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GIS 기반의 교통관리체계 개발
A Development of GIS-based Transformation Management System : A Field-level Desktop GIS-T[1)]

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要 旨

퍼스널 컴퓨터(PC)를 기반으로 하는 지리정보 시스템을이용하여 도시의 교통관련 시설물의 관리 및 교통관리를 지원하는 교통지리정보시스템 (GIS-T)이 소개되었다. 기존의 교통 시설물을 장부나, 카드식 대장에 의해 관리함으로써 설치형태나, 설치일, 교체주기 등의 관련통계자료 및 정보를 유지하는데 있어서 많은 시간과 노력이 필요하였으나 제안된 시스템을 이용하여 효율적인 시설물관리시스템은 물론 데이터의 공유 및 의사결정지원에 이르기까지 이용에 있어서 구청단위의 광범위한 활용도를 보여 주었다. 본 고에서는 현재 서울시 중구청에서 거의 구축이 완료된 교통시설물 관리시스템의 구축과정 및 시설물 관리 및 교통운영 측면에서의 활용방안에 대해서 살펴보았다. "중구교통관리시스템(CTMS)" 이라고 명명된 이 시스템은 탁상 (Desktop) 환경을 기반으로 PC ARC/INFO 와 MapInfo를 이용하여 MS-Windows 95 상에서 구축되었고 자치구 차원의 소규모 비용과 예산으로 교통관련 시설물을 관리, 운영, 및 더나아가서 교통계획에 활용할 수 있는 가능성에 대해서도 검토되었다.

ABSTRACT

As can be seen in US case with the introduction of ISTEA and CAAA, the expansion of the transportation decision-making role of local government is expected to be quite apparent in Korea, and the increased importance of decision-making in transportation issues requires increased attention to both justification and analysis of transportation initiatives.

A GIS-based facility management system in a desktop computing environment has been constructed using MapInfo, ARC/INFO, and Microstation to allow such expanded role of local government's decision- making activities.

In this paper, first, authors try to explain the procedures of system design; that is, the digital map production including vectorizing, data conversion, attribute data entry, and application programming development. Then, various management functions which are basically embedded in MapInfo environment, and application functions established by the use of MapBasic language has been explored. Finally, the possible benefits of combining geographic information systems with traffic planning scheme has also been described with some discussion.

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1. Introduction

Since the late 1970s, GIS-oriented management systems for managing facilities of various sizes, complexities and purposes have been conceived and partly implemented with the aid of GIS, and have been proven in service for years. Among various facility management examples, the density of georeferenced information in cities is far greater than that in towns or rural areas. Consequently, city agencies and bureaus were among the first to implement GIS-based facility management systems, primarily to support municipal services (Bernhardsen, 1992)[2]

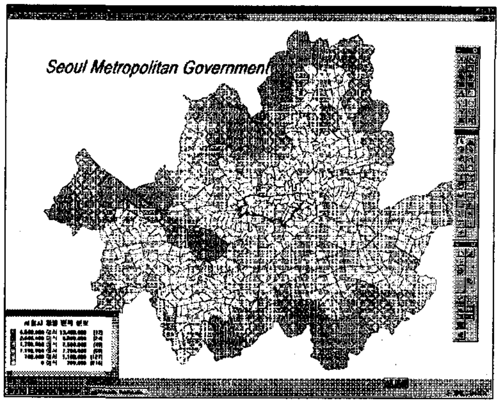

Figure 1. : Seoul and Choong-Gu

Choong-Gu (a district-level local government in Seoul, see Figure 1, 2 for the map of the entire Seoul and Choong-Gu) initiated GIS, called CTMS (Choong-Gu Transportation Management System) with special emphasis on transportation and traffic setting last year. In this paper, the detailed system setup procedures and proposed functions will be sketched. Basically, the system is a kind of spatial decision support system in a sense that it incorporated database management system, user interface, and model base which allows the traffic and transportation planning inside the integrated environment. Although all the introduction of detailed system setting procedures may look boring, we took the liberty of describing them to the Regional Science Association, in which GIS is still a new area of knowledge quest, and modified a bit to be submitted to the Journal of the Korean Society for the Geo-spatial Information Systems.

