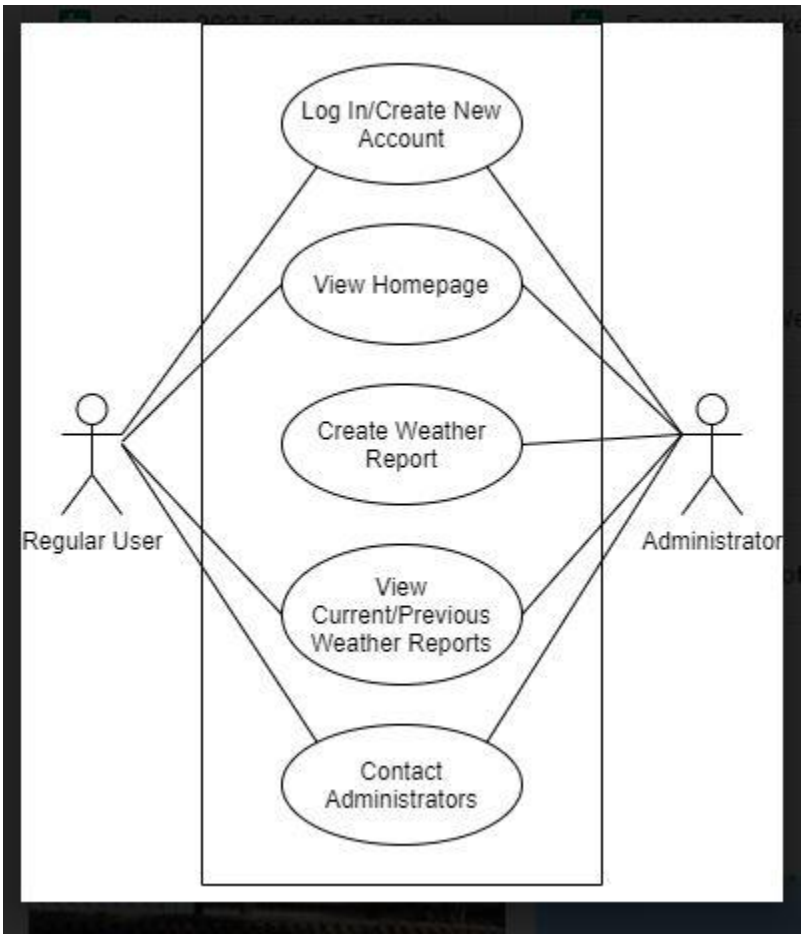

Figure 2.1: Use Case Diagram

Log in and/or Create an Account

- **Goal:** Anybody should be able to download the app and make an account. Certain authorized people will be given administrative privileges.
- **Actor:** General User or Administrator
- **Pre-condition:** An individual has downloaded the app from the Google Play store and opened the app.
- **Post-condition:** That individual is taken to the homepage after creating an account and logging in.

View Homepage

- **Goal:** An individual can view their homepage where they can see previous or current weather reports. They have the option to click on those reports to read further, such as announcements.
- **Actor:** General User or Administrator
- **Pre-condition:** The user is logged in.
- **Post-condition:** The user is directed to view other weather reports and check announcements.

Read a Weather Report

- **Goal:** The user can read a report about weather measurements and indicators with additional announcements included by the administrator..
- **Actor:** General User or Administrator
- **Pre-condition:** The user has logged in and clicked on a weather report.
- **Post-condition:** The user has read a report about weather indicators and returns to the homepage.

Compile a Weather Report

- **Goal:** An administrator can compile a weather report from data on an excel spreadsheet and add a relevant announcement.
- **Actor:** Administrator
- **Pre-condition:** The user has logged into the website and has administrative rights. The user has then clicked on “upload file” under the section to create a new weather report. The user has added an optional announcement.

- **Post-condition:** The administrator can choose from pre-selected indicators via checkboxes to adjust weather report information. The administrator can add an announcement and post a weather report to be viewed on the homepage.

Contact Administrators

- **Goal:** The user can contact administrators about weather reports or announcements via WhatsApp.
- **Actor:** General User or Administrator
- **Pre-condition:** The user has opened a weather report and located the WhatsApp group link at the bottom of the report.
- **Post-condition:** The user can message administrators.

2.3 Activity Diagrams

General User Activity Diagram

Figure 2.2 displays how a general user can flow through the application. Since this application is building off a previous senior design project, we indicated where users will make a choice to view information regarding water quality or weather information. To simplify our diagrams, we grouped together all the functionalities of the water portion of the app.

