GENERAL DYNAMICS
Mission Systems

Rescue21 SWAPR Data Dashboard

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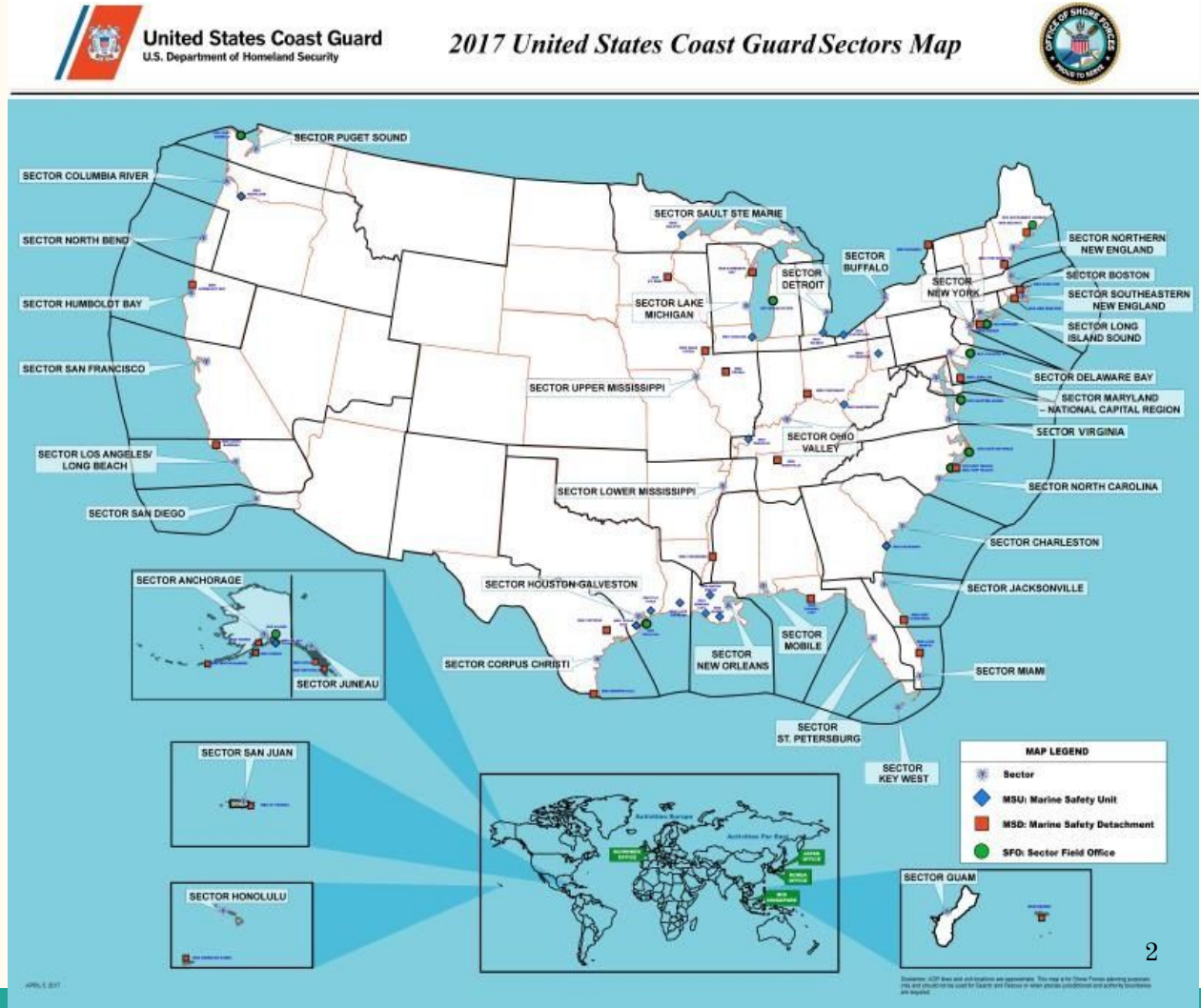
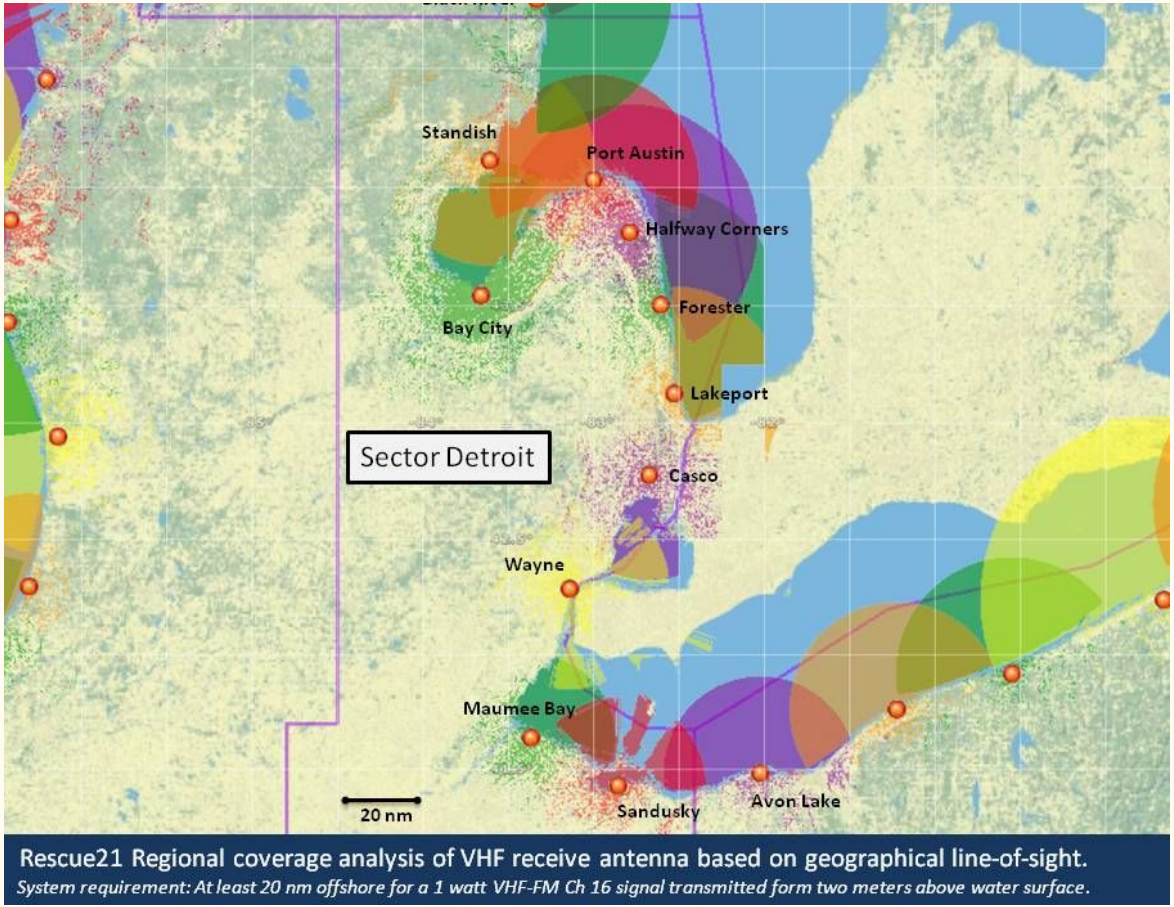
Team Mentor: Han Peng

Coast Guard Coverage

The US Coast Guard monitors over 296,000 nautical miles of sea in addition to land coverage.



Rescue21 Coverage



Rescue21 Regional coverage analysis of VHF receive antenna based on geographical line-of-sight.
System requirement: At least 20 nm offshore for a 1 watt VHF-FM Ch 16 signal transmitted form two meters above water surface.

Rescue21 RFF Station

GDMS Additions

- Ability to
  - Collect Weather Information
    - Temperature, Humidity, Rain, Wind Speed, Wind Direction
  - Collect Power Information
    - Antenna Power Information (4 different antennas)

Rain output:	value from 0 to 1023	(1023 = no rain : 0 = Heavy rain)
Direction:	Output range from 0 to 360 deg	
Power levels range:	Range from -105 dBm to -85 dBm	
Humidity sensor levels:	0 to 100%	
Temperature:	Range from -40 to 80 Celsius	(-40 to 176 Fahrenheit)
Wind Speed:	Range from 0 to 200 mph	

What will additions do for GDMS?

