Project Proposal: Energy Demand

CARE

Creating and Revitalizing Energy

ACC 311 / CSC 315

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Problem Statement:

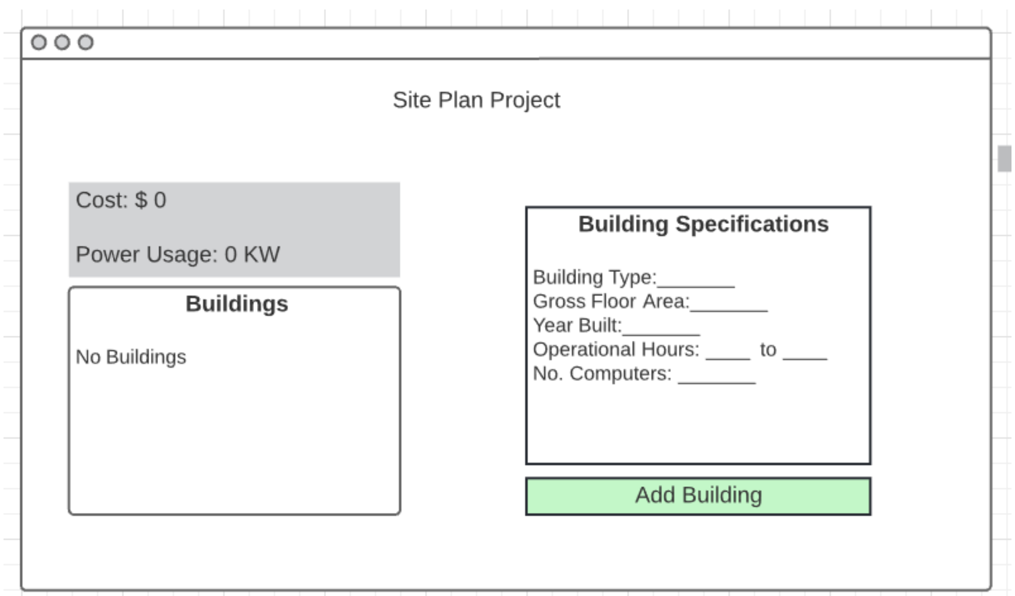
The College of New Jersey is attempting to become a genuine leader in higher education efforts to promote environmental sustainability. Our goal is to develop a tool that can be utilized by The College of New Jersey which enables the testing of different scenarios employing the concepts learned in cost accounting and computer science. Specifically, we want to develop a database that can determine the energy consumption of campus buildings on a Gross Square Footage basis as well as the carbon emissions of campus buildings on a Gross Square Footage basis, on both a site and source basis. By addressing these concerns, The College of New Jersey will be able to minimize its carbon footprint, better steward its resources, and provide environmental leadership on and beyond campus.

Module Objectives:

The objectives of the module include the implementation of a database with numerous innovative queries and entities that are large enough to require the effort of several persons' to be completed on time. Another objective enables different users with different levels of access to understand and use the module while providing an easy and simple way to use the web-based user interface. The model aims to discuss and solve the issues related to which buildings require the most energy use while also having the ability to portray a realistic outcome of additional buildings and modifications. The concerns the model is attempting to eliminate involve the economic and environmental strain on the community of The College of New Jersey. The module will capitalize on each member's experience, skills, interests, and background while also serving as a benefit to the college by allowing the use of energy detection, prevention and classification to occur.

Description*: *Desired End Product

Our database will be user-friendly, enabling users to enter in their energy data to find out the energy consumption of campus buildings on a Gross Square Footage basis as well as the carbon emissions of campus buildings on a Gross Square Footage basis, on both a site and source basis. With energy prices increasing but energy sources decreasing, we must look at where energy is being lost and where energy is being used on campus. Gaining knowledge and understanding on the growth and pattern of energy demand from the different campus buildings is needed to forecast future energy demand. Energy demand forecasting is imperative for ensuring future environmental security and economic growth.



(This image shows the basis of how our program will work in terms of the UI).

The program will start with no buildings in the building field and with cost and power usage at values of 0. The user may create new buildings by entering the specifications of the new building that they would like to add to the site plan. Once the user enters all the relevant information, they may click the ‘Add Building’ button. The building will then be added to the building list and the cost and power usage fields will be updated. The program will use the specifications added by the user in combination with the data held in the database to calculate the cost and power usage of the buildings in the building list. The user will also be able to select individual buildings to see the individual cost and power usage of a specific building as well as the total.

Description*: *Importance

Once the user has inputted the energy data, the database will provide the ability to create new buildings to get an idea of what it would cost as well as the emissions. A feature that allows the user to create multiple buildings by adding specifications of operational hours, building usage and building size will be implemented. Once this information is acquired, the application will be able to predict the energy consumption and emissions of the buildings individually and collectively. Additionally, the ability for users to create a map of the buildings to give the user additional usability of the application will be added to the database.

