

GoodLiving: An Amenity- and Location-sensitive Cross-city Property Search Tool

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Abstract

GoodLiving (<https://goodliving-beta.herokuapp.com/>) is a system that supports new features for property search. GoodLiving specifically provides users the ability to find properties near places that they would like to visit (e.g. specific tourist destinations) or utilize (e.g. specific ethnic restaurants) and far from places they want to avoid (e.g. train stations). We built GoodLiving focusing both on creating an easy to use, simple and intuitive user experience, and on offering as many searchable attributes as possible. We then conducted a preliminary pilot user test, which despite being affected by imperfections in the prototype, showed great promise for GoodLiving and our proposed features (see complete data and scripts [here](#)), leading us to strongly recommend further work being done on developing GoodLiving and generally good location-based search parameters for property search. GoodLiving is open source (<https://github.com/emilgoldsmith/GoodLiving>) to allow further development.

1 Introduction

Imagine you are planning a short vacation to Copenhagen. You have heard that Christiania is an interesting area so you would like to be near there, but also near the harbor. Since you are planning to rent a bike, you would like these places to be within 10 minutes by bike. You are going with your partner, so you will be two adults, and your budget is 100\$ a night.

There are many services that offer a centralized search for short-term and long-term accommodation, but no product that we could find currently allows for a search that would include all the constraints given in our example above. Some search products, such as Airbnb.com, allow people to rent out their own property, whether it be just a room in their home, their whole home, or any other real estate they own. They can also choose to rent their property out for just short visits or sublet it for longer periods of time.[3] Booking.com offers a centralized place to search for accommodations, notably hotels or apartments for short-term visits,[4] and StreetEasy.com specializes in supporting users interested in purchasing or renting real-estate for long-term stays in New York City.[10]

None of these sites or any other products we have been able to find offer extensive searching capabilities when it comes to the attributes of different locations though. As demonstrated in our initial example, when we talk about the attributes of locations we mean setting constraints on the search such as the distance from several different points. These points could include a workplace, the home of one's parents, distance from certain landmarks or tourist attractions, the distance from the nearest school or maybe a specific school. In all these cases, distance could be defined in many different ways such as straight line distance, or the estimated walking/driving time. We also want to support the specification of different types of places based on qualities of the area such as noise level, the safety in terms of crime in the neighbourhood, the availability of certain types of cuisine in the area. As can be seen in the below related work section some of the above mentioned sites support one or maybe two of these functionalities but not all.

The current prototype of GoodLiving gathers data on available accommodation from Airbnb, and uses the Open Street Maps (OSM) API to gather the data necessary to infer as much as possible related to answering as many of the above mentioned search queries as possible. In the future we plan to include more sources of data both for possible accommodation options and map/location/neighbourhood data, but for the scope of this initial paper we have limited it to a few data sources and core functionalities in order to test the viability of GoodLiving.

One of the challenges to this project is dynamically adjusting the options based on how much available data we have. For example, Open Street Maps has more information about some cities than others. Our system strives to adapt to this variation by offering some features for some cities and other features for other cities, such as only offering to filter by distance from the beach when you're looking at a seaside location, and not a landlocked city.

Another big challenge is presenting our product in a way that is easily usable by potential users. We have decided to take a map-first approach to the user interface, being especially inspired by the successful map product Google Maps. On top of that we have experimented with ways for users to input their constraints related to locations/surroundings, and also for the best way to display results and current filters applied. Finally we have done a qualitative pilot user test to establish the usability of our prototype and try to estimate the potential of the new features we have brought to the space of property search. Because the results of that test were positive, we encourage further research into this approach to property search.

2 Related Work

In Roth et al.'s paper titled "User studies in cartography: opportunities for empirical research on interactive maps and visualization" [7] they advocate for new approaches to the development and assessment of interactive maps. They suggest re-envisioning the map reader as the map user and to focus more on the user experience and using user centered design. They list holes in the current literature, and ask for these holes to be filled. For example, they suggest (i) the need for in-depth discussions of approaches to user studies as well as the problems with current user studies, (ii) meta studies comparing empirical results on static versus interactive maps, (iii) a "multi-authored edited volume on best practices or gold standards," for conducting user studies, (iv) exploratory projects taking inspiration from other disciplines, and (v) more educational resources for conducting user studies on interactive maps. In our work on GoodLiving we have tried to employ this focus on the user experience and user-centered design as we designed the product. In our design process we have also been mindful of the trade-off between interface complexity and available features, though we are still working on balancing between the two. We are also very aware of the importance of listening to the suggestions from Roth et al. to focus on proper user sampling and best practices when doing user testing on map interfaces. This will be particularly important, when a future version of GoodLiving undergoes a more comprehensive user test.

Zhao, Wigdor and Balakrishnan developed TrailMap as a way to implicitly generate bookmarks for the different sites (current keyword + location + zoom level) you have interacted with on an interactive map for ease of navigation backwards and forwards between different searches. While it was not a top priority to include advanced features like this in the prototype developed for this project, it would be very interesting to include some of these features into GoodLiving in the future. A big part of the GoodLiving project is also to make sure that our user experience is smooth and efficient, therefore we also took some inspiration from their approach to map application user studies when we conducted our pilot test. This included the way we approached collecting data on the user's previous experience with property search applications, and using feedback questionnaires. For a

future full-scale user test we also suggest taking inspiration from Zhao, Wigdor and Balakrishnan and possibly also doing feedback interviews and using interaction logs for collecting different kinds of qualitative and also quantitative data.[9]

Airbnb.com is a site that offers both short-term rentals and subletting for up to 6 months[2] and is widely used as can be seen from Airbnb offering over 5 million possible residences in more than 81,000 cities.[1] As can be seen in figure 1, Airbnb has a map view when searching for listings, and it also has a form on the left side which allows the user to specify things such as amenities, room type, price and date range (price and date range are at the top of the form, in the image the form has been scrolled to the bottom). Airbnb does not however options based on surroundings or locations such as distance from certain tourist attractions or distance from specific types of restaurants. Airbnb also does not employ a map-first user interface as the map has to be actively selected from a small button in the corner.