With weather and power data, General Dynamics will be able to:

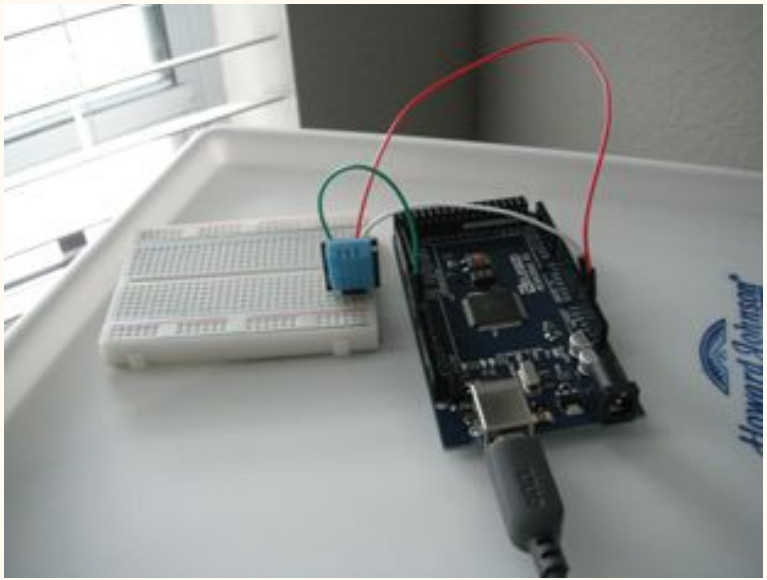
- Reduce Outage Time
- Predict Equipment Damage
- Help with Maintenance Scheduling

These additions will increase the chances that SAR missions will succeed.

Site Weather and Power Recorder (SWAPR)

We are expanding upon last year's Electrical Engineering Capstone Project: Site Weather and Power Recorder (SWAPR)

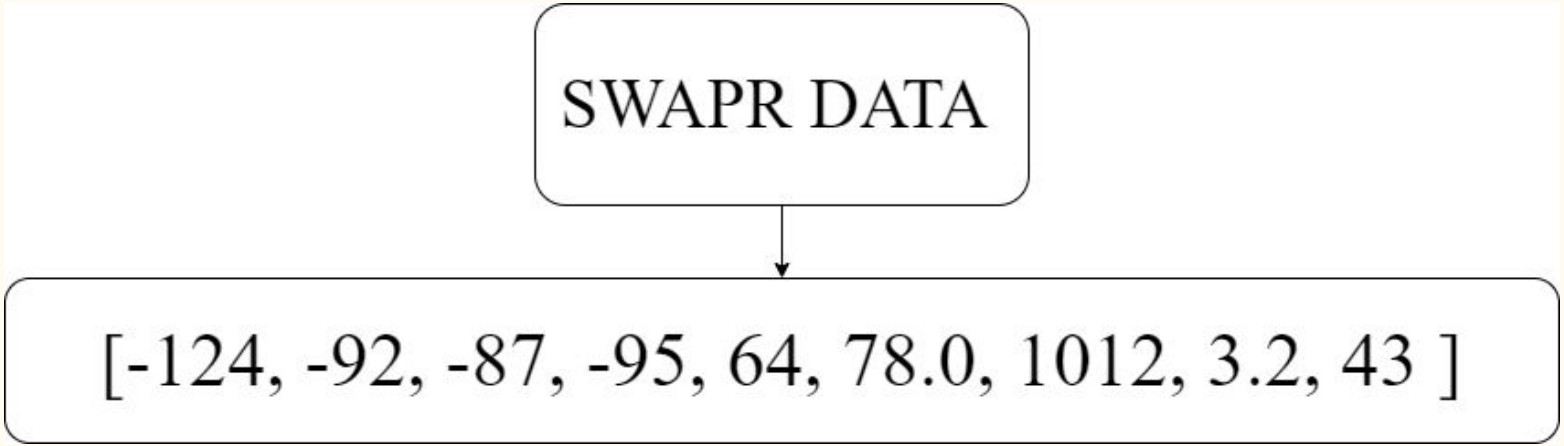
SWAPR Wind Sensor



SWAPR Humidity Sensor

Problem Statement

- Output is difficult to read/analyze and there is no interface
- The SWAPR data is only available directly at the site



Solution Overview

Our team has built a secure web application that expands on the functionality of an existing prototype.

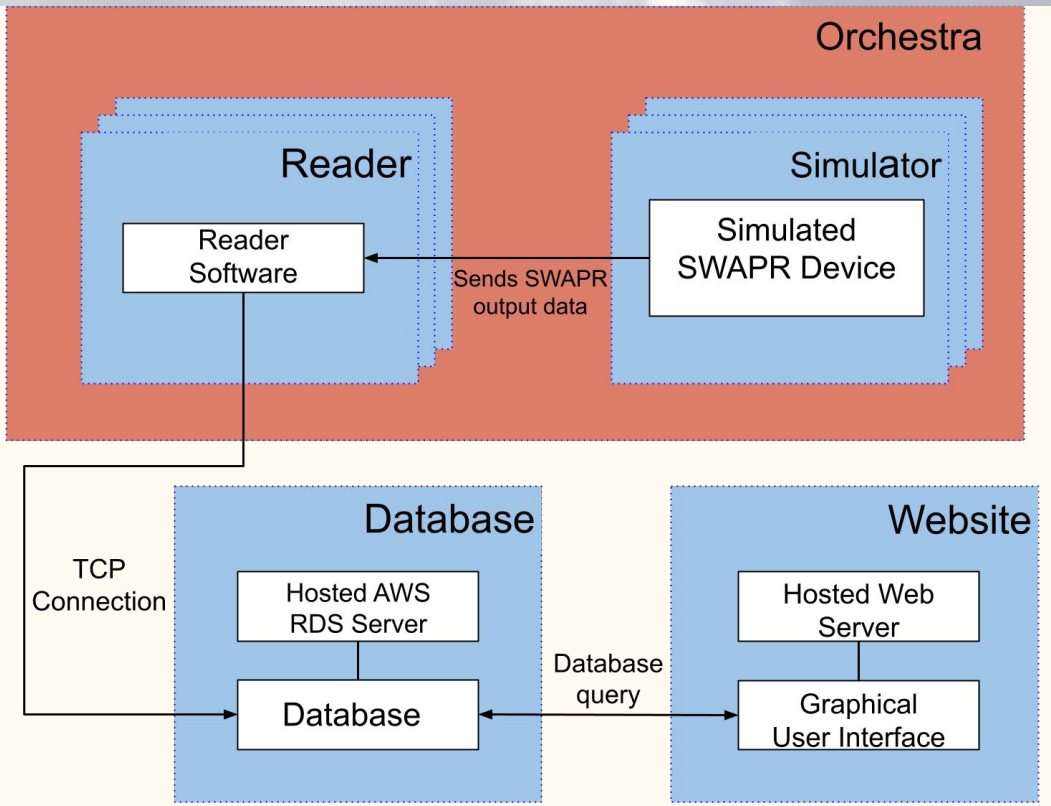
This solution provides new features such as:

- Remote data storage and access
- Interactive, visual representations of the data
- Monitoring the operational status of RFF sites
- Notifications for RFFs entering critical events

Solution Overview: System Workflow

Five Subsystems:

- **Simulator** generates output
- **Reader** transfers data to the database
- **Database** stores data
- **Website** displays data using graphical user interface
- **Orchestra** simulates an entire network of SWAPR devices



Solution Overview: Website

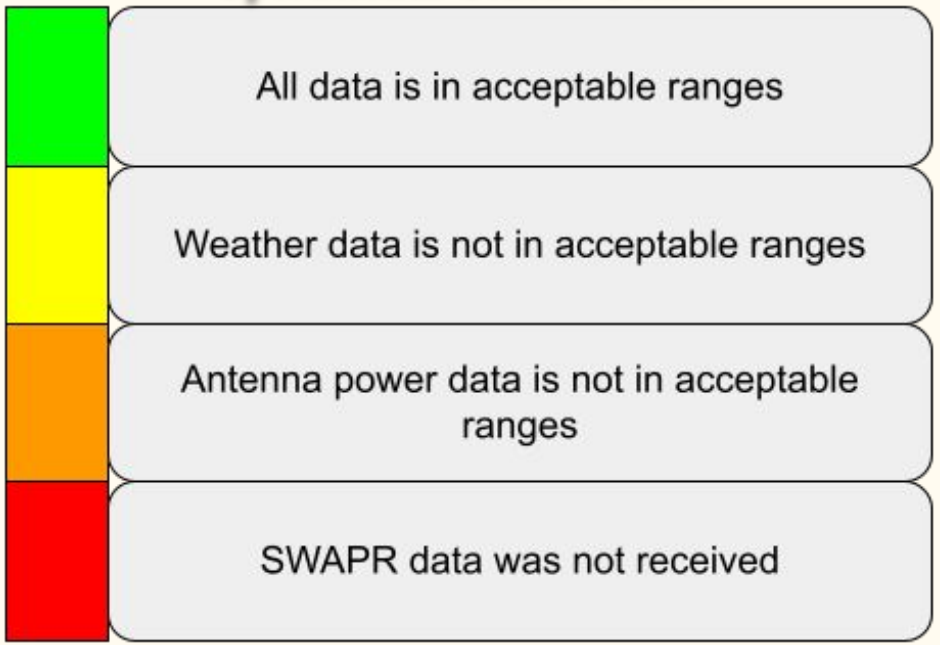
Website Subsystem queries the database to retrieve data to generate views and status notifications for the user.

