Microgrid Data Platform Enhancements

Design Document

sdmay23-37

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Executive Summary

Development Standards & Practices Used

NIST SP 800-53:

This standard is a catalog of different Cyber Security Controls and their use cases. It is a rather flexible framework for establishing what an organization's needs are, and ensuring sufficient controls are in place. This framework will be useful when we assess the Solar Crate's current security posture, as well as for facilitating conversations with the client to determine areas for improvement.

IEEE STD 12207:

This standard provides a framework for the life cycle of creating software. This may be helpful as we progress from planning to implementation of our design.

IEEE STD 829:

This standard is concerned with the documentation of testing, including both software, hardware, and the interfaces connecting them. This will be helpful when we begin testing, as our design covers software and hardware, and we will need to ensure communication succeeds between them.

IEEE STD 830:

This standard describes the proper specification of software requirements. Since our project is heavily influenced by a client, this standard would be helpful to confirm that our design meets the given needs.

Summary of Requirements

Functional Requirements:

- **The web app should display historical data from microgrids.**
- **Ability to view data from following perspectives: 24 hrs, 7 days, month, year**
- **Ability to download data from graphs**
- **The system should restrict mirogrid viewing access to authorized users.**
- **The system should securely transmit data from the microgrid to the database and webserver.**
- **The system should collect and store data from microgrid sensors.**
- **The system should allow new components on the microgrid to send data to the database.**
- **The system should allow new microgrids to be added to the system.**
- **The system should query data from the solar crate every 1 minute.**
- **The web app should have functionality parity with the existing mobile app**

Resource Requirements:

- **The system shall use existing ETG computing resources.**

User Experience Requirements:

- **The web app should display the graphs from the micro grid in an easy and digestible format appropriate to its audience.**
- **The web app should display simplified data for public users.**
- **The web app should provide a more advanced breakdown for researchers.**
- **The system should be easy to navigate between different graphs and different components of the microgrid.**

Economic Requirements:

- **No budget allotted; Granted ETG computing resources**
- **The system shall utilize the existing Solar Crate.**

UI Requirements:

- **Our web app should be reachable from the Electric Power Research Center's website**
- **Needs an administrator page as well as public view**

Applicable Courses from Iowa State University Curriculum

- COM S 228 (Data Structures)
- COM S 327 / CPR E 288 (Advanced Programming / Embedded Systems I)
- SE 309 (Software Development Practices)
- COM S 363 (Database Management Systems)
- COM S 352 / CPR E 308 (Operating Systems)
- SE 329 / SE 317 (Software Project Management / Software Testing)
- CPR E 388 (Embedded Systems II)
- CYB E 230 / CYB E 231 (Cyber Security Fundamentals / Cyber Security Concepts and Tools)

New Skills/Knowledge acquired that was not taught in courses

- React
- Plotly
- Python
- NoSQL Databases

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1 Team

1.1 Team Members

Alexander Haack

Kenyon Fergen

Carson Love

David Harmon

Harvey Forchu

1.2 Required Skill Sets for Your Project

Backend Server Development - We will be updating and modifying the backend code to suit any API changes we need to make for the updated security measures.

Frontend Client Development - We will be updating the frontend of the microgrid from a mobile application to a web application.

Cyber Security Knowledge - We will be upgrading the security measures of the microgrid data retrieval system in order to protect user data and access rights.

Database Querying - We will be upgrading our database scripts to accommodate different microgrids.

1.3 Skill Sets covered by the Team

Backend Server Development - Alexander, David, Harvey, Kenyon

Frontend Client Development - Alexander, David. Harvey, Kenyon

Cyber Security Knowledge - Carson, Kenyon

Database Querying - Alexander, David, Harvey, Kenyon

1.4 Project Management Style Adopted by the team

We will be utilizing Waterfall + Agile as our project management style. We will use waterfall for the overall project, and agile for the cyber security portions of the project.

Waterfall works well for the overall project due to the preset requirements and expectations for the system. Additional frontend features for the web application and backend APIs to the current system are relatively well known and predefined.

Agile works well for the cyber security portion of the project due to the open ended nature of the requirement. It makes more sense to use an iterative approach to gradually increase the security of the project based on findings and changing priorities.

1.5 Initial Project Management Roles

Alexander: Software

Kenyon: Software/Cyber Security

Carson: Cyber Security

David: Software

Harvey: Computer

2 Introduction

2.1 Problem Statement

Our project is focused on gathering data from self-contained power stations known as microgrids, storing the data, and then presenting it for research, demonstration, and publicity on a web application. We are focused primarily on a specific microgrid called a solar crate owned by Iowa State University, which fits inside of a small shipping container. The data collected will be made available to microgrid administrators, researchers, and the general public. The groundwork for this project has already been developed by a prior senior design team (Senior Design Team 21 in Fall 2021 [sddec21-21]), and we will be building upon this foundation by upgrading the frontend from a mobile application to a web application, improving the security measures of the system, and enabling collection of data from more microgrids besides the solar crate owned by Iowa State University.

