GEOGRAPHIC INFORMATION SYSTEM

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Contents

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Summary

GIS (Geographic Information System) is a computer-based system for mapping and analyzing the resources and objects in the real world.

Data sets used in GIS contain both nongraphic as well as graphic data. Graphic data depict the appearance of resources and objects in the real world. Nongraphic data provide further descriptive information about associated graphic data by using conventional alphanumeric formats. The entities of graphic data are generally constructed by two data models: raster and vector. Raster and vector structures have different methods of storing and displaying spatial data. The geographic data are also mapped into separate files referred to as a data layer, depending on themes. However, the position of each layer is registered in relation to other layers through a common coordinate system.

As a result, entire data in all layers are handled as if they were one seamless spatial data file.

Digital data that are used in a GIS usually come from a variety of sources. There are also many methods as much as the number of various data sources. From a very simple point of view, they are condensed by two different approaches: either generating new digital data or acquiring existing digital data.

There are various inputs or converting devices such as keyboard, digitizing table, digital stereo-plotter, scanner, COGO, remote sensing and GPS for generating new digital data. However, the process of data acquisition is typically the most expensive and time-consuming part of GIS. The use of existing digital data is more cost-effective for GIS users. When using existing digital data, the digital data undergoes conversion of file structures and formats to be usable with specific system of translation programs and digital cartographic standards.

Most GISs are equipped with a set of analytical functions for spatial data analysis. Measurement analysis, spatial relation analysis, buffering, overlay, Thiessen polygon, and network terrain analysis are the examples of most common and useful analytical functions.

After spatial analysis, GIS can provide a variety of products in graphic form as charts, diagrams, and maps; and in numerical form as statistical tabulations on various output media. The outputs are generally divided into soft copy as transient images on monitor displays and hard copy as durable outputs printed on paper and film. The output production is the final phase, where outputs are created by GIS.

GIS is a computer-based system for mapping and analyzing the resources and objects in the real world. In this sense, GIS is thought to be very useful to analyze substantive real-world problems, especially problems related to geographic locations. The GIS technology is being used worldwide, at all levels of government, in business and industry, by public utilities, and in personal applications. Obviously, GIS has become a very powerful tool for a very wide variety of applications, and its use will further increase significantly in the future.

1. Introduction

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The term GIS (Geographic Information System, Geographical Information System) is a relatively new one, which first appeared in published literatures around the mid-1960s.

As a literal interpretation, geographic information system is an information system about geography which describes and interprets the physical location of resources and objects in the real world. The term “spatial” or “geospatial” is often synonymous with “geographic”. In this context, the terms “geographic”, “spatial” and “geospatial” are used interchangeably in GIS-related literature.

The most common and traditional medium for recording resources and objects in the real world has been the paper map document. A map is actually the medium for recording real-world data on the paper in virtual format.

The map depicts several kinds of observations and records information on characteristics such as the shape of terrain, land cover, and a various kinds of artificial and natural features of the entity. When depicting observations and information, geographic referencing or address system would ordinarily be needed for recording positions of the entities. Latitude and longitude coordinate system is the most commonly used geographic referencing system.

However, the paper map has its own limitations and can not cope up with the increasing information to be recorded and the complex demand of modern society. The key solution to reasonably solve these problems is certainly the employment of systematic approach. The function of an information system, therefore, must be to improve one’s ability to cope with the increasing volume of the information and cater to the complex demand of modern society.

Paper map documents also have another major drawback when used as data storage devices. It is expensive and time consuming to change them when updates need to be made to the spatial database. To cope with these problems, the data is employed into digital format. Once data of any kind is converted into digital format, it is much easier for a computer to store, manage and update the data.

Computer technology has played a crucial role in addressing these concerns. Computers could serve as data storage devices as well as calculating machines. The great progresses in computer technology during the last two decades have made it much easier to apply computerized system to the problem of storing, manipulating and analyzing large volumes of spatial data.

In these circumstances, the first Geographic Information System (GIS) was developed as computer-based response around the middle of 1960s.

The first system in the modern era to be generally acknowledged as a GIS was the Canada Geographic Information System (CGIS) that was designed specifically for the Agricultural Rehabilitation and Development Agency Program within the Canadian government. It is still functioning although its current versions are very different from their original format. It is one of the most successful examples of GISs. Modern GISs have evolved from this prototype.

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In this sense, GIS is a computer-based system for mapping and analyzing the resources and objects in the real world. A typical GIS, as a computer-based system, is usually composed of user, data, software and hardware.

The recent dramatic progress of IT (Information Technology) industry has accelerated the development of GIS technology. It is bringing significant reductions in the price of GIS hardware and software. With the growing market for the digitalized spatial data, GIS users are able to get data for GIS applications at cheaper prices. These factors are encouraging more users to apply GIS in various fields. Obviously, GISs have become very powerful tools for a very wide variety of applications. It is expected that their use will increase significantly in the future.

The contents of GIS are described in the following sections.

2. Types of Data used in GIS

As explained in introduction, GIS is a computer-based system for mapping and analyzing the resources and objects in the real world. For understanding GIS, the types of data used in GIS will be explained first.

Data sets used in GIS consist of graphic and nongraphic data. Graphic data depict the appearance of features and objects in the real world. Nongraphic data provides further descriptive information that is actually associated with graphic data in conventional alphanumeric format.

Each of these types has specific characteristics for efficient description and analysis of real situations. The characteristics of these two types of data are described in the subsections below.

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Biographical Sketch

M. Y. Pior was born in 1960 in Korea. He received his B.S.(1988) and M.A.(1990) degree in civil engineering from the National University of Seoul. He came to Japan to pursue graduate studies in civil engineering at the National University of Tokyo, earning Ph.D. in 1996. His dissertation at the National University of Tokyo was on “Benefit evaluation of infrastructure improvement applying GIS integrated system”. After receiving Ph.D., he worked in Institute for Transport Policy Studies in Japan for three years (1996-1999). He is currently associate professor of real estate science at the University of Meika in Japan. Pior’s research interests are in the applications of GIS, especially focusing on the fields of real estate science and transportation planning.

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