CAR IDENTIFICATION FOR BRAKE LIGHT DETECTION USING HAAR CASCADE APPROACH

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Abstract

Lighting system in a car is comprising of lighting and signaling components. These are installed inside the vehicle, on the front and at the rare side of the vehicles. Precisely, lighting systems are used for providing illumination inside the vehicle for passengers and at the front of the vehicle for road visibility to the driver. Along with this purpose, the light is also used for indicating the projected activity of the vehicle through signaling. With the passage of time, revolutionary modifications are done in automobile industries. Autonomous vehicles are the recent outcome of such revolutionary changes. There are diverse components which are to be developed in order to bring the autonomous vehicle to the level of human driven vehicles. Out of this numerous building blocks, brake light detection of the forward vehicle is one of the challenging jogs, which can be explored for collision avoidance, maintaining safe distance and forward vehicle activity detection. In the proposed research work, brake light detection of the forward car is projected. The research work is divided in to car identification and brake light detection. In this research paper, car detection using HAAR transformation is explored. The implementation is carried out using Deep Learning Approach and configured using Python language.

Keywords: Car Detection, Deep Learning, Haar Transformation, Brake Light Detection,

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1. Introduction

With the rapid technical revolution and development in the luxury, safety and comfort provided through the LMV and other categories of vehicles have attracted consumers to own a vehicle. This resulted in to long traffic jams and serious accidents which pose threat to the human life, to the environment and social economy. To deal with this situation, many researches are carried out with respect to the human safety and pollution control. Driver behaviour detection, blind spot warning, Anti-Lock Braking System, Air bags, Tyre Pressure Monitoring Sensors, Parking Sensors and Camera, Downhill Assist Control, Adaptive Cruise Control, Automatic Emergency Braking, Lane Departure Warning, Facial Recognition Software are the some of the recent development in the safety segment of the LMVs.

Considering the revolutionary technical developments in past decade, vehicle driven without human interference that is autonomous vehicles or driverless car or robotic car, are also thought of in the decade of 40s and first model was developed in the 50 by GM Motors. In the successive development the speed at which the vehicle can move in increased with the added safety features. In this concept there are numerous sensitive tiny components which are engineered delicately. Out of those numerous significant components, more precise methodology for automatic braking light detection is addressed. Brake light detection of the forward vehicle is done in two steps: car detection and then brake light detection. In this research paper, model implementation for identification of car along the road is discussed in details. This module can be implemented in any autonomous vehicles.

I. Literature Survey

Taillight detection plays an important role in an automatic driving system. Such detection and recognition are essential to avoid rear-end crashes or accidents. Traditional methods based on acoustic sonar sensors are available to rear-end accident warning but it is quite a costly method. The authors in [1] have proposed and implemented a new two-step method for the detection of tail light from an individual image. In the proposed approach, tail lights patterns are trained by many layers of observation artificial neural networks. A deep classifier is used to distinguish between normal and brake images. To increase the speed of the identification procedure and enhance the toughness of the proposed system a new point of the area of concern and road segmentation identification technique is employed.

Nowadays, count of vehicles on the roads is growing exponentially. The statistical investigation shows that the maximum number of road crashes occurs during the hours of darkness. One of the most important tasks for decreasing night crashes is to identify vehicles at night-time and maintain proper distance between two vehicles. In night-time situations, the in-front vehicles are normally recognized by their brake and tail lights. The vehicle visibility is somewhat dissimilar at night-time when compared with daytime due to several parameters like the reflection of light from the car body, the color of the car, and natural light. The authors proposed a technique for car vehicle identification based on tail light color from the acquired color image. [2]