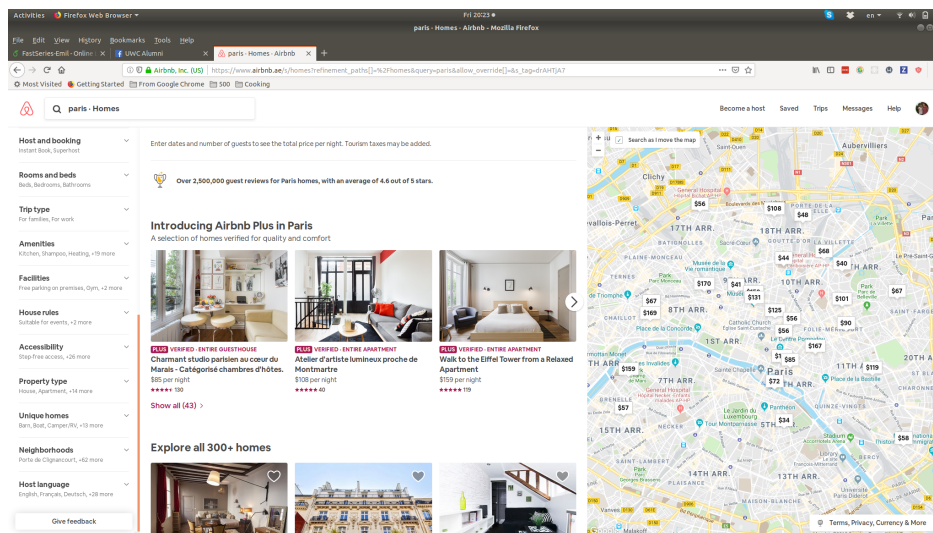


Figure 1: The Airbnb map interface for finding accommodation

Booking.com is a website that is also focused on finding places to stay. Booking.com focuses on short-term vacation stays.[5] It is also a very successful site as can be seen from the on average 1,550,000 room nights being booked on Booking.com every day.[5] Booking.com also offers a map view when searching for apartments as can be seen in figure 2, and similarly to Airbnb also has a form on the left side. They have a relevant feature in the neighbourhoods part of the form where, in addition to specific neighbourhood options such as "city centre" and "9th arr," they also offer vague but useful annotations such as "best areas outside centre" and "guests' favourite area." This feature may be interesting to adopt in GoodLiving. Again Booking.com does not have a map-first user interface and doesn't offer more complex options about location and surroundings when searching.

StreetEasy.com is a website for shopping for real estate in New York City. With hundreds of real estate brokerages providing information and over 60 employees it can also be seen that StreetEasy has at least had moderate success.[11] StreetEasy, like Airbnb and Booking.com, has a map view. The search parameters and form are not available from the map view though. To access the form with specific requirements, one needs to not be in the map view, then click refine search, and finally click advanced options. StreetEasy does offer searching based on school zones, and distance to metro lines, which shows the usefulness of location-based features. It is not a map-first UI, and, while it does have the above location specific parameters, it doesn't have a breadth of possibilities such as searching for distance from different cuisines, sports facilities, key points such as place of

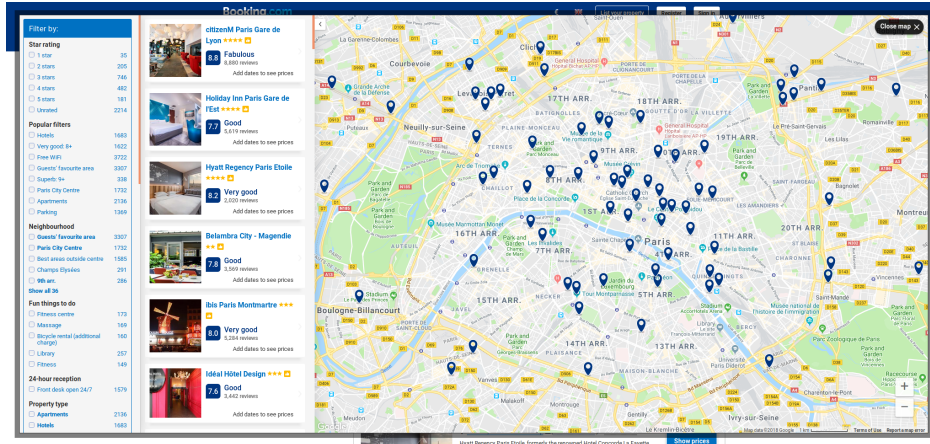


Figure 2: The Booking.com map interface for finding accommodation

work etc. Finally StreetEasy focuses only on New York City as opposed to trying to cover most of the world.

