Creating a Mobile City Guide

TDT4520 Depth Study

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Abstract

This project is about the process of creating a mobile service with information for users who are out on the town. The goal is to make an application for mobile phones that people will find useful for learning about current events, restaurants, bars and pubs in the city of Trondheim.

The service that was created in this project was an application that shows the user at their current position on a map. It will then display a number of data points surrounding the user. These points can symbolize current events or places to eat and drink. Users can navigate around the map to see other data points, and they can read further information on any point that is displayed.

The service was not tested on real users, but it was shown to fulfill a number of requirements and assumed to be useful by testing it with some hypothetical scenarios.

Preface

This report is a documentation of the project work performed in the subject TDT4520 “Program- and information systems, Depth Study” by Eirik Blakstad.

The project counts for 15 study points and is carried out during the third semester of the two year Master’s Degree Programme in Computer Science at the Norwegian University of Science and Technology, NTNU.

I would like to thank John Krogstie, my advisor on this project, for helpful guidance and feedback.

Trondheim, 16 December 2008

Eirik Blakstad

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Chapter 1: Introduction

1.1 Motivation

In recent years, the opportunities for people to access information wherever they are has increased significantly. New technology has made people more mobile, with almost everyone in society now having tools for accessing the Internet wirelessly at their disposal. While technologies enabling this have existed for a while, the real change has been in the areas of affordability and bandwidth, which have pushed the use of wireless Internet access from a pure novelty to a tool which most people will use on a daily basis.

At the same time, third generation mobile networks are revolutionizing mobile Internet access, and other technologies enabling the creation of new sorts of context-aware applications are becoming increasingly common in mobile devices. Built-in GPS and Wi-Fi enable applications to take a user's location into account, and combined with constant Internet access this creates an opportunity to make very powerful mobile services.

The goal of my project is to create one such application, with information on events, places to eat, places to go out and many other types of businesses available to a user on their mobile phone. By taking location into account, the user should have a simple, informative map-like interface that is appropriate for a small mobile device. This should serve as a genuinely helpful and informative tool for use by both locals and people visiting an unfamiliar city.

1.2 Project context

This project is a continuation of previous projects making use of the Wireless Trondheim infrastructure and developing location based mobile applications. In particular the projects of [Hansen 2007] and [Ibrahim 2008] can be considered precursors to this project. It is also inspired by a request from Wireless Trondheim as to improve and expand the applications that have resulted from the other recent projects.

1.3 Problem definition

This project should result in a service, *Tguide*, that displays information on current events, places to go and eating and drinking establishments in Trondheim.

The service should be accessible by mobile phone and help users find events and establishments in relation to their current position.

1.4 Report outline

Chapter 2: Prestudy studies existing solutions and the state of the art, and goes through technologies that are useful for the project

Chapter 3: Research approach describes the Design science research method and how it is used in the project

Chapter 4: Requirements introduces scenarios for evaluating the service and a number of requirements

Chapter 5: Development environment describes some existing projects and technologies that were used when implementing the service for this project

Chapter 6: Solution goes through how the solution was created and which choices were made

Chapter 7: Evaluation discusses the results compared to requirements and scenarios

Chapter 8: Summary is a conclusion of the project and a discussion on further work that can be done

Chapter 2: Prestudy

New features are constantly being added to modern mobile phones, and a number of new technologies have made its impact in recent years. In this chapter some of the technologies that are relevant for this project will be presented and a couple of similar existing solutions described.

2.1 Mobile applications

The idea of developing standalone applications for regular mobile phones is a recent phenomenon. The introduction of smartphones enabled the move from server based WAP solutions to standalone applications, and introduced new opportunities for creating mobile services.

2.1.1 WAP

The first mobile services were based on WAP technology. WAP (Wireless Application Protocol) in essence enabled mobile users to interact with custom made web pages, which could feature animation, streaming media and downloadable music. WAP usage never took off in Europe and USA, because of slow lines, lack of interesting content and poor usability. Japan's version of WAP, the I-Mode service, had a much higher adoption. This was done by avoiding most of the problems surrounding European and American implementations, partly by creating it from the beginning as a source of entertainment [TARIFIC 2001].

2.1.2 Smartphones

There is no widely agreed upon definition of what a smartphone really is, but it is often described as a mobile phone that runs an open operating system, with the ability to add applications from third parties. The first smartphones saw the light in the early 1990s, but were originally mostly a tool for advanced business tasks. In the past couple of years, smartphones have become widespread amongst regular users, which has created a new market for personal mobile software. This market will lead to a huge growth in revenue for mobile content, with the European market reaching 11 billion Euros by 2012 [Frost 2008].

2.2 Context and Context-awareness

When making a "smart" application, giving the application access to a context is essential. As intelligent beings, humans use context extensively when interacting. The ability to read cues in another person is key to be able to get across a message, and using one's other senses is required for making good decisions and ultimately for survival.

For computers to better be able to communicate with their human users, they should then have access to some situational information, and with this it should be possible to increase the degree of usability and user friendliness in human-computer interactions.

Taking previous definitions into account, [Dey 2001] defines context as:

"any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves."

