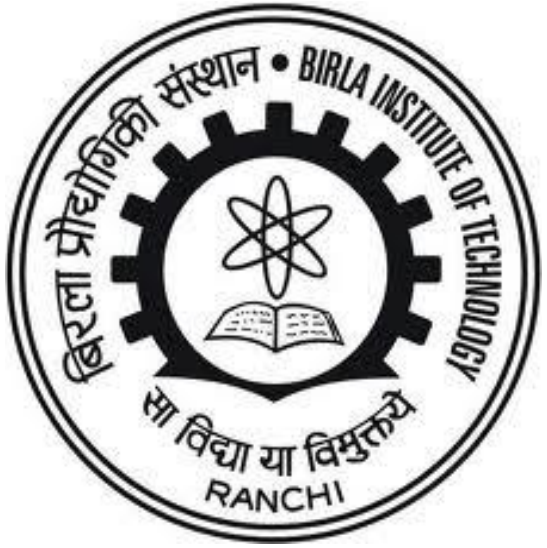
# Estimation of Urbanization of an Area




## Team Members

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# Introduction

**Urbanization** refers to the population shift from rural to urban areas, "the gradual increase in the proportion of people living in urban areas", and the ways in which each society adapts to the change. Urbanization can be quantified either in terms of the level of urban development relative to the overall population, or as the rate at which the urban proportion of the population is increasing.

Previous literature measures the extent of urban areas using household-survey based socio-economic data, night-time lights, and mobile-phone records which requires some professional expertise for estimation. In our project we will use Satellite Imaginary to classify Built Up(BU) and Non Built-Up Area(NBU) and use some techniques for vegetation extraction and building detection, which will result in the urbanization of an area.

# Scope

The Project will helpful in the following areas:-

- Urban Planning
- Nature Monitoring
- Change Detection
- Military Application

# Objective

- Classification of Built-Up and Non Built-Up areas based Image Segmentation Technique.
- Extraction of vegetation from aerial image using Image Segmentation and Clustering Technique.
- Extraction of building from high resolution satellite image using various Detection and Transformation Technique.
- Graphical representation of Urbanization of an area.

# General Constraints, Dependencies, Guidelines

- **Software Constraints**

  Windows XP, Windows 7, 8.

  Matlab and other libraries.

- **Hardware Constraints**

  Minimum of 10GB space of hard disk.

