Introducing the Space Recommender System: How crowd-sourced voting data can enrich Urban Exploration in the digital Era

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ABSTRACT
Navigation systems like Google Maps and TomTom are designed to generate the shortest and less time consuming path for the user to reach a certain destination from his origin location, not taking into account the user's actual walking experience.

This paper investigates physical and digital urban navigation and describes a new approach by implementing common digital online methods of commenting and recommender systems into the physical world. Those methods are being translated into the urban environment, using Facebook voting data to generate an alternative to the shortest route in order to maximize the pleasure of an urban walk. Initial findings highlight the general importance of the walking experience to the public and suggest that implementing recommendations, based on social media voting systems, in route finding algorithms for mobile applications may enhance the pleasure of urban strolling. The testing of the system in a real world context together with collected feedback and the observations throughout the design process stimulate the discussions of wider issues.

Author Keywords
Wayfinding; Urban Pedestrian Navigation; Social Networks; Voting data; Mobile Devices; Recommendation Systems.

ACM Classification Keywords
H.5.1 INFORMATION INTERFACES AND PRESENTATION (e.g., HCI): Hypertext navigation and maps

General Terms
Human Factors; Design;

INTRODUCTION
Sharing knowledge and making recommendations based on experiences have gained an additional dimension with the introduction of the web 2.0. Voting and commenting systems are common digital methods for people to spread their opinions about almost anything that is presented online – reaching from consumer items to newspaper articles. While sharing opinions with other users via online platforms and forums contains a personalized component, automated recommender systems have changed the way how we use the internet completely. Defined by algorithms, these systems influence the user's decision making by recommending pages to visit, items to buy, songs to hear or friends to add on social networks [12].

With the rise of new media and ubiquitous computing in the urban environment [15], this recommended navigation is not limited to the digital anymore. Location based services offer a platform to implement recommendation systems into the physical world and effect in that way how we move through the city. Route finder services like Google Maps or TomTom on location based mobile devices play a significant role in today's pedestrian mobility by recommending routes through urban fabric, consisting on target orientated movements known from architectural theories [4].

Matching our zeitgeist, efficiency and optimization are prioritized in the algorithmic approach, defining the route between the two points. A short transfer time has priority, the quality of the route is less important if leading via busy roads or quiet back paths. Maybe there would be an interesting shop or a nice pub in the closer surrounding to drop in, but how could the user know?

At the same time social networks have become strongly location-based tools. They allow users to share not only their location [9] but also their opinion about certain places by using voting and commenting systems. With the rise of importance of those networks Shang et al propose a new approach for the development of recommendation models, which is not based on the improvement of collaborative filtering techniques but on social contagion and social influence network theory [14].

Building on these facts and with the hope to animate people for more walking within the urban landscape we propose the 'Space Recommender System' – SRS – which incorporates social media data in recommendation models in order to guide the user through urban landscape. With the development of the SRS for the metropolitan area of London and similar urban environments we explore the combination of methods such as recommender, comment and voting systems, social media and a pedestrian navigation system. Our aim is the development of a new methodology for urban pedestrian navigation based on pleasure rather than transfer time. As input Facebook's 'Like' data is being used with the aim to define the route according to the voting system's output.

In this paper we report on a pilot study as part of our ongoing efforts to develop SRS, a different approach to how people engage more with the environment using mobile phones. In the next section, we outline related work followed by a description of SRS (for further information about the technical implementation of the system we recommend our CHI work-in-progess paper [16]). Finally we will present initial findings from our studies and conclude by summarizing our ongoing work.

RELATED WORK

The idea of urban strolling is not a novelty. In theories and studies of the psychogeographical movement that happened in 19th century Paris and London, Debord describes 'derive', the aimless drift through a city, as "a mode of experimental behavior linked to the conditions of urban society: a technique of transient passage through varied ambiances." [2]. Benjamin introduces with 'The Arcade Projects' the poetic term of the 'Flâneur' to the urban context [1].

Based on these theories different approaches towards urban navigation have been studied a lot within the (mobile) HCI community [8] mainly focusing on tourists. Raubal and Winter [11] incorporate local landmarks into the navigation procedure focused. Schöning suggests with WikiEar [13] a route finder system that takes snippets of automated organized Wikipedia articles according to the narrative theory. Not only for tourists, GetLostBot [5,6] is an application that supports the idea of breaking out of static movement patterns. It reads in addition to foursquare (https://foursquare.com/) the users check in patterns and suggests near-by places when detecting a routine. The exciting project gets limited by the total serendipitous approach for location recommendations that result in a limited willingness to follow the suggestions generated by the system.

