CHAPTER THREE

GEOGRAPHCAL INFORMATION SYSTEMS

3.1 Overview:

A geographic information system (GIS), in a narrow definition is a computer system for the input, manipulation, storage and output of digital spatial data. In a more board definition it is a digital system for the acquisition, management, analysis and visualization of spatial data for the purposes of planning, administering and monitoring the natural and socioeconomic environment. It represents a digital model of spatial data in it is widest sense.

The U.S Federal Interagency Coordinating Committee (1988) definition stated that a GIS is a system of computer hardware, software and procedures designed to support the computer management, manipulation, analysis, modularity and display of spatially referenced data for solving complex planning and management problems .

Generally GIS is defined as a computer based information system that is used to input, store, retrieve, manipulate, analyze and output spatially referenced data or geospatial data, to support decision making for planning and management of land use, natural resources, environment, transportation, urban facilities and other administrative records. This system has the ability to connect the geographical information to non geographical information and relative them.

3.2 Components of GIS:

Generally GIS composed of hardware and software.

3.2.1 Hardware Components:

The hardware of a GIS composed of:

- Input devices.

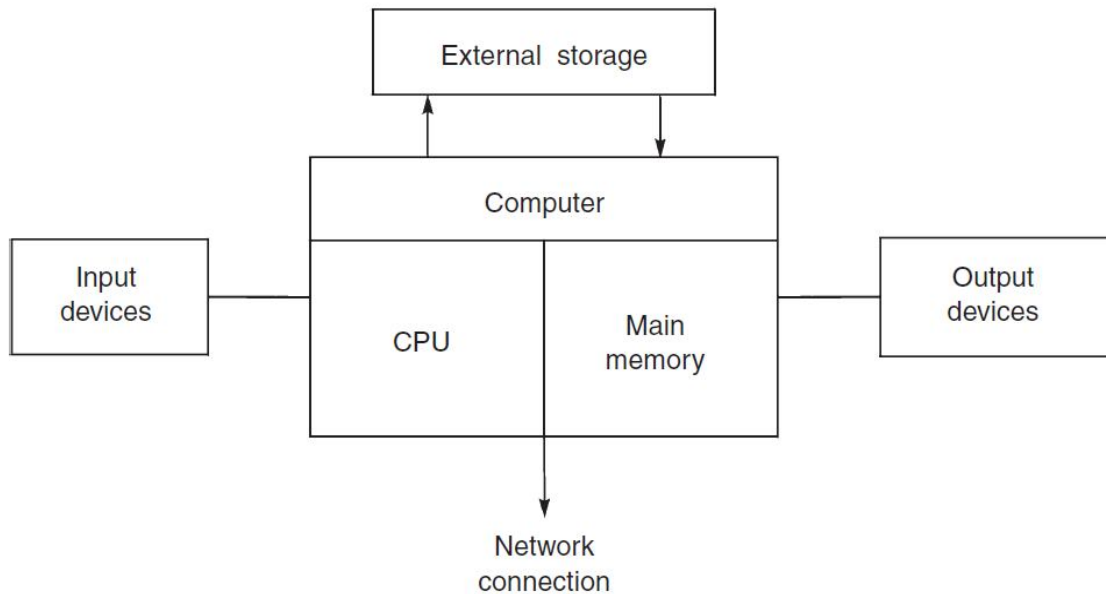- Processing and storage devices.

- Output devices.

Figure (3.1) GIS hardware components

3.2.1.1 Input devices :

Digital data input depends on the type of data to be utilized . Imagery input is possible from analogue images through the use of image Scanners. Digital air borne and space-borne systems already use Charge Coupled Device (CCD) Sensors.

