A Novel Method for Vehicle Detection using Edge Detection and Fuzzy Logic Based Algorithm

M. Jansirani, P. Sumitra

Abstract: ***Vehicles moving on road are of importance because problems like traffic congestion, economic waste, jamming on the underpasses and over-bridges (if the vehicle passing through is not of the permissible size) are associated with them. These problems can be dealt with by using various morphological processes based image processing techniques to detect the vehicles. In this thesis, the images of moving and still vehicles have been taken and an algorithm is used for vehicle detection which is based on image processing techniques and classification of vehicles in the form of natural description based on fuzzy logic such as classification based on area and circumference using Fuzzy Logic. To perform classification, fuzzification of area and circumference is done and each vehicle type (e.g. small, medium and big) is assigned a measurement range of values by designing fuzzy rules and finally defuzzification is done. Edge detection is considered to be fundamental step in the field of image processing and computer vision. There are 3 types of discontinuities in a digital image: point, line, edge. The most common way is to use spatial masks which have properties to detect these discontinuities. More than isolated points and lines detecting edges are important because they form an important part of image segmentation. Edge detection is basically a method of segmenting an image into regions based on discontinuity, enhancing the presence of these discontinuities in the image allows us to improve the perceived image quality under certain conditions. Edge detection makes use of differential operators to detect changes in the gradients of the grey or color levels in the image. Edge detection is divided into two main categories: first-order edge detection, example for first order edge detection are Sobel, Robert, Perwitt and second-order edge detection, example for second order edge detection are Laplacian and Canny. Image edge is often buried by noise, so it's necessary to research edge detection algorithm. Since traditional edge detection like Sobel, Perwitt, Robert operator are sensitive noise, to overcome that problem, some new algorithm is applied in edge detection such as Canny, Morphology, Neural network and Fuzzy logic. This is to be implemented in MATLAB. Fuzzy logic is one of the new methods and it was based on set theory. Fuzzy logic based algorithm is very efficient and flexible to detect the edges of vehicle in an input image by scanning it through the 2*2 mask. The main benefit of fuzzy set theory is able to model the ambiguity and the uncertainty. In the proposed method trapezoidal and triangular membership function of mamdani type FIS is used for four inputs containing two fuzzy set and one output containing one fuzzy set. The 2*2 masks is slide over entire vehicle image, and then pixels values of masks are examined through various ten rules which are defined in FIS rule editor. Based on these set of rules the output of fuzzy is decided that particular pixel is edge or not. For getting better results Gaussian filtering is used. Experimental result shows the ability of the proposed method in finding the thin edges of vehicle image.***

Index Terms: ***Fuzzy Logic, Neural Network, Canny, Morphology.***

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Mrs. M. Jansirani, Ph.D Scholar, Department of Computer Science, Vivekanandha College of Arts and Sciences for Women (Autonomous), Elayampalayam (Tiruchengode)–637205. India.

Dr. P. Sumitra, Professor, Department of Computer Science, Vivekanandha College of Arts and Sciences for Women (Autonomous), Elayampalayam (Tiruchengode)–637205. India.

I. INTRODUCTION

Fuzzy logic provides a simple way to arrive at a definite conclusion based upon vague, ambiguous, imprecise, noisy, or missing input information. Fuzzy logic is a mathematical representation of human concept formulation and reasoning. Fuzzy logic is a widely used tool in image processing since it gives very efficient result. It can be implemented in hardware, software, or a combination of both. Fuzzy reasoning is nothing else than a straightforward formalism for encoding human knowledge or common sense in a numerical framework. Fuzzy Logic has been applied to problems that are either difficult to face mathematically or applications where the use of Fuzzy Logic provides improved performance and/or simpler implementations. At present, the application of Fuzzy Logic exceeds the control domain since it is also employed for other knowledge based decision making tasks. It involves medical diagnosis, business forecasting, traffic control, network management, image processing, signal processing, computer vision, geology and many more[1]. Edge detection is a well developed field on its own within image processing. Edge is the important characteristic of image[2]. Edges come in an image because of variation of the discontinuities of the scene features, usually brightness, and give rise to edges. In other words, edges are representation of the discontinuities of the scene intensity function. There could be various reasons such as type of materials, surface texture, lighting conditions, which play important role in forming these discontinuities. An edge is a set of connected pixels that form a boundary between two disjoint regions. Edge can be described based on edge strength, edge direction and edge position.

And different types of edges are step edge, ramp edge, roof edge, ridge edge. The quality of edge detection can be measured from several criteria. The five criteria for edge detection are: Good detection, Noise sensitivity, Good localization, Orientation Sensitivity, Speed and efficiency. Edge detection aims to mark sharp intensity changes in an image and is a basis for a large number of image analysis and machine vision applications. Many edge detection techniques have been developed for extracting edges from digital images, each designed to be sensitive to certain type of edges. There are two different edge detection operators: first order edge detection or gradient based classical operators as their names suggest, first order edge detection is based on the use of firstorder image derivatives, example for first order edge detection operator are Robert, Prewitt, Sobel operator and second order edge detection or Laplacian based operators is based on the use of second-order image derivatives example for second order edge detection operator are canny

detection. Nowadays fuzzy techniques plays main role in image processing and in its applications. It seems that fuzzy approaches produce more efficient results than existing techniques.

