CHAPTER 2
LITERATURE SURVEY

A number of papers were studied during this thesis work, which helps to understand the basic concept of edge detectors, functioning of different operator and main idea of thesis work. Some papers are discussed below

**John Canny**[3], In this paper computational approach to edge-detection was described. The success of the approach depends on the definition of a comprehensive set of goals for the computation of edge points. This paper defines detection and localization criteria for a class of edges and present mathematical forms for these criteria as functional on the operator impulse response then added to ensure that the detector has only one response to a single edge. After analysis to step edges, find that there is a natural uncertainty principle between detection and localization performance, which are the two main goals. With this principle derive a single operator shape which is optimal at any scale. The optimal detector has a simple approximate implementation in which edges are marked at maxima in gradient magnitude of a Gaussian-smoothed image and extend this simple detector using operators of several widths to cope with different signal-to-noise ratios in the image. This paper presents a general method, called feature synthesis, for the fine-to-coarse integration of information from operators at different scales. Finally it shows that step edge detector performance improves considerably as the operator point spread function is extended along the edge.

**Raman Maini, Dr. Himanshu Aggarwal**[6] are focused on study and comparison of various image edge-detection techniques. According to this paper Edges characterize boundaries are a problem in image processing. Image edge-detection significantly reduces the amount of data and filters out useless information, while preserving the important structural properties in an image. Since edge-detection is in the forefront of image processing for object detection, it is crucial to have a good understanding of edge-detection algorithms [20]. In this paper the comparative analysis of various Image Edge-detection techniques is presented. The software is developed using MATLAB 6.0.
Lijun Ding, Ardeshir Goshtasby\cite{8} work on the Canny edge detector and explain the Canny edge detector is widely used in computer vision to locate sharp intensity changes and to find object boundaries in an image. The Canny edge detector classifies a pixel as an edge if the gradient magnitude of the pixel is larger than those of pixels at both its sides in the direction of maximum intensity change\cite{19}. They show that defining edges in this manner causes some obvious edges to be missed. They also show how to revise the Canny edge detector to improve its detection accuracy.

Wang, Zhi; Li, Qingquan; Zhong, Sidong; He, Saixian\cite{12}, In this paper, an algorithm, based on finding edge region and background region in the gradient magnitude histogram plot, is proposed which is capable of performing hysteresis threshold fast and adaptively. Its effectiveness is demonstrated on a variety of images, showing its successful application to Canny edge detector. The results of the fast adaptive threshold Canny edge detector presented better output than the results of Canny edge detector with fixed threshold. Further tests are carried out on all sorts of real data using our method to select thresholds and get the good results. These demonstrate that the proposed algorithm is capable of performing hysteresis threshold fast and adaptively, often better than fixed upper and low threshold Canny edge detector that are run for comparison.

MEI Yue-song, YANG Shu-xing and MO Bo\cite{13}, In this paper, an improved edge-detection algorithm based on Canny operator is proposed in which Gauss filter is replaced by MTM filter. Then the parameters in the algorithm are studied. Experiment shows that the veracity of edge-detection is improved evidently, calculating quantity is reduced enormously, and a preferable result is obtained.

Li Er-sen, Zhu Shu-long and Zhu Bao-shan\cite{15}, On the basis of analyzing the conventional Canny algorithm, this paper advanced an adaptive edge-detection method based on the Canny operator. This method not only keeps the Canny’s good performance in good detection, good localization and only one response to a single edge, but also improves the capability of restraining the fake edge and the automaticity of edge-detection based on the OTSU’s thresholding method. Through experiments, it is demonstrated that the adaptive edge-detection method in this paper is very effective.