  Minimum of 1024MB RAM

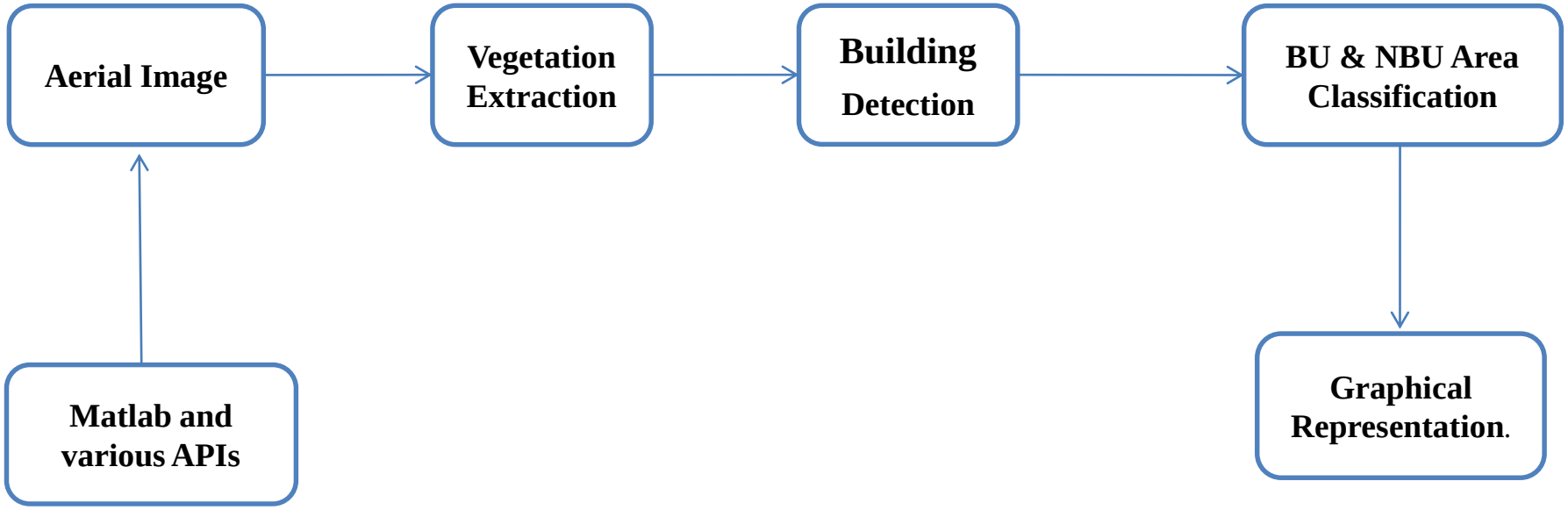
- **Guidelines**

  Code is kept clean and simple for future upgrades and maintenance

- **Assumptions**

  User will provide aerial or satellite image with a preferable quality.

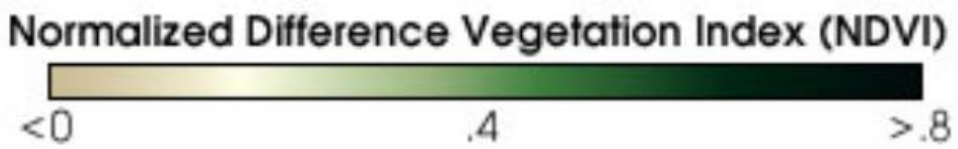
# How it Works?


Aerial Image
Vegetation Extraction
Building Detection
BU & NBU Area Classification
Matlab and various APIs
Graphical Representation.

# Vegetation Extraction

Normalized Difference Vegetation Index is a spectral band calculation that uses the Visible (RGB) and Near Infrared (NIR) bands of the electromagnetic spectrum. True NDVI also known as Red NDVI and has been used in scientific research for over 40 years .

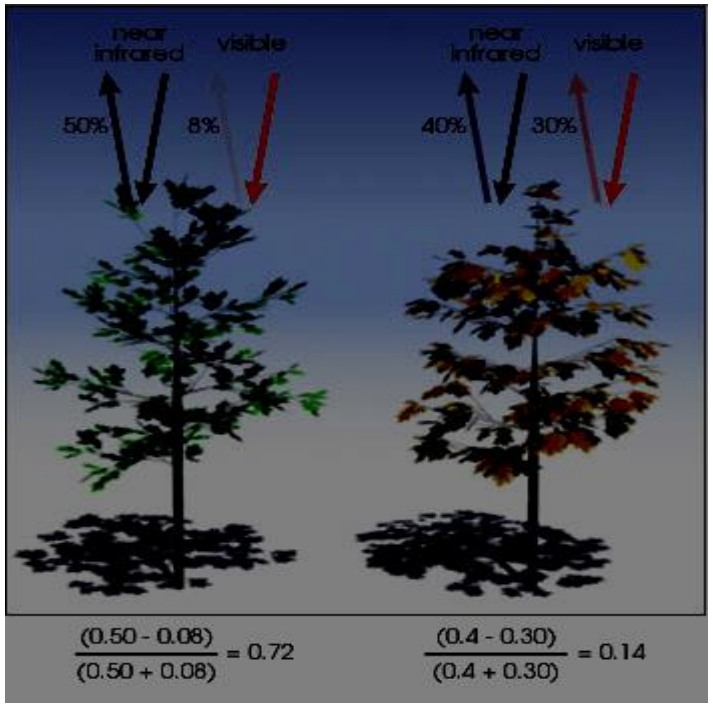
The basic concept is that chlorophyll in plants absorb red light during photosynthesis and healthy plants reflect very strongly in the NIR band. The Red NDVI vegetation index has been widely studied and adopted by the scientific community as a means of measuring crop health.

