Automatic Cruise Guidance and Control System for Detection and Identification of Indian Road Signs using Artificial Neural Network

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***Abstract*—Road accidents are the main reason for high mortality worldwide. Observation and following the road signs meticulously reduces the potential accidents. Driving in unknown territories, fatigue, atmospheric conditions reduce the effective observation and recognition of traffic signs. This paper builds an automatic cruise control and guidance system for recognition of a subset of Traffic signs and alerts the driver with potential road sign and a voice output. A robot prototype is built to take necessary action corresponding to the sign recognized. A neural network based classification consists of two modules, viz., Detection and Recognition. A feed forward perceptron is built to recognize seven most important signs like stop, right turn, left turn, no U turn, yield etc.,. The results demonstrate good accuracy of recognition low false positives.**

Keywords—Automatic detection, Neural Network, feed forward perceptron, Performance, Accuracy, Error Histogram

I. INTRODUCTION

One of the reasons for high mortality in India is due to road accidents. Road Traffic Accident (RTA) can be defined as, 'An event that occurs on a way or street open to public traffic; results in one or more persons being injured or died, where at least one moving vehicle is involved. Thus RTA is a collision between two vehicles; between vehicles and pedestrians; between vehicles and animals; or between vehicles and geographical or architectural obstacles.' Road traffic accidents are a human tragedy. They involve high human suffering and socio-economic costs in terms of premature deaths, injuries, loss of productivity, and so on.[1] Road Traffic Injuries (RTI) ranked fourth among the leading causes of death in the world.[2] Nearly 1.3 million people die every year on the world's roads and 20 to 50 million people suffer non-fatal juries, with many sustaining a disability as a result of their injury.[3]Road traffic injuries are the leading cause of death among young people aged 15-29 years and cost countries 1-3% of the gross domestic product (GDP).[3-4] By 2020 road traffic crashes are predicted to result in the deaths of around 1.9 million people annually.[4] Most of the accidents and fatalities occur due to limitations of the driver in observing and following the most important Traffic signs. Driving is a task based almost entirely on visual information. for successful navigation. Identification, recognition and following of traffic signs is very important. Traffic signs provide information about the current state of road, restrictions, prohibitions, warnings and other helpful information for navigation. For an ordinary observer due to fatigue, unknown terrains, atmospheric conditions like fog and mist decrease the efficiency of driver in recognizing and following the traffic signs. An automatic cruise control and driver guidance system may of great help to reduce the accidents.

This paper discusses recognition of a subset (7) of most important traffic signs and alert the driver with a voice output, display the traffic sign detected on the driver's video console and a corresponding action will be initiated.

This paper is organized into six sections, Section I discusses introduction and motivation, section II discusses survey of literature, section III discusses classifications of the road signs, section IV speaks about methodology, section V illustrates results and section VI discusses conclusions and Future scope.

II. LITERATURE SURVEY

A lot of research has been carried out for design a robust traffic sign recognition system and it is difficult to compare between those approaches since they are based on different data. J. Miura et al [5] proposes YUV plane decomposition of the scene to detect blue rectangular signs. J. Lillo-Castellano et al [6] uses L-a-b and HSI colour space to extract the candidate blobs for chromatic signs. White signs are detected with the help of an achromatic decomposition. Post-processing is performed to discard non interest regions, and to connect fragmented signs. Maltonado et al [7-8] used a signature defined as the distance from the mass centre to the edge of blob as a function of angle to classify blobs as triangles, squares or circles**.** Gabrilla.et al. [9] used distance transform (DT) and template matching to detect circular and triangular signs. Ruta et al [10] used the colour distance transform, where a DT is computed for every colour channel separately. Larsson et al [11] used locally segmented contours combined with an implicit star shaped object model as photo types for different sign classes. The contours are described by Fourier descriptors.

III. CLASSIFICATIONS OF ROAD SIGNS

Traffic signs have been designed so that they are easily recognizable. The colour for traffic sign is assigned such that it serves purpose of easy detection and interpretation. These signs are represented by fixed shapes like triangle, circle, octagon and rectangle. The combined features of colour and shape are used by driver to distinguish a traffic sign. Traffic signs are located at well-defined locations so that the drivers can more or less expect the position of the sign. The road sign may contain text as a string of characters or pictogram of both to represent to meaning of the sign. They are characterized by using fixed text fonts and character heights. The traffic signs in India are categorized as WARNING (40), COMPULSARY (27), REGULATORY (10) and INFORMATORY (15). Figure.1 demonstrates different categories of road signs.