2.2 Intended Users and Uses

This product will be used by researchers, renewable energy enthusiasts, and microgrid administrators. They would be able to use our product to understand and further study the data collected by the microgrid, assessing if it works as intended, and finding out new data trends from it.

Microgrid Administrators: Microgrid Administrators will be more technical and interested in finer details than the other users. They will need to be able to make sure it is working correctly and be able to change settings. They will benefit from this by being able to fulfill this role remotely.

Researchers: Researchers are actively working on the solar crate. They need to see how efficiently the solar crate is converting energy and what devices are using more energy than others in order to make changes to the interior. This will allow for them to view information from the crate remotely so they can monitor energy levels more often.

Renewable energy enthusiasts: These individuals do not have any immediate cause of the need for the data, but are interested in understanding how the grid works, how it conserves energy, and how it is used to benefit the community. They would like to see how much energy is being processed and how efficiently the grid is working. The platform we create would be able to easily depict this information and provide them with other material they may be interested in.

2.3 Requirements & Constraints

Functional Requirements:

- **The web app should display historical data from microgrids.**
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2.4 Engineering Standards

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3 Project Plan

3.1 Project Management/Tracking Procedures

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Waterfall works well for the overall project due to the preset requirements and expectations for the system. Additional frontend features for the web application and backend APIs to the current system are relatively well known and predefined.

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Our team will be utilizing Git to version control our software development and to enable easy collaboration, and we will be using Discord as our primary form of communication to discuss important issues and plan out meetings.

3.2 Task Decomposition

- **Study existing Cassandra and Spring**
- **Change/implement Cassandra and Spring to suit project needs**
- **Design web application**
- **Design data collection scripts**
- **Prototype web application**
- **Prototype data collection scripts**
- **Edit APIs in existing backend to suit project needs**
- **Create frontend of web application**
- **Integrate graphs into frontend**
- **Identify and evaluate existing security posture**
- **Expand on existing security implementations and expand on further implementations.**

3.3 Project Proposed Milestones, Metrics, and Evaluation Criteria

Milestones:

- **Web app prototype**
- **All mobile app functionality transferred to the web app.**
- **Report of current security posture completed.**
- **All added/improved security and access control integrated into the system.**

3.4 Project Timeline/Schedule

Task	Timeline
Web app design	October 30, 2022
Data-collection script design	October 30, 2022
Study existing Cassandra and Spring	January 30, 2023
Identify and evaluate existing security posture	January 30, 2023
Web app prototype	January 30, 2023
Data-collection script prototype	January 30, 2023
Change/implement Cassandra and Spring to suit project needs	February 30, 2023
Edit APIs in existing backend to suit project needs	February 30, 2023
Create frontend of web-app	March 15, 2023
Integrate graphs into frontend	April 15, 2023
New Security Controls implemented	April 15, 2023

3.5 Risks And Risk Management/Mitigation

Risks	Probability	Severity	Total Risk
Solar Grid goes offline (breaks)	0-10%	Moderate	Low
Solar Grid goes offline (moved/scheduled maintenance)	40-60%	Moderate	Moderate
Security Breach - corrupting/manipulating data	0-10%	High	Low
Code lost to laptop crash	80-100%	Low	Moderate
ETG VMs go down	20-40%	High	Moderate

Mitigations

Risk	Mitigation
Solar Grid goes offline (breaks)	Use existing data for testing the project.
Solar Grid goes offline (moved/scheduled maintenance)	Be aware of planned downtime by the grid and plan around it.
Security Breach - corrupting/manipulating data	Backup our data to restore any lost/corrupted information.
Code lost to laptop crash	Push code regularly. Every time a feature is finished, push it. Work on separate branches to store progress without breaking other people's code.
ETG VMs go down	Restart VMs, be able to contact ETG for support if needed.