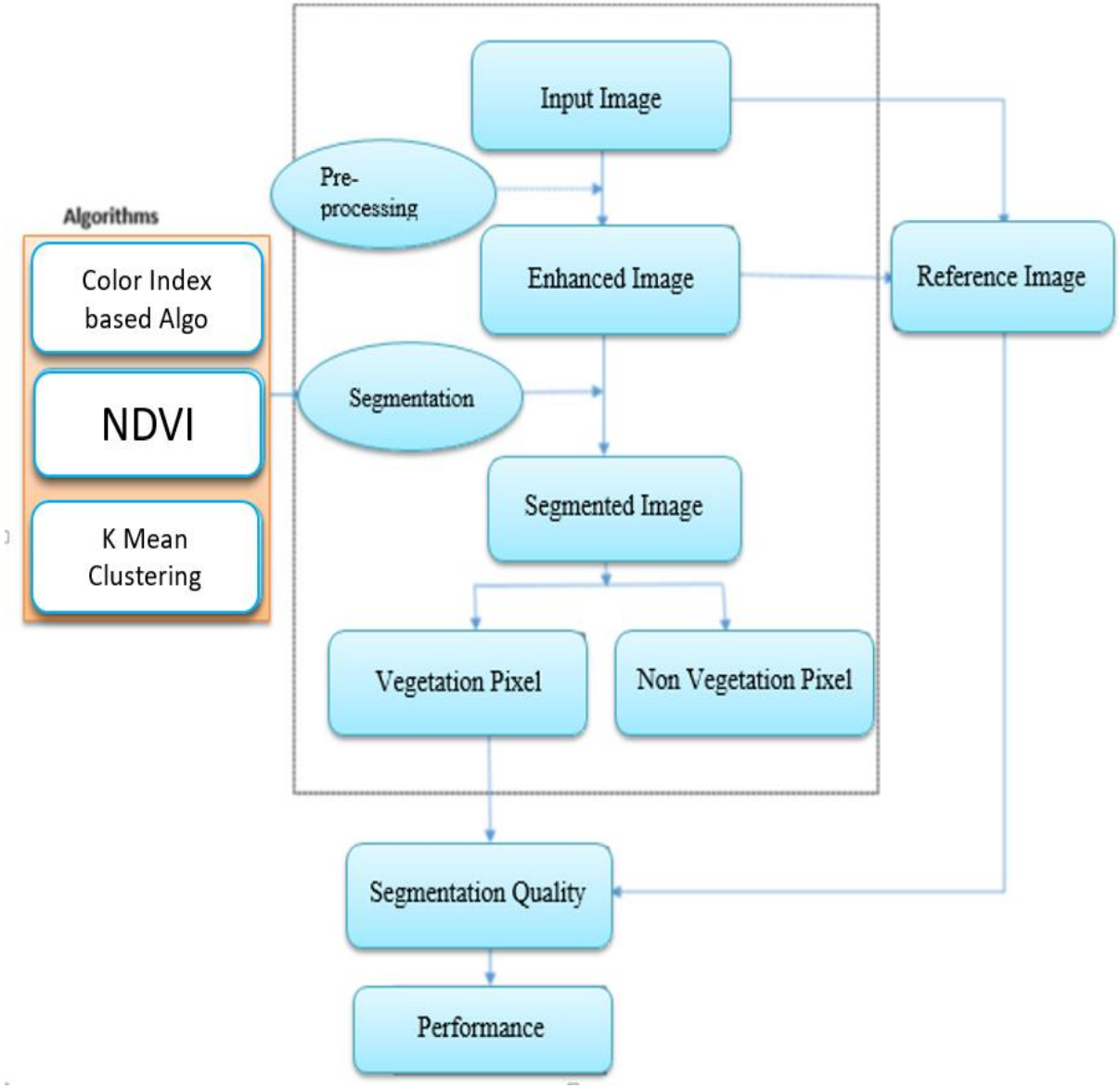



Very low values of NDVI (0.1 and below) correspond to barren areas of rock, sand, or snow. Moderate values represent shrub and grassland (0.2 to 0.3), while high values indicate temperate and tropical rainforests (0.6 to 0.8).

