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The Revolutionary Role of Remote Sensing in Civil Engineering

Er. Tajamul Zargar[1], Faizan Manzoor Wani[2], Mateen Sheikh[3], Mudasir Sadiq Khan[4], Seerab Bashir[5]
[1]*Assistant Professor, Civil Engineering Department, SSM College Of Engineering ,Kashmir,India*
[2, 3, 4, 5]*B.E. student, Civil Engineering Department, SSM College Of Engineerin, Kashmir, India*

Abstract: Civil engineering is considered as the second oldest engineering discipline of the world. It deals with the design, maintenance and constructions of different structural and building elements like roads, bridges, dams etc. It comprises of many sub divisions like surveying, water resources, environment etc. Remote sensing plays a key role in acquiring and providing topographical data and 3D images. It also helps in examining existing structures and layouts. Thus remote sensing is indispensable in the field of civil engineering. This paper tries to give a brief overview of what remote sensing is and how it plays a vital role in making civil engineering more convenient, simple and efficient.

I. INTRODUCTION

Remote sensing is a geospatial technique used for obtaining information about the physical characteristics of earth's surface without coming in contact with it. Remote sensing uses portions of electromagnetic radiations which are reflected or emitted from the surface of earth and captured by the onboard sensors of the satellites/aircrafts etc. In remote sensing, segments of electromagnetic radiation which holds the utility for practical operation covers visible light and extends through the near and shortwave infrared, to thermal infrared and microwave bands. Remote sensing technology is classified in to two categories: active remote sensing and passive remote sensing. Passive remote sensors detect radiations that are emitted or reflected from the objects, thus they can only be used when the naturally occurring energy is available. On the other hand, active sensors emit their own radiation which interacts with target to be investigated. It is then reflected back to the sensor to be detected and measured. With the development in spatial, spectral and temporal resolution, the location and demarcation of different objects and boundaries has become easier. In addition to that, it enables us to get 3D images that help in the proper measurement of heights. In Kashmir valley where the topography is rugged, surveying becomes quite difficult as it demands a lot of time, manpower and capital. Under such circumstances, remote sensing proves to be a helpful tool by providing us with all essential parameters without having to be on the field. It also helps in strategic future development by providing information about the land use and the geological and environmental interactions.

A. Applications Of Remote Sensing

1) *Extracting Building in urban Development:* Compact city planning requires diverse demand and supply data such as number of buildings ,persons living in a locality , quality of living condition, traffic pattern, electricity and water usage, road conditions , etc. Automatic detection of buildings in very high spatial resolution remotely sensed imagery has been an important and critical problem because the detection/extraction results can be used in various applications viz: Structure change detection, urbanization, monitoring and digital map production. Very high resolution satellite images provide valuable information to researchers. The sensors which provide VHR satellite images are Quickbird, GeoEye-1 , GeoEye-2, world view-2 ,etc.

The developed approaches include two main stages:

a) Detecting the building patches.
b) Delineating the building boundaries.

The building patches were detected from high resolution satellite imagery using the Support Vector Machines (SVM) classification, which is utilized for both the building extraction and updating approaches. In the building extraction part, the detected patches are lineated using the Hough Transform and boundary tracing based technique. Edges are detected by Canny Edge Detection Algorithm. The edges are then converted into vector form using Hough Transform which is widely used technique for extracting the lines or curves of the objects. The vector lines and curves represent the building edges and are grouped based on perceptual groupings, and the building boundaries are constructed. The proposed approach is implemented using a program written in MATLAB.