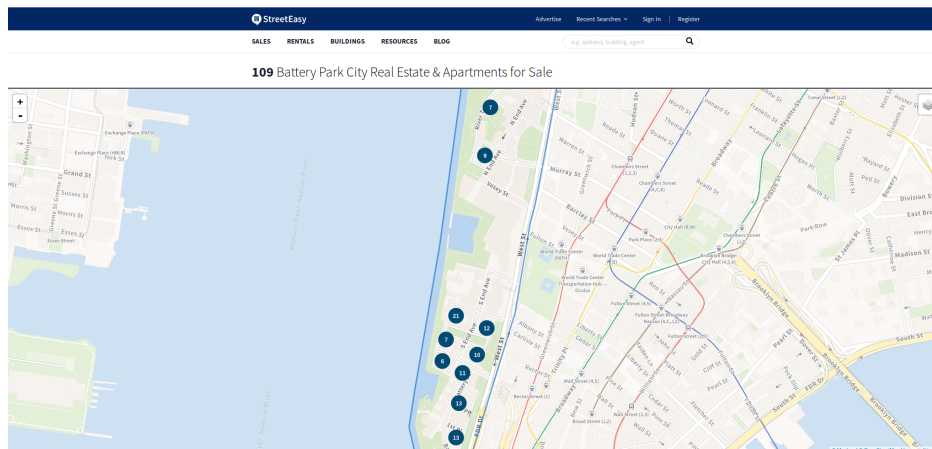


Figure 3: The StreetEasy map interface for finding accommodation

Google Maps is a very successful product with 13.08% of the top 1 million websites using it.[8] Google is also generally known for its clean and well designed products, and its Material Design specification is widely used and followed by many products.[6] These are the main reasons that we have taken a lot of inspiration from Google Maps when we designed GoodLiving, and built it as a map-first user interface, while trying to keep the rest of the functionality as intuitive, minimalist and non-intrusive to the main map experience as possible.

3 The Prototype

In order to test the viability and value added by GoodLiving we implemented a minimal prototype. We detail the main decisions that were made in the design and implementation of this prototype here.

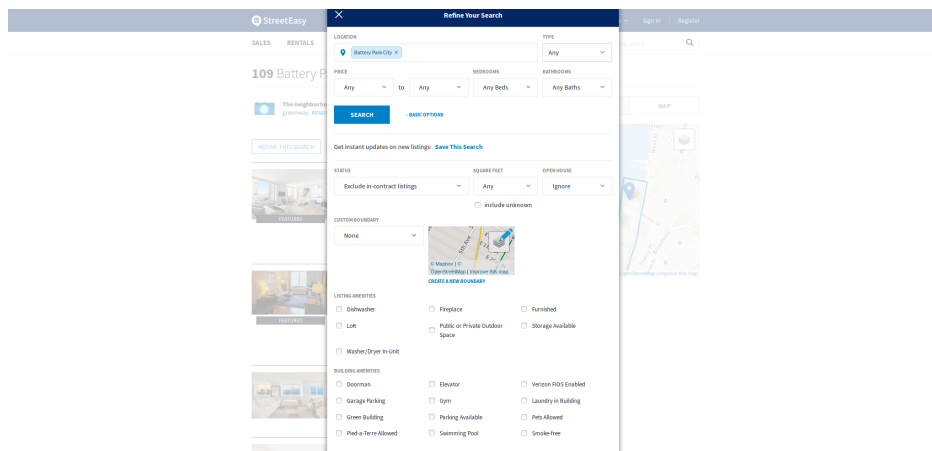


Figure 4: The StreetEasy form for specifying advanced search parameters

3.1 The User Interface

The User Interface (UI) of the GoodLiving prototype can be seen in figure 5. We decided to go with a map-centered UI as inspired by Google Maps, where the search is automatically constrained to the visible area on the map. This means the user will select the search area by changing the zoom level or adjusting the center of the map. The map has blue markers for each of the properties the search has found to fit the current filters. If a marker is clicked, a popup with further description of the property will show up. This pop-up has the same layout as the property shown in the results section in the right sidebar, by the label C in figure 5. At the top left is a search bar (labelled A in figure 5) for moving the map location to anywhere in the world, which is powered by Nominatim, an OSM geocoding API. To the side of the main search bar, labelled B, is the form area, where users are able to input their different constraints. This both includes more normal, but crucial, constraints such as dates, price range and number of guests, but also includes auto-completing, hierarchical form inputs where desired amenities and distance constraints can be input. Images showing how the auto-completing form for distance constraints work can be seen in figure 6. When selecting a distance constraint from the form input a modal pops up that allows the user to input the minimum and maximum distance the user would like to be from this feature as seen in figure 7. Finally the user’s current filters and a ”Clear Filters” button are at the bottom right of the screen (labelled D in figure 5) . Here one can see one’s current filters, edit them or remove them.

3.2 The Software

The web-app front end is written using React, bootstrapped with Create React App (see documentation [here](#)). It is organized with a main JavaScript file that supports most of the app, with the modals and advanced inputs being modularized to their own files, with all JavaScript files having their own locally scoped CSS files. Our back-end is a Node.js server which both serves the static files such as the HTML, JavaScript and CSS, but also acts as our API, and at the time of writing this is hosted on Heroku at <https://goodliving-beta.herokuapp.com>. It is written in a mixture of JavaScript and Typescript, and is organized with a top index file, which sets up the serving of the static files, and imports the API paths from subdirectories which each are responsible for a single type of API call. The API currently has three responsibilities. (i) Geocoding which is essentially just a proxy to the Nominatim API which OSM provides. (ii) Fetching Airbnb data. As a temporary measure, this is done by accessing the internal API of Airbnb to query for the