II. RELATED WORK

This section describes research on road vehicles rather than military ones. In general, research on road vehicle recognition is performed for traffic management or automated driver assistance system [3].Traffic monitoring by using a circular array, consisting of 152 microphones, but 143 of them were of interest. After the data were pre-processed to only maintain the components between 2700Hz and 5400Hz, the 30-dimension feature vectors were extracted from the energy over each 0.2 seconds in the time domain. PCA was processed to reduce the dimension to 24 before performing classification with either kNN, Multilayer Perceptron (MLP) or Adaptive Fuzzy Logic System (AFLS).

Although the exact number of vehicles in each class was not clear, it was stated that they varied between each class; and there were data of 1327 vehicles in total. Problems caused by this inequality of the sizes of training sets was addressed in the thesis by considering the effect on the training as well as introducing the learning factor, a method intended to take care of the issue. Moreover, it attempted to deal with the inequality derived from the fact some classes are easier to be learned than others by allocating misclassification costs for each pattern although there was no logical explanation regarding how they were determined. The obtained classification accuracies were 97.95%, 92.24% and 78.67% for 2-class, 4- class, and 5-class experiments respectively. Although the use of such a large number of microphones may not be appropriate for developing a cost effective and compact recognition system, this study played a good role in initiating research on acoustic road vehicle recognition with fairly accurate results[4].

III. EXISTING SYSTEM

Over the past few decades, fuzzy logic has been used in a wide range of problem domains. Although the fuzzy logic is relatively young theory, the areas of applications are very wide. There are three main parts in a fuzzy logic system. First part is fuzzification, which is input the data to fuzzy set. Second part is differencing, which evaluates the fuzzy rules in IF-THEN form. Last part is the defuzzification, which describes the output values of fuzzy set. Fuzzy inference is the process of formulating the mapping from a given input to an output using fuzzy logic. Fuzzy inference system involves: Membership Functions, Logical Operations, and If-Then Rules. There are two types of fuzzy inference systems that can be implemented in Fuzzy Logic, which are Toolbox, Mamdani-type and Sugeno-type[5].

IV. LIMITATIONS OF EXISTING SYSTEM

The distance can be measured based on the wireless radio signal power. Once deployed, the nodes dose not move. The base station is located in the center of the WSNs.

- **Heavy Traffic Jams**

With increasing number of vehicles on road, heavy traffic congestion has substantially increased in major cities. This happened usually at the main junctions commonly in the morning, before office hour and in the evening, after office hours. The main effect of this matter is increased time wasting of the people on the road.

- **No traffic, but still need to wait**

At certain junctions, sometimes even if there is no traffic, people have to wait. Because the traffic light remains red for the preset time period, the the road users should wait until the light turn to green. If they run the red

V. PROPOSED SYSTEM

The fuzzy technique is an operator introduced in order to simulate at an exact level the compensatory behavior in process of decision making. It appears that fuzzy methodologies deliver more operative results than any other existing systems. Image gradient in fuzzy logic is the method which is utilized to extract data from images. The implication of membership functions is a delicate point in the framework of fuzzy controller. In proposed system triangular membership function is used due to its simplicity which requires only three parameters to define[6].

A. Phase 1 of Edge Detection Input: RGB to Gray-Scale Converted Image

- Step 1: Obtain the gradient along magnitude and direction for image gradient using Sobel operator as an input, output of the Sobel is obtained before applying fuzzy rules.
- Step 2: Triangular Membership function is applied for the fuzzy inference system where pixels are taken as a crisp input for FIS system, to be converted into morphological variable i.e. black and white, by using triangular membership function.
- Step 3: If else rules is applied as fuzzy rules to obtain output image as given If Fx is zero and Fy is zero then Fout is white Else If Fx is not zero or Fy is not zero then Fout is black where Fx and Fy are input of image gradient along x-axis and y-axis and Fout is the desired Output.
- Step 4: Fuzzy output is defuzzified using centroid method to get the intermediate output. The Fuzzy output retrieved from the Fuzzy Inference System is considered as an input to canny edge detection technique.

B. Phase 2 of Edge Detection Input:

Intermediate Image from phase 1. Output: Resultant fuzzy canny output image with edge detection.

- Step 1:Gaussian filter is applied for flattening the image
- Step 2: Gradient and direction of transitional output image is determined.
- Step 3: By applying non-maximum suppression, weak edges are suppressed to get thin line.
- Step 4: Edge threshold is determined, and then final output image is obtained.