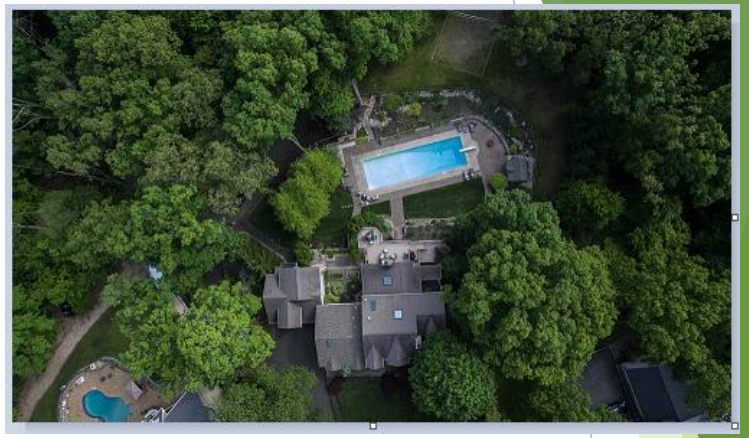
# Example :-

when sunlight falls on the leaves on a healthy plant or tree, as indicates on the left, the red band absorbs more light and reflects more NIR light producing a larger NDVI value while the tree on the right absorbs less Red light and reflects less NIR resulting in a lower NDVI value.






Input Image



Output Image

Flowchart of vegetation Extraction

# K Mean Clustering

Let us consider an image with resolution of $x \times y$ and the image has to be cluster into $k$ number of cluster. Let $p(x, y)$ be an input pixels to be cluster and $c_k$ be the cluster centers. The algorithm for $k$-means[13] clustering is following as:

1. Initialize number of cluster $k$ and centre.
2. For each pixel of an image, calculate the Euclidean distance $d$, between the center and each pixel of an image using the relation given below.

$$d = \| p(x, y) - c_k \| \tag{3}$$

3. Assign all the pixels to the nearest centre based on distance $d$.
4. After all pixels have been assigned, recalculate new position of the centre using the relation given below.