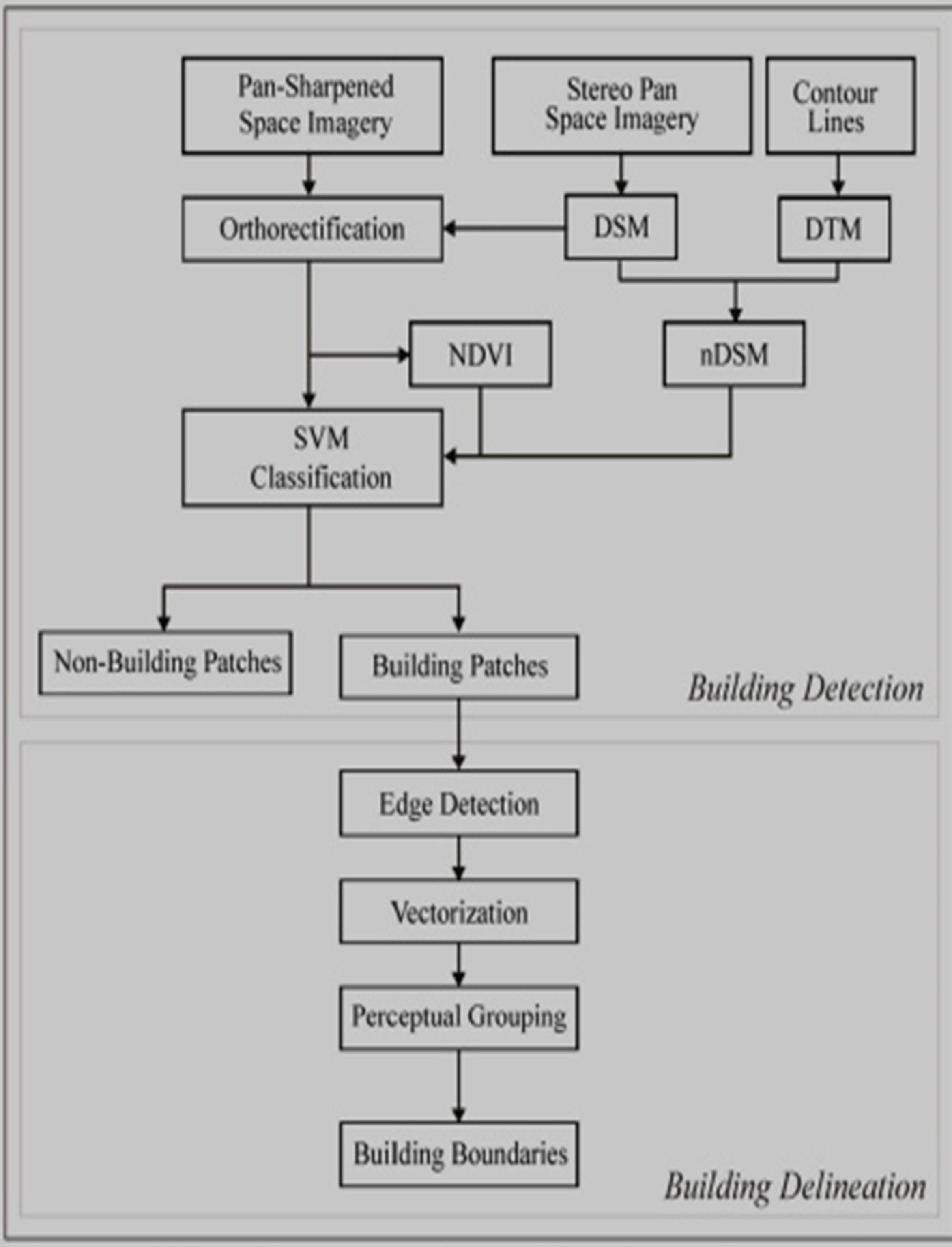

Figure 2. The flowchart of the building extraction procedure.