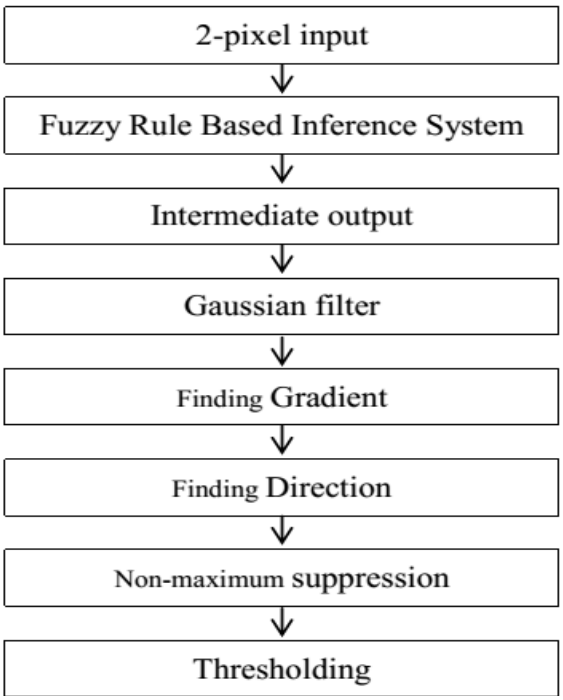

Fig 1: Phase 1 and 2 of Edge Detection Input

C. *Advantage*

- Low cost processing
- Consistently high quality of the image
- Ability to manipulate all aspects of the process
- Cost of storage memory started dropping

D. *System Model*

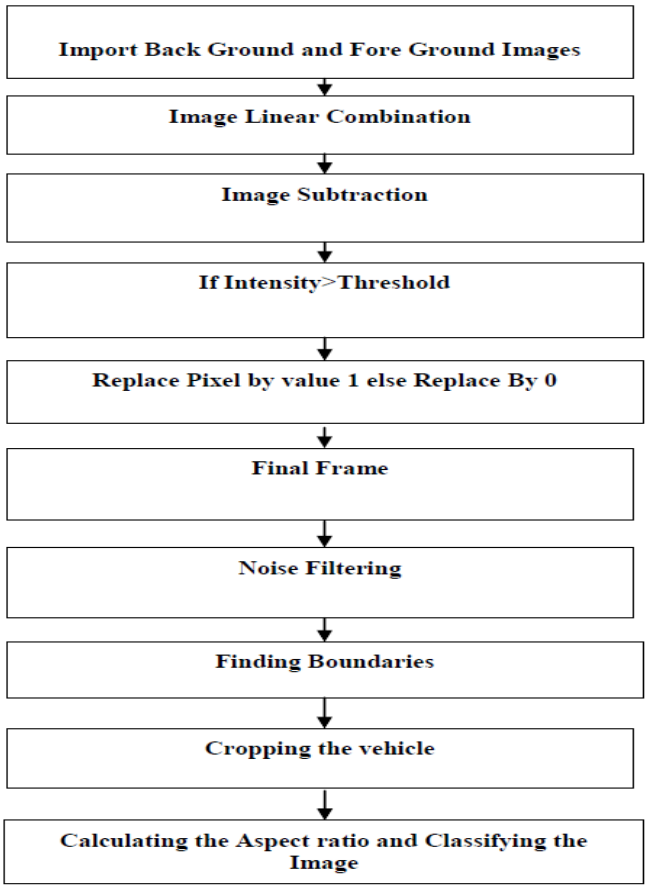

Fig 2: System Model to Calculate the Aspect Ratio

VI. CONCLUSION

In this paper, we have developed an algorithmic approach to vehicle detection and classification using fuzzy logic. This not only reduces the complexity of the system but enhances its use in the areas which are too Vehicle Detection Using Image Processing and Fuzzy Logic 257 difficult to be detected by normal means. Further it is proposed that after detection objects can be classified using techniques like neuro fuzzy etc so as supervised and unsupervised learning can be used to train the system. This algorithm can be applied on real time projects and further improvement can be the techniques mentioned above.

VII. FUTURE AND ENHANCE

The proposed method have a novel method for vehicle detection using edge detection and fuzzy logic based algorithm for traffic images that take into account the differential original profile and boundary detection for detection process. Further extensions are needed to reduce the misclassification and improve the detection accuracy.

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AUTHOR PROFILE

Dr. P. Sumitra, completed her Ph.D Degree in Computer Science from Mother Teresa Women's University, Kodaikannal, TamilNadu, India in the year 2013. She is guiding Ph.D Research Scholars. She published many International Journal paper, International Conference and National Conference. Her research area includes Digital Image Processing, Data Mining and Bio-metrics. She has 15 years of teaching experience in Self Finance Institution.

Mrs. M. Jansirani, currently doing Ph.D Degree in Computer Science in Vivkenanadha College of Arts and Sciences for Women(Autonomous). Her research area includes Digital Image Processing and Fuzzy Logic. She has 10 years of teaching experience in Self Finance Institution.