Shepard introduced with the Serendipitor (http://serendipitor.net/) a system that generates random paths between two defined points, and adds tasks designed by celebrates for the user to complete along the way. The aim of this application is to "help you (to) find something by looking for something else" as mentioned on the website. A test of the application supports the argument that Serendipitor must be seen more as a game rather than a routing system, focusing on the tasks the user is animated to do rather than the directions themselves.

As further example, Walkit.com (http://walkit.com/) is a website that includes the air pollution data into the route finding process. Therefore it generates routes through parks, by rivers/canals or quieter streets, rather than following busy routes that minimize the overall exposure to NO2. In that way it depends on modeled data, which means it cannot guarantee to generate the route with the lowest pollution at any time. After having tested the application and compared the route with live air quality data (http://londonair.org.uk/) the results were quite diverse. The lack of real-time data makes the interesting idea too static and not highly efficient for its purposes.

With SRS we seek a novel approach towards pedestrian urban wayfinding through the strong integration of existing social media voting data. In our prototype we use Facebook 'Like' data for various facilities within the city that refers to the idea to incorporate social data in recommendation models [14]. At this stage we chose Facebook 'Like' data for the ease of prototyping that explores the combination of methods known from digital media – such as recommender, comment and voting systems – social media and a pedestrian navigation system in order to develop a new methodology for urban pedestrian navigation based on pleasure rather than transfer time. The choice of the source of course is not limited to Facebook and can vary from other social networks, as Foursquare and Twitter, to crowd-sourced, more localized data (part of our future work).

SPACE RECOMMENDER SYSTEM

To design a SRS it is crucial to know the general behavior towards recommendations of the crowd. The translation into the urban space requires an investigation of the walking behavioral background. Thirty questionnaires with seven questions regarding the general usage of smartphones and general behavior towards recommendations and strolling were handed out to random volunteers on the street near University College London (UK). Participants were aged from twenty to fourty years, 60% male. All of the participants were familiar with the use of mobile and desktop based map and navigation systems and almost half use such tools more than twice a week. Most of the participants (66%) frequently enjoyed strolling in their free time or on vacations. Most participants also agreed to take a longer detour into account to be able to walk along a pleasant route. Furthermore the findings show that 33% of the participants frequently tend to visit recommended places from online communities in a familiar surrounding and even 66% of the participants in unknown areas, as on vacation.

From this pre-questionnaire we concluded that,

- The participants saw a great potential of urban strolling and agreed on the general importance towards gaining pleasure while walking avoiding main roads and exploring interesting results;
- The participants agreed that social networks are often one of the main recommendation sources for locations;
- The participants would take a longer detour into account to be able to walk along a pleasant route.

The Prototype

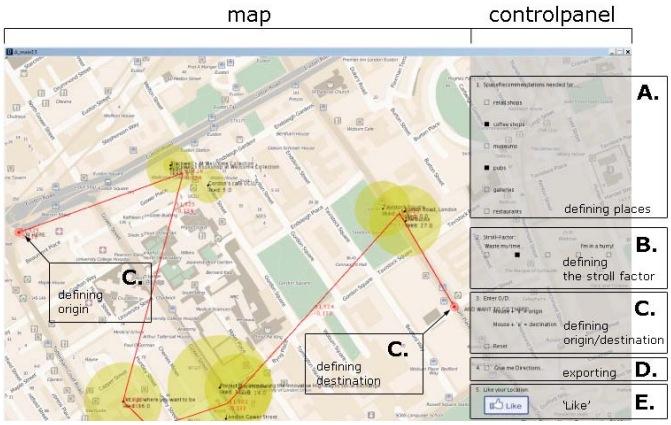

Figure 1. Space Recommender System Interface

Based on the findings of the pre-questionnaire, we have developed a desktop prototype using Processing (http://processing.org/). Location, facility details and voting data were accessed via Facebook API and fed into the system depending on the user's location. The route generation process uses neural network techniques [7] to lead the user into dense patches of places of interest. The number of likes is being translated as weights – the more likes a facility contains, the more it pulls the route towards itself.

