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Image Vehicle Classification Based on Adaptive Edge Detection & PCA Method

A DISSERTATION

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CHAPTER 1

INTRODUCTION

In this chapter the common aspects of the research is discussed. These aspects include the vehicle recognition phenomenon along with associated approaches and operations. These approaches includes the segmentation, feature extraction, object modelling etc. The chapter has presented the relative recognition model in most of the pattern recognition system.

1.1 Recognition System Model

Image processing is having the significance in digital system environment to provide the information transition based on the behavioural analysis. The basic image processing activity is the recognition system. This operation itself defined as a model in which most of the image processing operations are involved in an integrated way. Here figure 1.1 is showing the recognition model.

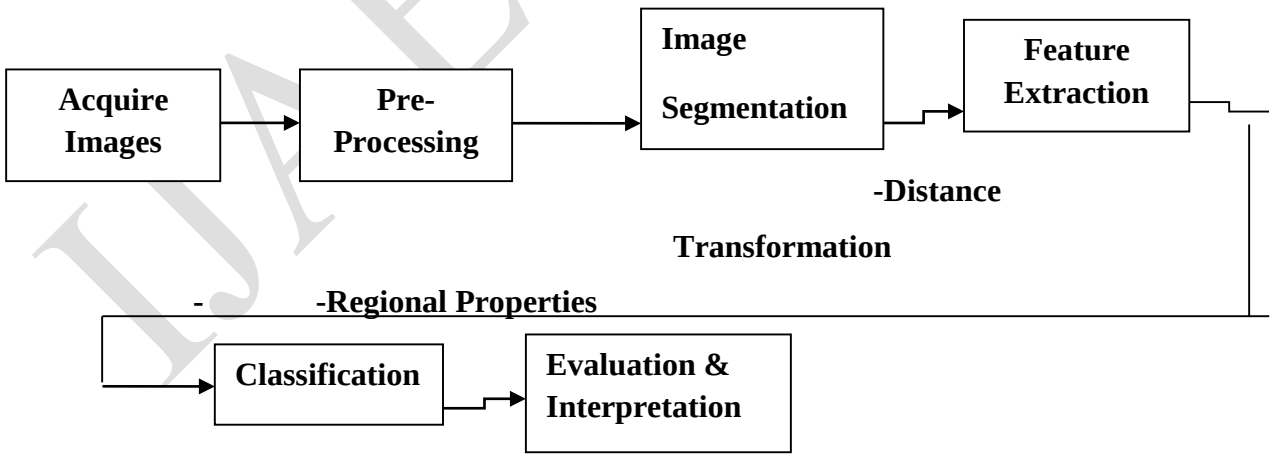


Figure 1.1: Recognition System Model

1.1.1 Image Acquisition

It is the process defined to capture the object image from real environment. The object image extraction is done in real environment using some scanner device. This scanner device can be a camera or some other image extraction device. The image acquisition is the prior stage of this model to perform the effective and relative recognition over the system. The image acquisition also described the reliability and accuracy of the dataset. More effectively and accurately the image is acquired, more accurate results are expected from the system. The work is here defining don the image processing dataset along with certain application specific description. The vehicle image extraction can be done using high resolution camera. The acquisition process also requires setting the device configuration so that the image will be obtained in required form.

1.1.2 Pre-processing

Image improvement is here defined to repair the distorted or impure images. Sometimes the acquired images or the available image set is not an idle image set. This kind of dataset has some variation over the images or some kind of distortion in different respect. Some of examples of these kinds of impurities include

- Noise level distortion
- Image format variation
- Image Resolution based variation
- Blur Image
- Color Unbalancing
- Contrast Unbalancing

To work on the dataset, it is required to define a normalize dataset so that the image processing will be done effectively. The pre-processing stage is defined before any

image processing activity to resolve these all kind of variation over the dataset. The improvement to the image can be done under following vectors

- Size level standardization
- Noise Reduction
- Image Equalization etc.

The improvement over the image can be done through multiple associated filters. Some of these filters include

1.1.2.1 Smoothing Filters

This filter is defined to remove the noise level distortion or the contrast balancing over the image. The image blur effective, sharpening effects can be reduced using smoothing filter. The specific filter is defined to reduce the uncertain image variation at the pixel level analysis so that the improvement to the image pixels will be obtained. The most common type of filter form is the mean filter or the median filter. This filter is effective to remove the hills and valleys in the histogram of image.

1.1.2.2 Neighbourhood Filters

This filter is defined as defined as the mathematical filter in which the window over the image is by keeping the center pixel as the result pixel. The aggregative operation is applied based on the window pixel. The pixels of this window are defined as the neighbourhood points to the center pixel of the window. The aggregative value obtained from the operation defined is then placed on the center pixel. The iterative analysis is defined to generate the pixel level analysis on neighbour pixels so that the pixel element based processing will be done. The neighbour filter is also a generalized form of smoothing filter. According to the type of aggregative filter there are different forms of these filters.

1.1.2.3 Histogram Equalization

Histogram is the graphical or the graph based representation of the intensity values over the image. This method is defined to analyze the image under occurrence and context level analysis. This histogram is here defined under graph level processing defined under different vectors. In this graph form, the x axis represents the frequency range and y axis representation the number of pixels available in that particular intensity range. If the image is not equalized, the image will have the valley or the hill in based histogram representation. As the equalization model is applied over the intensity level adjustment to the image is done. The dynamic range specification based image adjustment will be done to improve the image features so that the effective image representation will be obtained.

1.1.2.4 Scaling Filter

The scaling vector based improvement to the image so that the contrast level improvement over the image is obtained. Author analyzed the visualization features of image and analyzed it under stretching effect. The intensity change over the image pixel is observed during this stretch operation. The image intensity span is here analyzed to provide the linear value adjustment so that the pixel level improvement over the image is obtained. The normalization under this vector is required to achieve the resolution level equalization and robustness. The scaling model is also effective so that the adjustment to the image pixel casting will be obtained under pixel shift mechanism. The computational environment based pixel setting can be adjusted to improve the image features and to reduce the information loss during stretch operation.

1.1.2.5 Cast Image Filter

This is another pixel level filter defined to provide the conversion of image from one form to other. This filter is defined under the intensity level formation so that the image conversion and type adjustment will be done effectively. This filter is defined using the formula

Result_Pixel= (RequiredForm) (InputPixel)

The casting is required to achieve format level or data level robustness so that the transformation from one form to other can be obtained.

1.1.2.6 Rescale Intensity Image Filter

This filter is defined as the mapper to the image sale so that the range level conversion can be obtained. If the image size is modified or the switching to the pixel form is done, the transformation of individual bit format is done for the image. This filter provides the pixel level transformation under cast and scale effect.

1.1.2.7 Shift Scale Image Filter

This filter provides the positional shift over the image pixel. The switching can be here performed to achieve linear transformation based image switching of pixel switching. This form is defined under shift operator. The formula based representation of this linear filter is given here as

$$ResultPixel = (InputPixel + ShiftVal) \acute{}ScaleVec$$

1.1.2.8 Normalization Image Filter

This filter is defined to transform the image to the normalized form. The normalization can be here defined as the vector to transform the input image form to the standard image form. This form is based on the image intensity analysis and the pixel value analysis. The statistics level analysis over the image is performed to achieve the transformation to the unit vector so that the image level scaling can be obtained and normalized under filter specification. This filter is also defined under the clustered value so that the spatial change to the intensity value can be obtained to obtain key point based analysis.

1.2 Image Segmentation

Segmentation is the primary image processing activity defined to extract the image feature under attribute level derivation. The segmentation specific image division is defined to generate the various regions over the image. The subdivision based

analysis is here defined under problem domain and application domain specification. The thresholding is applied to extract the relative volume specific image segment over the input image. This segmented region is obtained under intensity level transformation so that the intensity point based image derivation will be obtained for input image. This kind of extraction also includes the intensity evaluation so that the image feature improvement will be done and the specification to the image pixels will be obtained. This derivation is based on the uniformity analysis on the object point under region specification and structural evaluation. This analysis also based on the global thresholdng and the segmentation like behaviour. The analysis is here been performed under non uniform value evaluation so that the pixel level derivation will be obtained from the work.

1.2.1 Edge detection

The edge detection is the type of segmentation operation defined to identify the boundaries over the object image. The effective vehicle area identification is one the core operation can be defined using edge detection technique. This approach is effectively defined with specification of object change identification so that the image level derivation so that the derivation so that the relative information derivation under object region identification and uniform region generation is defined. This area identification and edge extraction approach is defined under availability vectors so that the image type and the edge type derivations will be obtained to represent the edge features of image.

1.2.2 Watershed Segmentation

This is the algorithmic representation to perform the segmentation under mathematical model specification. This method is based on the intuitive behaviour based transformation applied on the topological behaviour of the image. The image point level extraction and the detection of the falling terrain over the image are done to obtain the watershed lines over the image. This image so that the catchment based mapping is here defined to achieve the relative and effective information derivation at

edge points. The gradient point based analysis is here performed to generate the key points over the image.

1.3 Vehicle Recognition

The vehicle detection comes under application defined to perform the object identification in moving video. Vehicle is the most common and most important feature recognition method used in many application such as surveillance camera, traffic monitoring and classification This method is having importance in various control systems, business application, human computer interfacing. This recognition is also defined to achieve the feature recognition under vector specification so that the cooperative target based recognition will be defined for the image. This form of image recognition can be defined to generate the effective information form so that the effective system identification will be done.

1.4 Problems in Image Processing

As the image is captured from the raw source it can have number of associated impurities. These impurities can occur because of device fault, faulty capturing process and the procedural information updation. These all operations collectively gives the information loss that can degrades the performance of various associated operations.

1.4.1 Image noise

The noise definition is here defined so that the distributed particle based impact is applied over the image. Noise basically affects the color information and the brightness values so that the image intensity is modified over the image. The noise can occur because of camera or the scanner problem. This problem can be physical and in the internal circuit of the devices.

The noise degrades the image quality so that some of important information of image can hide and gives information loss at various pixel points. The significant information change over the image can be obtained as the image quality is improved

and the effective information image can be obtained from the actual image. This kind of image information can be derived under low contrast information specification so that the image information can be improved effectively.

1.4.2 Image sharpening

Sharping the image problem that highlights the image edge point at certain level by incrasing the brightness or contrast at those specific points. The sharpening operation affects the image features at various level so that the effective image filteration can be applied over it. This kind of image level improvement can be obtained by adjusting the kernel value so that the image level distrotation can be obtained. In some cases to extract the image features the sharpening operation can be applied over the images. The kernel matrix for sharpening process is given here under

$$\begin{bmatrix} -1/9 & -1/9 & -1/9 \\ -1/9 & 1 & -1/9 \\ -1/9 & -1/9 & -1/9 \end{bmatrix}$$

The sharpening the image processing activity that actually perform the image level transition to identify the image quality and extract the features so that the improvement over the image can be obtained. The edge value analysis so that the visual effects over the image can be obtained. This kind of fileration is also effective to reduce the blur effects over the image. The image improvement can also be obtained so that the feature distribution and equalization will be obtained. The pixel level improvement can be here obtained under lighter image derivation and to achieve the image enhancement so that the relative improvement over the image will be obtained.

1.4.3 Image Restoration

The Restoration is the process to improve the discrimitive properties of image by applying the retouching operation. This operation is basically to enhance the image features so that the image information will be obtained back from the imag itself. This

stage also includes the generation of image photography under the drepresentation of printing requirements for the image. The content level editing and creative maintenance over the image is applied to improve the image features so that the effective information derivation will be obtained from the image.

This kind of improvement not only improve the physical strength of image but also improve the accuracy of asscoaited image processing operations. The process level properties are here defined under variation analysis so that the associated image features will be obtained from the image. This kind of derivation is specified under image registration so that the defects over the image will be repaired. The focus problem over the image can be adjusted to obtain the featured data and eliminate the non required elements over the image. This operation is defined under rectification of data image so that the image operations can be improved. The properties of image given here under

- Improve against noise
- Resolve unequal brightness problem
- The improve image resolution
- Improve Brightness over the Image
- Improve the color information over the image
- Repair the associated patches.

1.5 Image Segmentation

Segmentation is the intermediate process defined by most of the image processing application to extract the image information under different aspcts. These aspects includes the identiifcaiton specific image area, extraction of image features, analysis on the image etc. The segmentation is performe specific to the asscoaited application and the process.

Segmentation can be performed by using two main approaches called region assisted segmentation and pixel specific segmentation. In case of region assisted segmentation, the region area specification is here performed to obtain the information area over the image such as separation of background, extraction of vehicle image, extraction of region ROI etc. The second type of segmentation is pixel based segmentation generally used to extract the image features. These features are here defined in terms of intensity level specification and evaluation so that the exploration to the effective image area will be done. This kind of information extraction can be done to improve the image part so that the image information based properties can be obtained to generate the effective featured image. This kind of information extraction can be obtained under effective information derivation so that selective information will be process. Because of this selective information, the reliability and efficiency of the segmentation process is also improved.

1.6 Image Segmentation Techniques

1.6.1 Thresholding

It is the most simplest method defined with range or the limit specification to accept the image pixels. This kind of specification is defined under specification of the condition to discard the selected image pixels. An intelligent approach or observation si required to take the decision about thresholding.

1.6.2 Clustering Methods

Clustering is the blind classification process in which data values are divided in certain groups but there is no specification of group name. The clustering begins with the specification of number of clusters and the distance level comparision is defined to identify the cluster members. The basic process adapted by any clustering algorithm is given here under

1. Define N number of clusters along with estimated centers.

2. Perform the difference analysis between the centers and data values present in the pool

3. Select the cluster to member based on minimum distance analysis to the cluster center.

4. Take the average distance of all clusters data to the center.

5. Updat the clusters based on averaging and repart from step 2.

1.6.3 Histogram-based Methods

Histogram is the processing activity defined under specification of segmentation process. Here the mutti pass based approach is defined to control the data processing under histogram specification. The pixel difference based intensity analysis is here deifned to generate the relative measures so that the updation to the system image will be obtained. This method also improve the image feature by providing the equalization on image pixels and also reduce the vally case over the image so that the balanced image will be presented.

1.6.4 Edge Detection

It is the another form of image segmentation or feature representation to identify the boundary level analysis over the image. The identification of effective region over the image is done under object value selection so that the derivation to the image will be done under information analysis. The segmentation is based on the effective image area specification so that the object boundaries will be generated in relative and significant way. This information processing can be generated under image value analysis so that the derivation to the work will be done under specification of data values. The effective object part is defined using edge detection approach.

CHAPTER 2

REVIEW OF LITERATURE

In this chapter, the work defined by earlier researchers is described. The chapter includes the literature study on different classification method applied for vehicle detection and class identification. These methods are based on image level classification as well as video based recognition and classification.

Kanwal Yousaf [1] defined a comparative study on different vehicle recognition and classification approaches. Author defined the work on different associated applications. This application includes surveillance method, security system analysis, traffic recognition, congestion avoidance, accident detection. Author defined the algorithm for vehicle classification and recognition. Author defined the algorithmic approach for evaluation of the vehicle in the videos as well provides the method to perform the identification of vehicle class. The work also includes the identification of algorithmic study on different algorithmic approaches. These methodologies include the parameter level study based on different performance metrics so that the effective vehicle identification and classification will be done. Author defined the work using probabilistic classification method that can provide more effective and accurate object detection. Author used the physical characteristics of vehicles as feature vector to perform effective classification. The classification includes the wheel distance analysis, wheel height analysis and vehicle structure analysis.

