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A Survey on Real Time Text Detection and Recognition from Traffic Panels

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Abstract*—The text detection and recognition from traffic panels is a challenging problem. Number of important application areas is dependent on text detection and recognition, including advanced driver assistance systems, road surveying, and autonomous vehicles. Text detection and recognition on traffic panels has been thoroughly studied for a long time. However, still it remains a challenge in computer vision due to its different types and the huge variability of the information depicted in them. This problem can be divided in two stages; First stage will be detection of region and second will be character recognition. The detection stage exploits knowledge of the structure of the scene, the size and location of the road in the frame. Once a potential traffic panels has been located, the next stage attempts to recognize text within the region. For detection and recognition of text from traffic panels, appropriate methods must be applied for accuracy purpose. Appropriate method will be achieved by survey on different methods of text detection and recognition from traffic boards.

Keywords*— Text detection, Text recognition, Maximally stable extremal regions (MSERs), Optical Character recognition (OCR)

I. INTRODUCTION

Each government imposes some sets of rules and regulations to ensure a safe traffic system. Each person specially the vehicle driver must obey these rules and regulations for a secure travel. Some of those laws are represented as visual language such as different signs and texts that are known as traffic signs. There are various categories of traffic signs that we can see beside the roads. An efficient driver must notice each of the road signs in front of him and need to act accordingly. Otherwise disastrous things can happen. A driver may not notice each of the road signs in front of his car due to lack of care or human perception errors. As shown in Fig. 1 there is a huge Percentage of road accidents in India. Therefore, it is desirable of having a automatic road sign detection and recognition system to assist the driver to ensure a safe travel.

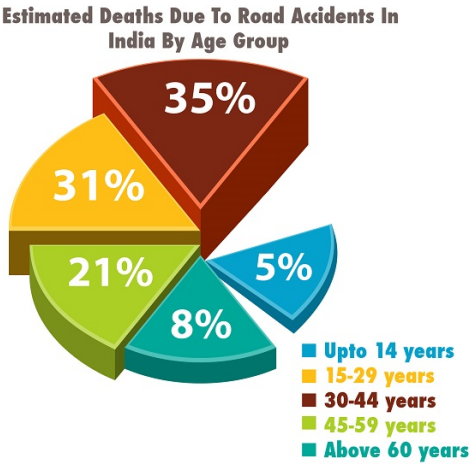

Fig. 1 Accidents in India

Automatic detection of road sign is a challenging but demanding job. Text detection and recognition system have a number of important application areas, including advanced driver assistance systems, road surveying, and autonomous vehicles. Automatic detection and recognition of traffic signs is a challenging problem. While much research exists on both the automatic detection and recognition of symbol-based traffic signs, and the recognition of text in real scenes there is far less research focused specifically on the recognition of text on traffic information signs. This could be partly due to the difficulty of the task caused by problems, such as

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illumination and shadows, blurring, occlusion, and sign deterioration. Main task in automatic text detection and recognition system is how to identify traffic signs from no traffic signs. Without the use of additional temporal
or contextual information, there is few information to determine traffic signs from no traffic signs on the y, while driving, other than basic features, such as shape or color. As shown in the Fig. 2 there are many traffic signboards present in India which are text based. It is impossible to notice all of them manually in a moving vehicle. Chances of missing very important signboards will be high. Manual capturing of signboards also diverts driver's attention. This may cause many accidents on Indian roads. To prevent accidents advanced driver assistance system plays an important role.

Traffic signboard detection and recognition have been an important issue for research recently. Traffic signs have a dual role: First, they regulate the traffic and, second, indicate the state of the road, guiding and warning drivers and pedestrians.

System can be comprises of two main stages:

1. Detection
2. Recognition

Detail explanation of these two stages is given in next sections.

