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To Study The Remote Sensing Technology In Geographical Information System

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ABSTRACT:

Remote sensing is a technique with the help of which information is collected about any object without any physical contact and the phenomenon is analyzed as well. This technique is used in many fields like geography, hydrology, ecology, oceanography, glaciology, geology. In this context, Geographic Information System is a tool that we use to map and analyze specific phenomena on Earth. Remote sensing and GIS techniques enable modern methods of statistical analysis and query to collect major databases and also combine them with maps. GIS technology provides us to different types of data, such as satellite imagery, topographic maps, and demographic data, and to perform spatial analysis to identify patterns and relationships. This information is used to conduct detailed studies of global topics related to the environment and earth sciences, such as land use change, natural resource management, and climate change. In this research paper, we will mainly study in detail about remote sensing techniques and their new modern uses.

Keywords: Remote sensing and Geographic Information System (GIS), Environment and earth sciences, Natural resources climate change

INTRODUCTION:

Nowadays the field of Remote Sensing and GIS has become very attractive and glamorous with rapidly growing opportunities. Remote sensing means sensing and identifying objects that are far away from the reach of our senses. It is an important tool to collect information about the characteristics of an object without coming in direct contact with it. In other words, remote sensing technology is used to obtain information about oceans and coastal, earth's surface such as land cover, forestry agriculture, geographical mapping etc. through sensing, energy emission and processing, analyzing and recording reflected images. It is also called doing science.

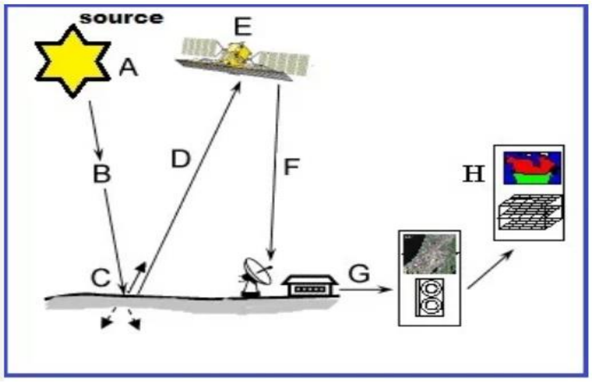
Geographic Information System GIS is a computer system for capturing, storing, examining, and displaying data related to positions on the Earth's surface. It is used to capture, store, analyze and display geographical information. GIS manages information on places and provides tools for analyzing and displaying various data including population, economic development, features and vegetation etc. It also links databases to create dynamic displays.

These capabilities make GIS different from other systems. Remote sensing is a technology known as private and public remote sensing applications for planning and predicting results from satellites.

REMOTE SENSING COMPONENTS:

- Energy Source (A) – the first requirement for remote sensing is to have an energy source which provides electromagnetic energy to the target of interest.
- Radiation and the Atmosphere (B) – As energy travels from its source to its target, it will come into contact with and interact with the environment it passes through. This interaction may occur a second time as the energy travels from the target to the sensor.
- Interaction with the Target (C) - once the energy makes its way to the target through the atmosphere, it interacts with the target depending on the properties of both the target and the radiation.
- Recording of Energy by the Sensor (D) - After energy is scattered or emitted by the target, we need a sensor to collect and record the electromagnetic radiation.
- Transmission, Reception, and Processing (E) - the energy recorded by the sensor has to be transmitted, often in electronic form, to a receiving and processing station where the data are processed into an image (hardcopy and/or digital).
- Interpretation and Analysis (F) - We interpret the images obtained through remote sensing process to get information about the object. The images are interpreted visually, digitally or electronically.
- Application (G) - Our goal is to obtain the final image of an object or subject through the remote sensing process so that we can better understand the received images and gain some new

information, or take advantage of them in solving a particular problem.



List of Remote Sensing Process

1. Energy Source (A)
2. Radiation and the Atmosphere (B)
3. Interaction with the Target (C)
4. Recording of Energy by the Sensor (D)
5. Transmission and Reception (E)
6. Data Processing (F)
7. Interpretation and Analysis (G)
8. Application (H)

Figure : Remote Sensing Comonents

CLASSIFICATION OF REMOTE SENSOR:

Remote sensing systems are divided into two parts based on solutions to different technical problems. Passive remote sensing systems measure and provide information about existing radiation, such as solar radiation reflected from the Earth's surface. Active remote sensing systems are different from passive remote sensing systems in that they emit radiation at the object of study and measure the reflected amount of radiation. Using the light present in a simple camera is a perfect example of a passive remote sensing system that input, and creates an image on the film. If a flash is attached to the camera, it becomes an active remote sensing system. Radar, sonar and echo-sounder are examples of active type remote sensing systems. Recently added lidar is lidar which uses laser technology to emit and then collect what captures images from the earth's surface. Photography, digital photography, scanning mirror (MSS), and push broom scanners are examples of passive types of remote sensing systems.

