DEVELOPING A MANAGEMENT MODEL AND DATA COLLECTION FOR EMERGENCY INCIDENTS USING MOBIL-GIS.

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Abstract

Recent days the new market fields come into existence related with the new services by development and adoptation of mobile technologies. All the reasons of incrasing of use of the services are enormous developing internet and its technologies, coming out the potential employment behind of this developing and successful application into the real life these employment, inceasing of wireless networks and getting powerfull of e-commerce technology and its structure. The target of mobile GIS is to find the location themselves, define the target that they want to go and reach to the target by taken GIS data form the net, mobile devices and GPS technology.

This study is part of the project funded by BAP-ITU (Science and Research Projects - Technical University of Istanbul) in order to develope a management model and realizing data collection for after and before disasters using Mobil-GIS. Istanbul, which is located in Western side of Turkey, has been selected for this study. As Istanbul has over 15 million population, more than one million houses in 384 km square and is located near to the Anatolian fault zone it is a realy good sample for all kind of emergency applications.

In this study, a main points of a management model are defined and the model is formed. The application fields of mobile GIS in Turkey and World, systems requirements, the problems in practice and data security are exeamined and a software are developed to collect and transmit data using handy computers. After an test application is executed in Istanbul.

Introductıon

Location a basic factor for a person to perceive and understand the globe he lives on. The frustrating speed of development on technology also affects the daily rhythm in the same way. In this sense, people are always in need of accessing spatial information anywhere, or anytime today. Cellular phones, pocket PCs, digital cameras, GPS receivers and Geographic Information System (GIS) applications that permanently entered our daily lives have made this need come true (Flick and Bell 2000; Yomralıoglu, 2000).

It is obvious that our futures will be shaped by the rules that will be decided according to technological conditions. As a matter of fact, many rules regarding to mobile and spatial information, like the necessity for more than %67 of the 911 emergency calls to contain the

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positional information with at most 125 meters of error, have been set in United States and Europe (Erden 2000).
Specialy, in case of imergency incients, mobile technology will help us to collect date and organize all equipments and personnel. Because all data can be collected and transmitted online instantly and the organization of emergency helpes can be realized instanly data.

Data Collection With Mobile GIS

Today, new services on development and adaptation of mobile technologies and markets for these applications are being developed. The frustrating development rate of the internet technologies, the understanding and application of the job opportunities behind this development, the growth of wireless mobile networks and the improvement of the e-commerce structure and technologies, have been the causes for the increase of the mobile technology use. 454 GSM operators in 182 countries were serving 730 million users by the end of 2002. In 2002, 75% of the new mobile clients started to use the GSM networking services. The number of the mobile network users has exceeded 1 billion for voice and data transfer these days. (http://www.infotech.com; Yomralıoglu, 2000).

Mobile GIS consists of more than one technology working together:

- Mobile hardware
- Computer
- GPS
- Wireless communication network

The aim of mobile GIS is: making users easily reach their objectives with the GPS technology and the GIS data they bought on the internet by determining their location and the target point. Although this system seems to be mainly used for touristic purposes, it can also be used in other projects by courier companies, infrastructural services, police, army, and administrative units like the Ministry of Finance, fire department, emergency services or taxi drivers (Derekenaris et al. 2001; Korol 2004; Virrantus at all 2001).

Data is the most important component of Location Based Services (LBS). In today's life, where there is a huge amount of data, the collection and the transfer of these data is a major problem. This problem increases when every individual and association collect data specifying their own different standards. Services can be used for different projects mainly by touristic affairs, courier companies, infrastructural services, police, army, and administrative units like the Ministry of Finance, fire department, emergency services or taxi drivers.

