



Application of Remote Sensing and Image Processing for Efficient Urban Planning: A Case Study of Indian City Bhopal

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Abstract--- *In India with increasing population there is a greater need for developing an information base for effective and faster management of urban area. It requires characterizing the urban planning it's monitoring and control while considering the environmental condition and cost effectiveness with changing technologies.*

The application of remotely sensed data has been found increasing in recent years. They collect a reliable data about the land-based objects with synoptic view of large area at a time, which is not possible from conventional survey methods. The digital data requires further interpretation by using digital image processing technique.

In this paper we have used Artificial Intelligence system to detect the roads from Multispectral Remote sensed data. This data with combination with some other relevant data provides us the key to model urban planning to any country. Therefore accurate and updated Information on the status and trends of urban resources is needed to develop strategies, and efficient planning and management of the resources of the city for sustainable development and to improve the livelihood of cities.

Keywords— *Remote Sensing, Urban planning, Multi Spectral, urbanization and Neuro Fuzzy*

I. INTRODUCTION

With a land area of 3.2874 million square kilometers and a population of 1.2 billion, India has 2.4 percent of world land area but supports 18 percent of world population. By 2020, India is estimated to have a population of 1.33 billion, with an astonishing demographic dividend; average age of an Indian would just be 29, compared to 37 in China and 48 for Japan. With economy poised to grow at 9 percent per annum, gainful employment of the huge workforce is both the challenge and the opportunity for India. Seventy percent of the Indian population lives in villages while 30 percent of the population lives in urban habitats. With economic growth, urbanization is projected to expand further, requiring to support 40 percent of the population by 2020. Most industrial and economic investments would be made in and around the urban habitats as part of the unabated economic growth.

Although scientists are engaged in using the remote sensing data applications in urban planning, yet the efforts are not adequate [2].

There are models from India and abroad trying to give proper planning scenario but does not explain complete prospects for public needs:

Chesko's Midtown Manhattan model: In this model, Skyscrapers grabs attention but real effort of them was in its details. Approximately 400 individual block were created in the district by tackling block by clock miniaturization. Michael Cheskospent devoted approximately 2000 hours for construction this midtown Manhattan model having high level of details and perfection in scale. He used Dremel, nail file and x-acto knife only, to sand, cut and glue the snow of mini metropolis which is placing in museum of New York Skyscraper.

Bay Model: This model was created by U.S. army engineers' corps, which was used for simulation the effect of disaster and public projects on tides and currents, in 1957. It was made by 286 slabs of a ton weight each made of concrete representing a total of six bridges with waterworks manipulation by a hydraulic system controlled by computer.

Socio-industrial model: The classic model in India which gave birth to industrial cities such as Bhilai, Bokaro, and Rourkela (all based on government owned steel plants) as well as Jamshedpur and Jamnagar (based on private sector steel, vehicle and petrochemical plants) was based on industries acting as engines of development. Despite generation of huge wealth these cities have failed to reach the status of even tier 2 cities in social attractiveness index. The same may be said of the several suburban industrial hubs that came up, or are coming up, near established top cities in various states. Despite major industrial investments, some new industrial cities have not measured up to the desired levels of sustained factor inflows. At the same time, even though each State has at least ten to twenty urban habitats which could have supported a larger industrial growth given their factor endowments such towns remained tier 2 habitats. Clearly, the trigger for synergistic socio-industrial growth is hard to identify.

Connectivity-productivity model: Experience in India and elsewhere suggests that connectivity is an essential element of industrial productivity. The Indian rail and road systems are saturated. The railway system has remained virtually static for decades while the national highway and golden quadrilateral road systems merely catch up with the current congestion. If the Indian railways create a new 10,000 kilometer cross-country rail network, connecting hitherto

unconnected tier 2 and tier 3 cities there would be all-round triggers for industrial dispersal. This when integrated with dedicated freight corridors and bullet trains would usher in a sea change as to how industries and societies feel connected with each other. The connectivity model would be a great new way of stand-alone employment besides channeling industrial investment into the interiors to spur further employment[15,16].

Role models and thought leaders: It is gratifying that India has many public sector and private sector role models that excelled in creating these systems in their own way. The top 21 public sector undertakings belonging to the Maharatna and Navaratna categories and the several top private sector conglomerates as well as some individual mega companies have excelled in creating assets, skills and wealth in barren tracts in India. Even as these and other groups venture into other countries to secure factor and cost advantages, focus must also be on the potential that still remains to be exploited within India itself to achieve more intense and more diversified social and industrial transformation.

