

Overpowered

Summer 2018

Walktime Error

Cynthia Khan, Ricky Le, Caio Melo, Sean Silva, Noah Yasarturk

6/8/18

Resumes

1. Cynthia Khan: Graduating Senior in the department of Computer Science at Georgia State University. I have selected Database & Knowledge Systems as my concentration and I find great interest in Data Science and System Automation topics. I have interned at Axiall Chemicals in Summer 2017 and was mentored by a Senior Database Administrator where I got exposure and hand-on experience on MS SQL Server databases. I currently work at Datascope, where I am modelling a visualization network, connecting their data to dynamic dashboards and generating reports from it. Outside of work I have also engaged myself in various voluntary projects relating to the concepts of Big Data, Data Mining and Machine Learning. I am confident in meeting the team's needs for Backend Development.
2. Ricky Le: I am a Senior at Georgia State University currently pursuing a Bachelor's Degree in Computer Science. I am undeclared in my concentration, however I have a strong interest in Hardware Systems. I am comfortable programming in Java, C, and UNIX Shell, and have a basic understanding of Python, C++, and Assembly (MASM). I have worked at the Mobile Cyber Physical Systems Lab as an intern doing research and development on Backscatter VLC on IoT Systems, and have experience working with microcontrollers, specifically Arduinos. My interest leans towards Electrical/Computer Engineering topics, specifically embedded systems and the Internet of Things.
3. Caio Melo: I am a Senior at Georgia State University pursuing a B.S. in Computer Science. I have experience with Java and Microsoft Office products. I'm currently in a marketing internship at Beecher Carlson, and I volunteer with Amazon's Mechanical Turks as a side income. I have beginner experience with MASM, Python, and HTML5. AI and botnet technologies fascinate me.
4. Sean Silva: I am a Senior at Auburn University who is currently pursuing a Bachelor's Degree in Software Engineering. My experience as far as programming goes is an adequate skill set with focus in Java, C++, and Python. I have worked minorly with other languages such as Ruby, Scheme and Prolog. Currently I am fascinated with game design and development as well as the robotics field. I have completed not only class assignments using Unity, but a couple personal projects as well. I currently work with a branch of my university's Office of Information Technology as a multimedia support member. From this work I have experience solving general IT problems that may arise in the audio and visual equipment of the classrooms. When it comes to my specific concentration, I am undecided as to what specific area of software engineering I want to focus on.
5. Noah Yasarturk: I am a Senior and Presidential Scholar at Georgia State University pursuing a B.S. in Computer Science with a concentration in Database & Knowledge Based Systems with a Math minor. I intend on pursuing a Master of Science in Analytics or Bioinformatics. I am proficient in R and Java primarily but am capable of using Python, C, and MASM (x86). I have a wealth of experience constructing UI in both Java

via the Swing package and in R. I have experience with text data mining algorithms as well as creating and analyzing a Twitter stream. I've worked as an undergraduate assistant for Dr. Cox here at GSU's Institute of Neuroscience investigating dendrite morphology in *Drosophila melanogaster*.

Member	Resume Link	Role
Cynthia Khan	https://www.slideshare.net/slideshow/embed_code/key/ban1T3yJekI5kt	Database Developer and Admin
Ricky Le	https://bit.ly/2Jnvmw2	Firmware Developer, API Admin
Caio Melo	https://docs.google.com/document/d/1D26zf54F7E-CJOgTXkIHP2z8GMXVUS4b-jf9V8lSctM/edit?usp=sharing	Lead Web Developer (mainly Front-end)
Sean Silva	https://drive.google.com/file/d/1V4Npqui_jgomTysXCcLnWGy9OwTvR_CO/view?usp=sharing	Lead UI Developer, IT Support, Video Editor
Noah Yasarturk	https://docs.google.com/document/d/1xrt3Hj4Y99Lm7tYyKCDH8wNh2-Ogmmh6qaS-4iFjEV8/edit?usp=sharing	Team Coordinator Junior UI Developer, Assistant Web Developer (mainly back-end)

Team Organization

Given the ease with which we have been able to concur on viable project ideas and to acknowledge each other's expertise in varying subfields, we will operate as a democracy.

