Sense-of-the-City

Bauke de Vries Yuzhong Lin and Joran Jessurun
Eindhoven University of Technology
Den Dolech 2
p5612 AZ Eindhoven
The Netherlands
B.d.Vries@tue.nl

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Abstract: Sense-of-the-City was a project that was executed in the city centre of Eindhoven using mobile phones with GPS. Ten persons carried this equipment during the working day for a period of one week. While carrying their route was traced and projected on a map that could be viewed on the internet. The citizens were asked to pictures of places of interest. These pictures are uploaded to the server and attached to the route. Later on text can be added to each picture through the website. All participants showed a high level of engagement in the project. Although the logbooks of the routes that were created on the web provided very personal insights, it was very hard to draw conclusions from these data.

1. INTRODUCTION

Today cities like Paris, Rotterdam and other European cities suffer from neighbourhoods where its citizens are dissatisfied about their well-being. This dissatisfaction may lead to decrease of safety, education and income which in return leads to people moving to another place to live. The municipality is aware of these changes and develops plans to stop this process. Traditionally politicians that are also aware of these neighbourhood problems, ask the municipality to take action. Urban planners and designers at the municipality have developed many methods for neighbourhood research. Commonly questionnaires are used based on techniques such as

revealed preference and stated preference. Today questionnaires can be provided electronically through the internet that supports the use of text and images in an easy accessible format. Using statistical tools the collected data are analysed and often presented as maps showing what the problems are and where you can find them. These maps and charts are input to the urban designer for the development of new plans and discuss these with the politicians and with the citizens.

Recently there is a trend that politicians approach the citizens directly to ask their opinion, to learn at first hand what is actually going on and also to win their vote (maybe in the next election). Meeting events are organised in the neighbourhood where the citizens can speak up and discuss the problems and the plans. However, the following problems with such events can be identified:

1. Only a specific group will show up
2. Without careful preparation and management it will lead to disappointment
3. It is hard to draw conclusions from the discussion

Consequently there is a search for tools that allows for direct communication with the citizens and preferably motivates them to cooperate in a discussion about their neighbourhood. With such a tool data should be collected to research what the citizens' perception is of the neighbourhood as input to new plans. Location Based Systems (LBS) are embraced by pioneers in this field as a strong candidate, because it is an appealing new technology that seems to suit these goals.

Sense-of-the-City was an experimental project executed in 2006 in the city centre of Eindhoven on behalf of the Eindhoven municipality using mobiles phones for communication with a server to create logbook of events from an Eindhoven citizen including text, images and routing. In this paper we will first give a brief overview of the state-of-the-art in Location Based Systems technology and applications. Next we will describe in full detail how we set out, which technology we used, how the experiment was actually executed and the results. In the evaluation section we look back on the technological problems we encountered, how the results were presented and finally discuss the potentials of this technology for future research and applications.

2. LBS RESEARCH

Location-Based Services (LBS) (e.g. Ahas, *et al*., 2005) build on three core technologies: mobiles devices, wireless networking and location

sensing. Mobiles devices range from laptop computers, Personal Digital Assistants (PDAs), mobile phones to mobile game computers. The key technology here is the mobile phone, because it is widespread and because mobile phones subsume other technologies such as MP3 players, photo camera and game console. Not yet consumer products, but presumable future technologies are: wearable computers and Augmented Reality (AR) devices (e.g. glasses). Wireless networking can be divided into four classes of technology: cellular telephony, Wireless Ethernet, Bluetooth and WIMAX. Cellular telephony is slowly moving from low-bandwidth to higher bandwidth (UMTS) to support more advanced services (e.g. graphics). Wireless networks provide a higher bandwidth but are primarily used for laptops and PDA's. Some public and private spaces provide so-called Hotspots to support access to the internet. Bluetooth is a low-bandwidth, short range protocol for communication between devices (e.g. mobile phone and head set). An upcoming technology is WIMAX that provides a long range, fast connection and potentially competes with the UMTS standard.

The most well known location sensing technology is of course the Global Positioning System (GPS). Examples include Wolf, *et al*. (2004), LaMance, *et al*., (2002), and Stopher and Collins (2005). Through triangulation of the transmission time from satellites, a GPS device can calculate its location within a precision of a few meters. In practice however, accuracy depends on coverage, occlusion and time-of-day. Wireless networks can be used for location calculation, although they were never developed for that purpose. In a cell phone network the location of the user can be determined by measuring the proximity of the base station (Asakura and Hato, 2004). The accuracy is of course very low and can range from 100m to 600m. Applications of other wireless network technologies for location calculation are scarce. On a small scale Radio Frequency Technology (RFID) is the prevailing technology. Like cell phones, only the proximity of the base station can be measured (10cm – 100m).