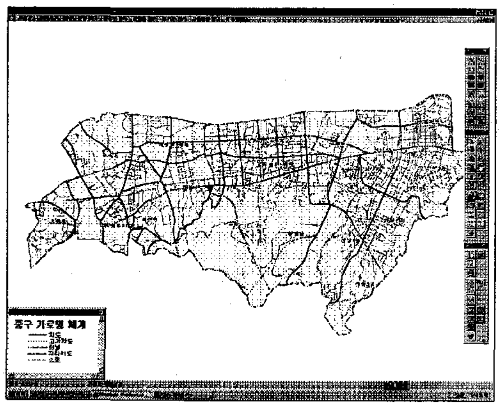

Figure 2. : Choong-Gu Network

2. Impetus for System Development

The main thrust of the system development is to attain greater internal efficiency, to increase effectiveness, and to improve decision making activities in Choong-Gu local government.

EFFICIENCY By creating and sharing the all relevant databases throughout the organization (Choong-Gu office), its efficiency is enhanced. According to Gillespie (1991)[3], one measure of enhanced efficiency would be to compare the difference in variable costs of producing all necessary information in-house versus retrieving form other sources that have already been produced, stored in the computer and shared among others who need information.

EFFECTIVENESS By effectiveness in GIS it means increase the quality of the output or produces a new output.

DECISION-MAKING According to Simon (1977)[4] decision-making processes fall along a continuum that ranges from highly structured (programmed) to highly unstructured (non-programmed) decisions. Intelligence, design, and choice are three phases[5] of decision-making and GIS can provide lots of appropriate information with planners, designers, and high ranked officials, in the stages of intelligence, design, and choice.

3. A Need for the Development of Database

Integrating collected data sets such as traffic counts, vehicle mixes, roadway characteristics, functional classification of network along with other inventory data (transportation and landuse) are crucial for the assessment of transportation projects small or large.

The establishment of a database to meet the requirements of users' community generally follows a well-defined series of steps irrespective of the subject matter of the database (Benyon, 1990)[6]. Simplied, these include the followings:

1. identification and documentation of the user requirement;
2. definition of the data requirements which will address the user requirement;
3. establishment of an information technology solution which offers facilities for data handling to meet the user requirements;
4. an assessment of the costs and benefits of such a solution; and
5. If the above are favorable, installation and implementation of the selected solution.

In Choong-Gu case, among other Gu's (25 Gu's in Seoul), it paid much attention to the traffic database management, thereby traffic count survey, parking survey, and other surveys such as bus stop etc. have been conducted prior to the efforts of others. They need to manage the surveyed data, especially with the help of GIS that are available. They reserved about 110,000 US$ for the system development (both hardware and software). 40 percent of money out of the total amount has been consumed for hardware (see Figure 3 for hardware configuration), while the rest for software--map database and application programming.

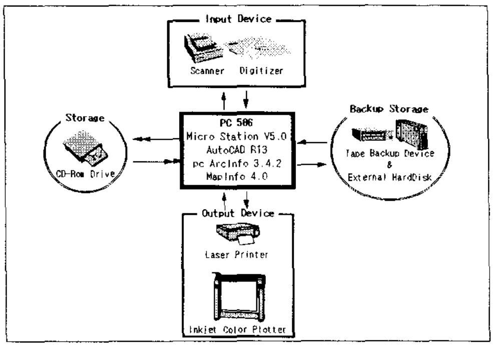

Figure 3. : System Configuration

4. Steps of Database Construction and Implementation Methodology

Generally, as organizations determine requirements, the quality, accuracy, structure and type of data to maintain become apparent. Based on the minimal requirements and the budget constraints initiating GIS shown above, desktop GIS platform has been selected.

4.1 Database Construction

The procedure of database construction taken in this project are as follows.

STEP 1 scanning of the paper maps scaled 1: 500, which have been originally made in 1989 and updated once since then;
STEP 2 hybrid screen digitizing and editing in Microstation[7]
STEP 3 conversion of Microstation IGDS format do ARC/INFO;
STEP 4 topology building in ARC/INFO
STEP 5 MapInfousing ArcLink;
STEP 6 raster map referencing in MapInfo;
STEP 7 attribute data and image data input in MapInfo;
STEP 8 application programming using MapBasic.

4.2 Layer Definition

As shown in Table, layers developed in step 2 contain index, administration code and name, road related layers, building layer, block layer, road centerline layer, subway rail layer, and elevation layer. A notable point is that the road related layers, which include centerline of road and the actual polygon-based roadway, have been distinguished.