They go on to define the four types of primary context: location, identity, time and activity.

In addition, [Dey 2001] defines a system as being context-aware if:

"[…] it uses context to provide relevant information and/or services to the user, where relevancy depends on the user's task."

2.2.1 Context in this project

From the definitions in [Dey 2001], this project can be classified as context-aware. It will mainly take location into account when presenting the service for the user, but other types of context may also be applicable. When displaying time-limited events, the current time can be used as a filter to show only events happening within a certain time period. In addition, when knowing the identity of the user, the service can enable additional tailoring through user settings and properties, and by storing and analyzing user behavior it can try to guess user intent, although this might be hard to realize in practice.

2.3 Wireless Internet access

Any system designed to present up-to-date data needs a way to access remote information. For mobile systems, this means the device needs to access the Internet wirelessly. While mobile phones have had this ability for many years, this was originally by using the phone as a modem and a traditional dial-up service. Nowadays, wireless technology has matured and always-on wireless internet access from a mobile phone is substantially faster, simpler and more economical than older solutions.

2.3.1 3G and 3.5G

3G, used to describe the third generation of mobile networks, usually comes with a service for wireless always-on data access from the mobile service provider. In a regular 3G network, speeds can vary from about 100 Kbps to several megabits. With newer technologies like HSDPA, often dubbed 3.5G, the maximum theoretical speed is 14.4 Mbps.

2.3.2 Wi-Fi

Wi-Fi is a trademarked name for the various IEEE 802.11 technologies that specify standards for wireless networking. Operating in the unlicensed 2.4 GHz band, access is provided by a base station that is connected to a wired network.

[Lehr 2002] points out advantages of each technology:

Coverage: While a single Wi-Fi access point has a range of up to 100m, several interconnected access points can provide much greater coverage. However, the ability to connect to a 3G base station several kilometers away, gives users this technology much more mobility.

Cost: 3G access is usually charged on a per-megabyte basis or as a relatively high monthly fee. Wi-Fi, not being bound to any particular provider, doesn't have any inherent usage costs. Often owners of access points provide access free of charge, although individual providers may charge users for accessing their access points, for example on a per-hour basis.

Bandwidth: Although 3G bandwidth has been constantly increasing, the data rate is much dependent on the distance from the base station, and will rarely exceed 2 Mbps. In comparison, current Wi-Fi technology enables bandwidths of up to 54 Mbps.

2.4 Location sensing technologies

Location is one of the more important context variables a system can utilize, and a number of technologies for determining the current location of a device exist.

2.4.1 GPS – Global Positioning System

GPS sends signals from a number of satellites encircling the earth to a receiver, enabling it to determine its current location. GPS is becoming increasingly widespread, and many high end mobile phones now have GPS receivers built in. However, GPS receivers do not work very well indoors or around high rise buildings, and a GPS receiver will drain the battery faster on mobile devices.

2.4.2 Wi-Fi localization

This technology uses an algorithm to calculate a user's position based on data from available Wi-Fi access points. Depending on environment characteristics, accuracy is calculated to be in the range of 13-40 meters, which means it is considerably less precise than GPS [Cheng 2005]. However, unlike GPS technology, Wi-Fi localization will work both indoors and outdoors, and is well suited for urban environments. In addition, Wi-Fi technology is built into many mobile devices that are not equipped with GPS, which makes Wi-Fi localization the most precise positioning technology for such devices.

2.4.3 Network based positioning

A third way of finding a user's position is through cell network localization. This technology is based on measuring the signal from various base stations nearby, and from that calculating a user's position. In many ways this is similar to Wi-Fi localization, but on a bigger scale. However, there are some drawbacks; it must be supported by the mobile operator, which may want to take money for such a service, and precision is only in the range of 50 meters.

2.5 Geocoding

One can not always assume that a data source with relevant information to be displayed has coordinates for all events in contains. Many times, location information is limited to a street address. In that case, a geocoder web service can receive a request with an address and then convert the address to coordinates before sending them back. This will make it possible to show the location on a map. Using such a tool is essential when the data to be displayed lacks coordinate information.

2.6 Similar applications

There are a number of services that are similar to the one being created in this project.

However, while similarities are many – they contain maps, use automatic localization and show some information on businesses nearby – there are often a number of elements they lack compared to this project. With the partial exception of i:byen, none of the identified services have the ability to also show updated information on current time-limited events and to show user supplied information, like user scores and reviews, on restaurants, cafés and bars.

Still, these services served as an inspiration when implementing this service, and they show there is a market for these types of mobile services.

2.6.1 i:byen

i:byen [Hansen 2007] was a project at NTNU with the aim of creating a mobile application for displaying information on current events in Trondheim. There were originally additional features planned, including calendar functions, but they were not implemented.

The resulting application shows a map and points of interest retrieved from UtGuiden [UtGuide 2008]. It uses GPS functionality to locate users on the map. This program has many similarities with the service that will be created by this project, and many of the requirements are similar. However, this project will support several additional data sources to show a wider variety of information, and there will be a higher focus on ease of use.