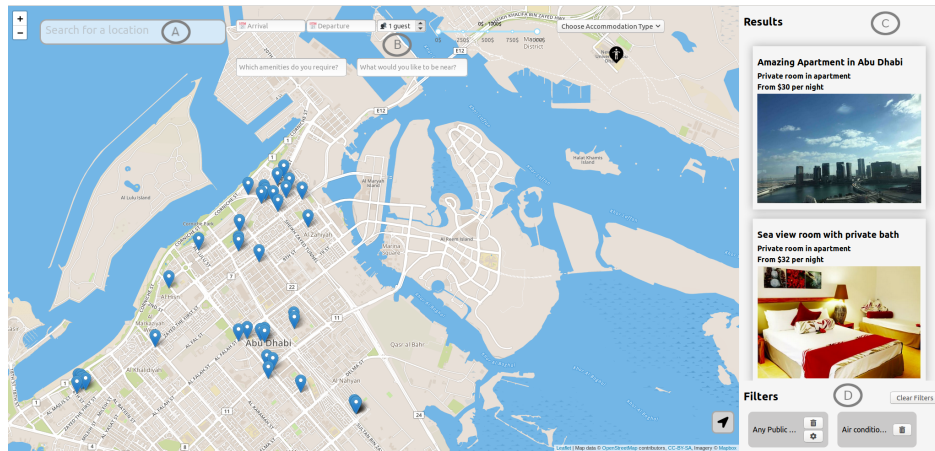


Figure 5: A labelled image of the GoodLiving UI

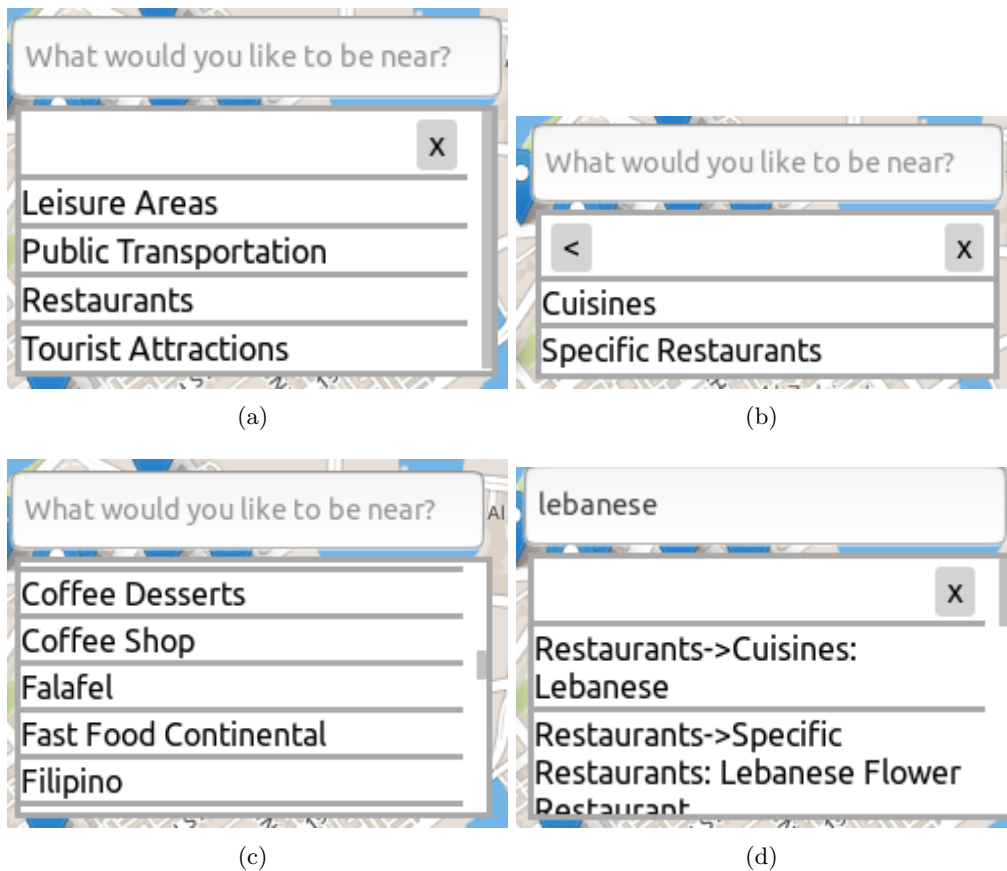


Figure 6: Images of the different states of the hierarchical auto-complete form input for distance constraints. (a) is the initial state. (b) is the state after clicking "Restaurants". (c) is the state after clicking "Restaurants" and then "Cuisines". (d) is the state after typing in "lebanese" from the initial state of the form input

