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Application of Image Processing in Real Time Traffic Light Control by Traffic Jam Detection

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Abstract: ***Traffic management is becoming one of the most important issues in rapidly growing cities. Due to bad traffic management a lot of man-hours are being wasted. Increasing congestion on highways and problems associated with existing detectors has generated an interest in vehicle detection technologies such as video image processing. Regarding this problem, developing a self adaptive system which can help in better traffic management using the technique of image processing is a necessity. Existing commercial image processing systems work well in free-flowing traffic, but the systems have difficulties with traffic congestion, shadows and various lighting conditions. The suggested feature-based tracking system will detect vehicles under these challenging conditions. Using image processing operations to calculate traffic density is cost effective as cameras are cheaper and affordable devices compared to any other devices such as sensors. Using the information obtained the development of an android application will be done, in which the user will get the traffic density at the location of choice.***

Keywords: ***Traffic management, motion detection, background subtraction, digital image processing.***

I. INTRODUCTION

Traffic system is at the heart of civilized world and development in many aspects of life relies on it. Excessive number of traffic on roads and improper controls of that traffic create traffic jam. It either hampers or stagnates schedule, business, and commerce. Automated traffic detection system is therefore required to run the civilization smooth and safe- which will eventually lead us towards proper analysis of traffic, proper adjustment of control management, and distribution of controlling signals [6]. In this paper we discuss a feature-based tracking system for detecting vehicles under various challenging conditions. Instead of tracking entire vehicles, vehicle features are tracked to make the system robust to partial occlusion. The system is fully functional under the changing lighting conditions because the most salient features at the given moment are using a common motion constraint. The groups represent individual vehicle trajectories, which can be used to measure traditional traffic parameters as well as new metrics suitable for improved automated surveillance. The system works by using latest Technologies like digital image processing. The system consists of cameras that are fixed in lanes which are prone to traffic jam. The camera continuously monitors the traffic by capturing videos. The system will extract frames at particular time intervals. The consecutive frames are compared and based on some parameters we determine whether there is a traffic jam. The system is flexible, reliable and cost-effective. Using the information obtained we will be developing an android application in which the user will know the density of traffic at the destination. This application will be easy and very handy for the user as no extra cost will have to be incurred. This application will also save time that the user will spend dodging busy streets by selecting the alternative route. User opens the application and gets the list of locations present in the database. The user selects the location of his choice and density of traffic is returned.

II. MOTIVATION

Recognizing that vehicle safety is a primary concern for motorists, many national and international companies have undertaken specialized research projects to investigate new technologies for improving safety and accident prevention. Looking at the statistical projection of traffic fatalities concerning the first nine months of 2012 show that around 25,580 people die in traffic crashes relating to motor vehicles. This represents an increase of nearly 7.1 percent from the 23,884 fatalities that occurred in the first nine months of year 2011[7]. Majority of accidents involve collision between vehicles. Due to recent advent in technology and extensive research in the fields of VANET it is now possible and even convenient to transfer data and information between vehicles. Consequently, on-board automotive driver assistance systems - aiming to alert a driver about driving environments, possible collision with other vehicles, or take control of the vehicle to enable collision avoidance. In these systems, robust and reliable vehicle detection is a critical step. The most common approach to vehicle detection is using active sensors such as lidar, millimeter-wave radars, and lasers. Prototype vehicles employing active sensors have shown promising results, which has put an extensive spotlight on such systems. However, active sensors have several drawbacks, such as low spatial resolution, slow scanning speed, and high cost. Moreover, when there is a large number of vehicles moving simultaneously in the same direction, interference among sensors of the same type poses a big problem. Passive sensors on the other hand, such as cameras, offer a more affordable solution and can be used to track more effectively cars entering a curve or moving from one side of the road to another as well as providing us information regarding traffic congestion. Moreover, visual information can be very important in a number of related applications, such as lane detection, traffic sign recognition, or object identification (e.g., pedestrians, obstacles, license plates) and they provide an upgrade without modifying current system [5].

