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1. INTRODUCTION

In order to gain background knowledge, to ensure that the project is realizable, to infer useful ideas from both successful and unsuccessful projects and to broaden our imaginations, the market research was inevitable. For this purpose, we found the related topics and assigned them to the members of the project.

In the market, since there are not enough projects which are exactly related to our project proposal topic, we did market research on similar internet mobile GIS projects and on a project having similar infrastructure to our proposal. We divided the applications as Location Based Services and Vehicle Tracking System. As Local Based Services, we further divided the group into two categories: Applications for tourism purposes and applications for social activities. WebPark and MacauMap are tourism oriented mobile GIS applications where Orange Guide, Turkcell NeNerede Services and Location Based Semantic Web Services Application for Mobile Environments from Ege University Computer Engineering Department are examples of social activity guides. Under Vehicle Tracking category we made research on Alfabim Computer Systems and FliteSoft Express.

2. MOBILE GIS APPLICATIONS

2.1 Location Based Services

This section is composed of two categories: Tourism-Oriented Applications and Applications for Social Activities.

2.1.1 Tourism Oriented Applications

In this section the research of WebPark and MacauMap projects are given.

2.1.1.1 WebPark Project [1]

2.1.1.1.1 Project Description

This application offers visitors information about the nature that they visit via smart phones and GPS device together. WebPark guide is a dynamic mobile website which behaves according to visitors' location, time and interest. Application warns the visitor according visitor interest. For instance you can get the answer of that question "Which plants grow here?". WebPark aims mainly two properties:

- Environmental Education
- new channel for (reselling) the park information

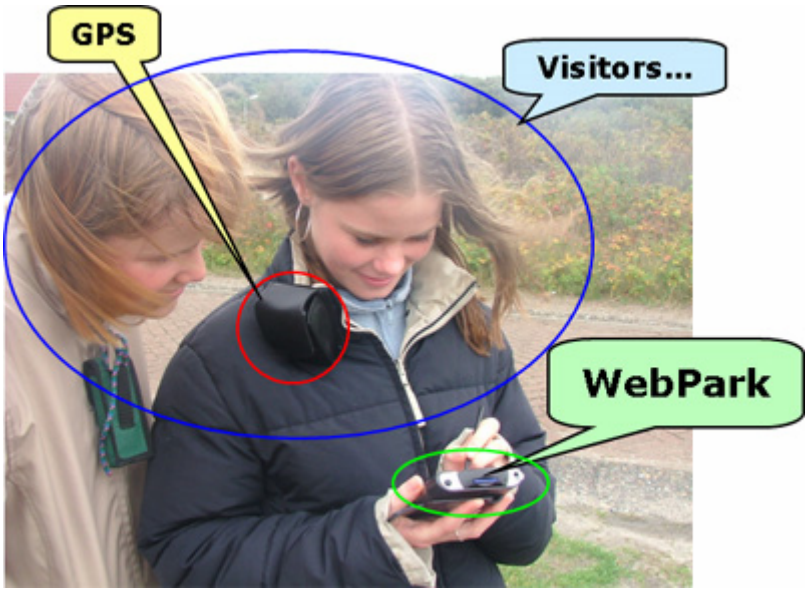


Figure 1-General usage of WebPark

2.1.1.1.2 The Advantages of WebPark for the Park Owner

There are too many benefits to the park owner and labor (employee). These are the advantages:

- They can easily reach to he visitors. With this application they can introduce all properties of the park to people well. For instance, if a park has a distinct characteristic than the others such as a plant which is rarely available, with this application they can illustrate it to the visitors. In this way, they gain more prestige and the percentage of attendance to the park increase.

- The employees have also benefits from WebPark Project. They can dispose of the questions which are asked again and again in a day time. For instance, "There is an excellent flower in here. Where can I find it?". The visitors can discover their own path which is gone to that "excellent flower".

- One advantage of this application to the park owners is to improve their facilities and properties. Since they can observe visitor's walkabout, they can build up more advance features to their application. For example, if visitors visit "excellent flower" too much, employees can put more signs which indicate the importance of that flower.

2.1.1.1.3 The Advantages of WebPark for Visitors (Usage)

There are also benefits of the application to the visitor. These are the followings:

- They can select from headings "Transports", "Accommodation", "Eating", "Administration", "Health" and more as it can be seen in the following figure:

Figure 2-Screenshot of the working application

- They can find answers for all of the questions.
- They do not have a chance to miss any place that is wonderful in the park.
- They do not have to find authorized person in order to ask the places which are worth to visit.
- They can run away from paper guides.
- Since GPS is used, application knows the accurate position of the visitor and gives accurate information. As it is shown in the figure, GPS has more correct data.

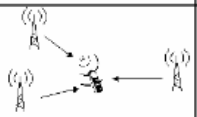
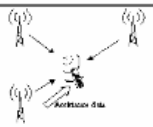
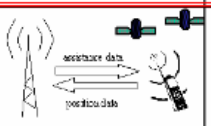
Technology	How it works	Accuracy	Advantages	Disadvantages
Basic Cell ID		Depends on cell size: **150m** (city) **to** **2 km** (rural area)	• No new handsets required • Cheapest of all technologies for operators	• Poor precision
Network-enhanced cell ID		Up to 50% improvement over basic cell ID	• Boosted precision, especially in rural areas • No new handsets required	• Requires homogenous network infrastructure for operators to contain costs
E-OTD		5 to 50 m	• Highest accuracy of non-GPS solutions	• High network investment – costs for the operator • Requires new handsets
GPS		1 to 10 m	• High accuracy	• Only outdoor use • New handsets • Expensive chip • High battery consume
Assisted GPS		Same as GPS, but also indoor	• High accuracy	• High network investment as E-OTD • Even more expensive handsets than basic GPS.

Figure 3-Positioning technology and its advantages and disadvantages

- If a visitor forgets to visit an interesting place according to the background information, the application beeps and highlights the feature. Therefore, the visitor could not have an unvisited place. The following picture indicates how signal shown in the PDA.

Figure 4-Signal representation and the path

Figure 5-Screen shot from the PDA when warning occurs

- Moreover, visitor is aware of how long it will take his trip. According to the visitors position (longitude, latitude and altitude), WebPark system calculate the remaining time.

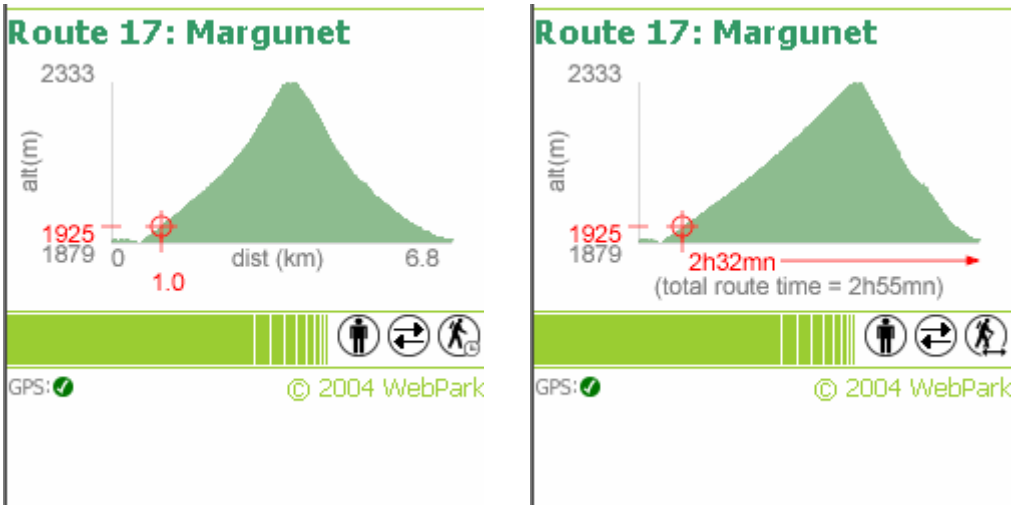


Figure 6-Application of calculating the remaining time

- Furthermore, visitor can take some notes according to him and share them with public if he wants. It is called geo-bookmarking. This figure can be the GUI of the geo-bookmarking.