Mohamed Elhoseiny[2] defined a work on video surveillance system to classify the available objects in multiple classes. Author defined the work some specialized applications including the road safety application, parking application and baggage applications. Author defined the work on object detection and recognition so that the reliable scene based recognition can be obtained. Author defined work on surveillance video processing includes the low resolution image processing and occluded object processing. Author used the PCA based entropy analysis to generate the image features and to analyze the vehicle class identification based on configuration analysis.

Ghada S. Moussa[3] defined a geometric feature analysis approach for attribute selection and vehicle type identification. Author generated the work on economic prosperity analysis so that the vehicle class for road feature identification will be done. Author defined the fact driven analysis applied on feature class generation based on vehicle category identification. Author presented a hybrid method on geometric and appearance adaptive feature class generation. Author presented the work on multiple class based analysis as well as provided the intra class identification so that the vehicle generation will be done effectively. Author used the vehicle classification under geometric and appearance attribute analysis so that the multiple class based experimentation will be obtained. Author generated the vehicle class and provided the intra class classification so that the sub class of vehicle will be obtained. Author obtained the potential feature class generation based on the vehicle class identification.

Suresh Babu Changalasetty[4] presented a work on moving vehicle classification. Author defined the road density analysis so that traffic control and the traffic density control for the cities will be identified. The work is here defined for the specific road monitoring. This kind of analysis includes the video surveillance system based processing so that the traffic management based work will be optimized for vehicle detection and classification. Author provided the work on traffic management and scene management with setting up the stationary camera on the road. Author presented the region and vehicle based communication so that the image sequence analysis will be performed. Author defined work as the layered model in which at first the background separation will be performed to identify the vehicle area. Once the vehicle ROI is tracked, the vehicle classification is performed to perform the recognition or classification of videos. Author identified the vehicle measures in terms of vehicle length, width, area, perimeter etc. This also includes the vehicle feature extraction and once the feature set obtained, the classification is performed using neural network approach. Author applied the work in weka environment. This paper defined the survey based analysis so that the cost of the recognition and classification will be reduced.

M.Vineela[5] presented a work on video stream processing using Bayesian network approach. Author defined the enhanced security mechanism to identify the target vehicle and based on which the aerial surveillance mechanism is proposed. Author improved the vehicle processing and detection algorithm. Author also provided the study on various associated algorithms so that the color level features generation. Author presented a video stream adaptive feature extraction approach for vehicle feature based classification. These features include color extraction, color transformation, edge analysis, and movement analysis. Author used the moment preserving method along with Bayesian network approach to generate the vehicle class. Author defined the feature inclusive method to extract the pixel level information so that the neighbor region generation will be obtained. Based on this adaptive investigation, the vehicle class can be identified from the captured video.

Zhiming Qian[6] defined a work on multiple vehicles tracking on a video. Author defined the vehicle detection and tracking using multiclass SVM and PCA classifiers. Author defined the set as the training and testing set and performed the vehicle sequence based recognition applied on the traffic scenes. Author provided the vehicle class identification using the traffic scenes. Author defined the sample set based training information analysis applied to perform the vehicle recognition and classification. Author defined the sequence frame analysis under traffic observation to achieve the effective recognition. The feature set is here generated using SIFT method.

Yan-shuang Hao[7] presented a work on road vehicle classification using extreme learning method. Author defined the work on traffic scene analysis and provided the security and transportation management under extreme learning method. Author improved the classification results by analyzing the movement based on the edge feature analysis. Author obtained the fast and satisfactory results.

E. Michaelsen[8] presented a work on structural analysis defined on the local features and provided the thermal form generation on the videos. The video detection is here based on the movement effective analysis applied on the planner graphics transformation model. Author obtained the results using eigen value analysis applied

to generate the average gradient from the image and perform the feature localization so that the effective recognition will be obtained. Author generate the finer level classification based on the adaptive feature analysis. Author obtained work on four called fix structure based analysis, risky structure, rejection class and the vehicle queue.

Habibu Rabiu[9] presented a work on vehicle recognition and detection based on the urban intersection analysis provided for the vehicles. Author obtained the traffic monitoring based application so that the predictive method will be applied for vehicle detection and classification. Author used the kalman filter approach to generate the feature segments and extract the features from the image. These features are here defined the form of vehicle extraction. Later on LDA classifier is applied to perform the detection and classification. Author obtained high recognition rate.

Mehran Kafai[10] presented the work on vehicle classification over the video using Bayesian network approach. Author defined the significant subject analysis so that the study based generation and the autonomous navigation based on the traffic analysis will be obtained. Author defined the security feature based analysis so that the video vehicle classification can be obtained. Author defined work on four vehicle classes called truck, SIV, sedan and unknown vehicles. Author generated the feature set based on the dimension analysis. Once the analysis is obtained, the feature set is generated. The hybrid Bayesian network is applied to perform the recognition. The feature vector based analysis is here obtained under the vehicle class formation so that the accurate class will be obtained. Author applied video on a larger video set and obtain high accuracy rate.

Longbin Chen[11] presented a work on integrated moving object classification applied on surveillance videos. Author analyzed the key features from the videos and obtained the real world conditions such as shadows, imagery objects, distortion analysis, arbitrary camera positions, mapping to the people group etc. Author obtained the analysis on discriminative features and generates the object information based on the histogram difference gradients. The feature set based on the distortion is later on defined on different camera views and provided the adaptation to generate the

information object based on the performance class. This performance class is based on the environmental adjustments and provided the effective recognition respective to the dataset specification.

Michael H¨odlmoser[12] provided the work on pose estimation and classification on the feature modeling applied based on discrete features. Author provided the feature classification and pose estimation under vehicle analysis so that the 3D model will be obtained from the video. Author generate the rank based features and provided the temporal view analysis based on the consecutive frame analysis and its refinement based on the vehicle type analysis. Author generated the solution under optimization problem with effective space and time analysis. Author generates the non convexity to the problem so that the initial point based formulation will be obtained. Author generate the optimized solution under future analysis obtained from the videos and provided the potential domain access so that the effective feature evaluation will be obtained from the work. Author provided the frame adaptive analysis applied on the feature points to render the video objects. Author also provided the global interference analysis for object recognition.

Amol Ambardekar[13] provided the vehicle detection and tracking for the surveillance system. Author provided the application adaptive vision performance improvement approach so that the improvement to the recognition process in the real environment will be obtained. Author analyzed the video under parameter aspects with traffic scene specification with spatial view analysis and real time video derivation. Author generated the primitive geometric features from the video and provided the positional plane analysis for model based vehicle detection and classification. Author obtained the vehicle sequence under foreground object detection, speed estimation and classification.

Ryan P. Avery[14] provided the vehicle detection based on the image length based video camera estimation. The accurate camera activity is here monitored under the frequent video frame analysis and the video vehicle identification. Author distinguished the video and the vehicle frame identification and classification. The length adaptive vehicle classification and the image stream analysis so that the

capturing to the video camera can be obtained. Author defined the work on language classification. Author defined a work on the actual observation so that the proposed algorithm.

Hakki Can Karaimer[15] presented a work on vehicle classification based on the directional video analysis based on the temporal average analysis. Author defined the work on classification method under shape based estimation. Author defined the application decision based approach for vehicle level classification. Author defined the decisional estimation based on wrong decision and poor extracted features. Author defined a work on decision boundaries so that the feature space will be generated from the video.

Xue Mei[16] defined a work on vehicle tracking and classification based on the sparse feature generation and representation. Author defined a method on vehicle tracking so that the particle filters framework generation. Author also handled the critical challenges such as occlusion, noise and challenging feature analysis. Author defined a work defined work on sparse feature space generation and tracking under the target monitoring and template generation. Author also propagates the results based on the visual features. The recognition is here based on the target monitoring based feature tracking in moving vehicle.

Brendan Morris[17] provided the work on vehicle tracking for video streaming and provided the work on camera processing based on the target monitoring. Author provided the availability under the tracking algorithm with large volume information set. Author defined a query adaptive mechanism for vehicle type classification. Author provided the image measurement and classification based on the feature tracking and merging so that the relative recognition and classification. Author defined the work on the traffic resolution analysis based on the tracking approach.

Jeffrey B. Flora[18] defined a work on image based classification so that the vehicle monitoring and tracking under the model specification. Author defined the work on pipelined so that the analysis to the vehicle detection and segmentation so that the adaptive recognition will be obtained. Author defined the feature adaptive analysis

based on the morphological so that the properties and histogram feature generation and feature adaptation will be obtained. Author defined the multi class analysis so that the support vector machine and classification. Author defined the SVM based classification under three classes. The video sequence classification and tracking so that the speed and relevancy analysis with different parameter formation so that the vehicle formation and tracking will be obtained. Author defined the work on tracking so that the speed feature analysis so that the speed feature so that the feature generation so that the tracking to the video will be obtained.

Sarfaraz Masood[19] has defined a worm on gabor filter adaptive classification approach for neural network. Author defined the access control mechanism under building and parking lot specification. Author defined a vehicle class identification method based on the feature adaptation. Author obtained the feature class and provided the visual object generation so that the feature tracking and feature formulation will be obtained in a generalized way. Author provided the work on adaptive variability analysis and object image generation. Author provided the feature adaptive visualization system for vehicle tracking and generating the functional aspects.

Yiling Chen[20] provided the work on video based vehicle detection and classification so that the vehicle scenario generation for videos will be obtained. Author defined an intelligent transportation system so that the tracking to the video under feature generation. The Gaussian mixture model so that the classification part analysis so that the SVM based fuzzy approach so that the recognition and classification will be performed. Author defined the adaptive model for recognition.

Susmita A. Meshram[21] provided the work on traffic formulation and classification and vehicle formulation. Author provided the traffic vehicle classification and video processing. Author provided the classification model under vehicle count generation and formulation. Author defined the thresholding model and provided the object formulation so that the vehicle tracking will be done.

Celil Ozkurt[22] provided a work on traffic density estimation under vehicle classification and tracking approach. Author provided the work on the surveillance system for neural adaptive recognition. Author defined the traffic management and monitoring for vehicle traffic analysis so that the density so that relative tracking so that the vehicle classification and the recognition will be performed.

IoanaSporea[23] has defined a work on spiking neuron based learning approach under neural network to perform the classification. Author analyzed the image under machine learning approach under impact of spikes over the image. Based on the spiking feature generation model, the linear predictive modeling is performed by the author. Based on this, the image feature is defined as the bench mark and the recognition process is performed over it. Author analyzed the work on many realtime imageset including iris dataset.

RianoLorenzo[24] has defined a work on spiking neuron based pattern recognitioin using neural network. In this paper, Author identify the pattern level anlaysis under pattern description and recovery so that the unsupervised learning results will be obtained from the work. Author defined a layered model to identify the image features and later on perform the recognition on the basis of real time feature modeling. Author presented the work as the relative information architecture based on the firing neuron.

Matthias Oster[25] defined a work on Saccadic Recognition system based on spike based analysis. Author applied the temporal information analysis under specification of information derivation from biometric ratinal image. The derivation is here performedunder moment level analysis defined for output encoding scheme. This scheme is here defined to control the object movement and provide the relative information generation so that the information classification based on the spiking values will be obtained effectivively.

QingXiangWu[26] has presented a spiking neuron based work on knowledge representation and learning mechanism. Author presented an intelligent system to perform knowledge discovery and data mining. The work was presented as an

intelligent system based on the neuron identification so that the intelligent information processing so that the computational phenomenon based information derivation will be obtained. Author defined a work on logic rule based derivation so that the model specific recognition process modeling will be obtained so that the computational analysis will be obtained under effective data extraction. Once the feature points are obtained, the mapping to the result dataset is performed to identify the relative mapping over the database system.

Susumu Nagatoishi[27] has defined a work to improve the performance vector for pattern sequencing. Author defined the work as the pattern learning process so that the sequence generation based neuron selection process is defined under weight learning approach.

Yan Meng[28] defined a work on human activity detection under spiking neuron to regulate the gene defined network. Author defined a reliable classifer to identify the temporal feature sover the image and perform the weight effective analysis to generate the gene regulatory network so that the neural specific development will be obtained from the work.

Jae-sun Seo[29] has presented a model based on the CMOS features and specification of architectural constraints to the environmental constraints so that the learning method over the network will be obtained under scalibiltiy vector. Author defined a learning effective approach to generate the image features so that the informationtrainision will be obtained. Based on these neuron features, the recognition process is performed and improved.

Qiang Yu[30] has defined a work on pattern recognition using spiking neuron based model to achieve time effective information model with machine leanring process. Author presented the peromance network based derivation applied on real time characters to sthat the relative pattern recognition will be obtained over the pattern image.

Kshitij Dhoble[31] has presented a work on temporal pattern based recognition system under spiking neuron based recognition. This vector includes the event representation, rank ordering and neuron learning. Author provided a dynamism to the feature environment so that the information spikes will be obtained and the real information encoding will be done. The machine learning mechanism is here defined under accurate information transition.

Nimish Kale[32] has presented the sensor replacement based human activity recognition under distance analysis so that the daily activity monitoring will be done effectively. A feature vector based work is defined to perform the monitoring and to configure the server at low level. Author applied the real time object activity recognition on image set based on the configurational analysis applied on rotated images. Author achieved the practical formation of motion analysis so that the sensor effective recognition will be obtained from the work. Author derived the body orienteation based recognition to improve the recognition model so that the sensor data improvement will be done.

Soumitra Samanta[33] has presented a detection and description based space time defined activity classification approach for detection of movement over the video data. Author defined a three dimentional model to geneate the space time based analsyis so that the interest analysis can be obtained. This kind of information derivation can be obtained under interest point analysis so that the video data processing based classification will be obtained from the work.

Kyungseo Park[34] has defined a behavior analysis based recognition system in real environment to identify the abnormal human activity. Author presented the behavior analysis so that that eventual analysis over the image will be obtained. Author map the scoring values under information aspect anlaysis so that the temporal aspects based analsyis will be obtained and determine the threhsolding under episode value derivation and information classification the relative aspects.

Georgios Goudelis[35] has presented a facial poses based video sequence analysis approach to obtain the facial pose estimation in video sequences. The proposed a

work based on the pose level estimation the algorithm under mutual information anlaysis under pose invariant analysis so that the view angle based recognition will be obtained from the work.

M. Mahmoud[36] has defined a behavior identification based dissimilarity analysis approach to analyze the abnormal behavior. Author observed the activity recognition based on the abnormal behavior analysis defined in an intelligent environment. Author applied the distance level similarity analysis so that the derivation to the stable values to the environment is obtained. Author mapped different distance method including hamming method, fuzzy effective method and the abnormal pattern analysis to geneate the information behavior so that the relative image recognition will be obtained.

Yingying Zhu[37] has presented the activity recognition based spatial context analysis approach for activity recognition. In this paper, Author presented an intelligent mathematical model to analyze the information context based on observation analysis and provided the information activity based derivation so that the information object will be recognized in more accurate form. The object derivaitona nd the learning process under attribute value analysis is here defined based on the testing distance analysis. Author also provided the model constraint specification for parameteric evaluation so that the prediction over multiple dataset will be improved. Author also provided the optimization the information extraction process under weight adjustment so that the relative information gain will be obtained from the work.

Nikolaos Doulamis[38] has defined a motion estimation based work under time and space analysis to identify the person fall. Author defined an integrated system to consider the camera specification so that the information tracking will be done under visualization effective properties adjustment with situation aspect specification . Author provided the combined framework based estimation to extrac the object image by background elimination. Author also increased the accuracy rate in scene level identification.

Toshiaki Miyazaki[39] has defined a work on human motion estimation and path identification under human movement path in a room. In this paper, Author defined the algorithmic model to identify the moment of multiple persons under visual sensing and relative hardware level adjustment.