Yu Hongshan Wang Yaonan\cite{16}, Image edge-detection is the first step to obtain image feature. In this thesis, an improved Canny edge-detection algorithm is represented to
obtain thin and robust edges. Compared with ordinary Canny method, there are four improvements to reduce computation time and ensure detection accuracy. Firstly, 2-D Gaussian filter is decomposed into two independent 1-D filters, i.e. row filter and column filter, which allows calculate image gradient in parallel way. As a result, computation time is reduced highly. Secondly, the method uses two thresholds, to detect strong and weak edges, and includes the weak edges in the output only if they are connected to strong edges. This method is therefore less likely than the others to be fooled by noise, and more likely to detect true weak edges. Thirdly, on-maximum suppression principle is adopted to detect true edges. Finally, edge thin operation is conducted based on morphological operator to obtain single pixel level edge. The effectiveness of the proposed method is demonstrated through practical experiment.

**Shuai Wan, Fuzheng Yang and Mingyi He**[^18], Despite the prevalence of conventional methods for gradient-threshold edge detection, the underlying global threshold is not adaptive to the image content with respect to the human perception. To address the inherent challenges, local thresholds are adaptively selected in this paper taking into account the activity masking characteristic of the human visual system. The selected local thresholds are then utilized for edge labeling in the gradient image. Extensive experimental results have demonstrated the effectiveness of the proposed method for edge-detection in perceptual quality.

**Praneeth.Ch, Srinivasa Rao V, Srinivas.K**[^26], they are worked on Image Edge-detection using Adaptive Filter[^11], they describe the Canny edge-detection technique is a multi-stage algorithm which is an optimal edge-detection technique. But it removes noise in an image using Gaussian filter to become insensitive to noise. The Gaussian filter smoothes even the edges in the images so that the throughput is decreased. That is some of the true edges may be missed and false edges may appear in the edge detection. They proposed the Adaptive smoothing filter for noise reduction which preserves the edges while smoothing the given image. Since adaptive filter preserves the edges, the rate of detection of true edges will be more and the false edge-detection will be less. Compared Gaussian filter with the adaptive filter yield better result[^11]. It has been widely used in image segmentation, pattern recognition and image analysis.
Ping Zhou, Wenjun YE, Yaojie Xia, Qi WANG\textsuperscript{[27]} An Improved Canny Algorithm for Edge-detection are illustrated in this paper, they explain edge-detection is an important part of digital image processing. They discusses the basic theory of edge detection, its method based on the traditional Canny operator, and proposes an improved algorithm based on the eight neighborhood gradient magnitude to overcome the disadvantages of being sensitive to noise in the calculation of the traditional Canny operator gradient \textsuperscript{[12]}. The two thresholds of the traditional Canny operator need manual setting, so there are some defects to different images. They put forward an adaptive threshold calculation by OTSU method. The experimental results prove that this improved method can effectively detect the edge of the image. And the continuity of the edge is strong, and positioning accuracy is high.

Gao Jie, Liu Ning\textsuperscript{[29]}, An improved adaptive threshold Canny edge-detection algorithm are discuss here \textsuperscript{[8]}, It has proposed an adaptive threshold edge-detection algorithm in this paper, which applies the bilateral filtering that has the advantages of edge-preserving and noise removing firstly. Then it uses OTSU, which is based on gradient magnitude to maximize the separability of the resultant classes, to determine the low and high thresholds of the Canny operator. Finally, the edge-detection and connection are performed. The experimental results show that this algorithm is practical and reliable.

Xiaoju Ma, Bo Li, Ying Zhang, Ming Yan\textsuperscript{[32]}, To solve the problem of the traditional Canny edge-detection operator has the weaknesses in excessive smoothing image and adaptability, and improved the parameter Sigma and the method to obtain high threshold. Experiment did on gray image of two cases with noise and without noise. The experimental results show that the improved Canny edge-detection operators can balance eliminating noise from getting more edge information, which has the well continuity of the edge detection, and can detect the edge detail of the image. According to the image adaptive calculation, the improved algorithm has the advantage of low computational complexity, less calculation time.