Project Proposal

For our project we assume to be working towards the need of an imaginary corporate client. The client receives daily utility bills for several of its buildings and use the service of a third party vendor that parses through the bills and composes the relevant information into a csv file. The csv file is then made available in a sftp server each morning for the client to retrieve.

We'll be fabricating this data for purposes of demonstrating the utility of our application using publicly available information as a baseline.

We will develop a web application which will automatically retrieve the csv file and store it to a location on the client's own server daily. The program will then populate/update the client's database with the new information obtained from the files each day. The program will provide a visualization dashboard based on the information garnered from the client's utility bill database for ease of analysis. Using machine learning, the program will process this information further and determine if there is a disproportionate usage of energy by a particular building on a particular day. Should this be true, the program will notify the client via email so that the client can identify the source of the discrepancy and thus control the overconsumption of power. To create a simulation for the software we will be using public datasets from the following website: <https://www.data.gov/energy/>. These datasets contain both commercial and residential building energy consumption information per hour over a period of years which will be valuable data for our project.

We'll use the Phillips Hue Smart Bulb and Bridge system. We may be able to add a feature into the program whereby the dashboard of the program could elucidate if any lights were left on overnight or in a vacant office space so that the user/system can shut off the light remotely. Similarly we can add remote climate control for smart thermostats if we can access an associated API to continue to further contribute to the user's control over utility usage, thus providing the client with a complete cost effective and environment friendly software.

Planning and Scheduling

Milestones	Principal Tasks	Software/Hardware Requirements
Realistic utility bill data simulation	<ol style="list-style-type: none"> 1.) Obtain real power bills/research typical power consumption to define lower/upper limits for random generation 2.) Randomly generate Strings and Floats 3.) Format as csv 4.) Feed csv to server 	Corporate Utility Bills Public datasets: https://www.data.gov/energy/
Create/configure server to be database (backend development)	<ol style="list-style-type: none"> 1.) Secure a GSU server 2.) Create permissions for us to access as admins <ol style="list-style-type: none"> 1) Create ER diagram 2) Create Database 	GSU Server: <ul style="list-style-type: none"> • OS = Windows • CPU = 4 core • RAM = • Storage = 1 GB Microsoft SQL Server

Database Server	schema 3) Test Table relationships/dependencies 4) Insert data 5) Test database connection/ functionality to support the rest of the software	
Design website aesthetically	1.) Research competition 2.) Draw a prototype digitally/photoshop of the individual pages 3.) Create the HTML skeleton 4.) Apply CSS styling as per customer directions 5.) Implement JavaScript or PHP functionalities to connect to Database or other APIs	HTML, CSS, JS, PHP, Sublime Text, Eclipse/IntelliJ
Machine learning algorithm development	1.) Determine what information the platform will be tracking and the client is concerned with 2.) Build Prediction models based on the training dataset from the database 3.) Research Python packages already available (Mussa is an expert on this, will help) 4.) Use the prediction model to predict future outcome given test conditions 5.) Send results to website interface for	Python/R

	client to view	
Configure/integrate smartbulb API to feed database power consumption information	<ol style="list-style-type: none"> 1.) Buy smart bulb 2.) Determine format of wattage info output; re-format to feed server, maintaining individual bulb ID 3.) Determine the ability to create clusters/groups with individual bulbs to classify as rooms/hallways 4.) Integrate with database 	Phillips Hue kit (smart bulb and bridge) Javascript
Configure/integrate smart bulb API to allow remote power operation (on/off switch)	<ol style="list-style-type: none"> 1.) Buy smart bulb 2.) Determine on/off function from API 3.) Determine ability to change intensity of bulbs (changing wattage output) 4.) Develop solution to link smart bulb(s) to back-end 5.) Link this to front-end web platform 	Phillips Hue kit Java/Javascript
Integrate data visualization tools to web platform	<ol style="list-style-type: none"> 1.) Create graph/ charts depicting overall building power consumption throughout day, week, month, etc. 2.) Create real-time graphic depicting power consumption by cluster 3.) Create bar chart integration depicting comparisons between clusters 4.) Create line graph 	Tableau, HTML