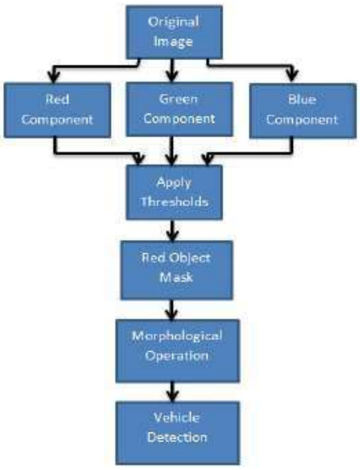

Fig.1. Flowchart of the proposed system

In automatic vehicles, the identification of vehicles employing a front face visual camera is primarily dependent on modern driver support systems. Many traditional techniques are available for the identification of vehicles during the daytime. For night-time vehicle identification, modern driver support systems depend on the brake light of the vehicles. The authors [3] have proposed two improvised techniques for the identification of vehicles during night-time using a front face visual camera. The first technique is for enhancing correctness for vehicles having dual taillights and the second technique is for enhancing correctness for vehicles having solo tail lights. Non-divergent visual flow points are employed for the identification of vehicles having single functional tail lights.

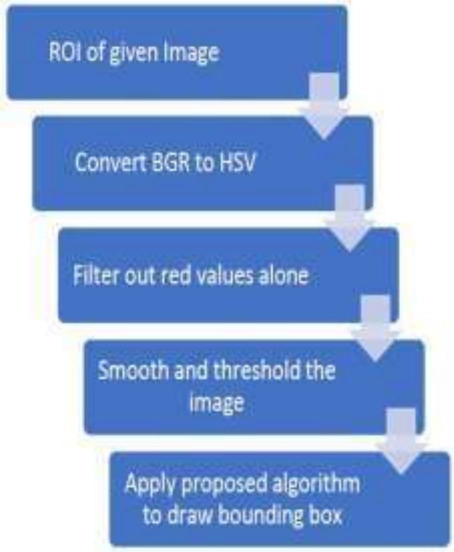

Fig.2. Proposed system model for vehicle detection

At night-time, the most challenging task for the human eye is to identify in front vehicles. identification of vehicles at night-time mainly depends upon factors in modern driver support systems. Such systems are capable of providing supplementary functional support during driving at night-time. In this paper, the authors [4] presented techniques to identify the vehicles by using the perception of edge identification. But such techniques are not implemented in real-time. The goal is to propose an automatic methodology for the detection of vehicle headlamps and brake lights at night-time employing the perception of blob identification in computer vision. Cars driving in front of the vehicle can be identified by their front and brake lights using a car dash camera. The flowchart of the proposed algorithm in disclosed through fig.3.

For intelligent transportation, technology such as the Internet of things is mostly used for giving adequate methodology and essential decisions. Internet of vehicles technology depends on the structure of the application layer, network layer, and perception layer. The present paper [5] concentrated on brake light conditions in the perception layer of automatic safety systems. Based on dynamic curve extraction and color characteristic investigation, the authors proposed a technique for the identification and recognition of tail light in front vehicles. Initially, the in-front vehicles are identified and recognized by artificial neural network and dynamic curve approaches. In next step, it evaluates the features of the brake lights by color space technique and position relative principle. Finally, the histogram distribution curve of the brake lights is evaluated in several conditions and completes the recognition process of brake lights.