- Summary Views
  - List View: Overview of RFF weather data
  - Map View: Overview of RFF locations and operational status
- Historical View
  - Graphs: History of entry weather and power data as a line, bar, or radar graph

Solution Overview: Website Continued

- Notification System
  - Notifications created to provide operational status
  - Drop-down list to view notifications

Operational Status Colors



Key for Status Colors

Requirements Overview

Key Requirements:

1. Create data imitating the SWAPR device's output
2. Take data from a SWAPR device and send it securely off-site
3. Store and serve SWAPR data in a secure manner
4. Establish a secure website environment with authentication
5. Create a list, map, and historical views of the SWAPR devices in the network
6. Create a way to notify operator when there is a problem with an RFF site

Requirements Overview Continued

- C# Programming Language
- Microsoft's Visual Studio IDE
- Built-in .NET 5 libraries
- Blazor Server Framework
- Windows Environment
- MySQL Database
- Amazon Web Services (AWS)
    - EC2, RDS, Lambda Function, SQS, SNS

Architecture & Implementation

Entry class contained data:

- RFF Site Id
- Datetime Entry
- Weather & Power data
- Status

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Direction:	Output range from 0 to 360 deg	
Power levels range:	Range from -105 dBm to -85 dBm	
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Temperature:	Range from -40 to 80 Celsius	(-40 to 176 Fahrenheit)
Wind Speed:	Range from 0 to 200 mph	

Architecture & Implementation: Review

Backend - Account Management, Database Queries, Notifications, & CSV Data Exporting

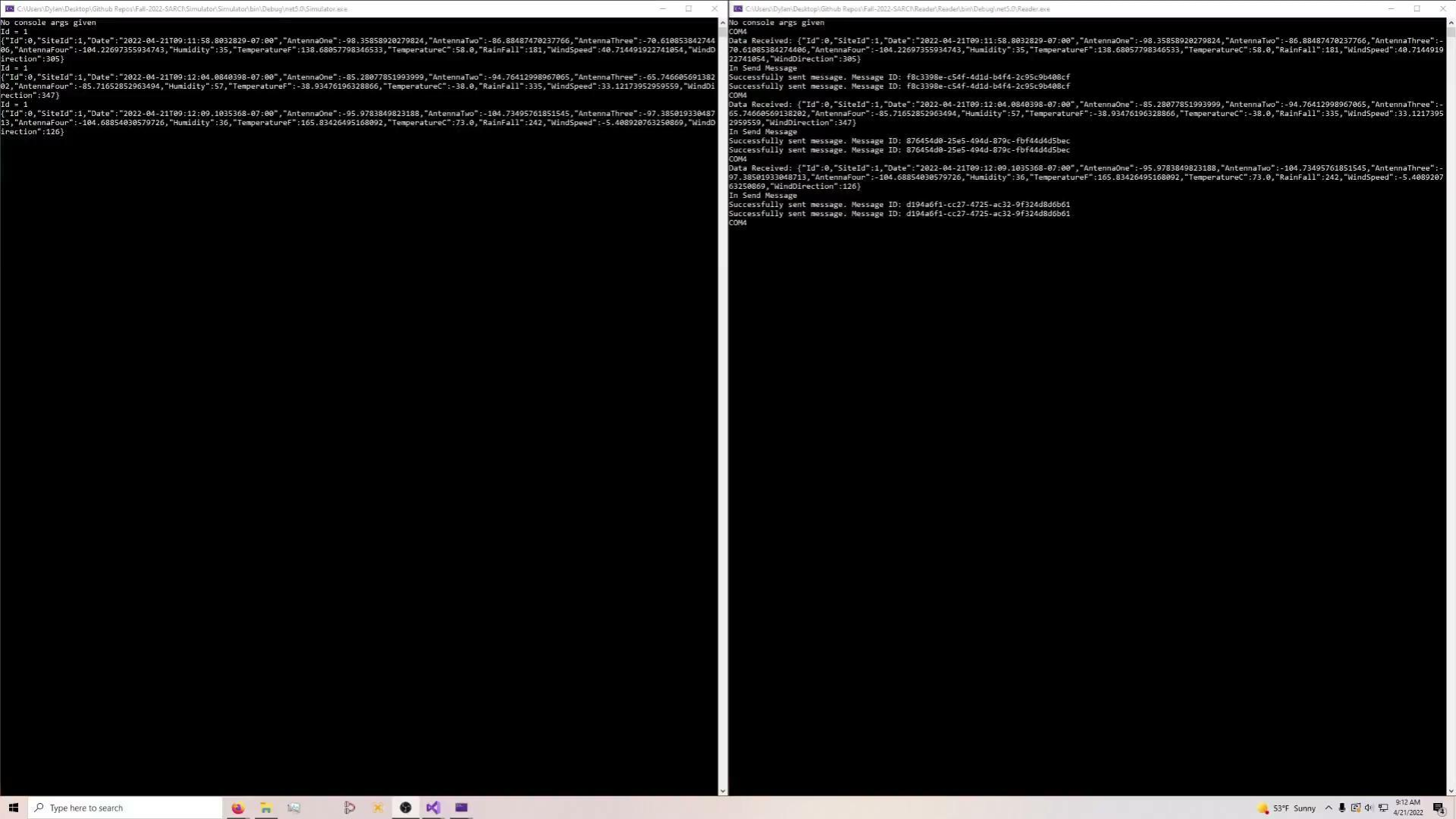
- C# Identity Class
- MySQL C# classes & DBContext class
- Custom C# Templates and Methods
- EPPlus, C# models, and IActionResult class

Frontend - List, Map, & Historical View

- C# wrapper class of Canvas.js
- Custom SVG document editor, html maps, & C# Navigation Manager
- C# wrapper class of Chart.js

