



Apartment Searching made Easier

SIMS 2006 Masters Final Project
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1 Executive Summary

The HomeSkim project is to develop an online apartment application, which will make apartment hunting easier for users.

The purpose of this report was to answer the following questions.

Apartment Searching Process

- How do people typically search for apartments?
- What do people usually look for when searching for apartments?

Needs Assessment

- Which sites do people use to search for apartments online?
- How satisfied are people with the current online sites?
- How can the current online apartment sites be improved?

Prototype Evaluation

- Does our prototype address the issues found with current online apartment sites?
- What additional improvements can be made to enhance our prototype?

Through various usability techniques, our team was able to answer these questions.

1.1 Apartment Search Process

- **How do people typically search for apartments?**

Usability Technique: Online Survey

- Online Listings (41% of participants)
- Recommendations from friends (24% of participants)

- **What do people usually look for when searching for apartments?**

Usability Technique: Online Survey

1. Price
2. Location
3. Proximity to Points of Interests

1.2 Needs Assessment

- **Which sites do people use to search for apartments online?**

Usability Technique: Online Survey

- craigslist.org
- apartments.com
- housingmaps.com

- **How satisfied are people with the current online sites?**

Usability Technique: User Testing Housingmaps.com

- 3/3 users had trouble identifying the target location in housingmaps
- 3/3 users encountered expired listings in housingmaps
- 2/3 users felt like they could do more with craigslist and a mapping site, than with housingmaps.com

Usability Technique: User Testing Apartments.com

- 2/3 users were unable to find an apartment that met their criteria
- 2/3 users had trouble with the apartment's map interface

- **How can the current online sites be improved?**

Usability Technique: Competitive Evaluation, Competitive Heuristic Evaluation, and Competitive User Testing

- Integrate the mapping interface in housingmaps.com with the search functionality of apartments.com
- Provide a way for users to enter "points of interest" for easier navigation
- Provide estimated time of travel to locations
- Give feedback to the users (e.g. number of returned search results or number of matching criteria)
- Provide multiple ways to search for a location (e.g. city/zip search and map search)
- Provide ability for users to save listings

1.3 Prototype Evaluation

- **Does our prototype address the issues found with current online apartment sites?**

Usability Technique: Usability Testing (3 Rounds)

- Focused on functionality suggested in the competitive user testing
- Received positive feedback from participants in the usability study on the feature enhancements beyond competitors
 - 3/6 participants said that they would use HomeSKIM as their primary search application, referring to craigslist only to get additional information.
 - 4/6 participants (4/4 participants familiar with housingmaps.com) preferred HomeSKIM to housingmaps.com

- **What additional improvements can be made to enhance our prototype?**

Usability Technique: Usability Testing (3 Rounds)

- Provide a categorized local search, so users do not have to think of particular business names
- Provide better data quality from craigslist by parsing listings to include more relevant data
- Provide ability to print listings and favorites

- Provide ability to show driving distances and times to public transit and local search locations, rather than user entered addresses

1.4 Application Demo

An interaction demo of the HomeSKIM project can be found at <http://dream.sims.berkeley.edu/groups/homeskim/prototype/index.html>.

Documentation for the HomeSkim project can be found at <http://groups.sims.berkeley.edu/homeskim/site/>

2 Introduction

Searching for housing is a task most of us are familiar with. For many it involves much more than just responding to a listing and signing a lease. Many variables, such as price, number of bedrooms, and location play into the selection process. As the set of variable becomes more complex, the experience inevitably becomes more time consuming and frustrating.

HomeSkim aims to alleviate some of those frustrations by pulling together information that is not accessible directly from apartment listings and presenting it in a user friendly fashion. HomeSkim allows users to compare the desirability of different listings by providing relevant map and neighborhood data alongside listings information.

3 Problem Statement

The advent of the Internet and websites such as Craigslist.org has substantially eased the task of apartment hunting by eliminating the need for scouring a multitude of local newspapers and driving around neighborhoods looking for “For Rent” signs. Craglist.org and other similar sites provide access to classified listings information to a growing audience. Often the set of apartment listings that can be accessed through the Internet is exponentially larger than would have been available through newspapers alone.

Apartment hunters face the challenge of making sense of all this data and narrowing their search down to a manageable set of potential matches. Our research has shown that apartment hunters currently receive very little help in this arena. The standard approach is to provide filters allowing users to narrow their search down based on the information available in the listing, such as price or number of bedrooms. Housingmaps.com went a step further by allowing its users to see where apartments are located with respect to each other on a map.

It is important to recognize, however, that specifying basic criteria such as price, number of bedrooms and general location is only the beginning of the selection process. Factors such as proximity to transportation, or certain points of interest, as well as other neighborhood information often play a major role in decision making.

In coming up with the idea for HomeSkim, we were motivated by the observation that people are often forced to turn to several different sources to evaluate each listing. For example, an apartment hunter finds a listing on Craigslist. After selecting a listing, she loads a mapping application such as Google or Yahoo! Maps to determine the location of the apartment. If she is concerned about public transportation, she may also need to open a separate instance of the mapping application to see nearby transit stops, since currently there is no way to map transit information and user entered addresses simultaneously. Depending on the complexity of her search criteria, the user might have to work with an unwieldy number of resources in order to research any given listing.

One of the aims of our research was to identify the major variables that go into the apartment selection process. Another goal was to incorporate those

variables into a working prototype of a system that allows apartment hunters to gather as much relevant information about available listings as possible without having to spend a lot of time and effort.

4 Objectives and Scope

Our research focuses primarily on accessing and visualizing information relevant to apartment hunters. Throughout the process we aimed to learn and understand as much as possible about the behavior and practices of apartment hunters and to bring that understanding into the design process.

For reasons of time we have only studied the needs and behavior of apartment hunters in the San Francisco Bay Area but an important objective of our project was to provide a model that can be easily extended to other parts of the United States.

Due to resource constraints we chose to use apartment listings made available through Craigslist.com, rather than building up our own listings database. Our data was more limited than what our user research has deemed appropriate listings set. While we had to structure our prototype around the available data, we note these shortcomings in our report and describe the ideal solution given sufficient time and resources.

Another objective was to be able to apply the insights we have gleaned by working on the HomeSkim project to other applications that might benefit from the availability of complex map based data. Relevant applications include real estate sites, hotel finders, meeting place selectors, tour planners and many others. We discuss these in more detail in the Future Work section of this report.

5 Relevant Coursework

The HomeSkim project integrates the skills we have gained in the two years of the iSchool program. The following are the courses we found especially relevant in the development of HomeSkim:

- IS 214 - Needs and Usability Assessment
- IS 256 - Applied Natural Language Processing
- IS 247 - Information Visualization and Presentation
- IS 213 - User Interface Design and Development

Through the Needs and Usability Assessment class, our team analyzed how people search for apartments and discovered the limitations of competitive sites. Applied Natural Language Processing was relevant for parsing the listings data from Craigslist. Information Visualization and Presentation gave the team a structured approach to visualizing apartment information through a map interface. User Interface Design and Development provided a structure to develop and analyze feedback for the multiple iterations of the HomeSkim interface.

6 Research and Development Methodology

For our research and development methodology, we followed the methodology introduced to us in IS 213 – User Interface Design and Development. In order to ground our design in concrete user data we conducted first completed a needs assessment stage of our project. As we moved on to prototype development and evaluation, we went back to our target users to make sure that our prototype was not only easy to use but also satisfied the needs that were originally outlined as well as those that might have come up during the development process.

7 Needs Assessment

7.1 Online Survey

7.1.1 Methodology

To better understand the apartment searching process, our team conducted an online survey. The survey was distributed to people across the United States, from Alaska to Massachusetts, through email and online web postings.

After identifying the main types of people who search for apartments 1) education relocation 2) job relocation or 3) family/housemate change situation, the HomeSkim team distributed the survey through personal contacts who met one of the previous criteria. The survey was also posted on a nationwide company online mailing list and a couple online journals (blogs).

This survey informed the team about the following apartment hunting factors.

Apartment Search Process and Motivation

- Length of apartment search process
- Reasons for looking for an apartment
- Methods people used to search for an apartment
- Number of people involved in apartment search

Key Apartment Criteria

- Important factors when looking for an apartment
- Importance of location based on points of interests, public transportation, or proximity to work

7.1.2 Participants

63 participants completed our online survey. Below are some participant statistics.

- Age
 - 21 to 25: 33%
 - 26 to 30: 41%**
 - 31 to 35: 17%

- Student/Working Status
 - Undergraduate student: 7%
 - Graduate student: 20%
 - Working full time: 64%**
- Last Apartment Search
 - This year: 56%**
 - 1-2 years ago: 20%
 - 2-3 years ago: 11%

