Senior Design Final Report

Saya.Life Web Application

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1. Introduction:

1.1. Background:

As resource management becomes more important, especially as it concerns water, new companies and technologies are stepping into the gap to provide solutions. One such company is Saya Life and their development of a web application to monitor water usage for property owners and the tenants of those properties. Their products provide the ability for tenants to monitor individual water consumption, detect leaks, pay their bill, and also use data forecasting to determine what their projected bill/consumption will be if they maintain their current water usage. In addition, the product allows landlords to view water expenditure across all of their owned properties, with data analytics tools that give them an accurate picture of where their facilities with the heaviest consumption are, as well as cost projections for that usage.

Saya intends for this product to be available and useful for a wider cross section of users, from individual tenants possibly living on their own for the first time, all the way to property management firms with many properties under their purview. To facilitate this, Saya has reached out to the Computer Science department at Cal State LA to provide them with an updated web application, which would more closely align to their goals of creating an intuitive, modular, and easy to navigate application.

1.2 Design Principles

Our main deliverable was a complete overhaul of the Saya.Life web application. The web application would need to connect to a database, populated by values from the Saya water sensors, as well as store data, and the associated tenants of each landlord's property. Connection to their sensors is also desired, but was not stressed as a priority. The application should be easy to navigate and have the ability for the user to change aspects of it to fit their particular needs or level of engagement desired. Analytics for water usage was also a priority. Finally, our application is a framework to be built upon, with Saya’s engineers able to make modifications or implement follow-on features that may arise in the future.

1.3 Design Benefits

Our application makes use of the React library for Java, as requested by our liaison with Saya, which means it's able to be expanded on by their in-house development team as they see fit. The use of a mySQL database also allows them to easily connect their own database in its place and achieve the same functionality we were able to implement. We also used native React libraries for our forecasting/analytics, allowing for easy expansion as well. The team focussed on both creating and implementing our user personas, keeping in mind the different people who would be making use of our application and their varying comfort with technology.

By making our application easy to navigate, uncluttered, and able to be modified to the user's liking, we feel that we have kept Saya's original instruction of a modularity focused product at the forefront of our design phase. We were also informed our design would also be compared to their inhouse design teams reworking of their web application and Saya would combine ideas and implementations from both they felt most met with their vision of how the app would function. The design we implemented is a framework able to be both expanded on and changed to fit with their goals, which we feel has been a value add to Saya.

1.4 Achievements

The team was successfully able to redesign Saya's web application, meeting all of the goals set by the company and giving them a product they can build on for the future. Our team was able to use an Agile design framework to prioritize tasks and make sure no one felt overwhelmed or unsure of their assigned duties. Throughout the academic year, we were able to design and implement our front-end application using React and create a back-end framework using mySQL, which would allow an easy port over for the Saya design team when it comes time to connect their inhouse database.

We have been able to create easy to understand analytics using data collected from Saya's water sensors and allow users to monitor their water consumption. Landlords are able to view the analytics across all of their properties and notify their tenants if need be. Finally, we created a notification system that informs users if they have a leak, overdue bill, or if they receive a message from the landlord

associated with their property. This prominently displayed section on the dashboard keeps our users informed and allows issues to be readily identified and fixed, preventing excessive loss of water leading to higher bills.

2. Related Technologies:

2.1 Existing Solutions:

When looking at existing products on the market for utilities management, our group noticed many of them are quite robust, but most are incredibly unwieldy, or not suited for the needs of both tenants and landlords. Several of the existing systems provide a user with a wide range of information, but make it very hard to navigate for someone who is not adept at using management software. The products, for the most part, are also more suited for utilities management companies and are not simple enough for a property manager to monitor water usage exclusively.

The product Syncta is very similar to the one offered by Saya, although they lack the ability to customize the dashboard and because of this, users can quickly feel overwhelmed by the amount of information conveyed to them. Their product also charges per test of your system, while ours would only charge a user for the use of our entire system and the sensors associated with it. Finally, their product is focused on back flow monitoring (or unwanted water usage), rather than an encapsulation of a user's total usage.