$$c_k = \frac{1}{k} \sum_{y \in c_k} \sum_{x \in c_k} p(x, y) \tag{4}$$

5. Repeat the process until it satisfies the tolerance or error value.
6. Reshape the cluster pixels into image.

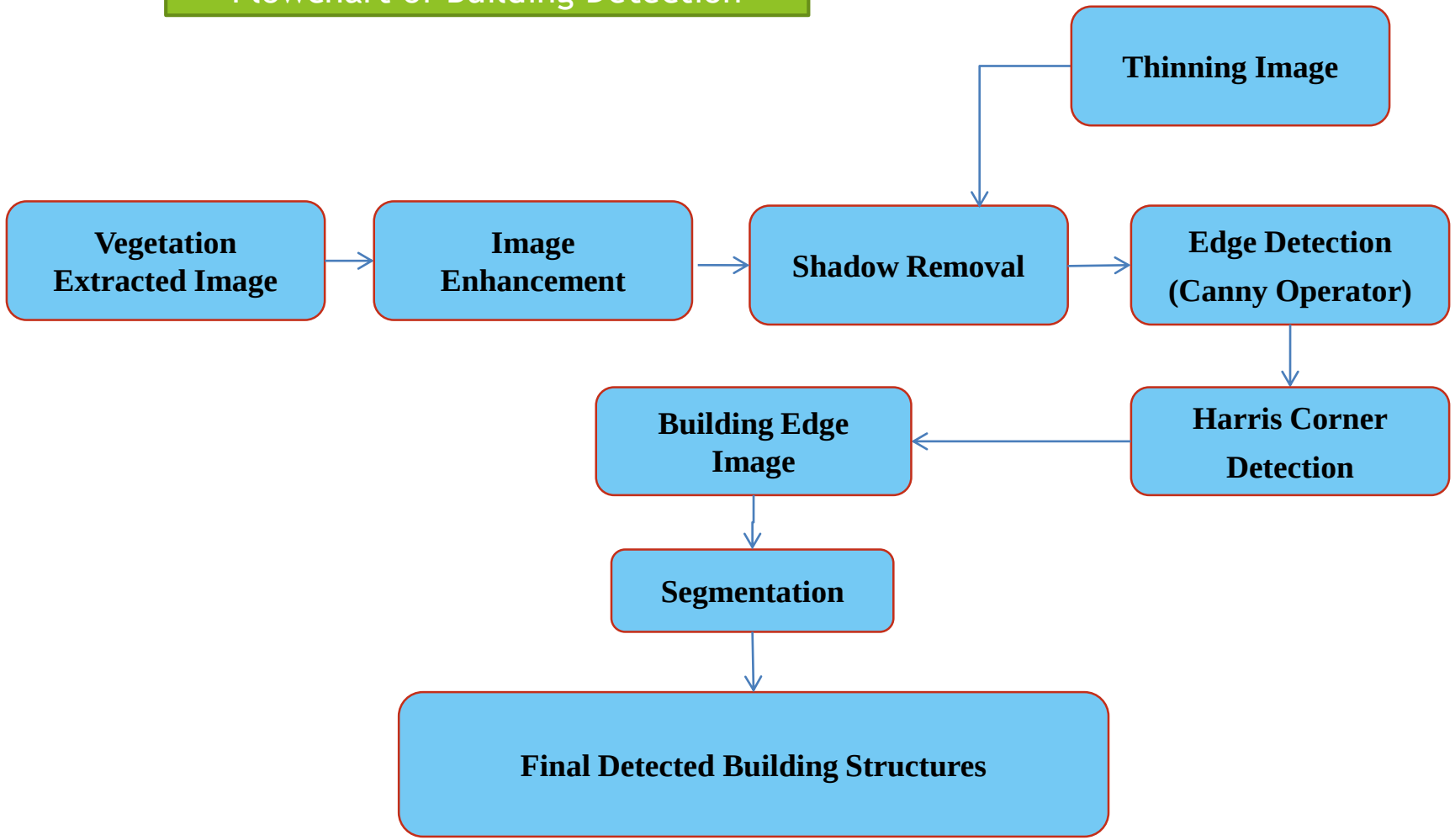
# Building Detection

In automated analysis of digital images, a sub problem often arises of detecting simple shapes, such as straight lines, circles or ellipses. In many cases an edge detector can be used as a pre-processing stage to obtain image points or image pixels that are on the desired curve in the image space.

Due to imperfections in either the image data or the edge detector, however, there may be missing points or pixels on the desired curves as well as spatial deviations between the ideal line/circle/ellipse and the noisy edge points as they are obtained from the edge detector. The following processing has to be done for the detection of building-

- Image Enhancement
- Shadow Removal using Thresholding
- Canny Edge Detection
- Harris Corner Detection

# Flowchart of Building Detection



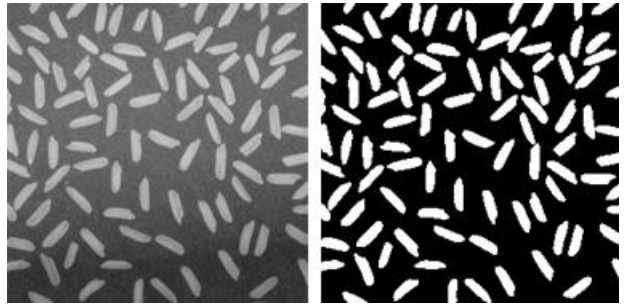
# Image Enhancement :

Image enhancement is the process of adjusting the digital images so that the results are more suitable for further image analysis.

Noise removal , sharpen or brighten an image ,making it easier to identify key features.

Example :

- Correcting non uniform illumination with morphological operators.



- Enhancing grayscale images with histogram equalization

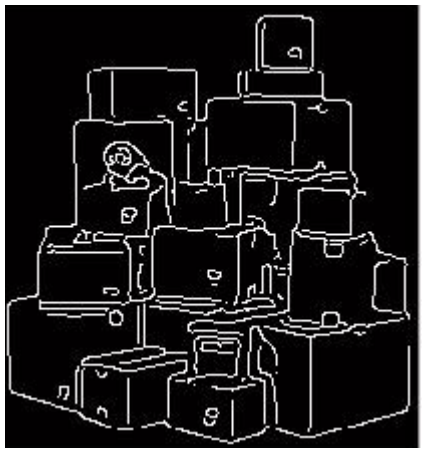
- Deblurring images using a Wiener filter.