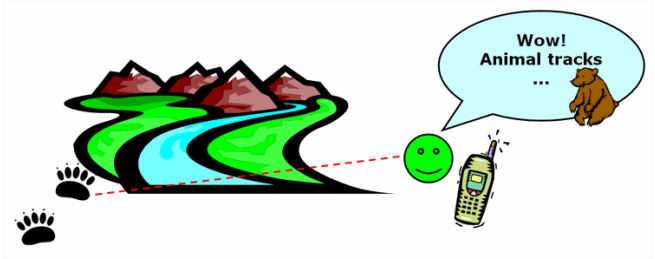


Figure 7-geo-bookmarking

- Not only one nation is considered, but also WebPark project is translated into German, French and Italian. According to the demand, it can be translated into different languages.

2.1.1.1.4 Requirements

- For user, there are some hardware requirements. They are a GPS device, and a PDA to run the application. However, it is not mentioned the physical properties of the devices in the website.
- Software requirements can be divided into 2 subgroups. One of them is database, the other is Graphical User interface.
    - It is used Multiple Database. Data are stored in relational databases and the access is ensured by an API.
    - For user interface, Java RMI and CORBA are used.

2.1.1.1.5 Evaluation and Conclusion

- We proposed in our proposal that we implement our application multi language. It could help us in that property.
- It is a completely GPS system and can be accessed via a PDA if there is a wireless connection. We can get a correct position of the user due to GPS.
- WebPark causes us to gain a nice idea which is geo-bookmarking. We can embed this idea in cinema etc. If someone likes a film, he can write it down to the PDA and if he want he ca share also with the other users.
- In the transportation part, we can calculate the remaining time. Therefore, WebPark project can guide us about the path algorithms.

To conclude, WebPark is Similar to our project and we can get help from this application.

2.1.1.2 MacauMap: Tourism-Oriented Mobile GIS Application [2]

2.1.1.2.1 Definition of the Project

Macau is a city where the tourism plays an active role in the economy of it. A great number of tourists visit the city every year. Since the tourism is so much important for the city, improving the tourism became also important.

The tourists visiting the city need some guide to help them. The government of Macau provides the tourists with some paper maps including some useful information of the main areas of interest, main streets and also thoroughfares. Of course, a tourist has some limitations with this kind of map. Firstly the map size is fixed and you can only see a limited area, moreover the tourist cannot make search about a specific place and finally the tourist cannot see own position on the map.

Since the paper maps had these disabilities, coming with a new solution became inevitable. The alternative of the paper maps was tourism oriented mobile GIS application. The tourists are provided with Personal Digital Assistants (PDAs) with PalmOS.

The properties of the application are;

- To display of street layout and street names, coastal lines, green areas, and lakes.
- Map navigation: zooming, panning, navigation history,
- To have the ability of displaying text labels in the map in English or Chinese, and to switch between languages,
- To display of the users current location using a reading obtained from a connected GPS device,
- To display public bus network and bus guide for calculating an optimal bus route from a starting bus stop to a destination bus stop,
- To have sightseeing guide providing information about museums, churches, temples, and other places of interest, as well as their location on the map,

- To have hotel and restaurant guide providing a choice of restaurants and hotels matching criteria of location, class and style, and displaying the location of selected hotels/restaurants on the map.

An example of the interface of MacauMap is shown in Figure 8.

Figure 8-MacauMap user interface

2.1.1.2.3 Evaluation and Conclusion

It is a fact that this new tool brings lots of easiness, reliance and speed to a visiting process. With some proper extensions to the current version, a more stable tool can be improved and served to the tourists.

If we compare this project with our project proposal, the two projects have the same infrastructure. They work in the same manner. User knows and sees his position on the map and searches for a place and sees how he/she can reach there. However, our project proposal is about not the interesting places for tourists, it is about social activity places for anyone.

2.1.2 Applications for Social Activities

In this section the research of Orange Guide, Turkcell NeNerede projects and Location Based Semantic Web Services Application for Mobile Environments from Ege University Computer Engineering Department are given.

2.1.2.1 Orange Switzerland LBS Project – Orange Guide [3][4]

2.1.2.1.1 Project Description

The Orange Switzerland Location Based Services (LBS) application Orange Guide was announced on December 18, 2000. It is WAP based and uses cell ID location technology, which provides cell dimension accuracy. With the Orange Guide, Orange introduces location-based WAP services with automatic location recognition unique in Switzerland. The web access to the services is available at http://wap.orange.ch.

To interface to a variety of LBS applications, Orange Switzerland employs the Webraska real-time Navigation Platform. The platform provides access to external resources that consist of map (Navtech), and point of interest (POI) databases. Traffic information comes from Touring Club Suisse (TCS). TCS derives its information from road sensors, police reports and TCS members. Orange Switzerland also provides cinema (movie) information through the Synergy database hosted by Orange directly.

By Orange Guide, it is easy to find the way to stations, airports, hotels, restaurants, hospitals, post offices, sports centers, galleries, cinemas, museums, discotheques and many more places in Swiss towns. The Orange Guide will guide the WAP mobile phone user directly to over 60,000 places of interest (by the time June 2001) in Switzerland, whether by car or on foot. Orange Guide is able to recognize by itself the town and approximately the street in which the phone user is located.

2.1.2.1.2 Usage

To receive services, the user places a WAP call and selects the service from a menu. The position of the caller is determined automatically using cell ID. The caller is first localized at a town level, then needs to select from a list of streets (where he potentially is). He than chooses a mean of transport to his destination (POI). The Orange Guide offers information under four headings: "Places of Interest", "Route Planner", "Traffic" and "Cinema".

For example, if user is in a strange town, with no idea where the cinemas are but he would really like to see the latest movie, he simply selects the town and name of the film under the heading "Cinema" - and immediately the Orange Guide shows the way to the cinema and also gives much more information such as the start of the movie, what it is about etc.

Under "Places of Interest" the WAP phone user can find most places of interest in every town in Switzerland, such as stations, airports, hotels, restaurants, hospitals etc. and also the location of cash points.

The Orange Guide tells users not only the address of the place they are looking for but also how far it is from their starting point. They are then directly guided to the desired location by the Orange Guide, either by car or on foot.

If user knows where he wants to go but don't know how to get there, he needs the Route Planner. It doesn't matter whether user is trying to find the way from one road to another in the same town or from one town to another. The Orange Guide Route Planner tells the WAP phone user the distance between the two locations and the approximate time it will take to get from one point to the other, by car or on foot. The Orange Guide sets out the route, telling the user the way through the streets and showing him at what point to turn into which street, or if necessary which highway to take. For backup purpose, the route can also be shown on a little map in the phone display.

To find out whether there are currently traffic jams in the train station surroundings, the WAP phone user looks at the latest traffic situation under the heading "Traffic". Under this item the Orange Guide supplies traffic information about the main traffic centers and interconnections. The constant updating of traffic reports allows the WAP phone user to get information about traffic jams in good time and to change the route in order to avoid delays.

In June 2001, the POI database had about 60,000 entries. The POIs includes transportation facilities (e.g. bus and train stations, parking facilities, car rental), shopping (e.g. shopping centers, bancomats, petrol stations), entertainment (e.g. cinemas, discotheques, amusement parks), cultural institutions (e.g. museums, art galleries, libraries), dining, lodging (hotels, camping sites), sport facilities (e.g. sport complexes, bowling alleys, ski resorts) and miscellaneous sites (e.g. exhibition centers, universities, car dealerships, tourist information).

