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RESEARCH ARTICLE

CARTOGRAPHIC DEVELOPMENTS IN GEOMATICS DATA PROCESSING AND PRESENTATION

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ABSTRACT

An insight review of the cartographic hardware and software was made in this paper. Hardware and software cartographic developments in geomatics data processing and presentation were discussed and the most important development issues were highlighted in the two areas. The future cartographic issues to be addressed were investigated. The developments made resulted in a dynamic change in all cartographic capabilities and created what is conceptually known as digital or modern cartography.

Key words: Modern cartography, cartographic software, cartographic hardware, cartography, GIS, remote sensing.

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INTRODUCTION

Cartography evolved through different stages starting from making lines and sketches on the rocks, leaves, and animal skins using fibers of trees and seashells, hand drawings, lettering and line scribing using photo-type setting machines, introduction of new letting fonts and styles with modern models of photo-type setting machines, computer aided cartography adopting simple drafting systems and ending up to what is conceptually known as digital or modern cartography, where the computer influenced every aspect of cartographic operations in both static and dynamic environments (Fig. 1). The dynamic environment provides the platform for the integration of GIS, computer cartography and scientific visualization, facilitates visual analysis of multi-variate geo-referenced data and creation of cartographic dynamic models. Cartographic operations are subject to the increasing flow of information coming from different fields and obtained for different purposes. Digital geomatics data is obtained from a variety of sources including, digital photogrammetry and remote sensing systems (Digital aerial photos, Satellite images, Radar systems, Laser systems), Acoustic systems, and Global Positioning systems. In the past most of the remote sensing systems derived third dimension data was based on ranging techniques. Typical examples of this are the height data derived from radar systems [4], GPS systems [7], acoustic systems [5], laser systems [1], [6]. However, the retrieval of bathymetric data from the multi-source remote sensing imagery using radiometric reflectance data adds an additional source to the cartographic operations flow of information [2], [3].

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Developments of digital cartography: Cartographic operations developments were running in parallel with the developments related to geomatics data capture and collection operations. The most important developments in digital cartography are related to cartographic hardware and cartographic software. The cartographic hardware is represented mainly by the computer (Microprocessor) and its associated peripherals such as the input devices (scanner, digitizer, Disc, Tape etc) and the output devices (Printing/Plotting devices, Storage devices, Display devices).
The cartographic software is represented by all types of application programs adopted for capture, storage, retrieval, processing, visualization, analysis and presentation of data. This includes, Geographical Information Systems (GIS), Remote sensing systems (RS), Computer aided drafting systems (CADS), and Mapping systems (MS).

Cartographic hardware developments: The incorporation of the microprocessor into the display device coupled with the advent of the graphical terminal as standalone system (Work station), facilitated the capture, storage, retrieval, processing and presentation of the geomatics data and its associated attribute data (Fig. 2). This made a dynamic change in the cartographic capabilities related to the compilation, processing and presentation of data. Also, the advent of the operating environments represents an excellent contribution to the cartographic capabilities in general and the multimedia data integration, visualization and analysis in particular.

Cartographic software developments: The most important development in cartographic software is the incorporation of the cartographic capabilities into GIS and remote sensing. A typical example of such GIS systems is ESRI GIS application program ArcGIS, which includes specialized modules for cartographic operations (Arc-edit for data editing, ArcView for layout and presentation and Arcplot for mapping plotting).