3.6 Personnel Effort Requirements

Task	Personnel Effort
Web app design	**3 hours**
Data-collection script design	**3 hours**
Study existing Cassandra and Spring	**5 hours**
Identify and evaluate existing security posture	**6 hours**
Web app prototype	**6 hours**
Data-collection script prototype	**6 hours**
Change/implement Cassandra and Spring to suit project needs	**8 hours**
Edit APIs in existing backend to suit project needs	**12 hours**
Create frontend of web-app	**40 hours**
Integrate graphs into frontend	**6 hours**
New Security Controls implemented	**40 hours**
Total	**135 hours**

3.7 Other Resource Requirements

- **ETG hosted VMs for backend**
- **Solar Crate**
- **Web frameworks/database frameworks**

4 Design

4.1 Design Context

4.1.1 Broader Context

Public Health/Safety/Welfare - **The Solar Crate can be used to promote Public Health when deployed in the event of an emergency. Getting electricity back online after a disaster is key to ensuring things like proper food preparation and adequate lighting and heating.**
Global/Cultural/Social - **As a society we are moving towards green energy sources. The shipping container microgrid could have been powered by a diesel generator, but instead it is solar to further investment in the area of green energy.** - **As a society we choose to set aside resources to prepare for emergencies. This crate is only possible because of this prioritization.**
Environmental - **This device utilizes solar panels, which have less environmental impact when running. Micro grids also have the potential to reduce resource investment in power lines if the generation and consumption are closer together.**
Economic - **When deployed in the event of a disaster, this crate has the potential to reduce economic damage and speed up recovery.** - **The majority of the crate's life will be spent not deployed in a disaster. With that in mind, the publicity and research use of the crate allows it to provide value outside of this rare circumstance.**

4.1.2 Prior Work/Solutions

A previous senior design team, sddec21-21, created a mobile application with the same purpose as our project. The problem with having a mobile application was the inconvenience of only being able to access the site through one platform. With a web application, it can be reached from any device with internet access. The previous project was able to narrow down the options of a backend and database, choosing to use a non-relational, NoSQL database for better scalability in the long run.

One con of our project being a web application as opposed to a mobile application will be portable accessibility. This means that it will be somewhat more difficult for our users to access the data they want from our system, as they will need to access it from the web instead of simply opening it up as an app on their phone.

The prior project also had limited security considerations in its design. Our design is focused on improving upon the existing security within the prior project and making the connections more secure.

4.1.3 Technical Complexity

Components/Subsystems:

- **Microgrid container**
- **Python data collectors**
- **Cassandra Database**
- **SpringBoot Backend server**
- **Web-based Frontend**

We have full-stack interactions between each of these components and subsystems, where the Microgrid container has a variety of different sensors and devices (e.g. Tesla Wall, Solar Panels, Sensors) attached to it which we must interface with. We interface with these subsystems within the Microgrid container via data collectors written as Python scripts. Connecting between the frontend and the backend components requires networking principles.

In addition to the full-stack interactions between these components, we have to apply authentication and modern cyber security practices to these layers to ensure that none of the data can be manipulated or stolen. This ensures that the data is accessed only by authorized personnel.

Our solution must ensure that we have secure data transmission over two different connections. First, from the various micro grids (e.g. SolarCrate) to the backend server, and then again to the front end web clients. This increases our potential attack surface and requires heightened security as a result.

The final portion of our project requires us to graph the output of the microgrids onto the web application for others to see and understand. This will require processing the data and displaying it in an easy and accessible format.

4.2 Design Exploration

4.2.1 Design Decisions

1. **What web framework to use?**
2. **What database to use?**
3. **What graphing framework to use?**

4.2.2 Ideation

React		
HTML/Javascript	Web Framework	
Wordpress/Wix/Other online framework	Angular	Vue

- **React - JavaScript based frontend framework created by Facebook with simple hooks and well documented**
- **Angular - JavaScript based frontend framework created by Google with well defined class structure and well documented**
- **Vue - Independent JavaScript based frontend framework**
- **HTML/JavaScript - Create the web app using JavaScript and HTML but without a bespoke framework**
- **Wordpress/Wix/Other online framework - Create the web app with minimal code by using third party website builder**