The phone can display routing information on its screen as maps or text consisting of step-by-step navigation instructions. The system incorporates this refined location information with the mode of transportation to identify real time optimized routing between the caller position and target location.

2.1.2.1.3 The Results of the Project

Orange Switzerland also provided some statistics for the first six months of its LBS operation. These statistics should be treated with caution because the service was very new by the time it was announced and the number of LBS users is small relative to the overall number of mobile subscribers. Also, the WAP interface is not very popular among the users. These early statistics suggest that the majority of LBS users, 88%, requested services while driving. Only 12% of the LBS users were pedestrians. The most popular service requested was routing (42%). POI was the second most popular service (33%). It was followed by traffic information (21%). At the lower end was the cinema service, requested only by 4% of the LBS users. Restaurants were the most popular POI selected (32%).

Orange Switzerland plans to build on its initial LBS offering. As future enhancements, it is considering adding personalization and customization features, as well as search engine and index capabilities. They are also looking into increasing the number of POI, and include traffic maps. Orange Switzerland also plans to include location in relevant existing services.

SMS, Web, voice and other devices are also explored for providing access. Orange Switzerland plans to introduce more accurate technologies, such as TA (Time of Arrival) and GPS, when they become available.

2.1.2.1.4 Evaluation and Conclusion

As CoreTech team members, we are very happy to find such a project that covers almost the same topics with our project. Apart from the fact that Orange Guide supplies the user connection with WAP and cell ID location, it is just a more generalized version of our project. Now, we will list the advantages and disadvantages of Orange Guide comparing with our project.

- **Advantages**

  - Orange Guide is very similar to our project. Its main purpose is to make users lives easy.

  - It has huge database of point of interests (POI). We narrowed our project application areas, with the advice of our project assistant, only to social places like cinemas, theatres, sport arenas and concert halls. However, Orange Guide serves users almost every kind of location information from hospitals to museums, petrol stations to ski resorts.

  - Orange Guide also tells the WAP phone user the distance between the two locations and the approximate time it will take to get from one point to the other, by car or on foot. We will also implement this facility; moreover we will suggest possible transportation methods.

- **Disadvantages**

  - There is very little information about the project on the internet even on the Orange Switzerland company's website. Only a small number of review pages can be found [3] [4], nothing more. Some visual data would be beneficial for our user interface design.

  - No technical information about the project can be found either. We would be happy if we found some technical information about the development environment, or map data, or how the connection is established between the user and server. These would be very beneficial for us.

  - Connection is done via WAP interface, however in our project connection is done via internet (with wireless if available, else GPRS). WAP is much weaker and slower than internet. Moreover, positioning of the user is done via cell ID technology in Orange Guide. But, we will use GPS. GPS gives very accurate results, however cell ID technology is usually unable to determine the accurate location of the user. Cell ID returns the location with a margin of error from 150 meters to 2 kilometers; on the contrary GPS returns the location with a margin of error from 1 to 10 meters only. In Orange Guide, the caller is first localized at a town level, then needs to select from a list of streets (where he potentially is).

- Orange Guide is designed for mobile phones. So its graphical interface is very limited compared to PDAs. Maps can not be shown appropriately even in modern mobile phones.

- Up-to-date information about Orange Guide is necessary. Being released in 2000 is a result of very innovative idea but current statistics are required to be known. By this way, we would have a chance to compare usage percentages of static solutions such as desktops with mobile solutions such as PDAs, mobile phones, etc.

2.1.2.2 Turkcell NeNerede Service [5][6]

2.1.2.2.1 Project Description

NeNerede is the name of the Location Based Service of leading telecommunication company Turkcell. It is similar to the previous reviewed project Orange Guide, but it has some differences. NeNerede does not use WAP interface, communication is done via SMS. However, method to determine the physical location of the user is the same with Orange Guide; that is Cell ID technology. Orange Guide has a huge database of points of interest (POI), but Turkcell deals with a much more compact database. NeNerede's interest areas are "Entertainment", "Health", "Commercial" and "Transportation".

Currently, there are 150.000 registered points of interest in the system. With Turkcell NeNerede Service, users can inquire locations in İstanbul, İzmir, Ankara, Antalya, Bursa provinces and in Bodrum distinct. Sending message to 2222 is free, however every response message is charged 3 SMS.

2.1.2.2.2 Usage

Turkcell NeNerede offers information under 4 headings of points of interest. These are:

- Entertainment: Restaurants, Cafés, Bars, Clubs, Discos, Restaurants with Authentic Live Turkish Music, Beerhouses, Pubs, Wine Houses;

- Health: Hospitals, Polyclinics, Pharmacies, Veterinaries;

- Commercial: Real Estate Offices, ATMs, Banks, Travel Agencies, Cabstands, Florists, KVK stores, Garments, Grocery Stores, Super Markets;

- Transportation: Fuel – Gas Stations.

The user sends his query via SMS in a special format to number 2222.

For example:

NEREDE RESTORAN/RESTAURANT (for the nearest restaurants)
NEREDE RESTORAN ITALYAN (for the nearest Italian restaurants)
NEREDE RESTORAN ODTÜ (for the restaurants in ODTÜ)
NEREDE HASTANE
NEREDE ECZANE
NEREDE CAFE
NEREDE OKUL

The physical location of the user is determined by Cell ID technology. Base stations play an important role in this step. When the message is received by the system, physical location of the user is determined. Then, according to user's query, POI database is checked and most reasonable answers are returned to user. The response consists of the address and telephone number information of found places.

As CoreTech team members, we tried NeNerede Service of Turkcell with the query "NENEREDE ECZANE" while we were in Faik Hızıroğlu Dormitory in ODTÜ. It took about 10 to 15 seconds to get the response of the system. The speed was impressive. Our 6 units were gone but we saw how fast such a system could be. Since, this service encapsulates emergency situations such as finding the nearest taxi station or pharmacy, Turkcell gained our appreciation with this speed. The response was the following:

Query:
"NENEREDE ECZANE"

Response:
"Ozge Eczanesi Odtu Carsi Cd N:6 Cankaya T:03122101475 devami icin D yazip gonderiniz"

2.1.2.2.3 The Results of the Project

Unfortunately, Turkcell does not give any statistical data about the usage of the NeNerede service. In order to concentrate on the most preferred topics in our project, we will try to get in contact with Turkcell and benefit from their statistics and experiences.

2.1.2.2.4 Evaluation and Conclusion

Turkcell NeNerede serves less information compared to Orange Guide, which is name of the location based service application that was discussed in the previous section. NeNerede' importance increases with its being a native service. Now, we will list advantages and disadvantages of NeNerede service comparing with our project. The stuff discussed here will be parallel to Orange Guide's properties.

- **Advantages**

  - NeNerede is a successful mobile LBS application. It serves in “Entertainment”, “Health”, “Commercial” and “Transportation” areas. These are the most important and preferred points of interest, so we can easily conclude that the choice of application area is achieved. However, we narrowed down our project application areas, with the advice of our project assistant, only to social places like cinemas, theatres, sport arenas and concert halls.

  - Today, total 150.000 points of interests are indexed in İstanbul, İzmir, Ankara, Antalya, Bursa and Bodrum. This is a big number that can not be underestimated.

  - NeNerede service impresses users with its speed. Response time in the interval 10 to 15 seconds makes the service usable in urgent cases such as finding a pharmacy or taxi station in the late night.

- **Disadvantages**

  - There is no technical information about NeNerede on the internet and even on the Turkcell’s website.

  - User has only one communication option: SMS. Either GPRS or WAP option should be added. These protocols would increase the quality of the service, for example, found place could be shown on a map. Thus, we can easily conclude that response has no opportunity to have visual data with this protocol.

