Remote Sensing : A Tool for Natural Resource Evaluation

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INTRODUCTION

The term "Remote Sensing" was originated in 1960 at the Willow Run Laboratories of the University of Michigan, U.S A.; now the Environmental Research Institute of Michigan. It is a fascinating subject of the modern times and is now known to scientists and technologists all over the world. Common men are, however, quite ignorant of what is remote sensing, although they are utilising natural remote sensing in their day to day life in one form or the other.[1]

Remote sensing is the science of gathering information describing distant objects or scences-targets that could not be studied without instruments, Instruments utilised in Remote Sensing Study permit the study of not only very distant objects, which are for some reason inaccessible or in hazardous locations. Thus remote sensing is useful if we wlsh to study the geology of Central Asia, which is politically and logistically difficult to study on the ground, or the depth of the ocean, which is in a hazardous environment.[2]

ACQUISITION OF DATA

Remotely sensed data are often acquired or displayed as images. The photograph is a familiar example. Because aerial photographs and other remotely sensed images are so important in natural resources, the term "remote sensing" is often used to mean "remote imaging"[3] The acquisition of data on earth's resources by remote sensing represents either a logical extention of existing capabilities for solutions of problems in a quicker time scale, or a completely new approach capable many useful variations and innovative approaches. Modern remote sensing devices include passive and active systems and employ different bands in the electromagnetic spectrum; in the near infrared, as well as in the centimetre radiowaves. The atmosphere is almost completely transparent to all these radiation-bands when cloud-free. The reflectivity and emissivity of the terrestrial objects in the lithosphere, hydrosphere or biosphere in the various bands of the electromagnetic spectrum are quantitatively registered by the sensitive devices. Recording in about ten bands - visible and invisible - over a ten stage intensity scale, can ptovide ideally ten billion combinations, or finger prints of terrestrial (land, sea and air) features.[4] Repetitive coverage of data is very useful in natural resources development.

HISTORY OF DATA ACQUISITION

The collection of remotely sensed data came into being with the invention or camera and later of aeroplane. Photographs taken from an aerial platform such as aeroplane are known as areal photographs. During the early stages remote sensing technology, the data were gathered in the form of photographic imagery. Various techniques were evolved in reducing useful information from simple black and white as well as multi-band photo imagery. However, modern remote sensor system or aircraft and spacecraft collect vast quantities of data. These are increasingly collected in the form of electrical signals mostly as trains of digital pulses. Their transmission, reception and recording are the areas of electrical engineering. But the translation of these signals into intelligible images for visual interpretation, or processing them in electronic computer for automatically deducing various

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kinds of useful information is a fairly new discipline - image processing/automatic data processing. It is in a rapidly advancing state of development to which contributions can still be made by innovative minds in India[5] as well as world.

The collection of information of earth's surface from space started in 1960 with the orbiting of U.S. Meteorological Satellite TIROS (Television Infra Red Observation Satellite), which is the first unmanned earth observatory. Photographs taken by the astronauts of Gemini and Apollo showed the potential of such photographs for earth's resource survey.

INDIAN CONTRIBUTION

Remote sensing was practised in India as early as in 1920, when black & white aerial photographs were extensively used for survey and geological exploration work. Later in the year 1926, aerial photography was used for flood assessment of Indus river, which was possibly the first application in a project other than land survey. Remote sensing as practised in the present day with the use of sophisticated sensors was first attempted in the field of agriculture by the Indian Space Research Organisation (ISRO) in 1970, which was aimed at detection of root wilt disease in coconut plantation in Kerala State. In this investigation, false colour infra red images of coconut plantation were obtained abroad a helicopter. Interpretation of these images proved that the remote sensing techniques can be utilised in early detection of disease - affected trees. Removal of such trees may thus help in controlling the spread of the disease and in the protection of the entire plantation.

Launching of the satellite enabled man to gather and study information of the surface of the earth from orbital heights. Sensors mounted on satellites look down to the earth and collect information from the surface of the earth. Satellite due to its vantage point in space can collect information of very large areas of the ground (Synoptic view) in a repetitive manner and thus provide monitoring capability. But, due to its orbital altitute, data thus obtained by the sensors, have relatively lower resolution as compared to some sensors being mounted on an aircraft. However, recent advances in technology enables collection of data with reasonable good solution.