2.6.2 Vindigo

Vindigo [Vindigo 2008] was a commercial creator of mobile city guides, founded in 1999. The company created amongst other things downloadable applications for mobile phones that would show nearby shops, restaurants, bars and so on. However, the applications did not incorporate automatic localization, and the amount of information available was very large, which made it hard for users to get the information they wanted. The company was reportedly shut down in September of 2008 [Alley 2008].

2.6.3 Navigation software

Manufacturers of standalone GPS devices have for a long time included various points of interest with their premium models. Called waypoints, this information can include gas stations, tourist attractions, restaurants and other information a traveler might find useful. With GPS being built into mobile phones, phone manufacturers have also started to include navigation applications with such information. In addition, third party software companies have begun offering their own navigation software for mobile phones.

Wayfinder [Wayfind 2008] is a Swedish company that creates navigation software for GPS enabled smartphones. Maps are downloaded dynamically to the phone through a 3G connection, and it comes with a large number of waypoints preloaded. The application comes preloaded on some Sony Ericsson phones, but it can also be purchased separately for several other brands.

Nokia Maps [Nokia 2008] is a navigation application that is included in some Nokia phones. It contains highly detailed map and supports walking routes, and a regular database with points of interest.

While useful, this type of navigation software usually does not have the ability to show dynamic content other than traffic related information. Points of interest are predefined statically by the manufacturer and will not contain information on current city events or user reviews of the restaurants and other places of businesses they feature.

2.7 Privacy issues

The use of context in an application introduces a variety of issues related to privacy. When both a user's identity and location is involved, great care has to be taken to make sure this information will remain private.

[Bandara 2005] claims there will always be a tradeoff between a program's usefulness and the need to disclose and use private information, and expresses the need for explicit privacy rights for mobile applications. One suggested way is letting the system ask a user to manually override her privacy policy if an application needs to send information to a third party. This should be accompanied by a learning behavior in the system that will determine through the user's actions when it is OK to send personal information and then do it automatically. This helps avoid frustrating the user unnecessarily with constant requests for authorization, while still containing some checks that let the user control when personal information is sent.

Chapter 3: Research approach

This chapter describes design science and shows how this methodology will be used in the project.

3.1 Design science

The research method used for this project is design science. This is a research methodology that offers guidelines for evaluating IT-related research projects. The focus is on improvement of the functional performance of an artifact, where the artifact can be a number of different things.

There are seven specific guidelines for evaluation and iteration provided in [Hevner 2004]:

Guideline	Description
1: Design as an Artifact	Design science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.
2: Problem Relevance	The objective of design science research is to develop technology-based solutions to important and relevant business problems.
3: Design Evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
4: Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations and/or design methodologies.
5: Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
6: Design as a Search Process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
7: Communication of Research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

Table 3.1*: Evaluation and Iteration Guidelines* from [Hevner 2004]

Following these guidelines, design science can be applied to this project as following:

- **Guideline 1** demands an actual artifact be produced. In this case this artifact will be the mobile application and supporting services developed in this project.
- **Guideline 2** requires the problem to be a relevant and important business problem. This relevance is shown through the list of requirements, based on earlier work. As similar projects have been undertaken before, there is clearly a wish for such a service, and the increasing number of mobile phones with the required capabilities shows this issue is becoming even more relevant.
- **Guideline 3** stresses the need to use well-executed evaluation methods. For this project, the evaluation will be based on providing a variety of relevant and plausible scenarios in which this service will be useful. Ideally there would have been performed usability testing on the product, but due to time constraints this was not possible. Instead, when the service has been created, each scenario will be carefully reviewed and the success of the service in providing a solution for the scenario will be determined.

- **Guideline 4** calls for the design-science research to provide a clear and verifiable contribution. The prestudy in chapter 2 lists similar existing services, but it also shows how the project is unique. Also, the list of requirements created from earlier projects show a demand for this type of service. This should provide a sufficient foundation for this project.
- **Guideline 5** requires the use of rigorous methods. In this project, the methods for construction and evaluation are chosen based on a study of various options given the requirements, and informed input from the project advisors.
- **Guideline 6** expresses the need to utilize the findings and use them to create a better product. This is very important, and for this project the requirements and demands discovered in this process will certainly be evaluated and incorporated into the final product.
- **Guideline 7** will be followed by explaining uncommon technical terms used and keeping in mind the inteded audience while writing the report.

As mentioned, this project will be evaluated by using scenarios. The prototype application will be compared against the scenarios, and it will be determined to what degree the application can be used for the activities indicated by the scenarios.

Chapter 4: Requirements

In this chapter, a number of scenarios are depicted and a list of requirements from various sources is presented.

4.1 Scenarios

The evaluation of the project will be in the form of scenarios. The identified requirements and intended usage of the service will serve as the basis for these scenarios. They should represent most of the types of tasks for which users would use the service.