Mobile Hardware and Operating Systems

Radical changes are seen in operating systems as the hardware performance of the mobile device increases. This situation has also effects on software development tools. The development of mobile GIS technologies gained acceleration with the development of pocket PCs that use various operating systems. The most common operating systems are: PALM OS and WINDOWS. The operating systems on Pocket PC (PPC), Pocket PC Phone Edition (PPC PE) and SmartPhone (SP) (table 1) are Windows CE based. The Pocket PC operating system, with its 2003 version, had a commercial-purposed name change as Windows Mobile 2003. Its second version that is named Windows Mobile 2003 SE supports horizontal mode – LandScape (Casademont at all 2004; Korol 2004; http://www.microsoft.com).

Software for Mobile Hardware

Mobile software development tools and their platforms are given in Table 2. Here, light and dark shaded boxes tell that the software developed with the given tool will work on the

corresponding platform, and the white boxes tell that it won't work. The difference between the light and dark shade is: Connecting to the device and performing processes like publishing or debugging are possible for the dark shaded boxes, whereas for light shaded boxes it is not possible. "R" indicates that the runtime libraries should be installed on the device (http://www.microsoft.com).

Table 1. Mobile Devices and Software Platforms

Software Development Environment	eVC 3 (C++)	eVC 3 (C++)	VC 3 (C++), eVC 4 (C++)	VS Whidbey (C#, VB.NET, C++)
Equipments				
Operation System	PPC 2000	PPC + PE 2002	PPC +PE 2003	PPC + PE v Next VGA Landscape Square Standart SP v Next QVGA Standart
APIs	Win32 POOM	MFC Network Administrator	.NET Compact Framework Bluetooth SMS	.NET CF Whidbey New Engines New Class Library DirectX
CE OS	3.0	3.0	4.2	5.0 (Macallan)

Table 2. Software Development Tools and Environment for Mobile PCs.

.NET Compact Framework	SP 2002	SP 2003	SP 5.0	PPC 2002	PPC 2003	PPC 5.0
1.0 – VS 2003				R		
1.0 – VS 2005				R		
2.0 – VS 2005			R		R	R
Native						
eCV 3						
eVC 4						
Other						
EVB 3					R	

A "Visual Basic .NET" software development platform, Microsoft DevelopmentEnvironment 2003 v.7.1.1.3088 and Microsoft .NET Framework Software Development Kit v.1.1 were used for this study. Microsoft .NET Framework v.1.1 is a necessary Windows component for developing XML Web Services and new generation software applications. The key components of the ".NET Framework" are the .NET Framework libraries that include ADO.NET, ASP.NET, Windows forms and common runtime environments. ".NET Framework" programs provide easy integration with other programing languages and easy

modification and improvement on the execution environment. ".NET" also provides platform independence.
".NET Software Development Kit" (SDK) is equipped with examples, compiler and the tools to help developing new applications and services based on ".NET Framework" technology. Any software developed by "Visual Basic .NET – SDK" is fully compatible with all pocket PCs working with Windows CE operating system. Testing should be done on a pocket PC during the development process. The test procedures are carried out by the on-line connection between the mobile device and the PC that the software is being developed. This process can also be done on PC using an emulator provided by the SDK. Microsoft ActiveSync software is used for the on-line connection between the PC and the mobile device.

ActiveSync synchronizes the PC and the pocket PC via cable, infrared or bluetooth connections. ActiveSync also enables connection of the device between other sources. To obtain a connection between the device and the PC, ActiveSync software must be installed beforehand. Remote access is not possible except from these connections. (http://www.asus.com, 2005; http://www.esri.com/software/arcgis/arcpad, 2005; http://www.trimble.com/mgis_mobilegis; http://www.hp.com, 2005).

Software has been tested with MS ActiveSync 4.0 and the data has been transferred to the pocket PC. The data used in the software is a reduced version of the standard data because of the limitations due to limited memory, storage and microprocessor. ASUS MyPal 620 and HP iPAQ hw6515 have been used as pocket PCs. Picture and data transfer, coordinate measurements may or may not be integrated depending on the hardware (Picture 4.2 a, b). ASUS MyPal 620 doesn't have GPS, GSM and camera properties integrated on it. These deficiencies are removed by the addition of GSM and GPS Compact Flash Cards to the device. GPS, GSM and camera properties are present in HP iPAQ hw6515 as default.

