VEHICLE DETECTION AND COUNT USING IMAGE PROCESSING IN SMART TRAFFIC MANAGEMENT SYSTEM

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Abstract: ***Today's traffic management system uses pre-set timers for traffic lights to control traffic congestion, which is an open loop system that leads to an unreliable traffic management. This problem can be solved by using closed loop system in which we capture image of current traffic scenario and digitally process the captured image to count number of vehicles detected in each lane using image processing techniques based on object detection in MATLAB software. Therefore priority to lanes and timers for traffic lights will get set according to the density of traffic present in respective lanes. Vehicle detection and count is carried out using blob detection technique that uses the Blob Analysis block to calculate statistics for labeled regions in a binary image. Additionally, this system includes an application of ambulance detection. Ambulance detection is done using color thresholding technique by using the selected threshold value of siren of ambulance and priority will be given to that lane in which ambulance is detected irrespective of the traffic density.***

Index Terms - Close loop system, Vehicle detection, MATLAB, Blob detection, Color thresholding

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I. INTRODUCTION

Automated traffic management and surveillance are important in today's vehicle populated world. This automated traffic management system will play vital role in Intelligent Transport System (ITS). Traffic parameter such as density and flow has been an active research area for the development of intelligent Transportation systems (ITS). It is identified that vision-based camera systems are more flexible for traffic parameter estimation [1,2]. Here comes an Image Processing of this images captured by camera of live traffic scenario, in which images are digitally processed and features are extracted from the digitally processed images. Therefore feature extraction of an image of current traffic scenario can provide quantitative description of traffic status that includes speed, vehicle count, etc. These quantitative traffic parameters can help us understand traffic flow information and leads us to design smart traffic management system [3].

Traffic density is an important aspect of traffic parameters. Traffic density can be evaluated by extracting vehicle count of each road of the lanes in a captured image. Vehicle count can be carried out using image processing techniques based on object detection. In this proposed system we used Blob detection technique which is one of the object detection techniques well suited for vehicle count. Blob detection returns the count of blobs present in that image. we have mentioned the different regions for different lanes in background model, so accordingly it returns the total count and depending on the regions we can decide the vehicle count in that particular lane. We put region of interest in each lane and gets the count for respective lane. Once blob detection returns blob count of IN and OUT roads of respective lanes, priority is given to lanes according to the vehicle density present in the IN side roads and timers will be given to the traffic lights according to vehicle density present in OUT roads.

Additional application in this proposed system is emergency vehicle i.e. Ambulance detection. In this we will use color based thresholding in which thresholding is to be done based on color values in natural images to detect an ambulance in an image. Where image will be compared with the predefined criteria of ambulance detection in which red color intensity of siren with number of pixels used to define a region of siren is set by the MATLAB programmer. When ambulance is detected in any of the lanes priority will be given to that lane irrespective of the traffic density.

II. LITERATURE REVIEW

Object detection has become a wide area of research in image processing. Many methods have been proposed for object detection in digitally processed images such as background subtraction, edge detection, blob detection etc. There are several applications of object detection in digitally processed images [4]. Vehicle detection is one of the applications of object detection widely used in smart traffic surveillance system.

M. Fathy and M.Y. Siyal in [5] developed a new background updating and a dynamic threshold selection technique. In this an alternative object detection technique used in image processing is based on edge detection techniques. However, an edge detector extracts the edges of the object of a scene irrespective of whether it belongs to the background details or the objects. Therefore to separate this two extra information is required. They have developed a new image detection method based on background differencing and edge detection techniques, which separates the objects from their backgrounds and works well under various lighting and weather conditions. This image detection technique can be used together with other techniques for calculating traffic parameters for example, counting number of vehicles.

M. Piccardi in [6] provides a review of the main methods and an original categorization of background subtraction methods based on speed, memory requirements and accuracy, such overview helps designer to select the most appropriate and suitable method for a given application in a principled way. Methods that are reviewed in this paper include parametric and non-parametric background density estimates and spatial correlation approaches.

G. Salvi in [7] proposed a system where count of number of vehicles present on lane is determined with the Blob detection technique which is structure based. In this the proposed algorithm is concatenated with background subtraction, blob detection, blob analysis, blob tracking and vehicle counting. A vehicle is classified via blob analysis. By analyzing the blob of vehicles, the feature extraction is done to get vehicle count.

Nilima Kulkarni in [8] explains that the thresholding is to be done based on color values in natural images. The color thresholding technique is being carried out based on thresholding values modification in the algorithm. This results in separation of object from the background using image segmentation technique by using the selected threshold value.