Note: Color match functionality with technologies

Data Generation - Simulator & Reader

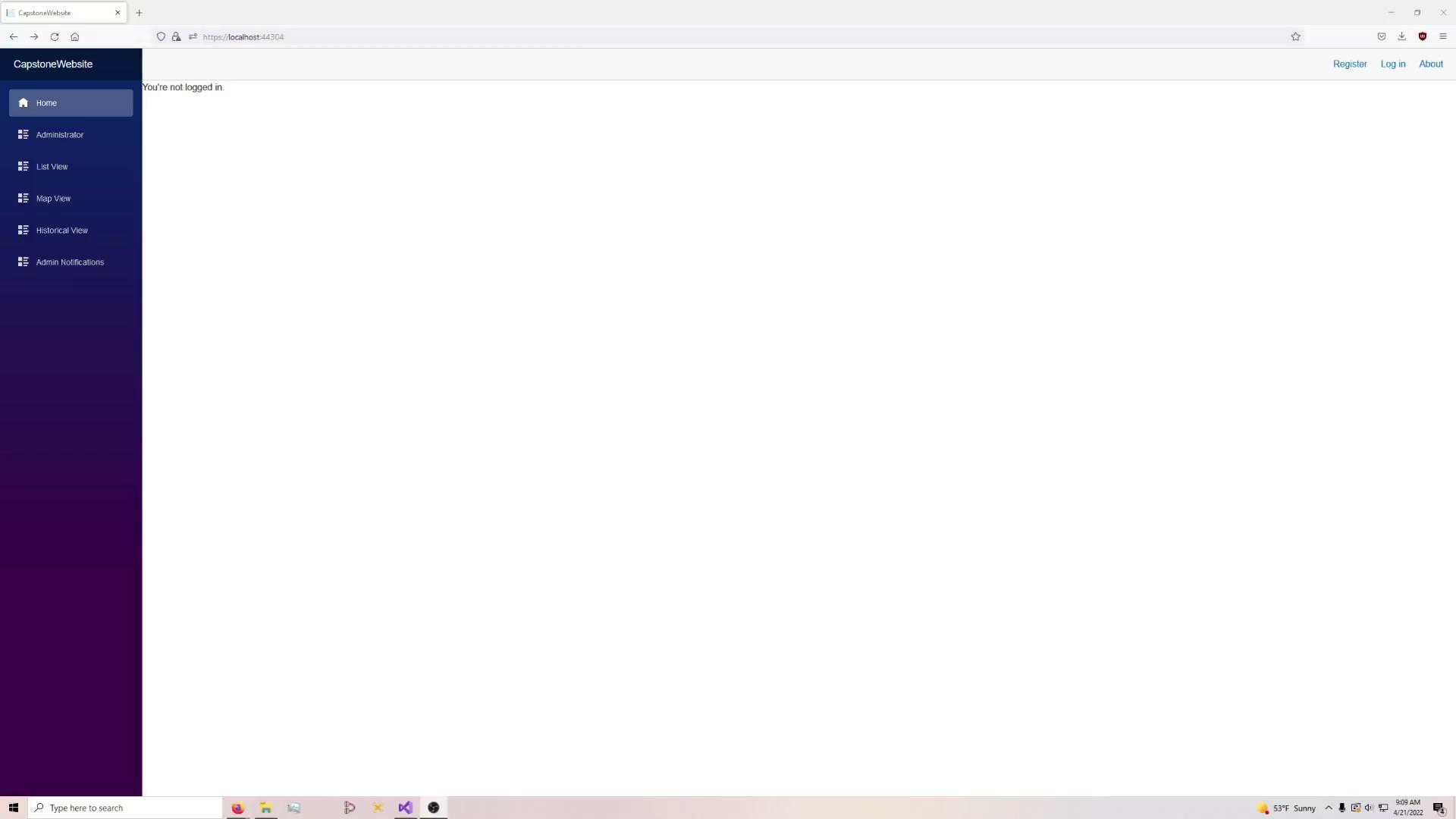

C:\Users\Dylan\Desktop\Github Repos\Fall-2022-SARC\Simulator\Simulator\bin\Debug\net5.0\Simulator.exe
No console args given
Id = 1
{"Id":0,"SiteId":1,"Date":"2022-04-21T09:11:58.8032829-07:00","AntennaOne":-98.35858920279824,"AntennaTwo":-86.88487470237766,"AntennaThree":-70.61085384274406,"AntennaFour":-104.22697355934743,"Humidity":35,"TemperatureF":138.68057798346533,"TemperatureC":58.0,"RainFall":181,"WindSpeed":40.714491922741054,"WindDirection":305}
Id = 1
{"Id":0,"SiteId":1,"Date":"2022-04-21T09:12:04.0840398-07:00","AntennaOne":-85.28077851993999,"AntennaTwo":-94.76412998967065,"AntennaThree":-65.74660569138202,"AntennaFour":-85.71652852963494,"Humidity":57,"TemperatureF":-38.93476196328866,"TemperatureC":-38.0,"RainFall":335,"WindSpeed":33.12173952959559,"WindDirection":347}
Id = 1
{"Id":0,"SiteId":1,"Date":"2022-04-21T09:12:09.1035368-07:00","AntennaOne":-95.9783849823188,"AntennaTwo":-104.73495761851545,"AntennaThree":-97.38501933048713,"AntennaFour":-104.68854030579726,"Humidity":36,"TemperatureF":165.83426495168092,"TemperatureC":73.0,"RainFall":242,"WindSpeed":-5.408920763250869,"WindDirection":126}
C:\Users\Dylan\Desktop\Github Repos\Fall-2022-SARC\Reader\Reader\bin\Debug\net5.0\Reader.exe
No console args given
COM4
Data Received: {"Id":0,"SiteId":1,"Date":"2022-04-21T09:11:58.8032829-07:00","AntennaOne":-98.35858920279824,"AntennaTwo":-86.88487470237766,"AntennaThree":-70.61085384274406,"AntennaFour":-104.22697355934743,"Humidity":35,"TemperatureF":138.68057798346533,"TemperatureC":58.0,"RainFall":181,"WindSpeed":40.714491922741054,"WindDirection":305}
In Send Message
Successfully sent message. Message ID: f8c3398e-c54f-4d1d-b4f4-2c95c9b408cf
Successfully sent message. Message ID: f8c3398e-c54f-4d1d-b4f4-2c95c9b408cf
COM4
Data Received: {"Id":0,"SiteId":1,"Date":"2022-04-21T09:12:04.0840398-07:00","AntennaOne":-85.28077851993999,"AntennaTwo":-94.76412998967065,"AntennaThree":-65.74660569138202,"AntennaFour":-85.71652852963494,"Humidity":57,"TemperatureF":-38.93476196328866,"TemperatureC":-38.0,"RainFall":335,"WindSpeed":33.12173952959559,"WindDirection":347}
In Send Message
Successfully sent message. Message ID: 876454d0-25e5-494d-879c-fbf44d4d5bec
Successfully sent message. Message ID: 876454d0-25e5-494d-879c-fbf44d4d5bec
COM4
Data Received: {"Id":0,"SiteId":1,"Date":"2022-04-21T09:12:09.1035368-07:00","AntennaOne":-95.9783849823188,"AntennaTwo":-104.73495761851545,"AntennaThree":-97.38501933048713,"AntennaFour":-104.68854030579726,"Humidity":36,"TemperatureF":165.83426495168092,"TemperatureC":73.0,"RainFall":242,"WindSpeed":-5.408920763250869,"WindDirection":126}
In Send Message
Successfully sent message. Message ID: d194a6f1-cc27-4725-ac32-9f324d8d6b61
Successfully sent message. Message ID: d194a6f1-cc27-4725-ac32-9f324d8d6b61
COM4
Type here to search
53°F Sunny
9:12 AM
4/21/2022

Data Generation - Orchestra

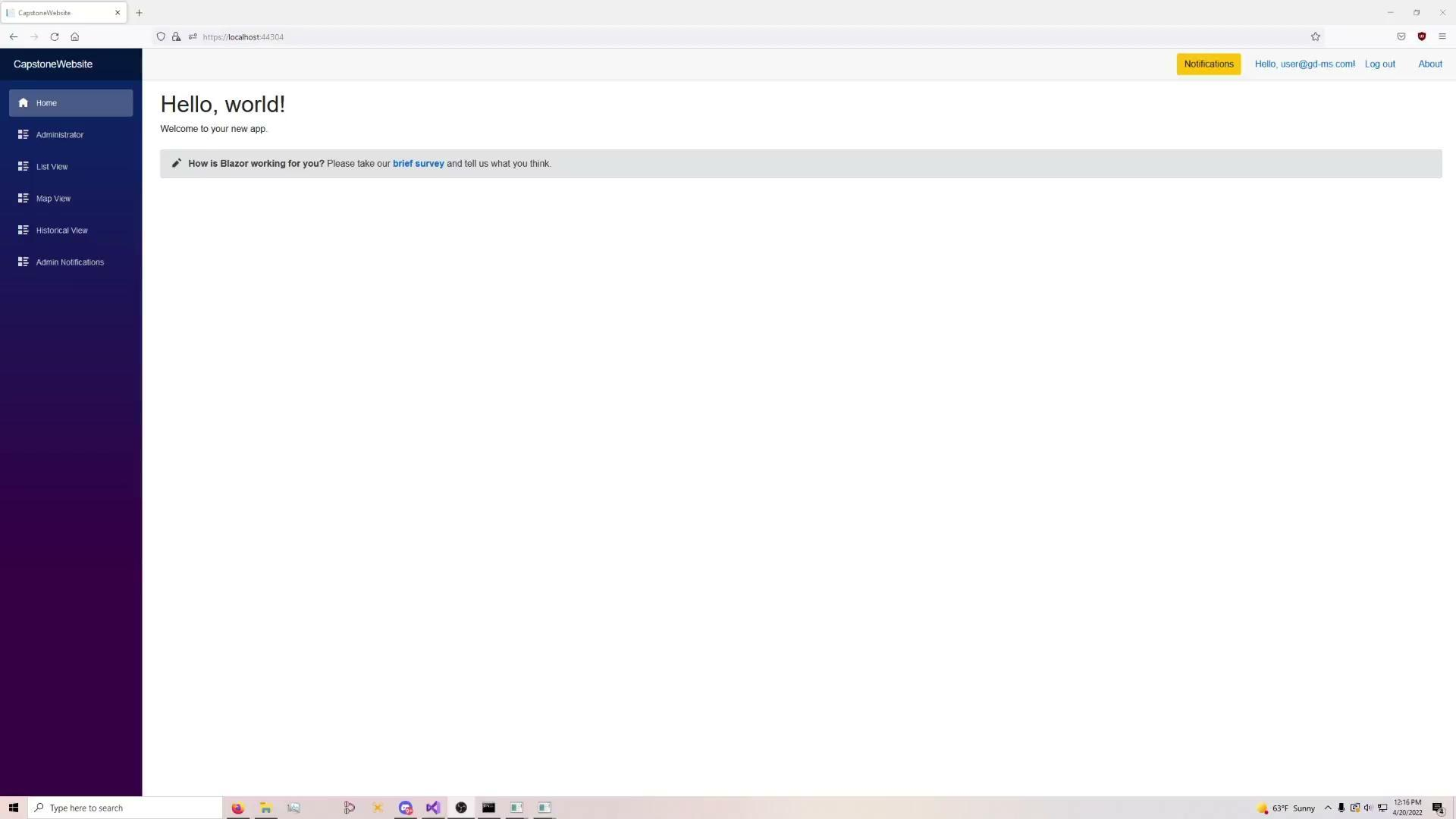
Administrator: Command Prompt

```
Microsoft Windows [Version 10.0.19044.1586]
(c) Microsoft Corporation. All rights reserved.

C:\WINDOWS\system32>cd C:\Users\Dylan\Desktop\Github Repos\Fall-2022-SARCI

C:\Users\Dylan\Desktop\Github Repos\Fall-2022-SARCI>Orchestra.bat 1
```