The user interface shows a map for mouse interaction (Fig. 1) with a UI panel on the right side of the screen where the user selects facilities of interest, as shops, coffee shops, museums, pubs, galleries or restaurants (Fig.2) and the length of the walk (Fig. 3) that defines the number of output waypoints of the Kohonen Network [7]. As the prototype does not use geo location as input, the user needs to define origin and destination point via mouse interaction (Fig. 4) and export the generated final route coordinates to Google Maps to receive directions for real world conditions (Fig. 5). While walking the user can also feed information back into the SRS (Fig. 6). In that way a nice view or memory about a certain location can be shared which feeds back into the system. The route description is then dynamically updated.

Figure 2. Space Recommendations needed for…

Figure 3. Stroll Factor

Figure 4. Enter Origin / Destination

Figure 5. Exporting to Google Maps: Give me Directions

Figure 6. Like your Geo Location

EVALUATION

As the project deals with the development of an application for people to use in the urban environment, it is necessary to test it under authentic conditions and get feedback in order to understand opinions to improve while developing. Setting up a questionnaire is a practical straight forward option to be able to gather standardized and individual feedback from a high variety of users with different backgrounds.

The aim of the questionnaire is on one side to explore people's perception of the urban environment during walks and on the other side getting feedback about the developed application. Therefore two routes have been generated following the two different approaches leading from the same origin to the same destination point. The questionnaire was handed out to thirty participants, divided into twenty students from all over the four courses taught at the Bartlett School for Graduate Studies, and ten randomly picked volunteers off the street. Mostly younger people were curious to take part in the experiment, which leads to an age variety between twenty and fourty years. Before answering the questions, the participant is asked about his familiarity with smartphone navigation in order to include his technical background into the findings. Below we describe the questionnaire in more detail.

The experiment was executed in the week from August 6th till August 12th 2012. Weather conditions were mostly overcast, partly sunny with slight rain showers from time to time and mild summer temperatures. In order to have similar conditions for each participant for both of his routes, the participant was encouraged to do both walks in one go instead of splitting them up on different days. After analyzing and reconsidering different areas within London it was soon clear to set up the testing in London / St. Prancras. With its mixture of large straight main roads and smaller winding alleys same as the mixture of land use and facility offers and its composition of green space the area offers a genuine urban setting and ideal conditions for the testing of the Space Recommender System. The evaluation for different route options all over the area took into account the authenticity of the urban landscape same as the amount of possible feedback from received Facebook data. With respect to the participants the route should not exceed 15min, as long as duration time won't have impact on the experiment outcome.

Both routes start from Central House/UCL on Upper Woburn Place 14, LONDON, WC1H 0NN and terminate at Guilford Street / Mecklenbourgh Place on the south edge of Coram's Fields (Fig.7).

Figure 7. SRS Output (before exporting) showing Origin / Destination point (red), Places of Interest (the size of the yellow markers represent the number of Like of the venue) and the generated path (blue)

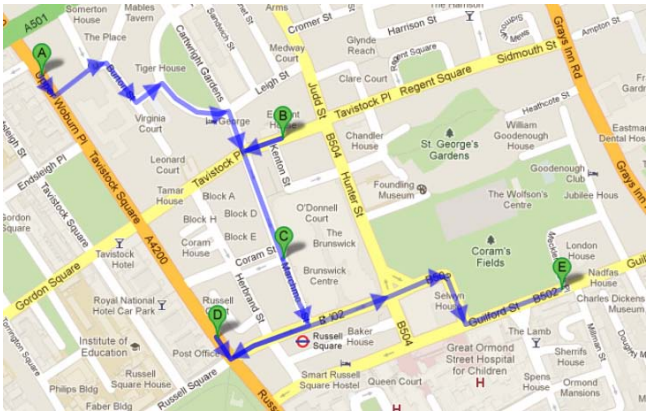

Figure 8. Route A – Recommended by SRS and exported into Google Maps

Route A (Fig.8), recommended by the SRS and defined by five waypoints (including starting point A and end point E), picks up smaller side roads and tends to route the user more via urban green space like parks and gardens. By leading the user back and forth in order to reach a certain waypoint, some routing decisions seem to be a bit awkward (points B and D on the map) and have to be taken into account for the sake of the experiment. For future development the avoidance of such decisions is a major point to improve the performance of the application. Time and distance, as provided by Google Maps, are mentioned with 21min for the one mile walk.