	integration depicting power usage over several time scales 5.) Take user input and display results	
Develop client alert system	1.) Define upper parameter for power overconsumption by either output of ML or client specification 2.) Send email (containing link to web platform) to client should parameter be breached	C++ or PHP, Database mail from MS SQL Server
Develop client registry parameters and definition	1.) Log in, register new client/user on web platform 2.) User authentication system 3.) Require client to register all smart devices / Define clusters	Database, Web API
Integrate front-end to back-end	1) Integrate Database, API Features, and all functionalities of website to dashboard	PHP, Javascript

Challenges and Risks

Given that we are all college students and furthermore do not live on campus, we all have varying schedules and limited time to dedicate to the project. Due to this fact, coordination and communication will present our greatest challenge.

Risk	Mitigation/Solution
Staff changes- there is a possibility a team member will withdraw from the course or be rendered unable to complete their assigned	Maintain constant communication so as to ensure we're all aware of each others' responsibilities should they need to be

role	redistributed
Dependency- some tasks are going to be dependent upon the completion of other tasks, such as being able to fabricate data before we can process it via machine learning	Use Jira/TSV to Map out general timeline of when Tasks need to be done / which tasks depend on the other
Integration- while the front-end and the back-end will be developed in parallel, if the two development teams are not in frequent communication with another about how their product is being developed, we may be faced with a situation where a back-end feature has nothing on the front-end to access it or a front-end feature is developed without necessary back-end input	Frequent communication between backend development and front end web service. Actively update GitHub with updates on increments of program/code to confirm compatibility.
Learning curve- given that this project may require a few of us to learn to use new tools (such as HTML-heavy web development or the Philips Hue API), it may mean that we spend longer than estimated on any given task	Start practicing languages/technologies we foresee being used and to more accurately estimate the time needed. Invest time ahead in learning
Project leader- our project leader has a tendency to assume too much responsibility and may be slow to require team members to complete their tasks on schedule	Due to the democracy we established, another group member can step up and assume some more responsibilities as well.
Data- there is a possibility that there is not publicly available data that we can use to train our machine learning model and get an idea of parameters with which we can fabricate our data	We will research available data and data simulation models along with a possibly new project idea

Task	Effort (person-days)	Duration (hours)	Dependencies	Person
Database Setup	1.86	6	Server setup Data	Cynthia Khan
Learn Tableau	1.3	5	Database and Website setup	Noah Yasarturk, Caio Melo, Sean Silva
Website	1.3	5	Server setup	Caio Melo

Template				
Smart Bulb API Integration	4	5-10	Smart Bulb Delivery Time, API Learning Curve	Ricky Le, Noah Yasarturk
Website Functions Integration	2	4	Functional database, Smartbulb API, Dashboard display	Noah Yasarturk, Sean Silva, Ricky Le, Cynthia Khan
Dashboard Creation	6	8-12	Database being created; Machine learning being able to cypher the data; learning Tableau	Sean Silva, Noah Yasarturk
User Registry	1	5	Website (front-end/back-end) being functional	Cynthia Khan, Ricky Le, Caio Melo
Prediction Modelling Integration	2.86	7	Acquire test data and training dataset	Cynthia Khan, Ricky Le, Noah Yasaturk
Realistic Data Simulation	2.9	8	Power Company Client Research	Noah Yasaturk, Sean Silva

Scheduling

Date	Noah	Ricky	Cynthia	Caio	Sean
6/19	Research public datasets for energy consumption	Learn smart bulb API functions	Set up Server Research on Microsoft SQL server	Design Website Template	Learn Tableau Functionalities; create theoretical client building structure

		Discover formatting for wattage output data	functionalities Create Database Insert public dataset into relevant tables		
6/20					
6/21					
6/22					
6/23					
6/24					
6/25	Develop algorithm to reliable feed realistic utility bill info	Integrate smart bulb with server	Determine ML Packages		Integrate smart bulb with server
6/26				Develop website front-end framework/design	
6/27	Link data simulator to server	Scale up smart bulb into theoretical building network; define clusters	Develop prediction model		Develop Real-Time Smart Bulb cluster GUI framework