All models from India and abroad gives proper planning scenario but does not explain complete prospects for public needs. Our model fulfills above all requirements. Needed for proper growth for healthy environments. So migration may be reduced from small cities to developed cities and nations too.

II. SATELLITES AND SENSORS

Viewing and image targeting may be done by placing instruments related to Remote sensing on different base. Aircraft base or ground base may be used as satellite provides great opportunity for imaging of remote sensing. A satellite has various type of characteristic and such type of characteristic is used in Earth surface remote sensing. Basically orbit may be defined as path which is followed by a satellite. Satellite orbits are matched to the capability and objective of the sensor(s) they carry. The selection of orbit can be in different terms Altitude, Orientation and Rotation relative to earth.

So if we take a view at very high altitudes, which view the same portion of the Earth's surface at all times have geostationary orbits. The rotation of geostationary satellites, at altitudes of approximately 36,000 kilometers matched with the Earth's rotation by which they have stationary position with the earth. According to the rotation, satellites can be observed and collect information continuously across specific areas. Generally this type of orbit have found in case of weather and communications satellites. Geostationary satellite related to weather forecasting monitors pattern of cloud and weather of a particular hemisphere of earth. [17,18].

A. GOALS OF SPACE PROGRAMME IN INDIA

Objectives of Space Program in India are for tackling these technologies for applications in the areas of remote sensing, search & rescue operations, disaster warning, meteorology, broadcasting and communications. Operational systems are applied in the above mentioned areas from nearly last twenty years. Elements of remote sensing related to program, particularly this way, achieved world-wide acceptance. We have built operational satellites and launched and they are performing well in several application like ocean and land.

B. INDIAN SATELLITES FOR REMOTE SENSING

Following are the milestones for Indian remote sensing abilities.

Bhaskara (1 & 2): These were trial satellite for remote sensing. Bhaskara 1 was launched in June 1979 and Bhaskara 2 in Nov 1981. We achieve experience for further developments in Space Research Program of India.

IRS (1A & 1B): The first generation, operational remote sensing satellite IRS-1A and IRS-1B were launched in march 1988 and august 1991 respectively. These satellites carried one Linear Imaging sensor (LISS-I) and one Self Scanning sensor (LISS-II) which can provide data having resolution 72.5 and 36.25 meters containing four spectral band and having 22 days receptivity. They provides vital data during the period of operations for projects of national importance.

IRS - P2: Polar Satellite Launch Vehicle 'PSLV-D2' was used for launching of IRS-P2 satellite in October 1994. It contained modified version of LISS camera.

IRS-1C & IRS-1D: The next generation operational remote sensing satellite IRS-1C & IRS-1D are launched at last of 20th century (Dec. 1995 & Sept. 1997) having improved sensor and coverage characteristics.

IRS - P3: PSLV – D3 launch vehicle was used for launching it in Apr. 1996. This satellite's payload includes three sensors, two imaging type and one non imaging type sensors. One of the sensor named WiFS (Wide Field Sensor) is used to send data containing three spectral band having 188m of spatial resolution in the regions of near infra red and visible containing 810 Km of swath. Remaining two sensors used are MOS (Modular Opto-electronic Scanner) & payload related to astronomy of X-ray. Products of MOS & WiFS data are disseminated for users.

OCEANSAT-1 or IRS-P4: It was launched in May 1999 and is eighth in the Indian Remote sensing Satellite program. One OCM (Ocean Color Monitor) is included in its payload which may operate in eight spectrum consisting infra red and visible region and MSMR (Multi frequency Scanning Microwave Radiometer) which can operate in four frequencies (6.6, 10.6, 18.0 & 21.0) GHz. The above mentioned sensors are used for biological and physical parameter measurements in ocean.

CARTOSAT-1 or IRS-P5: It has capability of fore-aft stereo and two PAN sensors having resolution of 2.5m. Its payload has capabilities of applications like- cadastral mapping, terrain modeling and cartography etc.

OCEANSAT-2: The mission of this created to offer extension in the services of Oceansat-1 for its users. It has advanced capabilities. It consist an Ocean Color Monitor (OCM) and Wind Scatter meter. The application of it includes snow mapping, ship routing, Flood inundation mapping, paddy crop yield estimation and acreage, Monitoring etc.

C. RESOURCESET-1 (IRS P6) AND ITS SENSORS

IRS-P6 mission have two main purposes:

- (a) It provides services related to data of remote sensing for water resources and integrated land management with upgraded spatial coverage and multi spectral containing stereo imaging capability at micro level.
- (b) It is used for developing study in the areas of advance level like- urban management, disaster management, pest/disease surveillance, crop stress, crop yield, crop discrimination etc.