Location based technologies are widely used nowadays in personal navigation such as the system of TomTom. The users can use TomTom either in their car, motorcycle or PDA/mobile phone to navigate in a certain environment. In addition to direction information, a guidance system can also offer extra information based on the geographic location. Applications like Vinfigo city guide (http://www.vindigo.com/) and jungleport (http://www.jungleport.com/) are examples that provide users with not only the map but also suggestions about which restaurants or hotel to go in the neighbourhood. More recent research on the Location Based System shows extensions into a personalized, interactive and dynamic system that provide

the most suitable information for different individuals according to user profile and context , such as CityVoyager (Takeuchi and Sugimoto, 2007) , GeoVecter (http://www.geovector.com/), etc. At the same time, users can also attach information (messages, photos, etc.) to a geographic location such as the application of urban tapestries (http://urbantapestries.net/). In this way, some personal experience can be shared among common users who cross the same place. In the GUIDE project (Cheverst, *et al.*, 2001), by sharing the location context users can benefit by knowing the whereabouts of their family members, or determining the popularity of attractions based on the number of visits. In addition, users can communicate with each other.

This communication platform provided by Location Based Service can also enable a social network. One of the latest applications is the Facebook application that offers location and mobile services for Mobile Social Networking (http://www.gomonews.com/mobile-lbs-applications-on-facebook/). You can let your friends know where you are, find out where they are and chat with them on real time via your smartphone. Other similar applications can be found in dating services, mobile gaming, etc. Another usage of location based technologies is for safety and security. For example, the Location information can be applied to locate the emergency caller or stolen vehicles. A family locator could keep track of young, elderly or disabled family members.

3. SENSE-OF-THE-CITY EXPERIMENT

3.1 Aim of the municipality

A few years ago, the Eindhoven city and the region of Eindhoven developed a long term mission, name ‘Brainport’. As the name already suggest, Eindhoven should be developed into a high-tech knowledge centre in Europe. Evidently this ambition builds upon the history of Eindhoven, being the founding place of the international Philips Company and today being the host of lots of high tech industries. In the Brainport report (www.brainporteindhoven.nl) a study was presented on how similar region elsewhere for example in the US were developed and how Eindhoven could learn form that. Not only political and commercial aspects were addressed in the report but also the urban and societal aspects of being a Brainport city. Finally a knowledge centre can only exist if it can accommodate knowledge workers that are motivated to live there.

As a side effect of the Brainport initiative the Eindhoven municipality is looking for other and better ways to develop the Eindhoven city. At the municipally maps are developed that present opportunities for revitalising the neighbourhood. These maps are developed using a vast amount of socio-economic data from Geographic Information Systems (GIS). Although these data sources are very reliable, they lack information about the perception of the people that actually live there. Other data collection methods are needed than the existing methods like surveys, questionnaires, data mining, etc. The Sense-of-the-City experiment fits within this search for new methods. The main goal of this project was to find out if the mobile phone + GPS technology could be used to engage citizens of Eindhoven in the creation of personal maps of Eindhoven. These maps tell the story of one day of their life presented in a logbook with images and explanatory text. There was no clear picture how these stories could be analysed and transferred into input for politicians or urban planners.

3.2 Technology

Sense-of-the-city project is based on GeoTracing, which is a software platform for creating multimedial geo-applications for tracking or tracing purposes. GeoTracing integrates GPS, mobile technology, GIS and content management (CMS) within an extensible client-server framework. Users can tell their multimedial story via locative media applications based on this software framework. Technologies included in Geotracing are Java (J2ME, J2EE), AJAX, XML, Google Maps and Google Earth. The GeoTracing server is run on an Ubuntu Linux system.

In our project, the devices employed to enable localization are a Bluetooth GPS receiver and a mobile phone with an application called MobiTracer. This mobile application can read GPS location data and send these data to the GeoTracing server. Users can use the functions of the mobile phone such as Camera and Recorder to send various media (text/photos/audio/video) to the server. They can also access and modify their media data through internet whenever they want.

3.3 Preparation

For practical reasons only ten mobile phones + GPS receivers were available for the Sense-of-the-City experiment. The mobile phones + GPS receivers were provided by a telecom company that sponsored the project. Each mobile needed to be prepared before use, which consisted of installing the tracing software, configuring the hardware and personalizing it. A group

of ten persons were asked to take part in the experiment each having a different profile. The assumption was that each person would create a different story and thereby a different view on the city of Eindhoven. Because the mobile phones were quite expensive they were insured against theft and loss. A manual was written the help the users operating the mobile phone and GPS. The manual includes a step by step plan how to establish the connection with the server and how to make picture with the camera and upload these to the server. Although the implemented software on the mobile phone also supported recording and transferring movies with audio, this functionality was not used because of the long transfer times.

All participants were invited to a restaurant in the city centre of Eindhoven. Here they listened to an introduction about the sense-of-the-City project and they were told what was expected from them. To be sure that everyone could operate the equipment, the participants were asked to make a short test round. When problems occurred a system developer was there to solve it. After this introduction meeting everyone took the equipment home for the real experiment the next day.

