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Perception of Traffic Light with Image Processing and Machine Learning

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Abstract:

In perception of traffic light detect various lights from an image and then recognize traffic light and then estimate the status of the light signal. Automatic detection and recognition of traffic light is an important perception function for advanced driver assistance system (ADAS) or an autonomous vehicle. Three key challenges of the system are computation time, varying illumination conditions and false positives. In our approach, perception of traffic light is done from the dark frames and accurately classified using machine learning in consecutive bright frames. A multiclass classifier is adopted to reduce number of false positives in the bright channel. In order to overcome challenging problems in the traffic light recognition, we have proposed a traffic light perception system based on an image processing and machine learning.

Keywords **— Traffic signal, traffic light recognition, image processing, machine learning, advanced driver assistance system, multiclass classifier.**

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INTRODUCTION

As population is increased traffic problem is one of the most dangerous problem. To ovrcome this problem traffic light recognition is very important for advance driver assistance car or autonomous vehicle. A driver from normal vehicle or car can easily recognize triffic light, but it is difficult for ADAS cars to recognize traffic light from the traffic signs, pedestrain, temporary road signs which have similar color with traffic light. For perception of traffic light, traffic light recognition is important task. After the traffic light recognition estimation of traffic signal is also important.

Perception of traffic light helps an autonomous car to take decision for further movement. Also according to status of traffic signal that car decides either continue or stop. Perception of traffic light

also helps to reduce the rate of road accidents which occures due to limitition in recognition of traffic light. In future, this system will also stop those who can break the traffic signal. Perception of traffic light is effective way for traffic control. For traffic light recognition consideration of differnt envirnmental conditions such as lightning is important.

It is easy to recognize traffic light form the dark frame, but as we have to recognize the traffic light from the bright frame various false positives are introduced such as traffic signs, pedestrain, temporary road signs which have similar color with traffic light. For that firstly the bright frame is converted to the dark frame and then from that dark frame traffic light is recognized. If traffic light is not present or not get detected from the frame then go for the next frame otherwise state the status of traffic light. After this car has to take decision to continue or to stop based on the status of traffic light.

Machine learning is very efficient method in which object is correctly classified or grouped or stated using different kind of methods or machine learning models. From that SVM is very useful model for multiclass classification. There are also some other models but the efficiency of SVM is more than other. We are taking the dataset for designing the SVM model, so the input for model is also in the form as per dataset. If not in that form then we have to convert it into suitable format. Another way is rather than converting image into dataset format create the model from set of images rather than the dataset.

Traffic light is recognized from other lights due to its intencities and the position. Traffic signal is made up of small LED's of red, green and amber color. As LED's of particilar color glows we observe signal with particular color. The meaning of traffic signal get change as color changes. The meaning of red light is the vehicle has to stop, yellow light is ready to stop or go and green light means vehicle can go forward. Color combinition of traffic signal may be different as per country or location. So while designing the system consideration of all these conditions is necessary.

LITERATURE SURVEY

Recognition of traffic light or signal and estimating the status of that signal is the main problem in autonomous cars. To overcome this problem we proposed a traffic light perception system. This system is consists of different algorithms studied from various reference papers. A region of interest is a subset of an image or a dataset identified for a particular purpose. Region of interest is identified by the boundaries of an object. The boundaries of object may be defined on an image, for the purpose of measuring its size. The concept of a ROI is commonly used in many application areas. The region of interest method is effective in feature extraction but inefficient because it is sensitive to illumination changes. In geographical information systems (GIS), a ROI can be taken literally as a polygonal selection from a 2D map. In many applications, symbolic (textual) labels are added to a ROI, to describe its content in a compact manner.

In saliency map filtering majority of existing methods utilize various color spaces and tuned color threshold to detect color blobs of traffic light. The color is primarily used for finding region of interest and classifying traffic light states. Instead of RGB color space, other color spaces are considered because color and intensity are mixed in three channels of the RGB color space. The input image is first abstracted into perceptually homogeneous elements. Color of the pixels of each element is represented. In this, saliency value is assigned to each pixel. Saliency refers to unique features

(pixels, resolution etc.) of the image in the context of visual processing. Saliency map is a topographical representation of them.

In multiple exposure images based traffic light recognition multiple exposure images consist of two images with different exposure times that are captured sequentially. We propose a color detection method based on multiple exposure images to solve the saturation problem. This method has two advantages first the color threshold region can be determined as narrow therefore false positives are reduced then saturation problems do not occur because of the brief exposure of low exposure images to light. This paper propose a multiple exposure images based traffic light recognition method. Color segmentation is widely used to detect traffic light signals in traffic light recognition system. Multiple exposure technique which enhances the robustness of color segmentation and recognition accuracy by integrating both low and normal exposure images.