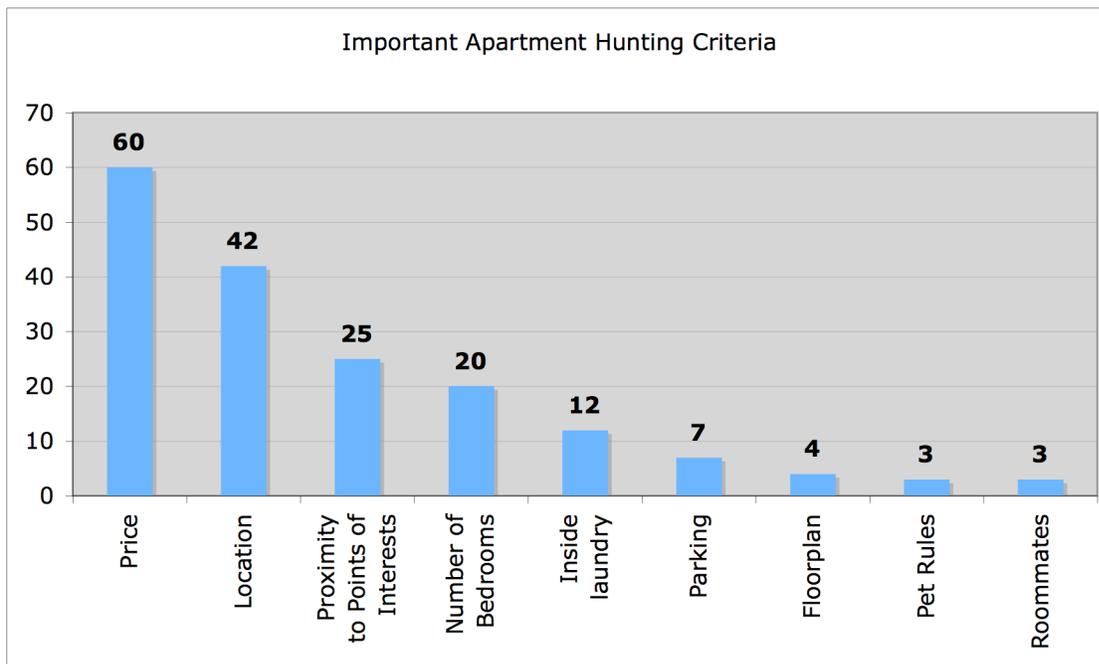
7.1.3 Key Findings

Apartment Search Process

- Length of apartment search process
 - Less than a week: 24%
 - Between a week and a month: 50%**
 - Between 1-2 months: 18%
- Reasons for looking for an apartment
 - Job related relocation: 38%**
 - Change in family/roommate situation: 25%
 - Wanted a bigger/smaller apartment: 15%
- Methods people used to search for an apartment
 - Online listings: 41%**
 - Recommendations from friends: 24%
 - Newspaper listings: 14%
- Number of total people involved in apartment search
 - 1 (Living alone) 37%
 - 2 51%**
 - 3 11%

Key Apartment Criteria

In order to determine key apartment criteria, survey takers were asked to list their top three criteria when searching for an apartment. The numbers were tallied, and the following graph shows the distribution.



- Participants defined key points of interests as:

Work:	38%
Transportation:	22%
Entertainment:	16%
Shopping:	14%
School:	8%

7.1.4 Result

- Initial Prototype:** The results from the web survey formed the basis for the initial HomeSkim paper prototype. Based on the top three important apartment hunting criteria, the team developed a prototype that would 1) map apartment locations 2) allow for easy price filtering and 3) allow users to input key points of interests.

7.2 Personas and Scenarios

To help us make the needs of our target audience more concrete, we have developed three personas whose characteristics closely match those of our target users. For each persona, we have created a scenario that helped us analyze how our application might be utilized to accomplish real world task. By providing context for the functionality we had in mind, this approach allowed us to prioritize our efforts and eliminate features that did not fit well with the goal of our application.

The use of personas and scenarios has helped to keep us on track and grounded during the needs assessment and development process. It has allowed us to design our application with real people and needs in mind rather than relying purely on the abstract notions of a user and a target audience.

For a more detailed description of personas and scenarios for HomeSkim, refer to Appendix.

7.3 Task Analysis

Based on the personas and scenarios we have come up with, as well as the initial discussions of HomeSKIM functionality, we have come up with a list of tasks that users of our application should be able to complete. The more detailed descriptions of each task emerged during the development process. Note that some subtasks are part of several major tasks. For completeness, we have chosen to include them along with each task.

Frequency refers to how often we expect users to perform a given task. Priority refers to how important implementing the functionality necessary for accomplishing a given task is to the overall usefulness of application. In some cases priority was assigned based on the assumption that while the functionality would be important within the finished product, it is not essential for the purposes of our limited prototype.

Task	Subtasks/Details	Frequency	Priority
Specify search location	Enter text in the textbox. Specify radius	Occasional	High
	Click on the map. Specify radius.	Frequent	
Specify apartment criteria	Price: enter price range	Frequent	High
	Bedrooms: enter minimum and maximum number of bedrooms	Occasional	High
	Pets: select if dogs or cats have to be allowed in the apartment	Occasional	
Specify addresses for important places	Enter address into an existing text field	Occasional	High
	Add more text fields	Rare	Medium
Examine listings within panel	Open original posting by clicking on the description link	Occasional	High
	Expand the bubble by clicking anywhere else within the listing	Frequent	
	Add to favorites by clicking on the star	Frequent	High

Examine listing bubble	Navigate between different tabs	Frequent	High
	View listing by itself with no other listings visible on the map	Frequent	Medium
	View photographs	Frequent	High
	View additional information	Occasional	Medium
	Add to/Remove from favorites	Occasional	High
Examine listing with respect to important places	Get driving times and distances from the listing to all My Place addresses	Occasional	Medium
	Map driving routes from listing to all My Place addresses	Frequent	Low
View listings on map	From the listings panel	Frequent	High
	From the bubble	Frequent	High
Add to/Delete from Favorites	On map	Occasional	Medium
	In the Favorites tab	Occasional	High
Examine favorites	On map	Occasional	High
	In the Favorites tab	Occasional	High
Search for neighborhood information	Enter keywords into the Local Search text box	Occasional	Medium
View transit stop	View stops for the different transit lines	Occasional	Medium
Order listings in the listings panel	Order listing by price, date, etc.	Occasional	Low

7.4 Competitive Interface Evaluation

7.4.1 Methodology

Before designing an apartment search prototype, our team evaluated competitive online apartment search applications. For three apartment hunting applications (*craigslist.org*, *Ontario Student Housing*, *Dynamic Home Finder*), we focused on the visual elements for conducting a search and displaying available listings.

Our team evaluated functionality and usability issues of two apartment search pages, *housingmaps.com* and *apartments.com*. Each of the sites takes a different approach to finding an apartment: map based vs. query based.

In our competitive evaluation, we performed competitive evaluations, heuristic evaluations, and user tests. The goal of the user testing was to reveal enjoyable and frustrating elements of the competitor websites. The tasks were design to highlight the limitations of the competitive websites. Our team was eager to discover how users dealt with interface limitations, such as travel distance or identification of public transportation lines.

7.4.2 Suggestions: Participant Quotes

The suggestions are ordered by function in the interface. Following each suggestion is a reference to the participant in the user testing. The table also lists the corresponding HomeSkim feature drawn from the participant suggestions.

Interface	HomeSkim Feature
The participant thought it might be nice to have the map and listings in frames, so she could decide if she wanted to see more of the map and less of the listings (and visa versa). (Participant #3)	Listings and Apartment Criteria have a Hide/Show Feature. If a side panel is hidden, the map enlarges to fill the hidden space.
Listings	
The participant would like to know how many listings come up. This would tell the participant the amount of listings and help to find average prices. (Participant #2)	The Listings Tab specifies the number of listings shown.
Pricing	
The participant compared the price range on <i>housingmaps.com</i> to <i>craigslist</i> . "I don't like the range, where I can't put my own maximum." (Participant #3)	In the apartment criteria, the user can specify the maximum and minimum prices.
Navigation	
"It'd be good to specify the zip code and list a 5-10 mile radius. There's a lot to look at in the southbay, but no way to really look at it. It requires a lot of scrolling." (Participant #1)	In the apartment criteria, The user can specify a zipcode or city/state combination with a radius.
Points of Interest/Transportation	

“I don’t know where UCSF is. I want to see it on a map. Is there a way to do that?”
“How do I know if I can get there from this apartment?” “I don’t know how to do this to see how close it is to UCSF.”
• After realizing that she couldn’t search accurately by typing UCSF, the participant stated, “I wish I could search by location.”
(Participant #3)

Users can perform a local search, which will plot a marker at the searched location.

Estimated Time of Travel

“It would be better if it can show distance in miles (since this is standard) and driving time.” (Participant #3)

In the driving tab, the user can find the distance in miles and driving times for their key places.

Marker

“I would like to track a location or multiple locations. I want to type in a location and show as a star on a map.” “Or if I could track a few places: church, work, relatives, or other points of interest.” (Participant #3)

Users can specify their key places addresses and have their places plotted along with the listings.

7.4.3 Design Recommendations

The design recommendations have been compiled from the results of each of the competitive usability evaluations. The recommendations are broken down into sections by functional area: overall, search, listings, and map. Following each recommendation is the source usability technique. The recommendations are ordered by level of importance and/or frustration to the user.

7.4.4 Overall

- **Provide Instructions on How to Navigate the Site:** Apartments.com provided clear instructions for search, whereas housingmaps.com's instructions were ambiguous. (Competitive Evaluation)
- **Provide a Legend if any Special Markers are Used:** Housingmaps.com's markers were confusing for all three users, since there was no legend on the page.

7.4.5 Search

- **Provide a Map Interface for Location Search:** This is helpful for users who are apartment hunting in an unfamiliar area. (Competitive Evaluation, User Testing)
- **Provide Multi-Step approach for Search:** For unfamiliar areas, it would be helpful for the user to have a multiple steps to identify location and enter search criteria. A one page search/results page may be overwhelming to the user. (Competitive Evaluation)
- **Provide Open Form Fields for Price Search:** Rather than selecting a price range from a drop down, allow users to manually enter price through a form field. (Heuristic Evaluation)

7.4.6 Listings

- **Show Available Apartments on a Map:** Though it is good to list available apartments in tabular form, plotting available apartments on a map allows users to visually identify where apartments are located. (Competitive Evaluation)
- **Provide a Summary of User's Search:** When listing search results, remind users what they originally entered. (Competitive Evaluation, User Testing)
- **Allow Users to Search Descriptions:** Important information may be available in the apartment descriptions. If the description is not searchable, the user may not be able to identify the apartment. (User Testing)
- **Provide Listings that Match Search Results:** Do not provide listings that do not fit the user's search criteria. One participant felt "lied to." (User Testing)
- **Do not display Expired or Incomplete Listings:** Listings should be complete, including pricing information. (User Testing)

- **Prices should be Ordered Logically:** Price should be ordered in an increasing or decreasing manner, not arbitrarily. (Heuristic Evaluation, User Testing)
- **Provide Feedback about Listings:** Identify why a particular apartment listing is good (e.g. 3 out of 3 amenities match). (Competitive Evaluation)
- **Provide way for Users to Save and Share Listings:** This would allow users to save favorite listings and distribute listings to friends. (Competitive Evaluation)
- **Provide Neighborhood Information:** Information about close public transportation, freeways, and schools is very helpful. (Competitive Evaluation)