# Canny Edge Detection

Canny edge detection is a technique to extract useful structural information from different vision objects and dramatically reduce the amount of data to be processed. It has been widely applied in various computer vision systems.

- Apply Gaussian filter to smooth the image in order to remove the noise.
- Apply double threshold to determine potential edges.
- Track edge by hysteresis Finalize the detection of edges by suppressing all the other edges that are weak and not connected to strong edges.

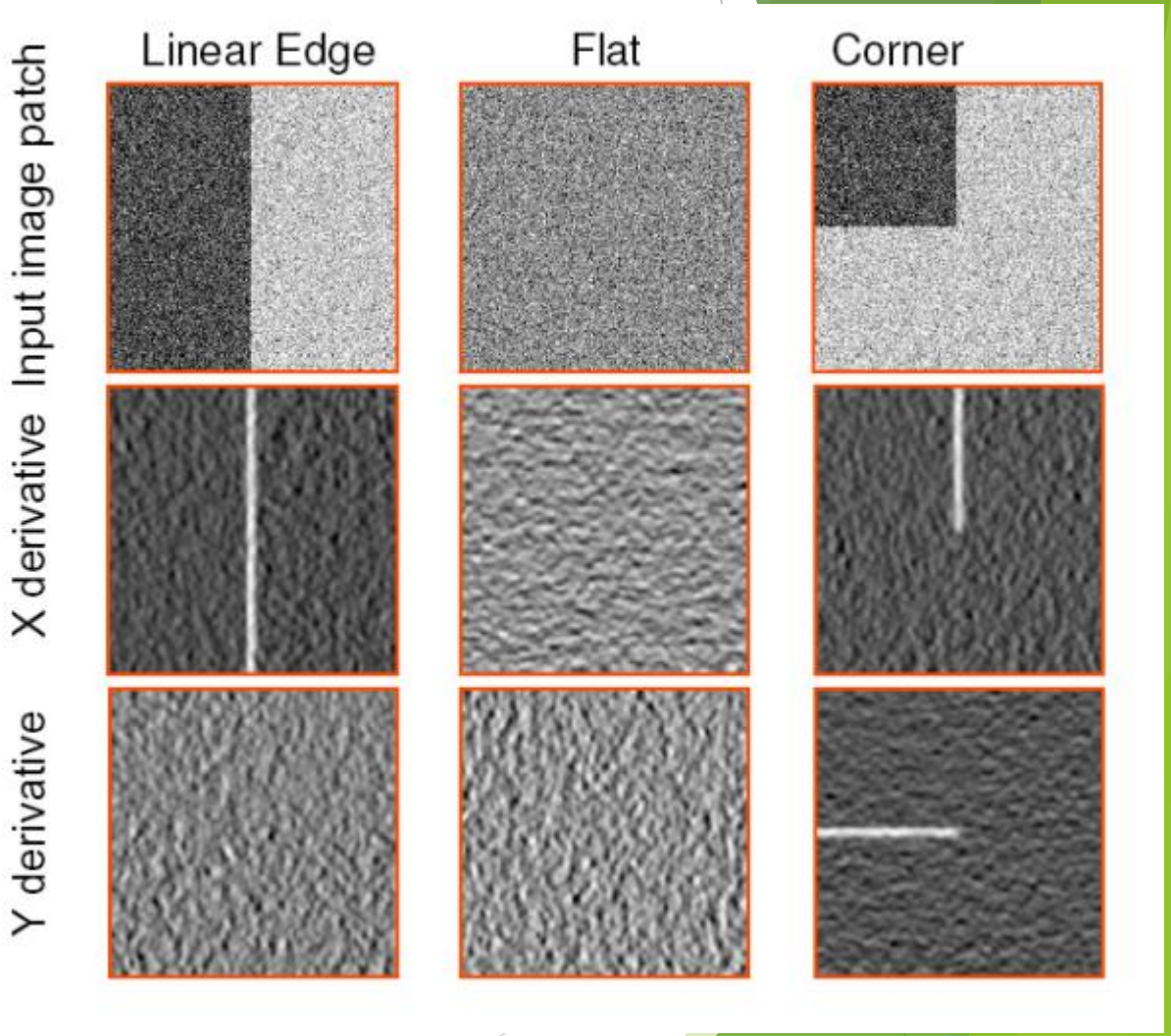
Sample :



# Corner Detection

Once the Edge is detected by the canny detector ,the main step is to find the Corners to construct the building. A corner is a point whose local neighborhood stands in two dominant and different edge directions.