6/28					
6/29					
6/30					
7/1					
7/2	Develop website back-end framework (platform structure, template for functionalities)	Integrate Smart bulb GUI with server			Integrate Smart bulb GUI with server
7/3					
7/4			Develop website back-end framework (email alert system, link to database)		
7/5		Develop Client Registry System		Integrate website front and backend, connect to server/database	Integrate Tableau visualization tools to website
7/6					
7/7					
7/8					

7/9	Integrate website front and backend, connect to server/database	Develop user-query system	Develop budget framework-include cost/watt		
7/10					Integrate website front and backend, connect to server/database
7/11					
7/12					
7/13	TESTING	TESTING	TESTING	TESTING	TESTING
7/14	(Margin for error)				
7/15					
7/16					
7/17	PRESENT	PRESENT	PRESENT	PRESENT	PRESENT

Monitoring and Reporting Mechanisms

We'll make use of Jira software to track our progress. Additionally, each morning we'll have a Scrum-like report via Slack where we each answer the following questions:

- What did you do yesterday?
- What will you do today?
- What is blocking progress?

Collaboration

GitHub link: <https://github.com/overpowered-gsu>

Slack Logs link: <https://github.com/overpowered-gsu/slacklogs>

YouTube Video link: <https://youtu.be/jdOaPTeZmjA>

Problem Statement

Overpowered is an intelligent system by which business clients can reduce their utility bill through provided data analytics and integrated hardware systems. It is for business clients and/or universities that can make widespread use of IoT technology (smart bulbs in particular) for more efficient power-gauging and monitoring. Overpowered solves the problem of power over-consumption, making it environmentally friendly, and excessive spending on utility bills and it drastically reduces the time clients spend analyzing their utility bills. While there are service alternatives such as motion sensor lights, our service provides a more reliable way to monitor light usage. Overpowered is a compelling project to pursue due to the fact that it incorporates new, emerging technology (IoT Technology) with machine learning concepts and data analytics to solve an issue that is applicable to a large group of people/businesses. This project's top level objective would be to have complete adoption of the system by a major consumer of electricity such as a residential building, or a college campus. This project incorporates machine learning with already available data to determine even the slightest changes that will benefit the energy consumption of a building as a whole. It will also provide a more secure system, as our database would be hosted at the client site, and not through the cloud. Target customers for this project include businesses with large buildings who receive daily updates of their utility usage and make widespread use of smart bulb technology. The scope of our project encompasses any building with multiple stories and/or multiple buildings of the same caliber. There are plenty of research papers published that reference using machine learning to predict and model energy consumption within buildings and how to make them efficient, however they have no systems in place to actually implement them. Upon further research, a company named [Verdigris](#) has implemented a similar product as our project, however this company focuses more on the hardware elements of energy management. They store their user information within a cloud database, which would not be as secure as an adhoc physical server.

System Requirements

Refer to Appendix Section 1.0 for Context Diagram

Requirement #: 1

Use Case: N/A

Date: June 15th, 2018

Introduction: Obtain Utility Bill Data and Implement into Database

Rationale: Information is needed to feed our machine learning system in order for it to function properly.

Author: Walktime Error

Input: Public Utility Usage Data

Requirement Description: Using public data of utility usage of specific buildings and businesses, the information fed to the system will allow precise and accurate predictions for optimal to suboptimal utility usage and spending.

Outputs: Functional Machine Learning System that is Precise and Accurate
Related Requirements: 2, 8

Requirement #: 2

Use Case: Database Functionality

Date: June 15th, 2018

Introduction: Create/Configure Server to be Database

Rationale: A Database needs to be created in order to implement machine learning algorithms, as well as a User Registry.

Author: Walktime Error

Input: User inputted Utility Data, Profile information

Requirement Description: Server access needs to be obtained to create a Database. This database will serve as the hub for our machine learning process, as well as our user registry. It will contain user profile information, as well as user inputted utility data.