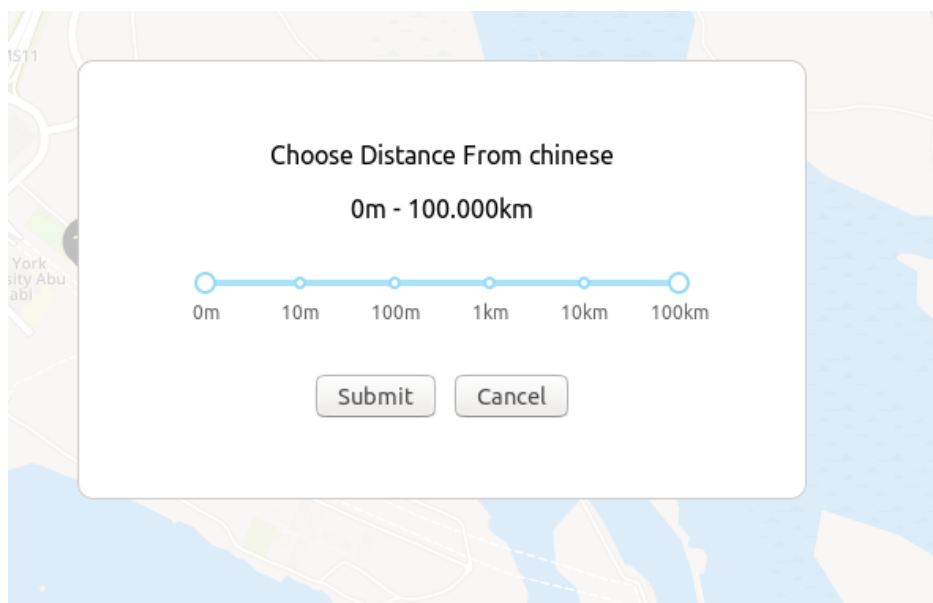


Figure 7: The modal that lets you decide or edit the range of distance you would like to be from the given specific or type of place

data the Airbnb website uses. Parameters of map location, price, number of guests, dates etc. are passed to our API which passes them on to Airbnb which returns a paginated response of listings fitting the criteria. (iii) Querying OSM’s Overpass API for OSM data. A rectangular area is given to our API which then queries Overpass for all restaurants, tourist attractions, leisure areas and public transport in that area and returns it to the front end.

Currently the functionality of GoodLiving is implemented so that only the amenities and distance filters that are relevant to the current location show. This is achieved by showing only the amenities that our listings source (currently Airbnb) provide us, and allowing only distance filters to places and types that are actually documented in our map data source (currently Overpass/OSM) and are available in the target search area. We implement the amenity filters by passing on the amenity requirements to our listings source. The distance constraints, on the other hand, are implemented by first fetching the map data from our map data source, and the relevant listings from our listings source, and then afterwards filtering the listings based on the distance constraint. This is essentially computing the intersection of the two requirements. As will be discussed further this also leads to some challenges in the number of results shown.

4 Pilot Testing

In order to evaluate the fitness of our proposed features, we conducted a small pilot test to gather some qualitative and quantitative data. All the pilot test scripts, tasks, screen recordings and results are publicly available at this link: <https://drive.google.com/open?id=1CQ320MC-pDwMZy6TotSBHYm7RPIVWD11>

4.1 Test Design

The pilot test cohort consisted of 12 people. The 12 people were all individually asked by the organizer of the test, and all had some relation to the organizer of the test. This was necessary as we were doing a pilot test and therefore couldn’t compensate testers or advertise it publicly. We

then made each of the testers do the test on a controlled laptop that we knew had GoodLiving running smoothly on it to avoid any unnecessary complications from different hardware/software, as our main focus was to test the features, not the cross-device robustness.

Each user first picked a yet to be chosen number between 1 and 12 which determined the order and pairing of tasks, as further explained below. Then the user read a short explanation and clarification of the purpose, content and guidelines for the test, and finally a screen recorder was started on the laptop and the user commenced the testing. The user was encouraged to try and figure out how best to solve the tasks alone first, but a silent observer was available nearby if any questions should arise.

Users were first given two similar tasks, either finding suitable accommodation within 200m from a Japanese restaurant in Manchester, England or suitable accommodation within 200m from a Chinese restaurant in Birmingham, England. One of the tasks was requested to be done on Airbnb and the other on GoodLiving, and before each task the user was given the option to use the web application they were about to use for up to 5 minutes. In order to reduce the learning effect and the effect of any differences in difficulty of each task, which task was used on which site, and whether the user tested GoodLiving or Airbnb first was randomized using the numbers picked above.

After this the user was asked to do three tasks specific to GoodLiving in order to test how they interacted with it. First they were asked to find a property to their liking in Monaco, which is a place we expected the testers not to be familiar with. They were then instructed to input specific search parameters we knew were too strict to give results, followed by them tweaking the constraints to find a property they were happy with. Finally they had a free-form task where they could use GoodLiving for anything they wanted.

After they were done with the test we then asked them to fill out a short survey where they were asked about their previous experience with property booking websites. We then asked them to rate how satisfied they were with the result of each task, how useful they found each of our newly introduced features, and the ease with which they could express their requirements on Airbnb and GoodLiving respectively. Finally they were asked to answer some free form questions asking for general feedback about our features, possible improvements and comparisons to other property booking sights.

Finally the test observer from our team took notes on any relevant behaviour during the test such as questions asked by the tester etc.

4.2 Test Analysis

To analyze the data we got, we first used the screen recording to time how long it took the user to complete each of the first two tasks (these were the comparable tasks on Airbnb and GoodLiving). This was done by manually pinpointing the time the user started typing in the place name for the task, and the time the user stopped interacting with the current website before starting the next task (as there was always a pause while finding the new task). These times are estimated to be correct to within ± 5 seconds.

The qualitative analysis of user behaviour used three sources of data: 1. The screen recordings to observe any pain points in the user interface, or unexpected user behaviour we could learn from; 2. The feedback from the survey each user took; and 3. The notes taken by the test observer during the tests.

4.3 Test Results

The results of the test showed us that the users had some problems with our interface, finding some parts of the interface unclear, and also that slow loading times confused them. Despite this, there was a general trend of interest and appreciation of the new features introduced, in addition to a desire to have a fully functional product like this available.

