Smart Traffic Control, Accident Detection and Ambulance Detection System using Image Processing

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Abstract— **The usage of vehicles is rapidly increasing due to recent technological and economic development, and at the same time, the lack of infrastructure against the demand is leading to an increasing number of accidents and fatality of life. The trivial issues in our life system motivated us to come up with an application to automate this process and save lives. With a review of literature and brainstorming, I proposed the project on a smart traffic management system using image processing. The objective of this project is to develop a (1) simulation to determine the traffic density, (2) detect a crash/accident, (3) detect ambulance using image processing and machine learning techniques.**

In the first phase, we determined traffic density to minimize the delay caused by traffic congestion and to provide the smooth flow of vehicles. The density of vehicles on each side can be identified by using datasets. If the density is low on a particular side, the period for that side is normal and if the density is high the period will automatically increase compared to normal density. In the second phase, we simulated a crash or accident detection and for the prototype consideration, we have used static accidental image and trained model. In the third phase, analyzed ambulance detection using the dataset, for the prototype consideration for this, used static ambulance image and trained dataset. On detection of an ambulance, the traffic light is automatically changed to green. In each phase, the data updating and monitoring are provided. This scheme is fully automated and identifies the emergency vehicle and controls the traffic lights dynamically. Hence, the traffic management module is done using image processing techniques.

Index Terms— **Vehicle Density Calculation, Crash Alert, Ambulance Detection, Background Subtraction, Edge Detection, Template Matching**

I. INTRODUCTION

Image processing is a method to convert an image into digital form and perform the necessary operations on it, to get an enhanced image and information. It is a type of signal dispensation in which input is an image, like a video frame or photograph or characteristics associated with that image. The image processing system includes considering images as two-dimensional signals while applying already set signal processing methods to them. It is among rapidly growing technology, with its applications in different aspects of a business. Image Processing forms the core research area within engineering and computer science [1]. Image processing includes Importing the image with an optical scanner or by photography, Analyzing and manipulating the image which incorporates data compression, image enhancement and spotting patterns that are not visible to human eyes like satellite photographs, and the output is obtained in the last stage in which the result can either be an altered image or a report that is based on image analysis.

II. LITERATURE REVIEW

The Association for Safe International Road Travel (ASIRT) reports, annually approx.1.3 million people fatality on the road, 20-50 million of road users are incapacitated. Road crashes cost 1-2% of their annual GDP in different countries. Currently, Road traffic crashes rank as the ninth leading cause of death

and account for 2.2% of all fatality globally. If it is not mitigated, road traffic hurts are predicted to become the fifth by 2030 [1]. The challenges imposed on local public servicing outsourcing in saving human lives resulting from vehicle accidents have become a critical concern. An automated and intelligent mobile solution is required for a zero mortality rate since there is a lack of automated on-site medical assistance, late accident reporting, inaccurate geographic location, and lack of injured medical information [2]. The current existing solutions that assist passengers in case of a vehicle accident are concerned with user interaction after the incident. Those mobile solutions require that the injured must launch the app and request help manually and that would not be possible if he/she is under the critical or serious non-vital situation. The situation becomes even worse if passengers go under an unconscious state. Traffic lights which are of current technology use a manual operating system for the time allocation and also require high maintenance during the operation. This causes, time lapsing, and an increase in vehicular traffic [3]. In the existing system, the traffic congestion is predicted manually which is hectic and involves manual efforts. Similarly, accident detection is predicted manually and doesn't ensure quick first-aid. On the whole, in the existing system, the traffic management system is manual and not automated, right from traffic lights, accident detection, emergency vehicle detection, and regulating the traffic which isn't as efficient as the automated system. This proposed system i.e. Smart Traffic Management System dynamically can change the signal lights based on the traffic density [4], detect a crash [5], and detect emergency vehicles and regulate the traffic accordingly [6].

III. PROPOSED SYSTEM

The objective of the proposed project is to develop a simulator to determine the traffic density, ambulance, and accident incidents using image processing and machine learning techniques.

In the first phase, we determined traffic density to minimize the delay caused by traffic congestion and to provide the smooth flow of vehicles.

The density of vehicles on each side can be identified by using datasets. If the density is low on a particular side, the time for that side is normal and if the density is high the time will automatically increase compared to normal density.