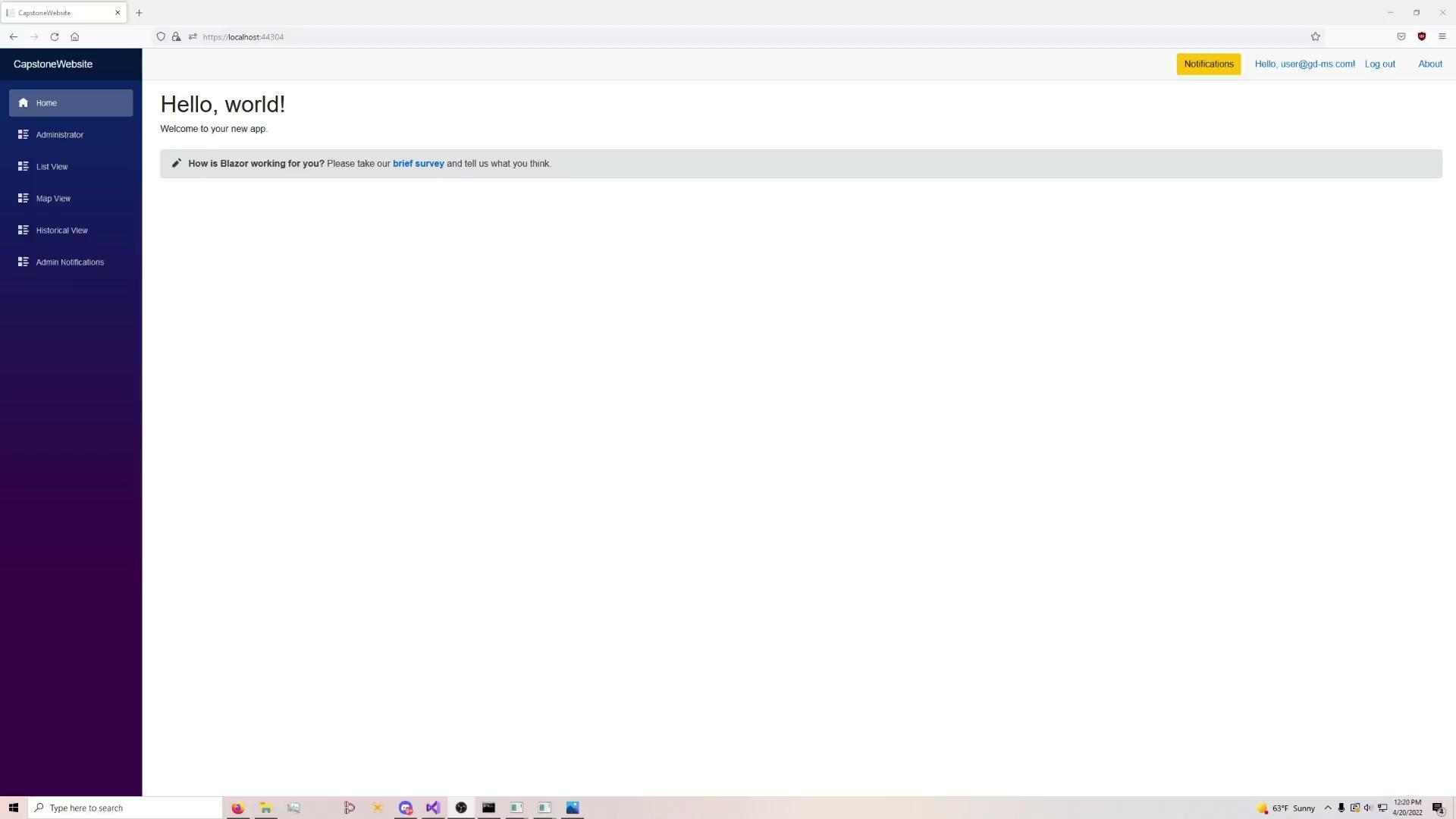
Identity Functionality - Logging in & Logging out


CapstoneWebsite
https://localhost:44304
CapstoneWebsite
Register
Log in
About
Home
Administrator
List View
Map View
Historical View
Admin Notifications
You're not logged in.
Type here to search
53°F Sunny
9:09 AM
4/21/2022

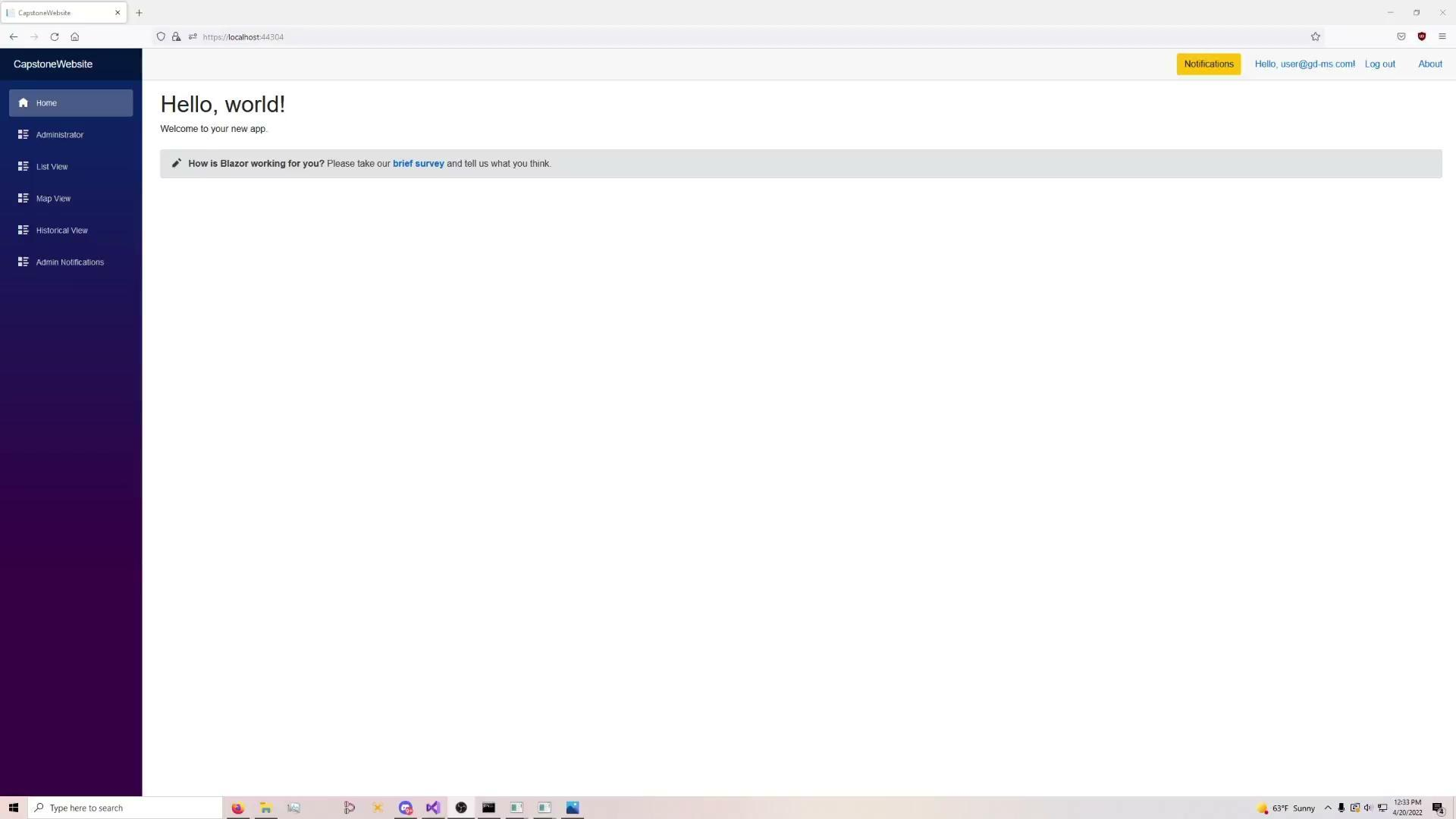
List View


CapstoneWebsite
https://localhost:44304
CapstoneWebsite
Notifications
Hello, user@gd-ms.com!
Log out
About
Home
Administrator
List View
Map View
Historical View
Admin Notifications
Hello, world!
Welcome to your new app.
How is Blazor working for you? Please take our brief survey and tell us what you think.
Type here to search
63°F Sunny
12:16 PM
4/20/2022

Map View


CapstoneWebsite
https://localhost:44304
CapstoneWebsite
Notifications
Hello, user@gd-ms.com!
Log out
About
Home
Administrator
List View
Map View
Historical View
Admin Notifications
Hello, world!
Welcome to your new app.
How is Blazor working for you? Please take our brief survey and tell us what you think.
Type here to search
63°F Sunny
12:20 PM
4/20/2022

