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Traffic road sign Detection and Recognition using Geometric shapes and Background color: Laying a foundation to use Augmented Reality (A.R.) in Autonomous vehicle Navigation and Decision making

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Abstract

The world is growing at a fast pace and research is widespread in each and every area. One Such Field is Automotive Industry. There are many Techniques which are currently being utilized for Navigation and Road Safety. Here in this paper, we have proposed a methodology with Augmented Reality as a new bee technique which acts as a navigation aid in autonomous vehicles. Automatic detection of traffic signs plays a vital role in navigation. This paper proposes a system in which the automatic recognition of traffic signs can be done by extracting the geometric features of a particular sign. The input image of the traffic sign from the camera is used to categorize the shape of the sign, and then on the basis of background color along with the properties of geometric shapes present, the sign is recognized. A simple yet definitive and optimized algorithm in which geometric shape based, color based recognition and image identification techniques together with Augmented Reality has been employed.

Keywords: Augmented Reality, Pseudo Autonomy, Navigation, Road Safety, Traffic Road sign Detection.

Introduction

The Augmented Reality Technology is a vast technology which is expanding its roots in almost all the fields. One such area is Navigation. Navigation is the process in which further route is planned after determining the accurate current position. Here is when the autonomous vehicle comes into play. The main objective of the Autonomous vehicle is pseudo-autonomy. Autonomous vehicle or Driverless Car with the help of the AR technology determines the navigation instructions. AR in navigation can be implemented using markers or without markers. On the move, traffic road Signs can act as Markers for decision making and further navigation. Traffic sign Recognition and Detection is a real time system in which Road Signs are detected and recognized. Usually color and Shape features are used as a basis for road sign detection and recognition. This paper describes the concept to detect and identify the traffic signs for Autonomous Vehicles using shapes and background color features.

There are Different types of signs for road safety and rules: i. Mandatory Signs: these are needed to be followed, ii. Cautionary Signs: these are for our safety, iii. Informative Signs: they provide some sort of information.

Mandatory Signs: These are the compulsory signs that need to be followed if not then it's a legal offence. Few of the signs are shown in Figure-1.

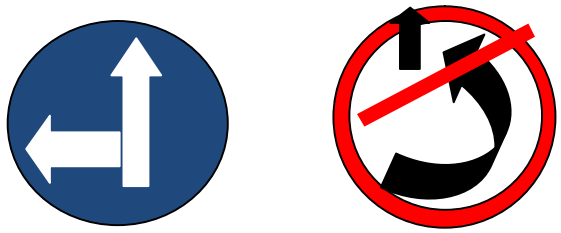


Figure-1
a) Compulsory Ahead or Turn Left
b) Overtaking Prohibited

Warning Signs: These signs are for the safety of the road users and they intend to warn them about the hazards on the road ahead. Few of the signs are shown in Figure-2.

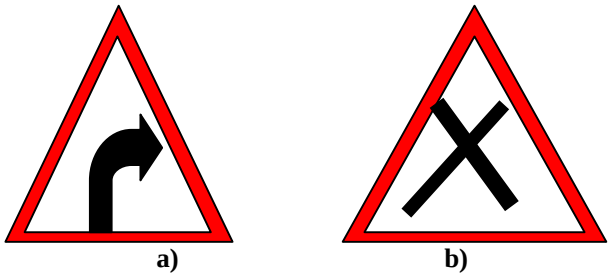
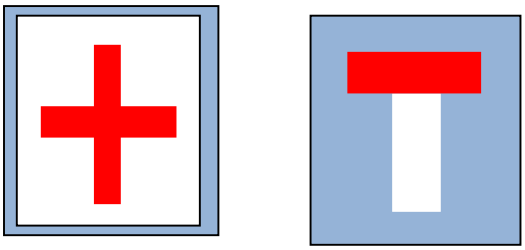


Figure-2
a) Right Hand Curve b) Cross Road

Informatory Signs: These signs provide some sort of general information that can be helpful on the route. Few of the signs are shown in Figure-3.