Medhat H. A. Awadalla[40] has defined a work on neural network based spike generation to obtain the pattern chart estimation and recognition. In this paper, spiking neural network architecture is proposed to be used for control charts pattern recognition (CCPR). Furthermore, enhancements to the SpikeProp learning algorithm are proposed. Author also defined the multiple vectors based learning rules with some constant parameters includes the neuron thresholds. These parameters can be adaptive to improve the work in generalized environment. Here the environment specification are baed on the neuron modeling.

JieYang[41] has defined an effective sign and translation recognition system. Author provided the sign level recognition so that the information object will be translated over the system. Author defined the detection and recognition mechanim under specification of the relative language. The sign language specificaiotn and relative object identification is here been performed under user centric evaluation so that the capability specific object identification will be done. To explore these capabiltes, the feature extraction is applied over the image.

EunjuKim[42] has defined an assurance specific activity recognition system. In this work, Author defined a work on differentiative analysis so that the activity over the obect will be identified under significant object generation and the relative information object exploration. Author also provided the experimental analysis so that the recognition ratio will be improved.

Derek HaoHu[43] presented a work on activity recognition to achieve multiple goals. In this article, Author identified the fundamental isuess and relative solution so that the accurate object identification will be done. Author anlyze the complexities under different levels so that the recognition accuracy over the complexities will be improved for the associated system specification. Author presented the work as the

model to identify the discrimitve features over the image and generate the modle based on the huge information derivation. Author analyzed the geometry of the image to take the decision about the recognition process.

CHAPTER 3

PROPOSED WORK

3.1 Problem Definition

Image classification is having its significance in various application areas to identify the object and the object category. As the quality or resolution of the images increases as well as size of image pool increases, efficiency becomes a challenge. The criticality of this recognition process increases in case of real time identification. According to this real time recognition, the object image is identified from captured images. The real time object category taken in this work is for the vehicle class. The presented work is about to recognize the vehicle object from the real time images. These images are captured from the real time videos. The work is also classifying these vehicle objects in terms of heavy vehicle, light vehicle and medium vehicles.

In this present work, an improved feature adaptive model is defined to perform the vehicle classification. The presented work is divided in three main stages. In first stage, the normalization over the image will be done. This normalization stage will improve the image features. In second stage, the normalized image will be process to extract the image features. In this work, the edge features will be collected. To generate the edge features canny method or Robert algorithm will be implied. Based on this edge level analysis, the feature extraction can be done. In final stage, PCA will be applied to perform the vehicle classification. The vehicles will be classified in this work in terms of heavy vehicle, light vehicle and medium size vehicle. The work will be implemented in matlab environment. The work is about to improve the recognition rate.

3.2 Significance of Work

The presented work is here defined as an improvement to the existing work under following aspects

1. The work is here defined on real time environment so that images are collected from real time scenarios.

2. The feature adaptive approach will be able to provide the better recognition rate.

3.3 Objectives

The proposed work is defined under following objectives

1. The main objective of work is to define a three stage model for vehicle class identification.

2. The objective of work is to obtain the feature set from the vehicle images using edge adaptive method.

3. The objective of work is to apply PCA model to identify the vehicle class.

4. The objective of work is to improve the recognition rate.

3.4 Data Source

The presented work is here applied on the vehicle classification. The work first obtain the real time videos and later on obtain the object images by performing the frame separation. Finally a real time vehicle dataset is obtained. The properties of this dataset is shown in table 3.1

Table 3.1 : Dataset Properties

Properties	Values
Type of Images	Vehicle
Source	Primary
Raw Form	Video
Processed Form	JPG
Resolution	1280x720

Image Type	Color

3.5 Research Methodology

In this present work, an effective vehicle classification approach is defined from real time images. The presented work is defined as a layered model. In first layer of this model, the preprpcessing will be done to improve the image features. In second stage, the feature selection over the image will be done by extracting the edges from the image. In this stage, Gaussian filter and frequency analysis approach will be defined to extract the image features. This stage will transform the imageset in the statistical feature set. At the final stage, PCA will be applied to obtain the vehicle class.

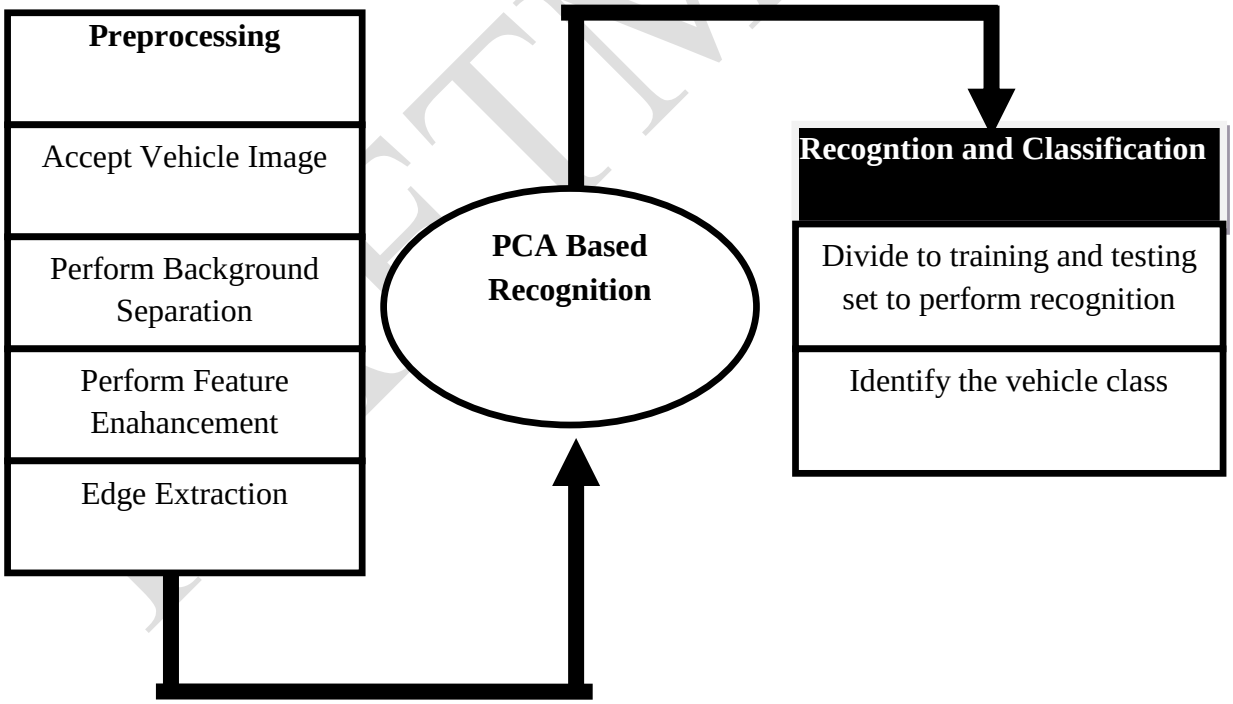
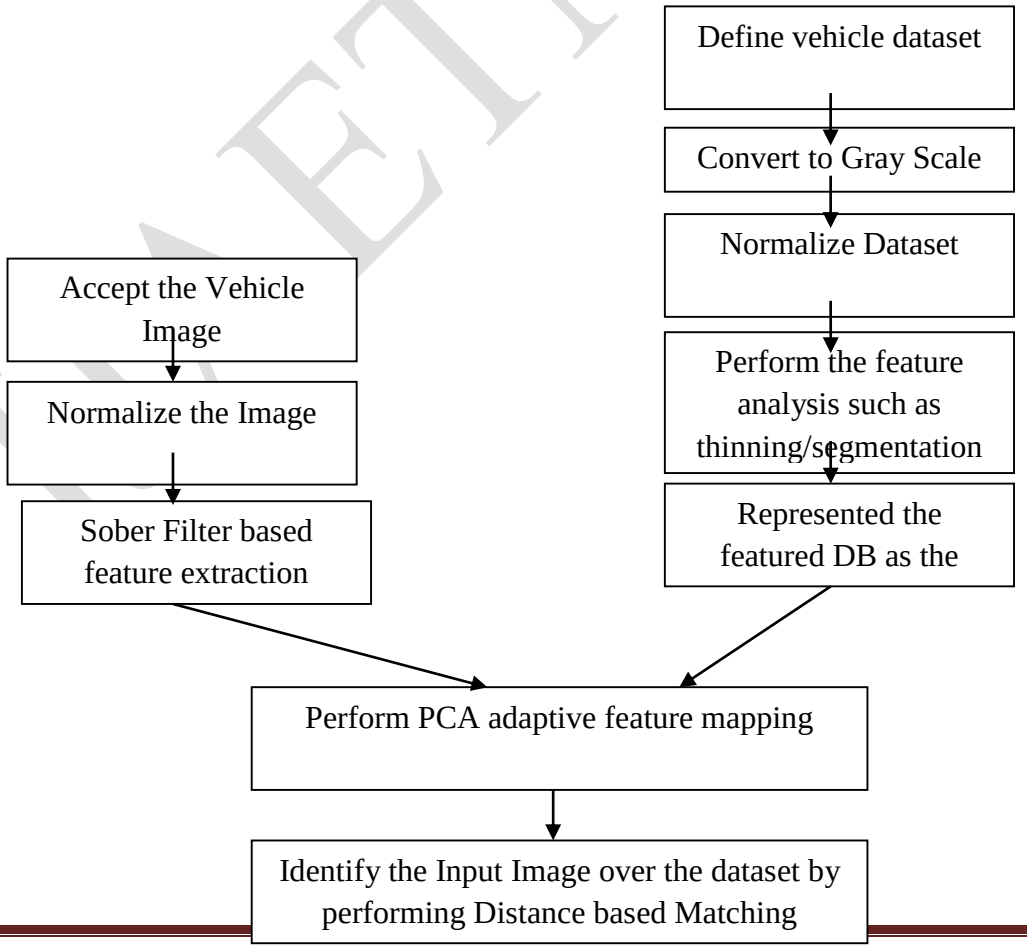


Figure 3.1 : Proposed Model

The figure 3.1 here shows the presented model to perform the recognition of vehicle as well as to identify the relative class. The classes are here divided in terms of light vehicle, heavy vehicle and medium size vehicle. The light vehicle here includes two

vehicles such as bike, scooter, cycle etc. Medium size vehicles includes car, auto etc. The heavy vehicle includes truck, bus, tempo etc. The presented work model has taken an image set as the training set. On this training set the set of operations are defined. These operations include normalization and the feature extraction. The edge adaptive features are here extracted using canny filters. Once the featureset is obtained, the input image is taken and process in same way. The feature adaptive map is here performed to perform the recognition. The adaptive PCA model is here applied to perform the recognition. To recognize the image, each of the database image is mapped with input image and the maximum mapped image is considered as the mapped image. This filter is applied after analyzing the performance and accuracy of various filter extraction approaches. In final stage, Adaptive PCA approach is applied to perform the classification. The classification is here done to identify the vehicle type i.e. to identify the heavy vehicle, light vehicle or medium size vehicle. The proposed model for the recognition or classification is shown in figure 3.2



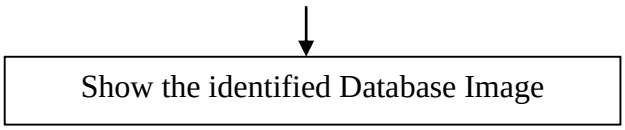


Figure 3.2 : Model

As the work is performed on real time images so that the preprocessing stage taken much time in this work. The preprocessing itself divided in multiple stages. In this preprocessing stage, a series of operators are applied. In final stage, the Canny filter is applied to extract the features of the frames.

This feature extraction stage is also applied for the dataset images. Based on which the featured dataset is generated. This featured dataset work as the training set and the input object features work as the test set. Now adaptive PCA is applied to perform the classification of vehicle. The approach is applied with specific parameters so that effective recognition of vehicle and vehicle class is done. The PCA approach is here applied to perform the vehicle class recognition

Canny filter has identified the connected features over the image and this connected featured set is used by distance adaptive mapping. The maximum mapped image is here taken as the result image and taken as the final result. The complete model is shown in figure 3.2

3.5.1 Accept Vehicle Image

The vehicle images are one of the most complex forms of vehicle recognition. These real time vehicles having the variation in terms of pose and illumination. The first requirement is to collect the appropriate dataset with less number of such variation. Higher the variation more difficult will be to recognize the vehicle and relative class. Once the imageset is taken, the next work is to accept the image in defined image format.

3.5.2 Improve Image Features

The second stage of work is to improve the image features. To improve the features, the requirement is to convert the image to normalized form. Once the enhanced image is obtained, using size level and contrast level adjustments. To improve the features, the histogram equalization is applied.

3.5.3 Feature Extraction

In next stage of this model, the feature extraction model is applied in this work. The feature extraction is here done using using edge adaptive model. In this work, the individual features are extracted using canny edge identification model approach.

3.5.4 Recognition

In the final stage of this model, the adaptive PCA based featured map model is applied to perform the recognition. This model is based on the distance adaptive analysis and the mapping ratio. The weighted model is here defined based on the individual feature map of input image with image dataset. As the image is mapped the recognized image is identified. Based on this image, the image class is identified.

3.6 PCA

Adaptive Principal Component Analysis (PCA) is the feature adaptive model based on the distance relative to the database images. The distance anlaysis is here applied on the featured imagset. The intensity adaptive weighted feature map is performed on individual input image with all dataset images. These dataset images are identified to perform the relative recognition. The image that provided the maximum map with dataset image is considered as the recognized image. Once the image is recognized, the next work is to identify the vehicle class. In this work, distance adaptive weighted approach is applied for the same. The work is defined using three different vehicle classes. These classes are light weight, medium weight and the heavy weight vehicles.

CHAPTER 4

RESULTS

4.1 Tool : Matlab

Matlab is used here as the simulation language that provide the interactive environment to provide quick and accurate results. Matlab is a product of Mathworks that includes the scientific software package integrated to provide the mathematical computation and provide graphical visualization so that result representation can be improved. For image processing, Maltab is having vast range of function to provide the effective information processing. Matlab provides the integration in the form

- Easy way to processing different image formats
- Provide work on different color model
- Provide work on different bit system
- Provide analytical function to analyze the processing quality
- Provide graphical representation of results
- Provide the adaptability to the videos
- Video frame processing in image form
- Feature extraction methods are integrated
- Statistical methods are integrated

4.2 Datasets

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The work is here applied on video datasets in raw form as well as in transformed statistical form. The selected datasets for this work are given here under in figure 4.1. The datasets are here defined in different image forms.