***Plan*:**

In order to identify the energy usage across campus, our program will be using building size, building use, building age, and operational hours. With the use of this information, the program can identify where energy is being used or lost most frequently and will give the user a better understanding of how he or she can create a positive impact on the environment. We are also going to take into account the site and source of energy usage, as well as the specific fuel emissions. By looking at the specific energy usage of buildings and different fuels involved, our program will be able to predict the energy demand cost and the different ways to minimize this cost plus the usage of energy. When all of this data is entered into the program, the user will be able to see the estimated energy usage and cost in an easily accessible and understandable manner.

***Similar Systems and Approaches*:**

The systems and approaches that exist include ENERGY Star Portfolio Manager which uses benchmarking to measure and compare the energy of a building to similar buildings, past consumption and a reference performance level. Benchmarking can identify underperforming buildings to target for efficiency improvements, identify best practices from efficient buildings, set investment priorities, verify savings and prevent snapback, earn recognition and share and report performance. Another system that exists is STARS; the sustainability, tracking, assessment and rating system. It is a transparent, self-reporting framework for universities and colleges to measure their sustainability performance. The main features of STARS are demonstrated in three sections consisting of reports, content display and a benchmarking tool. ESG Investing is also a similar approach because it involves the consideration of environmental, social and governance factors in financial analysis. The module we created is different and better than the systems and approaches listed above because not only will it be able to provide information on the current and/or past data within the database, but it will also be able to predict future trends if new buildings or structures are introduced to the campus. This can be used as a tool to gain a better understanding of how new buildings may affect the energy consumption or emission impact of the campus.

Possible Applications:

The main goal of our program is to predict cost and energy consumption for energy demand with the use of information about existing buildings and having the user “map out” their own design. We also want the user to be able to minimize this cost and the amount of energy used and lost. However, this is not the only way our program can be used. Another application of our system is for users to track their own personal energy consumption. Our program could be modified by creating a page where users can enter/log specific tasks and activities they performed in the building in order to see which tools and equipment in the building uses the least or most energy consumption. When users are notified of this, they can attempt to lessen their high energy consuming tasks in order to lessen their carbon footprint as well as the cost of energy.

Performance:

The database should have close to, if not completely, optimal performance due to the low amount of data entries. With fewer rows to run through, the database benefits from a simpler location process and fast retrieval. This low number also indicates that there will likely be enough memory in all situations for all the processes to run smoothly. A possible plan to further optimize the database's efficiency is to add indexes. With this, a certain attribute is treated as a key to a specific address that stores all the rest of the data, meaning that a search will automatically sort the data to immediately reach these keys. With the traditional query, the database would have to search through all rows before accessing the desired information.

Security:

The security features included in the database will consist of a dual factor authentication and antivirus protection. The dual factor authentication adds an extra layer of security by requiring the verification and identification of the user by issuing a randomized code for each attempt to access the database. The database will have antivirus software to prevent, detect, scan, and delete viruses from a device. The software will run in real time in the background of the database to prevent virus attacks. The College of New Jersey already utilizes dual factor authentication and has the ability to implement it to the database.

