Detection of Vehicular Area for Smart Traffic Control System

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Abstract

The increasing number of road traffic jams has led to the improvement in framing smarter traffic control mechanisms. This paper proposes a system of determining the vehicular area in order to know the space occupied by the vehicle on the road. By determining this, the count is separately made for heavy and light vehicles which can accurately give the congestion status of a road with heavy traffic. The system uses vehicle tracking algorithm and blob detection for processing the video sequences from the road. On obtaining the count and congestion status it is intimated to the vehicle users at the destined location through a LCD display.
Keywords- Blob Detection, Congestion Status, Region Properties, Vehicle Tracking

I. INTRODUCTION

In order to reduce the number of accidents increasing in densely populated countries, a system to alert the vehicle users about the traffic congestion in a particular area is necessary. This paper proposes a system of analyzing area of the vehicles that arrive and stand still in a road intersection with traffic signals. The traffic conditions of a particular road are continuously monitored by a camera placed at height in accordance to the larger area coverage. The system uses a processed video frame which contains the number of vehicles arriving to a particular junction of the road. Upon using the algorithms in tracking the vehicle and blob detection, the number and size of the vehicles are determined. We determine this such that the exact congestion of the road is known.

II. PROPOSED SYSTEM

This system proposes to implement the measurement of traffic density using real time video processing technique. Our proposed system consists of Matlab simulation with hardware implementation using ATMEL microcontroller by wireless transmission systems. The block diagram of the software simulation is illustrated in figure 1.

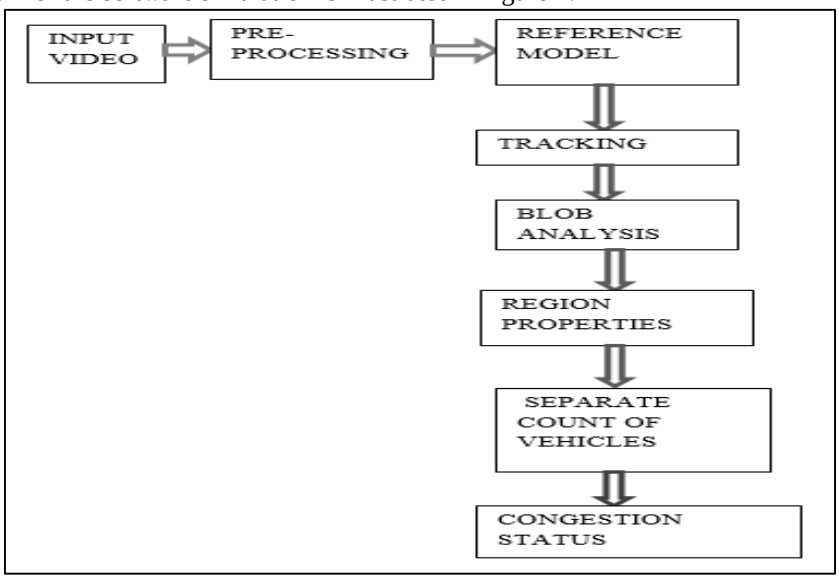

Fig. 1: Block Diagram of the System

The simulation process involves five steps that are described as follows:

A. Reference Model

An empty road is taken as the reference 0model. The region properties of this empty road as a background image are analyzed. Using the concepts of expectations and maximization the clusters in the background image are found. By utilizing the initial means the data points are selected randomly and the covariance matrix is set for each cluster.

In the expectation step, probability of each data point belonging to a cluster is determined. In the maximization step, the means and co-variances of the cluster is determined. Upon determining the reference model specifications, the vehicle tracking is done.

B. Tracking

The video sequences of a road are initially captured by the camera. The moving object from a particular frame of the video is considered and tracked based on the predefined parameters in the MATLAB functions. The moving parameters of the vehicle are centroid, area change fraction which are defined a minimum value in order to track the moving vehicle to calculate the area occupied.

C. Blob Detection

Blob detection is a methodology that describes about the detection of different properties of a digital image in comparison with the adjacent regions. A region having some constant properties in an image is known as blob. Every point in a blob is referred in terms of similarity to the other. The area of the vehicle is determined using the blobs applied to the vehicles. This will be useful in determining the size of the vehicle. The blob analysis performed for the captured video sequence which consists of a number of vehicles that have entered a road and waiting in the traffic signal is shown in the figure 2.

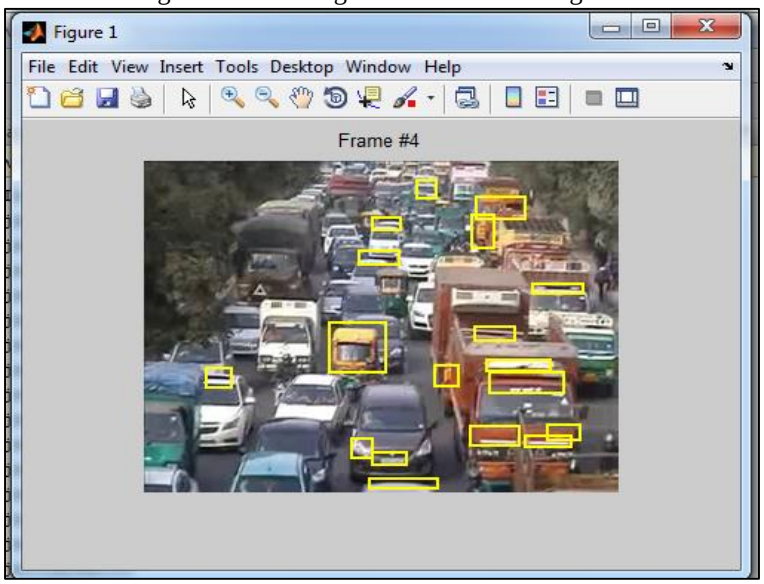

Fig. 2: Blob Detection

Here the blob is put for the vehicles in a rectangular format. Once the blob detection of the moving parameters in a road is done, the region properties of the blob representation are analyzed.