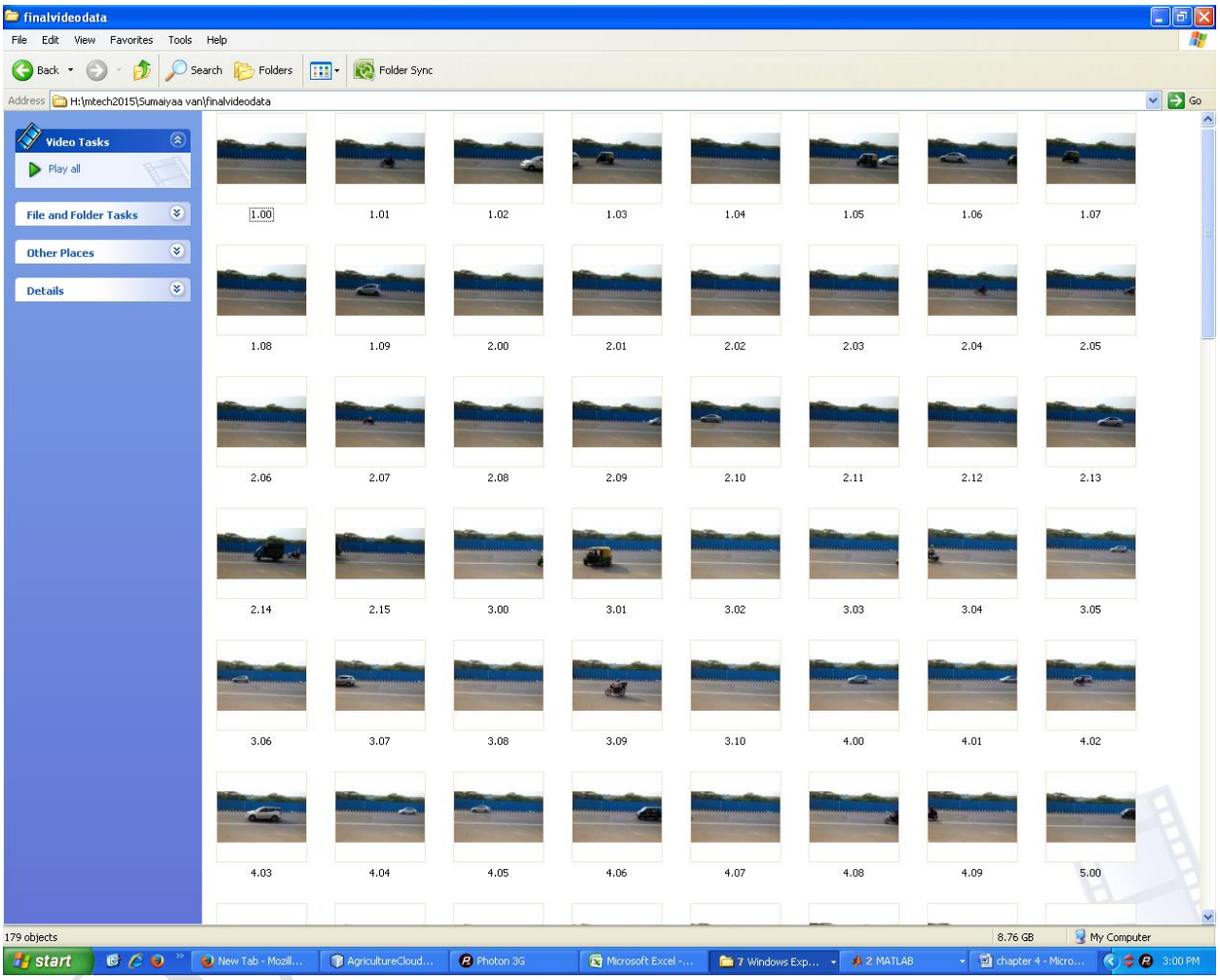

Figure 4.1 : Video Set

The figure 4.1 is showing the vast video set taken in this work. This video set is in AVI form. The raw forms of videos were in MP4 form. The conversion to the required form is done to process the video for vehicle classification.

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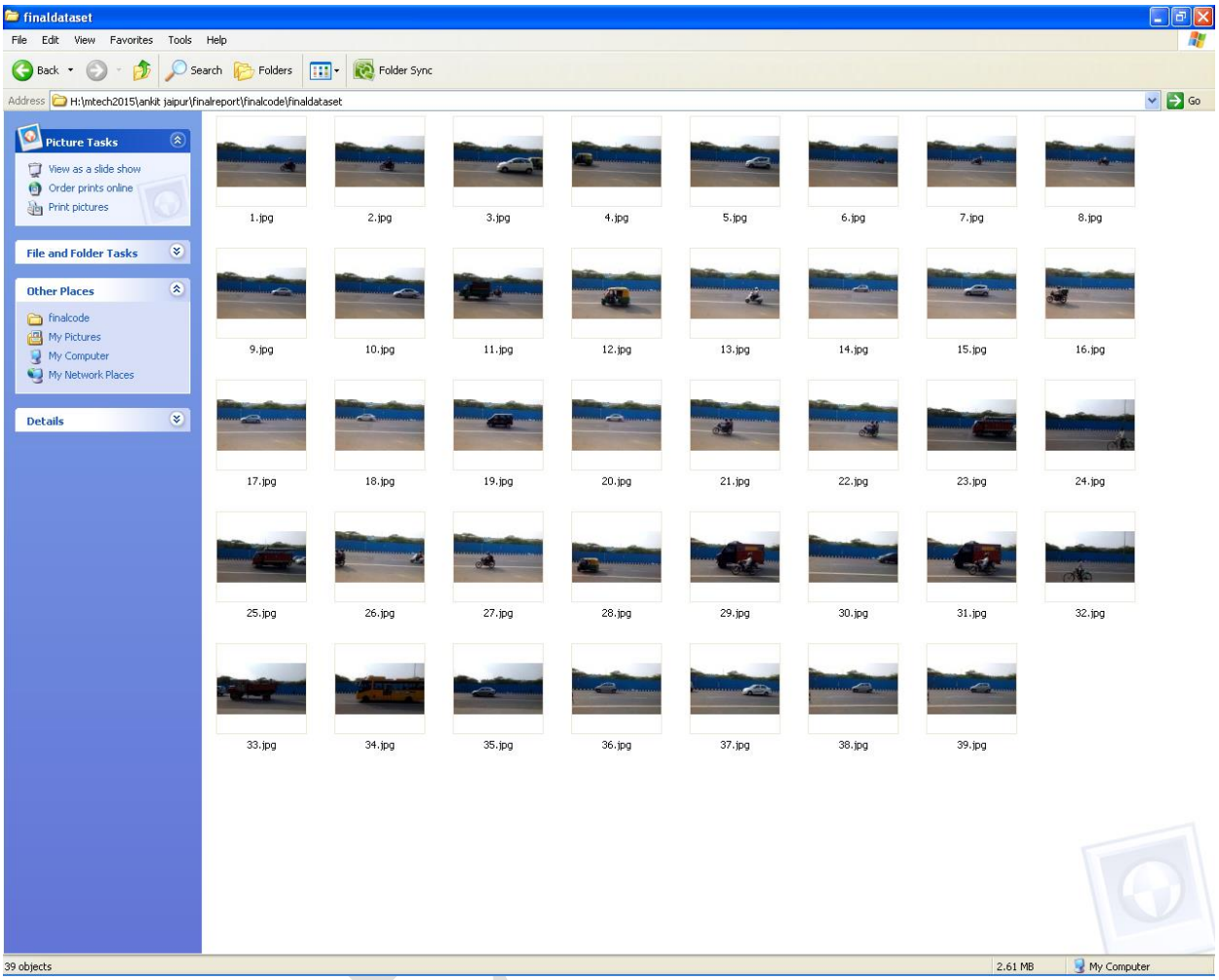

Figure 4.2 : Image Dataset

As the raw video images are collected then the first stage of work was to obtain the vehicle object image. By using the video splitter, the images are extracted and a dataset of images is formed. The recognition is here applied on this dataset instead of videos.

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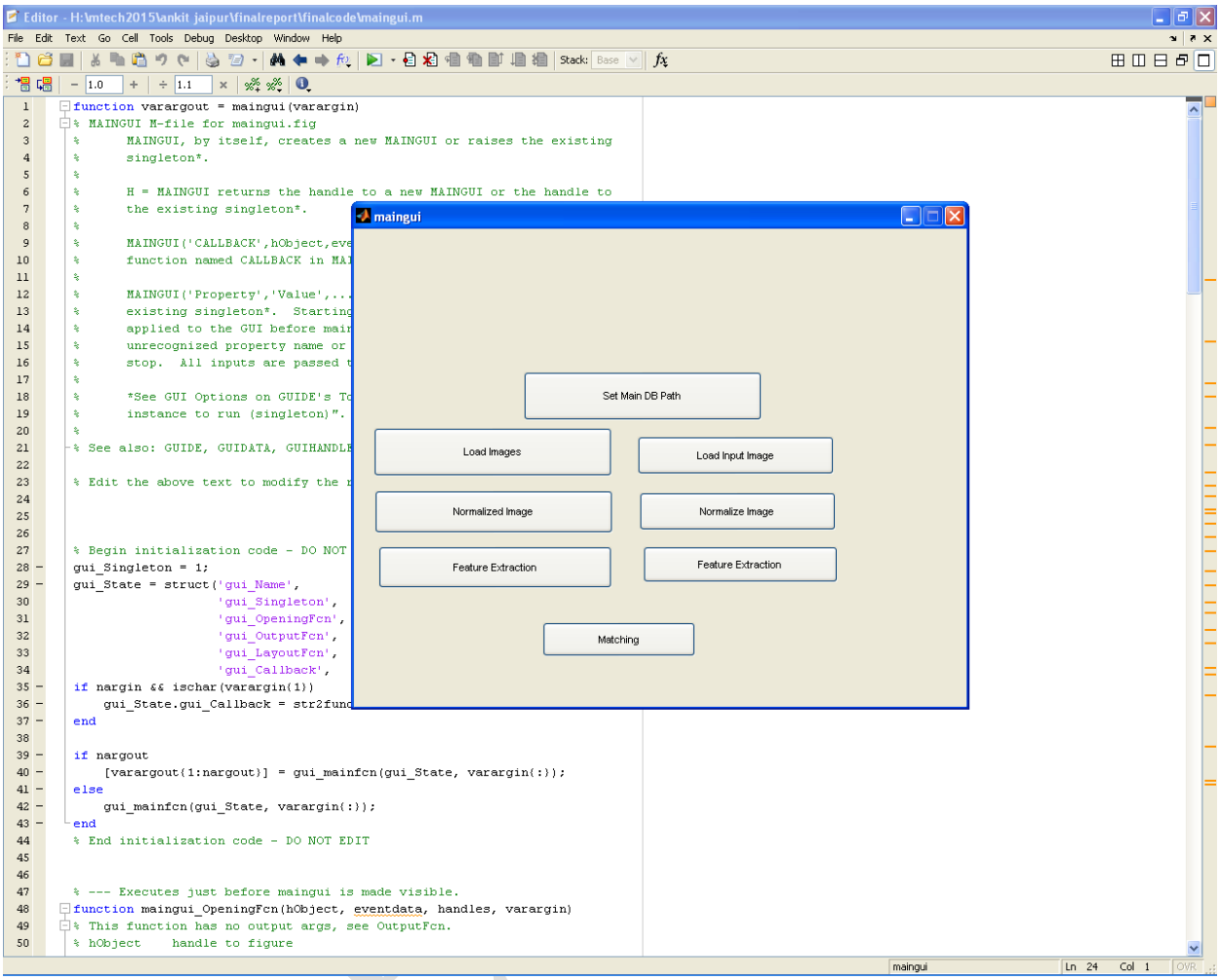

Figure 4.3 : Graphical Interface

Here figure 4.3 is showing the graphical interface to present the work with relative stages. The figure shows all the stages of process model in the form of buttons. The complete work is here divided in two stages, first to process the dataset and second to process the input image. Finally, the recognition algorithm is applied to identify the vehicle and the vehicle class.

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4.3 Dataset Processing

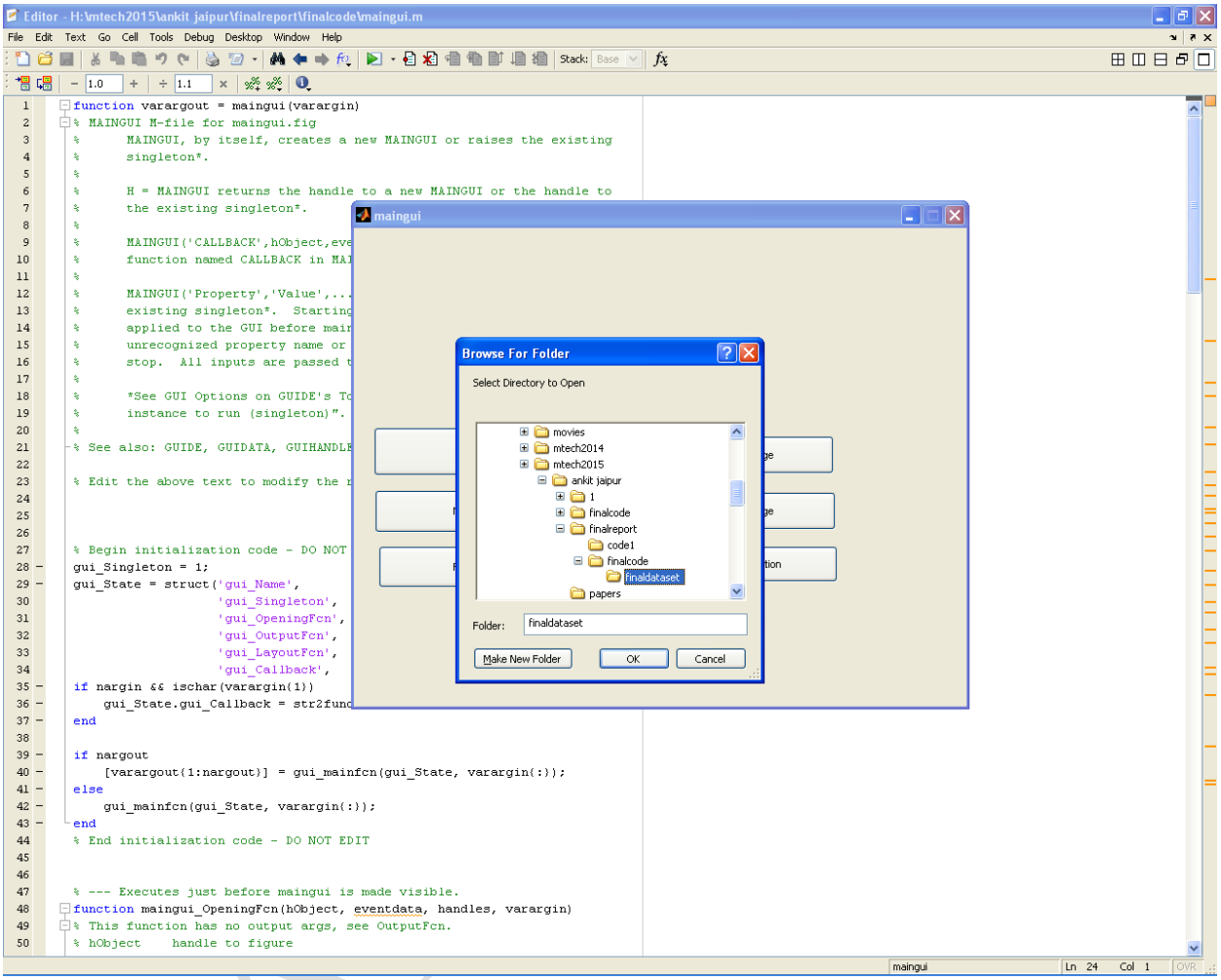

Figure 4.4 : Select Dataset Path

Her figure 4.4 is showing the graphical interface to select the database. The database is here defined with vehicle images. The figure showing the user friendly and robust way to load the images.