4.2.3 Decision-Making and Trade-Off

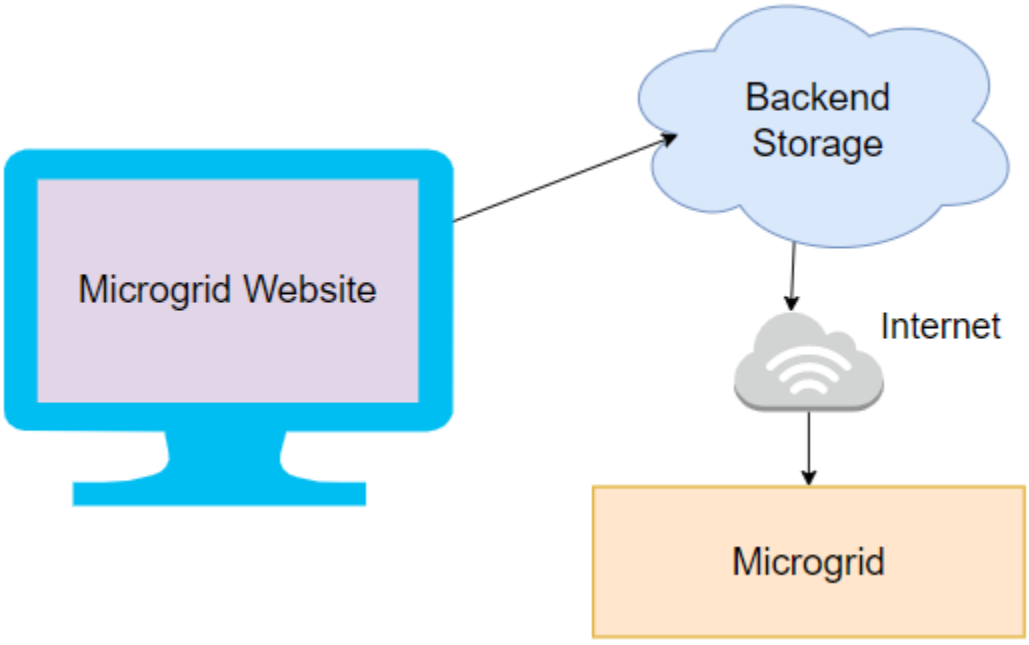
Web Framework Decision Matrix

Criteria	Weight	React	Angular	Vue	Pure HTML/JS	Wordpress/ Other website-builder
Ease of Implementation	0.3	4	3	3	1	3
Flexibility/Customizability	0.3	5	5	5	5	1
Prior Experience/Knowledge	0.4	4	4	1	3	1
Totals	1.0	4.3	4	2.8	3	1.6

We chose to use a decision matrix to determine the best design options because of the ability to make a choice based on what we believed were the most important attributes. We chose features that we wanted our ideal framework to include and weighted them based on the impact each would have on the outcome of our project. We wanted to stick with a framework we were familiar with, but also wanted to make sure another option wouldn't be better, so this was able to show us a ranking of each option we considered based on what we valued.

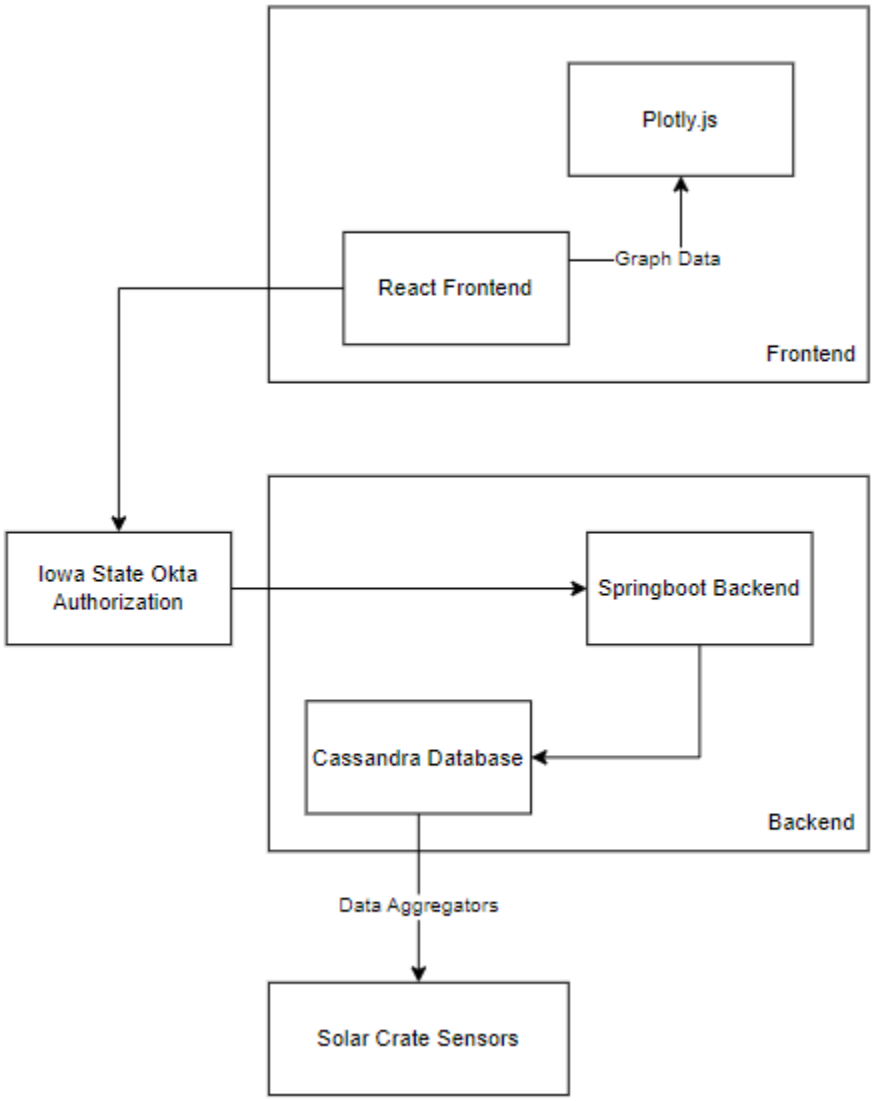
4.3 Proposed Design

4.3.1 Overview



Our web application's design consists of a frontend and backend, along with the physical ISU EPRC Solar Crate. The backend communicates with sensors on the Solar Crate to store information about efficiency and power usage on the cloud, which is then displayed by the frontend of the website for users to see and interact with.