Outputs: Machine Learning Data Visualization, User Registry, Email Alert System

Related Requirements: 1, 3, 4, 6, 8

Requirement #: 3

Use Case: Register New User, User Login, Database Functionality, Smartbulb API Functionality

Date: June 15th, 2018

Introduction: Develop Client Registry Parameters and Definition

Rationale: User needs to be able to register a profile in order to limit access to Utility Administrators, and to submit information to be analyzed and produce visualized data, such as charts, graphs, and graphics.

Author: Walktime Error

Input: Username, Password, Building Layout Schematics, Utility Admin Email, Utility Provider, Utility Bill Budget Target

Requirement Description: User submits Username and Password, which then leads to submitting Utility data and Building Layout Schematics, and registering of smart devices.

Outputs: Profile information is saved into Database, which allows future login to access website dashboard.

Related Requirements: 2, 4, 5, 7

Requirement #: 4

Use Case: Register New User, User Login, Dashboard Display Functionality, Database Functionality, Smartbulb API Functionality, Machine Learning Functionality

Date: June 15th, 2018

Introduction: Website Design Functionality

Rationale: Create a website that allows users to submit information in order to receive data analytics and control over smart devices to decrease utility spending.

Author: Walktime Error

Input: Database Information (Profile information + Utility information), Smart Device API functions

Requirement Description: Website should have the following functions:

- User Profile Registration
- User Login
- Remote Smart Device Control
- Access to Data Analytics
- User Logout
- Backend integration of Database

Outputs: A website with working buttons that lead to their corresponding functions.

Related Requirements: 2, 3, 5, 7, 8

Requirement #: 5

Use Case: Dashboard Display Functionality

Date: June 15th, 2018

Introduction: Website Aesthetics / Dashboard

Rationale: Along with integration of website functionality, the website must look simple and easy to use, and not confusing to user.

Author: Walktime Error

Input: Website Functions

Requirement Description: All backend functions should be tied to frontend functions, including the use of sliders, buttons, and aesthetic animations for smoothness of use.

Outputs: An aesthetically pleasing, easy to use website.

Related Requirements: 3, 4, 7

Requirement #: 6

Use Case: Database Display Functionality, Smart Bulb API Functionality, Machine Learning Functionality

Date: June 15th, 2018

Introduction: Implement Machine Learning Algorithms

Rationale: Using this allows our system to be intelligent and provide accurate utility predictions to better optimize utility efficiency

Author: Walktime Error

Input: Utility Data from Database

Requirement Description: Using public Machine Learning packages and algorithms, the system will use client provided utility data to analyze and identify inefficient utility use per building and send out an email whenever inefficiency is identified. Inefficiency is defined through the mathematics behind the machine learning algorithms.

Outputs: Alert Email , Machine Learning Predictions, Data visualizations

Related Requirements: 2, 7, 8

Requirement #: 7

Use Case: Register New User, Dashboard Display Functionality, Smart Bulb API Functionality

Date: June 15th, 2018

Introduction: Configure/Integrate Smart Bulb API Features

Rationale: Using the Phillips Hue Smart Bulb API, integrate the smart devices functions with website functions to have more utility control, as well as easier access, as all needed functions will be provided in a single area.

Author: Walktime Error

Input: Smart Bulb API Functions

Requirement Description:

Outputs: Remote Control of Lighting, Grouping/Clustering of Individual Lights, Timed toggles, Integration within Website Features

Related Requirements: 3, 4, 5, 6

Requirement #: 8

Use Case: Dashboard Display Functionality, Smart Bulb API Functionality, Machine Learning Functionality

Date: June 15th, 2018

Introduction: Integrate Data Visualization

Rationale: Integration of Data Visualization will allow easier to understand information and data analytics, as it will take information from the machine learning system and incorporate visual data such as graphs, charts, and graphics.

Author: Walktime Error

Input: Database Information Pertaining to Utilities

Requirement Description: Using user submitted information about utility usage, and getting outputs from the machine learning system, the integration will provide visual data to help improve utility spending and efficiency.