7.4.7 Map

- **Provide Ability to Mark and Reference Points of Interest:** Users should be able to view and manually mark relevant points of interest. (User Testing)
- **Provide Estimated Time/Distance to Locations:** Participants wanted the average driving times or distance in miles to user inputted locations or key points of interest (transportation). (User Testing)
- **Provide a Mini Map Legend:** This way users will not get lost within the map due to the zoom level. (User Testing)

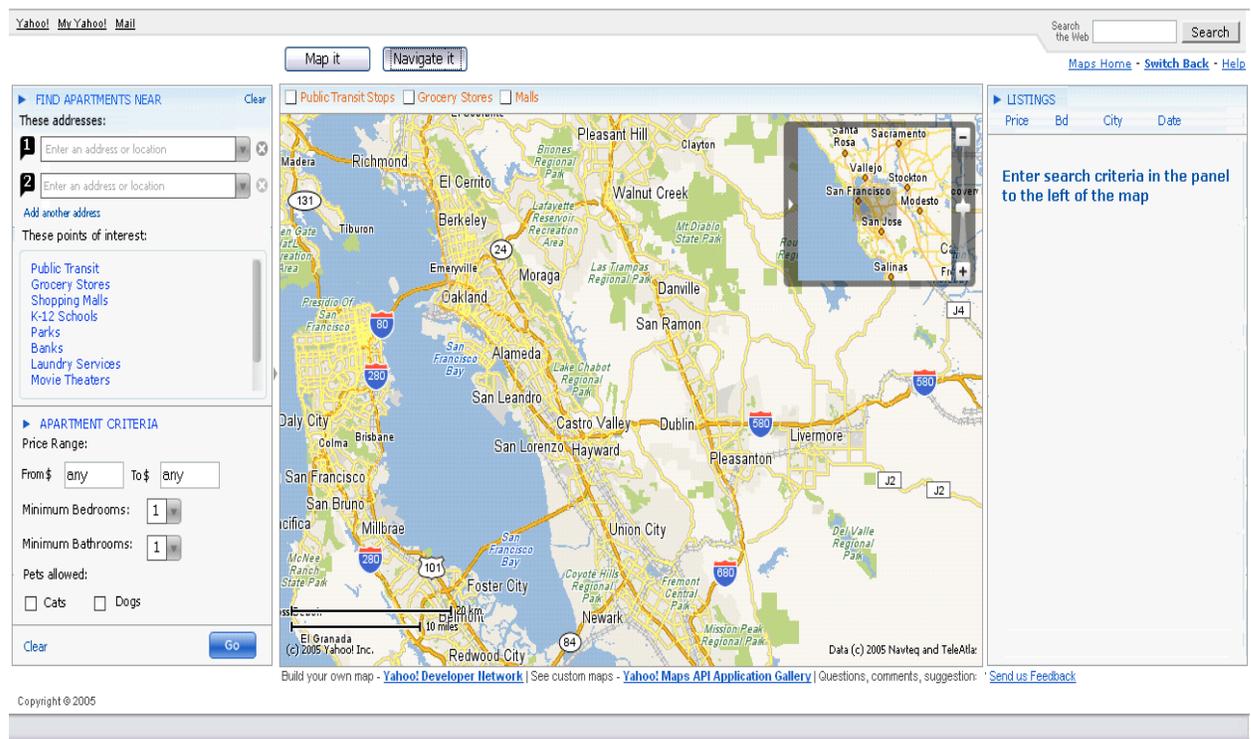
8 Prototype Development

8.1.1 Prototype #1: Suggested Area

This prototype was developed and tested under the assumption that our application would determine the search area for the user. This area is referred to as “suggested area” in the write up. After our needs assessment interviews revealed that users would prefer to select their own area, this portion of the interface had to be completely redesigned. (See: *User Interviews: Suggested Area?*) However we found that the rest of the interface was still applicable to our modified objectives and the lessons we have learned from usability testing done on this prototype still relevant. The prototype was created using Jasc Pain Shop Pro and was not interactive. All testing was done using Microsoft Power Point.

8.1.2 Design

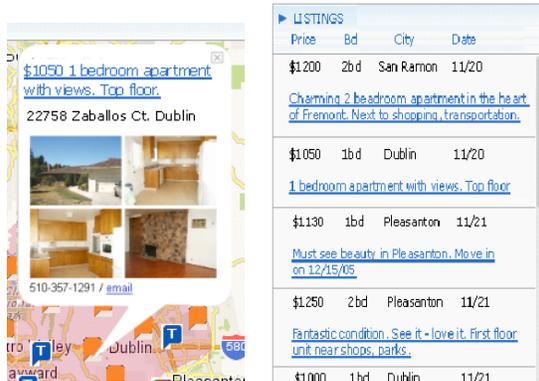
We based the layout of our first prototype on the layout of the new Beta version of Yahoo! Maps. We also felt that the layout corresponded well with our needs and gave us a good starting point.



HomeSkim Prototype #1: Main Interface

We divided the screen into three sections. The section on the left is a modification of the addresses section of Yahoo! Maps. The top part of the section is used to enter the information used to determine the dimensions of the “suggested area.” Space to enter addresses for points of interest is also

provided. Below that is a list of general points of interest that users can select as part of their specification. The lower part of the panel is used to enter search criteria for the apartments. Based on this information, appropriate apartments are selected and displayed within the “suggested area.”



Relevant apartments are visualized as markers. Points of interest are also displayed on the map via markers that correspond to the type of the point of interest they represent. The apartment listings that correspond to the markers on the map are displayed in the right-side panel.

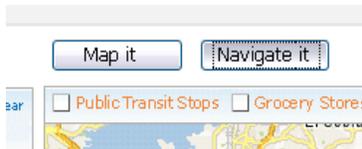
We used brushing and linking to connect the listings on the right panel to the markers on the map. When a user selects a listing, the marker for that apartment expands into a balloon that gives the users a more detailed description of the apartment together with pictures if available. If users click on a marker, they not only expand the marker but shift the listings on the right to bring the listing that corresponds to the selected marker into focus.



In order to make the interface’s functionality more flexible, we wanted to provide users with a way to see points of interest without having to recalculate the “suggested area.” To accomplish this, above the map, we provided a toolbar with a list of points of interest and a checkbox next to each of them. When users select a checkbox, markers for the corresponding point of interest category appear on the map.

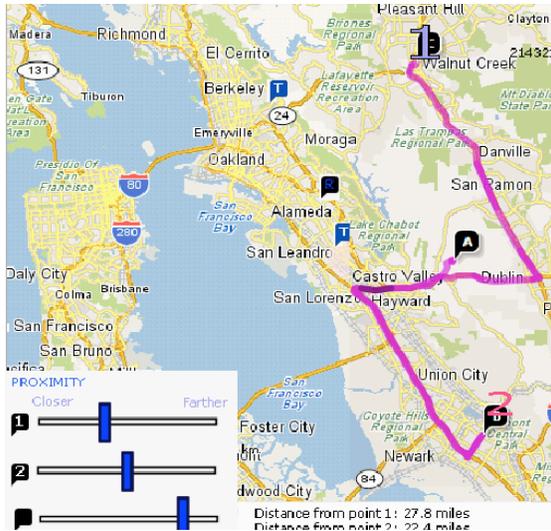
During this iteration of the prototype, we came up with several ideas about how to display and manipulate search results based with respect to points of interest.

The first idea was to give control over the “suggested area” to the user by providing him/her with a means to reshape it by clicking on an area of the map and having the “suggested area” contract or expand to fit the edge of the area to the selected point on the map.



Because clicking and dragging is already used by all map interfaces for positioning the map, we decided to implement two modes of operation. The “Navigate It” mode is the default mode and clicking and dragging in that mode serve the traditional function of positioning the map. The “Map It” mode changes the cursor from a hand to a pencil (to provide a clue to users) and

allows users to modify the “suggested area.” To allow switching between the two modes, we placed two toggle buttons labeled “Map It” and “Navigate It” above the map area of the interface.



Our second approach to user-driven control of “suggested area” was providing a slider for each of the points of interest. Moving the slider to the left would shift the “suggested area” closer to the point of interests, and moving it to the right would shift the slider away from it. Each side of the slider is labeled as either “closer” or “farther” to provide context to the user. Each slider is also labeled with the corresponding marker symbol.

We wanted to enable the users to be able to visualize the route from a selected apartment to the points of interest. When a user hovers over an apartment marker, the other markers fade into the background and route to the points of interest are displayed on the map. Route distances are also shown to allow a more quantitative comparison.

▶ MIDWAY BETWEEN A AND B			
\$1000	1bd	Dublin	11/21
1 bedroom, fireplace in living room, Hardwood floors, Remodeled kitchen.			
\$1100	1bd	San Ramon	11/21
Beautiful location, Kid-friendly neighborhood, Inside laundry.			
▶ CLOSER TO A			
\$1050	1bd	Dublin	11/20
1 bedroom apartment with views, Top floor			
▶ CLOSER TO B			
Fantastic condition, See it - love it, First floor unit near shops, parks.			
\$1000	1bd	Dublin	11/21
1 bedroom, fireplace in living room, Hardwood floors, Remodeled kitchen.			

Another idea we considered is making the relationship of apartment listings to points of interest more explicit in the right panel textual display by subdividing listings into categories. The categories would group together apartments based on their proximity to the points of interest.

8.1.3 Usability Testing

We conducted usability testing of this prototype with 5 participants that closely matched the characteristics of our target users. The results we got from these sessions were extremely useful in guiding the development of our next prototype.

8.1.4 Design Recommendations

- **Reveal information gradually.** Do not introduce too much complexity at the same time. Reinforce brushing and linking by numbering listings and markers.
- **Color should be used for differentiation.** Use of color to differentiate markers was appreciated however distinguishing same colored routes that lead to different points of interest was challenging.
- **Make button names descriptive or provide instructions.** For example, “Map It” and “Navigate It” are too ambiguous.
- **Make functionality easily discoverable.** Hovering over markers to reveal key functionality such as route and distance information is not intuitive.
- **Use objective measurement scales.** Such terms as “closer” and “farther” are too subjective. If distance is being measured, miles should be used instead.
- **Add easy and quick to use map controls.** One option is to add the ability to click on the map to include an area in the search. This option makes selection less flexible but quicker than outlining an area on the map.