4.1.1 Scenario 1: Running into an old friend

While sitting at a bench outside Trondheim Torg a Saturday afternoon, Alice suddenly spots Bob, an old friend she hasn't seen in years. She calls him over and they start talking. Bob is just visiting the city for the day, and in order to catch up they decide to sit down at a restaurant. Bob says he is in the mood for some Mexican food, but Alice can't think of any Mexican restaurants nearby. She quickly opens the *Tguide* and looks at the map of restaurants near them. After a few seconds she can see the restaurant "Mex-Tex" on the map, just 50 meters away. She looks at a couple of reviews. All of them are positive, and many recommend the enchilladas. They head over to the restaurant.

4.1.2 Scenario 2: Where is the theater?

Carol, Dave and Eve live in Steinkjer, a couple of hours outside of Trondheim. Today, they are visiting the city to see the production of "Rent" at Trøndelag Teater, but after going off the bus at Trondheim Torg, they can't remember which way to go to get to the theater. Always quick-witted, Carol opens her phone, selects to show today's events on a map, and can see the exact location where "Rent" is playing.

4.1.3 Scenario 3: Nothing to do

Isaac and Ivan are sitting around at home a Sunday afternoon with nothing to do. Randomly flipping around his mobile phone, Isaac turns on the *Tguide* to see what is happening. He notices there is a jazz festival in town and the first concert is scheduled for that evening. The number to buy tickets is also displayed, and they quickly order two tickets before getting ready for a night of fun.

4.1.4 Scenario 4: Out on the town

It's Saturday night, 1 AM, and Justin is walking around trying to remember where his friends went. He knows the name of the club and the general location, but is unable to find it. Quickly checking *Tguide* on his phone he can see he was standing right beside it the whole time.

4.2 Specific requirements

4.2.1 Wireless Trondheim

Because Wireless Trondheim had been involved with several previous projects, and served as an initiator of this project, they had already a good idea of what they wanted. In a meeting with representatives from the organization, a list of their requirements was established:

- The service should show current events from UtGuiden
- The service should show data from Vibb
- The client should have a simple and intuitive user interface
- Users should get clear error messages and the program should communicate clearly to the user what it is doing

4.2.2 Functional requirements

From the requirements of Wireless Trondheim, the requirements and specifications of previous projects, and a further analysis of this project, these functional requirements were established.

Map

#	Requirement	Priority
1	The map must show the user's current position	H
2	Users should be able to move the map to other positions	M
3	Users should be able to zoom in on and out of the map	H

Options

#	Requirement	Priority
4	Users should be able to choose which data sources to display	H
5	Users should be able to choose what map to display	M

Display

#	Requirement	Priority
6	In the map display, points of interest on the map should be easily identifiable	H
7	Screen must show more information on data points when selected	M
8	Event points on the map should identify category/event type	M
9	Restaurants on the map should show a user score	M

User interface

#	Requirement	Priority
10	The user interface must be easy to read on small screens	H
11	Buttons must be clearly marked and easy to understand	H
12	Navigation must be intuitive and very easy to learn	M
13	Program must be responsive and not sluggish in use	M
14	User interface should be adaptable to a wide variety of screens and devices	M

Error handling

#	Requirement	Priority
15	Errors and exceptions must be clearly communicated to the user	H

16	The program should display some status of what it is doing in the background	**M**

Technology related

#	Requirement	Priority
17	The application should not be bound by a particular wireless technology	**M**
18	The application should support different maps	**M**
19	The application should support both GPS and Wi-Fi localization	**M**

4.3 Hypotheses

The following hypotheses will be tested in this project:

- The application is useful for people planning what to do out on the town
- The application is useful for people that are in the city center

Chapter 5: Development environment

This chapter will present the previous projects of which the results will be used in this project and describe in what way these projects will be utilized. Some other decisions related to the project will also be presented.

The geographical scope of the service that will be created is limited to the city of Trondheim. Because the project is partly initiated by Wireless Trondheim, and the service is meant to use the Wireless Trondheim Wi-Fi network, this is a natural limitation. However, this limitation would probably be imposed anyway, since the service would require an urban environment to be useful, and limiting oneself to a single city in the beginning makes testing and evaluation easier.

5.1 Previous projects

There have been several previous projects carried out at NTNU and other places with the purpose of creating wireless services and technologies supporting such services. Because of this, there is some existing work that this project can be built upon.

5.1.1 Wireless Trondheim

Wireless Trondheim [Andresen 2007] is a Wi-Fi wireless computer network encompassing much of the Trondheim city center, especially the more popular public areas.

Created as a coalition between NTNU and local officials and businesses, it serves as a huge laboratory that can work as a testing ground for new services and equipment, and it gives people in Trondheim a low-cost way to access the Internet from cafes, restaurants and public spaces in the city. Coverage is not complete, but it does cover the most popular shopping and dining areas of the city.

5.1.2 GeoPos – Geographical Positioning Service

GeoPos [GeoPos 2008] is a project initiated at NTNU which aims to give a user connected to the Wireless Trondheim network their current location through a simple web request. It uses the principles of Wi-Fi positioning to determine a user's position, and is a very promising service, although it is still in the testing phase. When fully functional, GeoPos should remove the need to use GPS when inside the scope of the service, but as for now this service is still not completely reliable and should primarily be used as a back-up or alternative to GPS.