Fig. 2 Traffic Signboards

II. LITERATURE SURVEY

Numerous research works have been conducted for automatic detection and recognition of road signs in order to assist the driver. Still more research works are being conducted on the issue, because of its enormous potential in practical traffic control system applications. Early text detection and recognition research was a natural extension of document analysis and recognition research, moving from scanned page images to camera captured imagery, focusing on basic preprocessing, detection and OCR technology. Recently, the application of sophisticated computer vision and learning methods has resulted from the realization that the problems do not lend themselves to a sequential series of independent solutions. The trend is to integrate the detection and recognition tasks into an end-to-end text recognition system. Most of the research exists on the detection and recognition of text in natural scenes. To solve these problems main two approaches are present. Approaches to this problem can be broadly
divided into two Parts : 1) Region-based methods and 2)Connected component (CC)- based methods. Region-based text detection methods use local features, such as texture, to locate text regions, whereas CC-based methods attempt to segment text characters individually by using information such as intensity, color distribution, and edges. They usually consist of three phases: a first stage to detect CCs within the image, a second stage to eliminate unlikely CCs based on their features, and a final stage that attempts to group the remaining CCs into words or lines. Main purpose of this study is to get text from traffic signboards. More relevant to the context of this paper, the amount of research focused specifically on the detection of text within traffic signs is limited, due to the difficulty of the task.

Many methods for text detection and recognition from Traffic signboards have been proposed over the past years; we will brief

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review some of these methods and the comparative study of these methods in next section.

A. Different Methods For Text Detection

1) *Connected Components Based Method:* The method consists of two steps. The first step is to draw CC from images using a specific method and the second step is to estimate whether the CC is text CC or not based on CC feature and CC relative feature.
2) *Sliding Window Based Method:* Sliding window based methods, also known as region-based methods, use a sliding window to search for possible texts in the image and then use machine learning techniques to identify text. These methods are slow as the image has to be processed in multiple scales.
3) *Hybrid Method:* The hybrid method presented by Pan et al exploits a region detector to detect text candidates and extracts connected components as character candidates by local binarization; non-characters are eliminated with a Conditional Random Fields model, and characters can finally be grouped into text.
4) *Edge Based Method:* This method is based on the factor like edge of character; edge is reliable feature of the text regardless of color/intensity, layout, orientations, etc. As the text region has high contrast to its background, the edges of character can be easily detected. There are two steps used in this method: first, an edge extraction algorithm (such as canny edge detector) is used to get the edges and second, smoothing algorithm or morphology is used for edges connections and obtaining a full character boundary. The main disadvantage of this method is that small image regions and stroke may be misidentified. Therefore this method needs to be verified using other methods.
5) *Color Based Method:* In this method, color clustering is done by categorizing the pixels with same or similar colors and forming a candidate region. Then the candidate regions are analyzed and the CC is estimated. The main challenge of this method is the degree of clustering. If the data is over clustered, the background and text region may be mixed together. And if the data is under clustered, the number of clustering will be increased and the system performance will be degraded.
6) *Combination Of Edges And Colors:* Some methods combine Method 1 and Method 2, which detects both edges and colors of the text. This method has achieved better results by combining both features together than using these features separately.
7) *Texture Based Method:* This method deals with text regions as a special texture. The region is identified as text region or not according to the extracted relevant texture of the candidate regions. To overcome the disadvantages mentioned above, hybrid approach is presented, which takes the advantages of both texture-based and CC-based methods, to robustly detect and localize texts in natural scene images. In this method, a text region detector is designed which is based on the texture. This can be used to estimate the probabilities of the position and the scale of the text and then it is analyzed to be text region or not.
8) *Corner Based Method:* This approach is inspired by the observation that the characters in the text, usually contains multiple corner points. The method is to describe the text regions formed by the corner points using several discriminative features. The research on the method based on corners is still in the early stage. Compared with texture based method, this method is faster but the performance is less satisfied.
9) *Stroke Based Method:* As a basic element of text strings, strokes provide robust features for text detection in natural scene images. Text can be modeled as a combination of stroke components with a variety of orientations, and features of text can be extracted from combinations and distributions of the stroke components. One feature that separates text from other elements of a scene is its nearly constant stroke feature like stroke width. This can be utilized to recover regions that are likely to contain text. For stroke-based methods, text stroke candidates are extracted by segmentation, verified by feature extraction and classification, and grouped together by clustering. These methods are easy to implement on specific applications because of the intuition and simplicity. However, complex backgrounds make text strokes hard to segment and verify.
10) *Semiautomatic Ground Truth Generation Method:* The semiautomatic ground truth generation system for text detection and recognition includes text with different orientation and language. In this method, the system allows user to manually correct the ground truth if the automatic method produces incorrect results. This method uses eleven attributes at the word level, namely: line index, word index, coordinate values of bounding box, area, content, script type, orientation information, type of text (caption/scene), and condition of text (distortion/distortion free), start frame, and end frame to evaluate the performance of the method.