The second phase work simulates a crash or accident detection and for the prototype consideration, used static accidental image and trained model.

During the third phase, analyzed the ambulance detection using a dataset, for the prototype consideration used static ambulance image and trained dataset. On detection of an ambulance, the traffic light is automatically changed to green.

1. Traffic density identification

1.1 Video processing to frame:

Video processing is a subcategory of Digital Signal Processing techniques where the input and output signals are video streams. In computers, one of the simplest ways to succeed in video analysis goals is using image processing methods in each video frame. In this case, motions are simply realized by comparing sequential frames. Video processing includes pre-filters, which may cause contrast changes and noise elimination alongside video frames pixel size conversions. Highlighting particular areas of videos, deleting unsuitable lighting effects, eliminating camera motions, and removing edge-artifacts are performable using video processing methods. OpenCV library of python is provided with functions that allow us to control videos and pictures.

1.2 RGB to Grayscale Conversion:

In video analysis, converting RGB color image to grayscale mode is completed by image processing methods. The main goal of this conversion is that processing the grayscale images can provide more acceptable leads to comparison to the first RGB images. In video processing techniques the sequence of captured video frames should be transformed from RGB color mode to a 0 to 255 gray level. When converting an RGB image to a grayscale mode, the RGB values for every pixel should be taken, and one value reflecting the brightness percentage of that pixel should be prepared as an output.

1.3 Canny Edge Detection:

Object detection is often performed using image matching functions and edge detection. Edges are points in digital images at which image brightness or gray levels change suddenly in amount. The main task of edge detection is locating all pixels of the image that correspond to the sides of the objects seen within the image. Among different edge detection methodologies, the Canny algorithm may be a simple and powerful edge detection method. Since edge detection is vulnerable to noise within the image, the initiative is to get rid of the noise within the image with a 5x5 Gaussian filter.

1.4 Kalman Filter to detect BLOB:

BLOB detection would contain BLOB detection, BLOB analysis, and BLOB tracking. Morphological closure operations including erosion and dilation would be used to increase the accuracy of the system for better detection of vehicles. Further region properties of BLOBs are calculated. Various properties are taken into considerations. These properties help a lot in analyzing the area of the BLOB. Area calculation would give us the density on the roads as low density, medium density, and high density depending on the area covered by the BLOBs.

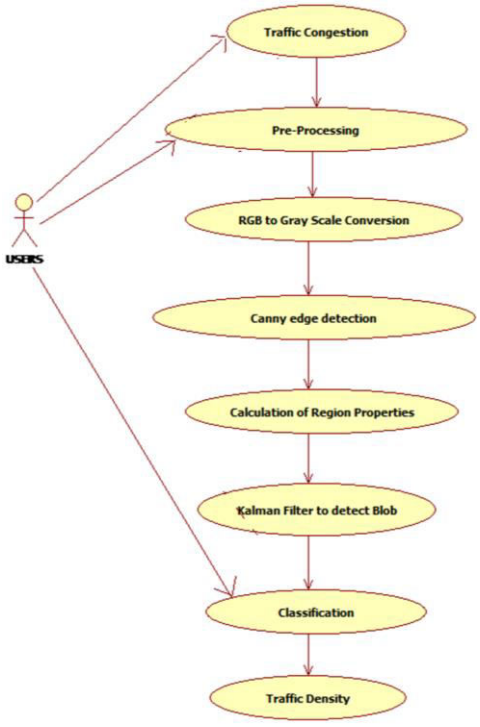

Figure 1. UML Diagram-Traffic Density Calculation

2. Vehicle Accident Detection

Once the vehicle is detected from the annotated image, with help of the number of pixels that the rear-width of the vehicle occupies in the image and the pre-calibrated distance and number of pixels occupied, the distance between the vehicle at the front and the other cars is determined. With the help of finding the change in distance after a short interval of time, the relative velocity in which the vehicle is moving could be determined. And with knowledge of this and the average speed in which each car moves in each region, the absolute velocity of the vehicle moving also can be determined. When there is a big difference possibility of an accident is detected and each frame is checked for vehicle accidents. Once we found the velocity of the vehicle at the front, we could easily understand the relative speed patterns as we know the speed in which each car moves in a specific region. With the relative speed that keeps on changes over time, the collision could be identified automatically using machine learning patterns.