Historical View - Line & CSV Exporting


CapstoneWebsite
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CapstoneWebsite
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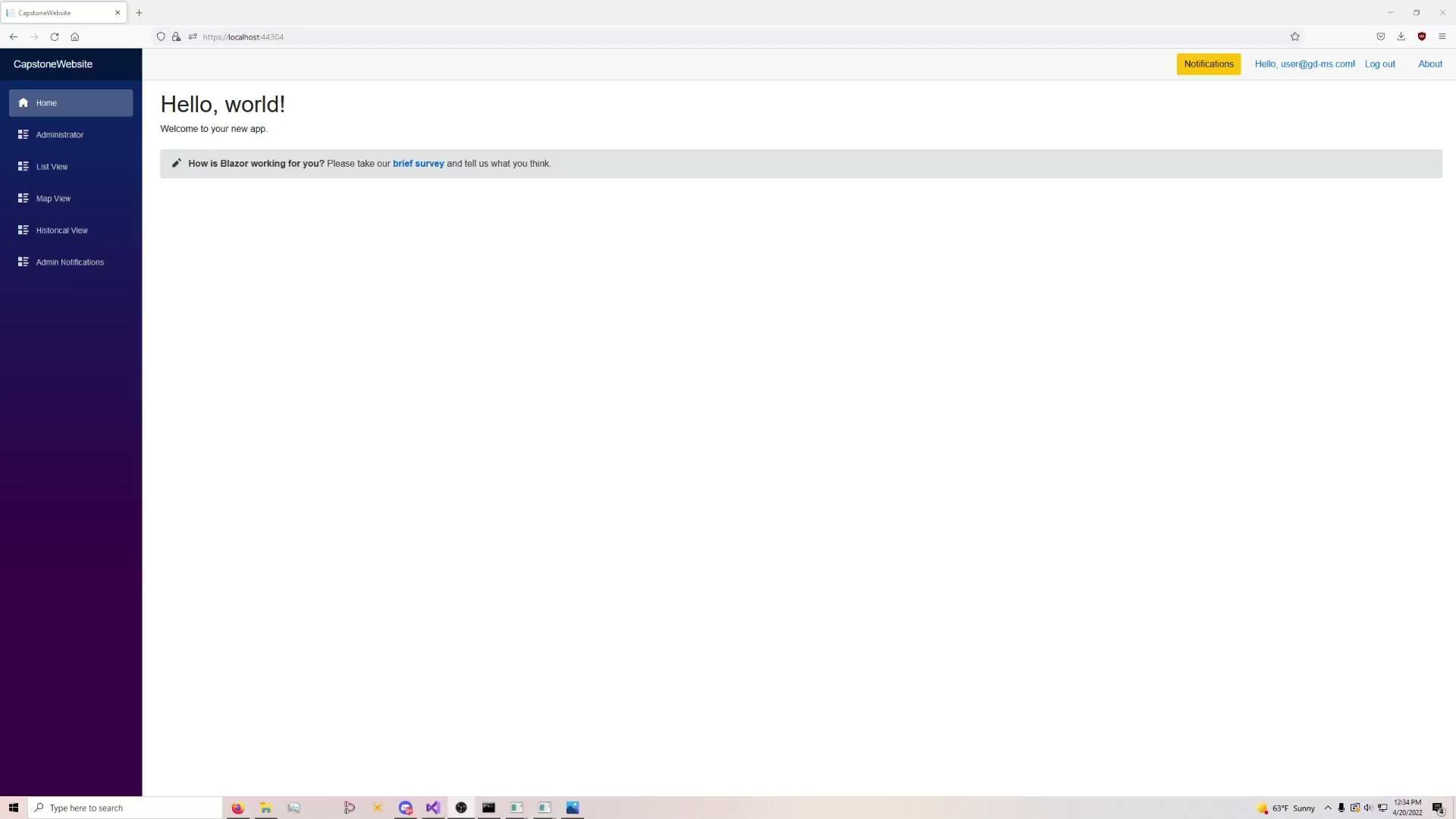
Type here to search
63°F Sunny
12:33 PM
4/20/2022

Historical View - Bar Graph


CapstoneWebsite
https://localhost:44304
CapstoneWebsite
Notifications
Hello, user@gd-ms.com!
Log out
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Hello, world!
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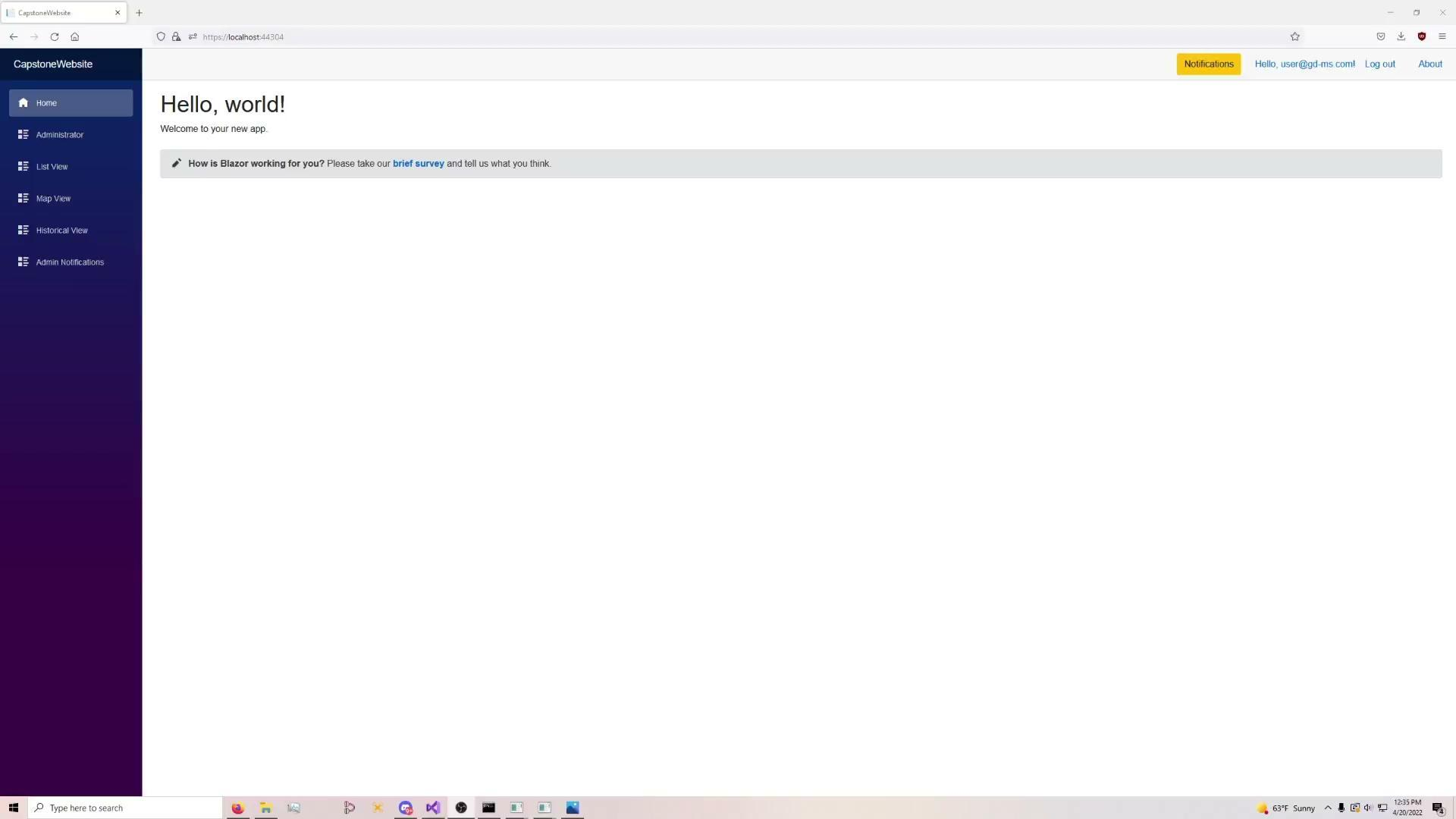
Type here to search
63°F Sunny
12:34 PM
4/20/2022