The FIIX system is specifically designed for utilities companies, with most of the tools focused on maintenance teams. Information on consumption is provided, but similar to other products, the scope does not include individual tenants or landlords managing multiple properties. Their software also includes gas monitoring as well and is more suited to large companies who provide both water and gas to large areas, rather than a more focused view of individual properties.

Taking this into account, our team strived to maintain the focused scope asked for by Saya and to make an app that was well suited to users with varying degrees of technology familiarity. If our product is to be successful and by extension if the goal of water conservation and intelligent management is to be successful, even the least software astute individuals should be able to navigate our site and customize it to their preference and desired level of use.

2.2 Reused Products:

Our application uses the React Javascript library, which is specifically designed for the ease of implementation of interfaces. The library provides a robust amount of features (called components) to create applications and the team found, after some initial study and practice, that the code base was very similar to what many of us were familiar with having taken the Web and Internet Programming class. We were able to implement fully functional login components, quick action bars, and other interface tools. A simple mySQL database was also created to add back end functionality and ensure that once our product was given over to Saya's engineers, they would be able to connect to their database and sensor monitoring systems.

3. System Architecture:

3.1 Overview:

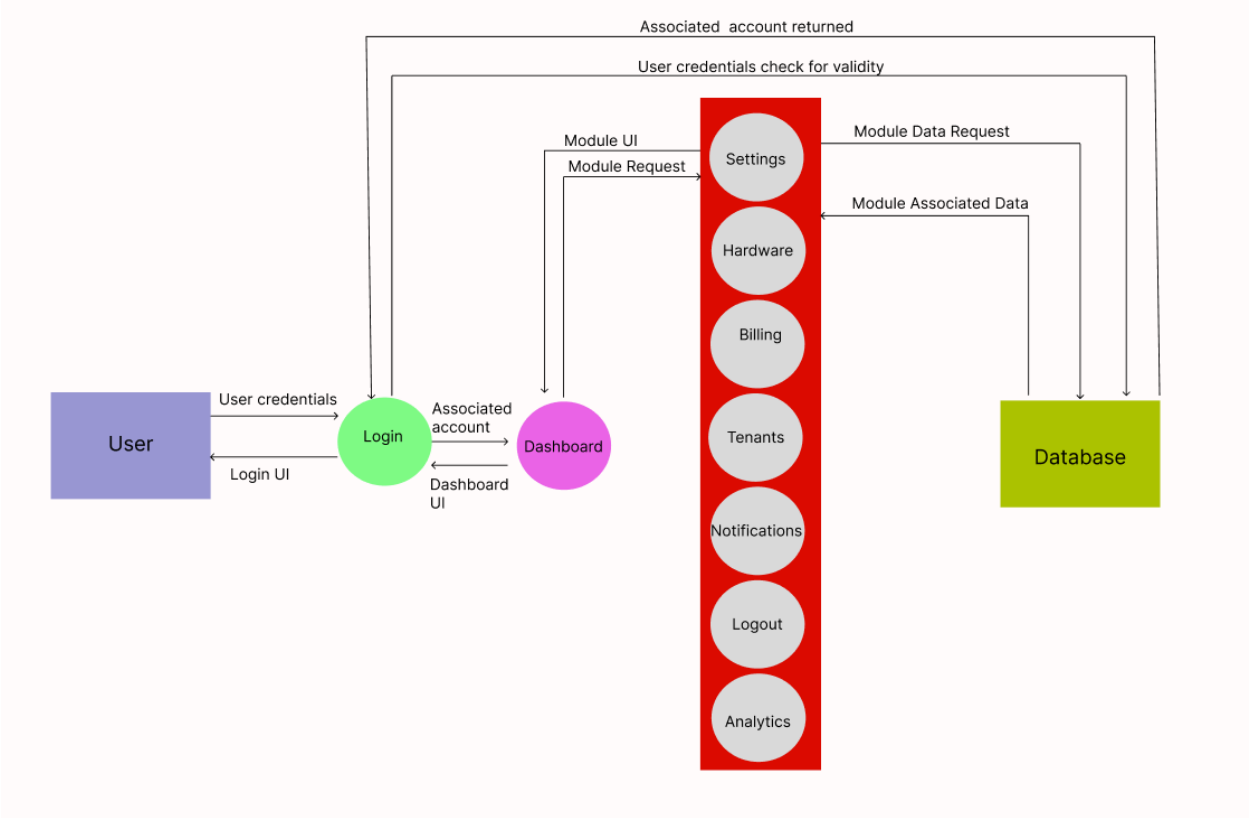
The architecture for our application can be broken up into three sections : our Users (landlords and tenants), the application itself with all of our modules/components, and finally the database where our values are stored. Here is a DFD 0 diagram to show how the application functions at a high level.

