STUDY ON REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM

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ABSTRACT: One of the most basic types of information used in field work is space information about a specific target area. There are various types of information which that fall within space information; such as information concerning topography, land use, social infrastructure, climate, and manufacturing infrastructure. All of this information must be appropriately gathered, in accordance with the objectives of a study or research. Remote sensing and geographic information systems (GIS) are among the many useful means for gathering and analyzing such information

KEYWORDS: Geographic information systems, remote sensing

1. INTRODUCTION

"Remote sensing" is a technical term which was coined during the space age of the 1960s, combining the words "remote" and "sensing" to describe what it is and does. The term refers to techniques which are used to analyze objects which are far away; for example, analyzing what these objects are or what states they are in. In order to obtain an understanding of the characteristics and status of a target object, the most-commonly used methods involve the reflection and radiation of electromagnetic waves. Target objects or phenomena can be deciphered and analyzed based upon the unique electromagnetic wave characteristics of objects, which can be summarized by the following statement.[1]"All objects, if their types and environmental conditions differ, have different characteristics in terms of the reflection or emission of electromagnetic waves." There are also other methods, such as those using magnetic or gravitational force instead of electromagnetic waves.

Remote sensing, which covers wide-scale terrestrial, atmospheric and oceanographic data collection as well as the monitoring of global-scale environmental shifts, has applications for a wide variety of fields. In terrestrial science, remote sensing is used as a means of acquiring and analyzing data about the environment and natural resources; such as data on land use, land cover, changes in vegetation and projections of crop growth and grain harvests. In oceanography, it is used to measure sea level, water pollution, the distribution of plant plankton, sea temperature and so on. In atmospheric science, it is used to examine the composition of minor atmospheric constituents, such as carbon dioxide and ozone, and to analyze cloud formations and other weather phenomena.[2]

Devices that measure electromagnetic waves reflected off of or emitted from objects are called remote sensors, with two of the familiar examples being digital cameras and scanners. Electromagnetic

waves have four elements - frequency (wavelength), direction of propagation, vibration amplitude and plane of polarization.

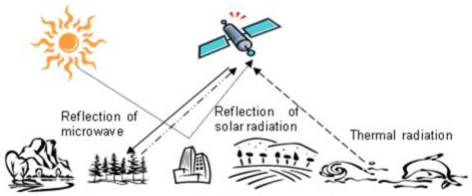


Figure1-1 Conceptual outline of remote sensing

Remote sensors are set up in such a way as to measure some or all of these elements according to the purpose of investigation.[3] The efficiency (resolution) of a sensor used in remote sensing is expressed in terms of how large (wide) of a target area is covered by a single pixel. A resolution of 30 m means that a single pixel covers an area of 30 square-meters. Usually, high resolution refers to a few meters or less, medium resolution refers to several dozen meters and low resolution refers to several hundred meters or more.[4]

II. LITERATURE REVIEW

According to White, Remote Sensing includes all methods of obtaining pictures or other forms of electromagnetic records of Earth's surface from a distance, and the treatment and processing of the picture data.

Remote Sensing then in the widest sense is concerned with detecting and recording electromagnetic radiation from the target areas in the field of view of the sensor instrument. This radiation may have originated directly from separate components of the target area, it may be solar energy reflected from them; or it may be reflections of energy transmitted to the target area from the sensor itself.[5]

According to the United Nations (95th Plenary meeting, 3rd December, 1986 have Remote Sensing means sensing of earth's surface from space by making use of the properties of electromagnetic wave emitted, reflected or diffracted by the sensed objects, for the purpose of improving natural resource management, land use and the protection of the environment.

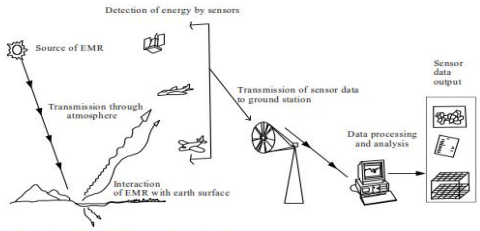


Fig.1: Stages of Remote Sensing

According to James B.Campell (1996), Remote Sensing is the practice of deriving information about the earth's land and water surfaces using images acquired from an overhead perspective, using electromagnetic radiation in one or more regions of the electromagnetic spectrum, reflected or emitted from the earth's surface.