  - Response of the system consists of only the address and telephone number of the found place. Neither the closeness information of the place, nor transportation methods are given to user. Our product will differentiate here.

  - Positioning of the user is done via Cell ID technology, so accurate determination of the user’s place is not possible. This problem may lead to wrong positioning and wrong response of the system. However, as we mentioned before, we will use GPS. GPS gives very accurate results, however cell ID technology is usually unable to determine the accurate location of the user. Cell ID returns the location with a margin of error from 150 meters to 2 kilometers; on the contrary GPS returns the location with a margin of error from 1 to 10 meters only.

  - NeNerede is an expensive service. Every response message charges 3 SMS/6 units. When the number of response messages increases for possible locations, user will be seriously in debt.

2.1.2.3 Location Based Semantic Web Services Application for Mobile Environments – Ege University Computer Engineering Department [7]

2.1.2.3.1 Project Description

The main purpose of the project is to integrate the semantic matching capability into mobile devices. An environment that provides a semantic matching based service information gathering capability for mobile users is developed. The semantic matching engine supplies domain independence, because a generic matching engine is able to accept inputs and return outputs using concepts from any ontology. Finally, in order to show the applicability of the research, a case study was implemented in Ege University campus area. In this study, users are able to find the closest places to rest or eat something via mobile phones which have GPS connection over the Bluetooth standard.

We had a chance to attend to seminar of this project in UYMS'05 (II. National Software Engineering Symposium – www.uyms.org.tr). It has important effects in deciding our project details.

2.1.2.3.2 Details of the Project

Semantic matching is an ontology based information seeking process. A semantic matching engine is able to accept concepts from an ontology as input and return the information that is matched with the taken concepts. The advantage of semantic matching is, when an exact match could not be found, semantically related results are returned to the user.

Developed application consists of 3 main components. These are; mobile client, server and semantic matching engine components.

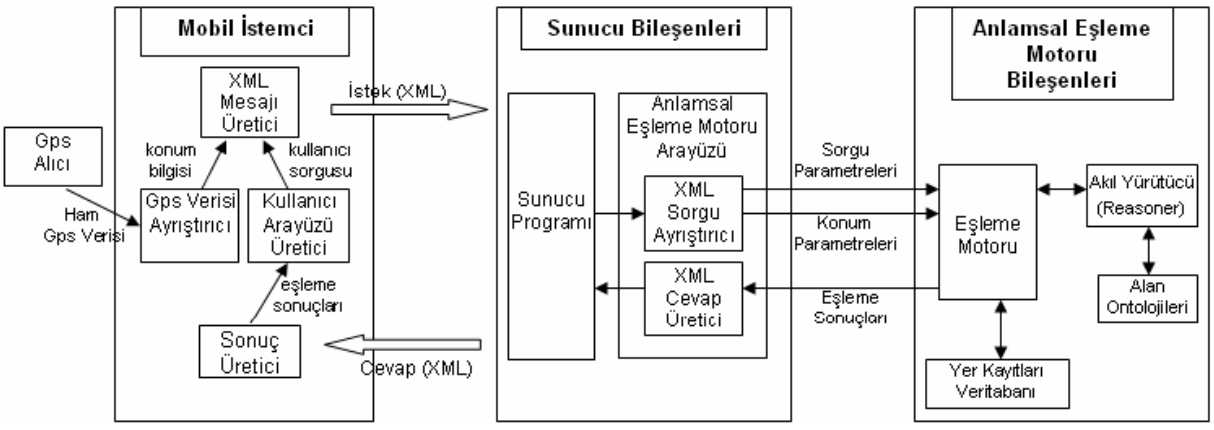


Figure 9-Inside units of client server components

Mobile Client

The duties of mobile client are:

- getting GPS data,
- forming the user interface for taking users' orders and showing responses,

- sending the user commands to server in XML format,
- processing the responses that are in XML format.

GPS connection between the mobile phone and GPS receiver is done over Bluetooth.

In fact, anthologies are stored in OWL (Web Ontology Language) in the semantic matching engine component. However, since mobile devices have restricted abilities, these anthologies are simplified to XML format.

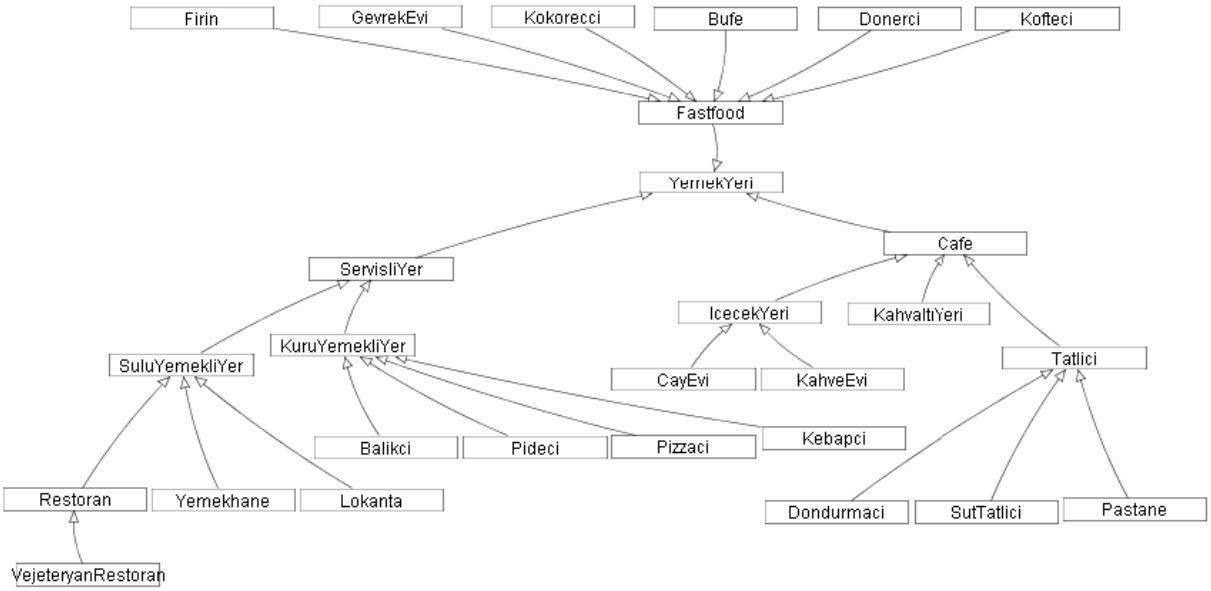


Figure 10-A sample "eating place" ontology

For example, if user selects *"Kebapci"* heading and also requests play garden for children, then the produced XML will be as the following:

```
<istek>
      <YerTipi>Kebapci</YerTipi>
      <OyunAlani>Var</OyunAlani>
      <GPSVerisi>
            <Enlem>22.333</Enlem>
            <Boylam>52.444</Boylam>
      </GPSVerisi>
</istek>
```

The response for this request that comes from HTTP server will be as the following:

```
<EslemeSonuclari>
      <sonuc>
            <isim>Antep Sofrası</isim>
            <EslemeDerecesi>Tam</EslemeDerecesi>
            <Sigara>Yok</Sigara>
            <Parkyeri>Var</Parkyeri>
            <OyunAlani>Var</OyunAlani>
            <Adres>Üniversite Cad. No:5 Bornova</Adres>
            <Tel>+90-232-1111111</Tel>
```

```
            <CalismaSaatleri>09:00-24:00</CalismaSaatleri>
            <GPSVerisi>
                  <Enlem>27.223</Enlem>
                  <Boylam>38.544</Boylam>
            </GPSVerisi>
            <Uzaklik>450m</Uzaklik>
            </sonuc>
            :
            :
</EslemeSonuclari>
```

"Antep Sofrası" is the most suitable result.