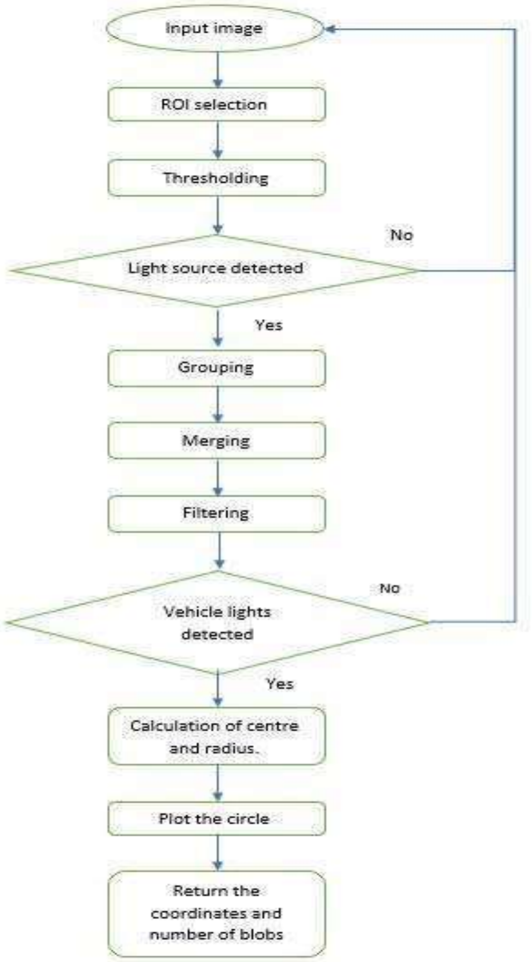

Fig.3. Flowchart of the proposed algorithm

The increase in the number of vehicles initiates the troubles of traffic jams and road accidents. Caution from tail lights is not all the time efficient to avoid accidents. To identify and recognize collisions of the vehicles, Intellectual transportation structure with wireless communication provides a better solution. A motor vehicle to motor vehicle communication structure is proposed which consists of following motor vehicle and leading motor vehicle. An accelerometer is employed to identify the brake type, as footbrake, handbrake and disc brake. Vehicle leading communication transmitter for the computation of fuzzy logic and binary information. Following motor vehicle recognizes binary information utilizing a photodiode in daylight and night-time circumstances. [6]

Haar cascade classifier and rule based image processing algorithm is proposed for the identification of vehicle brake lights for night-time. Haar cascade classifier is best suited and recurrently employed for the identification of vehicle and brake lights of motor vehicles are used for identification. These algorithms are generally used for the identification of vehicles in the daytime. The authors presented experimental outputs for the Haar cascade classifier and rule based image processing combination for night-time vehicle brake light identification. [7]

Accidents may take place at any instant and anyplace, but it is observed that the highway roadside is the most dangerous spot where most of the rear-end collisions or accidents occur. With the increasing number of accidents, several methodologies have been evolved to avoid rear-end accidents like a sensors-based crash identification system to calculate the distance between two vehicles itinerant in a similar route. In the paper [8], based on machine learning the authors developed a tail light identification system for the avoidance of rear-end accidents with high precision. The proposed system employed the Yolo algorithm for learning and substantiation of the information.

The rapidly increasing number of vehicles worldwide increases the critical issue of modern safety vehicles for automobiles. Many smart visual-based identification systems are available that employ digital cameras for the prevention of rear-end collisions or accidents. While traveling at night, cars in front are usually observable by their back and brake lights. The paper [9] proposed a new technique for the prevention of rear-end collisions at night utilizing a digital camera by examining the signal in frequency and spatial sphere of influence. The proposed technique concentrated on achieving the invariant characteristics from the areas of tail lights in the frequency field and hence be able to carry out the identification procedure in a partial manner.

In driver support structure, brake handle indication analytic is a significant characteristic. The main objective of realizing this characteristic is to prevent the identification of fake brake handle indications. It is also capable of indicating brake switch failure. The proposed technique realization ensures that the feature is tested for high accuracy before being employed in the vehicle. Embedded C language is used to write the code for this characteristic. Real-time rational assessment and poly space tools are employed for testing purposes. The proposed technique concentrated on the realization and testing of brake handle indication analytics in the vehicle. [10]

The authors [11] have proposed a reduction in speed identification systems for in-front vehicles such as cars and motorcycles in the night darkness. When a comparison is done between cars and motorcycles, it is observed that the motorcycles are more dangerous and unbalanced. The proposed technique steadily identifies the reduction in speed of in-front vehicles in the night darkness. The first step is to adjust the dimension and location of the area of interest and then to identify the movement of in-front vehicles. In the second step, a support vector machine is used to detect and situate the location of tail lights. The Kalman filter method is employed to keep the track record of identified tail lights. In the final step, the tail light threshold adjustment algorithm is applied to identify the initial movement of the tail lights of the front vehicles.

