3 Design

3.1 Design Context

3.1.1 Broader Context

Describe the broader context in which your design problem is situated. What communities are you designing for? What communities are affected by your design? What societal needs does your project address?

Our design project is intended to be used by any member of the population that is searching for an ideal area to live in. The application can subsequently find ideal areas for businesses with recurring client models. The community impact of this application offers many benefits to all users: however, it affects lower-income and disabled users the most. The tools provided allow users with limited transportation or need to be within a certain distance from a care facility to better find housing that matches their needs. Our goal for this project is to solve the societal issue of locating housing based on the user's needs.

List relevant considerations related to your project in each of the following areas:

Area	**Description**	**Examples**
Public health, safety, and welfare	Low-income and disabled users will be empowered to locate housing that matches their needs.	Low-income users can find housing near public transportation or their worksite, helping with transportation costs. Disabled users can find housing near care centers or resources in case of emergencies. The direct users of our application are likely to benefit from the convenience and time-saving aspect of the tool. Using our application, users can find a living location that is most convenient for them in terms of the time spent on daily trips, which can lead to less stress, more free time, and a better quality of life. Communities, where our application is used, may also indirectly benefit

		from reduced traffic congestion and associated pollution levels, which can lead to improved public health and safety. Our project could positively affect public health and safety by reducing commuting time. By reducing the time spent on the road, there is a potential reduction in the likelihood of accidents, which can lead to fewer injuries and fatalities.
Global, cultural, and social	This application is not geared toward any social community. It is designed to be useable for any member of the population.	No code of ethics will be violated with this application. Specific communities and ethnic cultures may have different values, preferences, and lifestyle choices that influence their perception of an optimal living location. Our project may need to consider these differences and provide customized features that reflect the values, practices, and aims of the cultural groups it affects. For example, a community that values walking and biking may prefer a more walkable or bike-friendly location.
Environmental	This is a software-only project that produces no environmental impact	Because this project is meant to replace current applications, no extra energy will be spent. Our project could contribute to reducing the overall carbon footprint by encouraging users to find living locations closer to their workplaces or daily destinations, therefore reducing

		the need for long commutes and associated carbon emissions. By reducing the time spent on daily trips, our project could also reduce traffic congestion, which can lead to improved air quality and reduced noise pollution. Our project may rely on data centers and servers, which can have high energy consumption and a carbon footprint.
Economic	Private: Users will be empowered to find ideal living locations that will ease their day-to-day spending. Commercial: Users will be able to expand or relocate to areas that are more convenient for their clients	Private: Employees can live closer to their employer, saving on transportation costs. Commercial: Small businesses with a dedicated clientele can move locations and maintain the same average commute for customers (i.e., dentists, day-cares, and family docs. Our project could contribute to reducing transportation costs for individuals and families by helping them find living locations that are closer to their workplaces or daily destinations. This could result in substantial savings in fuel costs, vehicle maintenance, and public transportation fees. Our project could also lead to increased economic activity in certain areas by encouraging people to move to certain neighborhoods or cities.

		However, it also may have a negative economic impact on certain neighborhoods or cities if it encourages people to move away from those areas

3.1.2 User Needs

List each of your user groups. For each user group, list a needs statement in the form of:

Home buyers need a way to search for ideal areas to live and see the properties available in those areas because current applications fail to provide adequate search customization.

Businesses need a way to ensure they are relocating or expanding to an area their clients will be satisfied with because long commutes or inopportune areas may cause undue hardships for their clientele or revenue loss.

Commuters need a way to find living locations that are closer to their workplaces or daily destinations because they want to reduce the amount of time and money spent on daily transportation and improve their quality of life.

Families with children need a way to find living locations that are in safe and convenient neighborhoods with good schools and parks because they want to provide their children with good education and a safe environment.

University students need a way to find living locations close to their campus and other facilities because they want to reduce the time and money spent on transportation and improve their academic performance and social life.

Retirees need a way to find living locations in calm, pleasant neighborhoods with access to healthcare services and social activities because they want to enjoy their retirement and maintain their physical and mental well-being.

Real estate developers need a way to identify areas with high demand for housing and potential for profitable investments because they want to maximize their profits.out

3.1.3 Prior Work/Solutions

Finding the best places to live based on daily travel times has been the subject of numerous research projects and web applications.