4.3.2 Detailed Design and Visual(s)



We will have a React-based frontend that interacts with a Spring Boot backend. Our data is stored within a Cassandra database, which grabs data from the microgrid via Python script data aggregators.

The React-based frontend will rely on using Plotly.js to display the requested data in graph format. Users on our site will be able to browse as the general public without needing to sign in, or they will be able to sign in as a researcher or an operator. Signing in as these roles will allow them to view restricted information not available to the general public. Upon user request, the frontend will query the backend for information about a particular microgrid and then display that information in graph form using Plotly.js.

The Spring Boot backend will interface between the frontend and the Cassandra database, processing API calls from the frontend to produce a database query that will produce the requested data. The backend will then translate that retrieved raw data into more refined values, depending on what the user requested specifically, and then send the response back to the frontend to be displayed. During this process, the backend will authenticate the user to verify that the requested data is either viewable by the general public, or that the user is an authenticated researcher/operator recognized by our system.

The Cassandra database will store the different types of microgrids connected to the system and their respective data that gets produced. Cassandra is a non-relational, NoSQL database that allows dynamic and flexible schema definitions, so the backend can query for any available data that the microgrid has available and store it in the Cassandra database, regardless of what other data we are/are not storing from other microgrids.

Finally, the Python data aggregators will periodically query for data from the microgrids themselves and then insert the data into the Cassandra database to their respective tables.

4.3.3 Functionality

There are two major user groups, and with that two use cases:

1) **General Public**

One of the purposes of the solar crate is to raise public awareness of solar microgrids. The public will reach our site either by navigating to it from the Electric Power Research Center's site, or when interacting with the crate while on display. The home page of our site will provide basic information with regards to the crate. There will also be navigable tabs for users to learn more about specifics like live performance data. Information that is accessible to unauthorized users will be kept simple and high level.

2) **Researchers/Operators**

Another purpose of our site is to assist researchers and operators that regularly interact with the crate. Once authenticated, our site will provide more verbose information collected from the crate. Researchers/Operators with quick questions can use the different dynamic graphs to focus on interesting data. These graphs can also be used for reporting purposes. Authenticated users will also be able to download data to be used offline with other analytical tools.

4.3.4 Areas of Concern and Development

The current design is set up to provide our client with a web frontend they want in order to visualize the data from the microgrid. Our design is ensuring data can be pulled from the grid into a database which our backend will pull from and send to the frontend to create a visualization for our client.

One aspect that concerns us is whether the current backend and database set up is able and sufficient enough to handle all the necessary data and sort them into the necessary categories. We plan to test the backend and database to ensure it works as intended, and write python scripts to address APIS not meeting requirements.

A question we have for the client is what kind of data are they interested in viewing from the microgrid? Which of the information getting pulled form the microgrid would be classified as vital, nice-to-have, and unnecessary?

4.4 Technology Considerations

For the frontend framework our group has chosen to use React. React's strengths include its ease of use and reduced workload compared to a html/javascript solution, its increased flexibility compared to a website building service such as wordpress or wix, and its native support for more complex functionality. One trade-off for this is it requires a bit more experience to use and can be a little more difficult for initial setup, but this is offset by our group already having experience with React.

Our group plans to use Okta for login and authentication. Okta is a secure method for authentication and is easier to use for a project than creating our own login system. It also has the advantage of our app potentially being integrated with Iowa State University's Okta login for easier use by users. One downside to this is our app would need to be approved by ISU for use with their Okta and this is not guaranteed and can't be decided until they can review the code for our application. If this is the case we may need to use an alternative such as building our own login system or using our own instance of Okta.

For the backend framework our group is planning to continue to use and modify as needed the existing Java Spring backend. Java Spring is a flexible and robust framework for providing APIs to the frontend. Working with the existing code also has the advantage of allowing time to be focused on other systems.

Our group is planning to continue using Cassandra for our database as well. Cassandra is a NoSQL database whose strengths include scalability, accessibility, and easier querying, especially with less organized data. Its weaknesses are that its data can be less organized and atomicized, and that it is harder to migrate its data across databases. These tradeoffs make sense for our project since we will have large amounts of data from potentially several microgrids, which may have different types of data to share, and are offset by our use of only a centralized database to increase data atomicity.