Outputs: Charts, Graphs, and Graphics

Related Requirements: 1, 2, 4, 5, 6

Use Cases

Refer to Appendix Section 1.1 for Use Case Diagram.

Use Case Name: Register New User

Summary: Client will be able to register a new user profile and add pertinent information.

Basic Course of Events:

1. Client clicks button to register new user.
2. The page redirects to another page to input basic user information, such as username, password, and Full Name.
3. The information submitted will be saved onto the database for login information.
4. The client clicks next button to submit more information required.
5. The page redirects to another page to input Building Layout, as well as pertinent information related to utilities (Utility Administrator email, utility provider, and provide a utility bill budget target). The Building Layout will consist of monochrome floor plans / blueprints for machine learning color coding by cluster.
6. Information will be saved onto the database for machine learning data analysis, and used for graphics and energy-use suggestions.
7. The client clicks the next button to submit more information required.
8. The page redirects to another page to register smart devices, and to define clusters/groups. These clusters will later be used to identify specific areas for power usage comparison.
9. Information will be saved and be used for machine learning data analysis, and will provide future functionality on the Dashboard.
10. The client clicks the Done button, and is redirected to the homepage / dashboard.

Alternative Paths: None

Exception Paths: In step 2, if illegal characters are used, or username/password requirements are not fulfilled, the page will reload and will ask to resubmit information without illegal characters/ to fulfill requirements. The submitted password will have a length requirement of at least 8 characters. In step 5, if an unreadable Building Layout format is submitted, or any

invalid information pertaining utilities is submitted, the page will reload and ask to re-submit information.

Extension Points: User will be able to go back and edit information submitted through an option on the dashboard

Trigger: The user wants to register a new profile.

Assumptions: The user has access to pertinent utility, smart device, and building layout information.

Precondition: The database has been established and can receive multiple forms of information.

Postcondition: The user has created a new login profile.

Author: Walktime Error

Date: June 15th, 2018

Use Case Name: User Login

Summary: User will be able to login using existing profile information.

Basic Course of Events:

1. User clicks a button to redirect to a login Page.
2. The Page will ask for username and password.
3. User submits username and password.
4. The database will verify the username and password.
5. The page will redirect to website dashboard.

Alternative Paths: If the user does not accurately submit username and/or password after 5 tries, the user is locked from attempting to log in for 30 minutes.

Exception Paths: In step 3, if user does not submit correct username and/or password, the page will reload and ask user to resubmit. (Display login error)

Extension Points: None

Trigger: User wants to log in to use application.

Assumptions: User has already registered a profile and has submitted pertinent information.

Precondition: The database is able to verify login credentials.

Postcondition: The login information has been accepted and the user can now proceed.

Author: Walktime Error

Date: June 15th, 2018

Use Case Name: Dashboard Display Functionality

Summary: After logging in, the user will see and be able to use all dashboard functionalities.

Basic Course of Events:

1. The user successfully logs in, and can see the functions placed on the dashboard.

2. The user has the option to:
 - a. Control Building's Smart Lights
 - b. Display Graphs of Energy Consumption
 - c. Display Building Graphic depicting power usage.
 - d. Change profile settings
 - e. Log out

Alternative Paths: From Step 2a, the user has the option to dim/brighten or power on/off Lights immediately, whether in defined cluster, or individual bulbs. Defined Clusters and registered smart devices will come from the user's submitted profile information. From Step 2b, user can view graphs or charts of energy consumption, created by the system. User can choose to categorize the information provided by Daily, Weekly, or Monthly, Annually. Information will come from the user's submitted profile information and information stored in the database through a period of time. From Step 2c, the user can view a graphic depicting the Building schematics, displaying power usage per building (color-coded). The building schematics will be retrieved from the submitted building information within the user's profile. From Step 2d, the user can edit submitted information in their profile, change password, or change profile settings. From here, the user can also redefine existent bulb clusters, as well as register new smart devices. The user can then click a button to save edited information, and will return to the Dashboard. From Step 2e, User will be logged out and will no longer be able to access the dashboard interface.