A monocular camera based tail lights identification and categorization algorithm are proposed which is tilting to collision caution. A path identification algorithm is utilized to detect the driving path. When the actual driving path is identified, the previous vehicle is identified employing the object detector technique. In the next step, tail and brake lights are identified by tying together intensity and color information. In the last step, a support machine vectors categorizer is employed to determine the status of brake lights. Based on characteristics evaluated both on light areas and the whole vehicle image, the braking status of the previous vehicle is identified. The experimental outputs show that the proposed system is capable of achieving an accuracy of 97.6% concerning dissimilar lighting situations and brake lights shape. [12]

In autonomous motor vehicle applications, accurate identification of attentive signals of front vehicles, like tail light and turn indications is exceptionally crucial. The authors proposed a new accurate and lightweight algorithm for the identification of turn indications and tail lights during the daytime and night-time. To diminish the processing load, the proposed technique utilized the Kalman filter. Several traditional techniques are available that only concentrate on the identification of tail lights at night-time, but the proposed technique is capable of identifying the turn indications and tail lights under any lightning situations with high precision rates. [13]

PROPOSED ALGORITHM

For implementation of the proposed concept, that is, to detect the vehicle in the video stream or in live mode Haar cascade algorithm is employed. Haar-Cascade classifier is developed with a purpose to detect particular objects in an image or video stream. This classifier was proposed by Paul Viola and Michael Jones for identification of objects so as to classify the selected objects through the numerous entries. Precise identification of the vehicle using the HAAR-Cascade algorithm is disclosed using the subsequent Fig.4.

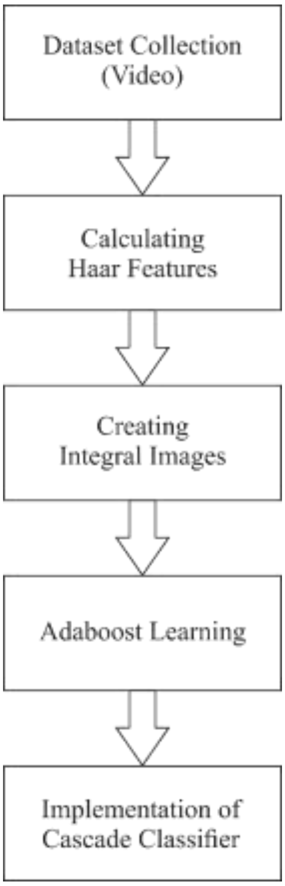

Fig.4. Systematic Block Arrangement of Vehicle Detection using Haar-Cascade Classifier

To implement solution to the proposed problem statement, the Haar cascade classifier algorithm is implemented using machine learning approach. In this process, Haar features are used to sort out likelihood components of the targeted object on the plane. Subsequently, boosting algorithms are employed to pick up strongly predicted components, out of combination of multiple combinations. And then, cascading classifiers are used to run boosting algorithms on different segments of the input image. The so-far discussed steps are disclosed in the subsequent steps.

A. Calculating Haar Features:

To begin with the process, it is important to collect Haar-like features of the object. Haar-like features considers the rectangular regions on the image plane in a detection window. The algorithm sums up the different pixel intensities in each region and analyzes the difference between these sums. This computation helps to categorize the subsections of an image. Some of the examples of the Haar-Like features are as follow:

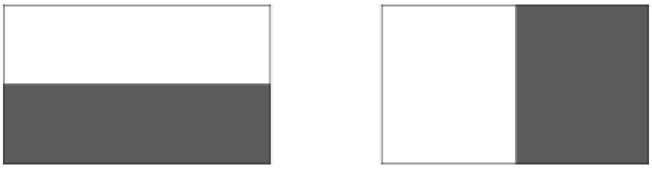

Fig.5. Haar-Like Edge Features

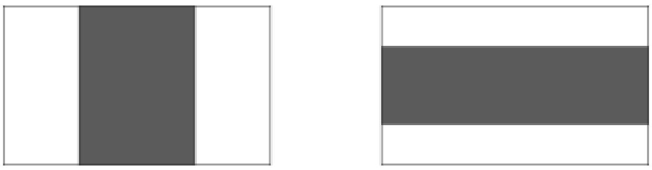

Fig.6. Haar-Like Line Feature

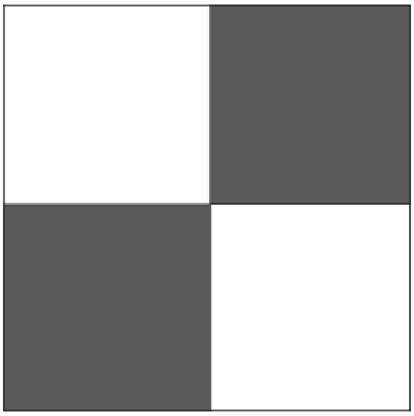

Fig.7. Haar-Like Four Rectangle Feature

***B.* Integral Images:**

This step speed up the calculations of the Haar features. To attain highest possible speed, instead of computing at every pixel, sub rectangles are formed and array references are created for sub rectangles. These are then used to compute the Haar features. While performing the object detection using Haar-like features, it is observed that, almost all of the features irrelevant. It is significant to detect only prime features which represents the object of interest from the input plane. For this purpose, adaboost training steps are performed.

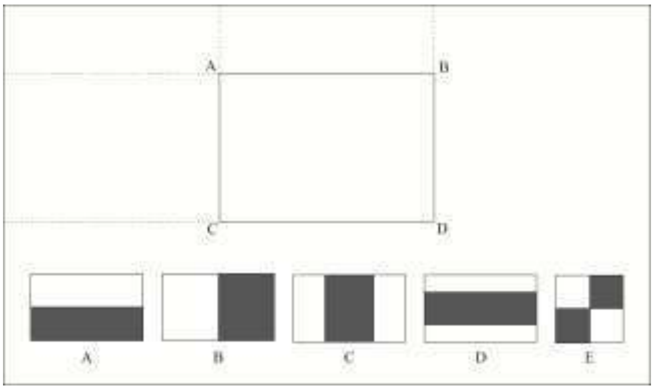

Fig.8. Illustration of Integral Image

C. Adaboost Training:

Out of numerous sampled Haar-Like features, adaboost selects the only essential samples which can be used to train the classifier. Adaboost makes it possible by using combination of weak classifier to create a strong classifier. Weak learners are created by moving a selection window over the input image and calculating the haar-like features for each subsection of the image. Outcome of this is compared with the threshold value which is separating the non-objects from the objects. Since these are weak classifiers, strong database of haar features is required to create a strong classifier with high accuracy.

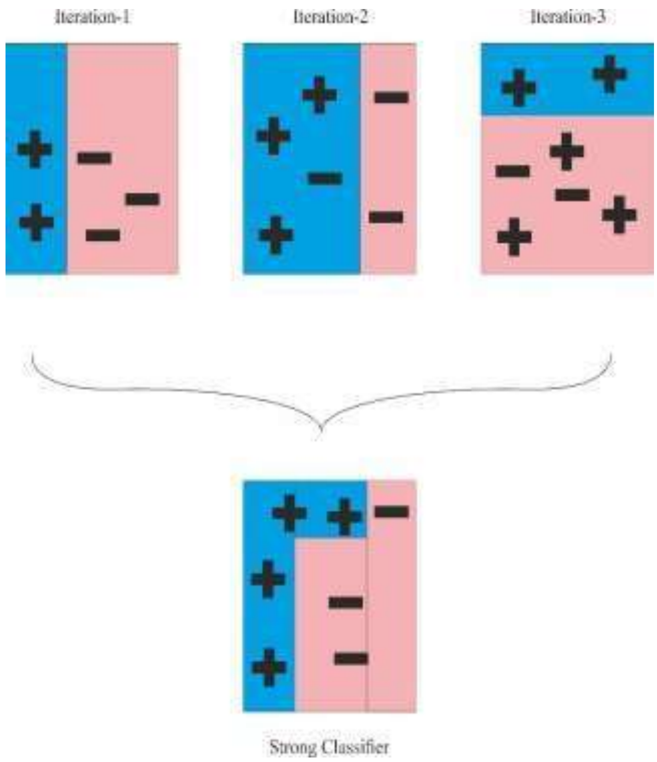

Fig.9. Strong Classifier from Weak Classifier in AdaBoost Training

D. Cascading Classifier:

Through the different stages the, comprising of the weak learners, are trained using AdaBoost training. This allows precise strong classifier from the mean prediction of all weak learners. Based on this prediction, the classifier chooses to indicate was positive or negative. The positive mean object was found and negative mean the object is moved in another region.