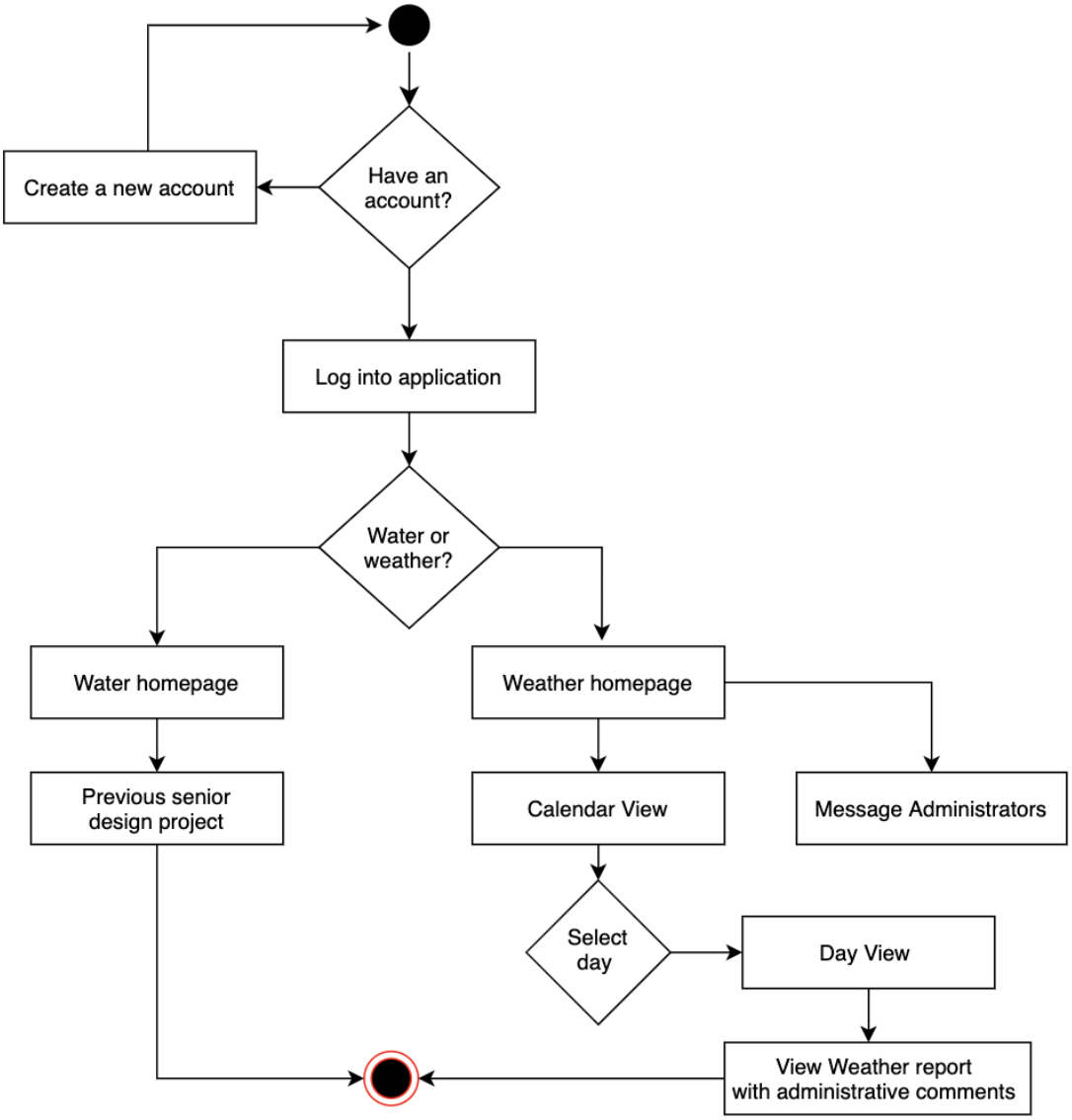

Figure 2.2: General User Activity Diagram

Administrator Activity Diagram

Figure 2.3 displays how an administrator will maneuver through our app. Administrators have additional functionality within the app compared to general users such as creating and publishing weather reports. Main administrators also have the ability to grant other users administrator access.