5.1.3 IPos

Developed at NTNU, IPos [Ibrahim 2008] is a server solution for geographical information systems. The aim is to give students and others tools to help create new location based services. It contains street maps that can be sent to a client, as well as databases of location points with arbitrary data fields associated with them. Different services can be defined under their own domains. Data is sent to a client through an XML interface and SQL queries. A PostgreSQL server is storing all point data.

IPos supports the use of several different maps and different zoom levels for each map. Only two map sources are currently available, a free map from the OpenStreetMap project and a map from Norge Digital. These maps differ in many ways, and both have their pros and cons.

OpenStreetMap, as implemented has a lot of information on the map, most streets are named and footpaths and other small roads are also shown. However, the map lacks detail when zoomed in, and doesn't support a close zoom level.

The Norge Digital map doesn't contain street names or other written information. On the other hand, the map is very detailed and contains outlines of all buildings in the city. It supports a much closer zoom level than the OpenStreetMap map.

5.1.4 J2ME Polish

J2ME Polish is a collection of tools and technologies that help developers of mobile software. Many of the tools focus on creating better looking user interfaces, as well as making it possible to port the applications to a wide variety of mobile phones and platforms.

For this project, Polish has been very important to be able to export applications for specific mobile phones, and creating a good looking, user friendly interface.

5.2 Content

5.2.1 UtGuiden

UtGuiden [UtGuide 2008] is a source of information on current events. Developed by Adresseavisen, the largest local newspaper in Trondheim, it gives a list of almost everything cultural that is happening in the city. This includes concerts, art exhibitions, festivals and theater productions. The list is constantly updated, and is well suited as a source of the information to be displayed in this project.

Being a contributing member of the Wireless Trondheim project, Adresseavisen also has an interest in services using the network, and provides and XML feed for fetching data.

5.2.2 Vibb

The goal of Vibb [Vibb 2008] is to create a guide of restaurants, cafés and nightlife in Norway's biggest cities. Through user contributions, the various businesses are ranked and users can post comments and reviews. Vibb has been very successful in getting people involved, and has an impressive amount of information available.

As a source for information on businesses, Vibb should be very well suited for this service.

Chapter 6: Solution

This chapter will describe the implementation of the service.

Many of the services and elements required in this project had already been created or initiated by earlier projects. Because of this, much of the work required to put together this service was in the area of utilizing these existing services in a new application.

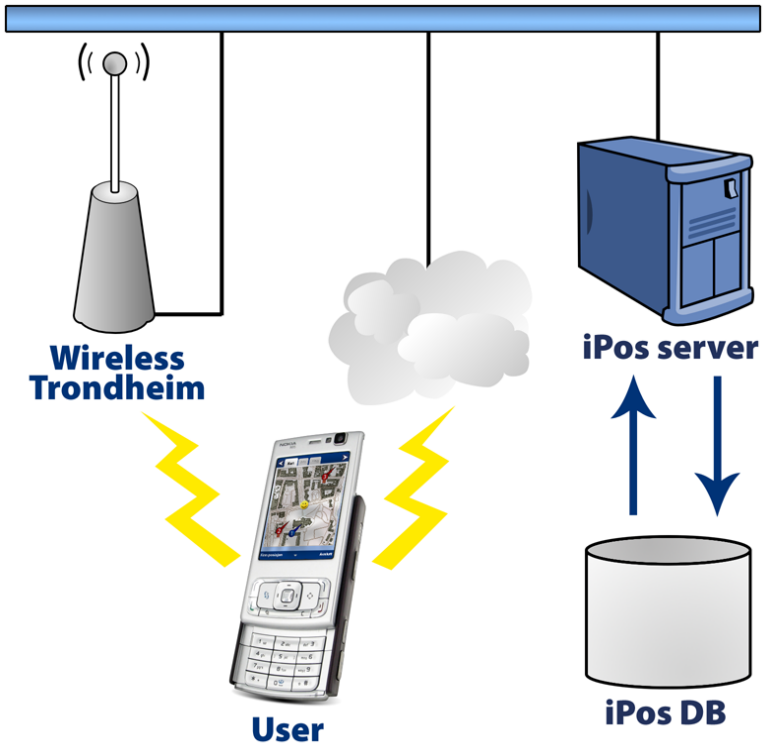

Figure 6.1: Service diagram

The work needed for this project could be divided into two parts, server-side and client-side. As indicated in the diagram, the mobile user could choose to connect through Wireless Trondheim or use any other way of accessing the Internet.

6.1 Server side

On the server side, the work was mostly centered on setting up new databases for IPos and getting data into them.

From the IPos project there was already a map server up and running. There were still some issues surrounding the map data and the mapping of coordinates to the map tiles. However, the service was usable and in practice worked very well.

A Java program for parsing XML data from UtGuiden and inserting them into a PostgreSQL database had been created earlier through the project of [Hansen 2007]. This greatly simplified the task of getting data into the system, although there were a few bugs that needed sorting out. The database had a very strict policy on which characters it would allow in text data, which meant all text in the provided XML data had to be thoroughly filtered to avoid errors. Although most characters were correctly filtered out, initially there were still a few that caused some problems.

