Explainable Real Time Vehicle Make Model Methodology Using Bag of Expressions Features for Indian Passenger Cars

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Abstract: Passenger Vehicle Identification is useful in many of the general-purpose applications. It will improve Intelligent transport system. It will also help to implement law and surveillance. There are many of the deep learning approaches to identify vehicles. Major work done based on shape, and back light identification. Another issue is research work is done on Europe and American vehicle's so there is lot of scope of work for the Indian vehicles.

Vehicle identity is also degraded with speed, day night conditions, rain etc. In addition to it the road traffic conditions are based on locations. It carries with weather and location. This research work is based on identification of the many features of the Vehicle and then comparing and take a decision which is based on multiple features. This approach decomposes area of the interest in the vehicles into small area of expressions. This includes identification of the headlamps, grille, logos, fog lamps, bumpers, and back lights. YOLOv8 framework and EfficientNet-B4 is used to extracts features, then train them and identify the vehicle. In this work a new data set for the Indian passenger vehicle have been planned and work is in progress to create a new data set for the work. This experimental result is under progress at this stage

Keywords: Vehicle Make and Model Recognition; Explainable AI; EfficientNetB4; Bag of Expressions; Intelligent Transportation Systems;

Introduction:

this project is focused on the Indian road conditions and the Indian vehicles. As the traffic conditions and need are different so the process and outcome also. In this EfficientNet4 used for the implementation part and a dataset was developed using local vehicles.

Related work: In the vehicle identification process many of the machine learning technique like Convolutional Neural Networks (CNNs) and transfer learning have been applied [1]. Perfect identification is helpful for the real time applications such as traffic surveillance, traffic management, law enforcement, parking automation, toll collection, border security [2], [3], [4]. research scholar done the work on identifying visual appearance features of vehicles such as shape, headlights, grille patterns, logos, textures, and body structures [5], [6]. In the real time traffic conditions, many factors affect the decision of the system like light conditions, blur image, image with motion, angle of camera, image angle of vehicle and quality of the image. A text-based research work done which is a different approach visual to text conversion used [7]. Performance was low in difficult weather conditions, concept and model was not able to extract all features under all conditions [8], [9].

EfficientNet-B4 Feature Extraction Network

EfficientNet-B4 framework is based on the Convolutional Neural Network (CNN) architecture. It was introduced by Tan and Le (2019). It is used for the primary deep feature extraction network. This framework has balance of recognition accuracy and computational complexity. This framework has capacity of learning from of visual features from images. This research work uses EfficientNet-B4 to extract deep semantic representations from multiple images.

These images are taken from headlamp, Logo, Front Grille, Back Light, Shape. The extracted feature vectors are subsequently concatenated to construct a unified Bag of Expressions (BoE) representation. The BoE representation is expected to improves the efficiency of the framework to identify the most of passenger vehicle expressions during classification.[10], [11], [12], [13].

Key Contribution

This research work based on the Indian vehicles, this is a Novelty of the work. most of work done is in the USA or Europe. Vehicles and their features are not same in different region. Another novelty is Indian traffic conditions are not comparable with the European traffic conditions. These two features makes it an novelty work in this segment

Method, Experiments and Results

In this structure, work is to train the system with the large number of small features from the vehicle. for this it is required to train the Efficient Net on the classes, which represent a small part of the complete vehicle. In the dataset efforts have been put to get many images of the headlight of a single vehicle, Images under multiple conditions. Then it was converted to image size of 380*380, which is suitable the proposed system. Now the system has been trained on these images.

This is the process repeated for other parts of the same vehicle. After the extraction of the features from a image the system will work on the in region of interest and will extract some specific feature. It will analysis the available region of interest. It will fetch some of the features from the image. System will work on the extracted features. Now a decision matrix is prepared. bag of expression has weightage on the on features. Final decision will be based on the multiple parameters.

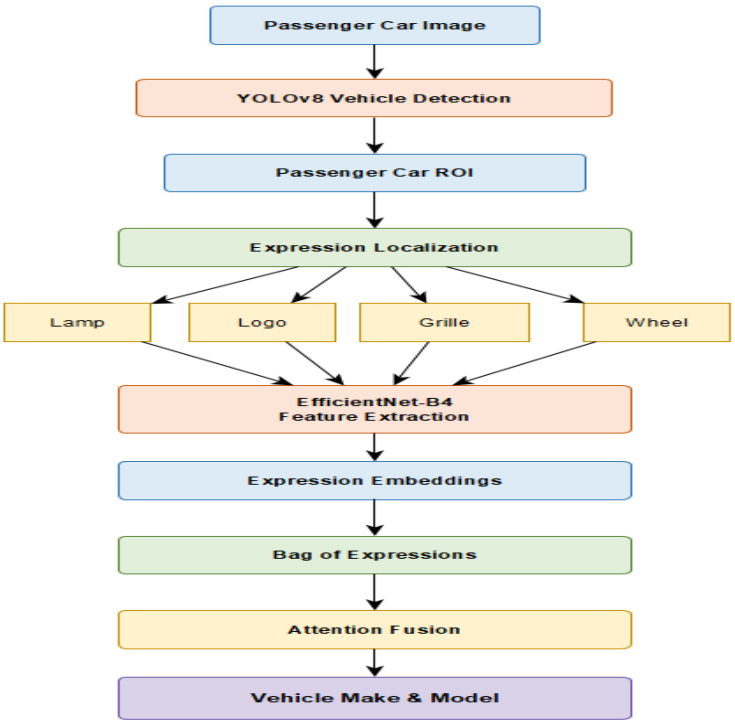

Figure 1:bag of expression and Explainable AI Module Grad-CAM methodology

The bag of expression and Explainable AI Module Grad-CAM methodology for the research work is as enclosed.