1. Walk Score: Walk Score is a web application that calculates the walkability of a given location by analyzing its closeness to nearby amenities such as grocery stores, restaurants, schools, and parks. One of the advantages of Walk Score is that it considers a wide range of factors that can affect the livability of a location.
   https://www.walkscore.com/

2. Trulia: Trulia is a real estate website that provides a heat map of neighborhoods based on factors such as crime rates, schools, and commute times. One of the advantages of Trulia is that it provides a broad view of different neighborhoods and their livability factors. https://www.trulia.com/

Our web application has several advantages compared to these existing products and research studies:

- ➢ First, it uses a data-driven approach to generate personalized heat maps that reflect individual users' commuting patterns and preferences.
- ➢ Second, it provides a user-friendly interface that allows users to easily explore different living locations and compare them based on commute time.
- ➢ Third , it can be integrated with other real estate websites and services to help users get a better experience.

However, one potential disadvantage of our web application is that it may require a large amount of data and computational resources to generate accurate heat maps for a wide range of users and locations.

Include relevant background/literature review for the project

– If similar products exist in the market, describe what has already been done

Applications such as Zillow provide some customization for calculating commute times; however, they lack the ability to generate ideal areas to live in, then connect the user to listings in those areas.

– If you are following previous work, cite that and discuss the **advantages/shortcomings**

We are not following previous work.

– Note that while you are not expected to "compete" with other existing products / research groups, you should be able to differentiate your project from what is available. Thus, provide a list of pros and cons of your target solution compared to all other related products/systems.

Pros	Cons

Visually identify ideal home areas	
Works with existing applications instead of competing with them. Listings are generated through APIs that link back to the existing site. Our goal is to provide customization. This allows the best [parts of other sites to be used while ensuring competitors do not box us out.	
Provides area searches and listings	

Detail any similar products or research done on this topic previously. Please cite your sources and include them in your references. All figures must be captioned and referenced in your text.

We have not found any previous iterations of this work.

3.1.4 Technical Complexity

Provide evidence that your project is of sufficient technical complexity. Use the following metric or argue for one of your own. Justify your statements (e.g., list the components/subsystems and describe the applicable scientific, mathematical, or engineering principles)

components/subsystems:

1. User Interface: Our application requires a user-friendly interface that allows users to create accounts, input the frequency and timing of their daily trips, and view generated heat maps. The design of such an interface requires knowledge of user experience design principles and front-end web development skills such as HTML, CSS, and JavaScript.

2. Data Storage: Our application will need to store user data securely and efficiently. This requires knowledge of database management principles, such as SQL and NoSQL databases.

3. Heatmap Generation: Our application will generate heatmaps based on user inputs. This requires knowledge of data analysis and visualization, as well as back-end development skills such as Python and Google Maps APIs.

4. Optimization Algorithms: Our application will also need to implement optimization algorithms to find the optimal living location for each user based on their daily trips. This requires knowledge of mathematical optimization principles.

In general, the project's technical complexity is sufficiently challenging, requiring a broad range of technical skills and expertise, including UX design, front-end, and back-end development, database management, data analysis and visualization, and mathematical optimization. Also, the project's requirements match current solutions and industry standards, such as location-based applications like Google Maps or Waze.

3.2 Design Exploration

3.2.1 Design Decisions

List key design decisions (at least three) that you have made or will need to make in relation to your proposed solution. These can include, but are not limited to, materials, subsystems, physical components, sensors/chips/devices, physical layout, features, etc.

1. Pleasing visual web design that is minimal to ensure understanding and ease of use.

2. Functional front end for processing user-inputted information coded in HTML and CSS

3. Functional back end for storing data, processing data, and connecting to APIs coded in JS and PHP

3.2.2 Ideation

For one design decision, describe how you ideated or identified potential options (e.g., lotus blossom technique). List at least five options that you considered.

Our teams used the brainstorming method with a storyboard technique to ideate a solution for structuring our web application.The storyboard gave us a visual representation of our ideas that we could build on and reference.

1. Front end only design

2. Front end with UI/UX design

3. Design built on public applications such as wix.com

4. Design hosted on a privet server

5. Design hosted on a cloud infrastructure

3.2.3 Decision-Making and Trade-Off

Demonstrate the process you used to identify the pros and cons or trade-offs between each of your ideated options. You may wish you include a weighted decision matrix or other relevant tool. Describe the option you chose and why you chose it.

We chose to identify the pros and cons of each idea through lists in our storyboard. We chose to first started with a front-end-only design to ensure functionality before moving to a cloud-hosted front-end UI/UX design for the final implementation. Our final implementation will allow greater user access with less overhead for our client.