The physical foundation of remote sensing: - Electromagnetic energy is treated by two principal theories, the theory of waves and the theory of particles. According to the theory of waves, electromagnetic energy travels in sinusoidal waves by the “speed of light”, c. The distance from one wave peak to the next is the wavelength (λ), and the number of peaks passing a point per unit time is the frequency (ν) (Figure 1). The relation between speed, wavelength and frequency is given by the basic physical expression:

$$c = \lambda \cdot \nu \qquad (1)$$

As c is fairly constant (around 3 x 10^8 m/s) the frequency and wavelength are related inversely. In remote sensing applications, the electromagnetic energy is normally classified according to its location in the electromagnetic spectrum, that is, by its wavelength (Figure 2). At the lower end (shorter wavelengths) of the spectrum is X-rays, and at the higher end different communication wavelengths (television and radio). While the wavelength of radio and television broadcasting can be measured in metres, the most common measuring units when speaking of the electromagnetic spectrum in remote sensing applications is the micrometer, μm, which is 10^{-6} m, but the ISO unit is Nanometer, which is 10^{-9} m.

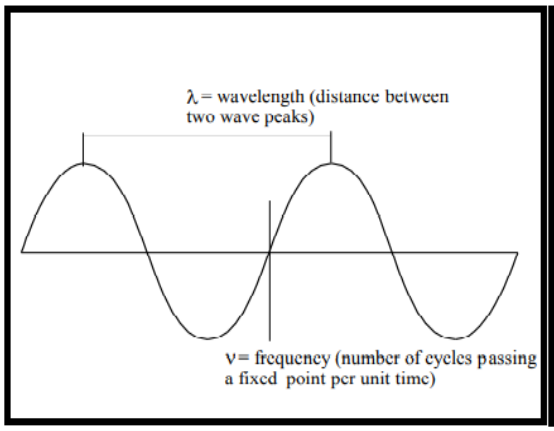


Figure 1: Definition of wavelength and frequency

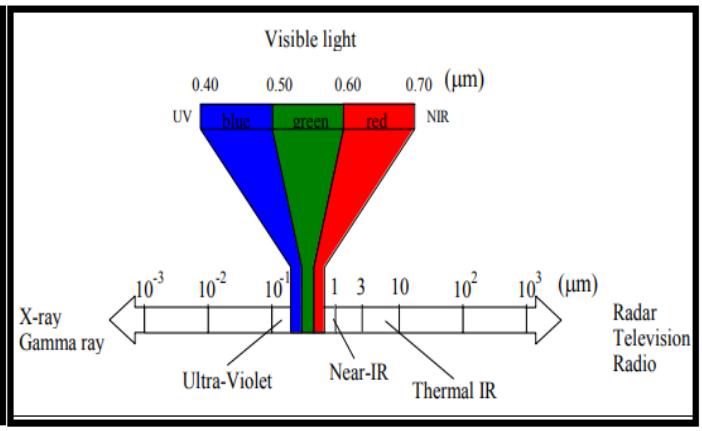


Figure 2: The spectrum of electromagnetic radiation.

ROLE OF GEOGRAPHICAL INFORMATION SYSTEM:

As an option to a more traditional approach for different kinds of planning work and studies Geographical Information Systems (GIS) has become more frequently applied. This is due to the increasing capacity of modern computers and the development of specialised and user friendly software. Over the years since it first appeared, GIS has been associated with several different names, so sometimes you encounter Geographical Information Science (GIS), Geographical Information Technology (GIT), Geospatial Information Studies or Technology (GIS/GIT) and other denominations for what is basically the same thing.

Since the structure of data storing is based on database technology, the amount of attributes that can be connected to each spatial data is virtually unlimited; in the well example above attributes could be information about water quality, the permeability of the aquifer, age of the well, area irrigated from the well, etc. GIS operates on two conceptually different data models, Raster model and Vector model. These two models are based on different concepts with inherent advantages and disadvantages.

AIMS & OBJECTIVES OF THE STUDY:

- Provide detail comprehensive knowledge and experience about remote sensing.
- To provide necessary information to understand the earth and various satellites.
- Collecting detailed information about satellite sensors.
- To acquire knowledge about Side Looking Airborne Radar and Synthetic Aperture Radar.