SPECIFICATION: IRS - P6 is a spacecraft having body stabilization in three axes, which was launched by PSLV – C5 at altitude of 817 Km in an orbit of sun synchronous, descending node and repetivity 341 orbits / cycle (24 days). The spacecraft has planned with 5 years of expecting life. Its payload contains a total of three optical camera.

Sensors of RESOURCESET-1 (IRS p6)

(1) LISS-IV - LINEAR IMAGING SELF SCANNING SENSOR CAMERA

LISS-IV has a high-resolution multi-spectral camera operating in three spectral bands

- a) 0.52 to 0.59 m.(Green (band 2).
- b) 0.62 to 0.68 m (Red (Band 3).
- c) 0.76 to 0.86 m (NIR (Band 4).

LISS-IV: It may be operated in multi spectral mode ‘Mx’ as well as mono mode, with a 5.8 m resolution on ground. A swath covering 23.9 Km, out of 70 Km, may be achieved in multi spectral mode ‘Mx’ and full swath covering 70 Km may be achieved using mono mode ‘Mono’ using any single band which may be select by ground most probably red band-B3. The camera of LISS – IV provides 5 days revisit period and may be tilted across track direction upto ± 26°.

(2) LISS-III - LINEAR IMAGING SELF SCANNING SENSOR CAMERA

This camera has 141 Km of swath containing all four bands. It has 23.5 m of spatial resolution of SWIR band ‘B5’ and rests of the features are same as in aircraft containing LISS – III flown in IRS – 1C / 1D.

(3) AWIFS - ADVANCED WIDE FIELD SENSOR

This camera is the upgraded form of the WIFS camera which is flown in IRS – 1C / 1D. It may provide 740 Km of swath and 56 m of spatial resolution. For wide swath covering, the ASIFS camera is spited into two separate modules of related to electro optics namely ASIFS – A and ASIFS – B. For enhancement the capabilities for supporting the operations related to Payload, spacecraft mainframe ‘IRS – P6’ is configured in respect of some new features.

(Note: we calculate one pixel in kilometers.)

Linear Imaging Self-Scanning Sensor – 4

- i) Contains VIS / NIR radiometer of 3 channels, each channel contains a camera.
- ii) Contains Bush broom having 4096 pixels per line per camera having 23.9 km of swath for using three camera, one camera for one channel ‘multi-spectral’, and a swath of 70 km for using all camera in the case of same channel parallel strip viewing ‘panchromatic’. It has a capability of ±26° related to pointing of cross track for orbits stereoscopy.
- iii) Then for one channel=23.9 km.
- iv) Value of one pixel (in km) = $(23.9*23.9) / (512*512) \text{ km}^2 = 0.0022 \text{ km}^2$.
- v) It covers full globe in 24 days and covers any target area in five days with a use of cross track pointing.

III. MATERIALS AND METHODS

A. STUDY AREA: BHOPAL

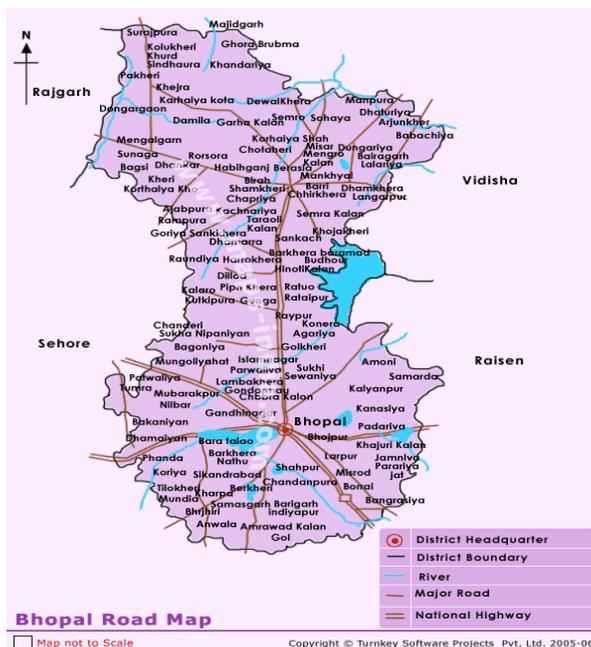


Fig 1. Map of Bhopal district (Madhya Pradesh)

Focus of our study is on areas in the city of Bhopal, which belongs to north central state of Madhya Pradesh. It has a population of almost 1.2 million people. The position of Bhopal in the centre of India having the height from sea level of 1637 feet (499 m). It is situated on Malwa plateau hence having higher level to the northern plains of India. The northern side of Bhopal is covered by three hills viz- Idgah hills, Shyamala hill and central Arera hills. Bhopal contains a beautiful lake which is known as Bhoj Watland built by King Bhoj, which is divided into two parts viz- Bada Talab (area 361 km²) & Chota Talab (area 9.6 km²). Upper Lake contains a national park known as Van Vihar National Park. The climate of Bhopal is humid.