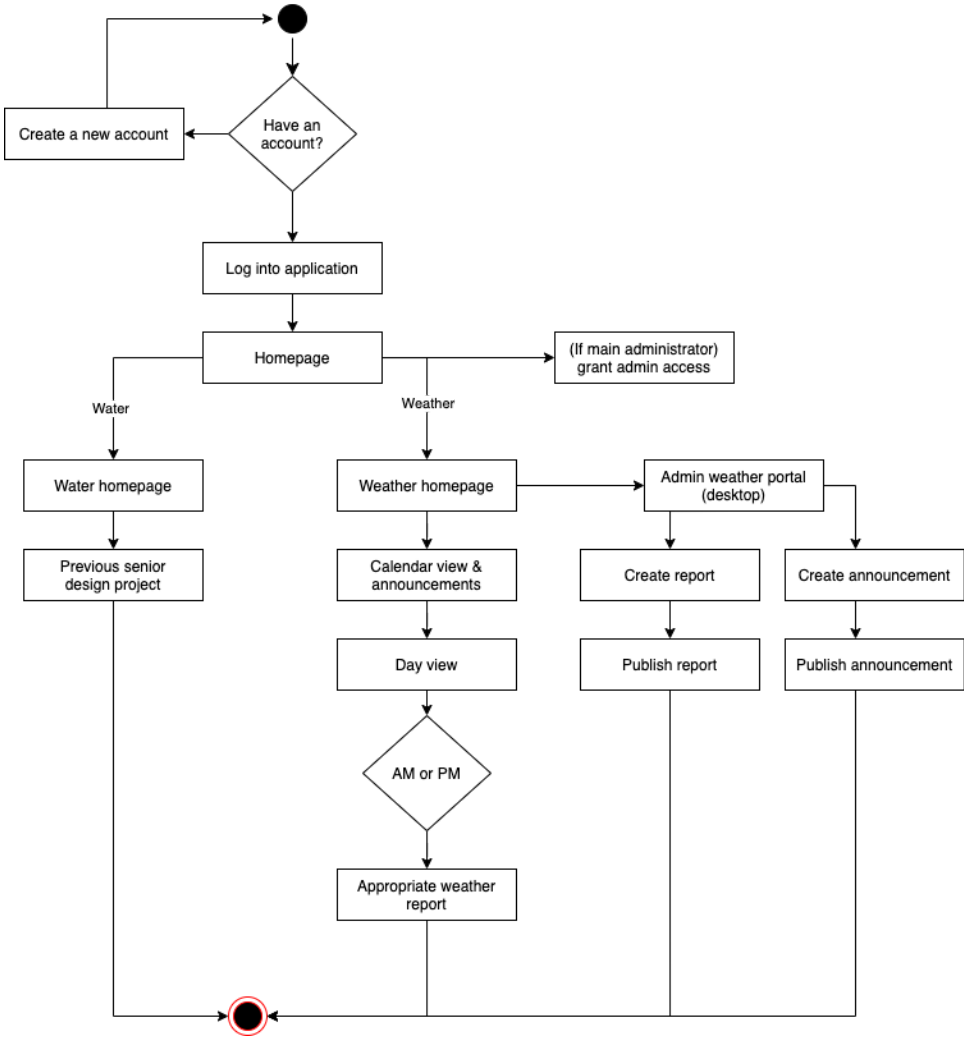

Figure 2.3: Administrator Activity Diagram

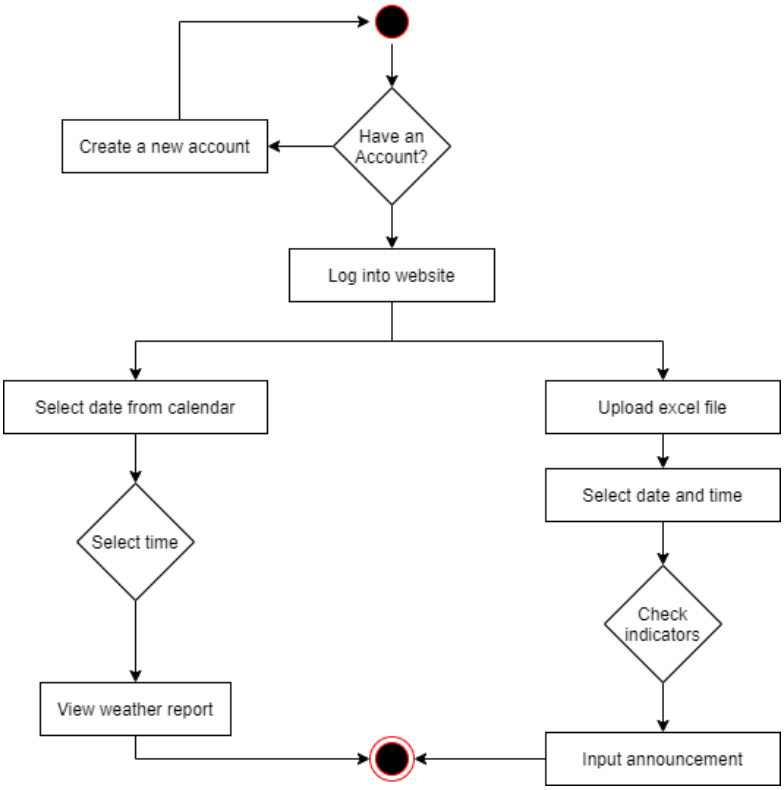

Figure 2.4. Website Activity Diagram

Chapter 3

Design Decisions

3.1 Architectural Diagram

In continuation with the previous project, we will be utilizing a similar architectural design to maximize our weather application's integration. The system will be data-centric with React Native as the front-end framework, Node.js as the server-side scripting language, and MySQL hosted on AWS servers as our database.

Figure 3.1: Architectural Diagram

3.2 Technologies Used

To build our application, we will be using React Native, Node.js, and MySQL hosted on AWS.

React Native

React Native is an open source mobile application framework that allows for cross-platform application development. As the community members have both Apple and Android cellphones, this enables our team to build both a native iOS and Android app.

MySQL Hosted on AWS

MySQL is an open-source relational database management system. AWS, or Amazon Web Services, provides on-demand cloud computing platforms and APIs to individuals and companies on a metered pay-as-you-go basis. Using MySQL hosted on AWS allows us to store information reliably and inexpensively. Additionally, with most database functionality already set up by the previous team, we decided to continue using MySQL on AWS in order to maximize efficiency and integration with the weather application.

Git

Git is a version control system where we keep our code properly updated between teammates. It keeps track of copies of our code throughout the design process.

3.3 Design Rationale

Last year's senior design project played a large role in most of our design choices. We decided to use their work as a starting point to deliver a usable app for the client with additional features to include weather information. In order to manage efficient integration of our weather application, we choose to maintain the previous groups' architectural system and technologies used (React Native, MySQL hosted on AWS, and Git).

Chapter 4

Planning Phase

4.1 Project Risks

Below, Table 4.1 outlines the risks our team has identified. We also included the impact value of each risk, calculated with the probability the event will occur and the severity of it occurring. In addition, we included potential mitigation strategies, which should reduce the probability of the risk event occurring.

Risk	**Consequences**	Probability	Severity	Impact	Mitigation
Unfamiliar Code	Team members must review previously written code and adapt to the current environment, structure, and design.	0.9	6	5.4	Familiarize ourselves with the previous code early.
Unfamiliar Technologies	Team members must learn new technologies before implementing them.	0.7	7	4.9	Learn and research these technologies.
Platform Compatibility Issues	The developed application does not fulfill functionality on Apple and Android mobile devices.	0.6	8	4.8	Test often to catch compatibility issues early.
Missing Requirements	The final system does not fully satisfy customer requirements.	0.5	8	4.0	Remain in communication with clients and focus on functional requirements.
Bugs In Code	The final system does not perform as expected.	0.9	3	2.1	Write good code that is easy to debug.
Language Barrier	Must communicate through our advisors in order to talk to ASDENIC employees.	1.0	2	2.0	Give ample time to set up meetings with all parties.
Insufficient Time	The final system is not completed in time.	0.2	8	1.6	Stick to our project schedule.

