Chapter 1.26
Towards Google Earth:
A History of Earth Geography

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ABSTRACT

Using geographical information systems (GIS) has been of great interest lately. A lot of GIS applications are being introduced to regular and noncomputer-expert people through their everyday used machines such as cars (GPS), mobile (location systems), Internet (locating systems and direction guiders), and others. "Google Earth," a free online application, is one of those online geographical systems that provide users with a variety of functionalities towards exploring any place on the earth. The software uses Internet to connect to the online world database and travel in seconds between cities. This chapter briefly explores "Google Earth" and presents a possible future view and an extension of this GIS application by adding a time feature that gives "Google Earth" the ability to store the history of the geographical information that leads towards a new "Google Earth: A History of Earth Geography." For this purpose, the chapter presents storage and indexing approaches to be used for the storage, indexing, retrieval, and manipulation of geographical data used by the geographical database of the world used by "Google Earth."

INTRODUCTION

This chapter explores "Google Earth" and presents a possible future view of this geographical information systems (GIS) application by extending it with a temporal (from time) feature that gives "Google Earth" the ability to store the history of the spatial (from space) and geographical information that leads towards a new "Google Earth: A History of Earth Geography."

There are many reasons for ranking "Google Earth" as one of the most professional and well done works in the field of geographical information systems. This section briefly presents the four important reasons for considering "Google Earth" as a revolution in the world of Internet GIS:

1. **Easy use of the software:** The software is designed for any Internet user who does not know anything about how GIS systems

behave. Spending 30 minutes to 1 hour exploring the software makes the user able to use most if not all the basic functionalities of the software.

2. **Availability of the software:** The software is available for free to be used by any Internet user. It is self-connected to the online database that is also available to everybody, through "Google Earth" (anyone having an Internet connection).

3. **Performance of the software:** The software interacts relatively very quickly with the user. If we consider the huge number of raster and other kinds of spatial and nonspatial data in the database, we can appreciate how fast "Google Earth" process the user input. The high performance is the result of using efficient spatial indexing structures and others. Such structures aim to index and categorize spatial data according to their position and use when the user asks a query. They consider the spatial information (location) in the query and go efficiently (in a tree structures, such as KD-trees, R-trees, or others) to the place asked in the query.

4. **Variety of data:** "Google Earth" offers different kinds of data. Here is a list of the most important:

    a. *Raster data:* Images with surfaces, elevation, and others.

    b. *Spatial data:* Geometries of spatial objects such as shapes, boundaries, directions, positions, distances, coordinates, and so forth.

    c. *Nonspatial data*: Information about the geography such as city names, country names, villages, businesses, and so forth.

    d. *Video:* online satellite camera showing movement (with delay).

Introducing all these features to non-GIS users in a user-friendly layout is a revolution in the field of spatial information science. "Google Earth" made it so easy to explore the Earth in a mouse click.

It will be useful to introduce the following definitions before going on with this section:

- **Spatial databases:** Database that deal with space and this includes geometries of objects, location of objects, and others

- **Temporal databases or historical database:** Databases that deal with the history of changes where old, current, and sometime future (estimates) data are stored in the database. In this case, time is involved in two common ways:

    1. *Time stamp:* One attribute is used to save the time of the validity

    2. *Time interval:* Two attributes are used to indicate the interval of validity (start time and end time).

- **Spatio-temporal databases:** A combination of spatial and temporal databases where changes occur on databases dealing with spatial information. Such databases are categorized in three main categories:

    1. *Discretely changing spatio-temporal databases:* Like the changes of the geometry of land parcels where it could occur once every year or more.

    2. *Continuously changing spatio-temporal databases:* Mostly deal with moving objects like plane or cars where the position of the object is changing continuously with time.

    3. A third category that is a combination of the above two.

The chapter is organized as follows: the next section presents the background of "Google Earth," its functionalities, as well as background of spatial, temporal, and spatio-temporal indexing approaches and their use in spatio-temporal databases. The next section presents the possible future view of "Google Earth" by introducing a design for storing the history of the geographical

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