B. CLIMATE & GEOGRAPHY OF BHOPAL

The climate of Bhopal is subtropical and humid having mild and dry winter and hot & long summer, monsoon season having humidity. The duration of summer season is between last-March and mid-June, having average temperature 30°C with a highest temperature of more than 40°C in May. The duration of Monsoon season is between last-June and last-September. In Monsoon season, flooding, thunderstorm and 100cm precipitation (with 115cm annual rainfall) takes place, with 25°C of average temperature and very high humidity. Bhopal has dry, sunny and mild winter with 18°C average temperature. In January minimum temperature nearly freezing point may occur.

C. METHODS OF ANALYSIS

To analyze of the multi spectral image, we have employed different Image Processing algorithms like Artificial Neural Networks (ANN) and fuzzy c-mean clustering (FCM) to generate the False Color Composite of the multi spectral image or to emphasize some of the features of the image that may be the particular regions or pixels of the image.

For the analysis of the multi spectral images using ANN, what we have used is the Back propagation algorithm. In this algorithm, we at first define a neural network which reflects the mapping relationship between the input data and the target. The input data are the pixels which best represent the particular feature of the image, may the vegetations, the water bodies or the concrete structures; and the target is the desired values of the colors for the FCC of the image. After the learning of the network, it is applied to whole the image to generate the desired FCC. After generating FCC image we worked for FCM image and got the values accordingly. For getting the results due to NEURO FUZZY we took the FCC image of ANN as the data and applied it for FCM.

But in the remote sensing situations are more complex, as energy response of the object may not be received correctly because atmosphere can absorb the emitted energy, problem could be because geometric and radiometric distortions. So we are required the certain corrections.

Energy response of the objects may not be received correctly because atmosphere can absorb the emitted energy, so on the basis of the ground survey we can minimize the effect of the atmospheric effects. As in our study we are using the FCM values also for classification of the objects, we have found the threshold values of FCM in sample locations for each object in a particular climate conditions. And after this we have generalized the values for whole image.

D. ANALYSIS OF THE MULTI SPECTRAL IMAGE USING ANN

Step 1 Assembling the Training Data

We have received the image of the Bareilly Ramganga region as shown in the figure 5.2 and by using the Data Cursor tool in the MATLAB we have obtained the R-G-B components of the pixels which best represent the different features of the image like the River & Water Bodies, the Concrete Structures, the Roads and the Vegetation and created the table:

Table 1 Few of Pixels representing different Features

Features	R	G	B
River & Water Bodies	120	059	056
	128	049	052
	131	051	060
	136	081	076
	142	052	058
Concrete Structures	151	104	096
	172	093	088
	181	059	074
	186	074	088
	197	098	104
Roads	154	049	064
	163	052	068
	169	096	087
	172	074	089
	178	062	073
	224	086	101

Vegetations	229	119	130
	230	096	105
	234	082	095
	240	104	114

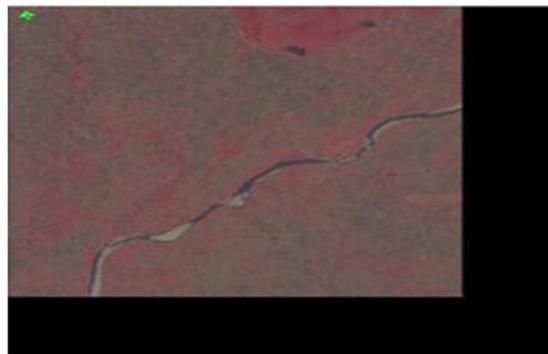


Fig 2.Original image of Bhopal

Thus we obtained R-G-B values of almost 100 pixels and these values may be moulded to form a 3x100 matrix as in figure

R:	120 128 131 136 142 151 172 181 186 197 154 163 169 172....
G:	059 049 051 081 052 104 093 059 074 098 049 052 096 074....
B:	056 052 060 076 058 096 088 074 088 104 064 068 087 089....

Fig 3. The Matrix of Input Pixels

Step 2 Create the Network Object

Now we define the network and specify its features like no. of neurons, range of the values of the input neurons, no. of layers etc. and specify the input and target matrices. In target matrix, there is a particular color for the particular feature to generate the FCC

R:	0.0 0.0 0.0 0.0 <u>0.6 0.6 0.6 0.6</u> 0.0 0.0 0.0 0.0 0.0 0.0 0.0....
G:	<u>0.7 0.7 0.7 0.7</u> 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0....
B:	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 <u>0.8 0.8 0.8 0.8</u> 0.0 0.0 0.0 0.0....