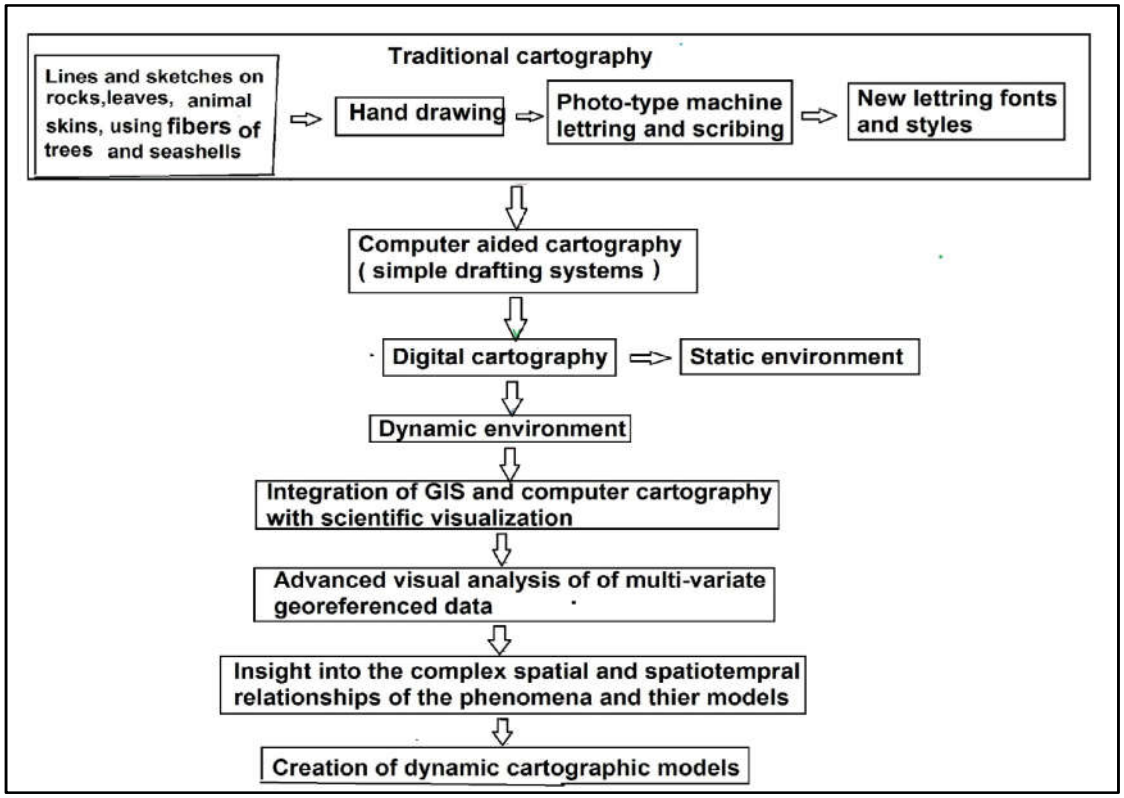

Figure 1. Stages of cartographic evolution

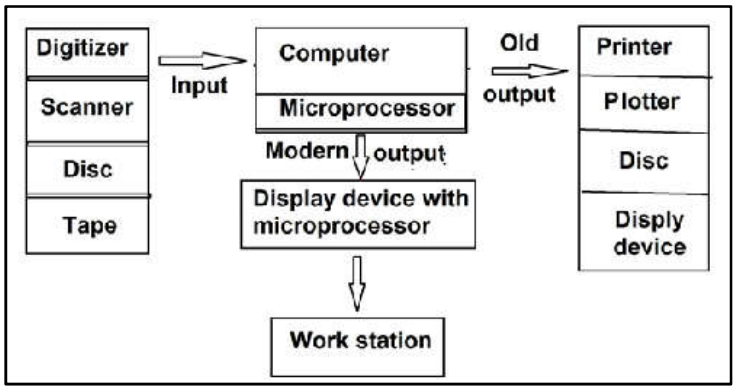

Figure 2. Developments in cartographic hardware

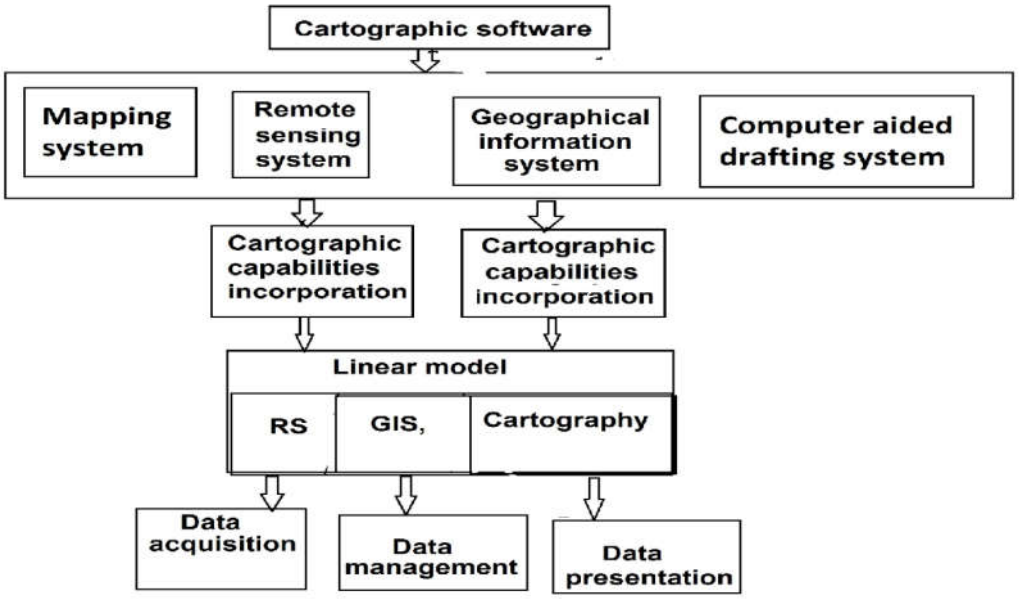

Figure 3. Developments in cartographic software

A typical example of a remote sensing system with incorporated cartographic capabilities is the application program Map composer from ERDAS. Also, most remote sensing systems allow the facility of converting Raster format class files into Vector format polygon files using the Raster to Vector dialogue, together with the facility of digitization, storage, and presentation of the vector output [12]. In fact, with most of the mapping application environments, these three systems i.e. remote sensing, GIS and cartography are integrated in what is conceptually known as a linear model for the acquisition (remote sensing), management (GIS) and presentation (cartography) of data. The fast developments are taking place in the management zone using GIS. With digital geomatics data stored in data layers in a digital data base the modern cartographic tools are capable of very fast production of digital outputs (nautical and coastal zone management charts, topographic maps, thematic maps, profiles, histograms, etc.). All the cartographic elements such as grids, labels, graticules, ticks, standard symbols and abbreviations, projection, scale and tide information can easily be added. Also, it is possible to integrate multi-thematic data such as topographical information, nature of coastline and coastal zone management data.

DISCUSSION

Hence using the digital hydrographic data base and cartographic tools available in GIS it is possible to produce hard and soft copy outputs with the required scale, projection, and data type. The display of each layer is scale dependent. This facility is important and prevents data blowing up which is quite common in GIS users' practice. Also, it is possible to apply all the elements of cartographic generalization, such as simplification, selection, combination, reclassification, and re-symbolization. This can be carried out using three different methods, at the layers level where the user may select the required data layers according to the intended application, selection of features based on the attribute data and editing of features using the cursor. The data symbolization and re-symbolization is easy and straight forward as most of the application programs offer three options. The direct application of the program default symbols, editing of the default symbols and the design of user custom symbols using the software menu commands. Also, the developments made in