III. PROPOSED ALGORITHM

In this first we will define regions of all four lanes with IN and OUT roads as shown in figure 1, color thresholding value with number of pixel for ambulance detection i.e. red color of siren of ambulance, Blob size for vehicle detection. Captured image will first go through RGB color thresholding for each lane as per defined regions. After color thresholding color image will get converted into grey scale image for blob detection as blob size is predefined for vehicle. Detected blobs are labeled for blob count in respective regions of lanes.

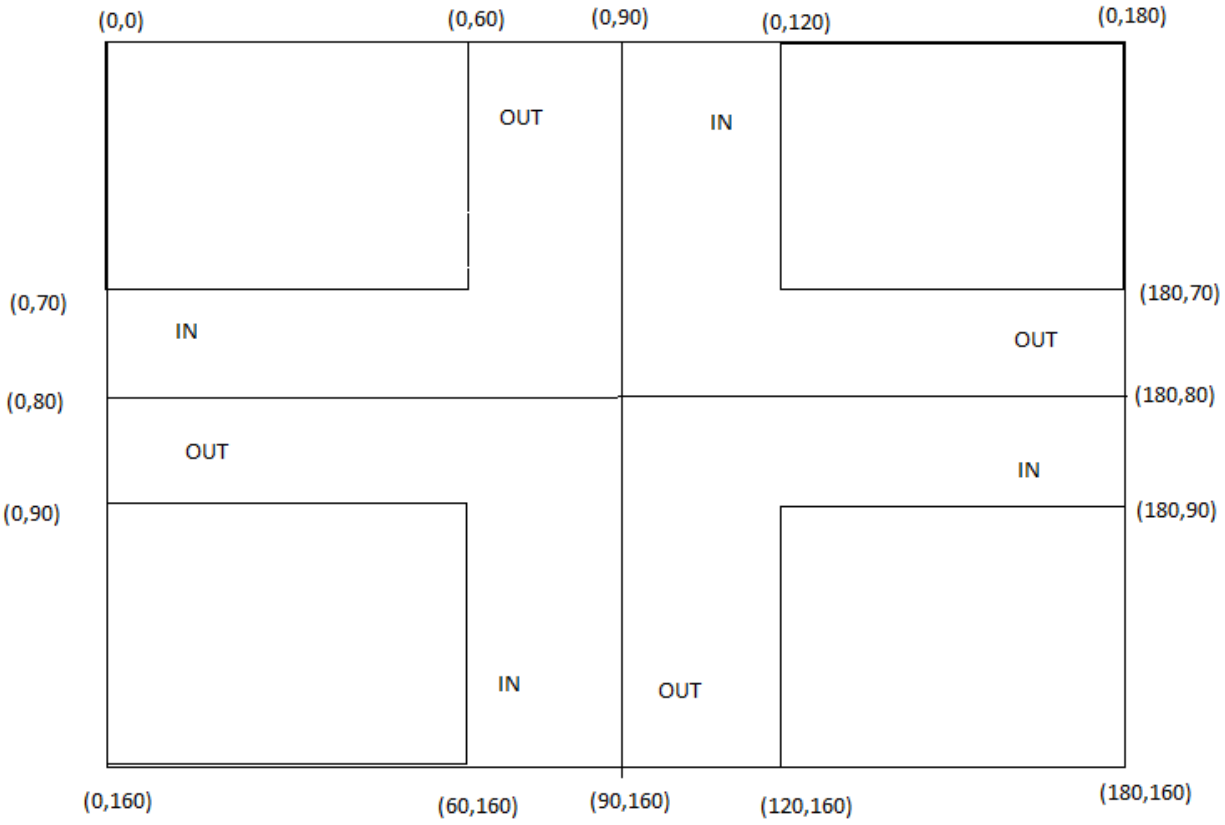
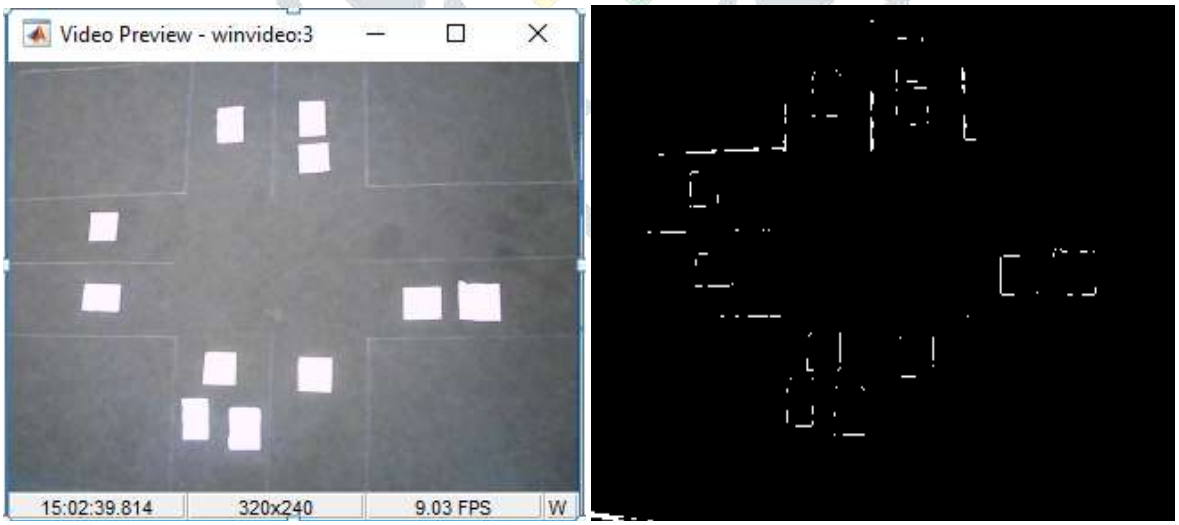