3.4 Execution

For each person the experiment lasted one week. In that week he or she was asked to carry the mobile phone + GPS with them during the day, and make pictures of objects or places they thought were interesting for what ever reason. The experiment started on Friday April 21st 2006 and ended a week later. During that week a system developer was stand-by through the phone, to give support when needed. At home the participants could view there own routes and add text to the pictures that they uploaded previously. At the final day, the participants had to return the equipment at a specific time and place.

3.5 Results

The municipality considered the enthusiasm of all participants the main result of the project disregarding the logbooks that were created. Without any exception, the participants enjoyed taking part in the experiment as they expressed afterwards. The profiles of the participants were: designer, broker, mother, police, student, city cleaner, ambulance, market salesman, pizza courier and marathon runner. On the website www.senseofthecity.nl some of them can be viewed. The logbooks differ a lot from one to another. Some persons simply travel more on one day and take more pictures than others. Most logbooks provide a par in a person's life. Pictures of family and friends are often used and pictures of places that are visited for private reasons or for

business. Most participants commented to places in the city of Eindhoven, because they knew this was important for the project. Some participants reported that they never experienced the city so consciously before, because the camera pictures forced them be aware of the environment.

4. EVALUATION

4.1 Technology

The preparation of the phones and the server took a lot of effort. For an unconfigured telephone 1 to 1½ hour was needed to set it up. If the telephone had already been prepared, 15 to 30 minutes is needed. Things that had to be done where:

- Setting the correct time, because the time is used to determine at what location a picture has been taken. Things like day light saving and time zones must be configured correctly.
- Configuring the camera so that the images don't become too big. Bigger images take a longer time to transmit.
- The email account at the provider had to be configured. The images in this project were sent by email. Recently the software allows images to be sent directly without using email.
- The configured email needs to be matched with the correct user on the server. Because only one user in the system may have the same email address, switching phones also means removing the email address from one user and set it for another one.
- Extra information for the person must be configured in the server, including an image thumbnail representing the profile of that user.
- All unneeded options like networks, bookmarks and addresses must be removed.
- The MobiTracer application must be installed and configured. This includes giving the application more rights to prevent security pop-ups and configuring it as a shortcut so it can be easily started.
- Configuring the Bluetooth settings.
- Pairing the GPS with the MobiTracer application.

Because the pictures where taken and emailed using the standard software, the memory must also be cleared before giving the phone to another user.

The users of this system can determine the location and time that the photo is taken and sent. They are in full control of their destination, route, and travelling speed. During the operation of the system, the only feedback

they received was their status of connection to the network and some – incomprehensible to the most – GPS information. They could be notified whether the GPS signal was sent to the server through audio feedback. Unfortunately, the high frequency beep was found annoying. We intend to improve the user interface and provide more efficient visual and audio feedback.

4.2 Results

Although the Sense-of-the-City website has been used many times for demonstration, we felt it is hard, if not impossible, to draw conclusions from the logbooks. Endeavors have been made to project the routes in time and place along different axis to create a schematic representation, but without a satisfactory result. From a scientific point of view more structured data are necessary to capture the Sense-of-the-City. Preferably the additional data can be captured without loosing the engagement that the technology arises with its users.

4.3 Future research

In general, the participants were interested in the concept of sharing their personal experience with others. They could express themselves by sharing the information about the places in the city with others. It provided an opportunity for them to thoroughly inspect their living environment. Out of their subjective opinions, we found an encouraging fact that the technology indeed managed to bring the citizens closer to their living neighbourhood.

Nevertheless, the outcome of this project is difficult to analyse and define. In addition to subjective judgments of the usability from the participants, obtaining more concrete information regarding the places would be a worthy cause. We intend to focus our attention on enriching the input with meaningful meta-data, so that we are able to categorize this information. We foresee that the user comments and media input over a specific location could be analyzed and combined in such a way that they can yield an integral image of the place in question.

In our project, information was only transferred from the user to the server. They had no information indicating where they were and how they could navigate. We feel the information should flow more dynamically between user and server and between users mutually. The question however is how much information the users like to receive. In certain circumstances,

users may passively receive the information, or actively request it, which paves the way for applying certain payment schemes. For the different user purposes, information can be provided in terms of actual information, describing the state of the system at hand, or may be presented in terms of recommendations in an attempt to stimulate particular kinds of user reactions to better control the system. The objectives of the information provider may also differ from personal assistance to achieving some common objective that is not necessarily of interest to the individual user. Technological implementation and user reaction will most likely depend on such differences.

Our primary future goal is to increase the semantic level of information while maintaining the level of engagement of users. The properties of the information and how it is presented will be our focus of attention. We believe that information provision will only be an improvement if the information satisfies users' anticipation. Therefore the future state of the system can be simulated realistically within some narrow error bounds and in real time. The development of such a system is our future research goal.

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