Historical View - Radar Graph


CapstoneWebsite
https://localhost:44304
CapstoneWebsite
Notifications
Hello, user@gd-ms.com!
Log out
About
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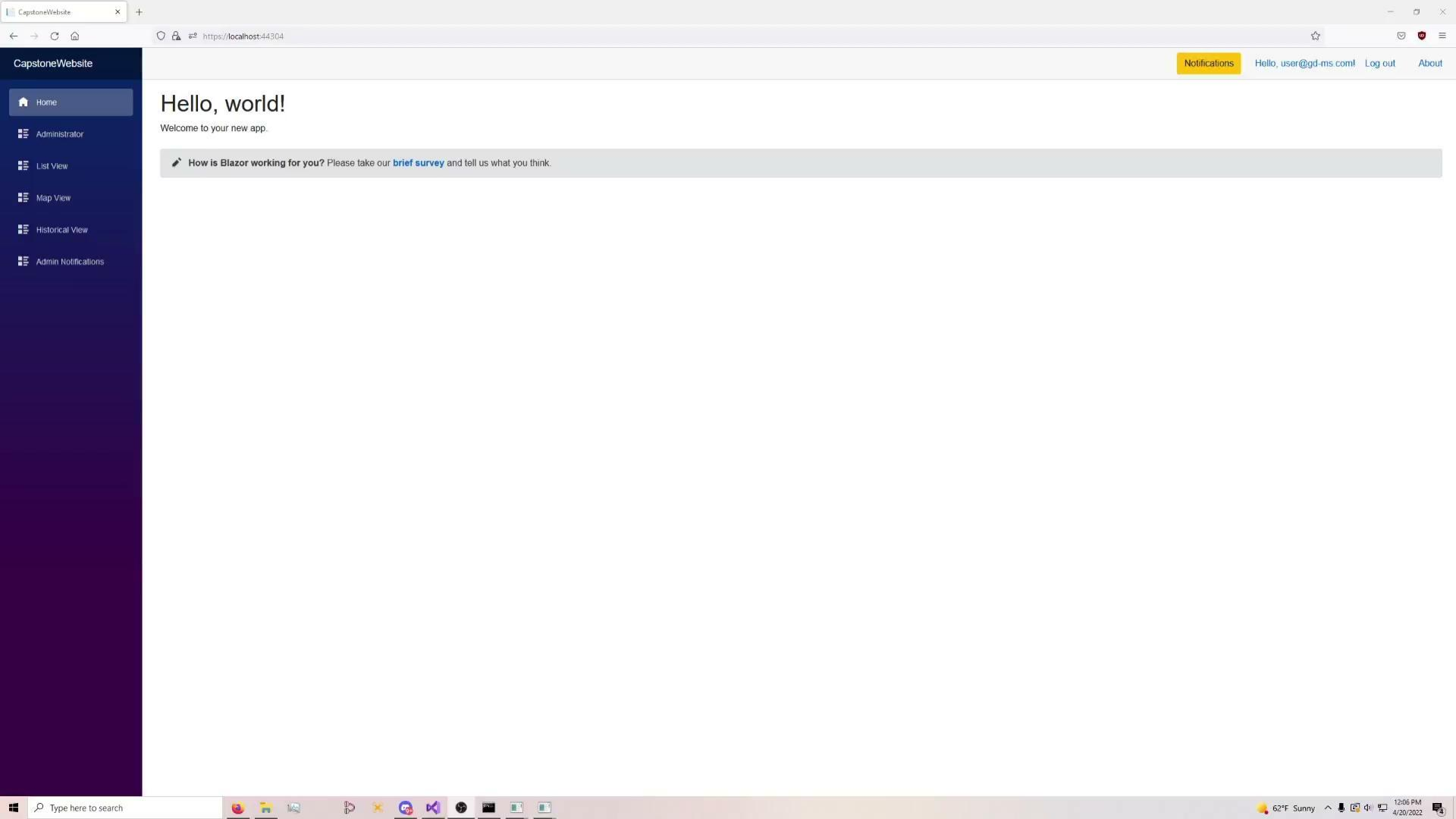
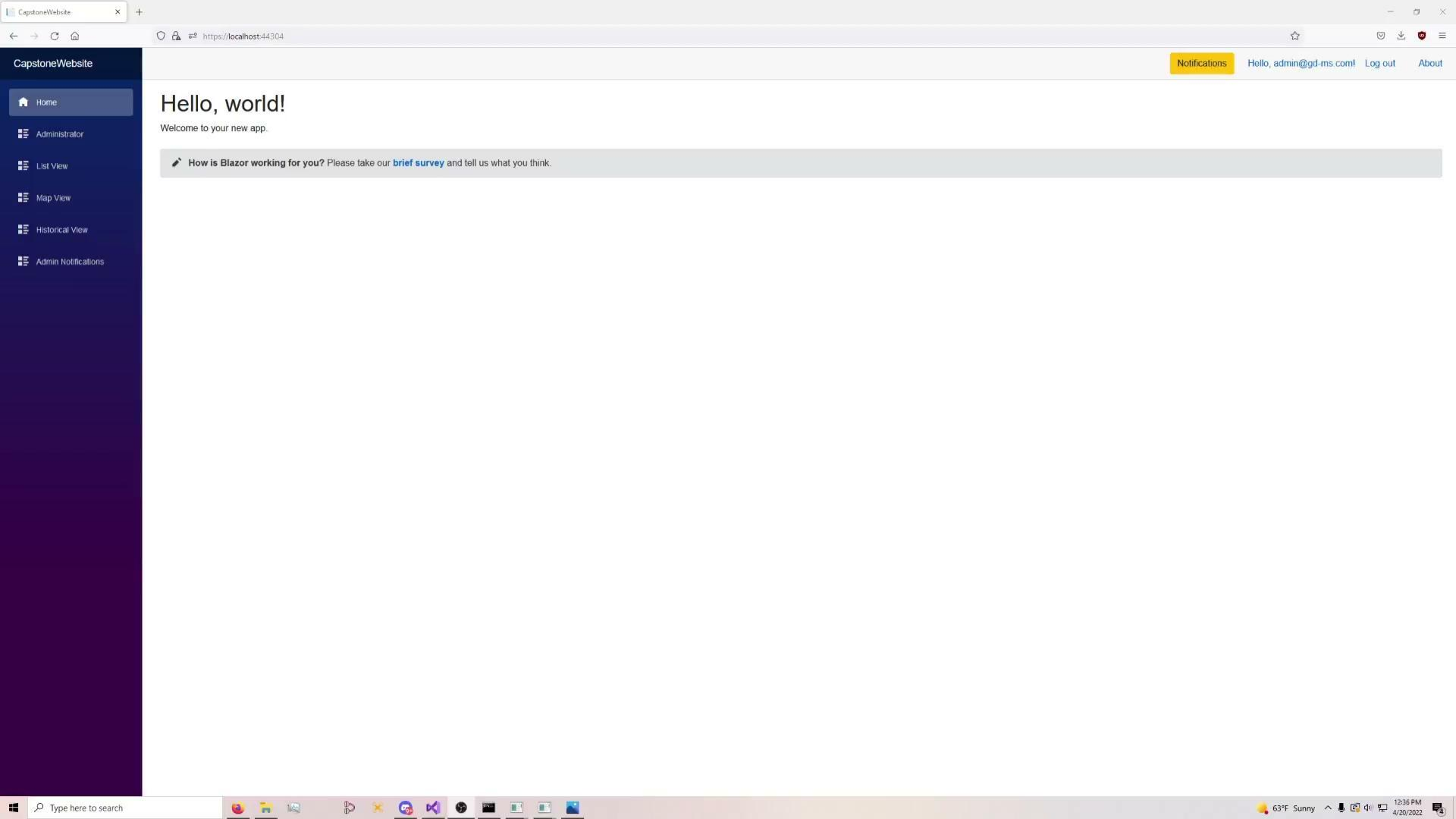
Administrator
List View
Map View
Historical View
Admin Notifications
Hello, world!
Welcome to your new app.
How is Blazor working for you? Please take our brief survey and tell us what you think.
Type here to search
63°F Sunny
12:35 PM
4/20/2022

User Notification View


CapstoneWebsite
https://localhost:44304
CapstoneWebsite
Notifications
Hello, user@gd-ms.com!
Log out
About
Home
Administrator
List View
Map View
Historical View
Admin Notifications
Hello, world!
Welcome to your new app.
How is Blazor working for you? Please take our brief survey and tell us what you think.
Type here to search
62°F Sunny
12:06 PM
4/20/2022