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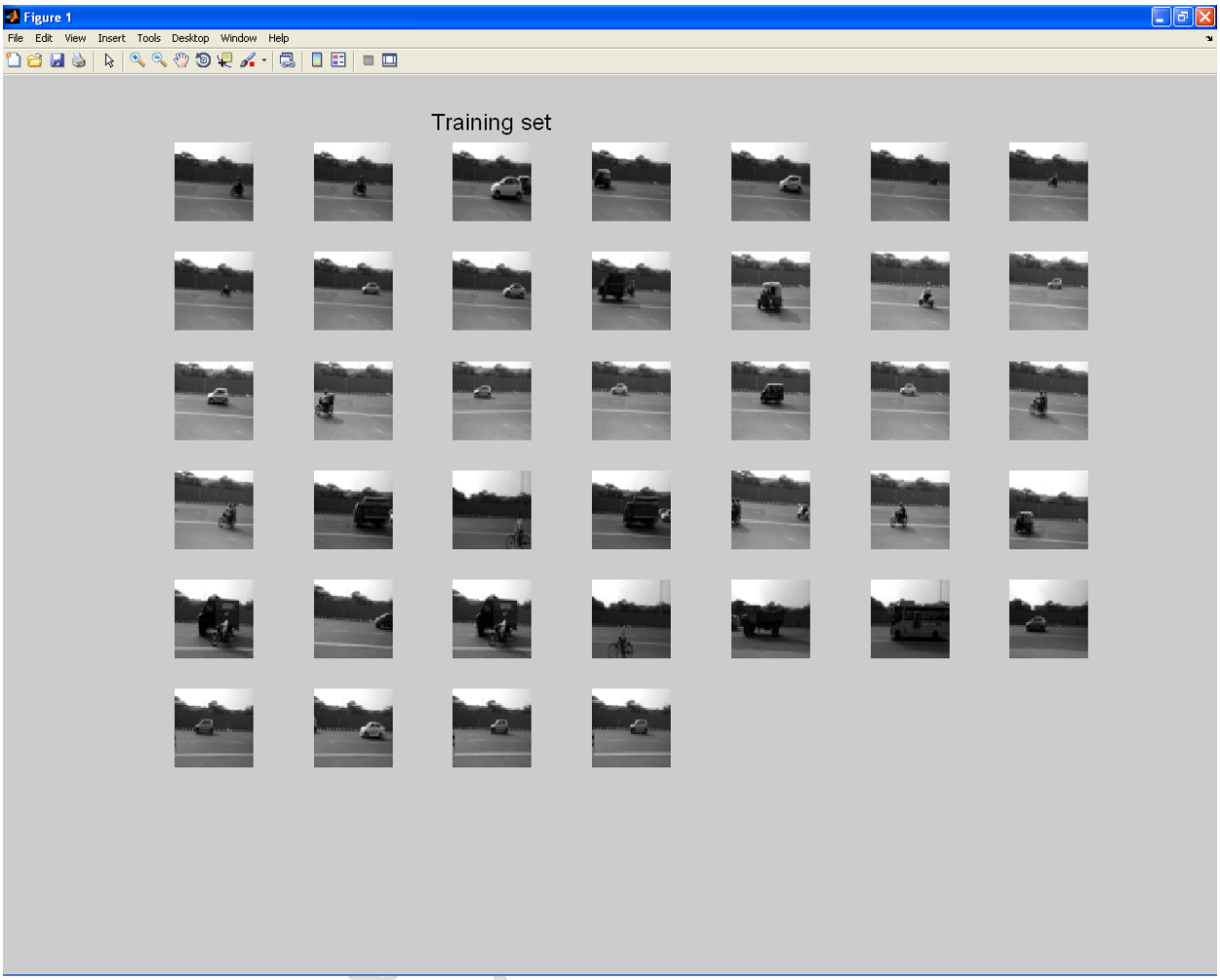

Figure 4.5 : Dataset Images

Here figure 4.5 is showing the loaded images from the dataset. The actual database images are color and the figure is showing the grayscale transformed images. The images are here of different vehicles including different vehicle classes.

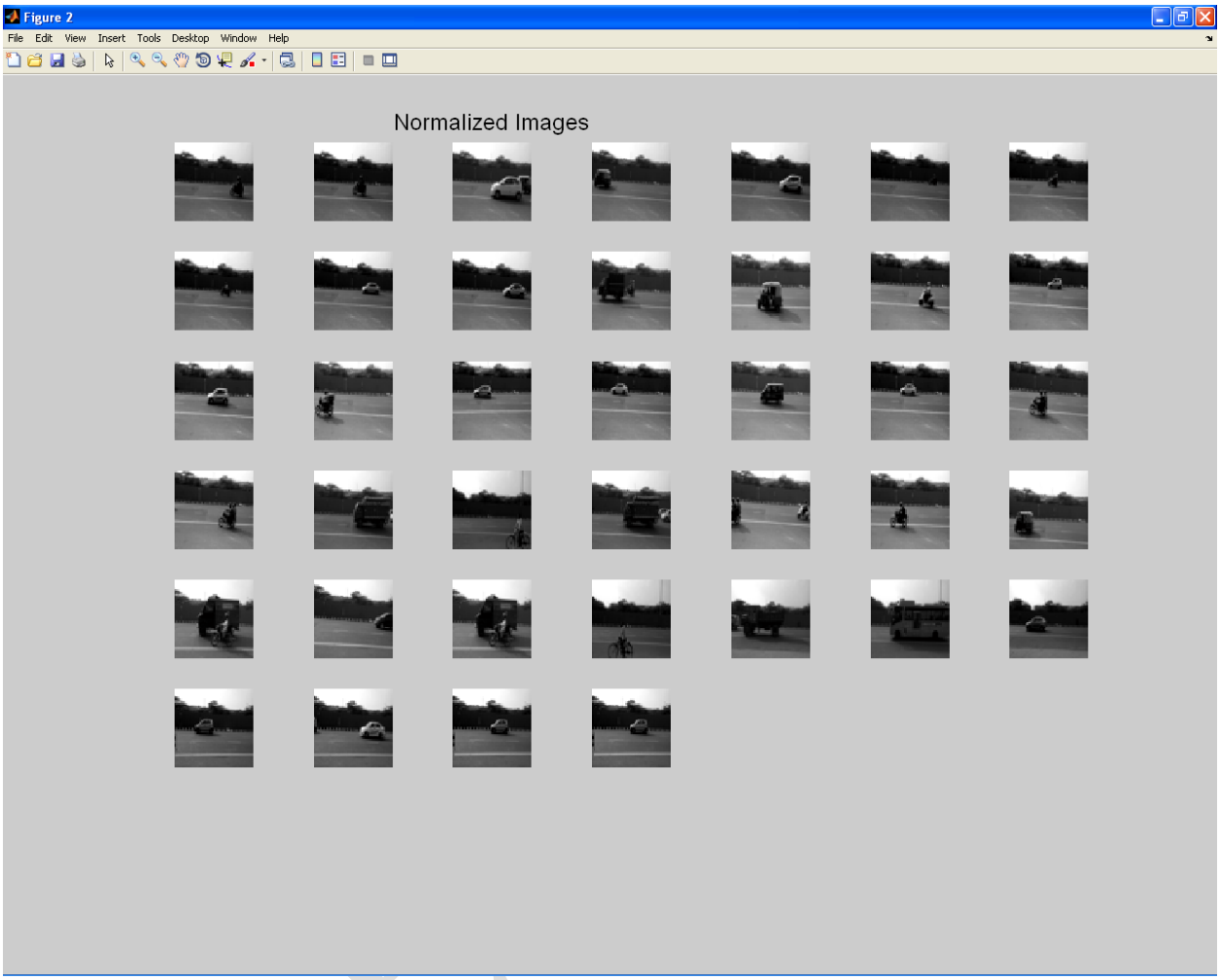

Figure 4.6 : Normalized Image set

Here figure 4.6 is showing the normalized imageset obtained from actual imageset. The normalization is here obtained in terms of image size and the contrast of image. The image features are here improved using histogram equalization method.

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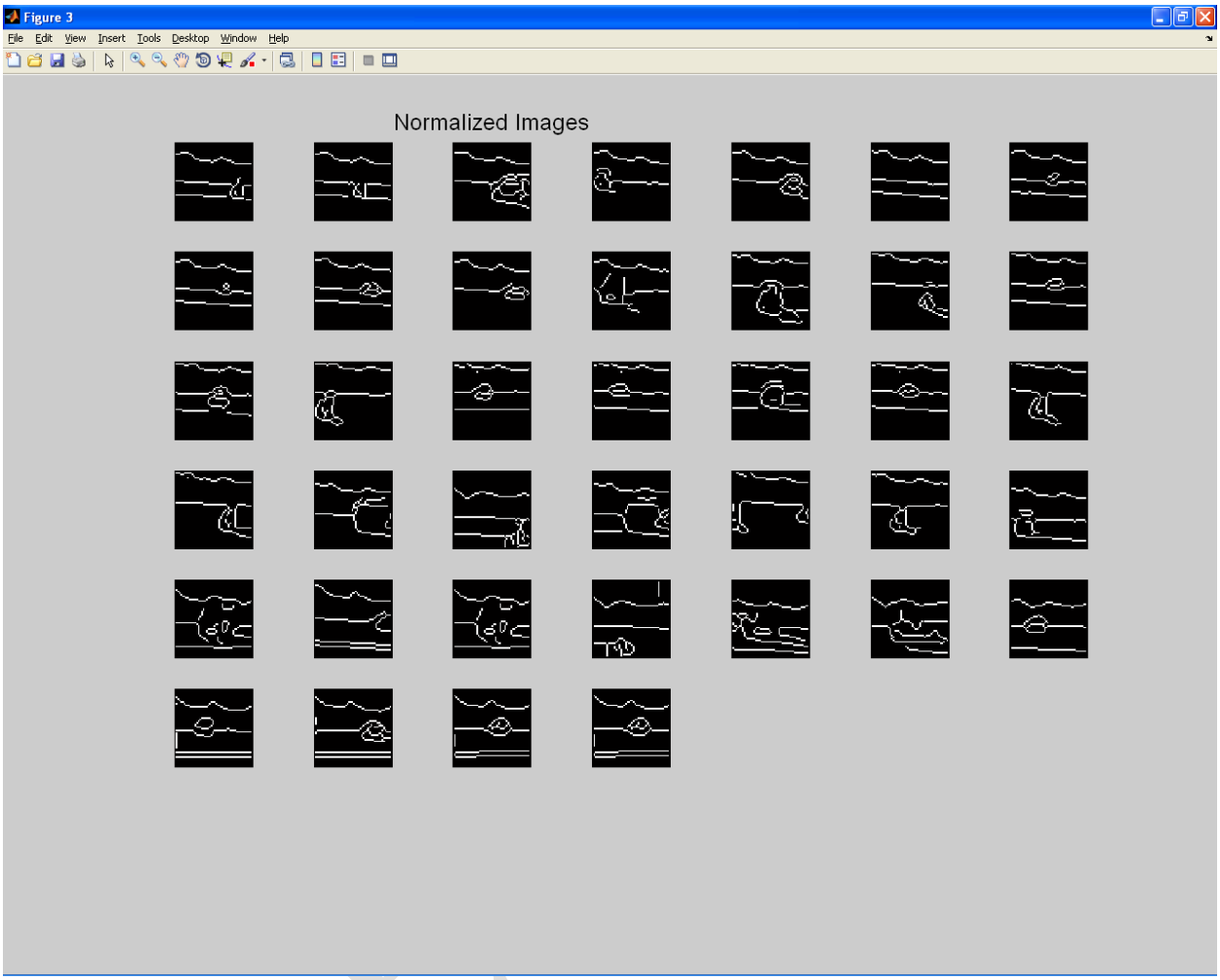

Figure 4.7 : Featured Dataset

Here figure 4.7 is showing the featured dataset obtained from the work. The features are here obtained to present the edge adaptive structure analysis. In this work, canny method is used to generate the features over the dataset.

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4.4 Process Image : I

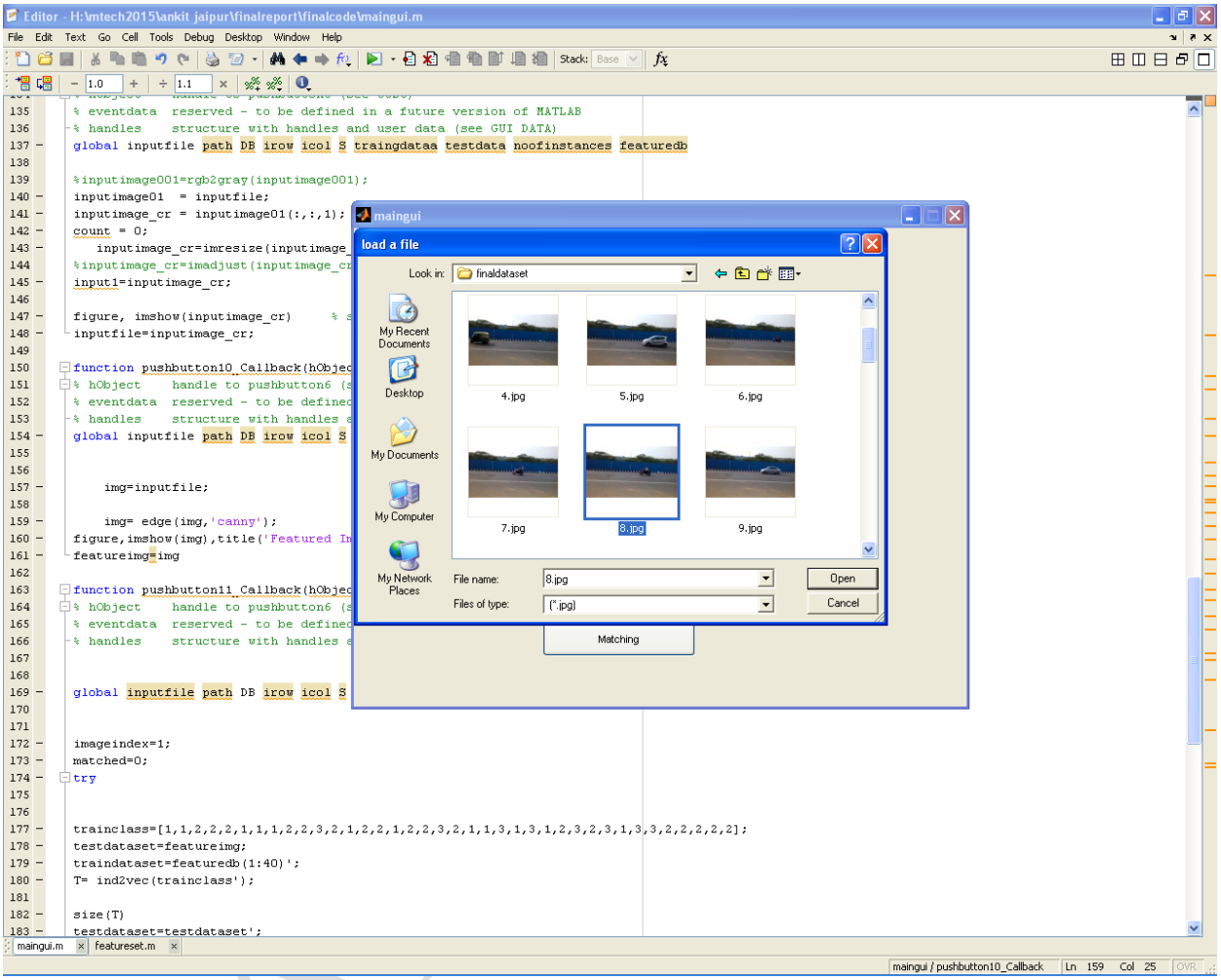

Figure 4.8 : Input Image

Here figure 4.8 is showing the input image taken from the user to perform the identification of vehicle or the class. The input is the sample image taken from the testing set. This image can be database image or some external image. The figure is showing the user friendly interface to load the input image.