Fig 4. The Matrix of Target FCC

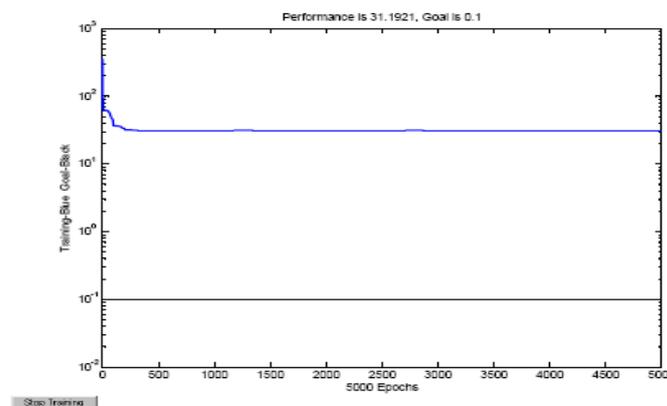


Fig 5. Training of network

Now starts the training of the network and the weights are assigned automatically. Since, the input and output are already defined; the weights for each input-output pair can be developed. Thus, the step 2 makes it to meet the requirement of the mapping relationship between the input and the target.

Step 3 Simulate the Network Response for Whole the Image

Now, as we have obtained the function representing the relation between the input and the target, we are ready to generate a resulting matrix corresponding to the final FCC of the given image.

But, before we simulate the image with the help of given network of neurons, we are to convert the 3-dimensional matrix of dimensions '512 x 512 x 3' corresponding to the multi spectral image into a 3-dimensional matrix of dimensions '3 x 512x512' i.e. '3 x 262144' .

Now this converted form of the multi spectral image applied to neural network for the simulation. After the simulation, what we get as the result is again a 2-dimensional matrix of the same dimensions '3 x 262144', which is again to be converted into the 3-dimensional matrix of dimensions which represents the FCC corresponding to the given multi spectral image.

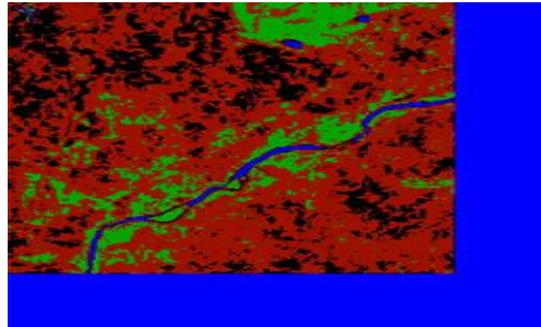


Fig 6. FCC Image of the Multi Spectral image

E. ANALYSIS OF THE MULTI SPECTRAL IMAGE USING FCM

Step 1: In the very first step we receive the multispectral image and convert it into the double image to apply the FCM algorithm on the image.

Step 2: After we have got the double image, we apply the nir,red and green band images algorithm of the FCM on the multi spectral image and analyze the averaged component of this multispectral image

Step 3: Now as we have obtained the arranged data in a matrix component of the multi spectral image, using "reshape" function.

Step 4: After getting the images of the different bands and reshape the image now our aim is to find out the cluster values of FCM of the given image

```
[CTR,CLASS]=FCM(DATA,4);
```

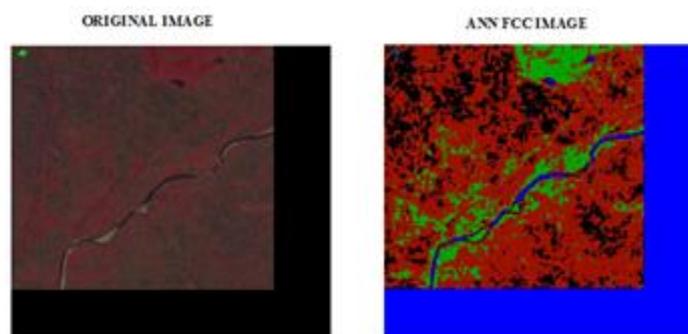
By using the MATLAB we got the cluster values of each pixel and finally we got the image. The values of cluster of FCM are in the range of 0 to +1 [10]

Step 5: Now we calculate the reshape of class data using reshape function.

Step 6: Next aim after getting the FCM image was to get the classified images of the region, in order to get these images we performed the ground survey at various places of the city and taken the proper longitude and latitude values of the survey region from Google earth, and with the help of that we identified the survey locations into the multi spectral images. By the help of the ground survey I found the specific range of the FCM for each object.