Table 4.1: Risk Analysis Table

4.2 Development Timeline

Below is our team's original projected development timeline. The roadmap set was intended to keep our team accountable and ensure that all requirements and deliverables were fulfilled on time. Despite our best efforts to remain on track, our team encountered several obstacles which hindered our ability in the implementation and testing portions of development. These obstacles included: specifications in the requirements changing, AWS database resource issues, and general end-to-end testing issues. Moving forward, we've learned the importance of setting clearer requirements early on and adapting to unexpected changes.

Task	Start Date	Due Date	September	October	November	December	January	February	March	April	May	June
Documentation												
Problem Statement	mid Sept.	10/9/2020										
Diagrams	late Oct.	12/11/2020										
Initial Design Report	late Nov.	12/11/2020										
Design Review	mid Dec.	week 2										
Senior Design Conference		5/13/2021										
Senior Thesis Submission	early Apr.	6/10/2021										
Implementation												
Development	mid Dec.	late Apr.										
Testing	late Feb.	early May										

Figure 4.2: Development Timeline

Chapter 5
Other Considerations

5.1 Ethical Considerations

Regarding ethical considerations, our project did not require human subjects of any kind which allowed for minimal risk and burden to our target group of users with reasonable benefit from using our final product. In order to best implement the wishes of the target users and allow for their input into our design, we worked closely in collaboration with the Frugal Innovation Hub and our person of contact at ASDENIC in order to get feedback on how to best incorporate their ideas and suggestions for the application. In doing so we hope to provide an application that works well for the community and is something they enjoy using and can easily implement into their daily lives.

One concern with an application like this is security and privacy as users must sign up with a name, phone number, and password. As passwords enter the database they are encrypted to protect users' security. Because phone numbers are connected to accounts, there are only a few administrators who have access to this information if there is a need to contact a user while general users do not have access to any other users' personal information including their phone number.

5.2 Social Considerations

Thinking about the social implications of our application, it was important that our final design was an effective tool for relaying information as well as communication. While in person meetings on a weekly basis are not ideal, especially during the COVID-19 pandemic when in person gatherings are restricted, they do provide a level of interaction and collaboration that is more difficult in an online environment. For this reason, our design seeks to inform while still allowing for discussion through the integration of the WhatsApp group messaging feature, especially as WhatsApp is a commonly used product already in Nicaragua. Furthermore, as ASDENIC strives to empower the people of Nicaragua, our design seeks to implement sustainable code that will allow for long term

use with minimal intervention after deployment. This way, the users will not have to rely on regular updates and fixes that could hinder their use of the application.

5.3 Geographical Considerations

Geographical considerations had a large influence on decisions regarding our application. Given the app will be deployed in rural Nicaragua we had to account for the infrastructure that would best allow for the use of our app. Nicaragua uses the global system for mobile communication (GSM) which largely supports more android devices over iOS while a larger percentage of our target users likely have android devices which was our reasoning for building an android application as opposed to iOS. Additionally, because of the language difference, we had to translate our app into Spanish through the use of online translation tools as well as with the help of our people of contact at the Frugal Innovation Hub in order to best evoke the nuances of the Spanish language. Finally, we chose to use phone numbers instead of emails when creating new accounts on the app as more residents of rural Nicaragua are likely to have a phone number if they are using the application on a mobile device as opposed to an email.

5.4 Usability

When it comes to usability, in addition to the other considerations we faced during the design and implementation processes, we wanted to maintain a simple and straightforward design for the ease of the user. To do so, we maintained the same design elements of the previous group that worked on the water side of the application which included a minimal color palette, clear wording, and uncluttered display for a more cohesive look. Throughout the process we prioritized simplicity in layout and visual design to make the app as accessible for any new user to mitigate confusion and make the experience of receiving information as easy as possible.

Chapter 6

Implementation

6.1 Weather App User Views

The following figure shows different screens the user will view when looking for a weather report. Since these reports are created at least twice a day, the monthly calendar view will help organize the reports, as well as allow users to compare previous years after the app is continuously used.