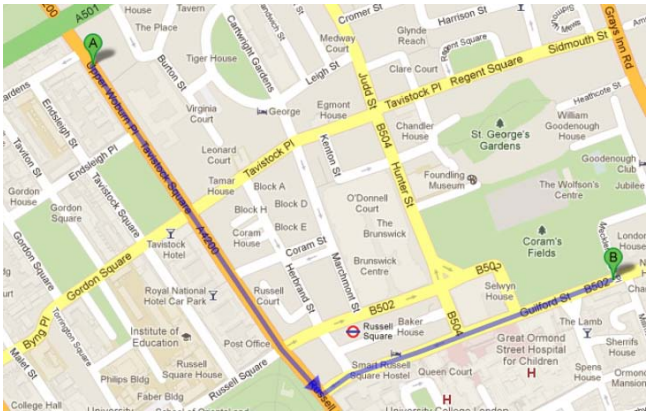

Figure 9. Route B – Recommended by Google Directions

Route B (Fig.9) as generated by Google Directions contains two waypoints for its definition – the origin and the destination location. As mentioned in the Background section, Google uses algorithms to define the shortest and quickest route for the user to get to his destination, which includes in this case the bigger main roads, along Upper Woburn Place and Tavistock Square, leading into Guilford Street, avoiding smaller windy side alleys. The distance got shortened to 0.7 miles and the duration time reduced to 14min – a third time saving compared to route A.

The questionnaire is set up in three parts:

1. General questions before doing the walks, about navigating and decision behavior of the participant, in order to understand how people build up decisions or what influences their decision making. To understand the relation of the received information and how it can be used for a space recommender approach it's crucial to know the general behavior towards recommendations of the participant. The translation into the urban space requires an investigation of the walking behavioral background.

2. The participant is then asked to carry out two short walks, the actual experiment, with the same origin/destination point: Route A generated with the rules of the Space Recommender System passing different waypoints, and Route B set up with Google Directions algorithms. The participant starts with Route A and fills out questions about the walking experience same as rating from 1 - 5 afterwards, then he is doing the same with Route B. The questions relate to his personal walk experience including a rating and a commenting part for detailed information, in order to receive feedback about the pleasure of walking.

3. After having finished both walking experiences the participant is asked to compare the two according to his personal experience. Questions relate to his preference, including a reasoning part and his opinion about using such routes in the every day, in order to investigate opportunities for a Space Recommender System on the market.

RESULTS

Thirty Questionnaires were handed out to volunteers within the age range from twenty to fourty years in a similar age distribution with 60% male participation. Everybody was familiar with the use of navigation systems on smartphones and almost half use such tools more than twice a week.

Friends and family were mentioned as most important recommendation source, followed by online reviews, forums, magazine articles and social networks. ¾ of the participants visit always, ¼ sometimes recommended places, like restaurants, shops and bars while traveling, whereas it's exactly the opposite for recommendations in their hometown.

Almost ¾ of the participants enjoy strolling from time to time – general route decisions are based on distance, time, surrounding and noise factors while road safety, people traffic or the road size play a secondary role. 60% are willing to take a detour in order to gain more pleasure while walking.

When walking along the testing directions, route A was sensed by most participants as exciting, diverse, calming and pleasant whereas route B was sensed as boring, monotone, stressful and unpleasant. Route B only can earn points in terms of distance and time efficiency (Table 1-6). Overall, almost ¾ think that the detour was worth doing route A, only 13% tend to see the longer route as a waste of time.

After having walked both routes, most of the participants (84%) noticed a difference between the two walks, which had in every case a positive effect on the walk: 80% preferred route A. Translated this scenario in their everyday life, more than half (57%) wouldn't make a different decision, for the remaining 43%, time is the major factor for changing their minds, besides the distance.

Analyzing the outcome in scattered charts shows three very strong trends among the given rating points which include diversity, calmness and the pleasure of the routes. Participants who enjoyed route A's diversity are most likely very unpleased with route B. A similar picture is seen at the other two property tables.

Below we show the outcome as graphs in detail, whereas blue represents route A and red route B.