1. For the vegetation, I found the FCM values are in between 0 & 1, the concentration of the vegetation is in the range of the 0.01 to 0.1:
(fcm(m,n)<0.1) & (fcm(m,n)>=0.01)
2. For the dense structures, I found the FCM values are in the range of between 0.1 to 0.2:
(fcm(m,n)<=0.2) & (fcm(m,n)>=0.1)
3. For the roads, I found the FCM values are in the range of between 1 & 0:
(fcm(m,n)<1.0) & (fcm(m,n)>=0.5)((nir(m,n)<0.79) & (nir(m,n)>0.7))
4. For the water, I found the FCM values are in the range of between 1 & 0:
(fcm(m,n)<0.225) & (fcm(m,n)>0.2)
5. For the weak structure, I found the FCM values are in the range of between 1 & 0:
(fcm(m,n)<0.5) & (fcm(m,n)>=0.225)
6. For the land, I found the FCM values are in the range of between 1 & 0:
(fcm(m,n)<0.01)

IV. RESULTS FOR IMAGES AFTER APPLYING DIFFERENT ALGORITHMS



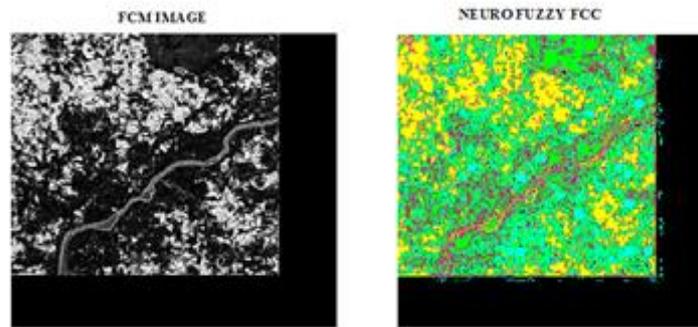


Fig 7. Images of Bhopal using different algorithms

V. ACCURACY OF RESULTS

Here is a table giving an approximate analysis of all these two algorithms and their results:

Table 2 .Table representing accuracy of results for Bhopal

AREA COVERED	FCM	% RESULT	NEURO FUZZY	% RESULT
TOTAL AREA	388.0800	100	388.0800	100
VEGETATION	261.4612	67.3730	317.9528	81.9297
WATER BODIES	70.6794	18.2126	115.1018	29.6593
ROADS	113.3572	29.2098	83.4438	21.5017
DENSE STRUCTURES	226.9586	58.4824	138.5560	35.7029
WEAK STRUCTURES	52.2830	13.4722	25.3726	6.5380
FREE LAND	6.9982	1.8033	84.2996	21.7222

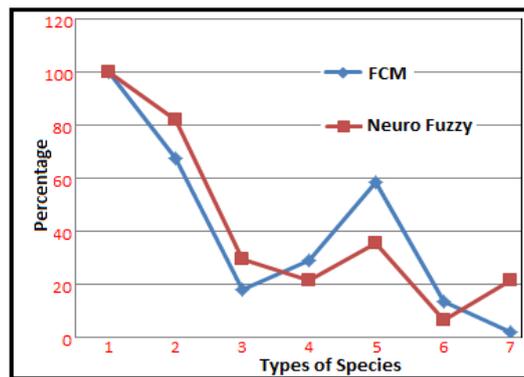


Fig 8 Graph Showing the comparative percentage between FCM and Neuro- Fuzzy

VI. EDGE DETECTION

Edge correspond to large changes in intensity of neighbors pixels in at least one direction. Edge is defined as that place on which contrast with a strong intensity takes place in an image. It may also be defined the area where a color difference occurs without a change in intensity. Edge defines the boundaries between regions in an image, which helps with segmentation and object recognition. Edge detection is a fundamental of low-level image processing and good edges are necessary for higher level processing. In general edge detectors have difficulty adapting to different situations. The quality of edge detection is highly dependent on lighting conditions, the presence of objects of similar intensity, color etc [10].

The task of edge detection may be achieved using several methods. All the methods may be divided into two groups:

There are many ways to perform edge detection. However, the majority of different methods

May be grouped into two categories:

i) **Gradient:**

In this group of methods edge is detected using maxima and minima in first derivative of image.

ii) **Laplacian:**

Edge is detected in this method by searching zero crossing in second derivative of image. One dimensional shape of ramp is known as edge and its location may be highlighted by calculating the derivative of image [10, 12, 13].