Miss Hetal J. Vala, Prof. Astha Baxi\textsuperscript{[34]}, they discuss about. Image segmentation is the fundamental approach of digital image processing. Among all the segmentation methods, OTSU method is one of the most successful methods for image thresholding because of
its simple calculation. OTSU is an automatic threshold selection region based segmentation method. This paper studies various OTSU algorithms.

Kang Yan, Fochi Wang, Zhongyuan Zhang, Ningcai Li, Fangcheng Lv\[35\], edge-detection of composite insulators hydrophobic image based on improved Canny operator are discussed in this paper. They explained the detection of hydrophobicity is an important way to evaluate the performance of composite insulators, which is helpful to the safe operation of composite insulators. Image processing technology is used to judge the hydrophobicity of composite insulators, which makes detection results more accurate and overcomes the subjective drawbacks of traditional detection method. As the traditional Canny operator requires manual intervention in selecting the variance of the Gaussian filter and threshold. First, the adaptive median filter replaces the Gaussian filter, which can eliminate the impact from the variance of Gaussian filter and remove noise according to the characteristics of the image itself. Then the OTSU threshold method is used to select the best threshold automatically, which makes the edge-detection be more continuous and reduce the presence of fake edges. The results depicted that the operator is applicable to all hydrophobic images.

Biman Debbarma and Dibyendu Ghosha\[37\], a Modified Canny Edge-detection Algorithm with Variable Sigma are present in this paper. According to this paper Canny Edge Detector is the most widely used and studied edge-detection algorithm because of its robustness to noise. In this paper a modified Canny Algorithm has been proposed which uses variable sigma for different parts of the image. Edge-detection literally means finding edge points of an image or finding discontinuity in an image. Edge-detection is of great importance as a good edge-detection technique. It improves the performance of other processing units. Various approaches have been adopted for detecting edges e.g. The Marr-Hilderth edge detector, Local Threshold and Boolean Function Based edge detector, Canny Edge Detector etc.

Sunanda Gupta, Charu Gupta, S.K. Chakarvarti\[38\], this paper gives review on Image Edge Detection, Edge-detection is important part of image processing for object detection. So it becomes extremely important to have a good understanding of edge-detection algorithms. An edge is the real or imagined line that marks the limit and divides of plane, object or appearance from other places or thing [5]. This means that if the edges
in an image can be identified accurately, all of the objects can be located and basic properties can be measured. This paper introduces a classification of most important and commonly used edge-detection algorithms, namely Sobel, Robert, Prewitt, Laplacian of Gaussian, Canny.

Rashmi, Mukesh Kumar and Rohini Saxena\textsuperscript{[39]}, an edge may be defined as a set of connected pixels that forms a boundary between two disjoint regions. Edge-detection is basically, a method of segmenting an image into regions of discontinuity. Edge-detection plays an important role in digital image processing and practical aspects of our life. In this paper, various edge-detection techniques are describe as Prewitt, Robert, Sobel, Marr Hildrith and Canny operators. After comparing them performance of Canny edge detector found better than all other edge detectors on various aspects such as it is adaptive in nature, performs better for noisy image, gives sharp edges, low probability of detecting false edges etc.

Geng Hao, Luo Min, Hu Fen\textsuperscript{[40]}, they worked for improved self-adaptive edge-detection method based on Canny. In this paper they describe edge-detection is an important topic in digital image processing, image analysis and recognition. The edge is not only the basic feature of an image and the important basis for the image segmentation, but also is the important information source of the texture feature and the basis of shape quality analysis. The premise of obtaining the clear object contour in traditional Canny operator is to set appropriate parameters, does not have the adaptive ability. They proposed an adaptive Canny edge-detection method which based on Canny theory. Maximum between-class variance method is used to obtain the high and low thresholds. With the diagram they showed that, their algorithm gave good edge detection.