4.3.1 User Difficulties with GoodLiving

The users experienced some difficulties using GoodLiving, some from the difficulties understanding and using the interface, and some from slow or unintended behaviour by the web-app. Many people had difficulties figuring out how the slider worked at the start, and in the feedback several users also expressed this. One user stated: “The scale for changing distances could be easier to use”. Another user did not like the logarithmic scale, and thought maybe it would be better to have simpler options such as “near me”:

I don't like the log scale of distance – sometimes when looking for housing, we aren't that precise about whether a particular restaurant or cuisine is 100 or 500m away from me [...] if we're traveling, we probably aren't sure where exactly we want to live close to, so probably a feature of “near me” where we can choose things like “metro or bus station”, “restaurants of specific cuisine with rating above 4”, or “city center” would be more helpful?

From our observations it seemed that users were mainly confused about the slider being double-ended, which is also confirmed by a user writing in the feedback that “The slider default behavior is to increase the minimum distance” indicating they did not understand the nature of the double-ended slider. We should therefore try and either change this behaviour (by for example only allowing setting maximum distance) or clarify the user interface for further iterations.

Users were also frequently confused about filters persisting in between different tasks. This is also backed up by feedback as a user stated:

whenever I do a search, the filters from previous searches are kept. [...] maybe refreshing on the filters for each search would be good?

It may be that doing several tasks in one session is not usual behaviour, but for a future test either a page refresh should be requested by the user after each task is completed, or functionality to make this more user friendly should be implemented.

Several users also expressed difficulty with using the autocompleting form inputs. Giving feedback such as “The search bars in good living were too small and hard to navigate” and “the amenities feature is a bit hard to navigate/scroll through”. While analyzing a screen recording we also observed a user attempting to search from a lower level of the hierarchical search for an item not in that subtree. This indicates that the search being from the current level in the hierarchy is not fully intuitive. One user also asked for multi-select during selections of amenities since “after selecting every amenity, the scrolling list would reset and I would have to begin from the top to find where I stopped the last time”

Users also encountered difficult behaviour that wasn't user interface specific. This included small bugs such as the date picker not being able to change months, and setting an end-date not automatically setting a beginning date. When trying to do the restricted task which was located in Abu Dhabi users were also faced with the location search not cooperating with them. This

happened due to Nominatim not returning UAE’s Abu Dhabi as a top result when querying it with ”Abu Dhabi,” indicating that we may need to use a better API.

The biggest issues were related to our data fetching though. When in areas with big data which happens in dense or very zoomed out map areas the loading time for the Open Street Map queries can be very slow, and the interface will usually have no results during this time, making the user think there are no results for their query. Some users then changed their parameters before the query could even finish causing further confusion. When zoomed out very far we still fetch a constant number of Airbnb properties which means they become more sparsely distributed, meaning that when combined with filters on a very zoomed out map, obvious queries that should have lots of results can sometimes have only one or even no results, to great confusion for the user.

4.3.2 Comparison with other sites

When comparing the users’ experience directly to Airbnb we generally saw great results. When users successfully completed the first two tasks, one on Airbnb and one on GoodLiving, they averaged 3.3 minutes on GoodLiving and 4.4 minutes on Airbnb. As can be seen in figure 8 the majority of users were at least decently satisfied with the result of their GoodLiving task as opposed to most people being dissatisfied or giving up on Airbnb. When comparing their answers on a per-user basis it could be seen that 75% of users were more satisfied with the task result on GoodLiving than on Airbnb.

When users were asked how easy they found it to express their requirements on each of the two sites they also generally tended to find it easier on GoodLiving as can be seen in figure 9.

We believe this shows promise that GoodLiving is providing something that other sites aren’t currently providing. Further, though users did face significant challenges with the interface and functionality of GoodLiving as described above, they still remain generally positive about GoodLiving in relation to Airbnb.

How satisfied were you with the result of your search in each task?

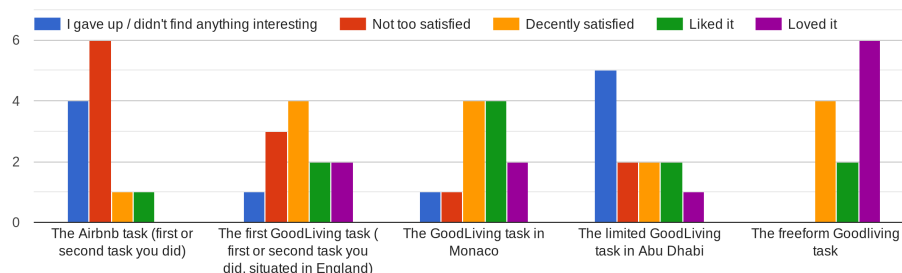


Figure 8: Results on how satisfied users were with the results of each task

This sentiment of difficulty to use but offering something promising is also corroborated by the users in the survey when asked how GoodLiving compares to other accommodation booking sites they use:

It is more difficult to use, but I like the map, I wish it worked better.

GoodLiving is much more powerful than anything I know of existing, but can be overwhelming

How easy was it to express requirements that mattered the most with respect to your accommodation in each of the sites?