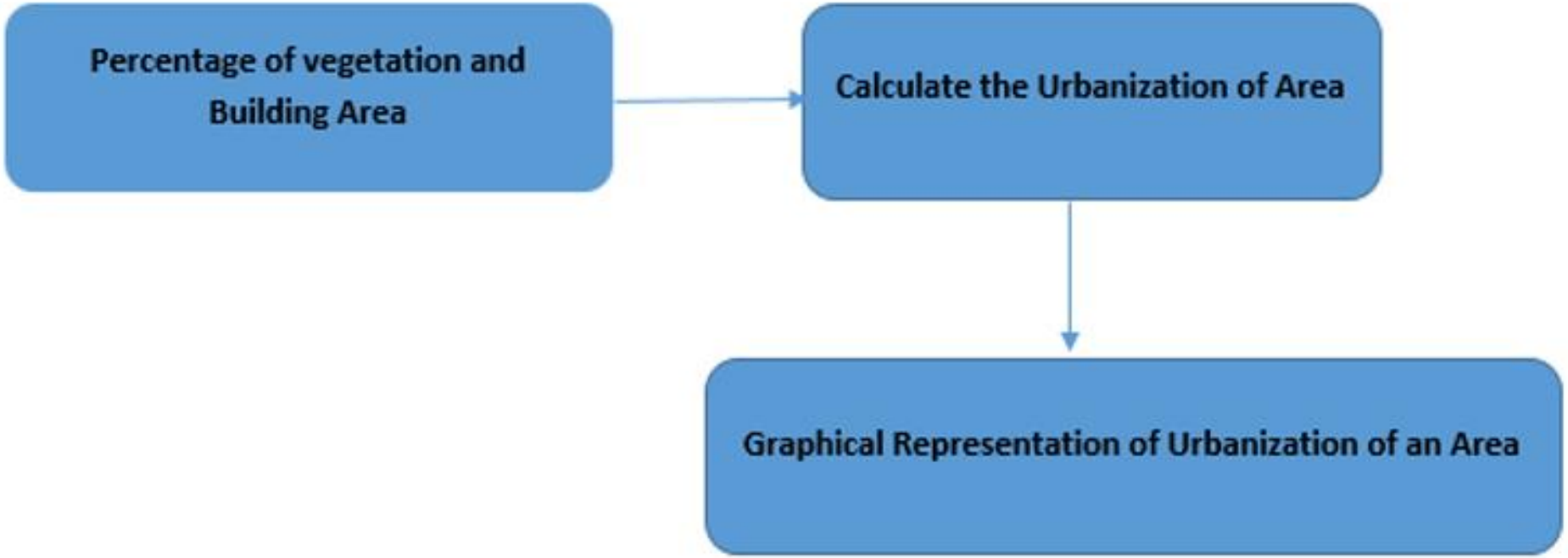
**Harris Corner Detector** is a corner detection operator that is commonly used in computer vision algorithms to extract corners and infer features of an image.



# Expected Outcomes

- Estimation of Urbanization of an Area.

- Visualization of development Graphically.



# References


**Satellite Imaginary-**

- Digitalglobe : http://www.digitalglobe.com/
- Geoeye : http://www.geoeye.com/

**Dataset-**

- Worldpop : http://www.worldpop.org.uk/

**Research Papers-**

- BigPixel : http://www.bigpixel.ucsd.edu/
- International Journal of Computer Applications Volume 145 – No.3, July 2016

# Work Distribution

**Piyush Kumar (BE/25032/14)**

- Vegetation extraction and estimation.

**Himanshu Changwal (BE/25012/14)**

- Building Detection and estimation.

**Rahul Kumar (BE/25013/14)**

- Clustering
- Graphical Representation.


Thank
you