- **Users:** This factor was emphasized by our liaison for Saya.life, as their product would be used by users with varying degrees of comfort with web applications. We first created user personas, covering a wide gamut of familiarity with the internet, and kept those in mind during our design lifecycle. After our platform was created we also solicited feedback from

fellow students, parents, partners, etc. to make sure we had accomplished the goal of creating an easy to understand and navigate application.

- **Application:** The main deliverable for our product, our application is an overhaul of the existing Saya.Life to allow for great user customization and ease of use. The application allows the user to manage their water usage, pay bills, view sensors associated with their account, as well as serving as an intermediary for the database.
- **Database:** The database we created was implemented to demonstrate the functionality of the application. We also kept in mind Saya's desire to use their own database once the application was handed off to them. In implementing the database we made sure to include all the required fields that Saya employs so that there would be no loss of functionality.

3.2 Data Flow:



What follows is a brief description of the 9 modules features in our application:

3.2.1.Login: the first page a user is brought to upon accessing the web application. Features a field for both a username and an email, as well as a button in case the user has forgotten their password. Once the users credentials are authenticated, they are brought to the dashboard associated with their account

3.2.2.Dashboard: the main epicenter of the application, featuring a sidebar that navigates to the other modules, a module featuring the most pressing notifications, a quick action bar to navigate to user designated modules of most importance, and a section displaying analytics the user has chosen to have displayed.

3.2.3.Settings: this module allows a user to change the values associated with their account and updates the database where those values are stored once a user selects the save button.

3.2.4.Hardware: displays all the Saya sensors, gateways, and devices associated with a given account. For landlords it will also display all the devices for each tenant associated with a given landlord's account. This data is also stored in the database, but is unable to be changed by a user.

3.2.5.Billing: provides details from the database showing a user's billing details, including amount owed, when the amount is due, and if there are any notifications of a late or defaulted payment.

3.2.6.Tenants: a list of tenants associated with a given landlord's account. These tenants are displayed in a table with information on the tenant's name and addresses.

3.2.7.Notifications: the notifications are displayed in a table and include both billing and leak alert information. There is a section on the dashboard featuring the most pertinent notifications, but the notifications page includes a list of past notifications, even those that have been resolved.

3.2.8.Analytics: contains charts, graphs, and other analytical tools to show a user's water consumption across a designated period of time. Includes both past data, with the ability to implement forecasting for keeping track of future water usage.

3.2.9.Logout: brings the user back to the login page and removes their access to the dashboard page until their credentials can be authenticated again by accessing the login module.

3.3 Implementation:

To implement Saya.life's web application we split into four teams to facilitate ease of development and ensure we were able to meet our timetable using the Agile framework. These include a front end team, back end team, analytics team, and documentation team.

3.3.1 Front End (User Interface/User Experience)

The bulk of the project was spent redesigning the web application's user interface to allow for a more navigable user experience, with the option for users to customize their dashboard page, etc. The front end was implemented using React.js as a programming language and was styled using Cascade Style Sheets. Our UI allows users to interact with all the above stated modules.