It is hard to handle out mobile GIS tasks with disintegrated pocket PCs. There are 3 Compact Flash additions that are necessary but there is one extra slot present in the device. This slot can be extended to two at most and one of the extra hardware must have BlueTooth compatibility. Also, software development is much more easier in integrated systems than others (Figure 1).

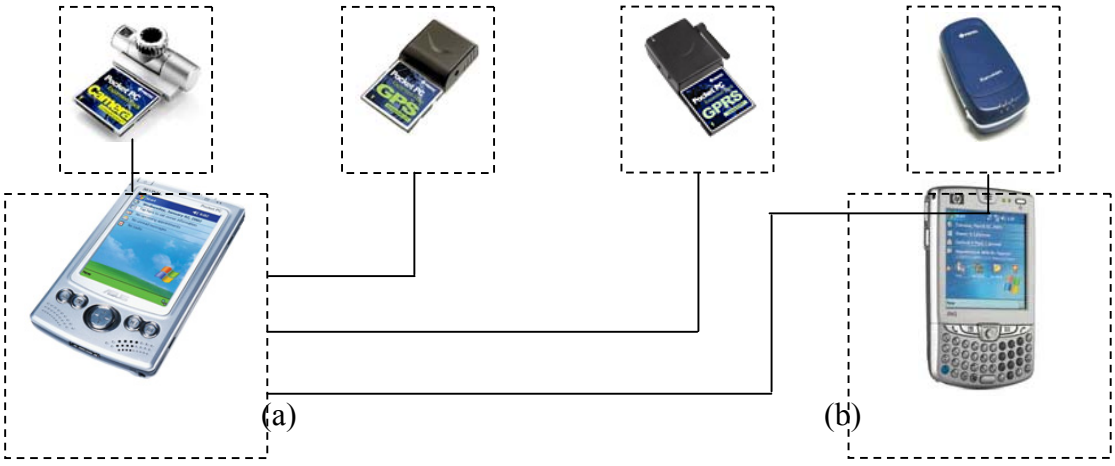

Figure 1. a) GPRS, GPS and camera disintegrated pocket PC,
b) GPRS, GPS and camera integrated pocket PC

Since the expansion slots will be occupied by other hardware on disintegrated devices, it will only be possible to use the devices internal storage, which will cause problems on data storage and processing. The processor-speed problems of the current generation integrated devices also prevents mobile GIS applications ineffective for the time being.

Management and Data Collection

As mentioned before, a wireless communicastion network is necessary in mobile GIS applications. This communication can either be done by GSM or a radio communication system to be built in the working area. Generally, this is possible in metropolitan areas of developed countries. Because of this, communication by GPRS, which is the most common way, is used. Other wireless technologies like intranet, bluetooth (nearly next future), radio-set network can also be used instead of GSM.