the data storage and transfer facilities made an excellent contribution to cartographic operations enhancements. Typical examples of these developments are the introduction of the Storage Area Networks (SANs), [8], which apply a networking to storage in data centers, the world-wide domain of internet protocol (IP), [9], server-based Direct Attached Storage (DAS), [10], file-oriented Network Attached Storage (NAS), [11], Needless to say that the changes made in the data storage media made a considerable effect in the cartographic operations enhancement. Data compilation, processing and creation of master data files is carried out by the data layer specialized unit, where each data layer is compiled, processed, updated and maintained by the unit assuming the responsibility for the layer. The same unit will be responsible for the quality control issue of the layer.

Conclusion

The developments made in cartographic hardware and software resulted in a dynamic change in all cartographic capabilities and created what is conceptually known as digital or modern cartography. With modern cartography the generation of geomatics output can easily be carried out using the geomatics data base supported by multi-media data coming from different geomatics data sources. The advent of the operating environments, which provide the parallel use of an unlimited number of files, folders, and application programs, modern cartographic techniques can be easily integrated with GIS and remote sensing.

This facilitates the integration of digital data from different geomatics data sources which provides the necessary integrating tools for the creation of geomatics data base for the fast production of geomatics output. There are many future cartographic issues to be addressed and most of these are related by a way or another to the inter-related issues between cartography, GIS and remote sensing. From the author point of view the most important of these issues is the blowing out of data by GIS users, which usually results in output data that is not supported by the source data. This problem results from the fact that most of GIS users, especially those who are not aware of the basic knowledge of spatial data standard issues and the data accuracy loss associated with the different processing operations. However, some appreciated efforts were made by the software houses and incorporated in the application programs. A typical example of these efforts is making the display of data layer scale dependent and similar facilities related to the data processing and presentation may be incorporated into the application softwares.

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