3.3 Proposed Design

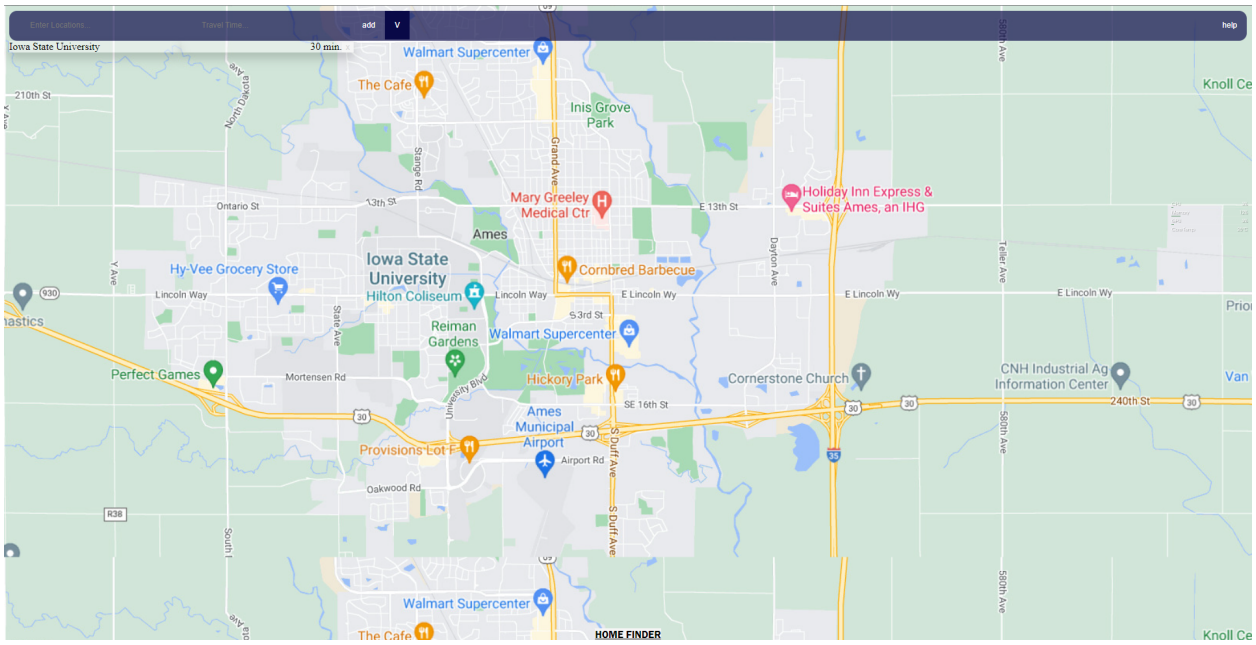
Discuss what you have done so far – what have you tried/implemented/tested?

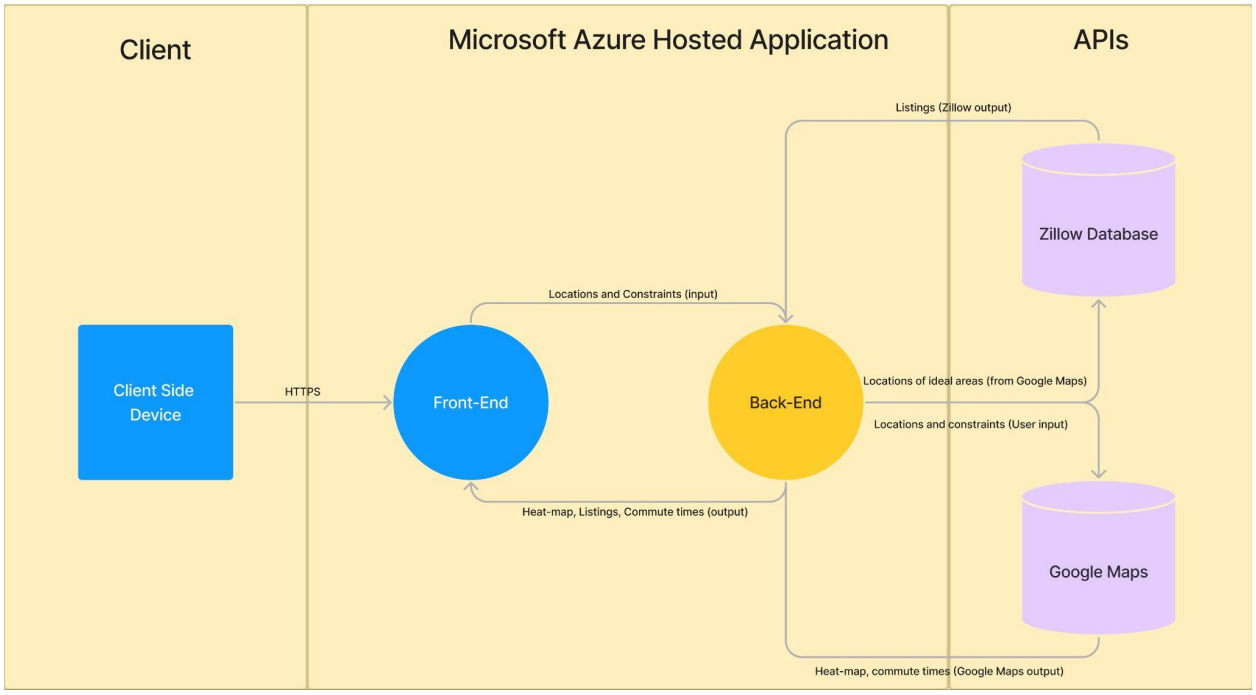
Our group has tested the API functionality for Google Maps and Zillow group research. These allow us to; pull real-time information about locations, travel distances, and times, create visuals, and connect to listings.