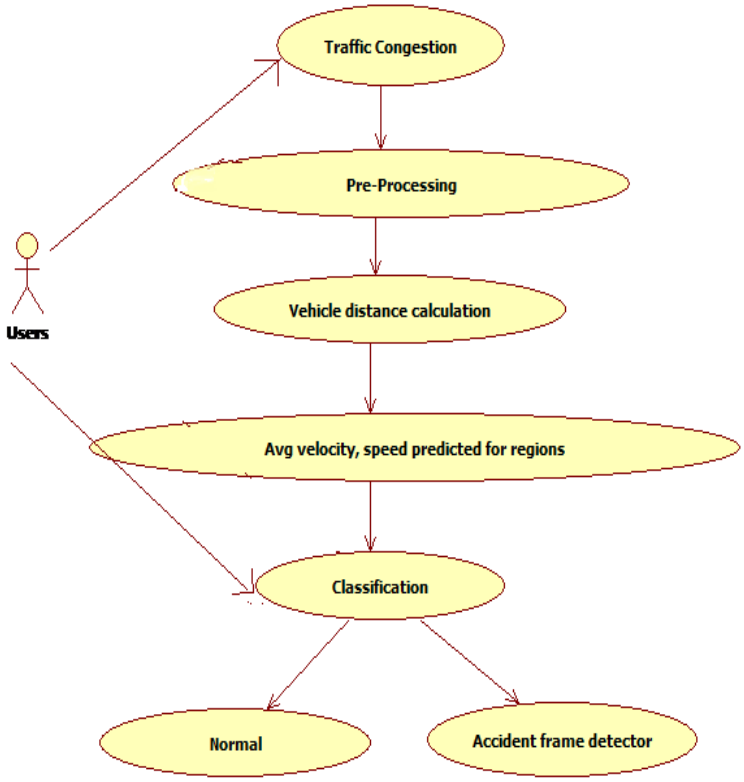

Figure 2. UML Diagram-Accident Detection

3. Ambulance Detection

The ripple algorithm is proposed and aims to detect the Ambulance from images obtained by a clear image. It can extract features of the target which are almost invariant when image rotations or target translation and scaling, such that it can detect targets. Moreover, by the templates representing targets, it also can detect the target using machine learning models which we have used to train the system.

Template Matching is a high-level machine vision technique that identifies the parts on a picture that match a predefined template. The Advanced template matching algorithms, Convolutional Neural Network allow us to find occurrences of the template regardless of their orientation and local brightness. The Template Matching techniques are flexible and relatively straightforward to use which makes them

one of the most popular methods of object localization. Applicability is restricted mostly by the available computational power as the identification of massive and sophisticated templates is often time-consuming.

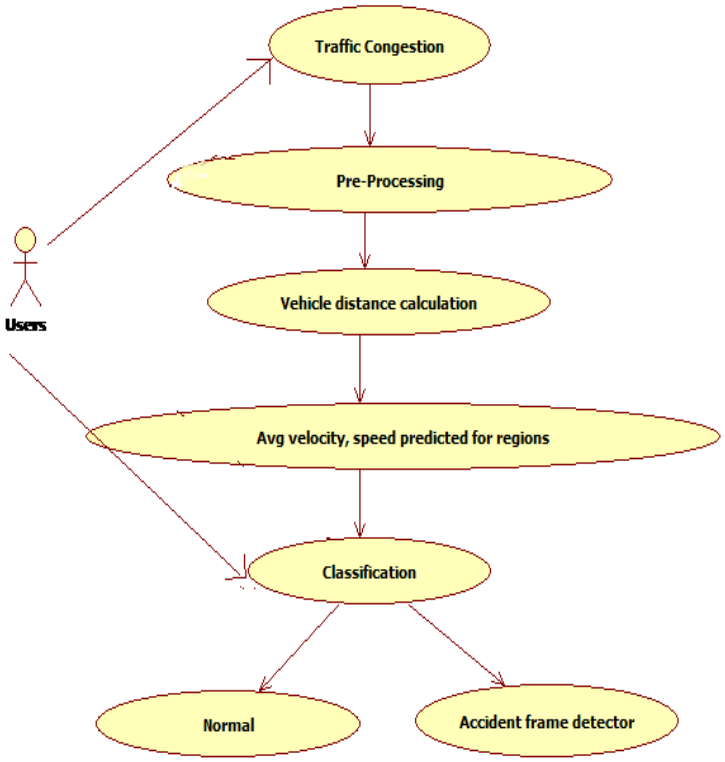

Figure 3. UML Diagram-Ambulance Detection

IV. METHODOLOGY

The project work has been planned to address the objectives of determining traffic density to minimize the delay caused by traffic congestion and to provide the smooth flow of vehicles. Besides, the work simulates a crash or an accident detection and for the prototype consideration, used static accidental image and trained model, and analyzed the ambulance detection using the dataset, for the prototype consideration used static ambulance image and trained dataset. On detection of an ambulance, the traffic light is automatically changed to green.