Exception Paths: None

Extension Points: From Steps 2a-d, the user will have access to a button that allows them to return to the dashboard. In regards to Step 2d, pressing this back button will not save edited information and a notification will be generated for the user.

Trigger: The user wants to access dashboard functionalities.

Assumptions: The login has been successful, thus allowing user to access dashboard.

Precondition: The front-end and back-end functionalities have been linked at their appropriate places. Information is able to be edited through the profile settings and the edits will change within the database. The machine learning system has already been set up (gone through all submitted information), and graphics have been produced based off of said information.

Postcondition: User is able to use all dashboard functionalities and is able to log off.

Author: Walktime Error

Date: June 15th, 2018

Use Case Name: Database Functionality

Summary: The Database will store all information pertaining to the energy consumption of client's assets and employee login credentials. Thus it will provide support to the front end applications.

Basic Course of Events:

1. Hourly energy consumption measures from installed meters would be recorded and updated in the database.
2. When a new user registers, the employee's ID, username and password will be saved in the database
3. When a user tries to login, the rows in the database will be searched sequentially to validate the user's credentials
4. When creating a prediction model, the data held in the database will be used in a systematic manner.

Alternative Paths: For Task 1, data collected from installed meters would be inserted to the database through automated scripts. In case, of corrupted data or data not meeting the database integrity, that particular record will be discarded and this action will be recorded in a log along with the reason for discarding the data. For Task 2, user information must meet the requirements specified in the database. Ineligible usernames and/or passwords would be rejected and this will trigger an alert to be sent in the form of a message to the user. For Task 3, information collected from user input would be scanned against all records in the Employee table for a match. In case of a match found a success message would be triggered. In case of no match, a failure message would be triggered for the user. For Task 4, the database would act as a source for the information needed by the Machine learning algorithms.

Exception Paths: Invalid or corrupted data.

Extension Points: Regular scheduled backups setup for the client

Trigger: Any information that needs to be saved or retrieved.

Assumptions: The database schema functions as desired and data is not corrupted.

Precondition: Database schema is setup properly with intended dependencies.

Postcondition: Data can be stored and retrieved with no unexpected delays

Author: Walktime Error

Date: June 15th, 2018

Use Case Name: Smart Bulb API Functionality

Summary: Using the Phillips Hue Smart Bulb API, functions will be integrated within the machine learning system, as well as the website.

Basic Course of Events:

1. Setup between the bridge and bulbs, and the network to ensure the devices are functioning properly.

2. Establish a connection between Smart Devices, and the Hue App API.
3. Apply methods within the API to create functions desired for machine learning and website functionality.

Alternative Paths: From step 3, multiple functions need to be created. The first function required is the ability to register devices individually and define clusters. The second function is to give our system access to be able to remotely toggle and change intensity of bulb clusters. The third function is to create a readable and storable format for wattage output of bulb clusters, to implement this information within our machine learning system.

Exception Paths: Bulb information regarding wattage is unreadable to the machine learning system, which function must be re-evaluated to output desirable information. The room/cluster of bulbs have been remotely toggled while there is occupancy, which occupants can manually reset by toggling the wall switch, or through the smartphone app.

Extension Points: User must be able to redefine clusters, as well as register new smart devices.

Trigger: The User would like to remotely toggle lights, and have wattage information available to be compared between clusters and buildings.

Assumptions: The Phillips Hue API is open and readily available to use.

Precondition: Access to the Phillips Hue API, Places where Smart Bulbs are implemented have a wall switch that remains in the On position.

Postcondition: Desired functions readily working for machine learning process, website functionality, and smart device registration.

Author: Walktime Error

Date: June 15th, 2018

Use Case Name: Machine Learning Functionality

Summary: Provide Machine Learning features to the user such as notifying of unusually high energy consumption in any particular area.