8.2 User Interviews: Suggested Area?

8.2.1 Methodology

From the user survey we conducted, we knew that equidistance from user specified points of interest was a major factor in the apartment selection process. Based on that data, we came up with an idea of a “suggested area.” “Suggested area” was an area on the map calculated based on the user specified points of interests. Apartments would then be displayed within to the user within the perimeter of that area. The original purpose of this needs assessment was to determine how large the suggested area would need to be and where its boundaries would need to fall relative to points of interest in order to satisfy user needs.

Each participant was presented with three map printouts with hypothetical points of interest marked on each one. The first map had 2 markers placed far apart (One in Walnut Creek, one in San Jose). The second map had the 2 markers placed closer together (within the limits of San Jose). The third map had 3 markers with 2 markers placed close to each other and 1 far away. For each map, the participants were asked to draw an outline of an area where they would search for apartments, given the points of interest, and to explain their choices.

The objective was to observe how the participants determine their search area in order to then approximate that approach in the suggested area algorithm we were planning to incorporate into our application.

8.2.2 Participants

We interviewed 5 participants, 2 females and 3 males.

- All participants have used the Internet to look for housing.
- 4 participants are married and 1 is single.
- 1 participant has children living with her.

8.2.3 Results

The results showed that the process by which people choose where to look for housing is much more complex than we anticipated and than could have been predicted by such quantitative methods as an online survey.

While all participants said that reasonable distance to frequent locations for all member of the household is an important factor in the apartment selection process, it is not the primary one.

The first thing one participant immediately looked for was proximity to parks. The reason he gave was that he likes walking and parks make the neighborhood look good. Another participant said that because her teenage children don't drive, proximity to public transportation is more important than driving time to either her or her husband's place of work. A revealing quote was “I'd rather drive to work than be a taxi driver for my kids.” When presented with the map with three locations plotted on it, the same participant pointed that her choice of an area would depend on exactly what those mappings represented. For example, if the three locations represent job addresses of 3 working members of the household, equidistance is important. However, if the three

locations are places that are relevant just for her, she would like to live to one side of them. That way she can stop by all of them on her way from or to work.

The theme of the importance of neighborhood information ran through all four of our interviews. Factors such as how close the area is to supermarkets, dance clubs and other local establishment played a major role. Access to freeways and routes that are known to be less traffic prone proved more important than total distance from points of interest. School districts and crime rates were also mentioned as major factors.

At the end of the interview, participants were specifically asked if they would like to have a system suggest a search area to them based on equidistance from their points of interest. One participant said that he would never use such a feature because he likes to make his own decisions. Others said that while this was an interesting idea, ultimately, since equidistance is not the main deciding factor, they don't think they would use this feature as much as options that allowed them to gather information about neighborhoods under consideration. Two participants pointed out that the suggestion feature would be useful as a starting point for someone who is completely unfamiliar with the area, but they also pointed out that without the additional information this suggestion would not have much value. Moreover, it could not be trusted, since it might lead the apartment hunter to rent an apartment in a very undesirable neighborhood.

8.2.4 Lessons Learned

This accidental needs assessment interview proved to be a valuable lesson for the team. At the point when the interviews were conducted, we had already sketched out and usability tested our first prototype and was ready to begin development. During those usability tests we never raised the issue of how useful the suggestion feature would be, concentrating more on the easy of use aspects of the prototype.

The biggest lesson we got out of this experience is not to make assumption about what the users need or want. The conclusion we came away with was that we needed to rethink our concept. Instead of trying to make decision for our users, we decided to present them with as much relevant information as possible in a manner that would make their decision making process easier.

8.2.5 Design Recommendations

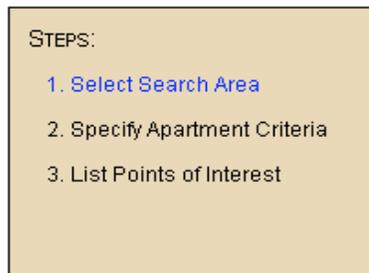
- ***Do not assume locations on the behalf of the user.*** Providing a "Suggested Area" will not be useful for the users, because individuals have different preferences where they would like to live. It is better to provide them with relevant data, so the user can choose the ideal location for himself.

8.3 Prototype #2: Step Approach

In the second iteration of our interface we tried to incorporate all the relevant lessons we learned from our first round of usability testing and build up the general design layout introduced in prototype 1.

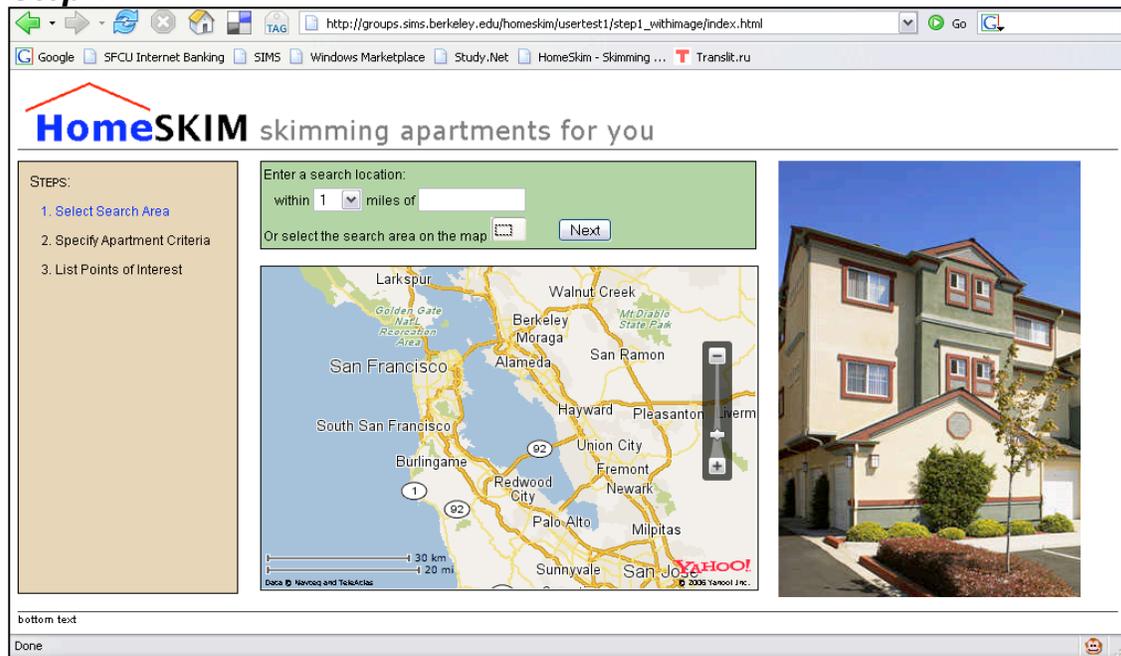
The prototype#2 interface was partially interactive. Users were able to fill in the apartment search criteria, but the resulting listings as well as the map were simulated with non-interactive images.

8.3.1 Design



Building on the feedback we received at our usability testing process, we implemented a step-wise set up process. With this approach, users are introduced to the interface features sequentially to reduce the perceived level of complexity by the time they encounter the main page. Each step is numbered and named to correspond to the functionality that step represents. As users move from step to step, their current step is highlighted in blue.

Step 1



Step 1 allows users to specify their search area in two ways. Users can either enter city, state or zip code in the provided text field or specify it directly on the map. This is accomplished by turning on the selection mode and selecting a rectangular area by dragging the mouse diagonally across the map. Users can also control the search radius by selecting the appropriate radius length from the drop down menu.

Step 2

STEPS:

1. Select Search Area
2. Specify Apartment Criteria
3. List Points of Interest

APARTMENT CRITERIA Clear

Price Range:
From \$ to \$

Minimum Bedrooms:

Maximum Bedrooms:

Pets allowed:
 Cats Dogs

Back Next

Step 2 allows users to specify criteria that an apartment listing must match in order to be of interest to the searcher. These include price range, number of bedrooms, and whether pets are permitted in the apartment.

Step 3

STEPS:

1. Select Search Area
2. Specify Apartment Criteria
3. List Points of Interest

POINTS OF INTEREST Clear

Enter Points of Interest such as work, school, or favorite place to hang out. Your Points of Interest will be plotted along with your apartment listings.