Server Component

Server program is a Java Servlet component that takes the users' orders and passes them to "Semantic Matching Engine Interface". "XML Inquiry Decomposer" component sends the request to semantic matching engine in a format that it can understand. Matching results comes according to position information and matching degree in a collection. This collection is transformed into XML by the "XML Response Producer". Finally, this XML message is sent to Servlet component as an HTTP response.

Semantic Matching Engine Component

Semantic matching engine is a database that keeps the information about points of interest (POI). A point of interest like a restaurant or hotel has to register itself first into this engine. In the "Kebapci" example, "Antep Sofrası" has already been registered for example.

Of all the attributes, "Place Type" is the most important one. Then comes the "Global Position: Longitude and Latitude". The other attributes are: name, address, telephone, working hours, cigarette situation, park place and play ground.

Let the requested place type be K1 and the registered place type be K2. According to matching algorithm, "Matching Engine" component can find 4 different matching degree between these concepts:

- K2=K1 OR K1 $\subseteq$ K2, *Exact Matching,*
- K2 $\supseteq$ K1, *Plug-in Matching,*
- K1 $\supseteq$ K2, *Subsumed Matching,*
- Else, *Fail.*

The pointing occurs in this order: exact > plug-in > subsumed > fail.

2.1.2.3.3 Usage

User interfaces are not complex and detailed because screens of mobile devices are restricted. In the following scenario, user first selects “yemek yeri”, then “café” and then “tatlici”. Next, he selects additional opportunities; no cigarettes and available park place. These steps are shown in the following figures:

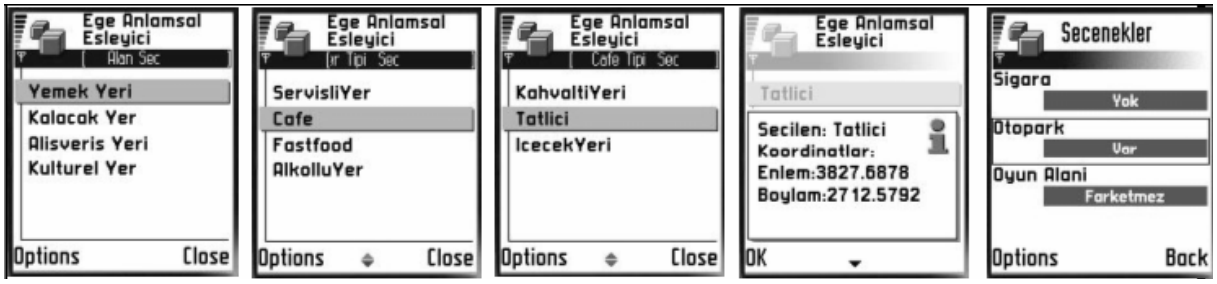


Figure 11-Screenshots from the selection menu

After the semantic matching process, engine returns 3 “tatlici” according to matching degree and distance. Then, user is able to view the details of these places:

Figure 12-Screenshots from the response menu

As it is clear in the figure, the first one is an *exact match* and the next two are *subsumed matches.*

2.1.2.3.4 Evaluation and Conclusion

This is a successful implementation of semantic web services for mobile devices. It is a very important project for our team because it has great affect on us in the determination of our detailed topics. Now, we will list advantages and disadvantages of this project comparing with our project.

- **Advantages**

  - The main idea of the project is completely included in our topic. This is a great advantage for us, we can get into contact with the developers (who are academic staff in Ege University Computer Engineering Department), ask for advice and benefit from their experiences.

- This project proves the applicability of our project.

➢ **Disadvantages**

- Application runs on mobile phones. This restricts the user interface of the project too much. PDAs would be the best choice we believe. However, during the seminar in UYMS'05 in ODTÜ, developer Özgün Bayrak told that the project will not stop here and continue. Expected additions are showing the results with map data.

- The project does not provide transportation solution. We will also find a solution to this problem.

2.2 Vehicle Tracking Applications

In this section the research for Alfabim Computer Systems and FliteSoft Express are given. Alfabim Computer Systems is a usual vehicle tracking system. FliteSoft is, on the other hand, a flight planning and navigator.

2.2.1 Alfabim Computer Systems [8]

2.2.1.1 Definition of the Project

People need to follow their vehicles to protect their customers and products and to increase the productivity in these days. Thus, tracking a vehicle in real time is very crucial and knowing the exact position of the vehicle increases the security of the people and product. Vehicle Tracking System is a high technology product which serves provides tracking the vehicles in real time with a very cheap cost using GPRS, GPS and current GSM infrastructure.

2.2.1.2 Benefits of Alfabim Track Vehicle System

- By tracking your vehicle on digital maps, you can detect exact position of it.
- You can determine the vehicles which are out of control, unlicensed and careless.
- You can control fuel products expenditures.
- Vehicles will obey speed, time and routine specifications.
- You can save time by providing the vehicle with the best routine.
- You can access immediately to the vehicle in an emergency.

2.2.1.3 Usage Areas of Track Vehicle System

- Police Stations
- Emergency Vehicles (Ambulance, Fire Truck)
- International and Interurban Marketing and Distribution Companies

- International and Interurban Transportation and Cargo Companies
- Public Transportation Vehicles
- Bus and Sea Transportation Companies
- Car – Renting Companies
- Taxies and Company Services
- Bank Vehicles
- Security Companies
- Armed Forces

2.2.1.4 Properties of Alfabim Vehicle Tracking System

Alfabim Vehicle Tracking System works in two ways:

- ***Online System:***

With this system, vehicles are tracked by the computers online. With the help of the GPS devices placed at the vehicles, the information about the position, moving way and the speed of the vehicle is sent to the central computer via GSM network or wireless. After that, the software improved for this work evaluates the information and locate the data on digital maps.

Especially when an emergency situation occurs, tracking the vehicles and canalizing other vehicles are easily done. The nearest vehicle to the emergency place is found and it is informed by the center.

By this system,

- The distance of the vehicle traveled, the time of the vehicle moving or waiting
- The maximum, minimum and the average speed of the vehicle
- Hard brakes, brake times and sudden accelerations
- The last information about the vehicle before an accident
- Geographic position information
- Date and time information

can be detected.

- **Offline System:**

After the journey of the vehicle ends, the vehicle device system on the vehicle is connected to the computer. By this way, the move of the vehicle is observed and kept in the database. This application is not for observing the vehicle online and knowing the position of it but it is for making some investigation about what the vehicle did or not during journey.