Fig. 1. Traffic model

IV. EXPERIMENT

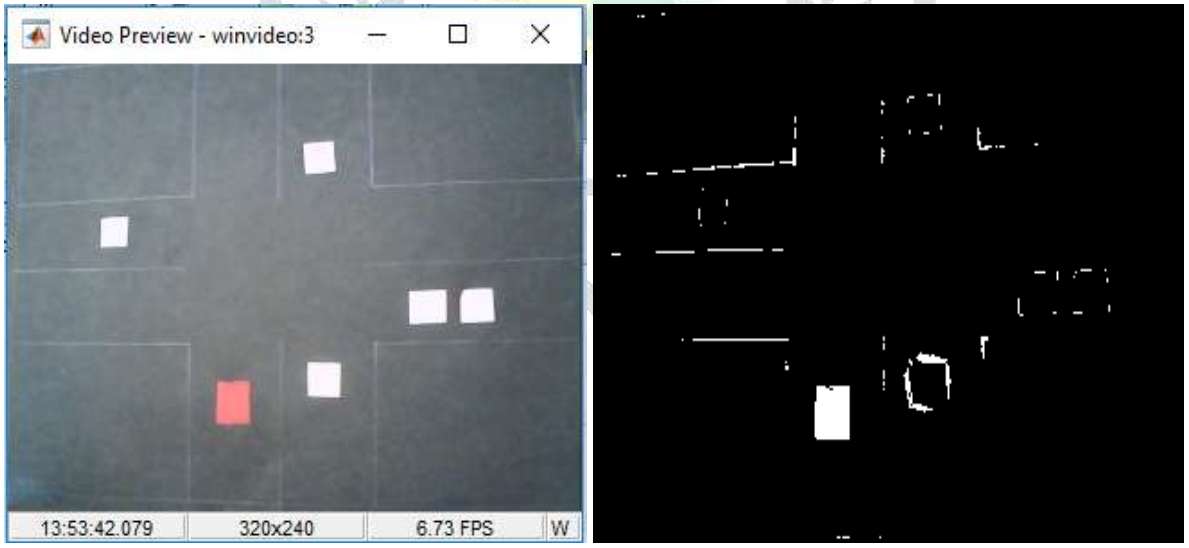


(a) (b)

(c)

Fig. 2. Experiment-1 (a) Original image (b) Blob detection (c) Output window

Fig. 2 shows Experiment 1 and (a) shows original image of traffic model with vehicles present in each lane, (b) Indicates blob detection process which shows the detection of vehicle as a blob, In (c) command window gives count of vehicles present IN side and OUT side of the lane to decide priority and set the timer.



(a) (b)

(c)

Fig. 3. Experiment-2 (a) Original image (b) Blob detection (c) Output window

Fig..3 shows Experiment 2 and (a) Original image of traffic model shows vehicles present in each lane and also ambulance, (b) describes blob detection process which shows the detection of vehicle as a blob and also indicates color Thresholding for detection of ambulance, in (c) command window gives count of vehicles present IN side and OUT side of the lane and detection of ambulance.