Because data from UtGuiden is only valid for a single day, the parsing program was set up to run every day as a cron job.

Getting data from Vibb was a more challenging task, as they had no XML feed to parse, and there had not been any earlier attempts at getting data from this source. For getting the data into the database, we created a Perl script that parsed the web pages directly and put the data into the database.

6.2 Client side

On the client side, a J2ME prototype for getting data from the iPos server had already been created. This application had implemented much of the basic functionality that would also be needed for the project. The functionality included downloading and displaying a map on the screen, parsing XML data from the server, sending requests to the GeoPos service and getting GPS data from the phone. Still, there was not much implemented in the way of displaying data to the user and showing data points in the map. User friendliness and visual design were areas that needed a lot of work.

The prototype worked excellently as a starting point, and the challenge was displaying the data in a simple manner, creating a user friendly interface and making the entire application more robust. In addition, a more advanced way of getting data into the phone had to be created because of the relatively large amount of data points that existed.

Showing data from Vibb was not entirely straightforward, as there was a very large amount of data on each place of business. Much of the data was user reviews, which would be very informative for the user, but would require a lot of text to be displayed on a small mobile screen, as well as much data that needed to be stored locally for each place of business. One initial solution was to only show the latest user review, and then let the user choose to view more reviews. Only then would the application download more reviews and show these to the user.

Data points in the map would be identified by the letters 1-10. Users could then go through each number to see the name and some information of each point directly in the map, or they could switch over to the information tab that listed all points in the map with some additional information. Users could then select and click a point to show all information for the event or establishment.

Because data from both Vibb and UtGuiden could be displayed at the same time, they were given different colors on the map. The Vibb data points would also show the user score of the establishment

directly on the map. As the amount of data points was increasing, the need to separate data points on the map emerged. Because many points were located at the same address, or very near each other, it was important to not have them overlap and obscure each other. A simple algorithm solved this problem by pointing an arrow to the data point from a nearby unoccupied spot.

Figure 6.2: Software when running on a Nokia N95

Smiley face denotes current position, red numbers are from Vibb

and show a user score, blue numbers are from UtGuiden

Chapter 7: Evaluation

In this chapter, the solution created will be evaluated. It will be compared to the scenarios described in chapter 4. This will help determining if the goals of the project were reached.

7.1 Running the scenarios

7.1.1 Scenario 1

The first scenario has Alice sitting outside Trondheim Torg and opening the *Tguide* application. When first starting the application, the opening screen will not show her current position. To move the map to her current position, Alice presses the button for "Finn posisjon". The default localization technology (GPS) is then polled and the map updates to show her current location.

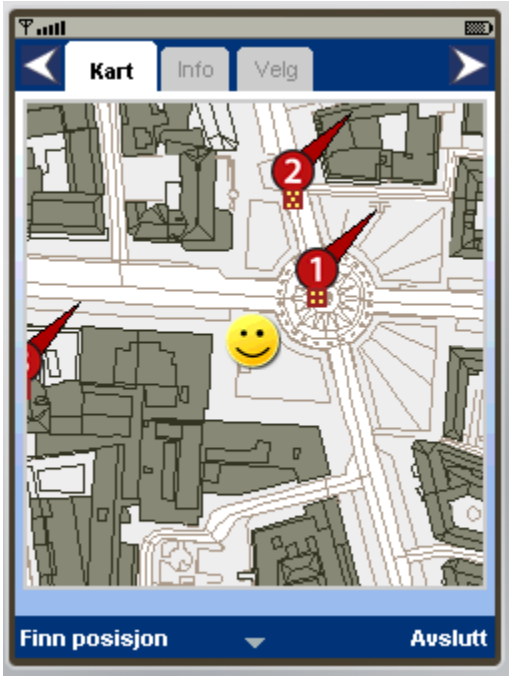

Figure 7.1: Opening screen after finding position

The map shows three restaurants around her (number 3 partly outside the screen). To see the restaurants' names and other information, Alice has two options. She can use the keys "1" and "3" to cycle through the names of the restaurants directly on the map, or she can press the "→" button to go to the middle tab, labeled "Info", which will show names and some information for all the restaurants on the map. Alice chooses the latter option.

Figure 7.2: Information tab

If she wanted to, Alice could look at all the information on a restaurant by selecting it in the list and clicking the button for "Vis informasjon". This is not necessary in this case, as Alice knows none of these restaurants serve Mexican food. She knows she has to zoom out to find other restaurants. She presses "←" to go back to the map (figure 6.3). She then presses "*" to zoom out and show a bigger area on the screen.

Figure 7.3: After zooming out

She now has 10 restaurants in her view. Hoping that one of them has Mexican food, she once again presses "→" to show the list of restaurant names.

Figure 7.4: Listing more restaurants

She can now see that the restaurant numbered 4 is a restaurant named "Mex-Tex" and with a good user score of 5. She goes back to the map screen (Figure 6.5) and can see exactly where the restaurant is.

Just to be certain, she wants to check the user reviews. She goes back to the info screen (Figure 6.6), uses the "↓" button to select the "Mex-Tex" restaurant and presses the button for "Vis informasjon" to show all information on the restaurant.