WORKING DIAGRAM OF GEOGRAPHICAL INFORMATION SYSTEM

GIS is a system that is mostly used to analyze the most difficult data and interpret it in a versatile manner. Meanwhile, data is collected and remote sensing technology is used to describe them in detail. This is analyzed with GIS. This data provides us with necessary and meaningful information. GIS is a computerized database system for capture, storage, retrieval, analysis, and display of spatial data. It is a general-purpose

technology for handling geographic data in digital form, and satisfying the following specific needs, 'among others

- ✓ the ability to preprocess data from large stores into a form suitable for analysis, including operations such as reformatting, change of projection, resampling, and generalisation.
- ✓ direct support for ana1lysis and modeling, so that form of analysis, calibrations of models, forecasting, and prediction are all handled through instructions to the GIS.
- ✓ post processing of results including such operations as reformatting, tabulation, report generation, and mapping.
- ✓ An information system is the chain of operations that takes us from planning the observation and collection of data, to storage and analysis of the data, and to the use of the derived information in some decision-making process. This brings us to an important concept that a map is kind of information system. A map is a collection of stored, analyzed data, and the information derived from this collection is used in making decisions. These, four activities are Measurement, Mapping, Monitoring and Modelling termed as key activities which can be enhanced by the using information systems technologies through GIS.

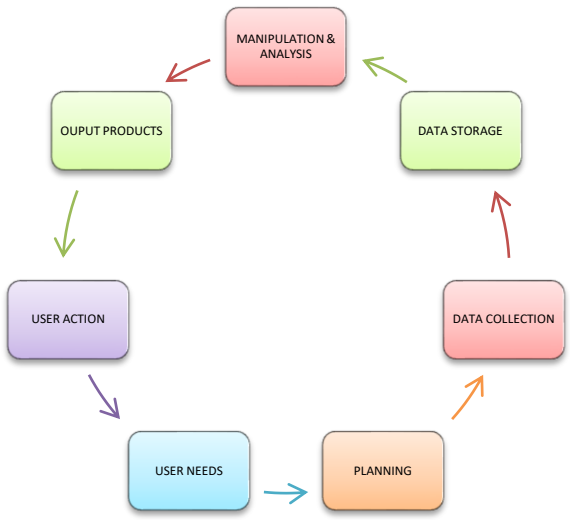


Figure: Simplified information system overview

DATA MODELS:

Conversion of real world geographical variation into discrete objects is done through data models. It represents the linkage between the real world domain of geographic data and computer representation of these features. Data models are of two types: Raster and Vector. There are three different geometric classes of data in both the models, viz. the point representing the position, line giving the length and polygon giving information about the perimeter or area.

Raster model: In raster type of representation of the geographic data, a set of cells located by coordinate is used; each cell is independently addressed with the value of an attribute. Each cell contains a single value and every location corresponds to a cell. Vector model: Vector data model uses line segments or points represented by their explicit 'x', 'y' coordinates to identify locations. Discrete objects are formed by connecting line segments which area is defined by set of line segments.

APPLICATIONS:

Each sensor in remote sensing system is designed for a specific purpose. With optical sensors, the design focuses on the spectral bands to be used. With radar imaging, the incidence angle and microwave band used plays an important role in defining which applications the sensor is best suited for. Each application itself has specific demands, for spectral resolution, spatial resolution, radiometric resolution and temporal resolution. Some of the important projects carried out in the country include groundwater prospects mapping under drinking water mission, Forecasting Agricultural Output Using Space, Agrometeorology And Land Based Observations (FASAL), forest cover/type mapping, grassland mapping, biodiversity characterization, snow & glacier studies, land use/cover mapping, coastal studies, coral and mangroves studies, wasteland mapping etc. There can be many applications for remote sensing, in different fields, as described by this. Crime mapping, Hydrology, Road networking, Wastewater and storm water systems, waste management, Change detection, Ortho rectification, Spectral analysis, Image classification, Wetland management, wasteland mapping, Land degradation etc.

CONCLUSION:

Due to increasing pressure on natural resources today growing human population, Remote Sensing and GIS can be used to manage these precious limited resources. Geospatial information are quite useful in the identification and analysis of factors that affect the utilization of these resources. In India remote sensing has been used for various applications during the last four decades and has contributed significantly towards development. GIS software encompasses digital maps and geo referenced data. GIS and Remote Sensing software is designed to store, retrieve, manage, display and analysis all types of geographic and spatial data obtained from satellite and air-borne sensor data. These software's can be categorized into open source and commercial software's. They have varied applications pertaining to environment, and are very helpful in various domains of environmental management.

Future plans of Remote Sensing and GIS:

The new technology, i.e., drones and automated robotics techniques will complement traditional airplanes and satellite platforms and deliver more insights than ever before possible. Drones and robots are the latest and most advanced remote sensing platforms catching the eye of the geospatial community. They offer

novel opportunities to monitor remote areas, and their form factors and cost enable a higher frequency of data collection compared to the aerial survey. Remote sensing technology is used in many fields, such as energy, oil and gas, aviation, forestry, transportation, emergency management, and natural resource preservation and restoration.

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