

A Peer Reviewed Open Access International Journal

A Novel approach of Traffic Sign Recognition and Classification for Driver Assistance System

P. Mohan

M. Tech, Department of ECE GIET college of Engineering A.P, India. peta.mohanakumar@gmail.com

Abstract

Many a times the warning sign on the road sides becomes difficult to watch for the drivers and the driver may sometimes miss the warning notes. These warning notes may be speed breaker ahead or narrow bridge or even accident zone etc. This becomes tedious during many times and at nights. Sometimes because of the traffic or the road condition driver may not read anything and even if he tries to read it with a wide eye there is a chance for the drive to lose concentration on the road.

This project aims at developing a solution for this problem using image processing technique. By placing a camera in front of the vehicle, it can pick road signs and give it to a system that processes the image. The image is de-noised and edge detection and shape parameters are used to identify the nature of the signs displayed. The MATLAB program identifies the signs and informs about the signs to the driver.Further the same is used to announce to the driver about the hurdles such as speed breakers. This voice alerting system helps the drivers to concentrate on the road without even worrying about the sign boards near the road. The sign recognition is done using image processing tools on a MATLB. The result of the recognition can be used for the application.

Thus the project can be highly helpful to drivers and the voice announcement can be in any language including Tamil, English or Hindi. As this project uses image processing no additional components are CH. Rajesh Babu

Assistant Professor, Department of ECE GIET college of Engineering A.P, India. rajeshchitikena@gmail.com

necessary to be placed on the sign boards and the existing sign boards can be kept as it is. Only the vehicle need to be fitted with this system but this can be left to the vehicle manufacturers and owners and they can use it as an extra feature for safety and to prevent accidents.

Introduction:

Road and traffic signs considered in this thesis are those that use a visual/symbolic language about the road(s) ahead that can be interpreted by drivers. The terms are used interchangeably in this thesis, and elsewhere might also appear in combination, as "road traffic signs". They provide the driver with pieces of information that make driving safe and convenient. A type of sign that is NOT considered in this thesis is the direction sign, in which the upcoming directions for getting to named towns or on numbered routes are shown not symbolically but essentially by text.

Road and traffic signs must be properly installed in the necessary locations and an inventory of them is ideally needed to help ensure adequate updating and maintenance. Meetings with the highway authorities in both Scotland and Sweden revealed the absence of but a need for an inventory of traffic signs. An automatic means of detecting and recognizing traffic signs can make a significant contribution to this goal by providing a fast method of detecting, classifying and logging signs. This method helps to develop the inventory accurately and consistently. Once this is done, the detection of disfigured or obscured signs becomes easier for human operator.



A Peer Reviewed Open Access International Journal

Road and traffic sign recognition is the field of study that can be used to aid the development of an inventory system (for which real-time recognition is not required) or aid the development of an in-car advisory system (when real-time recognition is necessary). Both road sign inventory and road sign recognition is concerned with traffic signs, face similar challenges and use automatic detection and recognition.

A road and traffic sign recognition system could in principle be developed as part of an Intelligent Transport Systems (ITS) that continuously monitors the driver, the vehicle, and the road in order, for example, to inform the driver in time about upcoming decision points regarding navigation and potentially risky traffic situations. Figure 1.1 depicts these relationships among the three fields.

ITS focuses on integrating information technology into transport infrastructure and vehicles. These systems can include road sensors, in-vehicle navigation services, electronic message signs, and traffic management and monitoring. The aim of intelligent transport systems is to increase transportation efficiency, road safety and to reduce the environmental impact with the use of advanced communication technologies. This thesis aims to develop a system to recognize and classify road and traffic signs for the purpose of developing an inventory which could assist the highway authorities to update and maintain the traffic signs. It is based on taking images by a camera from a moving vehicle and invoking colour segmentation, shape recognition, and classification to detect the signs in these images.



The relationship among Road Sign Inventory, Road Sign Recognition and ITS.

Aims and Objectives of the Research:

The overall aim is to develop a system that can be used for traffic sign inventory. This system can assist local or national authorities in the task of maintaining and updating their road and traffic signs by automatically detecting and classifying one or more traffic signs from a complex scene when captured by a camera from a vehicle.