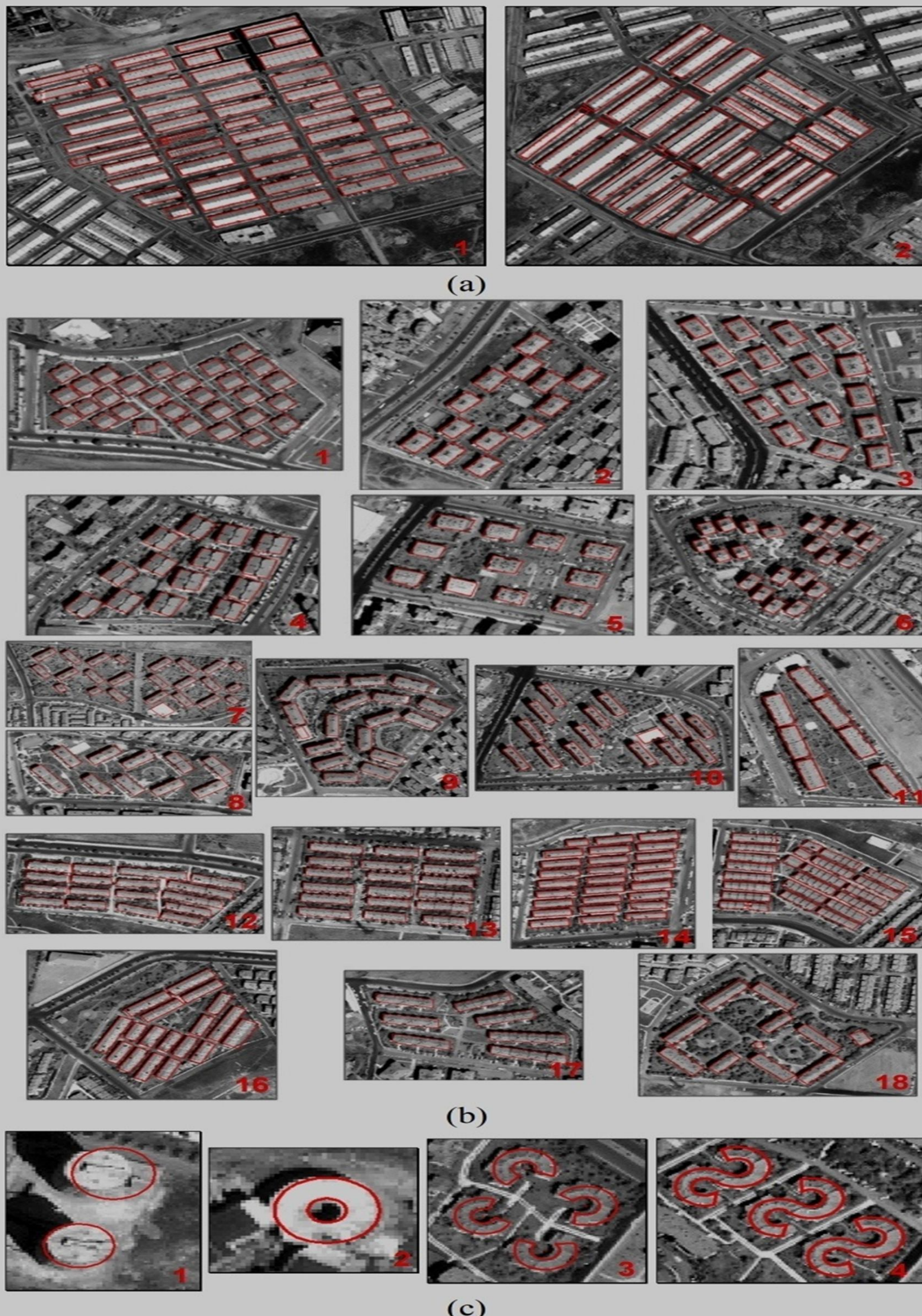

Figure 4. The delineated building boundaries for urban blocks that contain (a) industrial rectangular buildings, (b) residential rectangular buildings, and (c) residential circular buildings

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II. STUDY OF NATURAL HAZARDS

Remote sensing can be used to study damages caused by earthquakes, volcanoes, landslides, floods and melting of ice in polar regions. Many time remote sensing will be helpful to predict the occurrence of natural hazards.