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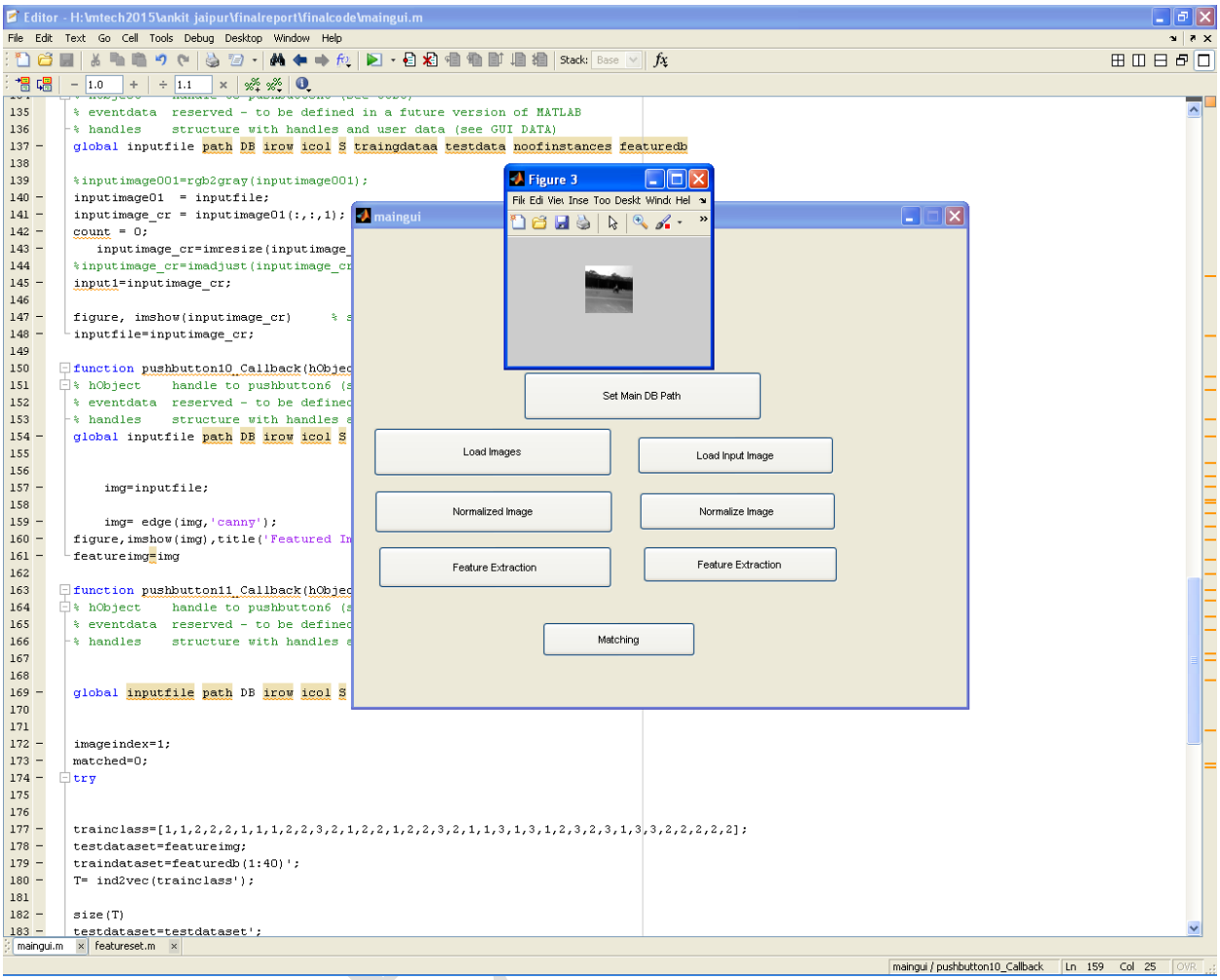

Figure 4.9 : Normalized Image

Here figure 4.9 is showing the output of normalization stage applied on input image. The normalization is here achieved in terms of size level adjustment and contrast adjustment. The histogram equalization is here taken to explore the feature of the image.

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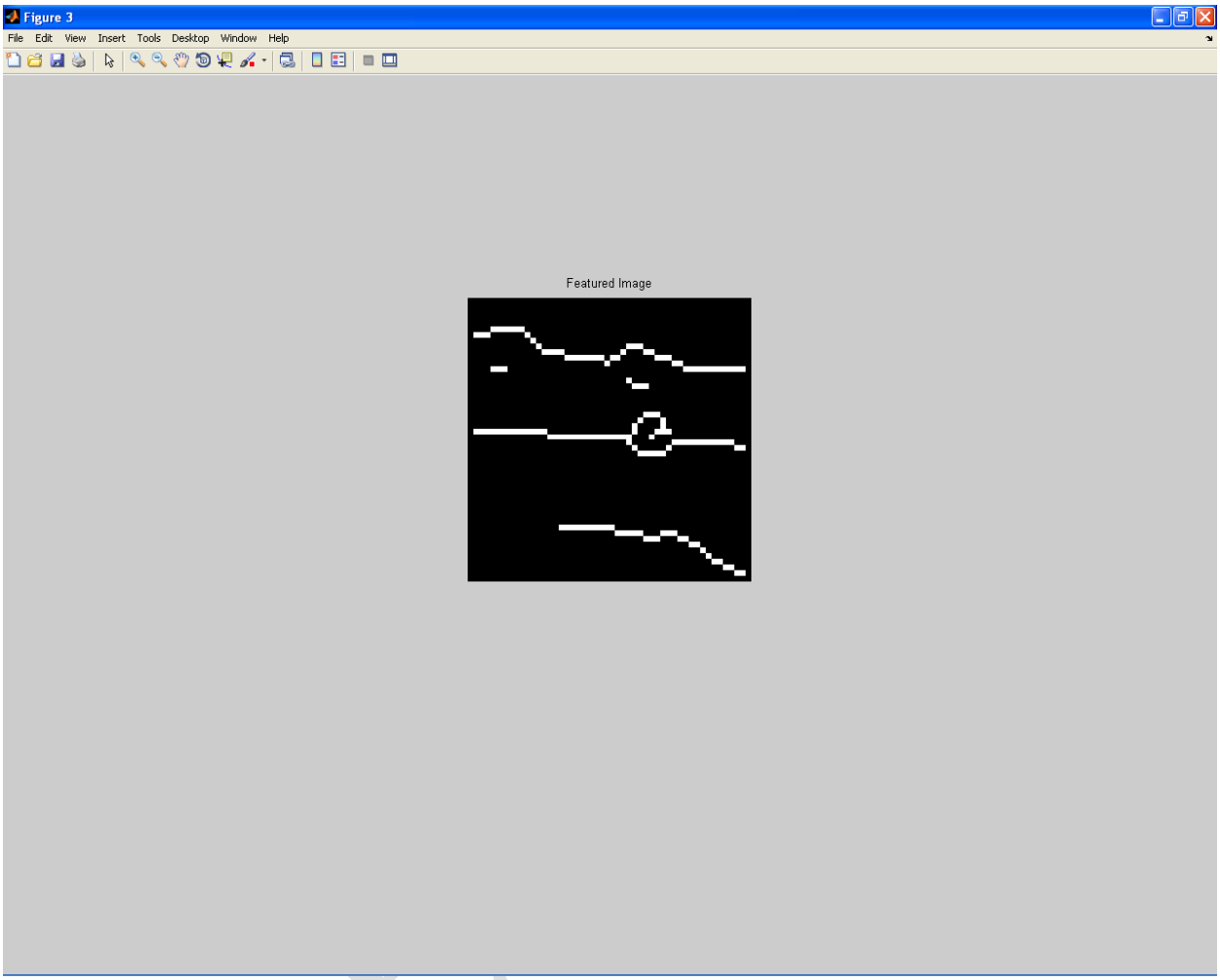

Figure 4.10 : Featured Image

Here figure 4.10 is showing the featured image obtained from the work. The feature is here extracted using canny method. Here figure is showing the edge feature adapted image for the input vehicle image.

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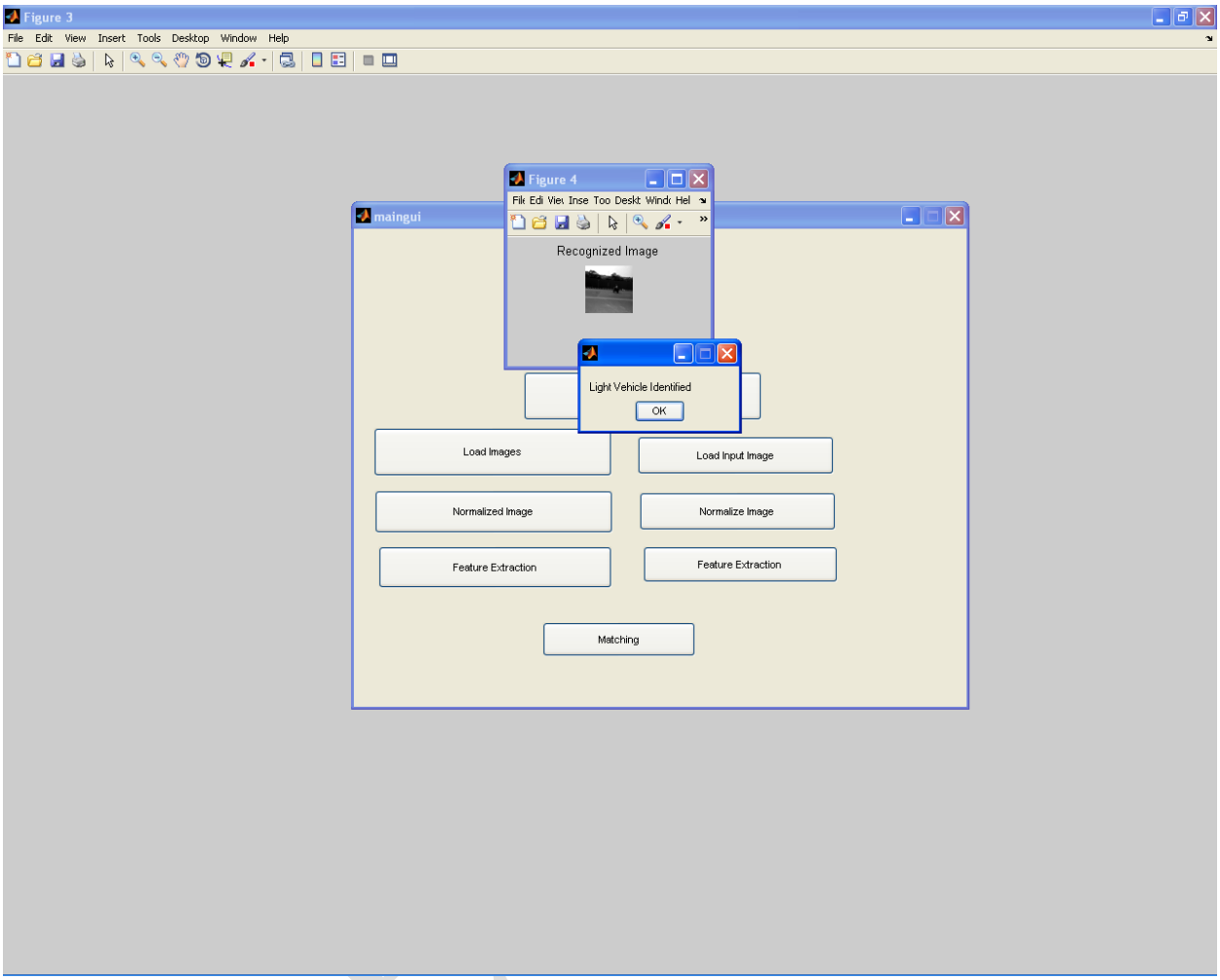

Figure 4.11 : Recognized Image

Here figure 4.11 is showing the results of adaptive feature based PCA method. This method is here applied to perform the image recognition based on featured mapping. The maximum mapped image is here considered as the recognized vehicle image. Once the image is recognized, the vehicle class is mapped. The figure is showing the identified database vehicle and the vehicle class.

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4.5 Processed Image : II

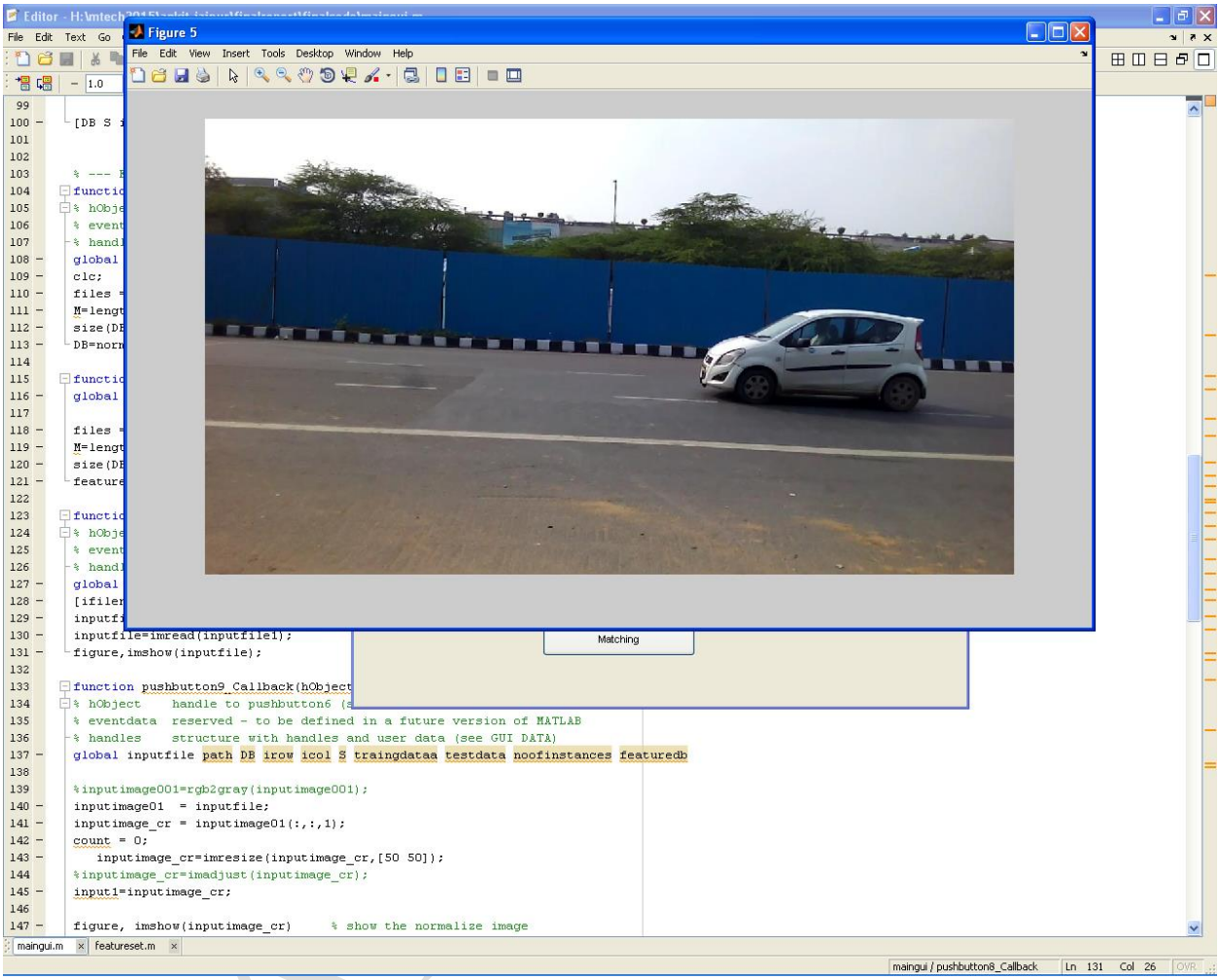

Figure 4.12 : Input Vehicle Image

Here figure 4.12 is showing the input vehicle image. The figure is showing the raw form of the input image. In this form, the image is color and of full size. The series of stages are applied on raw image to perform the recognition.