III. EXISTING METHOD FOR TRAFFIC JAM DETECTION

Several approaches have been taken to detect traffic jam. The most widely used basic approach for this is to employ a person at important traffic points. But with the advent of technology and increment of traffic flow, it is more convenient to have automated systems. Magnetic Loop Detectors (MLD) are used to count the number of vehicles using magnetic properties. Current traffic control techniques like magnetic loop detectors buried in the road, infra-red and radar sensors on the side provide limited traffic information and require separate systems for traffic counting and for traffic surveillance. Inductive loop detectors do provide a cost-effective solution, however they are subject to a high failure rate when installed in poor road surfaces, leading to decrease in pavement life and obstruct traffic during maintenance and repair. Light beams (IR, LASER etc) are also used. As traffic moves light beams are obstructed. Electronic devices can record these events and detect traffic jam. Infrared sensors on the other hand are affected to a greater degree by fog than video cameras and cannot be used for effective surveillance [2]. In Contemporary approaches; image processing, computer vision etc are highly recommended. In these types of approaches involvement of computers provide online characteristics, facilitate centralized control over distributed system and develop compact platform. In these approaches, information feed through telephone or web networks can easily be supported. Even, traffic flow of whole city can be observed from a centre and statistics can be made [6]. In contrast to afore mentioned techniques, video-based systems offer many advantages. They provide more traffic information, combine both surveillance and traffic control technologies, are easily installed, and are scalable with progress in image processing techniques. Traffic systems design and urban planning can be very efficient by basing them on the statistics taken from computer aided traffic systems We are using computer aided image processing to attain optimal support.

IV. IMAGE PROCESSING

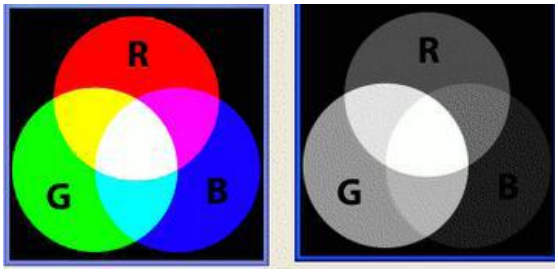
Mostly, automated systems need interaction with a computer that requires an algorithm to meet the specific requirements. Human eye can easily detect whether there is a traffic jam or not. Within less than a second, human brain processes the image of the traffic, detects and analyzes objects, and thereafter comes to a decision. However, implementation of such a thought process requires some special steps. Computers can process only binary data. A picture of the road can be represented as a digital image, which is actually binary data. This image is used as primary input. But, an image, when it is captured from natural environment,

is raw and unformatted. Programmers have to process the data and extract relevant information from images for efficient processing. Frequent need of extracting information from images has led to the development of several fields (e.g. Image processing, Computer Vision, Object recognition etc) in computing industry. The field of digital image processing comprises of methods involving processing digital images by means of a computer. A digital image is composed of a finite number of elements, each of which has a particular location and value. These elements are called picture elements or pixels. Image processing revolves around issues related to image representation, their compression and various other complex operations, which can be carried out on the image data. The operations that come under image processing are image enhancement operations such as sharpening, blurring, and brightening and edge enhancement [4].

V. PROCEDURE FOR IMAGE PROCESSING

We have used image processing along with object detection to detect traffic jam. It involves several steps of image processing to make decision about traffic jam. Key points of these steps are, • Image Analysis • Object detection • Typed object count • Motion detection • Result representation we have integrated these steps in our system and have developed an application for android operating system.

Phase 1: Frames are extracted from the recorded video .The acquired frame is first converted into grayscale. To convert any color to a grayscale representation of its luminance, first one must obtain the values of its red, green and blue primaries in linear intensity encoding. Later the grayscale image is converted into binary.



RGB to Grayscale Conversion

Phase 2: Morphological operations apply a structuring element to an input image and generate an output image [3]. The most basic morphological operations are Erosion and Dilation. These operations have an extensive amount of uses like removing noise, isolation of individual elements and joining disparate elements in an image, detecting intensity bumps or holes in an image. Erosion and dilation produce contrasting results when applied to either grayscale or binary image. Erosion shrinks image objects while dilation expands them. Now we need to bring our image in contrast to background so that proper threshold value may be selected while binary conversion is carried out on the image. Erosion gradually decreases the size of objects and removes small anomalies by subtracting objects which have radius smaller than the structuring element. When the structuring element is passed over the grayscale image, erosion reduces the brightness (and therefore the size) of bright objects on a dark background by taking the neighborhood minimum. With binary images, erosion completely removes objects smaller than the structuring element and removes perimeter pixels from larger image objects.

Preview of Erosion Operation

Dilation generally increases the size of the objects by filling in holes and broken areas, and connecting areas that are separated by spaces smaller than the size of the structuring element. When the structuring element is passed over grayscale images, dilation increases the brightness of objects by taking the neighborhood maximum. With binary images, dilation connects areas that are separated by spaces smaller than the structuring element and adds pixels to the perimeter of each image object.

Preview of Dilation Operation

Phase 3: The approach used here is a spatial-domain technique to detect queue – implemented in real-time using low-cost system. For this purpose, queue detection algorithm is used which comprises of motion detection operation and vehicle detection operation. Motion detection is carried out first because vehicle detection mostly gives positive result, while in reality, there may not be any queue at all. This scheme also reduces computation time. Operations are applied to profiles consisting sub-profiles to detect queue. Motion Detection makes use of frame differencing technique applied to profiles of the images along the road. Vehicle detection operation is based on applying edge detection on these profiles. It is aimed to measure queue parameters accurately.