This reflects the fact that the big scale map (here 1:500) often requires the same entity (road) may be represented as different objects (centerline and polygon-based road) in mapping the real world. The name of roadfac coverage also contains the mapping of entities like bus, taxi stops, and sign and signal as point objects.

Table 1 : Layers Included and Definition Codes

Coverage		Type	Items	Layer Num
index		poly	index	9999
admin		poly	Admin code	8117
			Admin name	8118
roadpoly		poly	roadway	0115
			walkway	0324
			bridge	0341
			over pass	0342
			tunnel	0122
			under pass	0123
			local road	0118
			trail	0119
buil		poly	building	3112
	park	poly	street	0361
			outdoor	0362
			indoor	0363
			under	0364
	block	poly	block	0331
	roadcent	line	roadway	8250
			bridge	8251
			over pass	8252
			tunnel	8253
			under pass	8254
			local road	8255
			trail	8256
	rail	line	over rail	1111
			under rail	1112
	roadfac	point	bus stop	0441
			taxi stop	0412
			signal	0413
			sign	0414
	pyogo	point	elevation	8888

4.3 System Configuration and User Interface

The operating system adopted is Windows 95 in a Pentium processor equipped PC, and MapInfo with MapBasic have been chosen for the main GIS engine. The MapInfo's advantages over ArcView, which is lower in cost and quite fast in accessing and displaying data.

The CTMS user interface is one that can be easily seen in any Windows-based application which is familiar to most users. Built around the Windows version of MapInfo, the Windows standard icons and boxes are adopted as user interface to provide such actions as point-and-click access and drag-and-drop along with OLE (object linking and embedding). Furthermore, the on-line help text supplements the system.

5. Proposed Functionality

Application programming with using the MapBasic allows extended menu system on top of the default MapInfo menu system. The followings are the first-level menu functions.

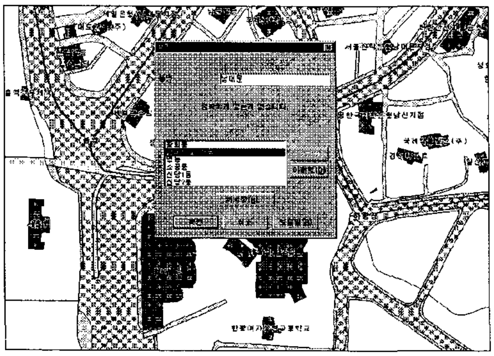

Figure 4 : Spatial Query by Name

File holds general file related features such as open, close, print, and exit to the system functions exist.

View holds window arrangement, layer control, and scale control.

Analysis function allows thematic mapping, buffer analysis, and statistics calculation, and distance-area calculation.

Status Quo displays various aspects of current Seoul and Choong-Gu attributes. It also has spatial query function. For example, search by name of address is possible(see Figure 4).

Traffic Database includes data such as traffic count (temporal, year-by-year, and intersection by intersection, see Figure 5), traffic parameters of signals (cycle, split, and offsets, see Figure 6), search by traffic volumes and intersection, and whole transportation network both transit (underground subway and bus line) and highway.

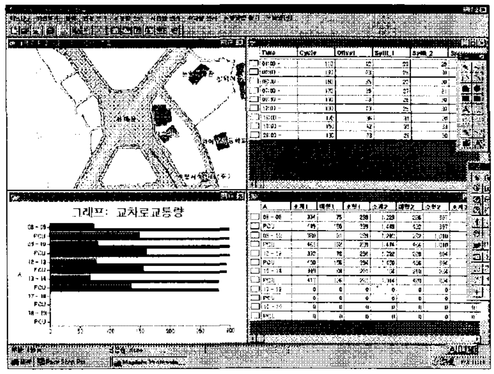

Figure 5 : Intersection Traffic Information

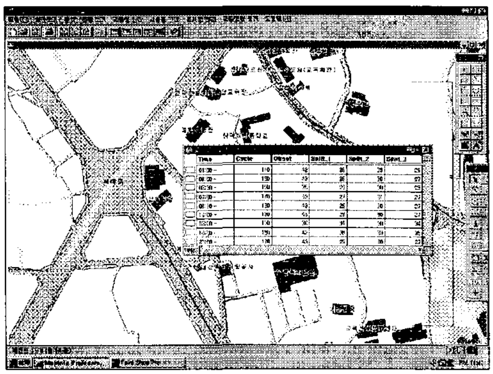

Figure 6 : Traffic Signal Parameter

Facility Management function typically manages various transportation facilities from large items such as station (subway, bus, and taxi, see Figure 7) to small signs on the highway.