The main strategy is to find the right combination of colours in the scene so that one colour is located inside the convex hull of another colour and combine this with the right shape. If a candidate is found, the system tries to classify the object according to the color combination and give the result of this classification. The objectives are thus:

- To understand the properties of road and traffic signs and their implications for image processing for the recognition task.
- To understand colour, colour spaces and colour space conversion.
- To develop robust colour segmentation algorithms that can be used in a wide range of environmental conditions.
- To develop a recognizer that is invariant to inplane transformations such as translation, rotation, and scaling based on invariant shape measures.
- To identify the most appropriate approach for feature extraction from road signs.
- To develop an appropriate road sign classification algorithm.
- To evaluate the performance of the aforementioned methods for robustness under different conditions of weather, lighting geometry, and sign.

Traffic Signs:

Road and traffic signs, traffic lights and other traffic devices are used to regulate, warn, guide or inform road users. They help achieve an acceptable level of road traffic quality and increase safety with orderly



A Peer Reviewed Open Access International Journal

and predictable movement of all traffic, both vehicular and pedestrians.

Road and traffic signs are designed to be easily recognized by drivers mainly because their shapes and colors are readily distinguishable from their surroundings. The Swedish Road Administration is in charge of defining the appearance of all signs and road markings in Sweden. Traffic signs in Sweden are fully regulated by this administration. They are placed two meters from the road and the base-sign is at a height of 1.6 meters for roads used by vehicles with motors. According to the Road Administration, the maximum number of signs on a single pole is three with the most important sign at the bottom. In accordance with European signs, all signs are designed to have a reflective layer added on selective parts of the sign.

Most Swedish road signs use pictograms to indicate the message of the sign. However, there are some exceptions in which text replaces pictograms. The STOP sign is one example of this kind of sign. All signs use Swedish text except the STOP sign where the English "STOP" word replaces the Swedish "STOPP" word.

The usual background colour on warning and prohibition signs on most European signs is white, whereas this colour is yellow in Sweden. The reason is to enhance the visibility of the signs during winter time. White signs would be very hard to see in snowfall conditions. A thicker rim is used for warning and prohibition signs in Sweden compared with their European counterparts.

Properties of Road and Traffic Signs:

Road and traffic signs are characterized by a number of features which make them recognizable with respect to the environment:

- Road signs are designed, manufactured and installed according to strict regulations.
- They are designed in fixed 2-D shapes such as triangles, circles, octagons, or rectangles.

- The colors of the signs are chosen to contrast with the surroundings, which make them easily recognizable by drivers.
- The colors are regulated by the sign category.
- The information on the sign has one colour and the rest of the sign has another colour.
- The tint of the paint which covers the sign should correspond to a specific wavelength in the visible spectrum.
- The signs are located in well-defined locations with respect to the road, so that the driver can, more or less, anticipate the location of these signs.
- They may contain a pictogram, a string of characters or both.
- In every country the road signs are characterized by using fixed text fonts, and character heights.
- They can appear in different conditions, including partly occluded, distorted, damaged and clustered in a group of more than one sign.

What is Road Sign Recognition?

Road Sign Recognition is a field which is concerned with the detection and recognition of road and traffic signs in traffic scenes acquired by a camera. It is a technique which uses computer vision and artificial intelligence to extract the road signs from outdoor images taken in uncontrolled lighting conditions where these signs may be occluded by other objects, and may suffer from different problems such as colour fading, disorientation, and variations in shape and size.

The first paper on the subject was published in Japan in 1984. The aim was to try various computer vision methods for the detection of road signs in outdoor scenes. Since that time many research groups and companies have shown interest, conducted research in the field, and generating an enormous amount of work. Different techniques have been used to cover different application areas (see next Section), and vast improvements have been achieved during the last



A Peer Reviewed Open Access International Journal

decade. The identification of the road signs is achieved through two main stages:

- Detection
- Recognition.

In the detection phase, the image is pre-processed, enhanced, and segmented according to the sign properties such as colour or shape or both. The output is a segmented image containing potential regions which could be recognized as possible road signs. The efficiency and speed of the detection are important factors because they reduce the search space and indicate only potential regions.

In the recognition stage, each of the candidates is tested against a certain set of features (a pattern) to decide whether it is in the group of road signs or not, and then according to these features they are classified into different groups. These features are chosen so as to emphasize the differences among the classes. The shape of the sign plays a central role in this stage and the signs are classified into different classes such as triangles, circles, octagons. Pictogram analysis allows a further stage of classification. By analyzing pictogram shapes together with the text available in the interior of the sign, it is easy to decide the individual class of the sign under consideration. A prototype of road sign detection and recognition system is shown in Figure 3.1. The system can be implemented by either colour information, shape information, or both. Combining colour and shape may give better results if the two features are available, but many studies have shown that detection and recognition can be achieved even if one component, colour or shape, is missing. For the purpose of clarity



A block diagram of the road sign recognition and classification.