2.2.1.5 Screen Shots of the Alfabim project

Figure 13-Vehicle Tracking System Device 1

Figure 14-Vehicle Tracking System Device 2

Figure 15-Vehicle Tracking System Device 3

Figure 16-Vehicle Tracking System Device 4

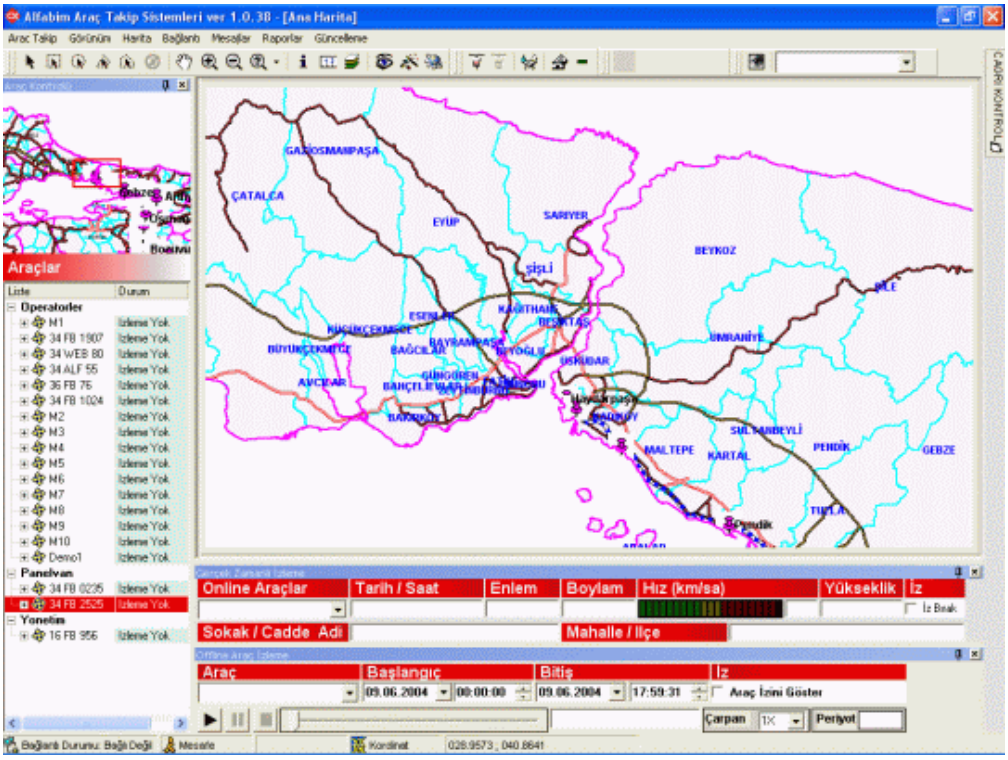


Figure 17-Vehicle Tracking System Screen 1

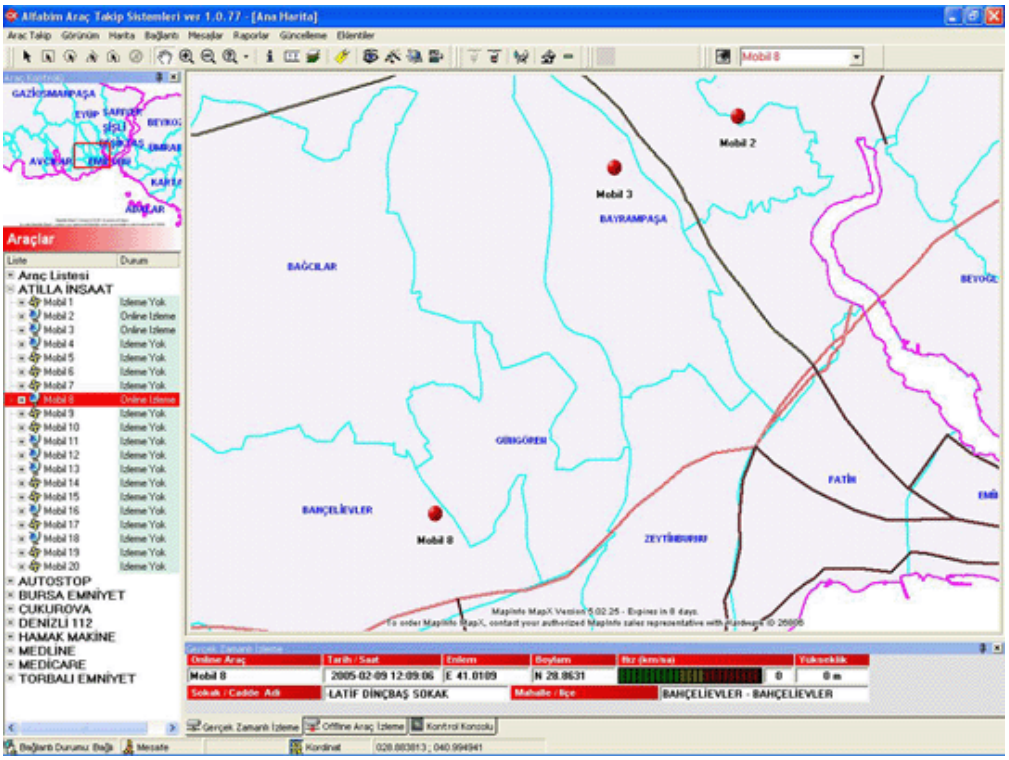


Figure 18-Vehicle Tracking System Screen 2

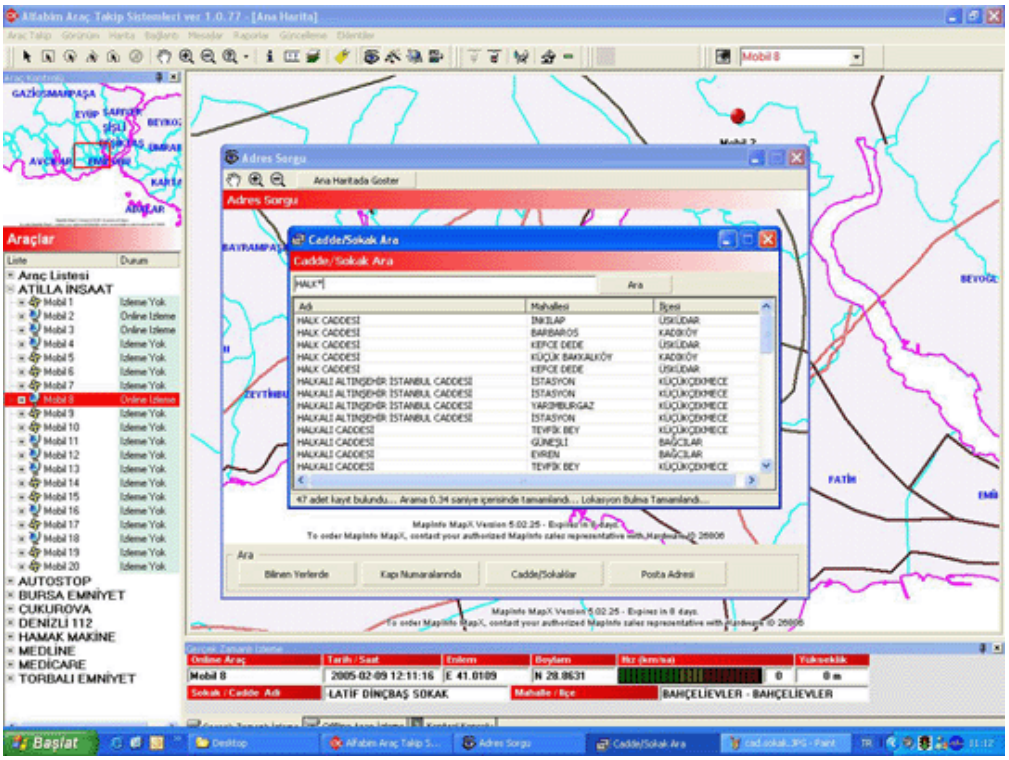


Figure 19-Vehicle Tracking System Screen 3

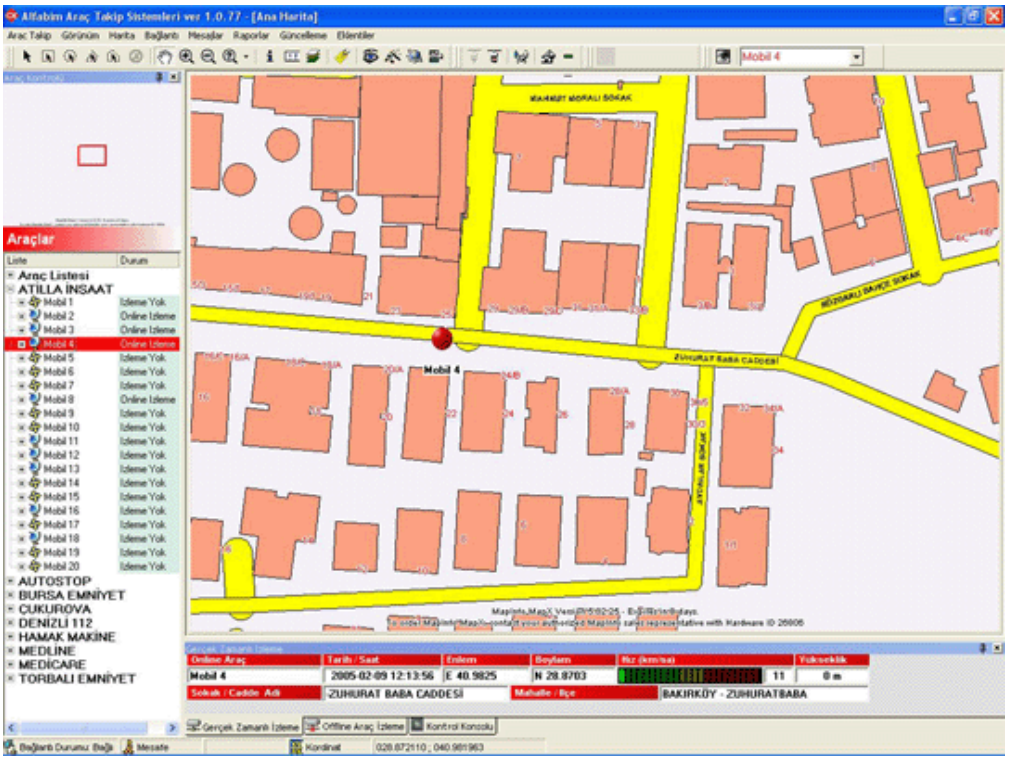


Figure 20-Vehicle Tracking System Screen 4

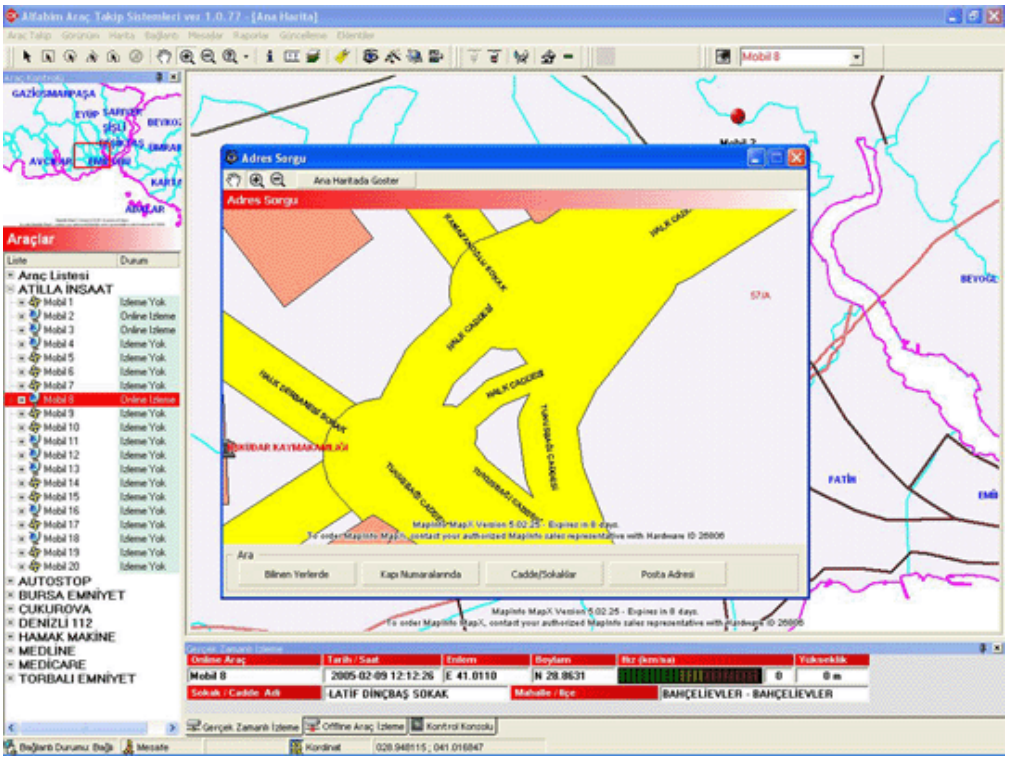


Figure 21-Vehicle Tracking System Screen 5

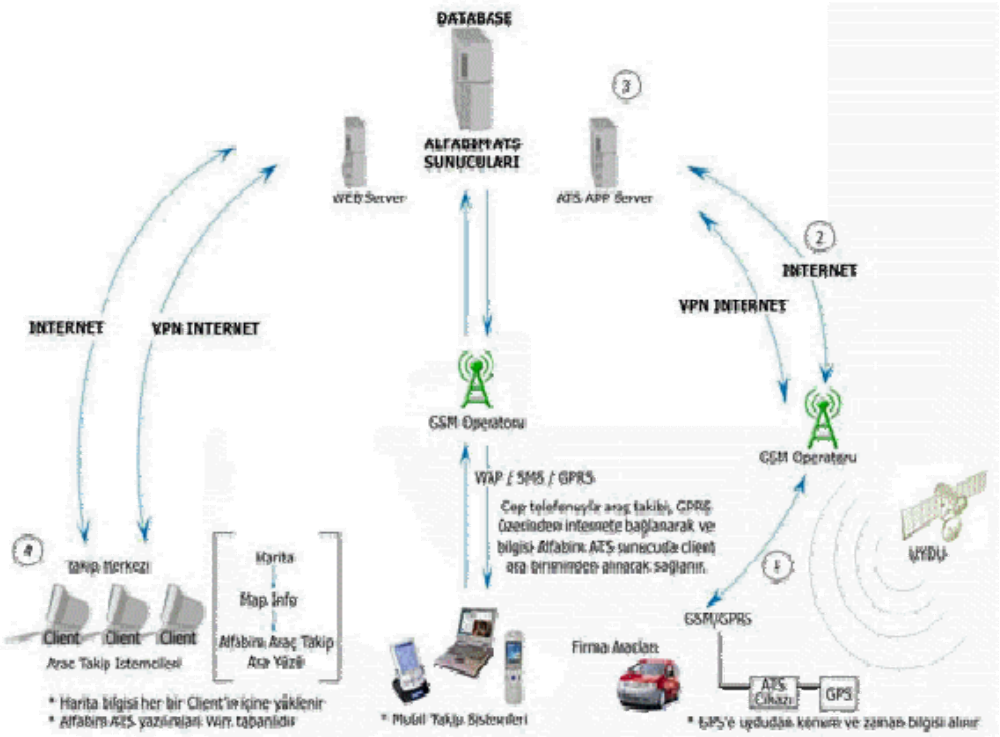


Figure 22-Vehicle Tracking System Flow Diagram

2.2.2 FliteSoft Express [9]

2.2.1.2 Project Description

This project provides a solution that involves a flight planning and moving map to the pilots through a PDA. FliteSoft Express is designed to be run on PDAs because their ease of mounting, small size and sunlight-readable screens are advantageous for the pilots. The software is most appropriate for HP iPAQ and Dell AXIM PDAs.

Basically, FliteSoft Express has identical features with Desktop FliteSoft which is another project of the same company. This has been achieved by:

- Using the same data and chart by both applications
- Providing the updates for both of them
- Displaying the same calculation results.

Although this application has components for flight planning we will focus on the parts of the solution that is related to our project namely moving map.

As a flight planning tool it provides routing on the Chart, identifier entry on the Flight Log, city search on both the Chart and the Flight Log, plus compatibility with saved routes from Flitesoft.