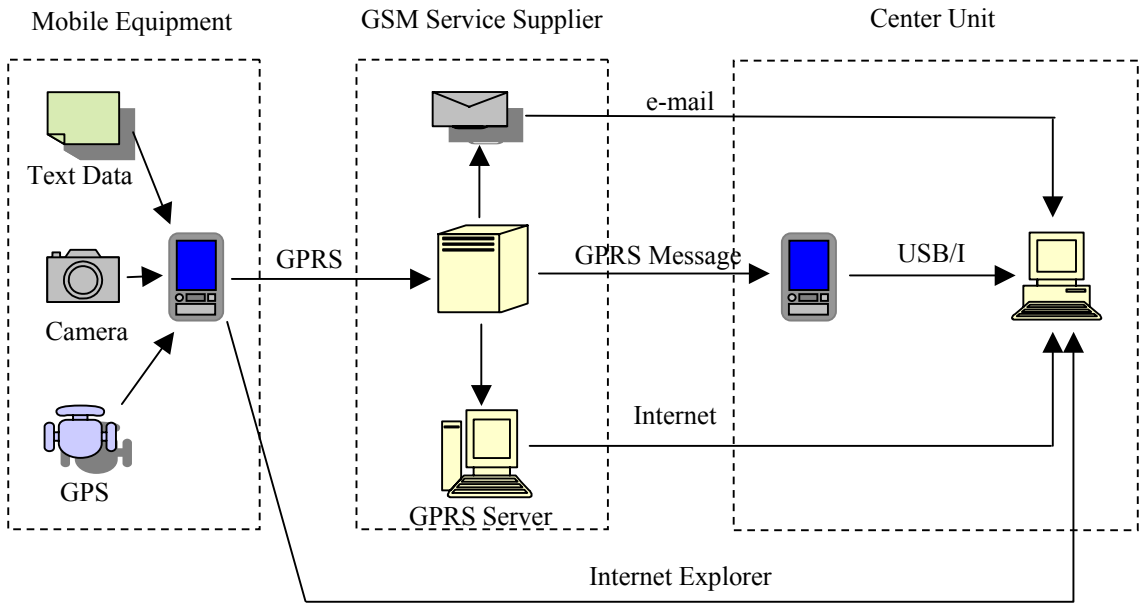

Figure 2. Mobile GIS Process Model

In this study, a model related to emergency management was tried to be built, which is one of the possible applications in mobile GIS. The aim in this study is to manage the emergency support teams and equipments effectively during an emergency situation. The working principles of this system are as stated below:

The mobile equipments all should meet the required specifications (camera, GPS receiver, GSM). Mobile devices are used to determine the damaged structures in the hazard area. First, the teams locate the damaged building and determine the coordinates of it with the GPS receiver. Location can be viewed in the program by using the software in the device and attributes of the structure (building type, current state, number of casualties, presence of emergency aid, access status etc.) can be defined and sent to the main unit. Data coming from all mobile devices are collected in the main unit and optimal distribution of the necessary help teams and equipments is made according to the collected data (Figure 2).

A software that work on pocket PCs have been developed for the mobile GIS application in emergency management. The amount of data the software can process is as much as the available storage in the device. For this reason, the data is transferred to the mobile devices after reducing the amount of graphic or non-graphic data as much as possible. For example, most of the properties (colour, type, thickness) of the road data were not used in the mobile GIS environment. Moreover, the unnecessary attributes were also sorted out from the transferred system.

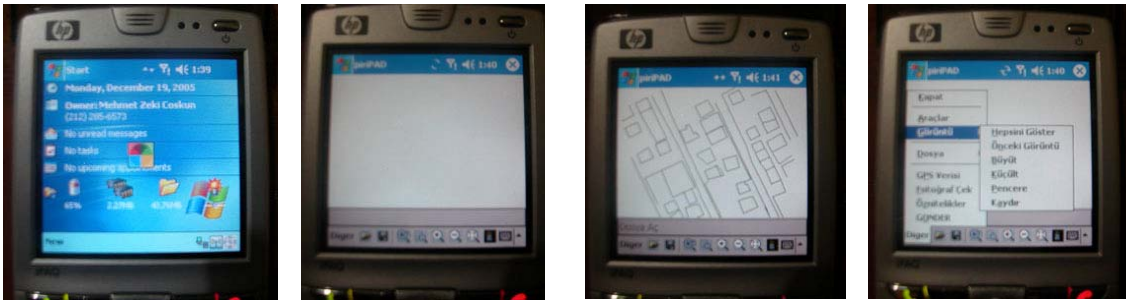

Figure 3. Display of sorted out data and Menu

The flow in the program is as stated above. On the developed mobile software, the position is found either from the map or from GPS coordinates (Picture 3).