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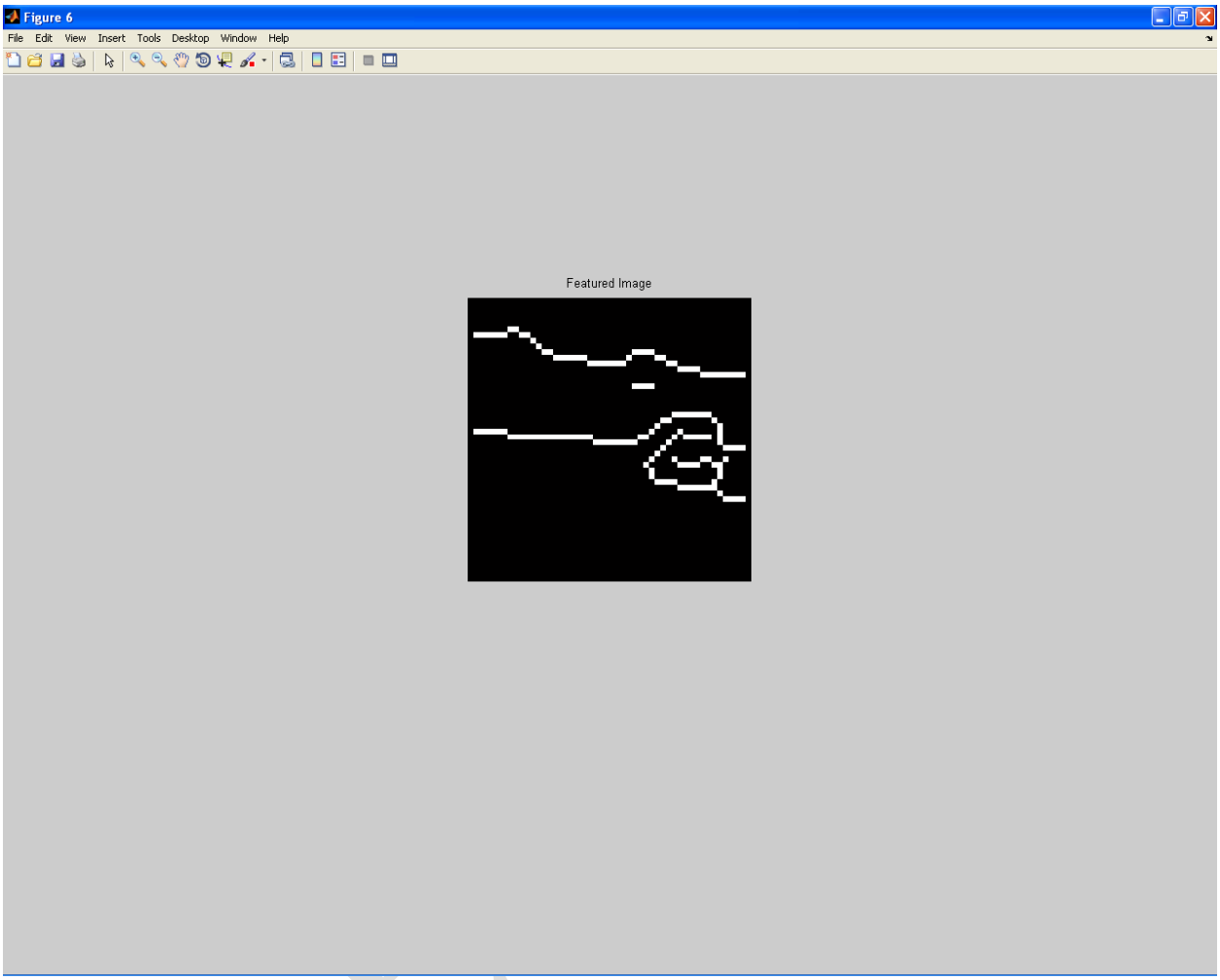

Figure 4.13 : Featured Image

Here figure 4.13 is showing the featured image obtained from the work. The feature is here extracted using canny method. Here figure is showing the edge feature adapted image for the input vehicle image.

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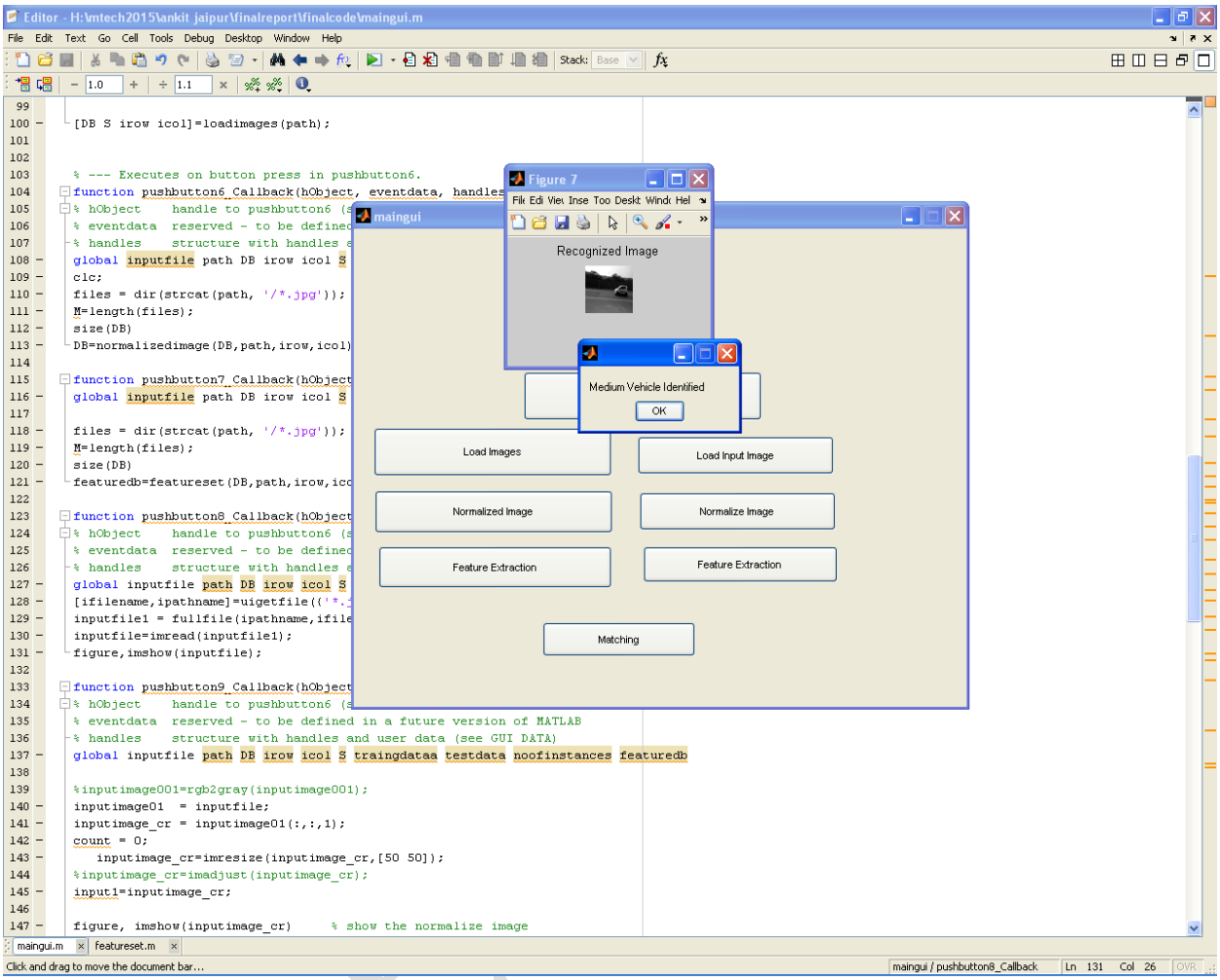

Figure 4.14 : Recognized Image

Here figure 4.14 is showing the results of adaptive feature based PCA method. This method is here applied to perform the image recognition based on featured mapping. The maximum mapped image is here considered as the recognized vehicle image. Once the image is recognized, the vehicle class is mapped. The figure is showing the identified database vehicle and the vehicle class. Here medium size vehicle is recognized.

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4.6 Processed Image : III

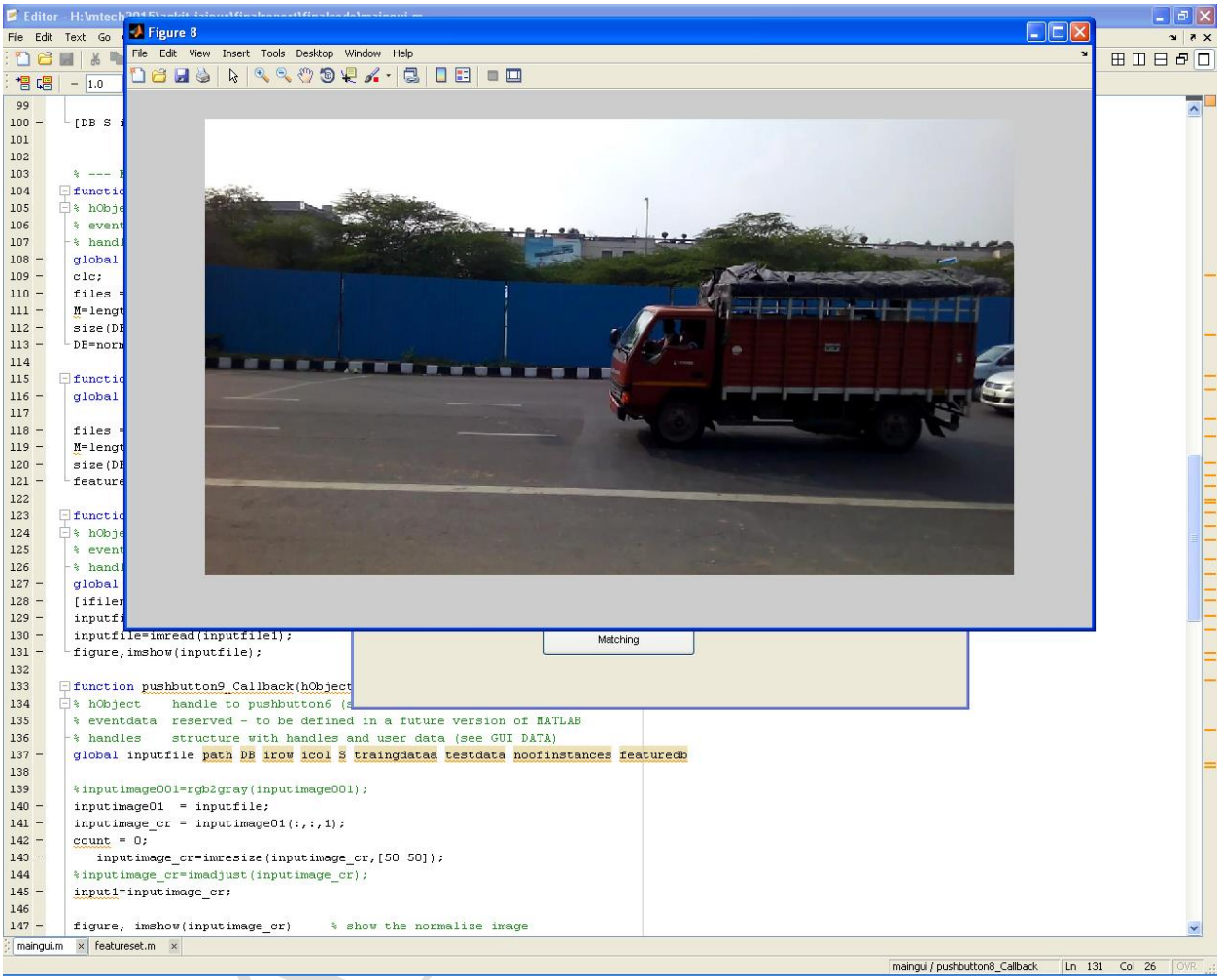

Figure 4.15 : Input Vehicle Image

Here figure 4.15 is showing the input vehicle image. The figure is showing the raw form of the input image. In this form, the image is color and of full size. The series of stages are applied on raw image to perform the recognition. Here a heavy vehicle is taken as input for recognition.

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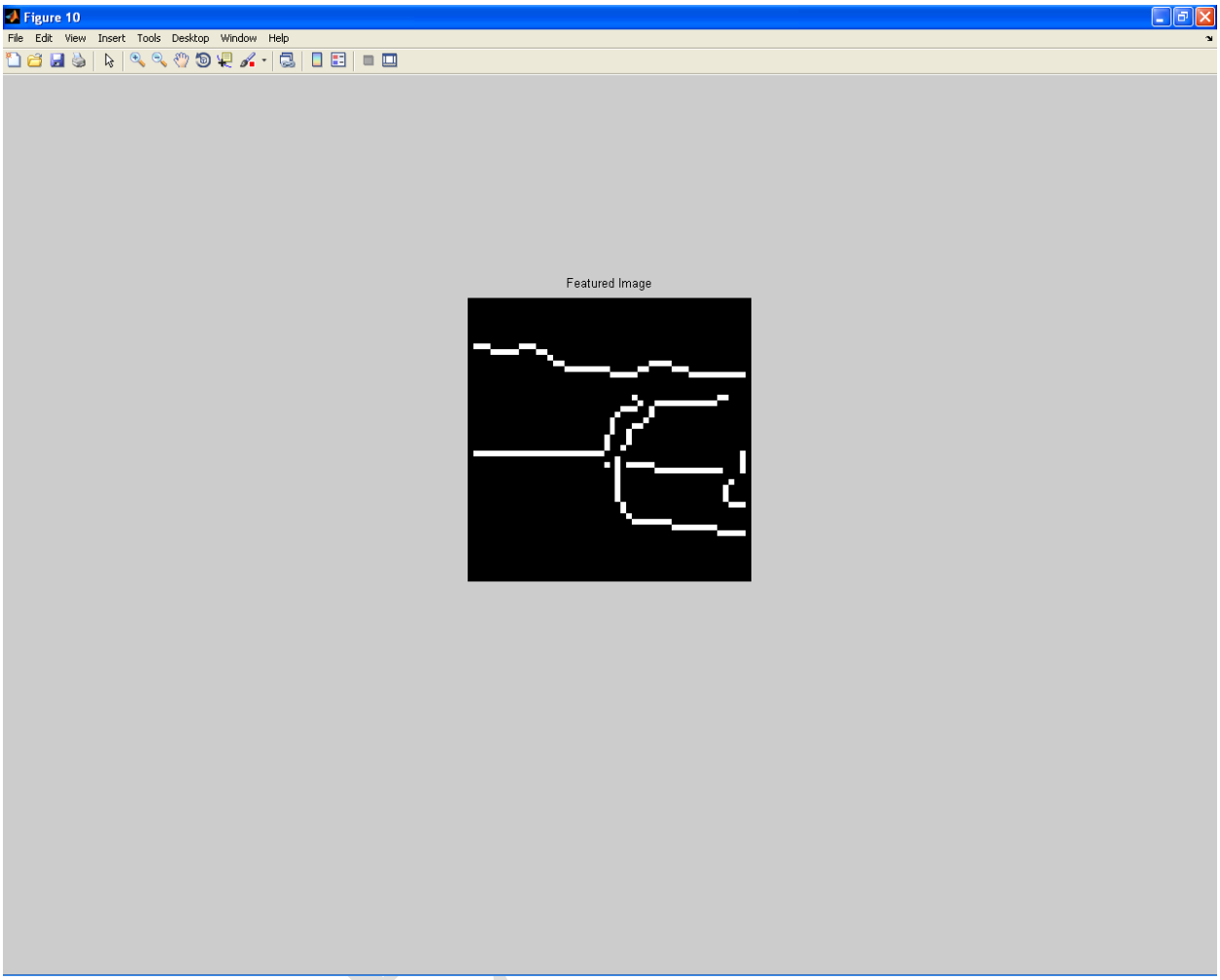

Figure 4.16 : Featured Image

Here figure 4.16 is showing the featured image obtained from the work. The feature is here extracted using canny method. Here figure is showing the edge feature adapted image for the input vehicle image.