The moving map in this software supports Clearance Check, includes a dynamic Direct To, Nearest, and Emergency functions, and provides direct access to airport, airspace, weather, terrain, and topographic data.

Along with Sectional and Terminal Area Charts which are scanned form of current chars, it also produces computer drawn charts which are Vector charts and Clearance Check. Vector charts provide zoom in intervals of 1-3000 NM scale. In this way, as much detail as user wants can be obtained. The labels existing on the chart do not overlap in any scale of zoom. An example view of it is given below.

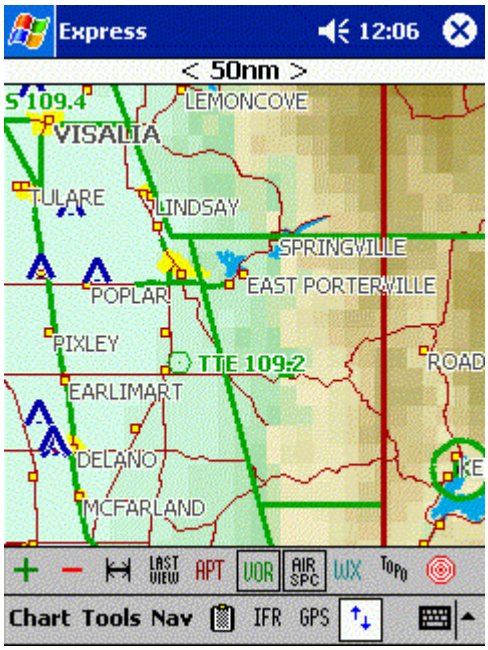


Figure 23-A Vector Chart Example

In the chart also weather graphics, direct access to waypoint data and current location of the plane in the map are given. Clearance Charts, on the other, give the terrain warnings. They are not included on the standard package but topography and airways can be combined to this chart. An example to this chart is below.

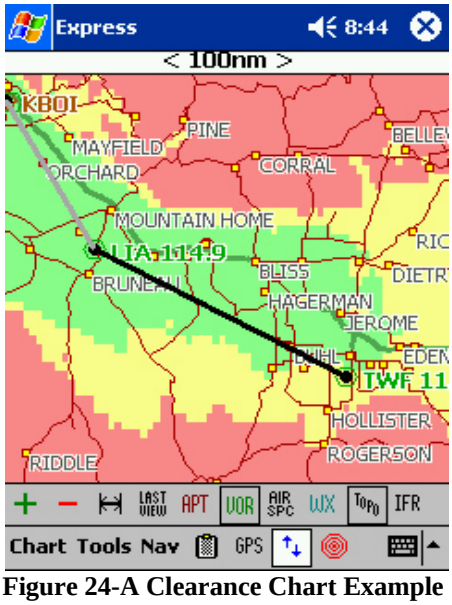


Figure 24-A Clearance Chart Example

The solution also includes an attitude indicator for the emergency situations in which the physical devices are damaged.

The project can also connect to the WxWorx Satellite and get weather data from the server.

An intelligent routing inference is provided. With this routing fuel warnings, time into flight, distance into flight, terrain clearance, and proper altitude warnings are supplied. The route is displayed in different colors on the map which has different meaning for the pilot. In out project we will also propose a path for the target considering the price and time of the travel. However, we will not include a colorful map which is difficult for the end users to accustom.

The application also has a component for infers the profile of the land. A screen from that component is below.

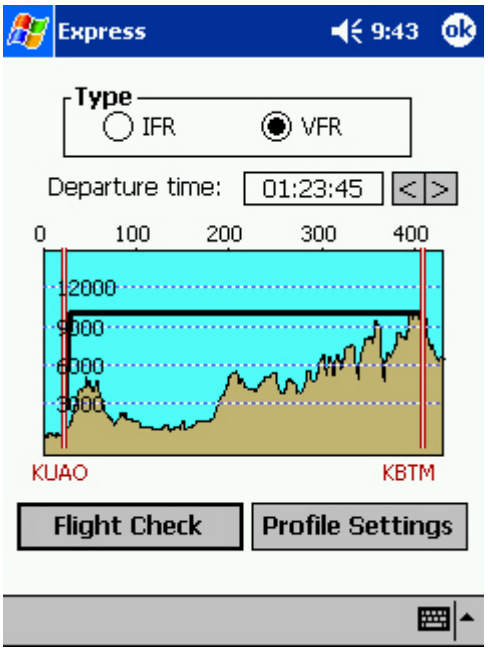


Figure 25-A Profile View

The other properties of the moving map are as follows:

- North- or course-up operation
- Easy-to-use Direct To function
- Convenient Nearest function
- Emergency function shows reachable area, airports, and major roads

A snapshot of moving map is here:

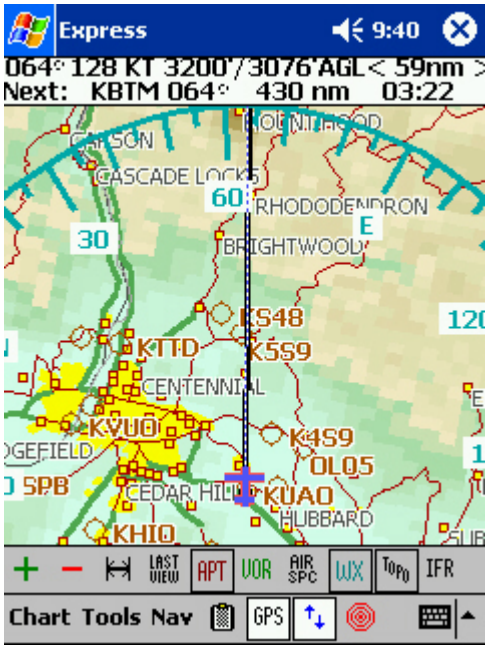


Figure 26-Moving Map Example

2.2.2.2 Evaluation and Conclusion

After reviewing this project, we made some points clearer for our structure of the project. Firstly, as it is written above, the software for PDAs does not have major differences from the desktop version regarding the functionality. Technically this is achieved by accessing the same resources and displaying the same calculations. This is possible through a server which holds the all the data and resources and which makes all the calculations. We also think to have this architecture and open an access point for other applications via web services.

3. CONCLUSION

We have gained valuable knowledge about our project area during the research period of this document. We have seen what kind of applications is present in the market. While making research about products, we found some extreme information too. For example, we used to know that there is no problem with the coverage area of GPS, however we have learned that GPS can not retrieve the position information in closed areas (we mean indoor). In order to overcome this obstacle, there is another option: assisted GPS.

We have seen that there are tons of mobile GIS applications in the market, some of them also benefits from GPS technology in order to get position information. Most popular application in the market is vehicle tracing system as far as we have seen, but this topic is a bit far away from our project. Tourist guides are also popular; these applications aim to assist tourists in touristic places and we can conclude that they are closer to our project, in sake of the used devices and technologies such as GPS, mobile devices (PDA or mobile phones), internet (GPRS or wireless).

As a result of our market research, we could not find an exact matching of our project topic. The closest applications are discussed in the Location Based Services with social activity approach section (2.1.2). In this part, most successful and wide application is the Orange Guide; it encapsulates almost all of our topics. If only it had used GPS instead of Cell ID and it had some improved visual properties, Orange Guide would easily be our reference project. Turkcell NeNerede is close to Orange Guide but it lacks some major properties like visual data and transportation. Finally in this section, Ege University Computer Engineering Department arrives on the scene and does his job successfully with semantic matching engine and GPS. It lacks map data but developers hope to add this function soon. We believe we could gain valuable experience by getting in contact with them.

To conclude, our research will not stop here and we will always avoid bad properties of the applications in the market. While we are benefiting from nice and worthy properties, we will cover the lacks of our reference projects.

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