A. Erosion

Soil erosion is a very serious environmental problem for many areas around the world. Study of soil erosion is important and very complex because the level of erosion risk is affected by multiple variables including cropping systems, climate and topography. Remote sensing has been widely used in the study of erosion. The use of Remote sensing methods has the potential to identify eroded areas and monitor erosion processes at regional levels.

Monitoring of erosion processes should consist of the following steps:

1) Analysis of the factors of erosion processes in the studied areas.
2) Selection of remote sensing materials in the studied areas, their analysis, processing and detection of erosion processes.
3) Studying the dynamics of erosion processes by series of different satellite images of the territory studied and comparing them with old topographic maps.
4) Creation of thematic catagraphic materials.
5) Prediction of development of erosion processes.
6) Creation of scheme of application of anti-erosion measures.

From the satellite we can get the information about the set of erosion factors , the topography, soils, vegetation, land use. Terrain characteristics can be obtained from digital elevation models created by satellite image processing such as ALOS, SRTM, ASTER GDEM.

B. Volcanoes

A volcano is a rupture in the crust of a planetary-mass object such as earth , that allows hot lava, volcanic ash and gasses to escape from a magma chamber below the surface. On earth, volcanoes are most often found where tectonic plates are diverging or converging , and most are found underwater.

Remote sensing is widely used to detect the impact of volcanic eruptions on the surrounding areas and atmosphere. Remote sensing methods are suitable to observe the surface processes of volcanic eruptions. These include also processes that precede a volcanic eruption:

Thermal remote sensing of takes or fumarale fields, Topographic changes like bulging and collapse of the volcanic edifice could be observed in optical and radar data, including interferometric data , gas emission are monitored from ground stations in order to detect changes in the gas composition , which could indicate a change in the behavior of volcano . New instruments on LANDSAT-7 and on the EO-1 polar platform to be launched at the end of the century by NASA and NASDA will provide thermal multi-spectral sensors with a footprint of 60m×60m on the ground. They will be much more capable of thermal mapping then the current thermal sensors on NOAA and other weather satellite.

C. Earthquakes

Earthquakes are one of the most serious types of natural disaster in the world. In earthquake prediction, remote sensing technologies have been applied widely to monitor crustal deformation and surface temperature rise, as well as hydrologic , electromagnetic and gravitational fields prior to earthquake occurrence . LANDSAT-TM satellite acts as a key for getting required observation.

III. LIDAR & ITS CIVIL ENGINEERING APPLICATIONS

LiDAR stands for light detection and ranging also known as laser scannimg or 3D scannimg. It is a remote sensing technique that utilizes light in the form of laser to measure ranges on earth. These light pulses along with the other data provided by the air borne system produce a precise 3D image of the earth's surface characteristics . LiDAR instrument primarily comprises of GPS receiver, a scanner and a laser. There are two basic types of the LiDAR viz

1) Topographic LiDAR
2) Bathymetric LiDAR

Topographic LiDAR maps the land with the help of near infrared laser while as the bathymetric LiDAR measures scafloor and riverbed elevations with the help of green light.

LiDAR helps in precise topographical surveying with accuracy upto cm level in vertical as well as in horizontal . It finds its use in transportation structural engineering, geotechnical engineering in addition to 3D modelling and planning application

Some of the applications of LiDAR in civil engineering are listed below briefly

a) LiDAR finds its use in transportation engineering application such as location and surveying of pavement defects and conditions, road geometry and pavement distress survey. It also helps in traffic volume study.
b) LiDAR is extensively used in 3D building modelling. It has been proven to give building height more accurately
c) The massive structures such as dams, bridges etc can be checked for strain, stress, surface crack, corrosion etc. With the help of terrestrial LiDAR orr terrestrial laser scanner. This is known as structural health monitoring (SHM)
d) LiDAR is capable of providing data that gives us the digital elevation model(DEM) and microtopography with high precision. The high resolution surface model provided by LiDAR help in landslides, slope stability analysis, cut and fill analysis, flood modelling, watershed delination, infrastructure planning, site planning etc.