OBJECT RECOGNITION

Object recognition includes the process of determining the object's identity or location in space. The problem of object or target recognition starts with the sensing of data with the help of sensors, such as video cameras and thermal sensors, and then interpreting these data in order to recognize an object or objects. We can divide the object-recognition problem into two categories: the modeling problem and the recognition problem.

Image Segmentation

Image segmentation is the process of partitioning a digital image into disjoined, meaningful regions. The meaningful regions may represent objects in an image of three-dimensional scene, regions corresponding to industrial, residential, agricultural, or natural terrain in an aerial recognizance application, and so on. A region is a connected set of pixels and the objects are considered either four-connected, if only laterally adjacent pixels are considered, or they can be eightconnected, if diagonally adjacent pixels are also considered to be connected. Image segmentation is an efficient and natural process for humans. A human eye (or rather, mind) sees not a complex scene, but rather a collection of objects. In contrast, image segmentation is not an easy task in digital image processing, and it may become a serious problem if the number of objects is large or unknown or if the boundaries between objects are not clear.

Sign Board segmentation:

To segment the BW regions here we use an efficient tool region props for shape detection of object Hough transform will be used.

Hough transform

The Hough transform is a feature extraction technique used in image analysis, computer vision, and digital image processing. The purpose of the technique is to find imperfect instances of objects within a certain class of shapes by a voting procedure. This voting procedure is carried out in a parameter space, from which object candidates are obtained as local maxima



A Peer Reviewed Open Access International Journal

in a so-called accumulator space that is explicitly constructed by the algorithm for computing the Hough transform.

The classical Hough transform was concerned with the identification of lines in the image, but later the Hough transform has been extended to identifying positions of arbitrary shapes, most commonly circles or ellipses. The Hough transform as it is universally used today was invented by Richard Duda and Peter Hart in 1972, who called it a "generalized Hough transform" after the related 1962 patent of Paul Hough. The transform was popularized in the computer vision community by Dana H. Ballard through a 1981 journal article titled "Generalizing the Hough transform to detect arbitrary shapes".

In automated analysis of digital images, a sub-problem often arises of detecting simple shapes, such as straight lines, circles or ellipses. In many cases an edge detector can be used as a pre-processing stage to obtain image points or image pixels that are on the desired curve in the image space. Due to imperfections in either the image data or the edge detector, however, there may be missing points or pixels on the desired curves as well as spatial deviations between the ideal line/circle/ellipse and the noisy edge points as they are obtained from the edge detector. For these reasons, it is often non-trivial to group the extracted edge features to an appropriate set of lines, circles or ellipses. The purpose of the Hough transform is to address this problem by making it possible to perform groupings of edge points into object candidates by performing an explicit voting procedure over a set of parameterized image objects (Shapiro and Stockman, 304).

The simplest case of Hough transform is the linear transform for detecting straight lines. In the image space, the straight line can be described as y = mx + b where the parameter*m* is the slope of the line, and *b* is the intercept (y-intercept). This is called the slope-intercept model of a straight line. In the Hough transform, a main idea is to consider the

characteristics of the straight line not as discrete image points (x_1, y_1) , (x_2, y_2) , etc., but instead, in terms of its parameters according to the slope-intercept model, i.e., the slope parameter *m* and the intercept parameter *b*. In general, the straight line y = mx + b can be represented as a point (b, m) in the parameter space. However, vertical lines pose a problem. They are more naturally described as x = a and would give rise to unbounded values of the slope parameter m. Thus, for computational reasons, Duda and Hart proposed the use of a different pair of parameters, denoted r and θ (*theta*), for the lines in the Hough transform. These two values, taken in conjunction, define a polar coordinate.



The parameter r represents the algebraic distance between the line and the origin, while θ is the angle of the vector orthogonal to the line and pointing toward the half upper plane (see Coordinates). If the line is located above the origin, θ is simply the angle of the vector from the origin to this closest point. Using this parameterization, the equation of the line can be written as^[4]

$$y = \left(-\frac{\cos\theta}{\sin\theta}\right)x + \left(\frac{r}{\sin\theta}\right)$$

which can be rearranged to $r = x \cos \theta + y \sin \theta$ (Shapiro and Stockman, 304).

It is therefore possible to associate with each line of the image a pair (r,θ) which is unique if $\theta \in [0,\pi)$ and $r \in \mathbf{R}$, or if $\theta \in [0, 2\pi)$ and $r \geq 0$. The (r,θ) plane is sometimes referred to as *Hough space* for the set of straight lines in two dimensions. This representation makes the Hough transform conceptually very close to the two-dimensional Radon



A Peer Reviewed Open Access International Journal

transform. (They can be seen as different ways of looking at the same transform.)