Figure 6.1: Mobile Weather Report Monthly View Mockup

Figure 6.2: Mobile Weather Report Daily View Mockup

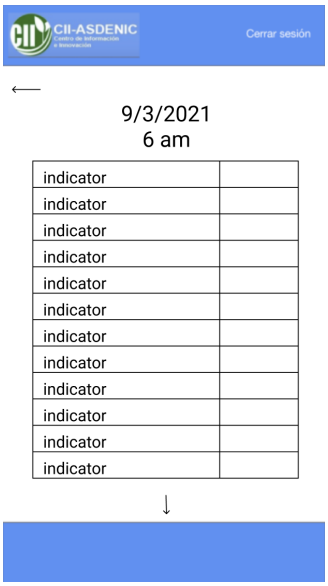

Figure 6.3: Mobile Weather Report Mockup

Figure 6.4: Mobile Weather Report Monthly Screenshot

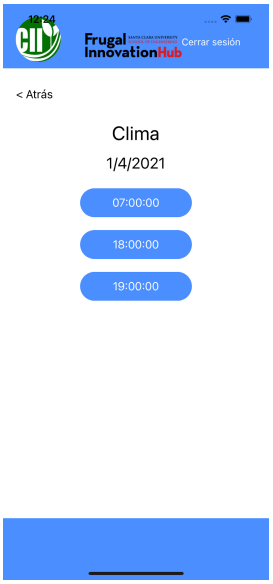

Figure 6.5: Mobile Weather Report Daily Screenshot

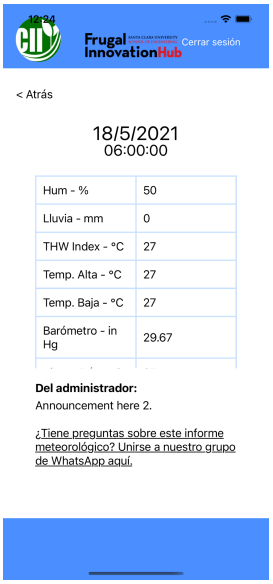

Figure 6.6: Mobile Weather Report Screenshot

6.2 Weather App Administrative Website Views

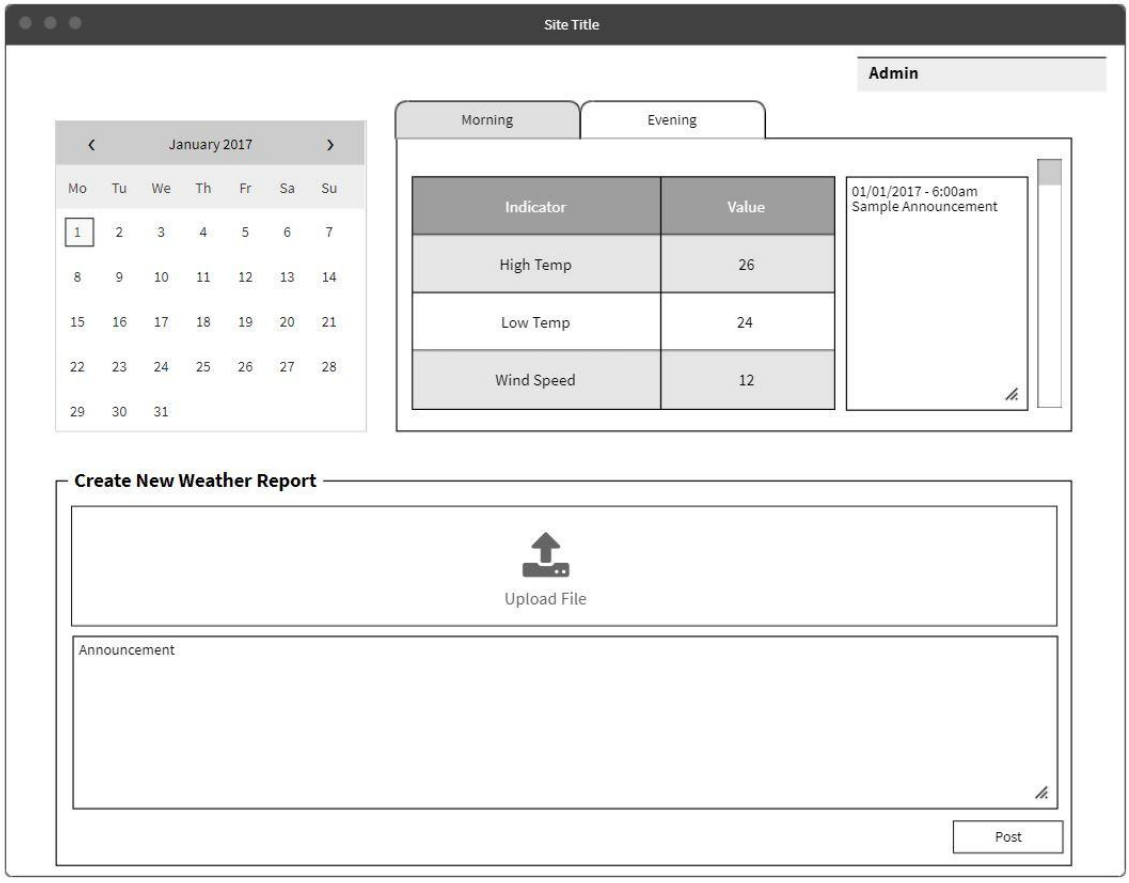

Figure 6.7: Web Administrative Home Page Mockup

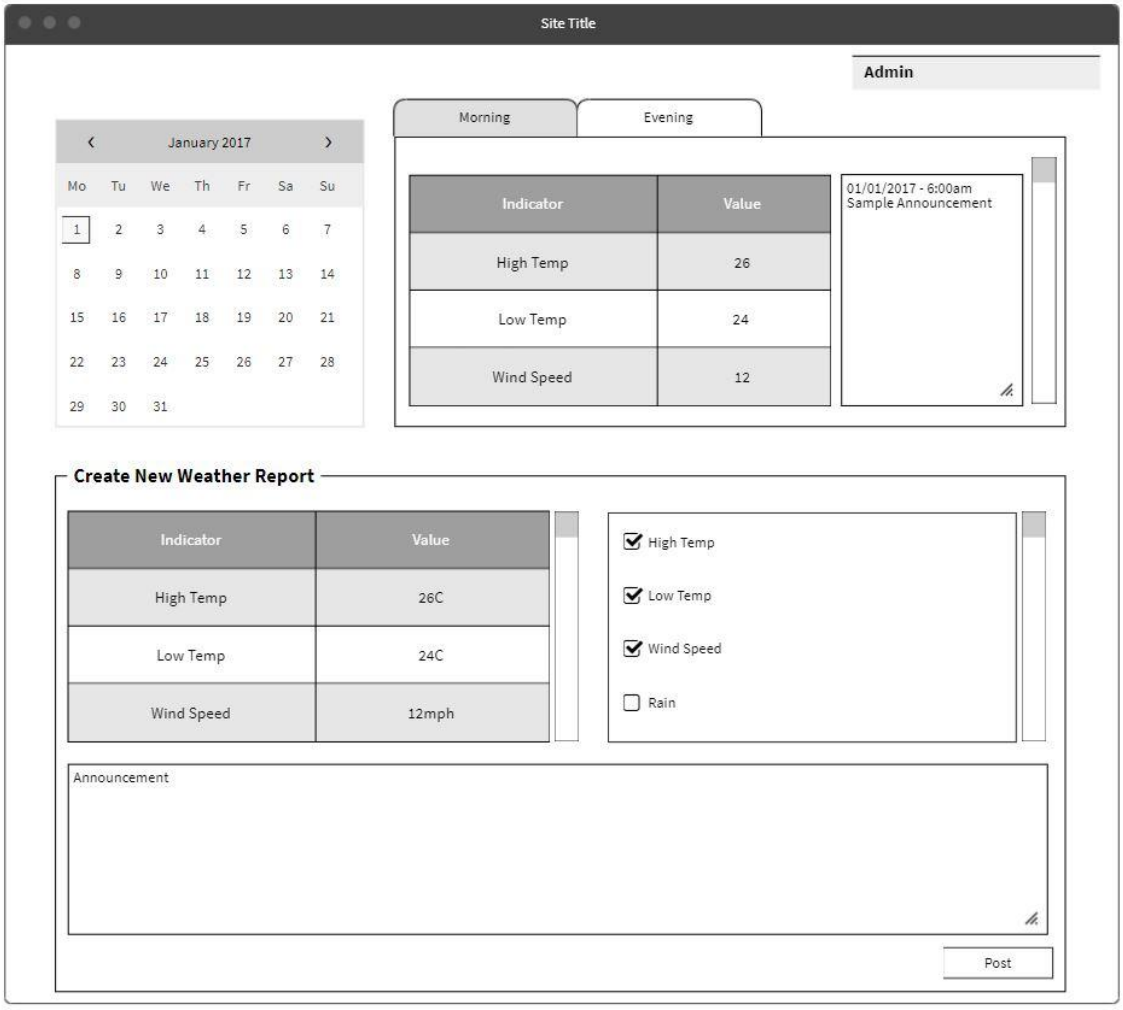

Figure 6.8: Web Create New Weather Report Mockup

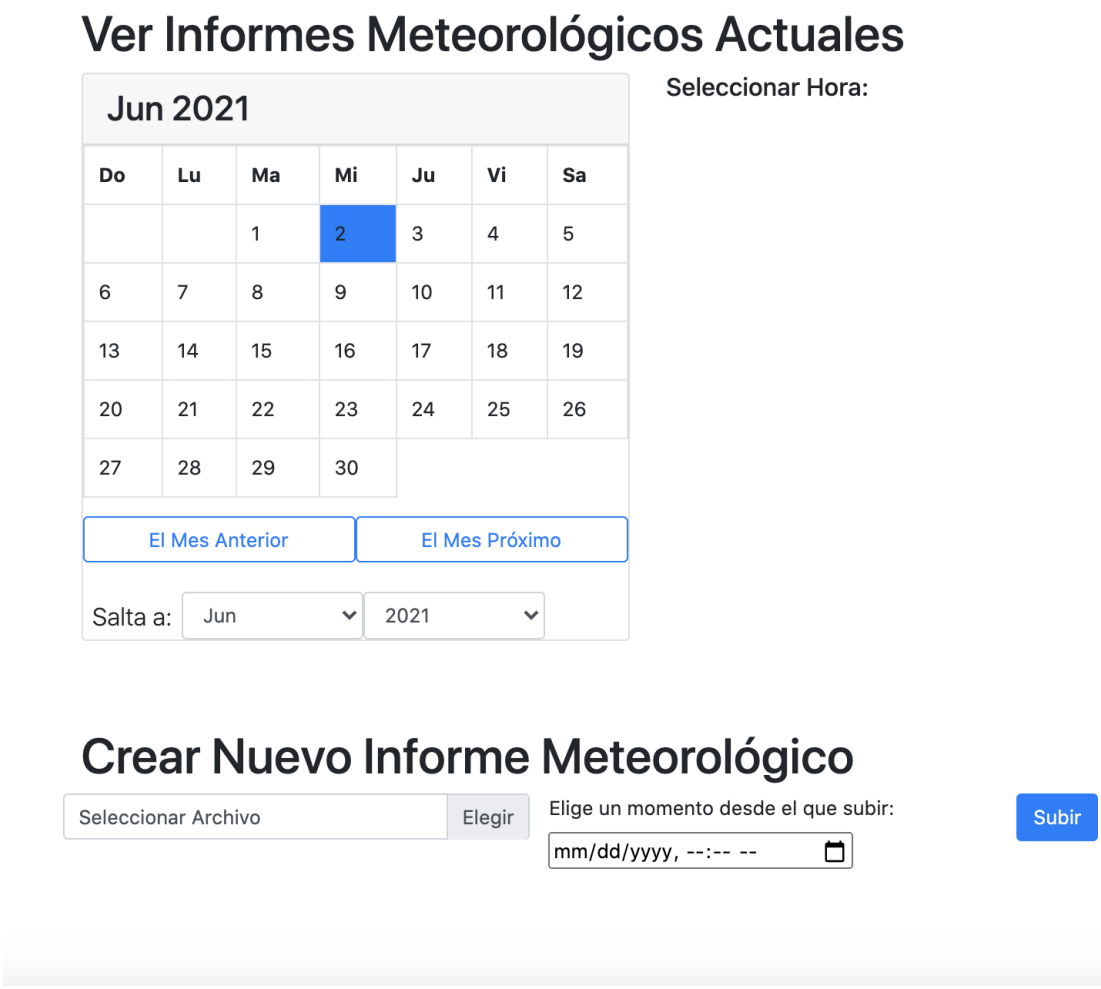

Figure 6.9: Web Weather Dashboard Screenshot

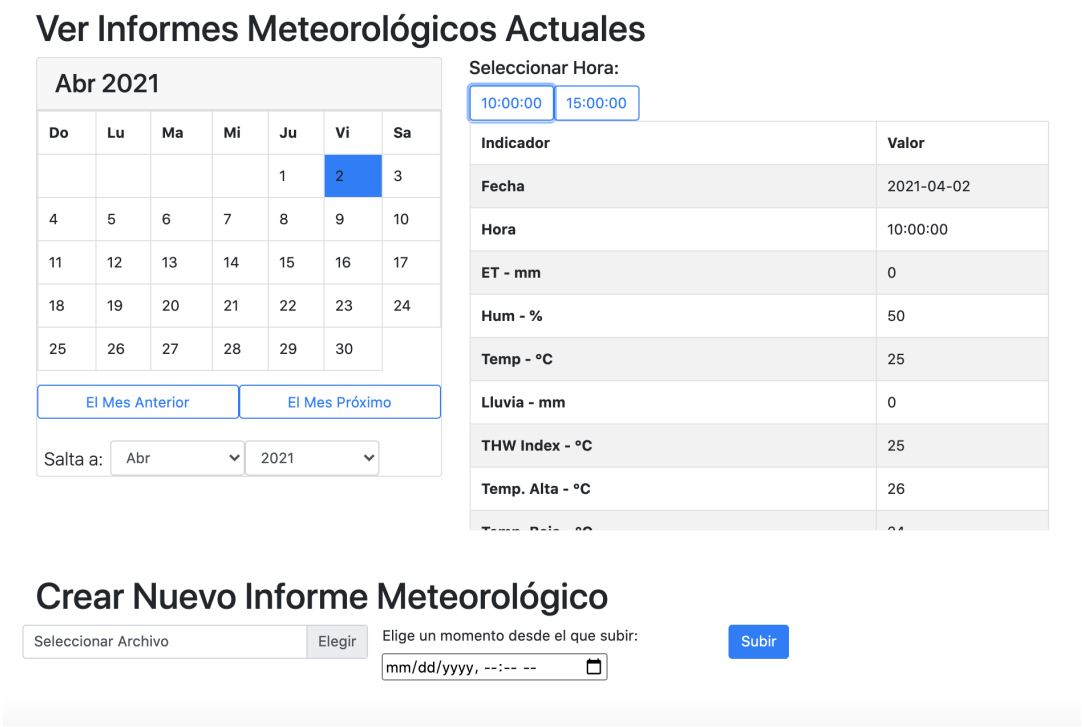