Figure 7.5: All data on the restaurant

After reading the glowing review of the restaurant, Alice is certain it is the right choice, and heads over with Bob to get a good meal.

7.1.2 Evaluating scenario 1

Overall, this scenario was successfully carried out using the created application. The user was able to find the information she needed in a simple and straightforward manner.

A room for improvement can be found in the very moment the application is starting. Instead of the program automatically finding its position, the user must press “Finn posisjon” to move the map to her current location. Reviewing the scenario, there should be an option that gave the user three choices. The first would be to use the system as it is, with the user’s position only being retrieved when the user presses the button to do so. The next option would be to have the system finding and updating the user’s position in the background, but not moving the user on the map until the user chooses to do so. This enables the user to quickly jump to her current position, and not have to wait for the polling of the positioning technology to be done before the map can be updated. The third option would be to constantly update and move the map with the user’s current position.

Which of these options should be the default behavior is another issue. Invoking the localization manually may use less energy, but may not be optimal from a usability perspective, and the energy savings may be negligible in practice.

7.1.3 Scenario 3

In the third scenario, Isaac and Ivan are looking for something to do. When Isaac first turns on the *Tguide* he will see a screen similar to Figure 6.3, which only shows restaurants and not events. To make it show events, he first presses the "→" button twice to go to the Velg tab.

Figure 7.6: The settings screen

In the "Velg" tab, he selects the first option, to show today's events from UtGuiden. He then presses "↓" to highlight the setting for restaurants from Vibb and presses the select button to deselect this, in order to only show UtGuiden events on the map.

Figure 7.7: Selecting to only show UtGuiden

Next, he presses "←" twice, to go back to the Kart tab that shows the map. To get a view of all events happening in Trondheim, he presses the "*" button several times to zoom out until the entire city center is showing on the map.

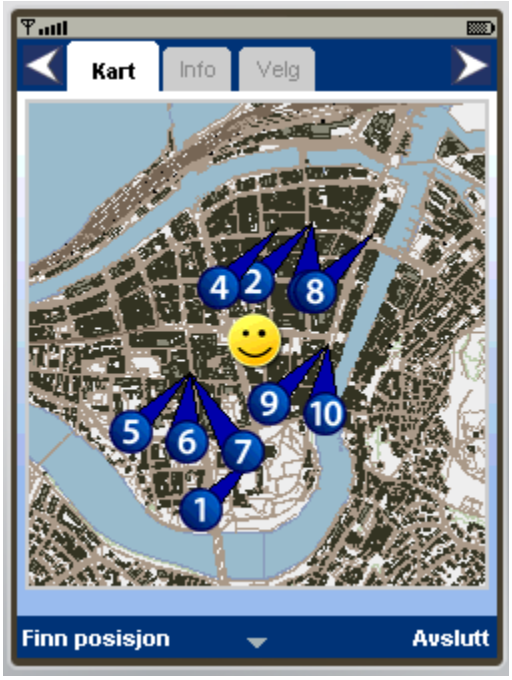

Figure 7.8: All events happening in Trondheim

He can see there are 10 events in the city today. To see information on each of them, he can either press "→" to go to the Info tab which shows a list of the events, or he can use the buttons "1" and "3" to show names for each event directly on the map. He chooses the latter option.

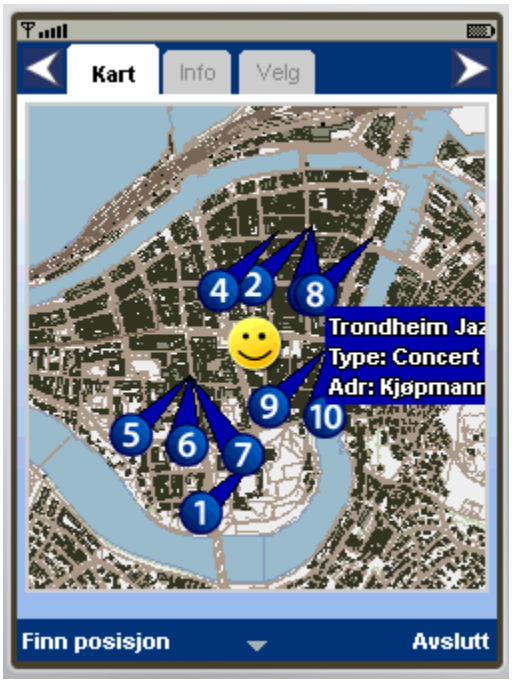

Figure 7.9: Showing information on number 8

Each time the "3" button is pressed, information on the next point on the map is shown. To avoid cluttering, only information on a single point can be shown at the same time. After cycling through the points, Isaac can see point 8 is for the Trondheim Jazz Festival, which is being held as a number of concerts in town today. To find more information, he presses the Select button.

Figure 7.10: Showing all data on the jazz concert

The information screen shows the concert performers and all other data associated with the concert, including the time it starts and the number to order tickets. Isaac can now call the number to order tickets.

7.1.4 Evaluating scenario 3

This scenario was also successfully carried out through the *Tguide* application.