For an arbitrary point on the image plane with coordinates, e.g., (x_0, y_0) , the lines that go through it are the pairs (r, θ) with

$$r(\theta) = x_0 \cos\theta + y_0 \sin\theta$$

where r (the algebraic distance between the line and the origin) is determined by $\theta \in [0, \pi)$.

If r is required to be positive, then θ must vary in $[0, 2\pi)$. In other words, θ is the angle of the vector from the origin and this closest point (if $r \neq 0$), or the angle of the vector orthogonal to the line and pointing to the half upper plane (if r = 0). The lines that go through (x_0, y_0) are then

 $r(\theta) = |x_0 \cos \theta + y_0 \sin \theta|$

These representations correspond to a sinusoidal curve in the (r,θ) plane, which is unique to that point. If the curves corresponding to two points are superimposed, the location (in the *Hough space*) where they cross corresponds to a line (in the original image space) that passes through both points. More generally, a set of points that form a straight line will produce sinusoids which cross at the parameters for that line. Thus, the problem of detecting collinear points can be converted to the problem of finding concurrent curves

The linear Hough transform algorithm uses a twodimensional array, called an accumulator, to detect the existence of line described a by $r = x \cos \theta + y \sin \theta$. The dimension of the accumulator equals the number of unknown parameters, i.e., two, considering quantized values of r and θ in the pair (r,θ) . For each pixel at (x,y) and its neighborhood, the Hough transform algorithm determines if there is enough evidence of a straight line at that pixel. If so, it will calculate the parameters (\mathbf{r}, θ) of that line, and then look for the accumulator's bin that the parameters fall into, and increment the

value of that bin. By finding the bins with the highest values, typically by looking for local maxima in the accumulator space, the most likely lines can be extracted. and their (approximate) geometric definitions read off. (Shapiro and Stockman, 304) The simplest way of finding these *peaks* is by applying some form of threshold, but other techniques may yield better results in different circumstances determining which lines are found as well as how many. Since the lines returned do not contain any length information, it is often necessary, in the next step, to find which parts of the image match up with which lines. Moreover, due to imperfection errors in the edge detection step, there will usually be errors in the accumulator space, which may make it non-trivial to find the appropriate peaks, and thus the appropriate lines.

The final result of the linear Hough transform is a twodimensional array (matrix) similar to the accumulator -- one dimension of this matrix is the quantized angle θ and the other dimension is the quantized distance r. Each element of the matrix has a value equal to the number of points or pixels that are positioned on the line represented by quantized parameters (r, θ). So the element with the highest value indicates the straight line that is most represented in the input image

Sign recognition

Sign recognition using feature extraction and comparison by correlation is done in MATLAB using trained database of signs.



December 2016



A Peer Reviewed Open Access International Journal

Results:



Fig: Move Backward sign Recognition



Fig: Move Forward sign Recognition

REFERENCES:

[1] Umar Farooq, TanveerulHaq, Muhammad Amar, Muhammad UsmanAsad, and AsimIqbal "GPS-GSM integration for enhancing public transportation management services," Proc. International Conference on Computer Engineering and Applications, 2010, pp. 142-147.

[2] AsimIqbal, Umar Farooq, Hassan Mahmood, Muhammad UsmanAsad, Akrama Khan and Hafiz Muhammad Atiq, "A self teaching image processing and voice recognition based intelligent and interactive system to educate visually impaired children," Proc. International Conference on Digital Image Processing, Feb 28-30, 2010.

[3] Umar Farooq, Hafiz Muhammad Atiq, Muhammad UsmanAsad, AsimIqbal, and ZeeshanAzmat, "Design and development of an image processing based adaptive traffic control system with GSM interface," Proc. International Conference on Machine Vision, Dec 28- 30, 2009, pp. 166-171.

[4] AsimIqbal, Umar Farooq, Hassan Mehmood, and Muhammad UsmanAsad, "A low cost artificial vision system for visually impaired people," Proc. International Conference on Computer and Electrical Engineering, Dec 28, 2009, pp. 474-479.

[5] Abdul Manan Khan, and AnsaTehreem, "Causes of road accidents in Pakistan," Journal of Asian Development Studies, vol. 1, no. 1, 2012, pp. 22-27

[6] MATLAB Documentation, MathWorks, Inc. Available [Online]: www.mathworks.com/help/matlab/

Volume No: 3 (2016), Issue No: 12 (December) www.ijmetmr.com