GIS INTEGRATION OF DATA COLLECTED BY MOBILE GPSSIT

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ABSTRACT:

Rapid developments in information technologies widespread the applications of GIS in several professional disciplines. Technological improvements in mapping processes especially impact of GPS facilitated rapid, complete and reliable data collection even for GIS. Mobile GPSSIT (GPS Sanal Istasyon Teknigi – GPS Virtual Station Technique) taking advantage of GPS has been developed as a detail measurement technique integrating GPS stop and go measurement technique and total station on pick-up truck. By this technique, it is possible to produce data accurately, rapidly and practically and in low cost.

In this study, Mobile GPSSIT was applied in the regional of Selcuk University houses for staffs, to obtain 3D digital data for details. In addition to those data, non-locational one was also collected to integrate both data in ArcGIS 9.0 GIS software. After this data integration, queries, analyses and a 3D model for the region were conducted and integration problems were also emphasized.

Keywords: GIS, Motorized GPSSIT

INTRODUCTION:

As any one will be agree with that GIS is a powerful tool for many disciplines, especially for those which are dependent on spatial data. They can manage their work and data at top level by the help of GIS features and advantages. They can also analyze their special data with respect to location data integrated with those special data. This provides information so that knowledge based decision support system for those, who use GIS. One, who has such decision support system, can manage his or her jobs very precisely without wasting any source, optimize his or her profits or benefits, inputs. So that, it means increases in his or her overall job performance and profit or benefit margins.

On the other hand, some institutional foundations like to have a database related to their works easily reachable, manageable and most importantly analyzable. Thus, they can have a chance to produce useful information that can vary with respect changing conditions and best fit the current situations. They can also monitor these changes and manage most powerfully.

Similar to that, analogous desires can be encountered when a small or large size of a residential area is liked to be managed. There must be a huge bulk of data related with several different subjects in this kind of management project. But most important issue in such cases is having the desired data in time, as accurate as possible and by an easiest way.

As any one can know very well now, the Global Positioning System (GPS) determines precise location and provides highly accurate time reference for almost anywhere on Earth decoding time signal transmissions from multiple satellites. Most precise location data can be produced by GPS single and/or phase observations.

GPS found a wide place in many application areas in the course of time. Now, rapid developments in Geographic Information System (GIS) have been being provided a possibility to use GPS for GIS in several applications. The geometric and geographic information obtained by GPS system constitute the GIS database and then proposed maps can be produced by using data from this database.

At this point, here in this paper, it is suggested a rabbit, accurate and easy data collection method especially for details. The method depends on GPSSIT detail measurement system (Kalayci, 2003 and Corumluoglu and Kalayci, 2007), set up not on the ground, so that mounted on a vehicle such as pick up truck. It is called as Motorized Mobile GPSSIT (MM-GPSSIT) (Kalayci and Corumluoglu, 2007).

GPS

The Global Positioning System (GPS) is a location system based on a constellation of about 24 satellites orbiting the earth at altitudes of approximately 20200 kilometers. Although GPS was developed by the United States Department of Defense (DOD), for its tremendous application for military purposes, over the past two decades, GPS has proven to be a useful tool in non-military mapping applications as well.

MM-GPSSIT

Today, Real Time Kinematic (RTK) and Stop and Go GPS techniques are widely used for the measurement of details on the ground if the details are accessible and reachable directly. On the other hand, if the details and their environment are not reachable or do not allow surveyors to apply GPS antenna directly over the details, in this case, for the measurement of such details, combined or sequent measurement techniques are applied in the practice such as GPS+EDM techniques. This solution is also dependent on traversing stations installed on the ground as being in conventional traversing using polar measurement technique, with just one exception that stations are not coordinated by conventional surveying techniques but GPS. Every one will be agree with that this dependency to the installed stations on the ground makes the surveying process longer and hard and adds some additional cost and effort when it is compared with the surveying processes in the case at where GPS antenna is applicable directly and vertically over details. So that, current approach of this ground point dependent combined surveying technique is not practical with respect to a technique which is independent of installed stations.