3.3.2 Back End

Our back end team created a mySql database to allow functionality to simulate aggregating values from the Saya sensors, store user data, and store associated values and fields that are connected with a given account.

3.3.3 Analytics

The analytics team was responsible for taking values from the database and providing users with visual analytical tools to show water usage across a given period of time.

3.3.4 Documentation

The document team created all of the requirements, design, project, and presentation documents for the team. This was accomplished using a range of documentation tools and services.

4. Conclusions:

4.1 Results:

Our team was able to deliver a working web application to replace the current landlord specific Saya.life web application. With some slight modifications, Saya's internal design team could very easily implement the tenant specific view of the application, as well as connect their own internal database containing the actual readings from their sensors. The original idea of implementing a Tableau based analytics page was unable to be realized, as Tableau did not lend itself to the React.jss specific implementation our team was instructed to create. We were able to use the data analytics tools within the Javascript library to create working charts that can be further expounded upon by Saya's team or future senior design groups. With further modification, future teams will be able to add forecasting tools to predict future water usage/cost to further the goal of saving money and minimizing water waste.

The database we created serves as a good framework for our web application and once Saya receives our product they can port over their existing database to provide the application with real data from their customers. This idea of eventually using their database was at the forefront of our brainstorming when coming up with our design, as we did not want to create an unstable product for their team. We also sought to minimize any confusion when the time came to port over their existing database by continuing to use their same naming conventions and similar fields to their existing database. This information was provided to us in the form of a CSV file we received from the Saya team.

Finally, we were able to keep the idea of modularity and user friendly page navigation by implementing several features not present in the original application. We added a fully customizable quick actions bar that will allow users to designate areas of interest they would like to access quickly or areas they interact with on a more frequent basis than others. Our main design focus was centered around, "everything within 2 clicks", which entailed keeping all of the features available to users with a maximum of two levels of navigation. Through the use of a sidebar on the dashboard and the quick action bar, we felt that even users with a limited familiarity with web applications will find our app very intuitive to use and reduce user frustration at cluttered and opaque interfaces.

4.2 Future:

As mentioned above, the final implementation of our project was centered around the landlord view, as the group felt that would be the more intricate implementation of Saya's design requests. Our group has been working in parallel with Saya's own design team and we feel that with the innovations from both teams web applications Saya will achieve their goal of a more user friendly and customizable experience.

- Implement a tenant specific view of the web application
- Create a portal for the third party software used for their billing
- Expand the analytics section to include forecasting
- Continue to add modular features to the application by adding more features to the settings module
- Test the final product using a wide tester base to ensure the goal of broad based accessibility is met
- Run the final product through applications such as Lighthouse, to make sure the application is accessible to users with disabilities

5. References:

Elling, S., Lentz, L., & De Jong, M. D. (2007). Website Evaluation Questionnaire: Development of a Research-Based Tool for Evaluating Informational Websites. In Lecture Notes in Computer Science (pp. 293–304). Springer Science+Business Media. https://doi.org/10.1007/978-3-540-74444-3_25

Ihtsham, A. (n.d.). The Top Web Development Frameworks of 2023. www.linkedin.com. https://www.linkedin.com/pulse/top-web-development-frameworks-2023-ali-ihtsham/

Martínez, R. M., Turró, M. R., & Saltiveri, T. G. I. (2019). Accessible statistical charts for people with low vision and color vision deficiency. In the International Conference on Human-Computer Interaction. https://doi.org/10.1145/3335595.3335618

Silvennoinen, J., & Jokinen, J. (2016). Appraisals of Salient Visual Elements in Web Page Design. Advances in Human-computer Interaction, 2016, 1–14. https://doi.org/10.1155/2016/3676704

Singh, N., & Srivastava, S. C. (2011). Impact of Colors on the Psychology of Marketing — A Comprehensive overView. Management and Labour Studies, 36(2), 199–209. https://doi.org/10.1177/0258042x1103600206

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