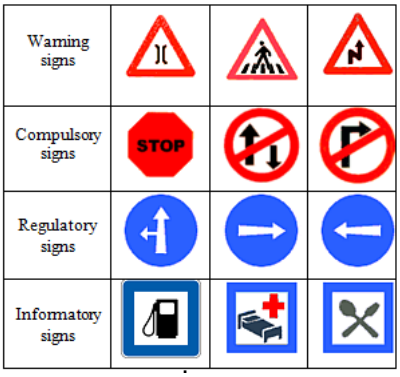

Fig. 1 Classification of road signs

A Warning sign consists of a triangle with red coloured border and white background. Different pictograms in black are used to represent the various warnings. This signs alert the driver with hazard ahead.

A Compulsory sign uses a circle with red border and white background. These signs restrict the action of drivers depending on the pictogram represented on the sign. Signs with a cross prohibit the driver from certain decision such as no left turn or no 'U' turn etc.., Speed limit signs are also included in this category, with speed limit as the pictogram..

A Regularity sign is a mandatory sign to control the action of the drivers. They are used to regulate the traffic flow and vehicles moving on a road. Blue circle with white border represents a regulatory sign. While the arrows within it represent the movement of the vehicle on road.

An Informatory sign gives information like nearby hospitals, telephone booth, first-aid, petrol pumps etc.., which help the driver in emergency. White rectangular with thick blue border and the necessary pictogram represents this category of signs. Parking information is also included in this category.

IV. METHODOLOGY

Automatic Cruise Guidance and Control System for Detection and Identification of Indian Road Signs using Artificial Neural Network consider seven most important Indian road signs obtained from Chandigarh Traffic Police Dataset. The data set is divided into 7 classes with a class label for each symbol. The colour and shape features are extracted from the dataset. A total of 1200 features from HSV (Hue, Saturation and Value) plane are extracted.The approach is described in the block diagram shown in Fig. 2.

The proposed System mainly consists of two main phases: Detection Phase (where the region of interest is extracted from an image of traffic sign) and Recognition Phase(where the detected traffic sign is recognized using neural network).

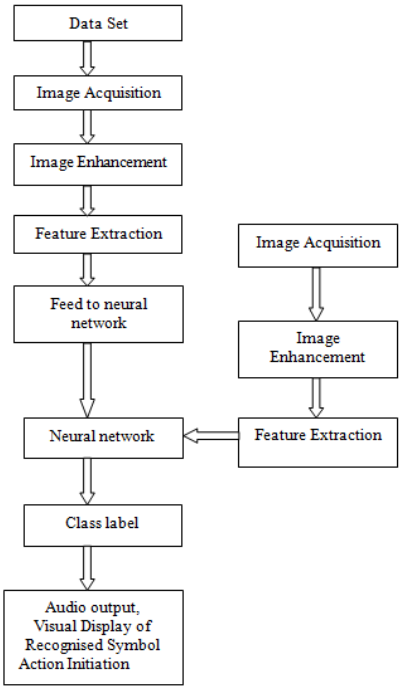

Fig. 2 Block diagram

The symbols used for training the system are shown in Fig. 3.

Fig 3. Symbols Used for Training

In image acquisition phase the real time image is acquired by using a mounted camera on vehicle. For simplicity 30 numbers of pre acquired real time images are used. The

captured image is subjected to noise, blur etc.. Image enhancement operations such as Histogram Equalization, Illumination correction and Noise removal is applied to enhance the recognition of the image. Median Filtering is applied to remove the noise present. A data set consisting of 7 classes of signs are used for training. The identification phase consists of two main phases.

The detection phase region of interest is recognised based on the colour in given image and the recognition phase extracted feature vector of the real time scene is fed for further classification. The Algorithm detection and classification is mentioned shown as below

1. Convert the image to HSV Plane
2. Perform max. Thresholding on S plane
3. Perform max. Thresholding on H plane
4. Segment the traffic sign
5. Obtain the feature vector for the above step
6. Feed feature vector to a neural Network for classification into one of 7 symbols

Calculation of Feature vectors is described as below

1. Resize the image to 100*100
2. Divide it into 5*5 blocks
3. Take the mean of R,G,B planes for these blocks
4. Concatenate it to form the feature vector

A prototype has been built to simulate the actions of the cruise whose block diagram is as shown in the fig 4.