Figure 6.10: Web Weather Report View Screenshot

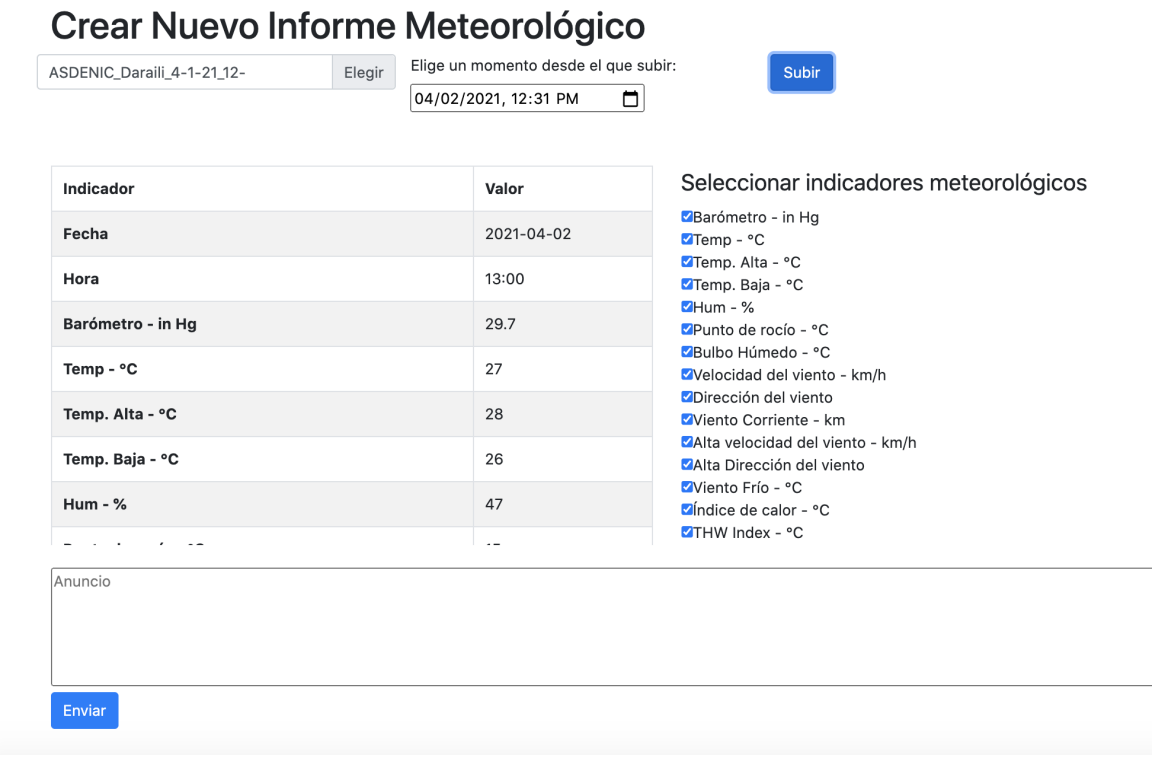

Figure 6.11: Web Weather Report Upload Interface 1 Screenshot

4

Figure 6.12: Web Weather Report Upload Interface 2 Screenshot

Chapter 7
Conclusion

7.1 Summary

Web

Our application, designed for ASDENIC of Nicaragua, acts as a platform for leaders to share valuable weather indicators with members of the community in real time. The web portion of the project features a sign-in page that brings administrators to a dashboard where they are able to view and upload weather reports. When viewing reports, a fully-functional calendar is available for administrators to select the current day, past months, or even jump to previous years. Once a date is selected, buttons will display for the different times reports have been uploaded for. When a time is selected, the report information and announcement will be populated and displayed for viewing. When creating a new weather report, administrators are prompted to upload an excel/csv file from the weather station and select the date and time from which to create a new report from. Upon submission, a new weather report is displayed alongside a checklist of all twenty weather indicators (all indicators are selected by default). Administrators can remove/include indicators to their discretion and include an announcement to be attached to the new report. Once uploaded, the new report is sent to our database where the mobile and web applications pull from to display reports to general users.