In Selcuk University, it is developed a practical and rabbit motorized GPS surveying technique which is called as MM-GPSSIT (Motorized Mobile GPS Sanal Istasyon Teknigi – GPS Virtual Station Technique) to overcome those problems experienced in practice and caused by detail features (Kalayci and Corumluoglu, 2007). GPSSIT basically makes detail surveying independent of traversing stations installed onto the ground since it uses virtual stations determined by GPS antenna phase center just few meters above the ground as it is explained in author' previous paper (Corumluoglu, 2007). On the other hand, Motorized Mobile GPSSIT represents more than that. So, in terms of surveying technique, MM-GPSSIT fundamentally depends on GPSSIT, but not on the ground, on a vehicle. More details about both techniques can be found in the authors other papers (Corumluoglu and Kalayci, 2007 and Kalayci and Corumluoglu, 2007).

GIS

A geographic information system (GIS) is a computer-based tool for mapping and analyzing existences and phenomena that occur on Earth. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps. These abilities distinguish GIS from other information systems and make it valuable to a wide range of public and private enterprises for explaining events, predicting outcomes, and planning strategies. A GIS focuses upon where something is, what it is, and why it is there.

Geographic Information is a complex, rapidly growing and important part of the Information Society. New Geographic Information technologies are developing rapidly. The great advantage of GI is that it has the capability of summing up and visualizing graphically what vast amounts of data are trying to tell one about the relationship between various phenomena on the Earth surface (such as the relationship between climate and certain health risks). There are many applications in international, national and local government, business and research, and in various commercial sectors. Geographic Information is important because of its value for planning, land management, marketing studies, environment, renewable energy resources, emergency services, health care, political analysis and many other uses (Born, 1992).

Geographic Information Systems (GIS) are tools for the management of geographic information, for spatial analysis and the visualization of this information. GIS are complex yet
general purpose tools, serving many types of users.

GPS and GIS Integration

Any one would agree that GPS has found many application areas in the field of Geographic Information Systems (GIS). GPS with small extent of some error budget can provide any point with its precise location on earth. A GIS includes basically a descriptive database of the earth or a desired part of the earth. GPS tells us where we are on the earth with X,Y and Z coordinates while GIS tells us what it is at location given in X,Y and Z coordinates; specific object or phenomenon. So, GPS tells us the "where". GIS tells us the "what" at that location. Therefore, GPS/GIS together offers us a powerful solution to locate, organize, analyze and map our resources.

Up to this point, it is explained what GPS determines on the surface of the Earth and what GIS is and does. Now we can move on to the process of describing what it is at that location. The "what" is the object or objects which will be mapped. These objects are referred to as "Features", and are used to build a GIS. It is the power of GPS to precisely locate these Features which adds so much to the utility of the GIS system. On the other hand, without Feature data, a coordinate location is of little value.

Feature data in GIS

Data is an important component for GIS. With GIS users have a tool to capture, manage, query and analyze their data from various sources. In GIS, there are two types of data.

First component of data stands for Location in three types of features such as:

Points - A Point Feature can be described as a single GPS coordinate position which is identified with a specific object. So they are discrete features ie, a tree, building, traffic sign.

Lines - A Line Feature can be a collection of GPS positions which are identified with the same object and linked together to form a line. So, they are connected locations ie, roads, rivers.

Areas - An Area Feature is very similar to a Line Feature, except that the ends of the line are tied to each other to form a closed area. So they have length and width ie, lakes, perimeter of a building etc.

The other component is a descriptive component describing the feature ie, length and kind of road, height and kind of tree or a building etc.

In this manner, GIS comes with its ability to identify relationships between features based on their locations and their attributes. GIS also provides us a medium to view these relationships in maps, charts, tabular forms etc. GIS is capable of creating different layers of data. In GIS, several layers can be created to introduce different type of objects such as roads, traffic signs, accidents, buildings, parks, water lines, etc. After the creation of layers, different layers can be superimposed and analyzed for determination of the relationship between various features and their attributes.

It is important to have relevant and current information for analyzing the data that can be obtained from various sources. Some data can be obtained from existing sources eg population, census, roads etc. On the other hand, some specific data which are necessary in the project may not be available and therefore they have to be collected by possibly GPS. After the collection of this data by GPS, it can be directly transferred into a GIS System. This data will have the spatial location as well as feature/attribute data attached to it.