Our group has also begun implementing the front-end-only design of the web application.

3.3.1 Design Visual and Description

Include a visual depiction of your current design. Different visual types may be relevant to different types of projects. You may include: a block diagram of individual components or subsystems and their interconnections, a circuit diagram, a sketch of physical components and their operation, etc.





Describe your current design, referencing the visual. This design description should be in sufficient detail that another team of engineers can look through it and implement it.

Our design is a front-end UI/UX website acccessed over HTTPS, The user side, box 1, is responsible for generating requests by entering in location and constraint information. This information is formatted by the front end and sent to the back-end through PHP (box2). The backend then processes the information and uses the Google Maps API to generate ideal locations. The ideal locations are broken into subdivisions on the back end and sent to the Zillow API to retrieve listings in those areas (box3). The heat map, and listings and commute times are then sent back to the front end for user viewing.

3.3.2 Functionality

Describe how your design is intended to operate in its user and/or real-world context. This description can be supplemented by a visual, such as a timeline, storyboard, or sketch.

Our design is intended to be used by home seekers as a first or last resort to aid in the home-buying process. The normal use of our application is a user connects to the web-based application and enters the locations most commonly visited and the time constraints for traveling to those locations. Our application will then process the imputed information and respond with a heatmap of the ideal living areas that fit the constraints for the entered locations. After generating the heatmap, users will be able to view the ideal areas and select from listings within those areas. Selecting a listing links the user to the listing's primary hosted site, where more information can be found.

How well does the current design satisfy functional and non-functional requirements?

Our current design takes user input and processes it into a usable format for the APIs. We currently do not have the APIs integrated with the application so no other work is being done.

3.3.3 Areas of Concern and Development

Based on your current design, what are your primary concerns for delivering a product/system that addresses requirements and meets user and client needs?

Our primary concern is the cost associated with large user requests. At a predefined number of user requests to the APIs, fees will start to accrue. Our team could not design the application without the use of the APIs because satellite and GPs information is needed to calculate ideal areas from commute times.

What are your immediate plans for developing the solution to address those concerns? What questions do you have for clients, TAs, and faculty advisers?

To address this issue, our team will present the functionality to our client and allow them to make a final decision based on their needs. This can be done by transferring the access tokem to an account in their name wherein the choice to continue API service after the set number of requests have been met can be made by the client at any time.

NOTE: The following sections will be included in your final design document but do not need to be completed for the current assignment. They are included for your reference. If you have ideas for these sections, they can also be discussed with your TA and/or faculty adviser.

3.4 Technology Considerations

Highlight the strengths, weaknesses, and trade-offs made in technology available.

APIs allow food information processing, however, require a specific format for input that could place constraints on our user's inputs

Discuss possible solutions and design alternatives

3.5 Design Analysis

– Did your proposed design from 3.3 work? Why or why not?

Our previous design worked as intended for this part of our process. It served as a front-end starting point that allowed for the input of information to be processed without doing the processing.

– What are your observations, thoughts, and ideas to modify or iterate over the design?

Future iterations will improve upon the visual design and add functionality to the information processing portions

3.6 Design Plan

Describe a design plan with respect to use-cases within the context of requirements, modules in your design (dependency/concurrency of modules through a module diagram, interfaces, architectural overview), module constraints tied to requirements.