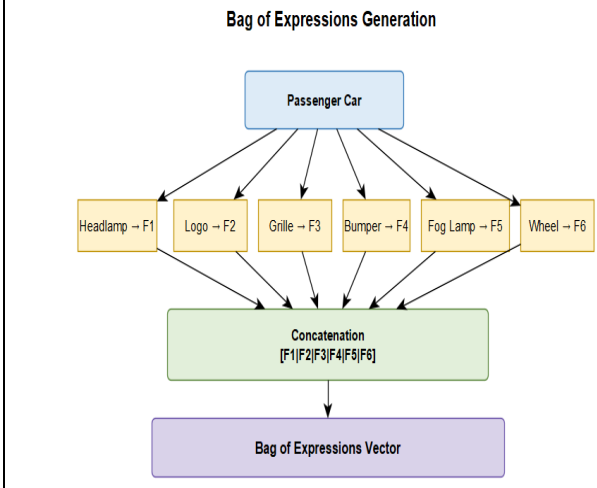

Figure 2: Bag of expression generation

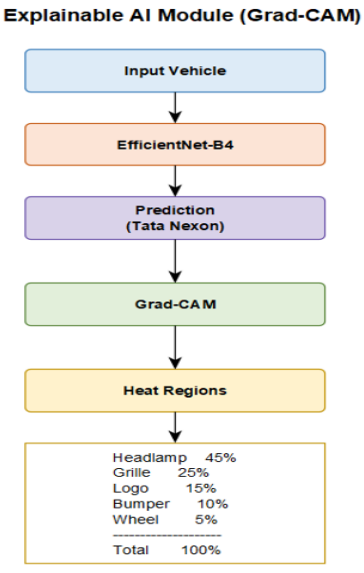

Figure 3: Explainable AI Module

Proposed Dataset Creation:

Data set is created keeping in mind the actual scenarios in the road conditions. Vehicle is easily identifiable when its day time and light is with full sun. but throughout the year weather and sun conditions are not same. In rainy season light is dim, vehicles are dirty. In winter fog is found in many parts of the region and camera cannot see long distance. In road sometimes vehicle speed is slower than normal speed. But same time few vehicles runs very fast. They are hidden by another vehicle, only partially visible. Identification marks are not clearly visible due to damage of vehicle. Companies introduce many new models of the same vehicle with some minor changes so it becomes a challenge for the system to identify the vehicle.

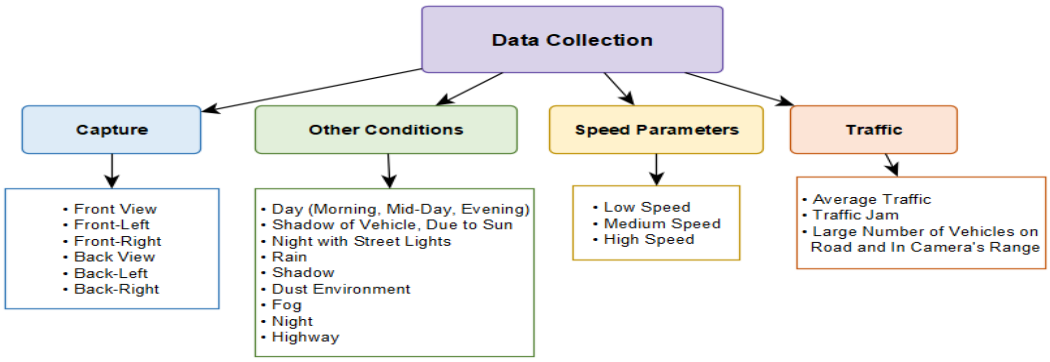

Figure 4: Data Collection

Bag of Expressions Vector constituents are as under.

[H | L | G | W | B | F]

Where:

H = Headlamp Features

L = Logo Features

G = Grille Features

W = Vehicle Features

B = Back lamp Features

F = Day Light Lamp Features

Discussions

Scope of the Vehicle types is vast and ever changing, new vehicle types are introduced each year. this project has scope for expansion. Currently limited to passenger car segment only.

Conclusions

The EfficientNet-B4 work can be applied in many of the applications which are based on the feature extraction. In this work it is working and model have been trained on the sample database of vehicles. dataset have been prepared and System trained. Progress on this work is under development and final results are under progress. final outcome will be published as the model is trained on the large dataset.

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