A. DIFFERENT EDGE DETECTORS

1) Sobel Edge detector

Sobel Edge detector is used to compute the approximation of gradient of function of image intensity and is an operator to calculate discrete differentiation. Sobel operator represents norm of the vector or corresponding gradient vector at each point of image. Sobel operator performs fewer computations as it is based upon the computation of convolution of image

with separable, small and integer value filter in vertical and horizontal direction. This operator provides highest increment from light to dark as well as rate of change of direction by calculating gradient of image intensity on each point. The edge may be detected using this technique as the results shows 'abrupt' or 'smooth' change at a point in image [14].

Sobel edge detector creates series of magnitudes of gradient by using a simple type of kernel related to convolution. This may be mathematically represented by applying K (convolution) to p (pixel group) as follows:

$$N(x,y) = \sum_{k=-1}^1 \sum_{j=-1}^1 k(j,k)p(x-j,y-k).$$

Hence sobel edge detector is using two kernels related to convolution first one for detection horizontal contrast (h_x) and another for detection for changes in vertical contrast (h_y).

$$(h_x) = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}, \quad (h_y) = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$$

(Sobel edge detector mask)

x -component and y -component of this vector represents two different gradients representing (h_x) and (h_y).

$$g = \begin{bmatrix} g_x \\ g_y \end{bmatrix}, \quad g = \sqrt{(g_x)^2 + (g_y)^2}, \quad \theta = \tan^{-1} \frac{g_x}{g_y}$$

Where g is the gradient vector, g is the gradient magnitude and θ is the gradient direction.

2) Prewitt Edge Detector

Prewitt operator is similar to the Sobel operator and is used for detecting vertical and horizontal edges in images

$$(h_x) = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}, \quad (h_y) = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix}$$

Prewitt edge detector mask. Robert's Cross Detector

This detector is used to measure 2D spatial gradient of an image in simple and quick manner. Absolute magnitude of spatial gradient of a point in input image is represented by the pixel value of that point in the output image.

The Roberts Cross operator performs a simple, quick to compute, 2 D spatial gradient measurement on an image. Pixel values at each point in the output represent the absolute magnitude of the spatial gradient of the input image at that point.

The Roberts Cross operator included (2 by 2) convolution kernels where other kernel may be obtained by rotating the first one by 90° .

1	0
0	-1

(Gx)

0	+1
-1	0

(Gy)

Robert edge detector mask.

The above two kernel responds maximally for the edges which are situated at an angle of 45° in the pixel grid and one kernel is needed for two orientations at perpendicular directions to each other. These two kernels may be applied on input image, separately, which provides different measurements for each orientation for the gradient component 'Gx' and 'Gy'.

The magnitude of the gradient is as follows:

$$|G| = \sqrt{(G_x)^2 + (G_y)^2}$$

The approximate value of the magnitude may be given as:

$$|G| = |G_x| + |G_y|$$

This computation may be done much fast.

Orientation angle related to edge, which express the increment in the spatial gradient which is related to grid orientation of pixel, may be expressed as:

$$\theta = \arctan(G_y/G_x) - 3\pi/4$$

B. LAPLACIAN OF GAUSSIAN :

If we calculate second derivative (spatial) of image and then calculate 2D measure (isotropic) of it, then the result is Laplacian. Laplacian is generally used for detection of edge as it highlights the regions where the change in intensity is rapid in an image. Firstly the sensitivity for noise of the image is reduced using Gaussian filter for smoothing then Laplacian is applied. The input and output to this operator are normally image of single gray level. The value of Laplacian of an image $L(X, Y)$ of the image having pixel intensity $I(X, Y)$ is denoted by:

$$L(X, Y) = \Delta$$

Now we will find kernel with discrete convolution which may be approximated 2nd derivatives in Laplacian, due to input image contains discrete pixel set.

Below diagram represents three kernels which are commonly used:

0	1	0
1	-4	1
0	1	0

1	1	1
1	-8	1
1	1	1

-1	2	-1
2	4	2
-1	2	-1

(Laplacian edge detector mask)

The above kernels are very sensitive for noise as they approximate the measurement of second derivative in image. Hence before applying Laplacian, smoothing is done upon the image through Gaussian operator. It is known as preprocessing which reduces high frequency components of noise before the next step of differentiation. We can use the convolution after the result of Gaussian Filter for smoothing with Laplacian filter, finally applying convolution upon this combined filter on image, due to convolution operator follows the associative law, and hence final result is achieved.