One area that can be improved is the integration between application and telephone functions. When Isaac wants to call to order tickets, he should be able to just select the number in the info screen and press for instance the “call” button to make the call directly from the program.

Another feature that should be added is remembering the user settings when exiting the program. If Isaac had previously selected to only show data from UtGuiden, he shouldn’t have to go back to the setting tab and redo his selections each time the program is started.

7.2 General evaluation

The service that was created did satisfy most of the listed requirements. There were however some functions that were not implemented due to time constraints and some functions that did not work as planned. The final product was not as polished as it should have been, also due to time constraints. Especially the requirements of having useful error messages and show the user what the program was doing had not been fulfilled.

Going through the list of requirements, it is possible to evaluate whether or not they have been successfully accomplished:

Map

#	Description	Successful?
1	The map shows the user's position through GPS and GeoPos localization	Yes
2	Users can move the map in four directions using the keys 2, 4, 6 and 8	Yes
3	Users can zoom in and out of the map using the keys # and *	Yes

Options

#	Requirement	Successful?
4	Users can choose to show any combination of UtGuiden, Vibb restaurants, Vibb bars/pubs and Vibb cafés	Yes
5	Users can choose between maps from Norge Digital and OpenStreetMap	Yes

Display

#	Requirement	Successful?
6	Points of interest are clearly identified with blue numbers for UtGuiden and red numbers for Vibb	Yes
7	A screen with more information on all data points is easily available	Yes
8	Event points on the map are not directly identified by category, this was not implemented due to time constraints	No
9	Data points from Vibb do show a user score directly on the map	Yes

User interface

#	Requirement	Successful?
10	The user interface has been easily readable on all tested screens	Yes
11	Most buttons are marked, but there could be more or clearer information on what the buttons do	Somewhat
12	Navigating by using the 4 way joystick and the keys 2, 4, 6 and 8 is common in many mobile applications and should be intuitive	Yes
13	While startup is slow, when in use the program is very responsive provided there is sufficient bandwidth	Yes
14	Because the user interface was created with J2ME Polish, it should be adaptable for many different devices	Yes

Error handling

#	Requirement	Successful?
15	While there are some error messages and exception handling, the communication of such events to the user has not been sufficiently implemented	No

16	The program does not display enough information about what it is doing in the background when starting up or otherwise	**No**

Technology related

#	Requirement	Successful?
17	The application supports all wireless technologies the phone can use, but it will not work very well on very low bandwidth connections	**Yes**
18	The application supports maps from Norge Digital and OpenStreetMap	**Yes**
19	The application supports both GPS and Wi-Fi localization, but the GeoPos Wi-Fi localization has not worked during testing	**Somewhat**

7.3 Evaluating the hypotheses

To thoroughly determine whether or not the hypotheses have been fulfilled, further user testing should be undertaken. It is still possible to try giving an estimation based on the results of running through the scenarios:

- *The application is useful for people planning what to do out on the town*

From the third scenario it can be shown that the application can be useful for people who are planning on what to do when they go out on the town. Most events they could partake in will be available through UtGuiden, and the availability of a mobile phone increases the number of areas where the guide can be accessed. This is especially useful when a spontaneous need for something to do arises.

- *The application is useful for people that are in the city center*

From the first scenario it can be shown that the application can be useful for people that are in the city center. They can use information from Vibb to determine where to eat or drink. Because Vibb normally is only accessible through a web page, the new opportunities arising from having it available on a mobile phone will be useful for people who are not near or do not have immediate access to a computer.

Chapter 8: Summary

In this chapter, the project is summed up and further work that can be done with the product is discussed.

8.1 Conclusion

The service resulting from this project gives users new ways of accessing information they would want when they are out on the town. It can serve as support both for people who are going out to eat and drink, and people who want to know about events in the city.

8.2 Improvements and additions

8.2.1 Further testing and evaluation

If time had permitted, the product would have been tested by a number of real users. This would have been a valuable source of real life input on which parts of the product have been successfully implemented and which need further improvement. It could also help identify features that the users are missing.

8.2.2 Extending the product

There are a number of features that could complement the existing application well if implemented.

A more advanced handling of the GPS data in the background could improve usability. As shown through the scenarios, some users could want to have the map continually update with their current position, while other users would want the map to stay stationary. Users should thus in any case be able to choose the behavior they need.

More advanced integration of the application with existing phone functions could be very useful for application users. Being able to make calls directly from the application is a basic functionality that definitely should be implemented. Other types of phone integration could be to send SMS messages with information from the application to people in the contact list, or clicking on URLs to open related websites in the phone's web browser.

User created content should also be looked at closer. Part of what makes the Vibb data useful is the ability to access user scores and reviews of businesses. A natural extension of the service would be to let users send reviews or pictures directly from their mobile phone. This would create a whole new level of interaction in the application and possibly increase user appeal significantly.

Access to even more information, like sights, museums and other tourist attractions, could be a natural addition to the service. People new to the city will often be interested in more than just current events and places to eat, and would likely be interested in using the same application for locating and reading about typical tourist places.

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