CNN to classify the presence of the object within that region. Faster RCNN replaces selective search with a very small convolutional network called Region Proposal Network to generate regions of Interests. R-CNN models first select several proposed regions from an image and then label their categories and bounding boxes. Then, they use a CNN to overcome false positives. Here we use the features of each proposed region to predict their categories and bounding boxes. The output dense layer consists of the features extracted from the image and the extracted features are fed into an SVM to classify the traffic signal within candidate region proposal.

The support vector machine employed to classify the status of the traffic lights is widely used to solve classification problem. The most important factors of SVM classification are to define vectors that can represent each category. The HOG descriptor is selected as the feature vector for the traffic light classification. SVM is a linear model for classification problems. It can solve linear and non-linear problems and work well for many practical problems. The idea of SVM is simple, the algorithm creates a line or a hyperplane which separates the data into classes.

METHODOLOGY

The main purpose of the system is to recognize traffic light from an image and state the status of traffic light. In this firstly SVM (Support vector machine) model is designed. SVM is machine learning model which is used for multiclass classification. Here we have to classify the Traffic light status. For classifiction we use dataset having various instances. Preprocessing of the dataset is done using various steps such as import libraries, import the dataset, taking care of missing data in dataset, encoding categorical data, splitting the dataset into training dataset and testing dataset, feature scaling. After preprocessing SVM model is designed on training dataset, then for performance measurement testing dataset is used. The architecture of the system is as follows:

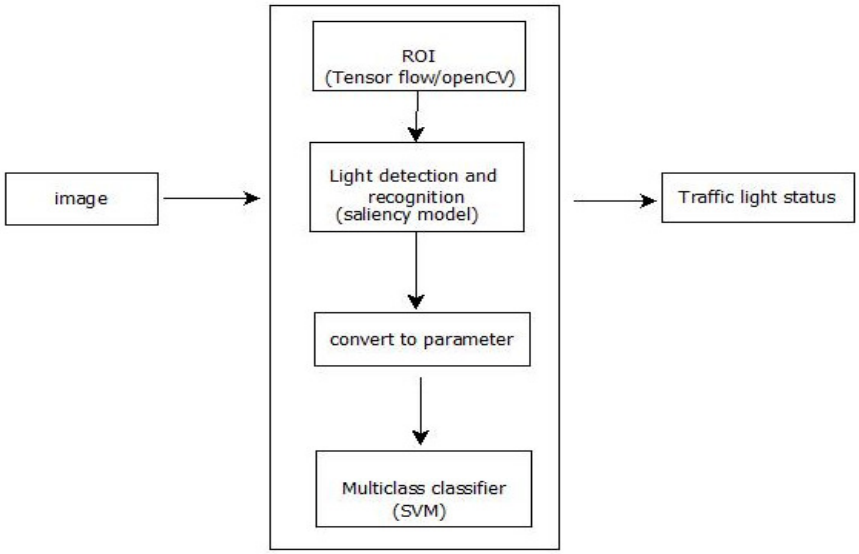

fig. Diagram of proposed traffic light perception system

An input image is taken then image processing is performed.Image processing starts with finding the region of interest in which object detection is the main part.For detecting object from inage openCV function is used. Filter an imge to get grayscale image. After grayscale conversion an image is converted to binary form using openCV function. Specify the boundary of object. Perform central portion localization on that image. From this process of finding region of interest we get the selected region. For finding region of interest also tensor flow method is used. Detect and recognize traffic light from the selected region obtained after finding region of interest using saliency model, for this different intensities are considered.

For recognition of traffic light there are some false positives such as traffic signs, pedestrain, temporary road signs which have similar color with traffic light. These false positives are overcome using CNN. After overcoming these false positives traffic light is correctly recognized. After recognition we have to state the status of traffic light. If there is no traffic light present in image then go for the next image. If traffic light is recognized then go for classification.

An input image is converted to its parametric form as per the dataset instances. These parametric form of image is added to dataset as single instance. All preprocessing operations done as per on dataset. This instance is given as input to SVM model. Draw confusion matrix for the model. After successful designing of machine learning model check the performance of the model. Also calculate the precision, recall, accuracy and error of the model. The system gives traffic light status as output.

CONCLUSIONS

In order to overcome the challenging problems in traffic light recognition, we have proposed traffic light recognition system based on image processing and machine learning in this paper. By using saliency map and region of interest we can recognize traffic light efficiently. Traffic light is correctly recognized using object detection which is part of image processing. To overcome false

positives caused by the traffic signs, pedestrain, temporary road signs which have similar color with traffic light CNN is used. For estimation of status of traffic signal SVM model of machine learning is designed successfully. It is very efficient system for controlling the traffic and minimizing the road accidents.

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