III. REMOTE SENSING

Remote sensing is the acquisition of information about an object or phenomenon without making physical contact with the object and thus in contrast to on-site observation, especially the Earth. Remote sensing is used in numerous fields, including geography, land surveying and most Earth Science disciplines (for example, hydrology, ecology, meteorology, oceanography, glaciology, geology); it also has military, intelligence, commercial, economic, planning, and humanitarian applications.

In current usage, the term "remote sensing" generally refers to the use of satellite- or aircraft-based sensor technologies to detect and classify objects on Earth, including on the surface and in the atmosphere and oceans, based on propagated signals (e.g. electromagnetic radiation). It may be split into "active" remote sensing (such as when a signal is emitted by a satellite or aircraft and its reflection by the object is detected by the sensor) and "passive" remote sensing (such as when the reflection of sunlight is detected by the sensor).

Passive sensors gather radiation that is emitted or reflected by the object or surrounding areas. Reflected sunlight is the most common source of radiation measured by passive sensors. Examples of passive remote sensors include film photography, infrared, charge-coupled devices, and radiometers. Active collection, on the other hand, emits energy in order to scan objects and areas whereupon a sensor then detects and measures the radiation that is reflected or backscattered from the target. RADAR and LiDAR are examples of active remote sensing where the time delay between emission and return is measured, establishing the location, speed and direction of an object.

IV. ILLUSTRATION OF REMOTE SENSING

Remote sensing makes it possible to collect data of dangerous or inaccessible areas. Remote sensing applications include monitoring deforestation in areas such as the Amazon Basin, glacial features in Arctic and Antarctic regions, and depth sounding of coastal and ocean depths. Military collection during the Cold War made use of stand-off collection of data about dangerous border areas. Remote sensing also replaces costly and slow data collection on the ground, ensuring in the process that areas or objects are not disturbed.

Orbital platforms collect and transmit data from different parts of the electromagnetic spectrum, which in conjunction with larger scale aerial or ground-based sensing and analysis, provides researchers with enough information to monitor trends such as El Niño and other natural long and short term phenomena. Other uses include different areas of the earth sciences such as natural resource management, agricultural fields such as land usage and conservation,[6][7] and national security and overhead, ground-based and stand-off collection on border areas.

Technical Components of Remote Sensing

The base, on which remote sensors are placed to acquire information about the Earth's surface, is called platform. Platforms can be stationary like a tripod (for field observation) and stationary balloons or mobile like aircrafts and spacecrafts. The types of platforms depend upon the needs as well as constraints of the observation mission. There are three main types of platforms, namely 1) Ground borne, 2) Air borne and 3) Space borne.

1. Ground borne platforms: These platforms are used on the surface of the Earth. Cherry arm configuration of Remote Sensing van and tripod are the two commonly used ground borne platforms. They have the capability of viewing the object from different angles and are mainly

used for collecting the ground truth or for laboratory simulation studies.

2. Air borne Platforms: These platforms are placed within the atmosphere of the Earth and can be further classified into balloons and aircrafts.

3. Space borne platforms: Platforms in space, i.e. satellites are not affected by the earth's atmosphere. These platforms move freely in their orbits around the earth. The entire earth or any part of the earth can be covered at specified intervals. The coverage mainly depends on the orbit of the satellite. It is through these space borne platforms, we get enormous amount of remote sensing data and as a result Remote Sensing has gained international popularity. According to the orbital mode, there are two types of satellites – Geostationary or Earth synchronous and sun-synchronous.

Geo-stationary Satellites: Geostationary satellites are the satellites which revolve round the earth above the equator at the height of about 36,000 to 41,000 km., in the direction of earth's rotation. They make one revolution in 24 hours, synchronous with the earth's rotation

Sun-synchronous Satellites: Sun-synchronous satellites are the satellites which revolved round the earth in north-south direction (pole to pole) at the height of about 300 to 1000 km.