In a multi-layered database system as mentioned above, description of a feature is essential for successful integration with any GIS system. For example, the location of each house on a city block can be mapped and each coordinate position can simply be labeled as a house. However, the addition of information such as color, size, cost, occupants, number of floors, height, covered area etc. will provide the ability to sort and classify the houses with respect to these parameters.

These descriptive parameters related to a Feature are called as Attributes. Attributes can also be thought as specifications of the Feature. Using the example above, the Attributes of the Feature "house" would be "height", "number of floor", "cost", "number of flats on a floor" and "occupants in a specific flat".

Logically, outcome of a query related to an Attribute is called Value. For example, an appropriate Value for the Attribute “height" of the Feature "house" may be "18 m".

By collecting the same type of data for each house which is mapped, a database is created. Tying this database to position information is the core philosophy underlying any GIS system.

In the field data entry or collection process can be streamlined with respect to each Feature and Attributes related to this Feature and then they are incorporated with GPS data in order to link the GPS and Feature data into the GIS system. During this process, a GIS "layer" is created for each Feature with respect to the related GPS data. For example, the process of linking a GPS data containing the data for House, Road and Lot Features would create a House layer, a Road layer and a Lot layer in the GIS system. These layers can then be incorporated with existing GIS data. Once the GPS data has been linked, the full power of the GIS system can be used to classify and evaluate the data.

If it is dealt with exaggerated buildings with height in 3D GIS environment, it will be useful to create sub-layers for floors of each building and even for each flat as well.

Creation of 3D Model of Residential Area in A GIS Environment by the Help of MM-GPSSIT

To create such models, first of all a study place was chosen and it was in the Selcuk University’s campus residential area designated for staff accommodation. There were more then 10 apartments with 4 floors and 2 flat in a floor and several other buildings (Figure 1).

Terrain details and building boundaries were measured by MM-GPSSIT with 2 persons and it took only one day to collect all the details. The

same details were also measured by using conventional surveying techniques. First, GPS was used to locate traversing stations and then using these station, all details around were measured by a total station with 4 persons and it took 2 days to complete the same task.

After the collection of details in the field, digital terrain model was created in a computer environment. And then this DTM was transferred into GIS software. Building details, superstructures and other details such as roads, streets, pavements, trees and etc. were entered into GIS environment as well. After all, all these data in layers were merged together and buildings were exaggerated, then all sides of buildings were textured by their photos.

In 3D GIS environment, each building side was divided into several individual parts with respect to flat distribution in the building and these individual parts were linked to the related attribute data or information collected and stored in GIS medium. Thus, the GIS constituted in this study was made ready for any inquiry to be done for the region.

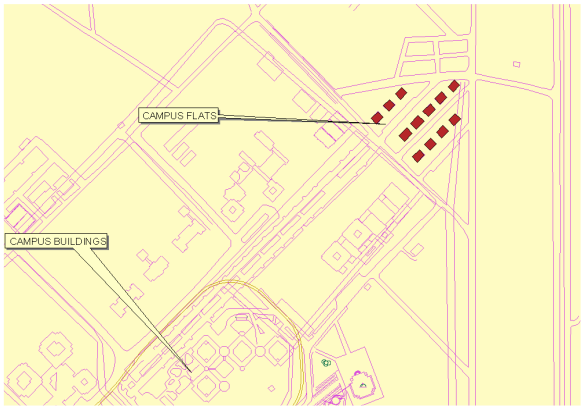

Figure 1: Selcuk University's campus residential area

Conclusion

Since GPSSIT as a sole surveying method is a detail measurement technique that does not depend on traversing points installed on the ground and can easily be used in the cases of when any detail can not be reachable or does not have a sight of view to efficient number of satellites since it is special structure or position, it provides a great opportunity to eliminate this part of a surveying process as being in the conventional traversing. Thus it saves money, time and labor and speeds up the detail measurement process even within consistent accuracies desired for a GIS project. MM-GPSSIT, which is used to measure details in this study, adds more than that. So, since MM-GPSSIT is a detail surveying technique that is done on a vehicle, it speeds up whole surveying processes significantly. It can be performed with maximum two persons even only one surveyor is enough. In whole process, since it saves time, effort, labor and etc. it means reduce the total cost and provide rapid data that is crucial for a GIS.

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