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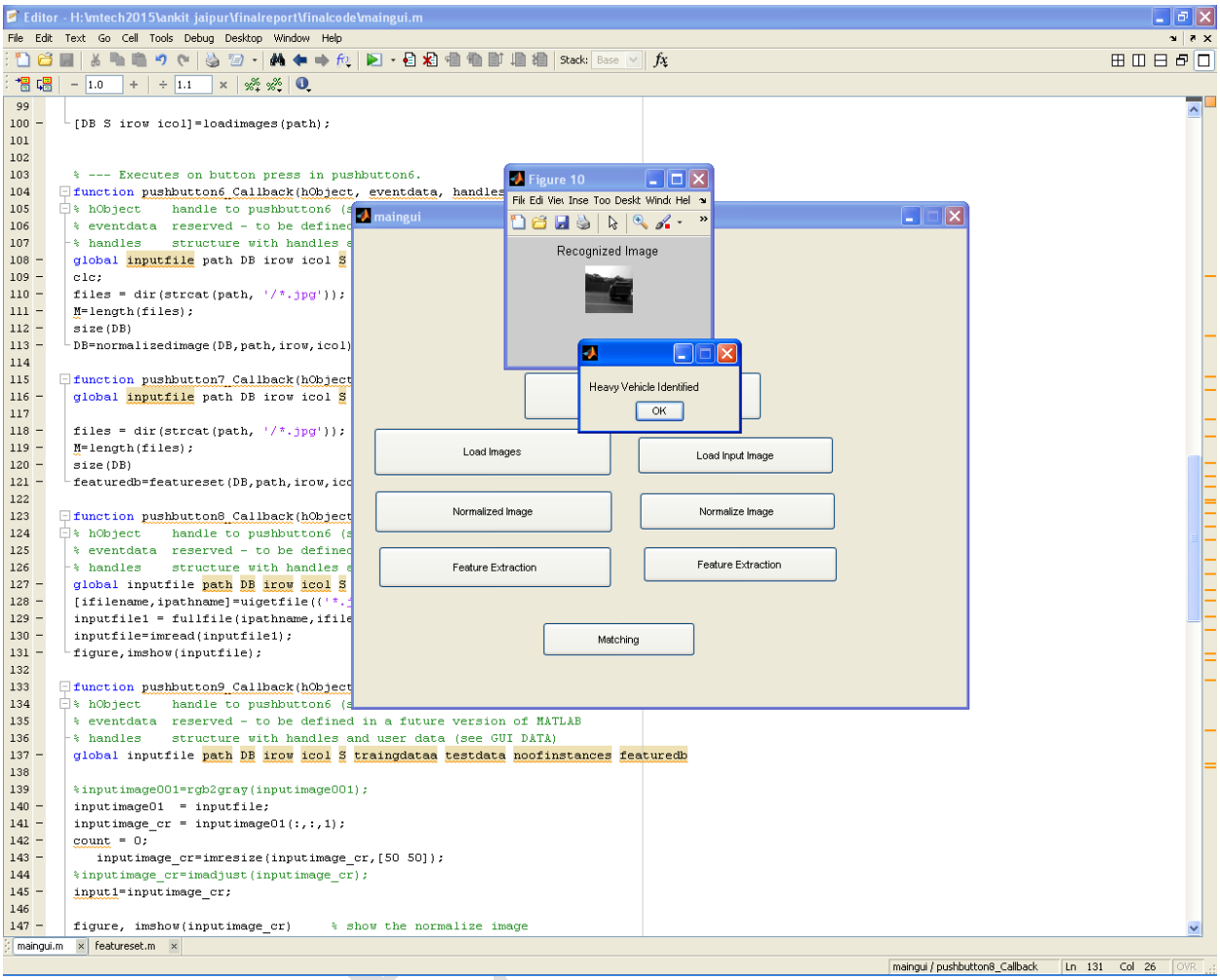

Figure 4.17 : Recognized Image

Here figure 4.17 is showing the results of adaptive feature based PCA method. This method is here applied to perform the image recognition based on featured mapping. The maximum mapped image is here considered as the recognized vehicle image. Once the image is recognized, the vehicle class is mapped. The figure is showing the identified database vehicle and the vehicle class. Here heavy size vehicle is recognized.

CHAPTER 5
ANALYSIS

To perform the analysis on the vehicle image and vehicle class recognition. The work is here applied on different sets of training and testing are taken and the recognition rate is estimated on each type of image. The dataset on which the recognition is shown in table 5.1

Table 5.1 : Dataset I

Property	Value
Number of Images	39
Format	JPG
Resolution	Random
Type	Color
Variation	Color/Brightness/Background/Object
Training Images	30
Test Images	20
Type of Images	Dataset Images
Number of Classes	3
Vehicle Correctly Recognized	17
Vehicle Class Correctly Recognized	19
Vehicle Recognition Rate	85%
Vehicle Class Recognition Rate	95%

To perform the analytical result representation, the experimentation is here performed on different datasets. These datasets are here defined under the specification of different number of training and testing images.

Table 5.2: Dataset II

Properties	Values
Trained Dataset Size	25
Test Set Size	10
Image Type	Dataset Image
Number of Images Analyzed	10
Vehicle Recognized Correctly	9
Incorrect Vehicle Recognition	1
Vehicle Class Recognized Correctly	10
Class Not Correctly Recognized	0
Vehicle Class Accuracy	100%
Vehicle Recognition Accuracy	90%
Type of Images	Vehicle

Here table 5.2 is showing the 100% recognition rate in case of vehicle class and the 90% recognition rate is obtained for vehicle recognition. The table shows that the recognition is here performed on the dataset image. It means the test image is also taken from the training dataset. The mix class testing set is here considered for recognition.

Table 5.3: Dataset III

Properties	Values
Trained Dataset Size	50
Test Set Size	30
Image Type	Dataset Image

Number of Images Analyzed	30
Vehicle Recognized Correctly	27
Incorrect Vehicle Recognition	3
Vehicle Class Recognized Correctly	29
Vehicle Class Not Correctly Recognized	1
Vehicle Class Accuracy	96.67%
Vehicle Recognition Accuracy	90%
Type of Images	Vehicle

Here table 5.3 is showing the 96.67% recognition rate in case of Vehicle Class and 90% in case of Vehicle recognition. The table shows that the recognition is here performed on the dataset image. It means the test image is also taken from the training dataset. The mix class testing set is here considered for recognition.

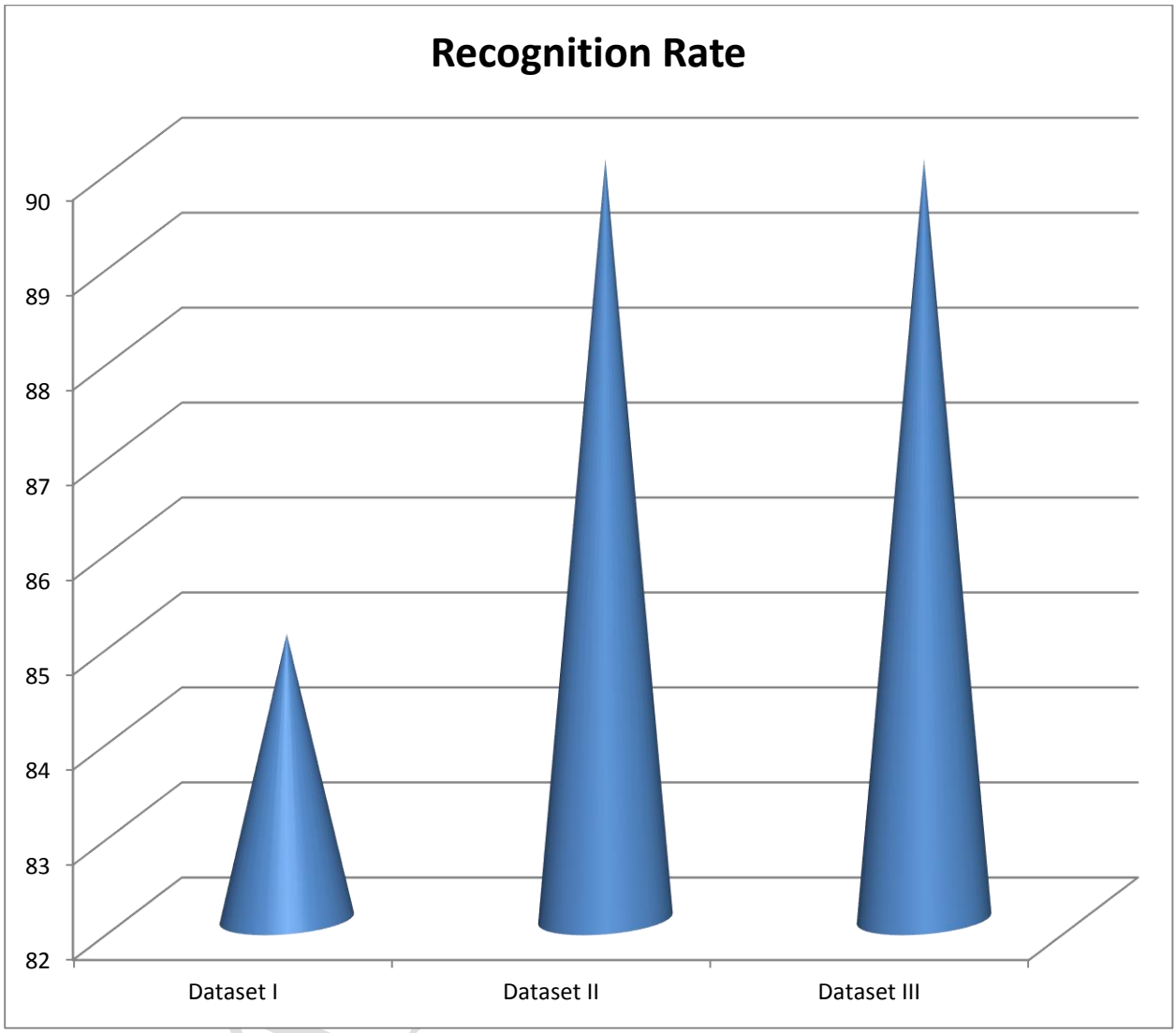

Figure 5.1 : Vehicle Recognition Rate

Here figure 5.1 is showing the recognition rate obtained for vehicle recognition on different datasets. The figure shows that the accuracy rate for Vehicle class recognition achieved in this work is about 90%.

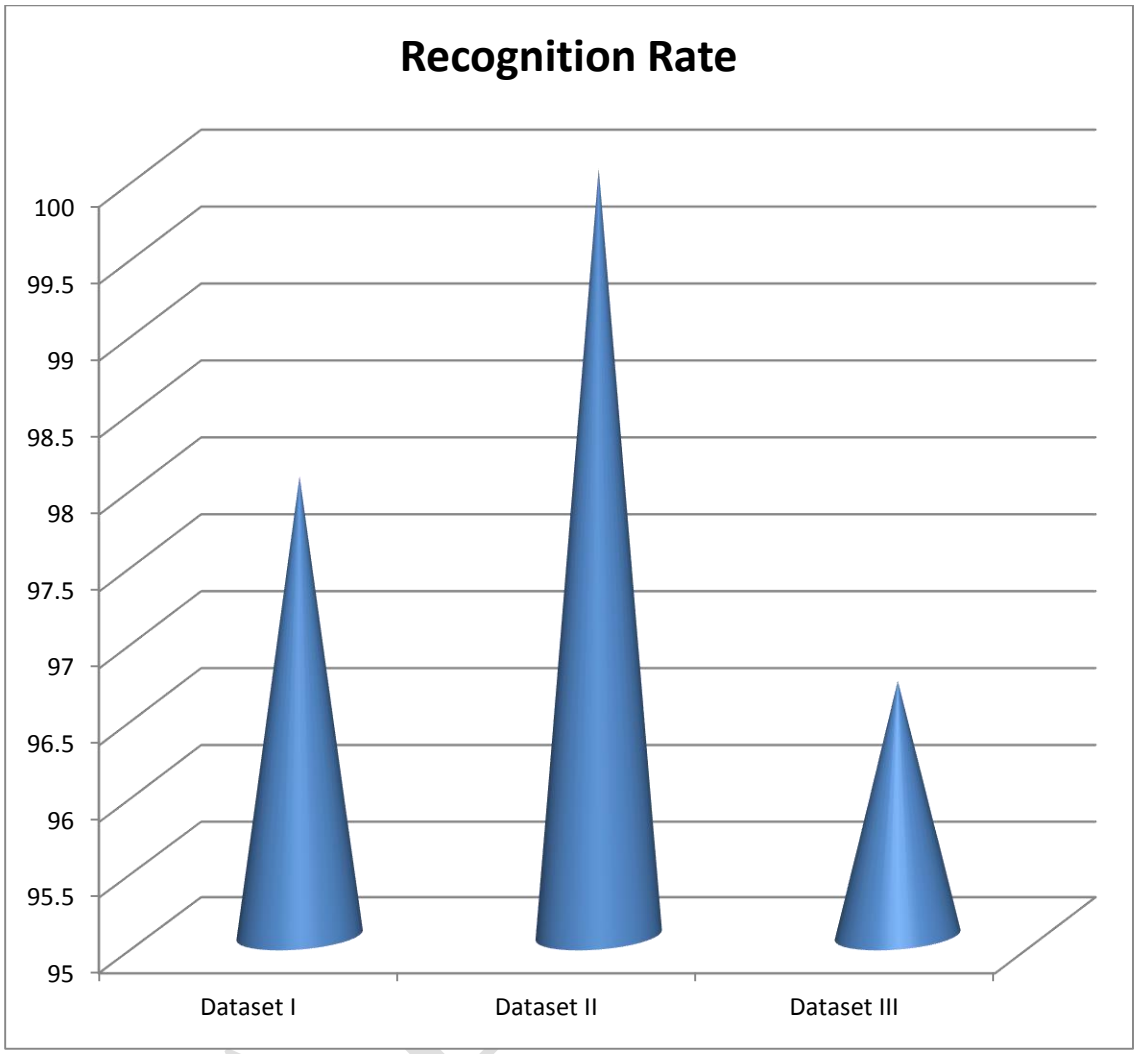

Figure 5.2 : Vehicle Class Recognition Rate

Here figure 5.2 is showing the recognition rate obtained for vehicle recognition on different datasets. The figure shows that the accuracy rate for vehicle class recognition achieved in this work is upto 100%.

CHAPTER 6
CONCLUSION AND FUTURE SCOPE

6.1 Conclusion

The presented work is defined to perform the classification of vehicles from the vehicle images. In this work, a feature adaptive model is presented for vehicle identification and vehicle class identification. According to this proposed model, the vehicle set is represented in the form of dataset. To obtain the vehicle features, the edge adaptive canny filter is applied. Once the featureset is obtained, PCA adaptive approach is defined to perform distance based mapping of input feature image. The maximum mapped image and relative vehicle class is considered as the object image and the vehicle class. The work is testing on multiple datasets. The results shows that the work has provided the effective recognition rate upto 100%.

6.2 Future Work

The presented work is applied on the vehicle images to perform the vehicle class identification using edge feature adaptive PCA approach. The work can be improved in future under different aspects

- In this work, the vehicle classification is performed on three methods called light weight vehicle, heavy weight vehicle and medium weight vehicle. In future more specific vehicle class can be identified.
- More work is required to improve the recognition rate.
- Some other feature vectors can be considered to improve the classification rate.

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