Graphing in our project is going to be handled by Plotly.js. Strengths of Plotly include a library for Plotly to work with React and a high degree of customizability in order to support different types of microgrids. One weakness of Plotly is that it is not the fastest graphing library available, however this is offset by its increased customizability and not needing to render multiple graphs simultaneously, or a large number of datapoints.

4.5 Design Analysis

For future implementations, we will be testing the current APIs built in the backend and write/adjust them to meet client expectations. While working on the backend, we will begin working on a general frontend and graph outlay which will be fully integrated with the backend once it is complete.

5 Testing

The testing plan should connect the requirements and the design to the adopted test strategy and instruments. In this overarching introduction, given an overview of the testing strategy and your team's overall testing philosophy. Emphasize any unique challenges to testing for your system/design.

In the sections below, describe specific methods for testing. You may include additional types of testing, if applicable to your design. If a particular type of testing is not applicable to your project, you must justify why you are not including it.

When writing your testing planning consider a few guidelines:

- **Is our testing plan unique to our project? (It should be)**
- **Are you testing related to all requirements? For requirements you're not testing (e.g., cost related requirements) can you justify their exclusion?**
- **Is your testing plan comprehensive?**
- **When should you be testing? (In most cases, it's early and often, not at the end of the project)**

5.1 Unit Testing

- **Aggregators**
  - **We will utilize unittest, a Python unit testing framework for testing our Python data aggregators. unittest will allow us to mock and fake calls to the microgrid in order to test functionality of the aggregators themselves and how they are prepared to be stored into the database.**
- **Backend API**
  - **We will be unit testing our backend APIs that our frontend will interact with. We will want to test underlying functionality of the microgrid data processing without interacting with the database level or the frontend calls. We will utilize JUnit and Mockito for mocking and testing the retrieved microgrid data and transforming it into readable and presentable data based on specific search parameters and filters.**
- **Frontend/React**
  - **We will be unit testing our React components using a combination of React Testing Library and Jest. Jest will allow us to mock React components by rendering them without their child components. React Testing Library will allow us to test the functionality of the components themselves. This will be useful when mocking out and testing our graphing components so they have all the correct information being included and displayed when provided certain properties related to filtering and authorized account type.**

5.2 Interface Testing

- **Frontend/React to Backend API**
  - **To test that the frontend of the web application is able to interact with the backend API we can use Postman to simulate the frontend to query the backend to test the response from the backend API. We can also use postman to stand in as a backend for the frontend web application to query in order to test that the queries are being formulated correctly.**

5.3 Integration Testing

- **Frontend to Backend API**
  - **We will use JUnit and Spring Boot's MockMVC to test the backend API calls from the frontend. MockMVC will allow us to simulate the calls to ensure that the frontend is properly connected to the backend and displays the appropriate data.**
- **Backend API to Database**
  - **We will use JUnit and Mockito to test the backend web server's interaction with the database. The database calls will be mocked with Mockito, which will ensure the backend can access and interact with the database.**
- **Aggregators to Database**
  - **We will use the Python testing framework unittest to test that the aggregators can access and interact with the database. We will verify that data can be properly input into the database following grabbing data from the microgrids.**

5.4 System Testing

- **Aggregation System Testing**
  - **Our System testing will involve testing the frequency of the aggregators accessing the microgrid and then storing it into the database. This will primarily involve the unit tests and integration tests specifically related to the Python data aggregators in conjunction with the database.**
- **Full-stack System Testing**
  - **Our system testing will also involve testing the interaction of grabbing various specific data related to different components of the microgrid stored within our database, processing it in the backend, and then displaying the desired information on our frontend. Our system testing will not specifically test the visual aspects of the data but will verify that the expected data has made its way to the frontend from the database.**

5.5 Regression Testing

For regression testing we plan on configuring the CI/CD pipeline within GitLab to run the existing unit tests and ensure that they continue to function as expected. Our project doesn't have any critical features however having components such as the backend API offline could create problems for other components so this regression testing will allow us to only build versions of the software that are working.

5.6 Acceptance Testing

We will hold meetings with our advisor every other week to showcase our finished implementation of the design and functionality as it appears on the frontend. This time will be used to demo new features or functionality that we have added to the application in terms of processing microgrid data, applying certain filtering, applying various permissions based on public users versus authorized users, or displaying specific graphs for different types of microgrid data. In addition, this time will be used to verify the design and styling of the application is pleasing and satisfactory to our client.

5.7 Security Testing

With security being a big part of the initial ask for this project, performing proper security testing is a high priority. We are tasked with assessing the current security posture of the Solar Crate and based on our findings refining the security. As such, we will split security testing into two groups: Initial and Ongoing.