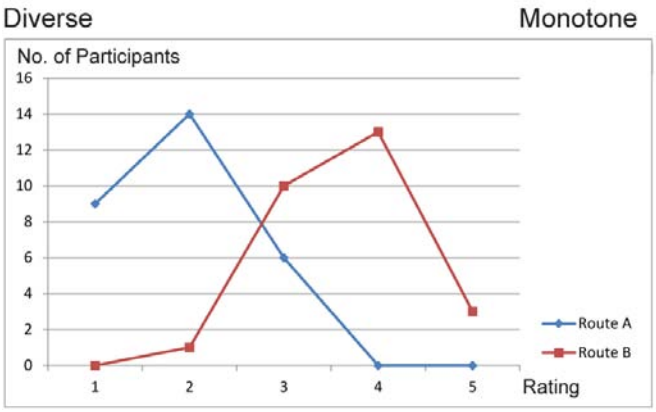

Table 1. Result: Diverse vs. Monotone

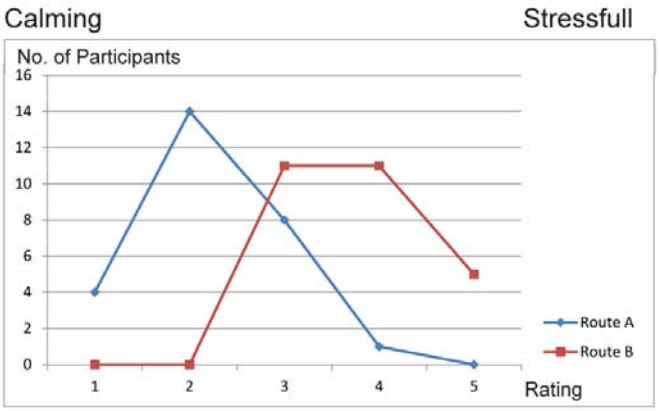

Table 2. Result: Calming vs. Stressfull

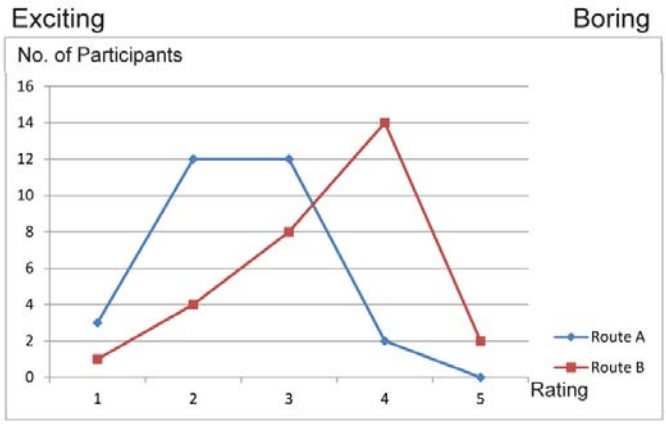

Table 3. Result: Exciting vs. Boring

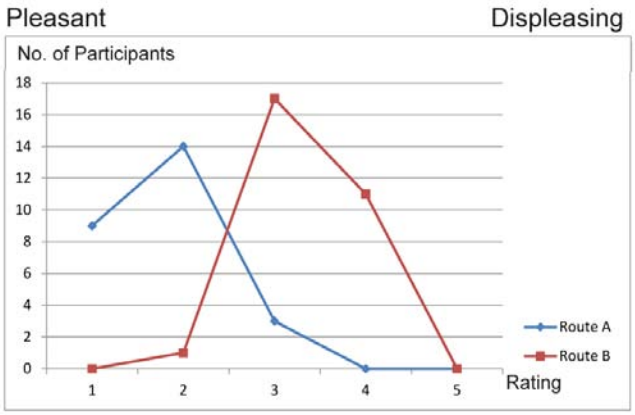

Table 4. Result: Pleasant vs. Displeasing

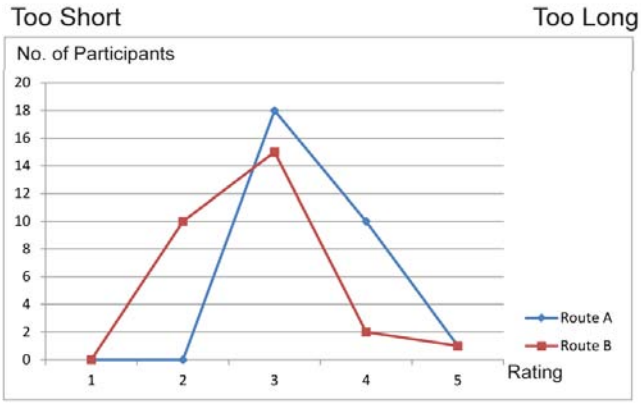

Table 5. Result: Too Short vs. Too Long

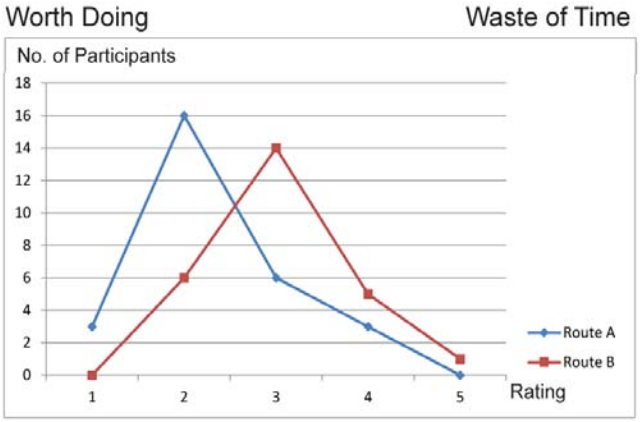

Table 6. Result: Worth Doing vs. Waste of Time

DISCUSSION & FUTURE WORK

This paper suggests that changing common algorithmic routing approaches of mobile pedestrian routing services, using open source online voting data of social networks as input, can open up possibilities to generate new experiences while walking through the cityscape, based on pleasure rather than on transfer time, and can act therefore as animator for people's walking behavior. It suggests a shift in human approach towards urban walking: focus has been shifted from the destination, towards the walk experience as a whole ("the path is the reward"). This is being achieved by leading the user via concentrated areas of places she/he gets recommended by the system, thus by public, which is at this stage based on general Facebook 'Like' voting data.

Recommendations are highly personal on one side, on the other side we want to avoid the risk of navigating through a 'filter bubble' [10] by just taking data from a certain group of people (as for example, friends in Facebook). In that respect it is important for further steps to understand and investigate in more detail in how we will incorporate the data from our recommendation sources.

On a more general view on recommendation sources we know from sentiment analysis that voting data opens up new opportunities in opinion mining [3], at the same time in the case of our project it should not limit our opportunities for generating exciting urban walks. The main reason for us to use Facebook as source was besides its richness of the database the easy access able dataset of public votes for locations via API. These circumstances make it ideal for the initial design stage of a prototype for our purposes. However, the source is changeable and can vary from other social networks, as Foursquare Check-Ins or geo-located Twitter data, to