Remote sensing satellites have been designed according to their application for use in either the study of the earth's resources or for mateorology. The earth resources satellites usually carry sensors with medium spatial resolutions of better than 0.25 km and slow repeat cycle of about two weeks, whereas the satellites designed for meteorological application carry sensors with a low spatial resolution of 0.75 km or less and a fast repeat cycle of better than a day.[6]

India's effort in launching sattelite beginning from 1975 is furnished in Table 1.

Table 1 : Indian Satellite launched so far.

Date	Satellite	Function	Launcher	Results
March 19, 1975	Aryabhatta	Scientific	USSR	Success
Juue 7, 1979	Bhasker-I	Earth Observation	USSR	Success
Aug. 10, 1979	Rohini	–do-	SLV-3	Failure
July 18, 1980	Rohini	-do-	SLV-3	Success
June 19, 1981	Apple	Communication	Arlanc	Success
Nov. 20, 1981	Bhaskara-II	Earth Observation	USSR	Success
May 31, 1981	Rohini	Scientific	SLV-3	Failure
April 17, 1983	Rohini	Scientific	SLV–3	Success
March 24, 1987	Sross-I	Technology & application	ASLV	Failure
March 19, 1988	IRS-IA	Remote Sensing	USSR	Success
March 13, 1988	Sross-II	Technology & application	ASLV	Failure
Aug. 29, 1991	IRS-IB	Remote Sensing	USSR	Success

BASIC AREAS IN WHICH REMOTE SENSING TECHNIQUES NORMALLY USED

The following are the important areas of study in which remote sensing techniques are normally used in India and abroad.[7]

(a) AGRICULTURE & FORESTRY: To study plant diseases and insect infestation, natural vegetation. Crop and fresh inventories; soil moisture content, study of arable and non arable lands. Assessment of plant growth and vigor for forecasting crop yield, Soil type and characteristics.

(b) HYDROLOGY: To study glaciers, snow cover, ice accumulation and their changes, Flood control and Water management, Surface water inventories, Seepage of underground water along river streams and sea coasts, Location of water wasting weeds, Status of sedimentation in reservoirs, Mapping land use changes.

(c) GEOLOGY: Out-crops and mineral mapping: Fault lines and plate tectonics. Detection of structural features associated with hidden mineral deposits including petroleum, Soil and rock types and conditions favourably for hidden mineral deposits, Detection of iodine gas associated with oil source rocks, Geothermal mapping, Detection of vegetation affected by mineral content of soil.

(d) CARTOGRAPHY & GEOGRAPHY: Topographic mapping; Study of urban areas and areas of development; Mapping of rivers, lakes etc., Delineation of wet lands (marshes etc.).

(e) ENVIRONMENTAL CONTROL: Monitoring of atmospheric pollution; Monitoring of sea water pollution; Study of aquatic eco-systems; Study of terrestrial eco-systems.