Basic Course of Events:

A substantial amount of training data is stored in the database. Then using a chosen Machine Learning Algorithm, a prediction model is produced. An accuracy score is also derived from the training data. The process is repeated for multiple algorithms until the best suited algorithm with the highest accuracy is obtained. Once the algorithm is selected, the prediction model produced by the algorithm is used to predict future instances. For example, when the system is trained in the described manner into knowing the energy consumption of a building at any particular hour, the next time the system is given the consumption within 15 mins, it would be able to predict if there will be an over consumption, average consumption or low consumption

by the end of the hour. This way the system can alert the user so that the user may choose to take action immediately and save precious energy.

Alternative Paths: Every hour, at a certain predetermined time, the system will automatically run a few selected algorithms against the available dataset and determine the best algorithm based on accuracy. Once it has determined the algorithm, it will then store the prediction model and use that model to predict the outcome at the end of the hour. If the prediction is lower than or within the threshold then no action is taken until the next hour when the process is repeated. If the prediction is higher than the threshold then the system triggers an alert and starts the process of notifying the user of the anticipated high consumption and the possible steps that may be taken. After that the system again waits for the next hour to repeat the process.

Exception Paths: None of the algorithms might produce an accurate enough result which may be depended upon.

Extension Points: The user may also be advised on which devices are having the highest consumption rate.

Trigger: A schedule may be set for the system to start this entire process.

Assumptions: The Machine Learning kit functions as desired and produces accurate predictions.

Precondition: The training data is clean and vast enough for optimal results.

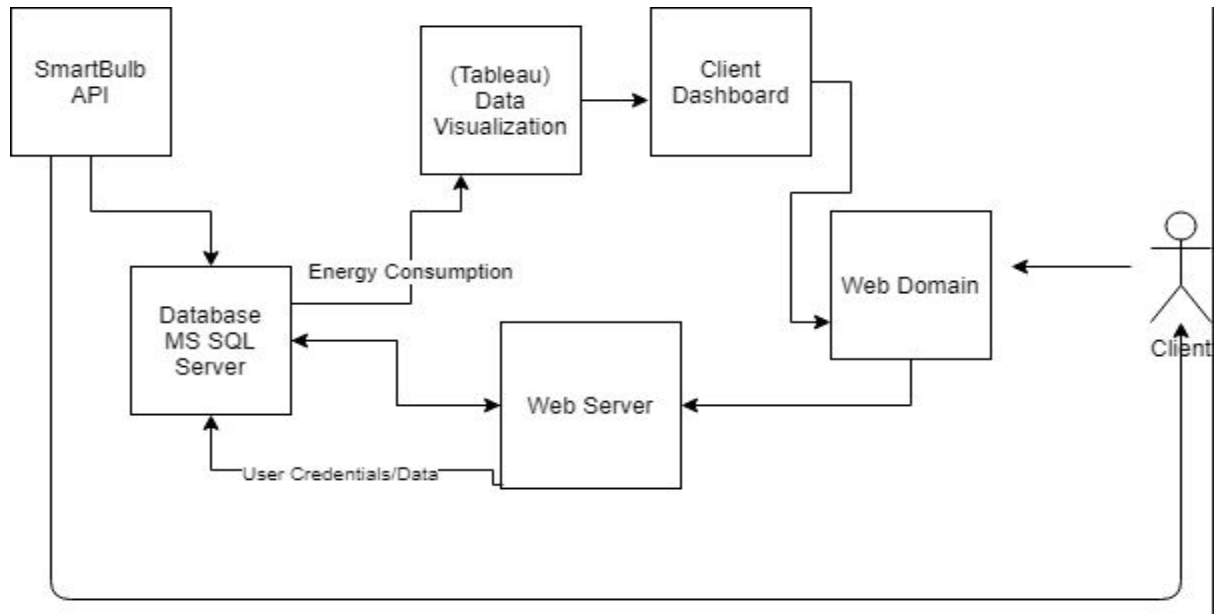
Postcondition: The system is able to predict the energy consumption outcome by the end of the hour.

Author: Walktime Error

Date: June 15th, 2018

Appendix

Appendix 1.0: <https://bit.ly/2yhQouQ>



Appendix 1.1: <https://bit.ly/2MtemGN>