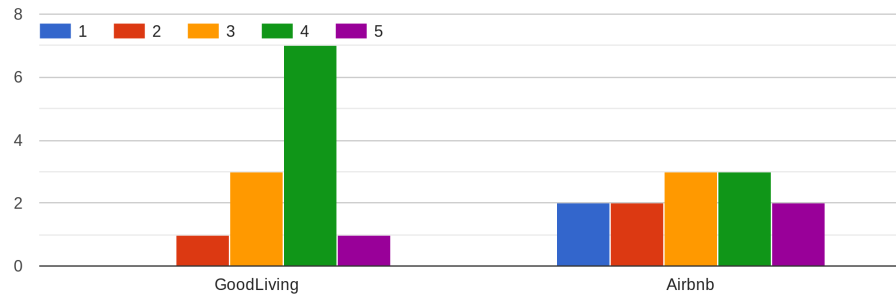


Figure 9: Results on how easy it was to express requirements on different sites

The interface could use some work but it provides features I haven't seen anywhere on the internet short of a livechat with a hotel concierge.

increased lag time and not as clear in overview, I really like however the option to filter by services/attractions around you.

While some users are also more purely positive

I like the map feature more than other websites for sure. I didn't have to open google maps on another tab like I usually always do when I am booking accommodation to find what kind of things I want to be around. That was the best part.

Goodliving was more intuitive because the proximity of an apartment or home to key services such as public transport, and amenities such as security or gym, are equally important as price.

I haven't seen the option to live close to cuisine-specific restaurants or malls on other websites! I really liked this option.

On top of that our test observer also noted several trends related to the different interactions with Airbnb and Goodliving:

- Even when users do complete the Airbnb task, they still only find a specific restaurant on an external site such as Google Maps and find an apartment close to that one restaurant, while on GoodLiving they can truly represent the more abstract query of all properties near a type of restaurant and then pick which one they like the best from that subset
- It seemed that when people gave up on Airbnb it was mostly because it was too inconvenient or seemed impossible, while on GoodLiving the main reason seemed to be buggy behaviour in the interface, mainly due to the loading issue mentioned above

How likely would you be to use GoodLiving again?

12 responses

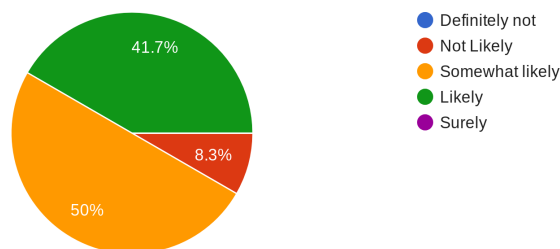


Figure 10: Results on how likely users find themselves to use GoodLiving again

4.3.3 User experience with GoodLiving tasks

As can be seen in figure 8 the users were generally not too satisfied with the results from the restricted task where we initially gave them parameters that would be too restricted to garner results. This is possibly understandable as it was initially restricted but maybe also points to issues with intuitive editing of the filters. When reviewing the screen recordings users generally seemed to edit the filters pretty intuitively though.

Otherwise the users were generally very happy with their results in the other two GoodLiving specific tasks, specifically loving the free-form task (everyone at least "decently satisfied" with over half "loving it") where they were allowed to use GoodLiving for any purpose they desired.

When users were asked how likely they were to use GoodLiving again in the future, it was also a positive response with only one person indicating less than the middle point of the likert scale, as can be seen in figure 10.

Our test observer also noticed that on several occasions testers would keep playing with GoodLiving after finishing the post-test survey, seemingly enjoying it, and several people also expressed to the tester that they had fun doing the test unprompted. Though it should of course be taken into account that the observer has some relationship with all the testers.

4.3.4 Evaluating the new features of GoodLiving

When we asked the users to quantify the usefulness of GoodLiving's newly introduced features, they were overwhelmingly positive when it comes to filtering by distance, and to a large extent filtering by amenities as well. However, they find the interface difficult to use especially regarding the perceived usefulness of the hierarchical auto-complete form input.

4.3.5 Features requests by users

We asked the users if there were any features they would like to see and got some useful suggestions such as:

- Sorting results by price / rating
- Search filters based on quality of restaurants (as opposed to just the type of restaurants), ease of travelling, cost of restaurants etc.

On a scale from 1 to 5 how useful did you find each of these features?

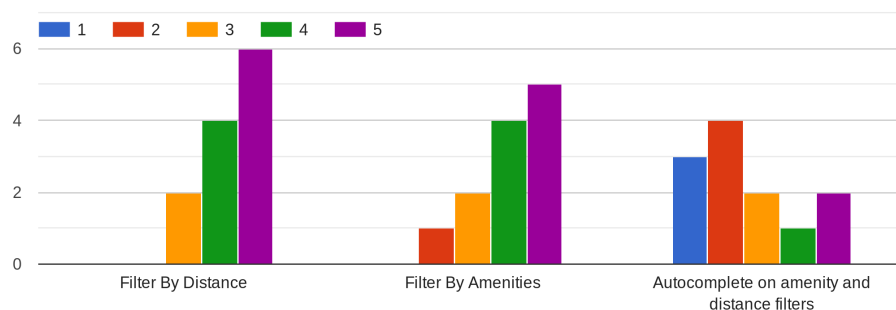


Figure 11: Results on how useful users found each feature

- Being able to see more details about properties before having to go to the source site, such as extra pictures and ratings
- Adding a "clear all criteria" button, which would include price, dates etc. (as of now we only have a clear all filters button)
- Making changing your search location reset all your criteria by default.
- Changing the UI so forms hovering over the map no longer block the access to certain map markers at the top, as it caused one user frustrations
- Moving the current filters box from the bottom right-side where one user felt it was out of the field of vision

5 Future Work

Since we conducted only a small pilot test and our sample size was too small to claim statistical significance for our results, we cannot reach any definitive conclusions. However, the qualitative results do show the value of the idea. Based on the observations and feedback we have gotten from our pilot, we strongly recommend several improvements that could be implemented before a full-fledged test on GoodLiving:

1. Fix the simple bugs associated with the date picker mentioned above
2. Design the next user test to refresh the page in between tasks, or implement a system that clears all filter/form states when moving to a new location. Note that while using the location search bar as a marker for change of location is easy, if also aiming to support determining when a "new location" is reached by zooming and/or dragging as opposed to when zooming and/or dragging are just used for refining the current location, this could be a quite challenging task.
3. Consider finding a way to fix the priority problems within Nominatim, possibly by filtering it yourself, or use a different, better API

4. Work out either improving or rethinking the interface for selecting constraints. Is a hierarchical auto-complete the best approach? If so how could it be done in a better, more user-friendly and intuitive way? If not, could a keyword/natural language approach be feasible/better.
5. Troubleshoot how to make the distance slider more intuitive. Consider maybe removing the minimum option and seeing how users react to that as it seemed to be the biggest point of confusion. Also consider a good way to make the logarithmic scale more intuitive. This could mean either adding more labels, changing the related UI in a different way, or maybe using a linear scale.
6. Fix problems with loading when in dense or zoomed out map view. There could be many different approaches to this including doing a better job at informing the user of what is happening, such as cancelling the request if it takes too long and asking the user to zoom in, telling them there was too much data etc. Another approach is maybe to try and fetch smaller bits of data at a time and slowly expand the area of the current map view you have filled incrementally. A third approach could be to experiment with caching, and there may be many more approaches.
7. Fix low number of results when zoomed out far. One approach to this is simply to fetch a lot more properties from the listing data-sources, but a much better approach would be to first compute the distance constraints, find bounding boxes for the intersections of these constraints, and then query the listing data sources only for the properties that fit within the constraints. Some heuristics may be needed to make sure one doesn't inefficiently send 100 small requests, but still merge some of them and maybe filter afterwards or something of the likes of that.

Other longer-term improvements that could also be valuable based on the data we collected would be to:

- Add a functionality to reset all form data, not just filters
- Add more information to property results such as several pictures and the ratings
- Add functionality to sort property results by different relevant criteria such as price or rating
- Add multi-select functionality to amenity filters (so a user can scroll through and tick off desired amenities as they scroll)
- Consider adding more detailed features such as being able to search for quality and cost within categories such as restaurants or tourist attractions. Possible ways to do this could be trying to integrate with TripAdvisor or other review sites
- Connect to several data sources such as such as Booking.com, StreetEasy, Zillow and HomeAway, and do it in a more official way which is possible with most of them
- Given the prevalence of browser access through smart phones in this day and age, it is also important to have a mobile-centered UI, that would have to be designed and implemented.

And finally here are some suggestions from individual users that could be studied but shouldn't necessarily be considered completely confirmed problems without more data:

- Consider whether the filters are displayed in the best place / the best way
- Consider if the overlay of form and inputs on the map clutters the top of the map too much

6 Conclusion

One of the main holes in the current offerings of accommodation search products is the ability to be able to search more specifically about what kind of location a user would like to stay in. We have developed a prototype of our version of a solution to fill this hole: GoodLiving.

The pilot user test suggests that, despite the many imperfections in the prototype, users were still very positive towards the product, finding that it provided new desirable features they had been missing from other sites. We recommend implementing and improving several of the suggestions listed above, and then performing a comprehensive and statistically valid test.

References

- [1] Airbnb. *About Us - Airbnb Press Room*. URL: <https://press.airbnb.com/about-us/> (visited on 12/11/2018).
- [2] Airbnb. *Need a sublet? Try Airbnb instead*. URL: <https://www.airbnb.ae/sublets> (visited on 12/11/2018).
- [3] Airbnb. *Vacation Rentals, Homes Experiences & Places - Airbnb*. URL: <https://www.airbnb.ae/> (visited on 12/11/2018).
- [4] Booking.com. *Booking.com: 29,034,651 hotel and property listings worldwide. 169+ million hotel reviews*. URL: <https://www.booking.com/> (visited on 12/11/2018).
- [5] Booking.com. *Booking.com: About Booking.com*. URL: <https://www.booking.com/content/about.en-gb.html> (visited on 12/11/2018).
- [6] Google. *Design - Material Design*. URL: <https://material.io/design/> (visited on 12/11/2018).
- [7] Robert E Roth, Arzu Çöltekin, Luciene Delazari, Homero Fonseca Filho, Amy Griffin, Andreas Hall, Jari Korpi, Ismini Lokka, André Mendonça, Kristien Ooms, et al. “User studies in cartography: opportunities for empirical research on interactive maps and visualizations”. In: *International Journal of Cartography* 3.sup1 (2017), pp. 61–89.
- [8] SimilarTech. *Google Maps VS Leaflet - Mapping Technologies Market Share Comparison*. URL: <https://www.similartech.com/compare/google-maps-vs-leaflet> (visited on 12/11/2018).
- [9] Jian Zhao, Daniel Wigdor, and Ravin Balakrishnan. “TrailMap: facilitating information seeking in a multi-scale digital map via implicit bookmarking”. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM. 2013, pp. 3009–3018.
- [10] Zillow. *New York City Real Estate — StreetEasy*. URL: <https://streeteasy.com/> (visited on 12/11/2018).
- [11] Zillow. *StreetEasy MediaRoom - Key Facts*. URL: <http://press.streeteasy.com/key-facts> (visited on 12/11/2018).