D. Region Properties

The region property of the vehicle is purely based on the background empty road before the vehicle could enter the road and after the vehicles start to arrive consecutively. The area, consecutiveness, centroid of the blob represented is considered for counting the number of vehicles according to the size. By utilizing the size of the vehicle, the count can be segregated for heavy and light vehicles.

E. Count of Vehicles

The vehicles are continuously counted with respect to the width and length of the bounding box drawn by a function. This count is used for estimating the accurate congestion status of the road. When the count of the count of large vehicle and small vehicle exceeds a predefined limit then the road is said to be heavily congested.

III. HARDWARE IMPLEMENTATION

The size and count of the vehicles and the congestion status obtained from the software simulation is interfaced with the ATMEL microcontroller. The RF transmitter transmits the output from the simulation to the microcontroller. The microcontroller is provided with a 4-bit HT encoder which encodes the transmitted data from the RF transmitter. This transmitter section is present where the video sequences are being captured. The communication is via wireless transmission medium. The RF receiver receives the modulated RF signals and it is demodulated. The RF receiver section is placed at the destination to where the traffic congestion has to be intimated to the vehicle users. This RF receiver is connected to a LCD display. The LCD displays the congestion status and large and small vehicle count directly from the simulated output. The port pins 3.1 of the controller are connected to the transmitter and the pin 3.0 is connected to the receiver. Port 1 of the microcontroller is interfaced with the LCD display.

IV. RESULTS AND DISCUSSION

The count of the large and small vehicle that has been observed and detected using the blob analysis is shown as a result from the simulation in the figure 3.

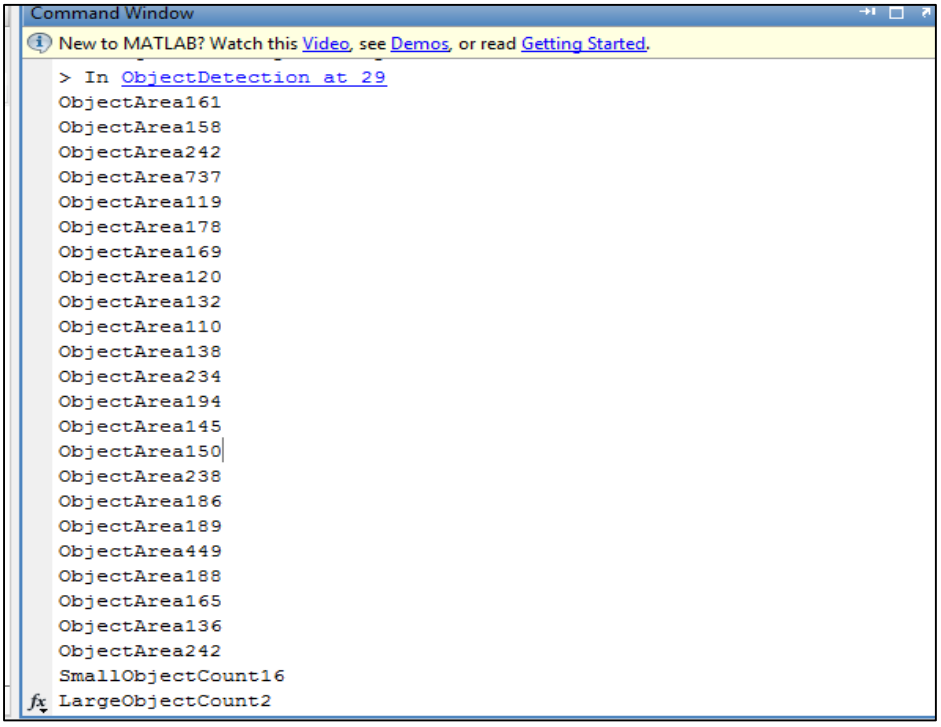

Fig. 3: Separate Counts for Vehicles

The congestion status for the corresponding road is displayed in a warning dialog box as shown in the figure 4.

Fig. 4: Congestion Status

V. ADVANTAGES OF THE PROPOSED SYSTEM

The system accounts for the advantages such that it uses MATLAB for the software simulation which is easy to implement for all video processing. The system determines count of the vehicles based on its area hence the congestion occurred in a road is exactly determined. Sensors are not used in a road with heavy traffic; hence additional time required is reduced in hardware implementation. The RF receiver can be placed anywhere at the destination of vehicle user because of the wireless transmission system.

VI. CONCLUSION

The project thus describes a smart approach to avoid traffic problems when compared to the existing systems of traffic problems. The main advantage of the project over the existing system is that it uses Matlab instead of openCV which has larger memory consumption for its library functions. The project finds further improvements with determining the congestion status even in rainy days. The system can be implemented in conventional traffic signaling systems. Video detection technology here is a new frontier in case of vehicle tracking because of its dependability. For future enhancements, the gathering of congestion status from adjacent roads gives extra accuracy during traffic signaling. Also drivers can check their destination route for any congestion from the server dedicated through a Smartphone application for reroute their destination. As a result, extra congestion would not occur.

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