GPS coordinates are taken using the program menu of the mobile device, the picture of the building is taken or a previous picture is added to the system. After entering the necessary attributes and explanations, data is sent using "Send" menu via GPRS or internet (Picture 4). Security in mobile GIS systems is very important because it is impossible to block the incoming spam messages. However, it is a controllable situation. In case of transferring the data via e-mails, spam e-mails can be manually sorted or this control can be carried out by putting a simple password to the e-mails.

In GPRS transfer, control can be done by adding the sender's GPRS number or a simple password to the messages.

Data sent through internet via GPRS of an internet browser can also be similarly controlled.

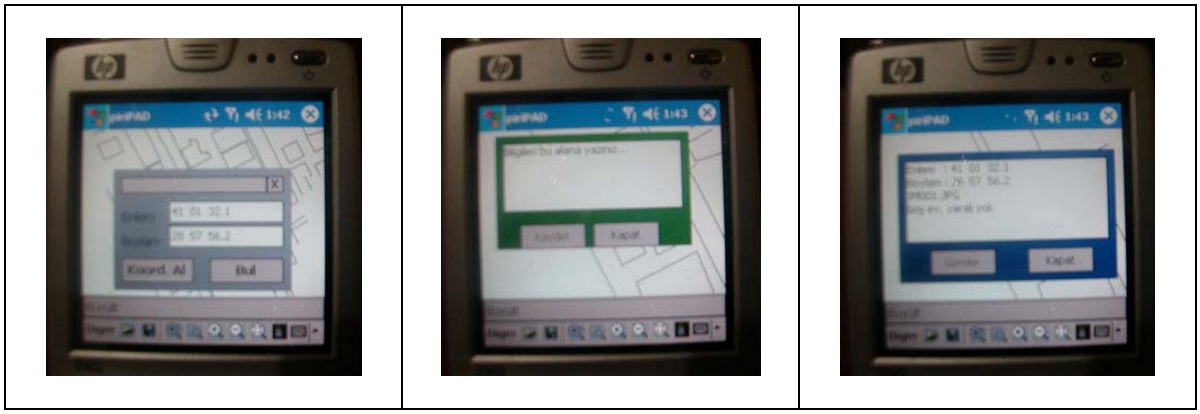

Figure 4. Data Collection and Data Transfer screens

Conclusion

When Istanbul is taken into account, it is necessary to collect data like roads, population, building structure or topography in electronic format. Direct data transfer from the servers will be prohibited due to security reasons. Instead, data will first be transferred to another computer. The hardware to be bought, a PC, GIS software and a GPS receiver will be used for the transfer process.

The hardware profiles of the PC and the mobile devices, the necessary connections, the GIS software to be used, the interface designs and the database to be used for the practical applications stated above is determined in this study.

In an emergency, i.e. eartquake or strom, all kind of data such as image and attrubutes of damaged buildings with their locations, number of injured and dead people or more information can be collected faster and online and sent to the center of emergency manegement office. Thus, these information are used to dispatch staff, equipments and medical supplies or etc to where the damages occur.

Next generation wireless technology specialy bleutooth can also be used as a wrieless technology. It was possible few meters between devices but now, it is much more than few meters depending on device class (class 1 or 2 or 3 radios class 1 have a range 100 meters). Ofcourse it is not necessary for this system drafted but this technology is developing enermously.

Mobile equipments and APIs (Application Programming Interfaces) has been still developing. Following topics have to be taken in to the account when a wriless technology and mobile applications is developed:

- Band with
- The process time in mobile and server
- Minimal programing codes
- Memory
- Minimal use of Recursive functions
- Design for small and less resolution
- Controlling OS for power saving

The main disadvantages of the mobile GIS devices can be stated as: A slower processor and lesser memory compared to the standard PC, a smaller screen with a lower resolution and the difficulty of software development. The processor speed is lower especially in integrated systems than disintegrated systems. However, these limitations do not significantly affect the use of these devices in emergency management.

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