1 X

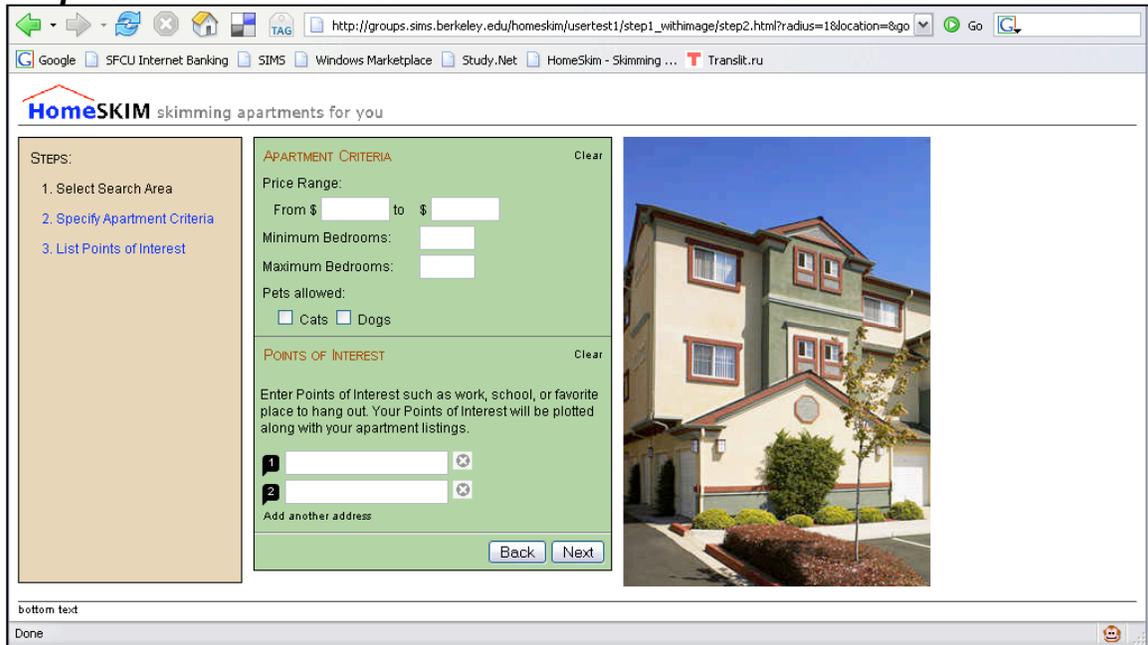
2 X

Add another address

Back Next

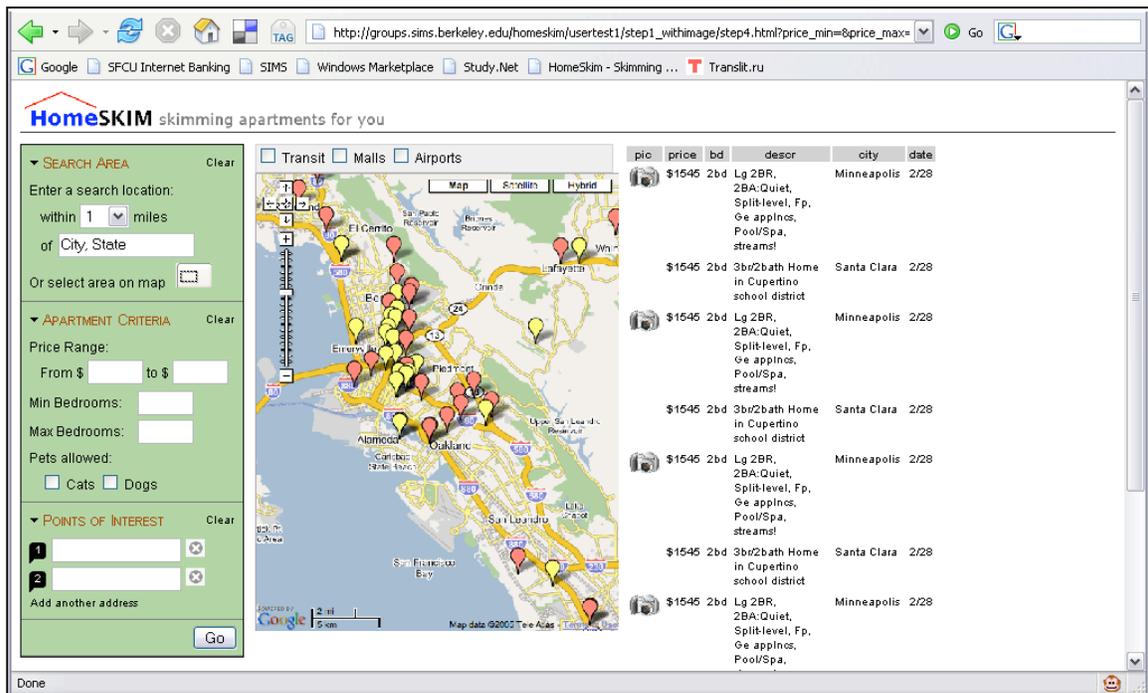
Step 3 introduces the concept of a Point of Interest and allows users to enter their points of interest at this stage. They can also skip this step and fill the points of interest information in on the main page of the interface.

Steps 2 and 3 Combined



We created an alternative step sequence combining steps 2 and 3 in order to see which approach users would prefer. We were concerned that our original sequence might be too granular.

Main page



We kept the layout of our main page similar to our previous prototype. In the left panel, the users are able to modify the criteria they specified during the set up process. The relevant listings appear on the right. Markers are expanded by clicking and we retained the brushing and linking functionality outlined in our original prototype. Specific addresses for points of interest can be entered on the left, and viewing categories of points of interest can be accomplished by selecting the appropriate category at the top of the map.

8.3.2 Usability Testing

In this study, we aimed to test the usability of the initial setup process for the HomeSkim application. The study was conducted with the help of 5 participants. The participants were selected on the basis of criteria we identified as characteristic of our target audience. All participants identified themselves as proficient in their computer skills. 3 of the participants were male and 2 female. Participant age ranged from 24 to 47. For more details about the Step Approach usability testing, refer to the Appendix.

8.3.3 Design Recommendations

Step Panel

- **Prevent non-clickable text from looking like a link.** Change the color of the current step from blue to red.
- **Provide short explanations of steps or eliminate step names.** Giving only the names was confusing because at this point people didn't know what the names represented.

Step 1

- **Make format expectations clear.** Either show the format within a textbox or give an example next to the textbox.
- **Replace the "outline" area functionality with "click and zoom" area selection.** Outlining and area is cumbersome. Simple clicking speeds up the area selection process.

Step 2

- **Add other selection criteria such as bathrooms.** This recommendation will not be possible to implement within the constraints of this project due to data limitations.

Step 3

- **Rename Points of Interest and rewrite the instructions to clarify the purpose of the functionality.** Clearly specify the format information should be entered in. This can be done within the textbox itself, or by providing an example next to the textbox. Consider proving the more general Google Local type functionality. This, however, is not a priority.

Main Page

- **Minimize user need to leave our application to get additional information.** Include apartment description in the bubble.
- **Add ability to compile a list of most relevant listings.** Give users the ability to mark listing as favorites.

Overall

- **Give buttons more descriptive names.** Rename the final “Next” button on the Step 3 page to either “Finish” or “Show Results.” Rename the “Go” button on the main page to either “Submit” or “Show Results.”
- **Give users a way to get to the main page without going through the steps.** On the first screen of the interface provide a “Skip wizard” link within the Steps panel. Clicking on the link would take users straight to the final page.

8.4 Prototype #3: Interactive Prototype

Prototype 3 was our first fully interactive prototype. We felt that the overall look and feel of the interface had significant improvements over previous iterations thanks to the feedback we received over the course of the earlier design cycles.

8.4.1 Design

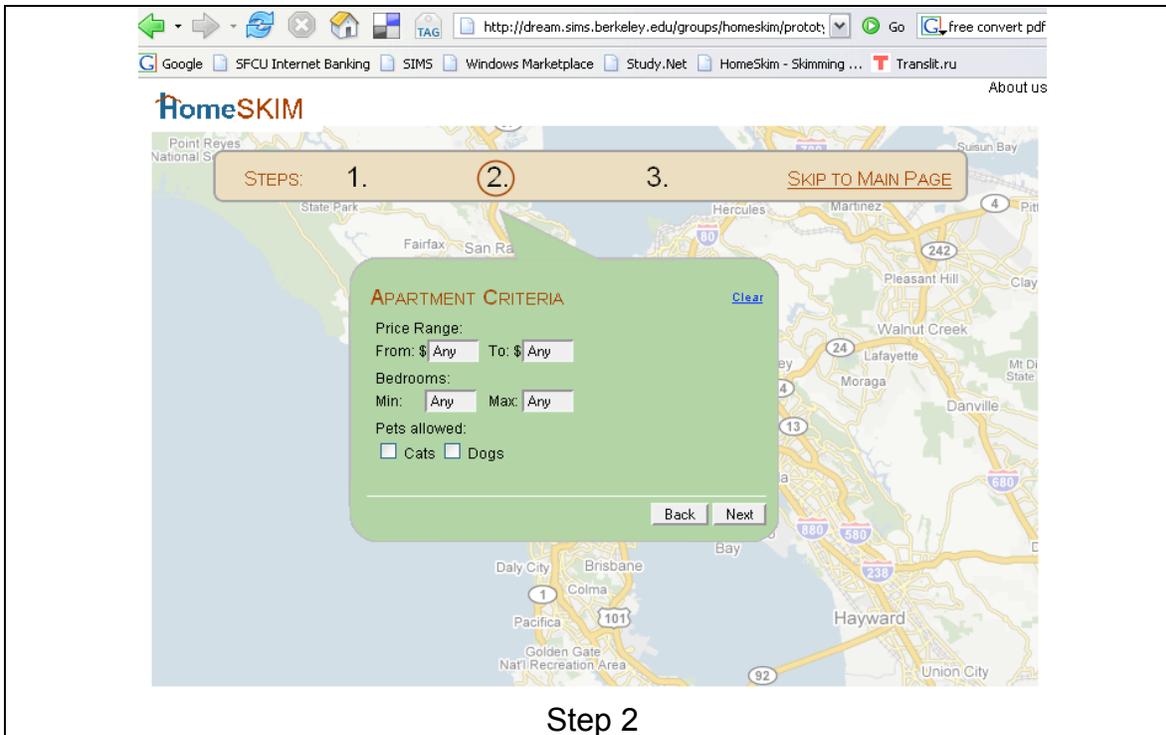
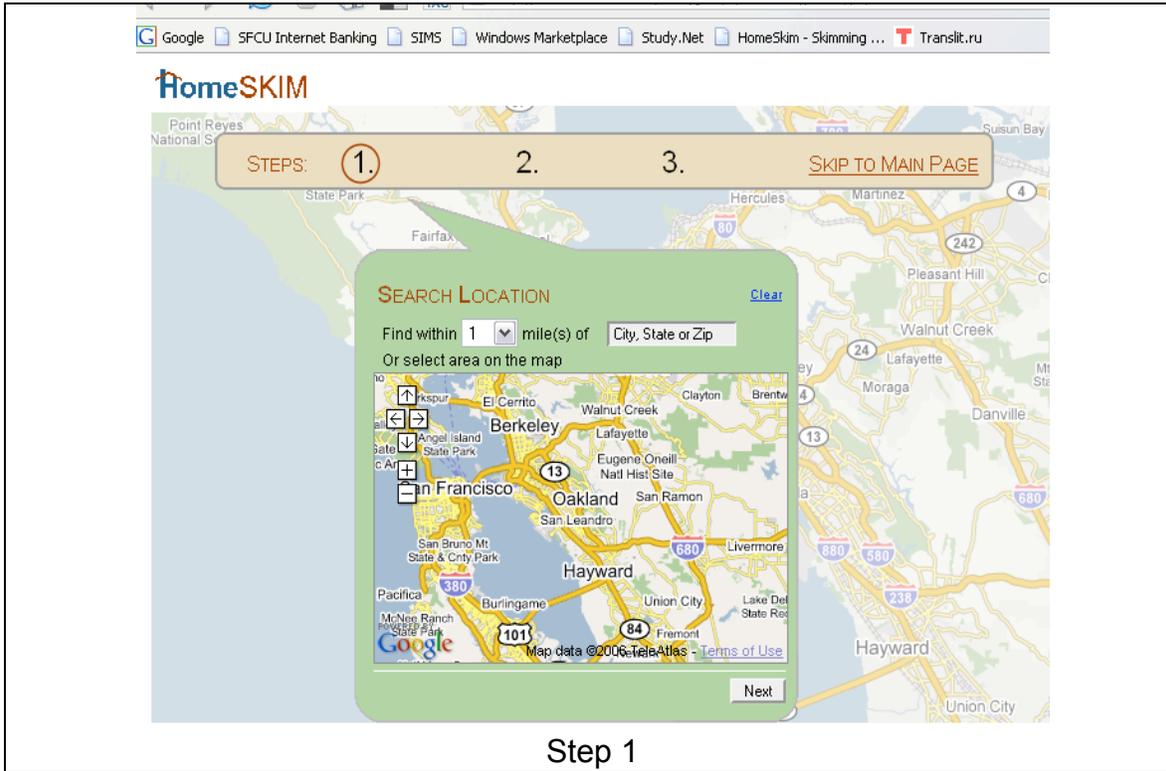