V. REMOTE SENSORS

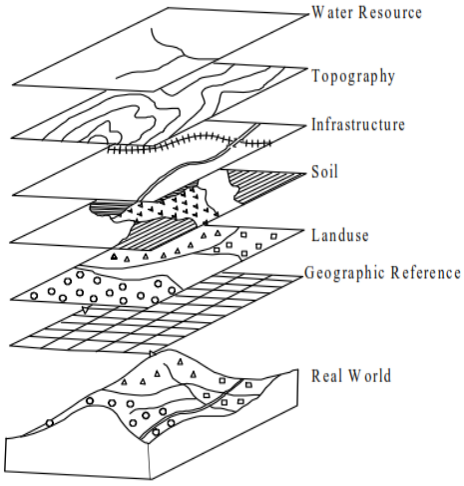
Remote sensors are the instruments which detect various objects on the earth's surface by measuring electromagnetic energy reflected or emitted from them. The sensors are mounted on the platforms discussed above. Different sensors record different wavelengths bands of electromagnetic energy coming from the earth's surface. As for example, an ordinary camera is the most familiar type of remote sensor which uses visible portion of electromagnetic radiation.

VI. GEOGRAPHICAL INFORMATION SYSTEM

The expansion of GIS is Geographic Information System which consists of three words, viz. Geographic, Information and System. Here the word 'Geographic' deals with spatial objects or features which can be referenced or related to a specific location on the earth surface.[9]

The object may be physical / natural or may be cultural / man made. Likewise the word 'Information' deals with the large volume of data about a particular object on the earth surface. The data includes a set of qualitative and quantitative aspects which the real world objects acquire.

The term 'System' is used to represent systems approach where the complex environment (consists of a large number, of objects / features on the earth surface and their complex characteristics) is broken down into their component parts for easy understanding and handling, but is considered to form an integrated whole for managing and decision making.



Now-a-days this is possible in a very short span of time with the development of sophisticated computer hardware and software.

Therefore, GIS is a computer based information system which attaches a variety of qualities and characteristics to geographical location and helps in planning and decision making. A Geographic Information System (GIS) may be defined in different manners.

Indian Society of Geomatics (ISG) and Indian Space Application Centre (ISRO) defined GIS as a system which provides a computerised mechanism for integrating various geoinformation data sets and analysing them in order to generate information relevant to planning needs in a context.

According to Centre for Spatial Database Management and Solutions (CSDMS), GIS is a computer based tool for mapping and analysing things that exist and events that happen one earth.

Key points of GIS:

1. **It is a computer system consisting of hardware and software:** A GIS system is a computer system that consists of software used to analyze the collected data and hardware that the software would operate in.

2. **It can cope with larger amounts of data:** A GIS system is designed to accept and analyze large amounts of data at any given time due to the large capacity of the software and an elaborate personnel system used to analyze the data.

3. **It can cover large study areas:** A GIS system is designed to cover an elaborate area of study due to its increased capacity to analyze vast and complex information simultaneously.

4. **It can cope with unlimited and frequent data edits:** A GIS system is a robust system that can be used to analyze huge amounts of data and can also allow for unlimited data edits and change without the risk of collapse.

5. **More robust and resistant to damage:** A GIS system is designed to be more robust in terms of functionality and less likely to be damaged due to its compact design.

6. **Faster and more efficient:** A GIS system is more efficient in terms of data processing due to the elaborate components in the system used to analyze the data.

7. **It requires less person, time and money:** A GIS system is self-sufficient and can be used to analyze large datasets with much less time, money and resources. A single person can analyze huge amounts of data to produce more complex information.

8. **Mostly used for data analysis:** A GIS system is mostly used to analyze

complex data and interpret the huge datasets into more meaningful information that can guide decision making.

9. Has a more simplified user interface: A GIS system is used by end users who can see a more simplified user interface that allows anyone to learn how to interpret the tons of data in the system.

10. Is an ideal tool for communication between different departments: A GIS system is easy to use which makes it ideal to be used as a tool of choice to communicate between different departments because the interface is easily understood?

VII. CONCLUSION

Remote sensing and GIS are integral to each other. The development of Remote Sensing is of no use without the development of GIS and vice versa. Remote Sensing has the capability of providing large amount of data of the whole earth and also very frequently. GIS has the capabilities of analyzing a large amount of data within no time. These voluminous data would have become useless without the development of GIS. Manual handling of one time remote sensing data would take years together, by the time a number of multi date data would have piled for analysis. Likewise capability of GIS would have no use without the development of Remote Sensing technology, which provides voluminous data.

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