3.2.1.2 Processing & storage devices:

Processing and storage devices consist of central processing unit (CPU) and the main memory the external storage devices and the user interface. Figure (3.1).The CPU executes the program commands. It is arithmetic unit performs algebraic and logical operations for the data. Arithmetic unit regulates the data transfer between arithmetic unit and the main memory .
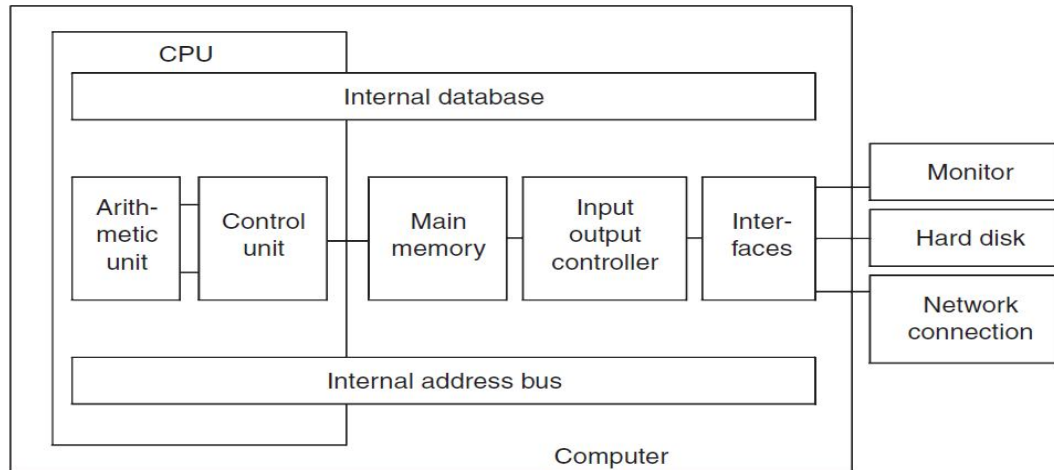
Figure (3.2) CPU and main computer memory

The main memory (random access memory or RAM) contains the machine programs and accepts data in short access time with caching, if required the I/O controller communicates with the periphery for hardware parts and for software drivers. The bus system establishes the figure (3.2) the connections.

To speed up the output process, additional graphic cards and criteria for the CPU performance are :

− The process or speed.
− The international data format.
− The external data format between the CPU and the main memory.
− The physical memory.
− The computing performance.
− And the external storage devices are linked to the computer .
− The user interface consist of a high resolution CRT Screen, with may be adapted for color viewing and optionally for stereo .

3.2.1.3 Output devices:

Output devices include the parts to printers. Specific to GIS are the following graphic output facilities .

Vector devices are flatbed plotters and drum plotters. Flatbed plotters is very accurate than the drum plotter's and it is operated with a pen or a light beam . The drum plotters .are less accurate but faster, they are used for verification plots. Raster devices permit the output of half tone in a pixel screened manner, they are able to permit (red – green - blue) colors in deferent saturations. They can combine vector and raster form. To printer pixel's are combined in half tone cells .

3.2.2 Software components:

Which consist of the following components:

3.2.2.1 Operating system:

The operation of a computer is based on it is operating system. It is assures that all parts of the computer function in liaison. Most common are Microsoft's operating systems for PCs.

3.2.2.2 Programming language:

The programming language of computers is made possibility of programming language which translate user formulations into a machine _ compatible code. For this translation a compiler for the respective programming language is required. Most GIS programs, based upon a chosen operating systems, have been programmed in the programming language Fortran (Formula Translation). More modern languages are C, C++, and Visual Basic.

3.2.2.3 Networking software:

The communication of computers with a local area network (LAN) and a wide area network (WAN) is assured by international standards organization (ISO) standards. The most common standards is (TCP/IP) (Transmission Control Protocol/Internet protocol). (TCP/IP) separates data transmission into

smaller packages transmitted from an identified sender to a receiving computer. The transmission of package is checked during the processes .

3.2.2.4 Graphic standard:

Graphic standards have been introduced so that the complex graphic instructions of the computer can be translated in to monitor compatible instructions. An internationally agreed graphic standard is the Graphic Kernel System (GKS). It defines 20 graphic primitives (position, height, line, type, font, color and fill).

3.3 GIS software's:

Based upon an operating system, augmented by additional programming tools and standards, various venders (ESRI, Intergraph, Simon's and many others) have developed GIS software packages. They have great number of elements in common :

− Translation (translation, Rotation and Scale change in the dimension of the screen).

− Polygon creation (linking a line network to the origin of the line string).

− Adjustment of polygons (observing conditions of right angles & parallel lines).

− Line smoothing (connecting line strings by curves).

− Vector to raster conversion (for display of vector information).

− Raster to vector conversion (line deviation of vectors from pix representing a line).

− Edge cut off (to fit a seamless data set to the screen).

− Edge matching (to fit lines of adjacent titles together).

− Geometry edits (to change point and line information).

− Intersections (between point locations, lines and polygons) in one layer.

- Intersections between layers.

- Buffer zone generation for points, lines and areas.

- Counting of points in areas.

- Measurement of point coordinates distances and areas.

- Interpolation.

- Modeling functions .

- Network analysis .

- Symbol and text generation .

- Generalization .

- Map annotation .

These tasks will be discussed for vector and raster system.

3.4 Field of application:

- Environmental management & conservation.

- Defense & intelligence purpose.

- Governmental administration.

- Resources management in agriculture & forestry.

- Geophysical exploration.

- Telecommunications.

- Utility management.

- Business applications.

- Construction projects.