crowd-sourced input with a stronger local relationship, as for example sharing local knowledge or storytelling. A deeper investigation in that area is part of our future work as well as a closer look into where the votes come from: The differentiation between votes for global players like 'Starbucks' and local "insider" tips for certain venues brought up some challenges with the dataset during our investigations [17].

For further research we will also focus on time/distance properties. As our testing outcome shows these are the main constrains towards using such an approach. In our prototype we have built in a more or less rough option to adjust the length of the route by defining the waypoints of the output: the more points selected, the longer the generated route becomes. In order to support urban walking by using such an approach and to make it useable in an everyday scenario that is often defined by tight schedules, it is important for the user to be able to have control about the walking time to get from a point A to a point B, whether if it's on the shortest or a longer way.

Furthermore the prototype as presented in this paper is desktop based. Currently we are developing a mobile version of SRS that runs as smartphone application in o test our approach in the wild. The raised questions, same as future discussions will help for a steady improvement in the SRS development, in order to explore new opportunities for urban exploration.

CONCLUSION

In this paper we present SRS, a system the combines crowd sourced data of social networks with a pedestrian route finder application. SRS was developed in response to the contribution to the urban walk and introduces a new approach for urban pedestrian navigation systems based on pleasure rather than time/distance proportions. By developing a prototype we investigated the possibility of using online social network data to feed into a recommender system that generates routes between a defined origin and a destination location in the urban landscape.

Early findings have indicated the potential of our approach and got supported by the final test results. It is possible to conclude that social network data has big potential to be used in order to enhance the urban walking experience.

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