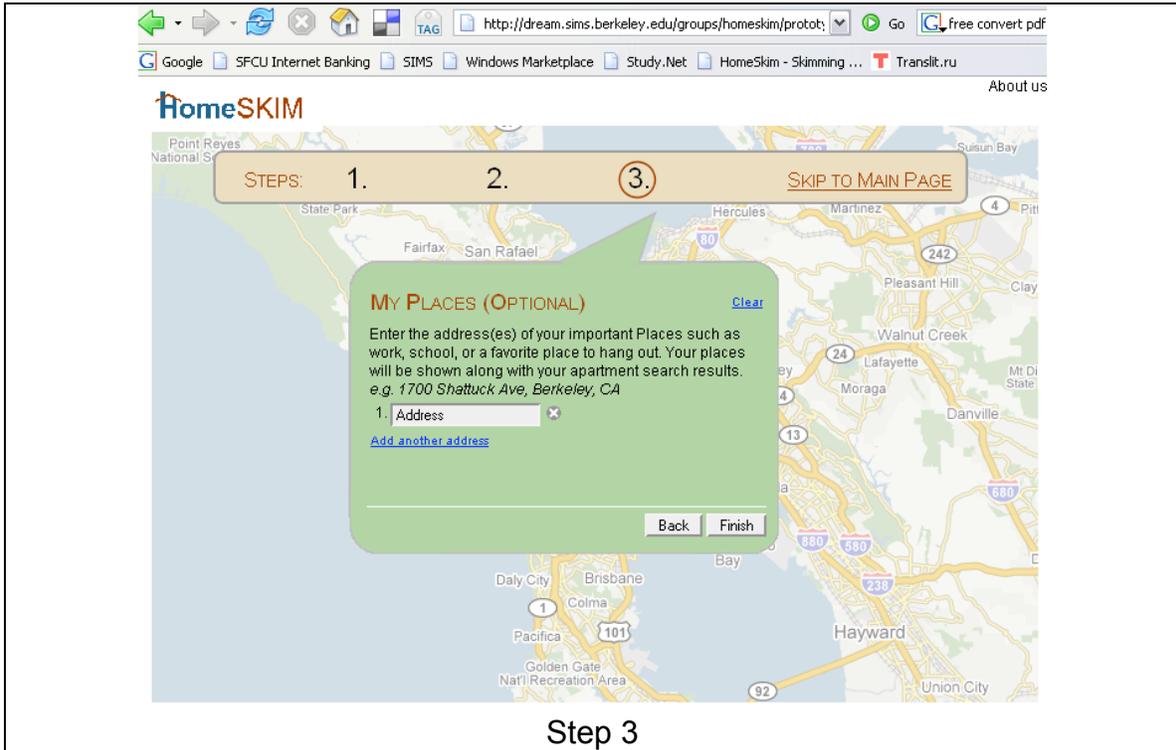
In this iteration of our design we modified the Steps panel in accordance with the feedback we received during our usability testing.

In particular we removed the step names and added a link to the main page to enable users to skip out of the setup wizard.

Steps

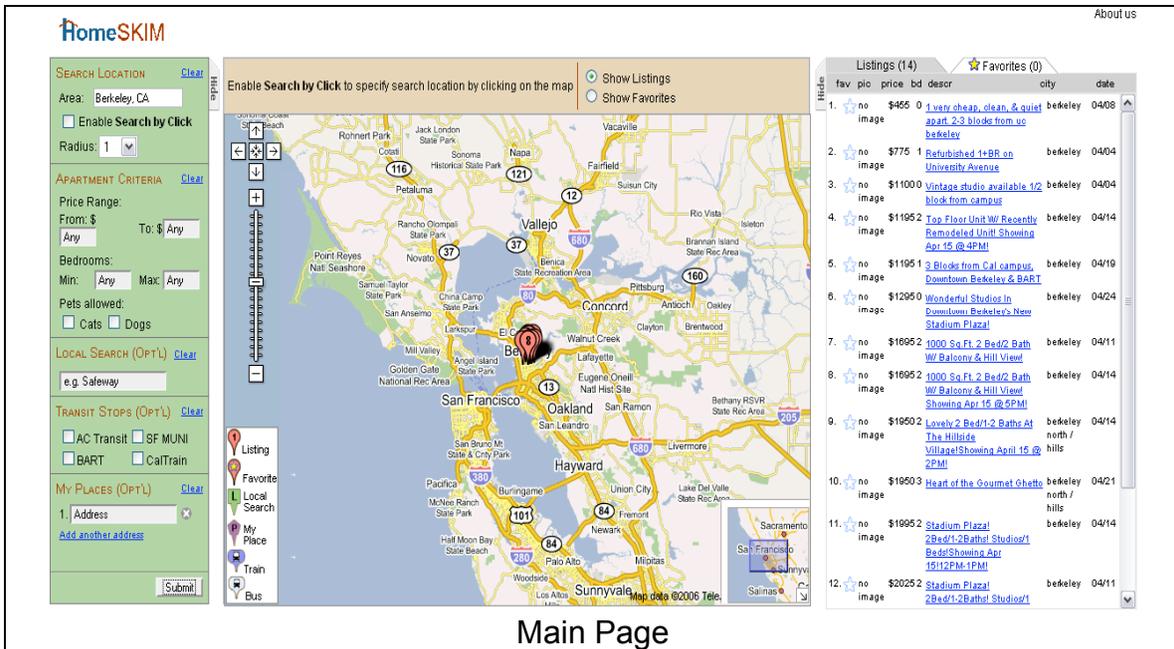
While we modified the look of the steps to make them more aesthetically pleasing, the functionality remained largely unchanged from our previous iteration. The most significant change was the substitution of the “outline” feature for the “click and zoom” suggested by study participants.





As illustrated in step 3, we have renamed our Points of Interest feature to My Places to make it more obvious to users that the function referred to addresses rather than general categories. We have also provided more extensive instructions.

Main page



Main Page

The general layout of the main page remained unchanged from the previous prototype. A mini map was added to the map panel to aid navigation.

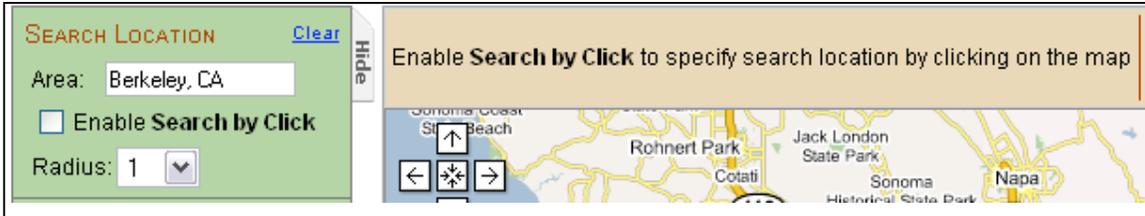


However, the criteria panel changed significantly since the previous iteration. Because viewing transit and local information is logically related to viewing My Places, these features were grouped together in this panel rather than being presented separately with My Places in the panel and other options in the top bar.

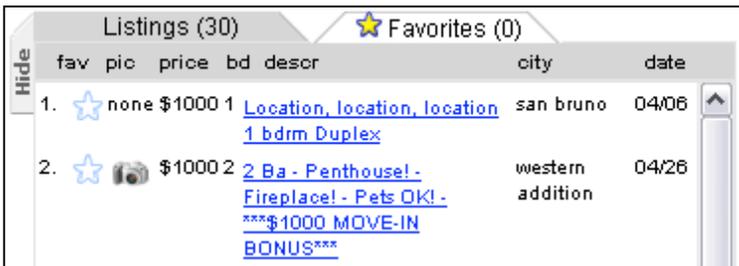
To make transit information more specific, we introduced the ability to see different Bay Area transit lines separately from one another. We have also introduced keyword based local search in place of category based checkboxes.

To increase viewing flexibility, we have introduced the “hide” option that allows users to enlarge the map by hiding either of the side panels when not in use.

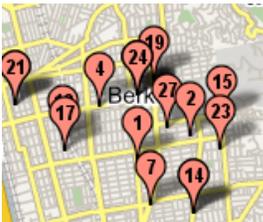
As mentioned above we made selection of search area directly on the map very easy for our users by making it possible to do so with a single click. In order to minimize accidental searches this functionality is available only when “Search by Click” is enabled. When “Search by Click” is disabled, clicking on the map exhibits the standard behavior of recentering the map relative to the point of the click.