5.7.1 Initial Security Testing

In order to assess the initial security of the Solar Crate, we will use a combination of provided documentation and open source tools. The provided documentation will inform us on what assets exist so we ensure full coverage of the tests. We will then perform the actual testing using an Operating System called Kali. Kali has a bunch of open source tools that are useful for tasks like scanning networks and testing web applications. Results from the initial security test will be compiled into a report for the client.

5.7.2 Ongoing Security Testing

Security is an ongoing process, and as such it is necessary to consider security as we build out new features. Ideally security flaws will be caught by individual expertise and open communication while a product is being created. However, this is not always the case. In order to ensure a secure final product, our group will make use of a peer review system. Before a new feature is pushed out to production, at minimum one other group member must review it for both functionality and security.

5.8 Results

As of 1st December 2022, we have yet to implement, and thus have yet to test. It is expected that the initial security testing (5.7.1) will be one of the first testing results to be reported, followed by unit testing (5.1) and interface testing (5.2). These results should be available starting January 2023.

6 Implementation

Our planned timeline for implementation is available in section 3.4. All activities with regards to implementation as of 1st December 2022 are inseparable from design. Refer to section 4.

7 Professional Responsibility

This discussion is with respect to the paper titled " Contextualizing Professionalism in Capstone Projects Using the IDEALS Professional Responsibility Assessment", *International Journal of Engineering Education* Vol. 28, No. 2, pp. 416–424, 2012

7.1 Areas of Responsibility

Pick one of IEEE, ACM, or SE code of ethics. Add a column to Table 1 from the paper corresponding to the society-specific code of ethics selected above. State how it addresses each of the areas of seven professional responsibilities in the table. Briefly describe each entry added to the table in your own words. How does the IEEE, ACM, or SE code of ethics differ from the NSPE version for each area?

Table 1. The seven areas of professional responsibility in the assessment instrument

Area of responsibility	Definition	NSPE Canon
Work Competence	Perform work of high quality, integrity, timeliness, and professional competence.	Perform services only in areas of their competence; Avoid deceptive acts.
Financial Responsibility	Deliver products and services of realizable value and at reasonable costs.	Act for each employer or client as faithful agents or trustees.
Communication Honesty	Report work truthfully, without deception, and understandable to stakeholders.	Issue public statements only in an objective and truthful manner; Avoid deceptive acts.
Health, Safety, Well-Being	Minimize risks to safety, health, and well-being of stakeholders.	Hold paramount the safety, health, and welfare of the public.
Property Ownership	Respect property, ideas, and information of clients and others.	Act for each employer or client as faithful agents or trustees.
Sustainability	Protect environment and natural resources locally and globally.	
Social Responsibility	Produce products and services that benefit society and communities.	Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

Area of Responsibility	Code of Ethic: "Seek, accept, and offer honest criticism"
Work Competence	This code will be useful in ensuring that we are putting forth our best work, and getting feedback on areas we can improve on
Financial Responsibility	Offering our honest opinion is a guide to make sure we are not exploiting our stakeholders
Communication Honesty	This code ensure that we are honest in our communication, and make others feel safe sharing their opinions
Health, Safety, Well-Being	Providing honest critics includes giving heads up and warnings where necessary if we notice something might become a health or safety hazard

Property Management	**This code guides us to call out and be honest about any acts that might lead to destruction of property**
Sustainability	**Seeking and accepting criticism can help us find and implement more sustainable methods in our project**
Social Responsibility	**This code calls us to be honest and seek feedback, which can entail learning how to account better to our social surroundings**

7.2 Project Specific Professional Responsibility Areas

Area of Responsibility	Importance Level	Current Performance
Work Competence	**High. It is important for us to work to our strengths to achieve our goals**	**High. We've been working well together to each other's strengths to get our different tasks done**
Financial Responsibility	**Low. Our project does not involve any financial commitments**	**Low. We are not expected to handle any finances**
Communication Honesty	**High. We need to communicate properly and be on the same page if we want to succeed**	**High. We talk a well with each other and communicate what is expected of one another**
Health, Safety, Well-Being	**Low. Our project does not create any health and safety hazards**	**Low. We haven't done anything so far that might cause a safety hazard**
Property Ownership	**Medium. We are responsible for the microgrid, and the data stored on it**	**Low. We haven't done anything that could jeopardize the grid or its data**
Sustainability	**Medium. We will need to use the microgrid carefully to preserve it for future use**	**Low. We haven't done anything with the microgrid yet that could jeopardize it**
Social Responsibility	**Medium. We will need to ensure that our product has good societal implications**	**Medium. We haven't worked on anything yet to hinder or improve our products societal impact**

7.3 Most Applicable Professional Responsibility Area

Work Competence is our most applicable area. We would like to complete the project we have in a timely manner, so focusing on our strengths will be important to maximize our work performance.