IV. WASTE MANAGEMENT

The past century saw major developments in terms of population growth, industrial development &urbanisation. As the cities are growing we see a lot of people immigrating for work and better lifestyle. In addition to putting pressure the resources, we see a massive increase in the waste production as well. As civil engineers we need to find the ways to diffuse off the waste effeciently. This naturally leads to the increase in the demand of landfill sites. A landfill needs to be chosen taking in account the various factors like socio economic and local factors as waste decomposition sees a lot of gasous emission as well RS & GIS is used extensively in various countries for landfill site section. Different approaches like multicritera decision analysis (MCDA), Passive comparison technique have been adopted for solid waste management. In addition to these, site suitability modellingis also used in site selection which considers the best case, worst case and the optimum case scenarios. ON the basis of conditions fulfilled as per the environmental and administrative conditions

V. LOCATION OF URBAN IMPERVIOUSNESS

Impervious surface is mainly defined as the surface in which water cannot infiltrate the soil. Due to the urban sprawl and rapid expansion of geographic extent of cities and towns, the naturally exposed ground area has been reduced with time, even the sidewalks are not spared. With the result the unnatural surface does not allow the rain water to penetrate into the ground and hence causing imperviousness of the ground surface, affecting the soil moisture and ground water level. Moreover this process of urbanisation replaces the agricultural areas, marshlands and wetlands with impervious surfaces. The effect of this rapid development is seen in frequent flooding events. Imperviousness is also considered as asoil sealing and a major cause of land degradation. Civil engineering plays a vital role to adress the problem of imperviousness

The imperviousness surface data can be extracted from remote sensing by classification of multi spectral remote sensing data using supervised classification. Another method of extracting the impervious data is to develop various indices over time to know the built up area from remote sensing. Examples are urban index (UI), Bare soil index (BI), Normalised difference built up index (NDBI), Normalised difference bareness index (NDBaI), & Enhanced built up and bareness index.

Presence of high spacial resolution, multi spectral remote sensing data like IKONOS, Quickbird, Resourcesat-LISS lV , GeoEYE etc is a key for mapping and estimating the impervious surface area. The best use of these images are that such data minimizes the mixed pixel problem thus providing information on land covers. In addition to this decision tree algorithm and object oriented classification is known to be useful for extracting impervious surface.

Extensive studies has enabled civil engineering to analyse the impact of development on stream network. The details about the distribution of pervious and impervioius surface would be quite significant in urban ecosystem studies like urban climate & hydrology and to spot hydrologically active areas for urban planning and resource management

VI. CONCLUSION

To sum it up, this paper sheds a light on remote sensing, its application and its relevance in the feilf of civil engineering. It is small effort to demonstrate the enormous potential opf remote sensing & GIS to make different civil engineering operations more convenient, accurate & simple.

REFERENCES

[1] Sohn, G., Dowman, I.J., 2001. Extraction of buildings from high resolution satellite data. In: Grün, A., Baltsavias, E.P., Henricsson, O. (Eds.), Automatic Extractionof Man-made Objects from Aerial and Space Images, vol. III. Balkema Publishers, Lisse, pp.345–356

[2] Sunar Erbek, F. Ulubay, A., Maktav, D. and Yagiz, E., 2005. The Use of Satellite Image Maps for Urban Planning in Turkey, International Journal of Remote Sensing, 26(4), pp.775-784.

[3] King, C., Baghdadi, N., Lecomte, V., Cerdan, O. [2020] The application of remote-sensing data to monitoring and modelling of soil erosion. Catena, 68, 79–93.

[4] Urai, M., 1996: Volcano monitoring using nighttime LANDSAT-TM data: The 1990-1995 eruption of Unzen Volcano, Japan - Proc. 11 Thematic Conference on Applied Geologic Remote Sensing, Las Vegas, Nevada, February 1996

[5] https://oceanservice.noaa.gov/facts/lidar.html