a) **b)**

Figure-3
a) First Aid Post b) Through Road Sign

Related work

Traffic Road Signs plays an important role for road safety and providing essential information for warning, guiding people to make the movement easier, safer and more convenient. Quite a work has been done in road traffic sign detection till now. D.S.Solanki *et.al.* in their paper have used feature based method for traffic sign detection. In their method the image of traffic sign is cropped and matched with the original image via identifying and matching the key points in both the images to find the similarity[1]. D.M.Shah *et.al.* in their work proposed the recognition of captured traffic sign via matching process. For the matching process, they used the translation of an image. In another of their similar work, color detection algorithm is employed for traffic sign detection and recognition[2,3]. A. Gonzalez *et.al.* in their work extracted information from street level images. They have used SVM or Naive Bayes for classification of traffic signs. Further, text is detected and analyzed to extract and save the information[4]. H.Kaur *et.al.* presented a modified method for road traffic sign recognition and detection. They have used over-segmentation technique to detect and recognize the road signs with the integration of shape analysis. The key feature of over-segmentation is to make much of the segmentation of the image so that object and the background can be distinguished easily. They have employed K-means for color quantization, Histogram equalization to enhance the contrast of the image and Euclidean Distance for shape analysis[5].

J. Greenhalgh *et.al.* in their work for traffic road sign detection detected candidate regions as maximally stable extremal regions (MSER). Recognition is performed via SVM classifier and training is provided using HOG feature[6]. A.Mogelmose *et.al.* performed traffic sign recognition using segmentation technique followed by feature extraction and then final sign detection[7]. G.A.Tagunde *et.al.* In their work proposed a system that uses color information to detect the traffic signs. It is applied on images or real time videos[8].

In most of the work, color and shape detection techniques are employed. Background color detection is nowhere in play. In this paper, we have proposed a new approach for traffic road sign detection and recognition which employs the shape detection followed by background color detection.

Problems in traffic sign detection and recognition

Certain Problems occur while detection and Recognition of the Traffic Road Signs. These Include: i. Lightening Conditions, weather conditions. ii. Color Fading of the Traffic Signs. Color information is affected due to varying illumination condition like weather conditions, shadowing. iii. Presence of other Objects nearby the signs or they partially hide the sign.

Proposed Work Methodology

The Flowchart in Figure-4 describes the steps for the proposed approach.

Algorithm

The Proposed Work methodology is explained as follows: i. Input is in the form of camera captured images. ii. Region of Interest is determined which consist of the Traffic Sign. iii. External Shape of the Sign is determined by detecting the number of end points to categorize it into types of signs prior to recognition. If End Points =3 with edges =3 the shape is Triangle, If End Points = 4, with edges=4, the Shape is Rectangle, If End Points=8, with edges =8 the shape is Octagon, If End Points >8, the shape is circle. iv. If the shape is rectangle then it is an Informatory Sign, Go to Step 7. v. If the Shape is Triangle, then it is a Warning Sign, Go to Step 7. vi. If the shape is Circle or Octagon or Triangle rotated at 180 degrees, then it is a Mandatory sign. Go to Step 5. vii. If it is Mandatory Sign, then Background Color is determined. If it blue, then it is a Compulsory Sign. Go to Step 7, If it is White, then it is a Prohibition sign. Go to step 6. viii. Check the Presence of Chord. If it is not present then the sign is SPEED LIMIT. Go to Step 8. ix. If Chord is Present, Go to Step 7. x. Based on the No. of Arrows, Picture and Arrow Rotation Angle, the sign is detected. xi. END

Conclusion

In the Previous Research, it can be noted that mostly the work is based on color based algorithm that also employ shape detection to recognize and determine the traffic sign. In this Paper, there is an inclusion of Augmented Reality Technology for Road Traffic Sign Recognition and detection. The methodology involves greater detailing while recognition and detection of traffic road signs. There is faster Detection of Geometric Shapes by determining the number of End Points and the number of edges in a shape. Decision Making Process involves Segmentation of Picture Components. Also Background color is taken into account instead of using the sign color which has not been considered until this methodology.