V. RESULT

Table -1 Result of Experiment-1

LANE		1				2				3				4			
ROAD		IN		OUT		IN		OUT		IN		OUT		IN		OUT	
VEHICLE COUNT (THEORETICAL)		2		1		2		0		3		1		1		1	
VEHICLE COUNT (PRACTICAL)		2		1		2		0		3		1		1		1	
PRIORITY to LANES(THEORETICAL)		3				2				1				4			
PRIORITY to LANES(PRACTICAL)		3				2				1				4			
TRAFFIC LIGHTS (LED)		RED	LG	CG	RG	RED	LG	CG	RG	RED	LG	CG	RG	RED	LG	CG	RG
THEORETICAL TIMER (IN SEC)	ROUND 1	**0**	**12**	**8**	**8**	12	0	0	0	12	0	0	0	12	0	0	0
	ROUND 2	12	0	0	0	**0**	**12**	**12**	**8**	12	0	0	0	12	0	0	0
	ROUND 3	12	0	0	0	12	0	0	0	**0**	**8**	**12**	**12**	12	0	0	0
	ROUND 4	12	0	0	0	12	0	0	0	12	0	0	0	**0**	**8**	**8**	**12**
PRACTICAL TIMER (IN SEC)	ROUND 1	**0**	**12**	**8**	**8**	12	0	0	0	12	0	0	0	12	0	0	0
	ROUND 2	12	0	0	0	**0**	**12**	**12**	**8**	12	0	0	0	12	0	0	0
	ROUND 3	12	0	0	0	12	0	0	0	**0**	**8**	**12**	**12**	12	0	0	0
	ROUND 4	12	0	0	0	12	0	0	0	12	0	0	0	**0**	**8**	**8**	**12**

Table -2 Result of Experiment-2

LANE		1		2		3		4	
ROAD		IN	OUT	IN	OUT	IN	OUT	IN	OUT
VEHICLE COUNT (THEORETICAL)		1	0	2	0	Ambulance Detected	1	1	0
VEHICLE COUNT (PRACTICAL)		1	0	2	0	Ambulance Detected	1	1	0
PRIORITY to LANES(THEORETICAL)		3		2		4		1	
PRIORITY to LANES(PRACTICAL)		3		2		4		1	
TRAFFIC LIGHTS (LED)		RED	LG CG RG	RED	LG CG RG	RED	LG CG RG	RED	LG CG RG
THEORETICAL TIMER (IN SEC)	ROUND 1	**0**	**12 12 12**	12	0 0 0	12	0 0 0	12	0 0 0
	ROUND 2	12	0 0 0	**0**	**8 12 12**	12	0 0 0	12	0 0 0
	ROUND 3	12	0 0 0	12	0 0 0	**0**	**12 12 8**	12	0 0 0
	ROUND 4	12	0 0 0	12	0 0 0	12	0 0 0	**0**	**12 8 12**
PRACTICAL TIMER (IN SEC)	ROUND 1	**0**	**12 12 12**	12	0 0 0	12	0 0 0	12	0 0 0
	ROUND 2	12	0 0 0	**0**	**8 12 12**	12	0 0 0	12	0 0 0
	ROUND 3	12	0 0 0	12	0 0 0	**0**	**12 12 8**	12	0 0 0
	ROUND 4	12	0 0 0	12	0 0 0	12	0 0 0	**0**	**12 8 12**

Table-1 shows count of vehicles present at IN side and OUT side of each lane both theoretically and practically. According to number of vehicles present at IN side lane priority is given as shown in figure.2. Then depending upon count of vehicles in OUT lane timer (in sec) is set for Red(RED), Left Green(LG), Centre Green(CG) and Right Green(RG) traffic lights in which 12 sec specifies presence of 0 vehicles, 8 sec specifies 1 vehicle, 4 sec specifies 2 vehicles and 0 sec specifies 3 vehicles.

Table-2 shows count of vehicles present at IN side and OUT side of each lane and presence of ambulance. As ambulance is detected in lane 3 IN side, first priority is given lane 3 and then priority will be given to lane 1, 2 and 4 based on count of vehicles. Depending upon count of vehicles in OUT lane timer (in sec) is set for Red(RED), Left Green(LG), Centre Green(CG) and Right Green(RG) traffic lights.

V. CONCLUSION

In smart traffic management system, vehicle detection and count using image processing is implemented. The vehicle detection and counting is done using Blob detection technique where the captured images of lanes are processed separately. According to count of vehicles priority is set. Also ambulance is detected by selecting threshold value of siren of ambulance using Color Thresholding technique. The priority is given to that lane in which ambulance is detected irrespective of traffic density. No errors are found in experiments according to comparison of practical values with theoretical values in result. Thus proposed algorithm works well in all possible scenarios. Therefore this system is more accurate to solve problem of traffic congestion as it is based on real time traffic. Due to the image processing and closed loop this system gives good accuracy and speed.

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