To make discoverability easier, instructions on how to enable “Search by Click” are provided at the top of the map. When “Search by Click” is enabled, instructions on how to disable it are provided, giving the user a way to easily see the status of the system.



The general layout of the listings panel remained the same throughout our design iterations. We have also maintained the brushing and linking functionality. Thus, when the description of a listing is clicked a corresponding marker on the map is expanded, and when a marker is clicked, the listing in the panel is highlighted



We have also reinforced this function by numbering the listings and adding corresponding numbers to the markers.

In this iteration of our design we introduced the “Favorites” option requested by many participants in our usability studies. One way to add a listing to Favorites is by clicking on the listing’s star.



To view their list of favorites, users can click on the “Favorites” tab. To remove a listing from the “Favorites” list users can click on the ‘x’ next to the listing.

When the “Favorites” tab is selected, only the markers that correspond to the listings in that tab are shown on the map.

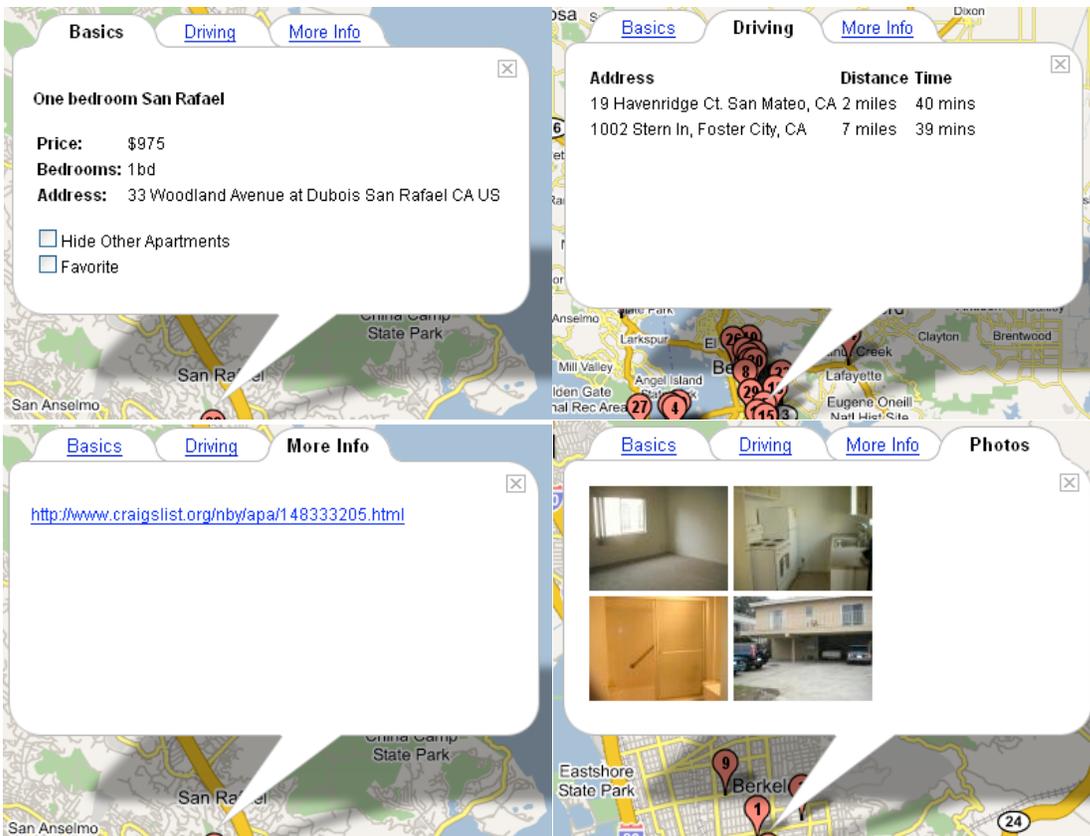


The “Favorites” and “Listings” tabs can also be manipulated by selecting the appropriate radio button in the top bar.

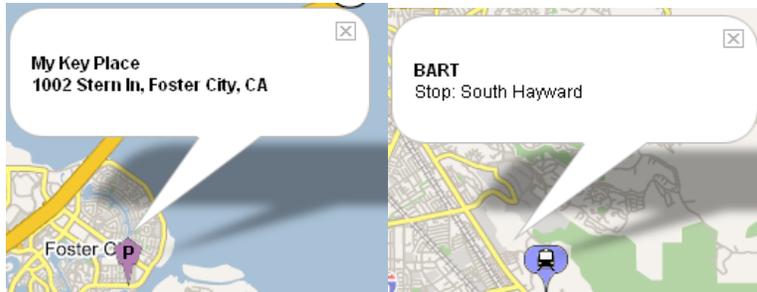


Different types of information available on the map are represented using different markers. A legend is provided in the lower left corner of the map avoiding the need to force users to constantly remember what each marker means.

Expanding the Listings and Favorites marker enables users to get additional details about the listing. The expanded marker also provides another way to add a listing to Favorites.



The Driving tab displays driving times and distances to the user's My Place addresses. The Photos tab is only visible if photos for that listing are available.



Expanding other markers displays basic information about the location that marker represents.

8.4.2 Usability Testing

To test the usability of our first fully interactive prototype a trained usability expert conducted a Heuristic Evaluation of the prototype.

Our team also conducted a user testing of the interface. Six participants took part in the study, three male and three female. Participant ages ranged from early 20s to early 40s. The objective was to find out what problems areas remain in the interface and what can be done to make it even more intuitive to learn and utilize for our users.

Refer to appendix for the complete results of the Heuristic Evaluation and User Testing for this prototype.

8.4.3 Design Recommendations

Specifying search location

- **Provide format and instructions for identical functionality consistent and precise across all pages.** Reword both Step 1 and Main Page to say “within _ miles from center of city.”
- **Provide zoom level on the map correspond to the radius specified by the user.** When radius changes, zoom the map to the level specified by the radius.
- **Provide the Search by Click functionality more visible and provide better instructions.** Move the Search Area section to the top of the maps. This would allow for more prominence and more room for clear instructions.

My Places

- **Rename My Places to better differentiate them from apartment listings.** Rename “My Places” to “Key Places” in order to eliminate the word “my” that elicited associations with “my apartment” for some participants.
- **Provide better indicators of key functionality.** Rewrite instructional text to mention that driving information from listings to Key Place addresses will be available.

Listings/Favorites Panel

- **Provide easy access to photos from within the panel.** When the camera icon is clicked, the listing marker should expand with the photo tab as the active tab.
- **Provide the ability to print Listings and Favorites.** Add a print link above the listings panel. When clicked, it would format the active tab (either listings or favorites) to a printer friendly format and send it to print.

Expanded listing

- **Provide the poster's contact information.** Add contact information to the Basics tab.
- **Provide the text of the apartment description in the More Info tab.** If we are not able to give users any information other than the link, move the link to the Basics tab and remove the More Info tab.
- **Photos in the Photos tab should be clickable.** Either open up a new window with the original posting or present the bigger version of the clicked photo.

Transit

- **Listings should be more prominent than the transit information.** Because of the time limitations the best we might be able to do is make the markers smaller.
- **Transit and other expanded markers should also have driving times.** Because of time limitations, we should at least add the address to the Bart station markers. Those were the ones people were most interested in.

Local Search

- **Be clear with the Local Search functionality.** Provide instructions explaining exactly what's to be expected.

Navigation

- **Make it clear that users know the screen for the third step is not the last screen of the application.** Rename the "finish" button to "search."

8.5 Final modifications to the prototype

While time limitations prevented us from implementing all of the changes necessitated by our final round of usability testing, we decided to tackle as many of them as time permitted.

The main changes were centered around providing clear instructions for the steps and various HomeSkim functionalities.

Steps

SEARCH LOCATION [Help](#)

Within mile(s) from the center of

Or select area on the map

In the last usability study, users were confused with the term “Radius” in apartment search. We have changed the text to “Within _ miles of city center.”

MY PLACES (OPTIONAL) [Help](#)

Enter the address(es) of your important Places such as work, school, or a favorite place to hang out. Your places

We also remained “My Places” to “Key Places”, where users can enter their key addresses relevant to their location search. Key places shows the importance of various addresses, removing the ambiguity of “My Places.”

We also improved the instructional text around Key Places, so users will know that driving times will be provided for the addresses they enter.

Main Page

HomeSKIM [About us](#)

APARTMENT CRITERIA [Help](#)

Price Range: From: \$ To: \$

Bedrooms: Min: Max:

Pets allowed: Cats Dogs

TRANSIT STOPS (OPTL) [Help](#)

AC Transit SF MUNI BART CalTrain

LOCAL SEARCH (OPTL) [Help](#)

KEY PLACES (OPTL) [Help](#)

1.

[Add another address](#)

SEARCH LOCATION [Help](#)

Within mile(s) from the center of

Or Check to set search area by clicking on the map

Listings (2) [Favorites \(1\)](#)

fav	pic	price	bd	descr	city	date
1		none \$775	1	Refurbished 1+BR on University Avenue	berkeley	04/04
2		none \$455	0	1 very cheap, clean, & quiet apart. 2-3 blocks from uc berkeley	berkeley	04/08

Main Page

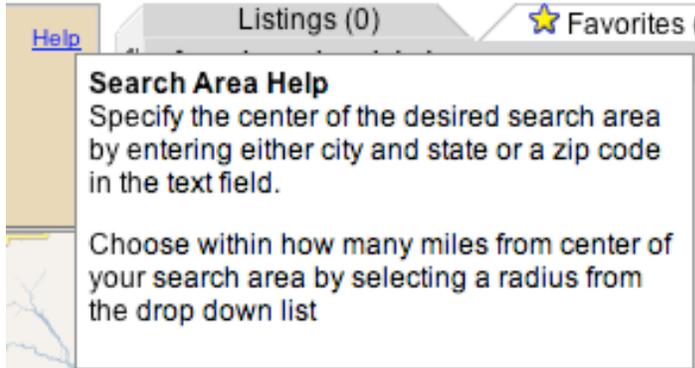
The overall layout of the main page remained consistent with the last version of the prototype. However, the team added more instructional text and provided better layout of key functionality.