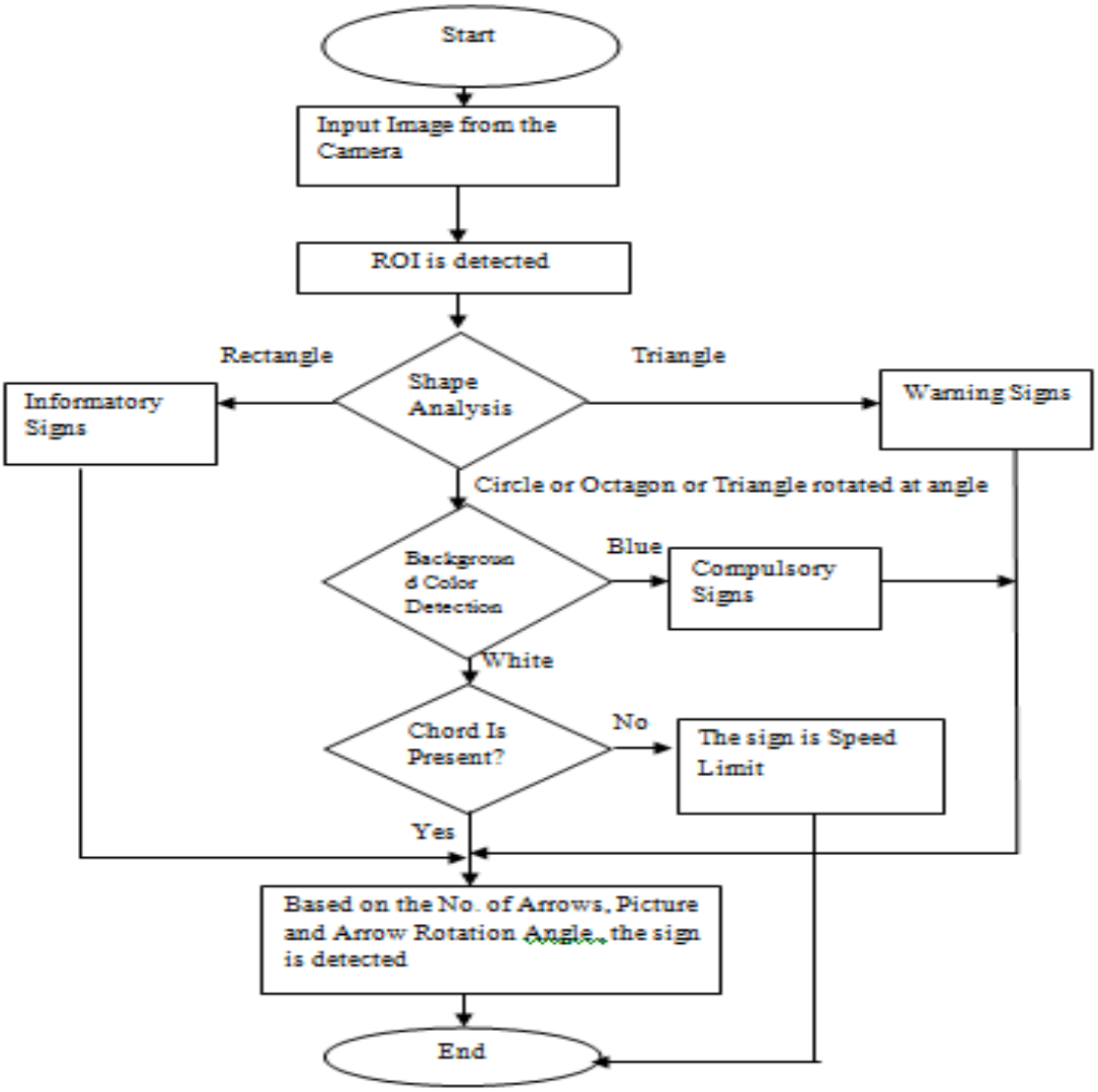


Figure-4
Flowchart showing the proposed Methodology

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