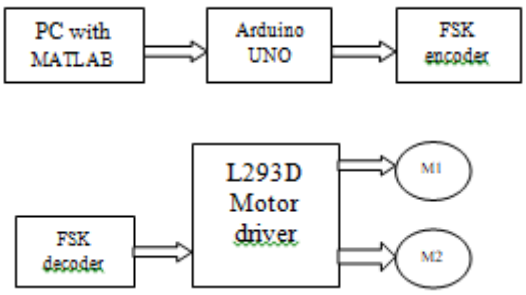

Fig 4: Block diagram of the prototype module

V. RESULTS

The training and testing results of the system are depicted in this section. A Pattern classification neural network cosnsiting 1200 input and 63 hidden nodes and 8 output nodes has been built.

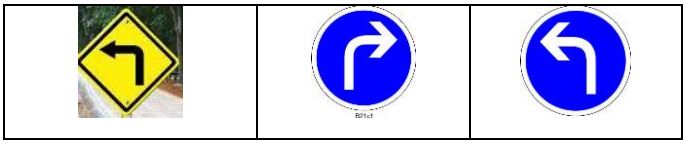

Fig. 5 Training Sample

Fig. 6 Testing Sample

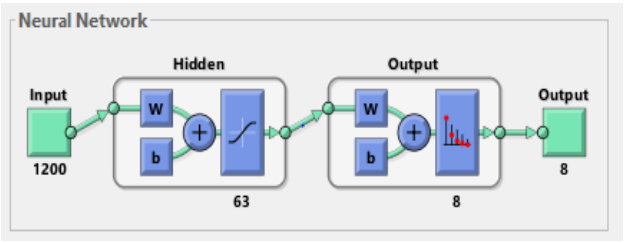

Fig 7:Block Diagram of neural net

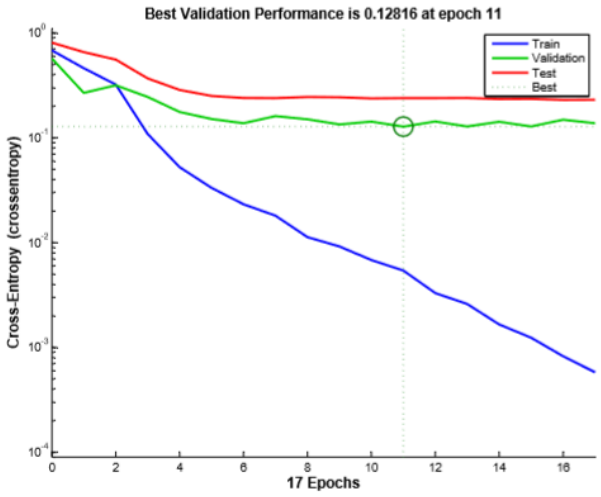

Fig 8: Performance curve

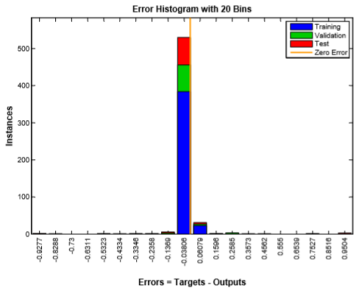

Fig. 9 Error Histogram

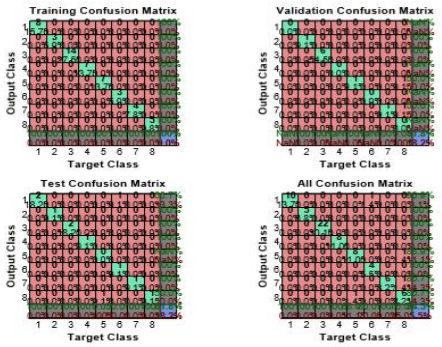

Fig. 10 Confusion Matrix

Fig. 11 Sample outputs

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VI. CONCLUSISIONS AND FUTURESCOPE

The system built around this model provides an accuracy of 80% for a dataset of 70 images. If multiple traffic signs are present or occlusions are present or occasionally misclassifies the symbol. Deep Neural networks may work well in this scenario which demands huge dataset. Availability of a standard Dataset for Indian conditions is an issue.

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