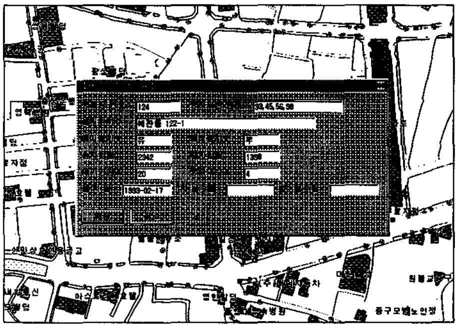

Figure 7 : Bus Stop Management

Parking Condition function reports the current parking areas and types along with its capacities (see Figure 8). Later the dynamic information about lots will be integrated in the future. At the same time, the private parking lots are maintained by owners.

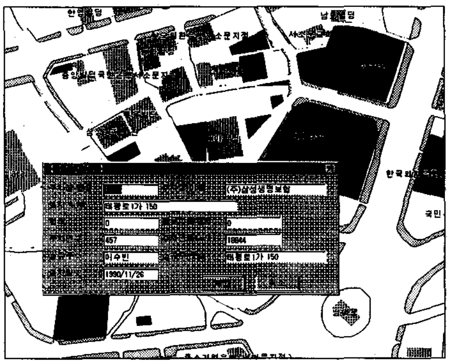

Figure 8 : Parking Lot Information

Traffic Impact Studies submenu shows the spatial distribution of buildings that went through the traffic impact studies along with other relevant information such as who conducted the studies, when, and other contingent information.

Of course, all the objects (invoked by point-and-click operation) contains databases and editing is possible on demand.

6. Connection to the Traffic Planning Software

In addition to the general functions provided in the system, transportation analysis and data management functions specific to the CTMS were integrated.

The data set in the database can be called and ASCII based text file can be produced to be fed into transportation modeling and analysis packages. At the moment only TRANPLAN and TRANSYT 7F are considered for the coupling.

TRANPLAN requires link-node topological network data and O/D tables for the CTMS zone system. Right now, the conversion of network data from MapInfo to TRANPLAN is underway. At the same time, the O/D table contains the trip exchange information out of surveyed data in 1990. Now the trip rate analysis function are being developed and production and attraction tables are linked to the trip rate analysis module to facilitate the what-if scenario such as new building installation effect on traffic demand.

The basic notion of incorporating TRANSYT 7F with GIS is that the coupling could enhance the process of coordinating a traffic signal system. The GIS system provide a needed data of TRANSYT along with relationships between intersections. The topological data structure that provides these relationships enabled such provision. At the same time, the process of analyzing different network optimization scenarios is simplified with this system because the user need only to select the intersections to be coordinated from GIS graphic display instead of the conventional cutting and pasting from existing input files. The proposed system can serve as a multipurpose signal information system. That is, interpretation and display of the optimization output is possible, thereby, provide improved access to signal data and allows for quick identification of intersections that experience excessively delays or unacceptable levels of service(Sarasua, 1995)[8]

7. Conclusion

In response to growing decision-making responsibilities in transportation planning, the CTMS has been developed to give a helping hand in policy implementation. The successful deployment in such a short period (4 months) was accomplished by drawing on the functionality of off-the-shelf solutions and integrating additional functionality through custom development. Due to the some inherent limitation of MapInfo, it was necessary to implement data and its structures in Microstation and to build custom-made functions with MapBasic language.

The proposed system brought a product that was integrated into the desktop Windows environment, setting the stage for tapping into a wealth of other software application and data available in the PC-based Windows world such as MS Excel and other Windows desktop database systems.

In spite of its limitations, users (normally work forces in the Choong-Gu office) will be able to manipulate the CTMS for application to various projects such as transportation improvement programs, long range transportation planning making and other often spatial queries and

reporting. The system if supplemented with some deficiencies will be a useful tool for decision-making and continued transportation initiatives.

참 고 문 헌

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Design - Inventing, developing and analyzing possible course of action.

Choice - selecting a course of action from those available.

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7. Although the software we chose support the function hybrid vectorizing, the accuracy issue have us work with Microstation, where much more freedom and flexibility can be exerted. The hybrid screen digitalizng refers to the vectoring with raster data overlaid.
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