A.M. Khan and Ravi. S\textsuperscript{[41]}, they describe about segmentation\textsuperscript{[41]}. Image segmentation is the fundamental step to analyze images and extract data from them. It is the field widely researched and still offers various challenges for the researchers. This paper tries to put light on the basic principles on the methods used to segment an image. This paper concentrates on the idea behind the basic methods used. Image segmentation can be broadly be categorized as semi-interactive approach and fully automatic approach and the algorithms developed lies in either of this approaches. Image segmentation is a crucial step as it directly influences the overall success to understand the image.
Mohamed Abo-Zahhad and et al\textsuperscript{[42]}, They presented edge-detection with preprocessing approach. Edge-detection is the process of determining where boundaries of objects fall within an image. So far, several standard operators-based methods have been widely used for edge detection. However, due to inherent quality of images, these methods prove ineffective if they are applied without any preprocessing. In this paper, an image preprocessing approach has been adopted in order to get certain parameters that are useful to perform better edge-detection with the standard operators based edge-detection methods. The proposed preprocessing approach involves computation of the histogram, finding out the total number of peaks and suppressing irrelevant peaks. From the intensity values corresponding to relevant peaks, threshold values are obtained. From these threshold values, optimal thresholds are calculated, Simulation results are presented to show that our preprocessed approach when used with a standard edge-detection method enhances its performance. It has been also shown that applying wavelet edge-detection method to the segmented images, generated through our preprocessing approach, yields the superior performance among other standard edge-detection methods.

D. Poobathy and Dr. R. Manicka Chezian\textsuperscript{[43]}, in this paper they describe the Edge detection methods which is available for pre-processing in computer vision. Canny, Sobel, Laplacian of Gaussian (LoG), Robert’s and Prewitt are most applied algorithms. In this paper, they compare each of these operators by the manner of checking Peak signal to Noise Ratio (PSNR) and Mean Squared Error (MSE) of resultant image. It evaluates the performance of each algorithm with Matlab and Java. The set of four universally standardized test images are used for the experimentation. The PSNR and MSE results are numeric values, based on that, performance of algorithms identified. The time required for each algorithm to detect edges is also documented. After the Experimentation, Canny operator found as the best among others in edge detection accuracy.

Tamilselvi Nagasankar and B. Ankaryarkanni\textsuperscript{[45]}, the objective of their work is analyzed the various edge detection algorithms to find the best and worst performance of edge detection algorithm. Edge detection is an important and basic operation to be completed for any image processing activities, image analysis, pattern recognition on various images such as satellite images, medical images etc. The performance of the
edged image is measured using the entropy and signal noise ratio. High entropy and SNR values specified the high quality of the edged image and the low values indicated the low quality of the image. Making a deep analysis on various edge detection algorithms is really worth enough in Image processing. Five commonly used edge detection algorithms such as Prewitt, Sobel, Robert, Log and Canny are consider for analysis. From the analysis, it is identified that Canny edge detection algorithm is performing better among the five algorithms. Out of the five image information, Canny algorithm on Dither binary image information yields the high entropy and SNR values.

**G.Bhuvaneswari and Dr.V.Subbiah Bharathi**[46], In this paper, they have undertaken a study to compare the performance of different acquisition methods in edge detection. The traditional way of image acquisition provides several restrictions in trying to depict depth as the two-dimensional nature of images are captured. The proposed image acquisition method helps us to reveal the depth information for further processing.

During thesis work, after reading various papers, Canny method gives good results as compare to Sobel, Prewitt, Robert and others method. These years, many researchers bring forward the advanced method of the Canny detector but on the entire practice because wrong selection of threshold level affect the quality of output image for further process and performance of edge detector is degrade. OTSU methods work on threshold level, in which whole image divided in to foreground and background, these methods provides good results than previous methods but the difficulty of choosing of proper threshold is still there, because while taking the two level of threshold some pixel value was not in countable, so some improvement is needed in OTSU method. So, multi-level threshold method can be use to get better results.