Fig.10. Cascade Classifier

Outcome of the Objection Detection

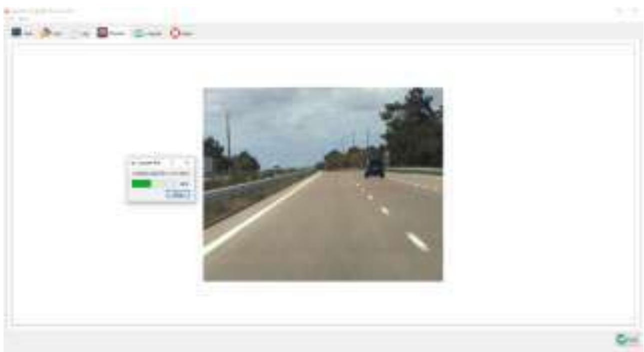

Fig.11. Haar-Cascade Training for Car Detection (a)

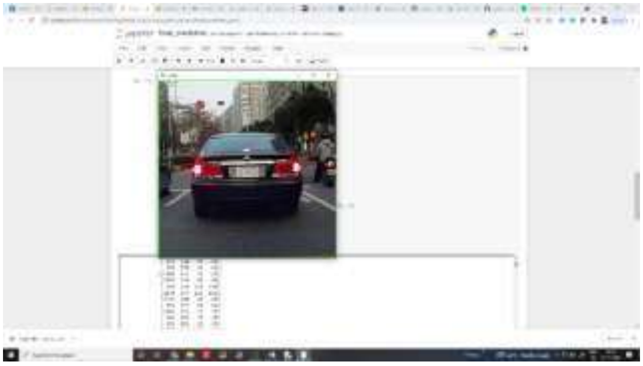

Fig.12. Haar-Cascade Training for Car Detection (b)

Fig.13. Haar-Cascade Training for Car Detection (c)

Fig.14. Selecting Lane Car at Onr Time (a)

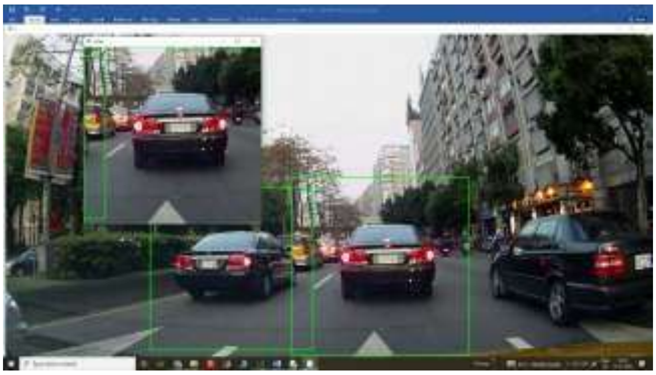

Fig.15. Selecting Lane Car at Onr Time (b)

2. CONCLUSION

Through the research paper, car identification for brake light detection using haar cascade approach is disclosed. The target is to precisely detect the brake light of the subsequent vehicle and neglect the indicator light, tail light and other signaling lights. The said module is applicable to the autonomous vehicles. In this paper, the first part of the brake light module that is car as a object detection mechanism is implemented using haar-cascade module. For detection of the vehicle, video dataset is used as the database for training of the module. Numerous car frame samples as positive database and non-car frame samples as negative database is used for precise detection of the vehicle. The implemented module precisely detects the subsequent vehicles. The outcome of the proposed module is disclosed through the previous section. In the subsequent version of the paper, precise brake light detection mechanism using machine learning module is disclosed.

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