Mobile

Our mobile application provides users in northern Nicaragua a streamlined process to instantly receive updates regarding water quality and weather information. Users must provide their name, community affiliation, phone number, and password to create an account. Then they can log in and choose to view water quality or weather information. After selecting to view weather information, users are taken to a screen displaying a fully-functional calendar, a button linking to the most up-to-date weather report, as well as a link to the Whatsapp messenger group. When the user selects a day on the calendar, a list of the available reports is displayed. Then each individual weather report is displayed

with a uniform format. The user can view all the weather indicators selected by the administrator, the administrator's announcement, and another link to the WhatsApp group.

7.2 Lessons Learned

Throughout our development process, we discovered several key takeaways to help us improve our project management and application development processes in the future. Most notably, we learned the importance of early research and communication. In the beginning of project development, our team had a brief idea of the application we were looking to make. However, several logistics remained unclear, including: which weather indicators to include, when to upload reports, and what key functionalities administrators should have. Despite creating a questionnaire for ASDENIC and eventually meeting with Raul, Allan, and Professor Musurlian to clarify the weather application's structure, we could have entered the design and development phases earlier had we anticipated the minor delays in setting up meetings with our client in Nicaragua, as well as any information that may have been lost in translation or not clarified. Additionally, after our project demo, we discovered that we were using an outdated excel format for our upload functionality. Subsequently, several adjustments to our excel reader were necessary to restore its functionality. This obstacle could have been avoided with more in-depth research into current client activities and clearer specifications of requirements.

7.3 Advantages/Disadvantages of Solution

Advantages

With our weather application, we have reduced the need for ASDENIC and community members of Nicaragua to meet in person and discuss weather conditions and information. This is especially notable given the COVID-19 pandemic and hazards from large group gatherings. Additionally, our application enables ASDENIC administrators to broadcast multiple reports a day and provide community members with better access to real-time information. By not including messaging functionality within the application itself, we have capitalized on the already well-integrated WhatsApp messaging app for community

members to contact each other. Lastly, community members now have the ability to look back at past weather reports and reference previous indicators.

Disadvantages

Some shortcomings of our application include the inability for community members to save or download reports. Making weather reports downloadable and being able to compare reports in-app has been a potential feature requested by our client that we were unable to implement in our project. In addition, the upload functionality of our web application is specific to the current .csv format outputted from the weather station - which could pose an issue if the format changes.

7.4 Future Work

Looking forward, the next steps for our project include passing over web-hosting to the Frugal Innovation Hub and testing the application with the community members of ASDENIC. Subsequently, there are bound to be changes, adjustments, and new features that may be needed - potentially another senior design group would be able to pick up from where we left off and continue developing features for ASDENIC. Some notable features that our team considered but decided to leave out of our scope included: downloadable weather reports, in-app comparison of weather reports, and in-app messaging.

Appendix A

Installation Guide

A.1 Test Beta Version on Your Android Device

1. Testing will be completed through the Google Play store.
2. Email Allan Baez Morales at the Frugal Innovation Hub to receive the app's Play Store URL and user manual.
    a. User manuals are available in both English and Spanish, but please note that the application is fully in Spanish.
3. Download and open the application. You can use the application as normal from here.
4. Leave us feedback! Instructions on how to provide feedback through the Google Play store can be found here: https://support.google.com/googleplay/answer/7003180/try-new-android-apps-before-their-official-release

A.2 To Download and Edit the Application

Clone the Git Repository

1. Copy the following link: https://github.com/alexa-grau/Senior-Design.git
2. In terminal, go to the directory that you would like the repository to be in on your local machine.
3. In terminal, type 'git clone', paste the link from above, and press enter.
4. Your code will now be on your local machine in a folder called Senior-Design.

Download Dependencies

1. Download Node.js and the node package manager here: https://nodejs.org/en/download/
2. In terminal, go to your Senior-Design directory and execute the following commands:
    a. npm install -g expo-cli
    b. npm install -g mysql
3. You may need to download additional dependencies later.

Install MySQL Workbench

1. Visit the following link and download the correct version for your operating system: https://dev.mysql.com/downloads/workbench/
2. Once downloaded, open the MySQL Workbench application and click on "Database" > "Connect to Database".
3. Email professor Angela Musurlian for the correct credentials. Currently, you will also need to add your IP address to the AWS security group.

Run the Application

Mobile Application

1. Open two terminal windows in your local Senior-Design directory.
    a. In one, execute 'node server.js'
    b. In the other, execute 'expo start'
2. You should be brought to a site on your web browser. Follow the instructions to open the application on your phone or a device simulator.

Web Administrator Page

1. Open your computer's file explorer and navigate to your Senior-Design directory.
2. Under this folder, open the 'excel-reader' folder and open the 'index.html' file in your preferred browser.
3. Note that for the full weather report functionality to work, you must start the server with the above 'node server.js' terminal command.

Appendix B

Works Cited

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