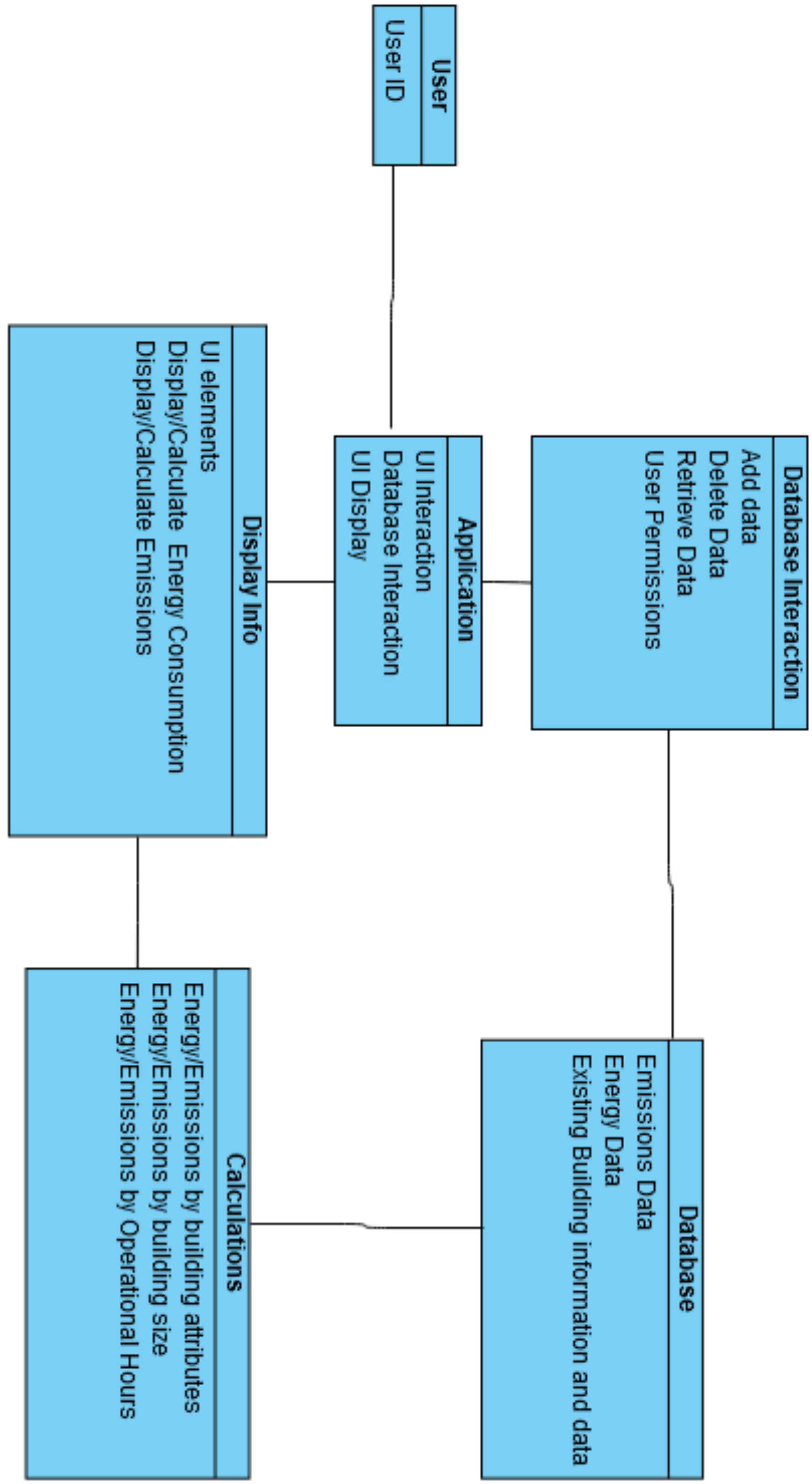
Backup and Recovery:

To backup on GitHub repository, BackHub will be used. By using BackHub, daily backups will be automated and repositories can be recovered with the associated metadata such as pull requests, projects, milestones, wikis, issues, releases, and more. Through BackHub, we are also able to keep an additional backup copy by syncing our backups to Amazon Simple Service Storage, or AWS S3. BackHub allows access to data anytime, even if GitHub is temporarily unavailable.

Technologies and Database Concepts:

Some of the technologies and database concepts the team will have to learn include: SQL DDL, SQL DML, entity-relationship diagrams, relationship schema, aggregation, composition, specialization/generalization, multiplicities, LucidChart. There is a familiarity with these concepts through computer science and information systems courses. The primary source for the technology aspect of creating the database will be the knowledge and experience of the team. However, outside resources are available including the professors and the Senior Director of Sustainability and Energy Management. In addition to the human power, there are also online resources that can be utilized such as Udemy and Coursera.

Diagrammatic Representation:



Quad Chart:

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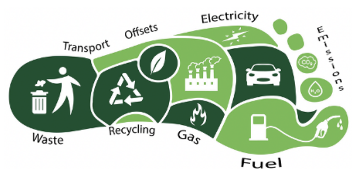
Need

- To determine energy usage and consumption in order to minimize carbon footprints and decrease cost spent on energy consumption
- Using an easily accessible and understandable program to determine energy usage and consumption

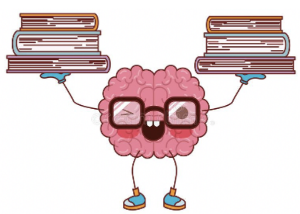


Approach

- The user can create a map and build new buildings in order to determine the specific costs and emission of energy consumption per building
- Users can recreate their current map to determine efficient ways of reducing energy consumption and costs without the need to adjust current layout

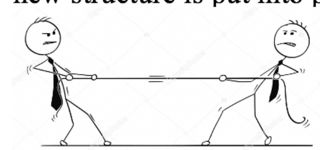
Benefit

- Education on energy usage and emissions as well as cost reduction
- Reducing their own carbon footprint/money spent on energy consumption



Competition

- By creating a map, the users can visually predict the cost and usage of their specific model and be able to grasp the concepts better
- The ability to not only have access to past energy consumption and emissions but also the ability to predict future energy consumption and emissions if a new structure is put into place



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