The objectives were screened with literature reviews and identified the project topic and its significance to the current context of the vehicle movement management to provide a safe drive and safe life.

The methodology is as follows:

Chosen the right images and datasets for training model, captured the density of vehicles in a particular frame, counted the number of vehicles in that frame and based on the density, changed the traffic light colors, used a sample video of an accident and set alert notification upon a crash, and lastly in the third part, used an image of an ambulance which was captured by the webcam and detected it as emergency service accordingly.

The input dataset images have been extracted; the background subtraction technique would be applied

to each of these frames. This process would lead us to urge a binary image from the frame is processed for BLOB detection. BLOB detection would contain BLOB detection, BLOB analysis, and BLOB tracking. Morphological closure operations including erosion and dilation would be wont to increase the accuracy of the system for better detection of vehicles. Further region properties of BLOBs are calculated.

Various properties are taken into considerations. These properties help a lot in analyzing the area of a BLOB. Area calculation would give us the density on the roads as low density, medium density, and high density depending on the area covered by the BLOBs. These classifications help us in better analysis of the traffic conditions, ambulance vehicle detection, and accidents of vehicle detection.

Hardware Interface

All the physical equipment's i.e. input devices, processor, and output device and interconnecting processor of the computer are called hardware.

- Hard Disk minimum of 40 GB.
- RAM minimum of 2 GB.
- Dual Core and up to 15" Monitor.
- Integrated webcam or external webcam (15 -20 fps).

Software Interface

A set of instructions or programs required to make a hardware platform suitable for the desired task is known as software. The software also can be defined because of the utility programs that are required to drive hardware of the pc.

- Operating system- Microsoft Windows 7 SP 1 or above; Python

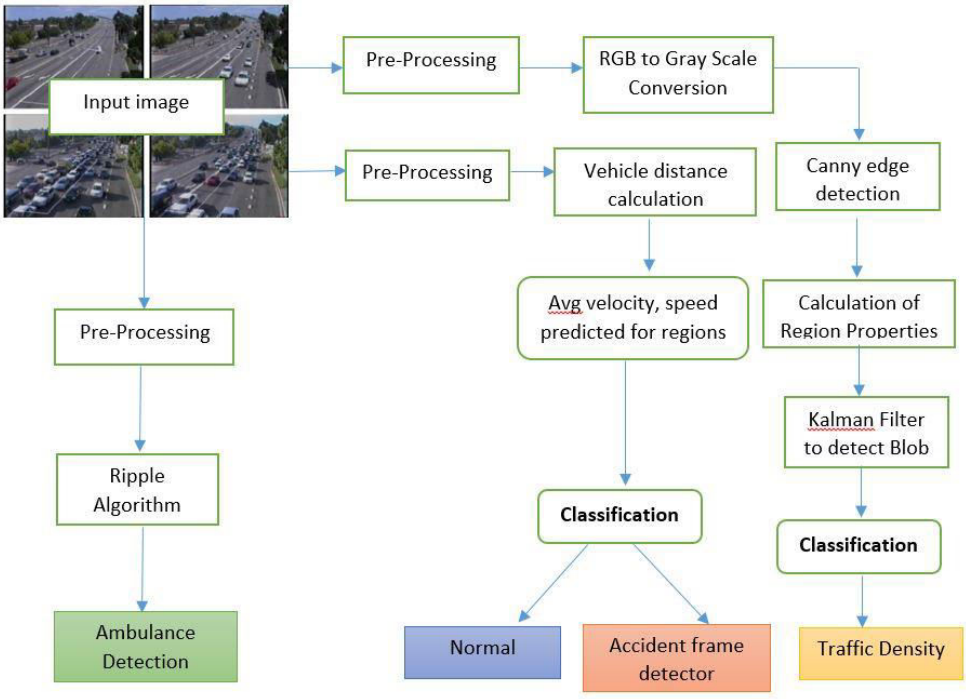

Figure 4. The architecture of the traffic management system

V. EXPERIMENTAL RESULTS

The following figures are the screenshots of the working module captured in an environment