8 Closing Material

8.1 Discussion

So far in this project we have designed the web application and planned the implementation of our web application and cyber security upgrades. These plans and designs meet the requirements of the project as stated by our client and laid out in the requirements section of this design document.

8.2 Conclusion

Our goals with this project are to create a web application to show real time and historical information for multiple microgrid projects (such as the solar crate), allow administrators of the microgrids to change settings, and to increase the cybersecurity of the existing systems and the web application. So far we have designed the web application and planned the implementation of the project. In the next semester we will implement the web application and the increased cybersecurity as planned.

8.3 References

"Important Engineering Software/Hardware Design Standards." Software/Hardware Design Standards, 2012, http://users.encs.concordia.ca/~ecewebdv/EDS/Software/std_list.htm.

"App For Microgrid Demonstration Project." sddec21, 2021, https://sddec21-21.sd.ece.iastate.edu/.

"Digital Standards." *Iowa State University*, 20 Nov. 2018, https://www.brandmarketing.iastate.edu/digital-standards/.

8.4 Appendices

8.4.1 Team Contract

Team Members:

1) Alexander Haack
2) Carson Love
3) David Harmon
4) Harvey Forchu
5) Kenyon Fergen

Team Procedures

1.Day, time, and location (face-to-face or virtual) for regular team meetings:

Wednesdays at 4:15PM in Coover (or asynchronously)

2. Preferred method of communication updates, reminders, issues, and scheduling (e.g., e-mail, phone, app, face-to-face):

Discord + Email

3. Decision-making policy (e.g., consensus, majority vote):

Consensus

4. Procedures for record keeping (i.e., who will keep meeting minutes, how will minutes be shared/archived):

Individual notes when talking with the advisor/client.

We will take turns tracking meeting minutes.

Participation Expectations

1. Expected individual attendance, punctuality, and participation at all team meetings:

Attendance and punctuality are expected unless notified otherwise ahead of time.

2. Expected level of responsibility for fulfilling team assignments, timelines, and deadlines:

Everyone is expected to put in their best effort.

3. Expected level of communication with other team members:

Communicate regularly with the rest of the team when needing help. Allow 24 hours

response time. Respond within 24 hours.

4. Expected level of commitment to team decisions and tasks:

Everyone is expected to put in their best effort.

Leadership

1. Leadership roles for each team member (e.g., team organization, client interaction, individual component design, testing, etc.):

David: Software

Xander: Software

Kenyon: Software/Cyber Security

Carson: Cyber Security

Harvey: Computer

2. Strategies for supporting and guiding the work of all team members:

Discuss what needs to be done, and what steps need to be taken during team meetings, sharing the workload and assisting each other where need be.

3. Strategies for recognizing the contributions of all team members:

Discuss individual progress made during team meetings.

Collaboration and Inclusion

1. Describe the skills, expertise, and unique perspectives each team member brings to the team.

David: React and Fullstack experience

Kenyon: React and Fullstack experience

Xander: Fullstack and embedded

Carson: Threat Assessment and Security Controls

Harvey: React, backend experience

2. Strategies for encouraging and support contributions and ideas from all team members:

Go around and ask for input from each team member for their opinion/ideas on a problem/solution for a problem.

3. Procedures for identifying and resolving collaboration or inclusion issues (e.g., how will a team member inform the team that the team environment is obstructing their opportunity or ability to contribute?)

Bring up issues as soon as they arise so the team can adapt.

Goal-Setting, Planning, and Execution

1. Team goals for this semester:

A grade, gain experience working with other majors. Get a better understanding of the microgrid and how it holds/transmits data.

2. Strategies for planning and assigning individual and team work:

Work together in meetings to plan out and distribute the work evenly and based on each individual's interests/expertise.

3. Strategies for keeping on task:

Check in with each other during meetings to ensure that deadlines are met.

Consequences for Not Adhering to Team Contract

1. How will you handle infractions of any of the obligations of this team contract?

Talk to the team member and reason out why said infraction is happening.

2. What will your team do if the infractions continue?

Bring it to the notice of the project advisor, and then the professor if the individual is not willing to change.

****

a) I participated in formulating the standards, roles, and procedures as stated in this contract.

b) I understand that I am obligated to abide by these terms and conditions.

c) I understand that if I do not abide by these terms and conditions, I will suffer the

consequences as stated in this contract.

1) _____Harvey Forchu_____ DATE _____09/20/2022____

2) _____Alexander Haack_____ DATE _____09/21/2022____

3) _____Kenyon Fergen_____ DATE _____09/21/2022____

4) _____Carson Love_____ DATE _____09/21/2022____

5) _____David Harmon_____ DATE _____09/21/2022____

8.4.2 Figma Prototype