Motion detection:

We take into account analysis of two consecutive frames, in which the histogram of key region parts of the frames is analyzed. We then compare the histogram with the determined threshold value. The key region should be at least 3-pixel-wide profile of the image along the road. Then a median filtering operation is first applied to the profile (key region) of each frame and one-pixel-wide profile is extracted. The Difference of two profiles is then compared to detect whether there is any displacement or motion. When there is motion, the differences of the profiles are greater than the case when there is no motion. Thus motion can be detected by selecting an appropriate threshold value. The size of the profile plays an essential role and hence is an important parameter.

Vehicle detection:

Theory: The profile along the road is partitioned into a number of smaller profiles (sub-profiles). Number of sub profiles depends on the resolution and accuracy required for the processing. The length of sub-profile should be equivalent to the length of vehicle which facilitates accurate working of both the algorithms.

Vehicle detection algorithm:

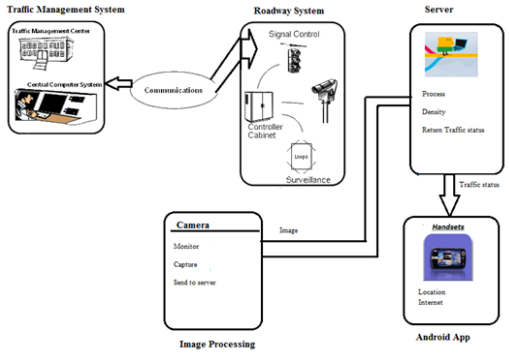
Following the process of the motion detection operation, a vehicle detection operation is applied on the profile of the unprocessed image. For implementation of algorithm in real time, two key strategies are often applied: key region processing and simple algorithms. Most of the vehicle detection algorithms developed so far is based on a background differencing technique, which is sensitive to variations of ambient lighting. We are also using the same concepts. We separate foreground objects from background by a process called as background subtraction by processing it in a sequence of frames. Based on the time of appearance we segment objects. An appropriate pixel level criterion is defined. Pixels which satisfy these criteria are declared as background and are eliminated.

VI. PROPOSED SYSTEM

The architecture consists of five major components: 1 .Traffic management 2. Roadway system 3. Server 4. Android App 5. Camera which is fixed at lanes continuously monitors traffic. Video recorded is extracted into frames, these frames are then sent to the server. Frames are further processed by the server i.e. brightening, blurring, sharpening etc. Concurrent frames are compared, based on the count of the vehicles in the frames, the server updates status as high traffic or medium traffic or low traffic. A new application user will first register and then login into the application using the login form. Then the server returns various locations present in the database to the android user along with the traffic status. User can use the status provided by the server to choose an alternative path to the destination.

VII. ANDROID APPLICATION

An android application based on the outcome of traffic detection will be developed. The user will come to know the traffic density at a particular location. This application will be easy, very handy and no extra cost will be incurred.



Proposed System

The application will save time that the user will spend dodging busy streets. In the application all locations previously present and also new locations are returned in the form of a list. The user then selects the location of his choice and then the traffic density at the particular location is displayed to the user. Then according to the density of traffic returned, the user can select the appropriate route to his destination.

VIII. FUTURE SCOPE

The idea of traffic jam detection can be extended further. Depending upon the location of the camera at the road level the filmed scenes can be used for number plate recognition. Processing problem is related to symbol extraction from number plate image and further symbol recognition. This will help in the progress of automatic number plate registration and recognition. Also the same concept can be used for Traffic Light Control wherein the timer of the signal for its corresponding road is automatically increased or decreased depending upon the traffic density on the particular road facing the camera. Speed of vehicles can be detected and eventually it can help the traffic management system and the police to get better control over the traffic flow of the particular location. Traffic Monitoring at night will become simpler as compared to the traditional patrol team scanning the roads.

IX. CONCLUSION

The study showed that image processing is a better technique to control traffic jam. It is also more consistent in detecting vehicle presence because it uses actual traffic frames. It visualizes the reality so it functions much better than those systems that rely on the detection of vehicles metal content. The analysis can thus be improved with multiple sequential cameras along a highway which in addition to localized congestion control, analyzes the congestion build up from the starting point to the end point. With the aggregate image data, the congestion control strategy can make global decisions and affect congestion control on a reasonably sized scale. Overall, the system is good but it still needs improvement to achieve a hundred percent accuracy.

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