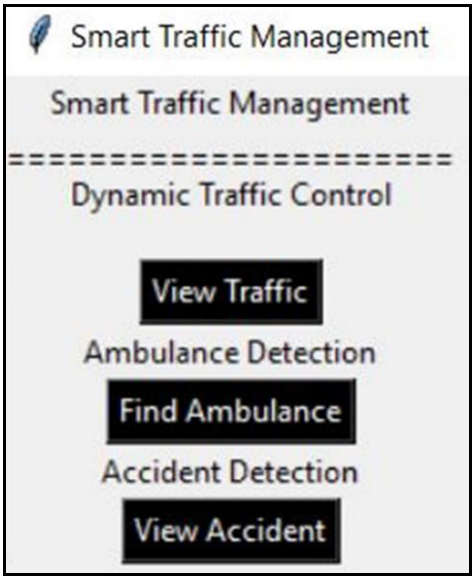

Figure 5. Dashboard

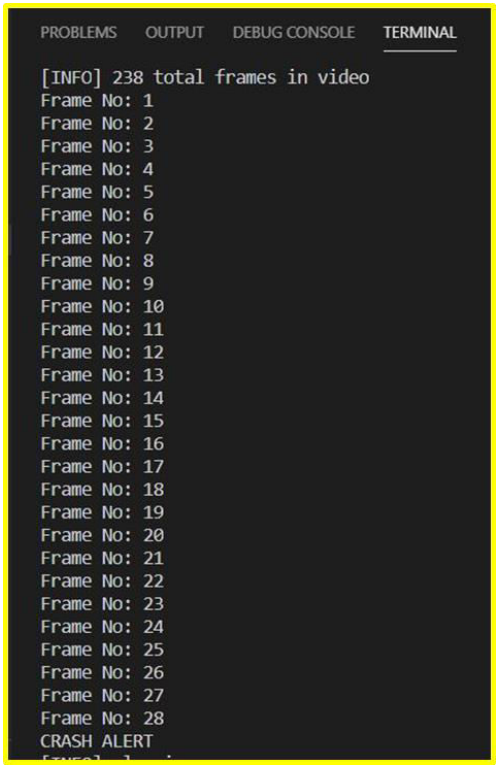

Figure 6. Accident Detection Output

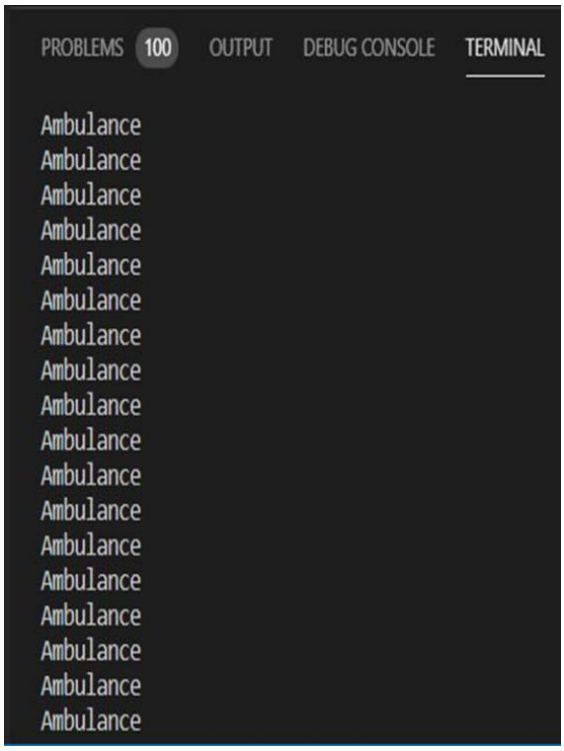

Figure 7. Ambulance Detection Output

Figure 8. Static image of an ambulance captured by the camera

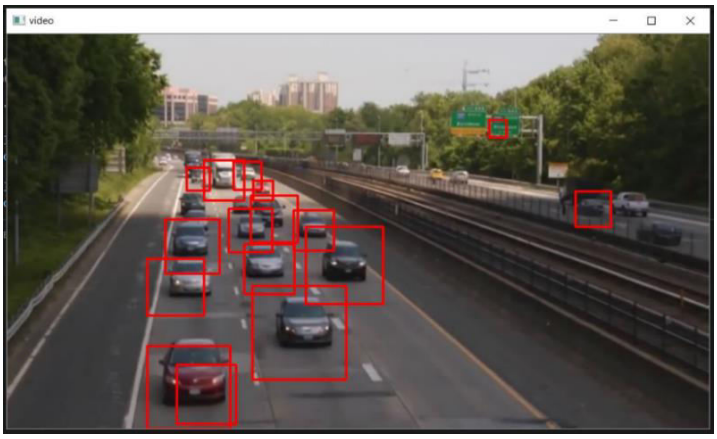

Figure 9. Count of the number of vehicles

VI. CONCLUSION

Traffic Density Analysis, Ambulance, and Accident detection System Using Image Processing has been discussed in this proposed system. This project provides a framework that analyses the dataset input images. Periodic frames would help to increase the processing speed of the framework. BLOBS increases the efficiency and improves the detection as well as analysis of vehicles. The framework to automatically classify traffic, ambulance vehicle, and accidents in the roads using image processing and machine learning techniques is one of the most successful topic models.

1. Limitations

The limitations of this simulated model are minimal. Firstly, the detection of vehicles approaching in both directions simultaneously doesn't offer the best result. Detection of vehicles on a single side produces accurate results. Secondly, in accident detection, when two vehicles come together nearby, the crash alert could be triggered sometimes when there is no crash. Thirdly, in ambulance detection, the existence of patients inside the ambulance cannot be identified by this and can be misused for false-emergency by the drivers. There is an enormous scope of image processing in traffic monitoring and analysis for future technologies.

2. Future enhancement

In the future, to this model, helmet detection and automated fine system can be added. The camera detects the person not wearing a helmet and captures the vehicle number. Then, the details of the rider are retrieved and a fine is imposed for the violation. Further, as an extension to the accident detection, SOS alert upon detection of a crash can be added.