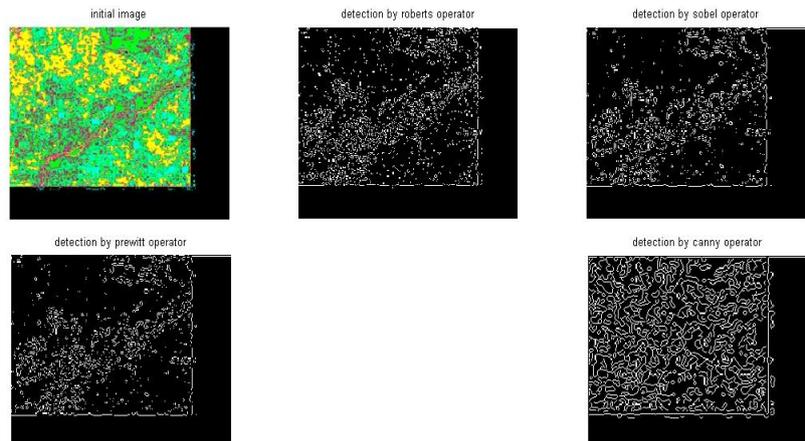


Fig 9. Showing different edge detector techniques

As in this case of edge detection it is not possible to detect the spies of multispectral Images. It may be possible to detect in case of RGB images.

VII. PROPOSED METHODOLOGY TO DESIGN MODEL

In the proposed researched attempt is made to overcome the above deficiencies by evolving a systematic methodology explained.

- (1) Select a region of interest and collect the satellite image for this region. The land-based objects will be identified using image-processing technique [19]. Image cluster of similar pixels characteristics can be formed by Edge detection technique algorithm in the following steps.
- (2) Having formed the image clusters in above steps, the area of the urban land will be estimated. The road & road junctions can be identified which will help in estimating the urban yield of the region of interest. This step will require use of fuzzy-neural technique applied to image processing. This technique can also be used for identifying the defects in urban land.
- (3) A simulation model of urban area will be developed with inputs like land area, material supply facility, atmospheric conditions, road & road junctions. The model would estimate the construction quality and compares it with target and feedback the error to the model input. This works in an iterative manner till a converged solution is obtained.

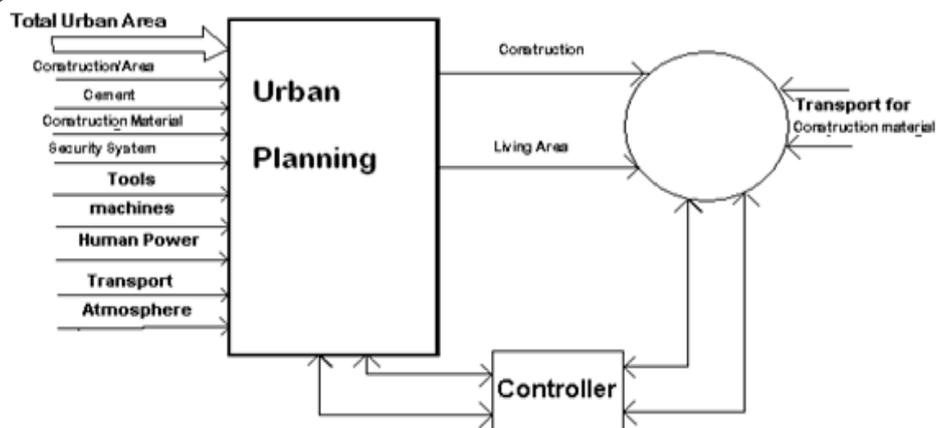


Fig10. Proposed Urban planning model

- [12] M.B. Ahmad & T.S. Choi,1999. "Local Threshold and Boolean Function Based Edge Detection", *IEEE Transactions on Consumer Electronics*, vol.45, no.3, pp.112118
- [13] J. Canny. A Computational Approach to Edge Detection, *IEEE Trans. Pattern Analysis and Machine Intelligence*, vol. 8, pp. 679-698, 1986.
- [14] Gonzalez, R. C., Woods, R. E., and Eddins, S. L. [2004]. *DigitalImage Processing Using MATLAB*, Prentice Hall
- [15] Antrop, M. (2004): Landscape change and the urbanization process in Europe. *Landscape and Urban Planning* 67: 9-26.
- [16] Brandt, J., Holmes, E. &Skriver, P. (2001): Urbanisation of the countryside? problems of interdisciplinarity in the study of rural landscape development. In: Conference on the Open SPACE Functions under URBAN Pressure. Gent, 19-21 September
- [17] Rao, P. V. N. and SessaSai, M. V. R. (eds), In *Remote Sensing with Resourcesat-1 – Early Results*, Programme Planning and Evaluation Group, National Remote Sensing Agency, Hyderabad, 2004, pp. 1–5.
- [18] Hand book of IRS P-6Resouresat-1 and its sensors