SEARCH LOCATION [Help](#)

Within mile(s) from the center of

Or Check to set search area by clicking on the map

The discoverability of the “Search by Click” function in the last version was low, because the checkbox was not well explained. We moved the Area Search in a more prominent position above the map. Since the space is less constrained, we were able to provide clearer instructions on the Search by Click function.



We added instructions for each step and search criteria in the form of tooltips. Users can click on the help icon to receive informative instructions about their current step.

In the last user study, users were frustrated when the zoom level was too high (birds-eye view) for viewing transit and apartment listings. This prototype sets the zoom level according to the radius entered by the user, which prevents the user from viewing overload of markers across a large area.

Expanded Listing

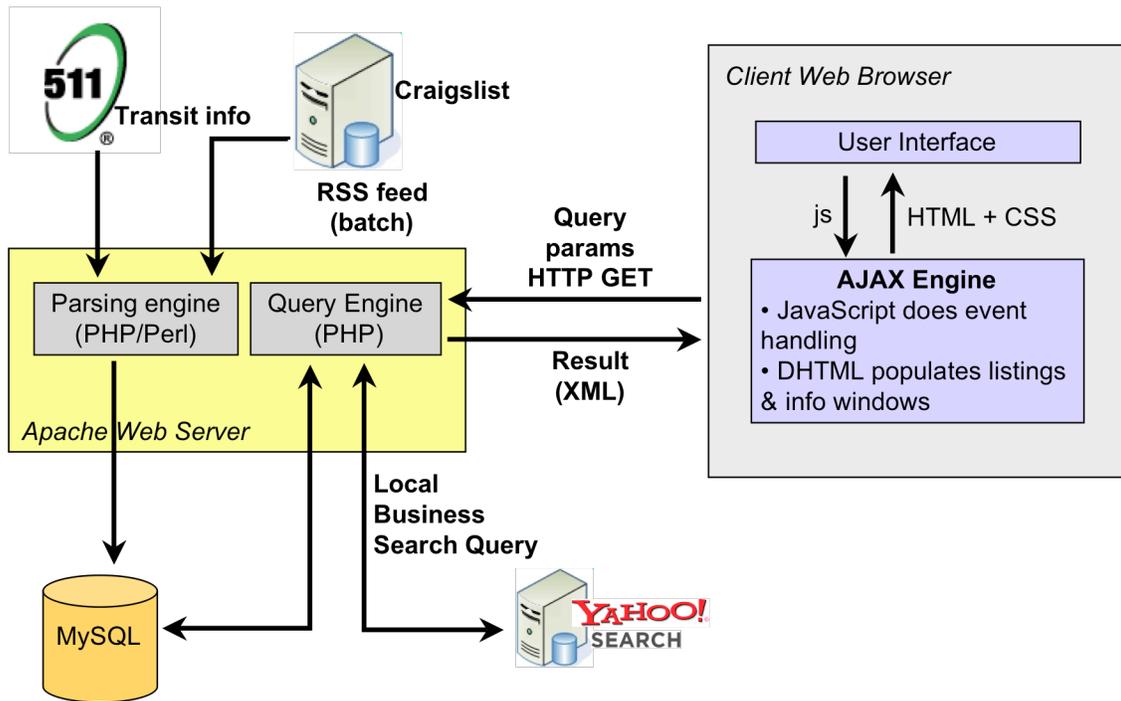
For user convenience, we added poster’s contact information to the basics tab.

9 General Design Principles

The following are the general principles for designing an apartment search application that came out of the competitive analysis and usability studies we conducted as part of our project.

- 1. Provide Instructions on How to Navigate the Site.** Make sure users don't get lost in your interface.
- 2. Provide a Legend if any Special Markers are Used.** Avoid forcing user to decipher and memorize unfamiliar symbols.
- 3. Provide a Multi-Step approach for Search.** Reduce information overload.
- 4. Show Available Apartments on a Map.** Though it is good to list available apartments in tabular form, plotting available apartments on a map allows users to visually identify where apartments are located.
- 5. Provide Neighborhood Information.** Information about close public transportation, freeways, and schools is very helpful.
- 6. Provide Ability to Mark and Reference Points of Interest.** Users should be able to view and manually mark relevant points of interest.
- 7. Provide Estimated Time/Distance to Locations.** Information about the average driving times or distance in miles to user inputted locations or key points of interest is very useful in the apartment selection process..
- 8. Zoom level on the map should be appropriate to user's need.** When radius changes, zoom the map to the level specified by the radius.
- 9. Make the format and instructions for identical functionality consistent and precise across all pages.** Don't make users wonder about the functionality. Instead, make instructions clear and consistent across all pages.

10 System Architecture



HomeSkim System Architecture

10.1 Aggregated Data

Apartment Listings - We have a batch process, coded in PHP, that parses out key entities from Craigslist.org apartment listings on a nightly basis. The process begins by calling Craigslist RSS feed for apartments, which gives us the title and the URL for each listing. From the title, we are able to extract out the city, price, and number of bedrooms. We then scrape the contents of the actual listing to extract out other entities, such as the address, contact information of the poster, and whether cats/dogs are allowed. After extracting out the address, we call the Yahoo Geocoding service to retrieve the latitude and longitude of each apartment, so that we can mark the apartment on the map. Once entity extraction is complete, the data is stored in a MySQL database. We decided to use a database for storing because we knew we would have to do a lot of sorting and filtering based on certain entities, and MySQL is optimized for such tasks.

Public Transit - To gather information on key bus lines in the Bay area, we built a simple crawler in PHP that searched through Transit 511's website to locate the intersection of every line of every bus system. For scoping reason, we chose to only fully process the information for AC Transit and SF Muni. We next scraped the addresses for each station from the Cal Train and BART websites. The final step was to call the Yahoo Geocoding service for every address/intersection and output the data to XML files. We decided that XML files would be appropriate in this case, rather than storing in MySQL, because we

knew we would not need to reprocess or filter the data when the web application called it. Thus, we could avoid the startup cost of making a database connection.

10.2 Client Web Application

For the web application itself, we utilized AJAX technologies with the Google Maps API. The application starts up as a simple PHP script. It uses Javascript with the Google Maps API V2 in order to create the map, place markers for items such as apartment and transit, create tabbed information windows for the markers, and to capture events such as clicking on the info windows or anywhere else on the map.

Once an action is called to populate or filter apartment data, a Javascript event makes a request to a PHP script that lives on our server, which returns back an XML file with the apartment search results. We then use DHTML to populate the listings panel. A similar event occurs for reading in public transit from our XML files.

Our application also allows people to perform Yahoo! Local searches. When the local search event occurs, Javascript sends the query to Yahoo through a PHP script, which returns back a XML file of the results. The results are parsed and then plotted on the map.

Javascript is also used for several supporting tasks of the web application, such as saving and viewing your favorite listings.

10.3 Supporting PHP/XML Scripts

There are several php scripts that are called from Javascript events which return back XML files to the client. Due to security settings on the SIMS servers, we could not directly call outside urls from the client, such as Yahoo Local or Yahoo's Geocoding service. As a results, we have PHP scripts which gets the query from the Javascript call, opens up a socket to the outside url, processes the results, and returns back XML to the client.

As mentioned earlier, a PHP script is also used to retrieve apartment data. This script is called in a similar way as other PHP/XML scripts, but instead of calling an outside url, it opens up a database connection, calls a sql statement based on the original query, and returns back the XML to the client.

11 Known Bugs and Limitations

11.1 Data Errors

To parse Craigslist, we assume that listings and titles will follow a standardized format. However, if certain information is missing or inaccurate, we will extract out the entities incorrectly. In addition, if the address information is incorrect or incomplete, the Yahoo Geocoding service will resolve the address at the city level, rather than at the address level, leading to several apartments at the same location (the city center). *Apartment listings may appear inconsistent or*

inaccurate.

Transit. Because Transit 511 only lists the intersection, sometimes the Yahoo Geocoding service may not resolve the address correctly. *This can lead to misplaced and missing transit stops.*

11.2 Functionality Limitations

When the "click to search" is enabled, sometimes the user might inaccurately click on a map location instead of a marker. Instead of the marker appearing, the map will be recentered and the map will repopulate with fresh listings. We attempted to resolve this issue by making the "click to search" activate on double click. However, we could not implement this due to API limitations. At the time of this writing, the Google API does not provide a doubleClick event listener for their map. Their current DoubleClick event cannot be overridden to perform custom functions *Due to this limitation, the single clicking on the map sometimes appears erratic and not perform according to expectations.*

The application performs limited data validation. For example, if the user enters invalid search parameters, no search results will be returned.

12 Future Directions

12.1 Prototype Enhancements

The results of the interactive prototype revealed multiple functionalities that we could enhance on future versions of the HomeSkim applications. We also recognize that the scope of the HomeSkim application could be expanded to more geographical areas and include more functionality.

Data Sources In future iterations of this prototype, we hope to include other craigslist geographic areas, including Seattle, Minnesota, etc. We could include other data sources, such as neighborhood safety data, categorized local search (e.g. restaurants, fitness centers, and other relevant information).

Functionality We plan to add features recommended in the usability studies, including printing listings and favorites, driving routes to public transit locations, and a “maybe fits” category where listings that almost fit all of the user’s apartment criteria are shown.

12.2 Future Applications

HomeSkim demonstrates the importance of showing points of interests within a given task. In this scenario, relevant points of interest include user defined addresses, transit points, and nearby businesses. This framework can be expanded to other scenarios such as searching for a hotel in an unfamiliar city, where relevant information include restaurant information, nearby tourist attractions/conference centers, and neighborhood safety ratings. Other applications include searching for houses, universities, volunteer opportunities, or workplaces.

We imagine the notion of mapping nearby locations as a location API, where developers can design applications to show relevant information to their user base. There continues to be growing opportunities to integrate relevant information from multiple data sources as technology continues to progress.