Further advancements in video-based traffic-flow detection can help in developing increasingly robust, real-time, and intelligent traffic management in an optimized system structure.

REFERENCES

[1] Kaviani, Razie, Parvin Ahmadi, and Iman Gholampour. "A new method for traffic density estimation based on topic model." Signal Processing and Intelligent Systems Conference (SPIS), 2015. IEEE, 2015.

[2] Hasan, Md Munir, et al. "Smart traffic control system with application of image processing techniques." Informatics, Electronics & Vision (ICIEV), 2014 International Conference on. IEEE, 2014.

[3] Kaviani, Razie, Parvin Ahmadi, and Iman Gholampour. "A new method for traffic density estimation based on topic model." Signal Processing and Intelligent Systems Conference (SPIS), 2015. IEEE, 2015.

[4] Hasan, Md Munir, et al. "Smart traffic control system with application of image processing techniques." Informatics, Electronics & Vision (ICIEV), 2014 International Conference on. IEEE, 2014.

[5] Surendra Gupte, Osama Masoud, Robert F. K. Martin, and Nikolaos P. Papanikolopoulos “Detection and Classification of Vehicles” IEEE Transactions on Intelligent Transportation Systems, Vol. 3, No. 1,pp.37- 47, March 2002.

[6] Suárez, P.D., Conci, A., de Oliveira Nunes, E. “VideoBased Distance Traffic Analysis: Application to Vehicle Tracking and Counting”, IEEE CS Journals and Magazines, Volume: 13, Issue:3, pp. 38-45,2011.

[7] Sobel, An Isotropic 3x3 Gradient Operator, Machine Vision for Three Dimensional Scenes, Freeman H., Academic Pres, NY, pp. 376-379,1990.

[8] B. Koszteczky, G. Simon, “Magnetic-based vehicle detection with sensor networks,” IEEE International Instrumentation and Measurement Technology Conference, pp. 265-270, May 2013.

[9] N. Otsu, “A Threshold Selection Method from GrayLevel Histograms,” IEEE Transactions on Systems, Man, and Cybernetics, Vol. 9, No. 1, 1979, pp. 62-66.