Admin Notification View

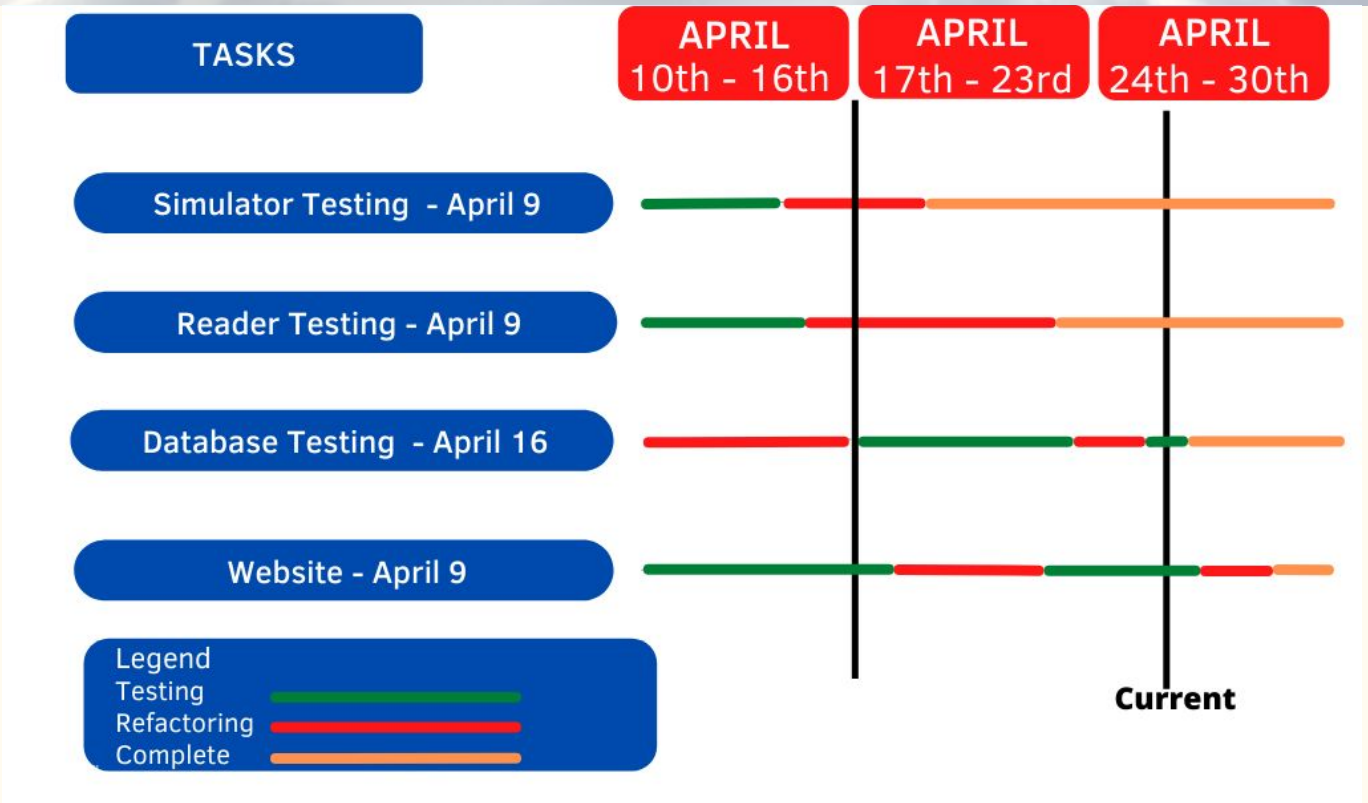

CapstoneWebsite
https://localhost:44304
CapstoneWebsite
Notifications
Hello, admin@gd-ms.com!
Log out
About
Home
Administrator
List View
Map View
Historical View
Admin Notifications
Hello, world!
Welcome to your new app.
How is Blazor working for you? Please take our brief survey and tell us what you think.
Type here to search
63°F Sunny
12:36 PM
4/20/2022

Challenges & Resolutions: Permissions

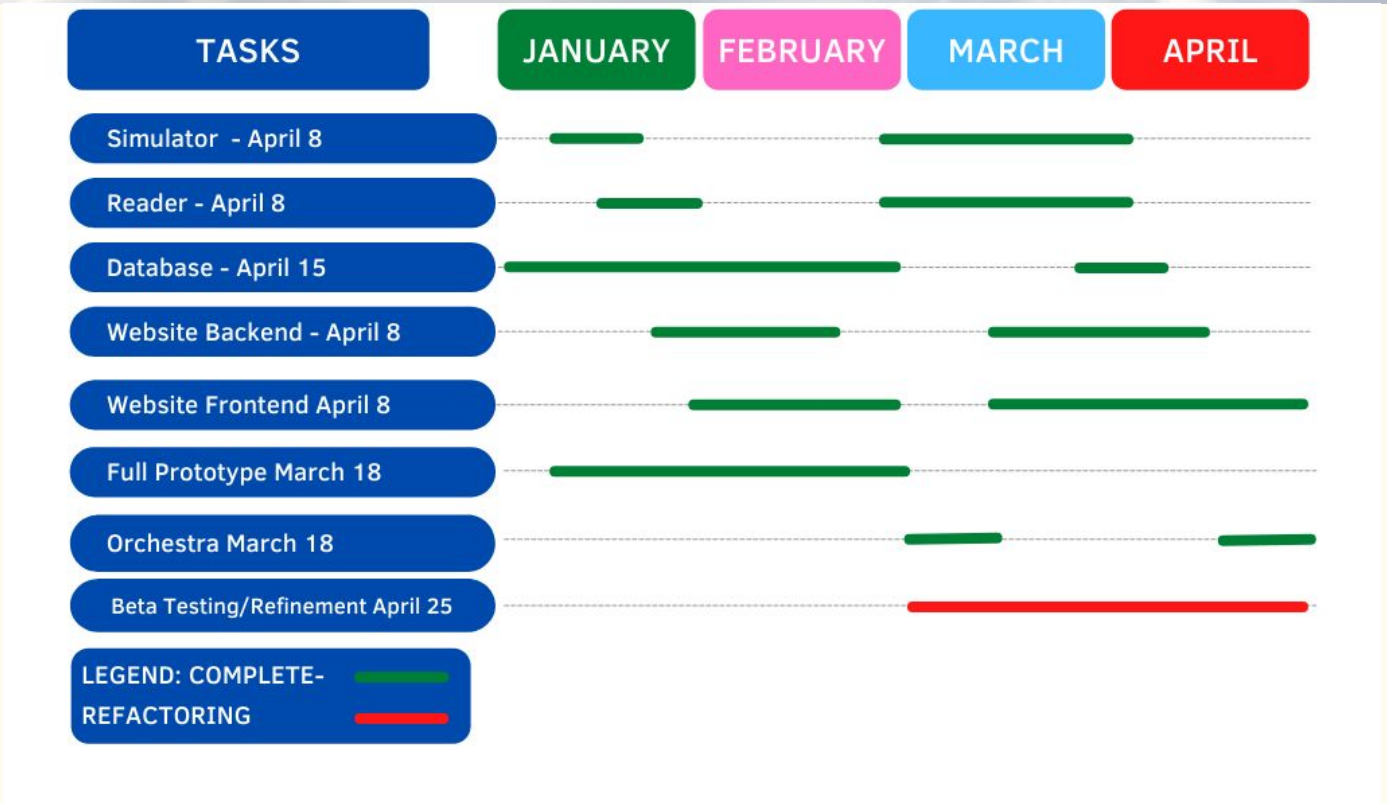
Inadequate research into packages:

- Caused set back due to delays caused from finding alternative solutions
- **Solution:** Find an open source solution or create custom solutions through .NET packages.
- EX: Tried using R for map view but it wouldn't import into Blazor Server. Found alternative after a month which involved using html maps, svg editing, and the Navigation Manager class.

Testing Plan



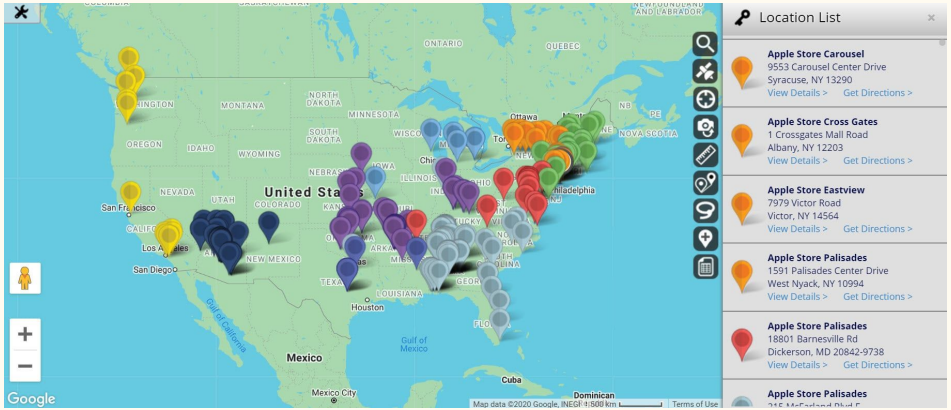
Schedule


TASKS
JANUARY
FEBRUARY
MARCH
APRIL
Simulator - April 8
Reader - April 8
Database - April 15
Website Backend - April 8
Website Frontend April 8
Full Prototype March 18
Orchestra March 18
Beta Testing/Refinement April 25
LEGEND: COMPLETE-
REFACTORING

Future Works

Version 2.0 Features

- Installing SWAPR devices at each RFF site
- Implementing Project into GDMS' architecture
  - Integration with...
    - Active Directory
    - Mapping Software
    - Hosting Services



Conclusion

- General Dynamics needs Weather and Antenna Power Data from RFFs
  - Predict Equipment Damage
  - Reduce Outage Time
  - Help with Maintenance Scheduling
- Our Project Builds:
  - Secure website with various graphical views
  - Architecture to collect and store data for website
- Deliver completed product by May 5th

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