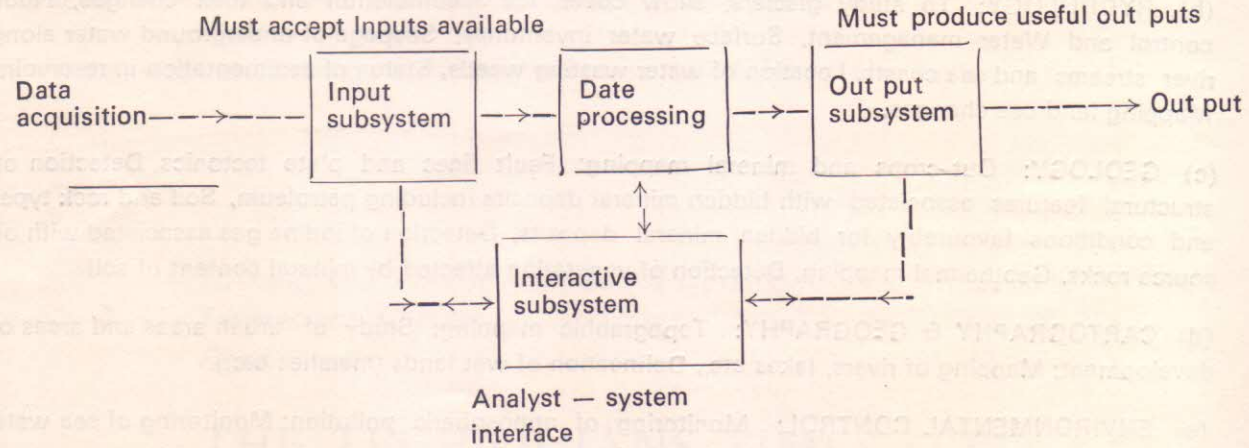
(f) OCEANOGRAPHY: Wave-heights and thence winds, Surface temperatures and thence, Location of schools of Fish, Estimation of Ocean currents; Estimation of evaporation, Forecasts of cyclone developement, Water colour tones and thence, Coastal underwater topography, Water pollution, Estimation of biomass Wave refrection and thence bottom topography, Oil slicks of petroleum origin or fish origin, Chlorophyll concentration (algae, plankton).

DATA PROCESSING

Processing of the data received through remote sensors for obtaining information operationally is useful in the various disciplines like agriculture, forestry, hydrology, oceanography etc., is a colossal task. It is one thing to say that they can be processed, but quite a different thing to have them processed expeditiously to be useful for operational i.e. decision making processes. When the information is not available in time for making decisions or even short term planning, the value of the information to the government or funding agency who pay for collection of data by remote sensing systems, comes down considerably.[8]

The organisation of an information system with respect to data flow is illustrated in Fig. 1. Data flow into the input sub system and are directed to the data processing subsystem. After the data have been processed, they are directed to output subsystem and eventually appear in the form of output data or information. All of these various subsystems are controlled by an interactive subsystem which provides an interface with the data analyst.

In a satellite system, the data from the satellite generally come from the telemetry link in digital form the electrical signals from the detectors are digitized on board the satellite. In some cases, other sensors such as multispectral scanners mounted in aircraft acquire data coincidentally with the data recorded by the satellite. in these cases, the multipsectral signals may be recorded in analog form. Surface observations are often made simultaneously with these aircraft and satellite overpasses, and these data may be recorded in tabular fashion on reporting forms. Thus it is possible for the data collected during any given data acquisition mission to be in different and diverse forms, including anaiog and digital signals recorded on magnetic tape, photographic products, surface observations recorded in tabular form data form special field sensors recorded on strip charts, and still other forms of data from various sources (e.g. meteorological data from Indian Meteorological Department). All of these data are related to each other and are often merged in to a meaningful and cohesive data set for subsequent analysis.



[Fig. 1] Data flow in a remote sensing information system

The way in which these data are handled depends to a larger extent on the characteristics of the data-processing system that will be used to handle the data after they are placed in the appropriate formats. If the data processing system is equipped with several geographically dispersed terminals, then it may be beneficial to catalogue the data in a data library accessible by many users [9]

CONCLUSIONS

Remotely sensed data provide a quick repetitive, uptodate and comprehensive information about the natural resources. A multi-disciplinary approach to this common data (imagery) brings out the interrelationship of the resources, avoids unnecessary duplication and brings out an integrated strategy to develop natural resources of an area.

The availability of a good x-ray picture of the chest of a patient is not sufficient. Its interpretation as to whether there is a tubercular patch or a cancerous patch or an enlarged heart, requires medical specialist. A novice in medicine can at best recognise a broken rib in picture. The interpretation of the hard copy image of a terrestrial or oceanographic scene requires several expeters, expeters in different discipline- agriculture' forestry, geology, hydrology, oceanography etc. So, it may be concluded that remote sensing applications to various disciplines have made our natural resource development proces more integrated accurate and dependable, which will definitely make the pace of progress and prosperity faster for the benefit of all.

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