B. Comparative Study

Comparison of MSER with other region detectors: Six region detectors are studied (Harris-affine, Hessian-affine, MSER, edge

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based regions, intensity extremal, and salient regions).
Region density: MSER detects about 2600 regions for a textured blur scene and 230 for a light changed.
Region size: MSER tended to detect many small regions, versus large regions which not cover a planar part of the scene.
Viewpoint change: MSER outperforms the 5 other region detectors in both the original images and those with repeated texture motifs.
Scale change: Following Hessian-affine detector, MSER comes in second under a scale change and in-plane rotation.
Blur: MSER proved to be the most sensitive to this type of change in image, which is the only area that this type of detection is lacking in.
Light change: MSER showed the highest repeatability score for this type of scene, with all the other having good robustness as well.

C. Optical Character Recognition System

It is a process of electronically extracting text from images. OCR (optical character recognition) is the recognition of printed or written text characters by a computer. This involves photo scanning of the text character-by-character, analysis of the scanned-in image, and then translation of the character image into character codes, such as ASCII, commonly used in data processing. Optical Character Recognition, or OCR, is a technology that enables you to convert different types of documents, such as scanned paper documents, PDF files or images captured by a digital camera into editable and searchable data.

TABLE I: COMPARISON OF TEXT DETECTION AND RECOGNITION METHODS

Sr. No.	Title/Publication	Author	Method	Comments
1.	"Recognizing Text-Based Traffic Signs" IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS 2015	Jack Greenhalgh and Majid Mirmehdi	MSER hue, saturation, and value color thresholding OCR	Search area for traffic signs was reduced
2.	"Text Detection and Recognition in Imagery: A Survey" IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, VOL. 37, NO. 7, JULY 2015	Qixiang Ye David Doermann	Survey	OCR typically achieves recognition rates higher than 99% on scanned documents
3.	"Real-Time Detection and Recognition of Road Traffic Signs " IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, VOL. 13, NO. 4, DECEMBER 2012	Jack Greenhalgh and Majid Mirmehdi, Senior	Histogram of oriented gradient features, maximally stable extremal regions ,support vector machines	Significantly insensitive to variations in illumination and lighting conditions
4.	"Text Detection and Recognition on Traffic Panels From Street-Level Imagery Using Visual Appearance" IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, VOL. 15, NO. 1, FEBRUARY 2014	Luis M. Bergasa, and J. Javier Yebes	Bag of visual words (BOVW)	Images are represented as a "bag of visual words" and classified using Naïve Bayes or support vector machines.

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5.	"TRAFFIC SIGN RECOGNITION USING MSER AND RANDOM FORESTS" EUSIPCO 2012	Jack Greenhalgh and Majid Mirmehdi	MSER, HOG	Robust to variations in lighting and illumination
6.	"Vision-Based Traffic Sign Detection and Analysis for Intelligent Driver Assistance Systems: Perspectives and Survey" IEEE VOL. 13, NO. 4, DECEMBER 2012	Andreas Møgelmose, Mohan Manubhai Trivedi, and Thomas B. Moeslund	Survey of all methods	Provided an overview of the state of sign detection
7.	"Road-Sign Detection and Recognition Based on Support Vector Machines" IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, VOL. 8, NO. 2, JUNE 2007	Saturnino Maldonado-Bascón,, Sergio Lafuente-Arroyo, Pedro Gil-Jiménez, Hilario Gómez-Moreno,, and Francisco López-Ferreras	Hue saturation intensity (HSI), support vector machines (SVMs)	Traffic-sign detection by shape classification using linear SVMs. Content recognition based on Gaussian-kernel SVMs.

III. CONCLUSIONS

In this survey we have listed and compared different methods for traffic signboard detection and recognition. Though the many research available for detection of traffic symbols present on traffic signboard, comparatively less work is seen on the text detection and recognition from traffic signboards. From comparative studies MSER and OCR are two methods can be used for better performance. Text detection based on MSERs and HSV thresholding gives better results as compare to other methods.OCR typically achieves recognition rates higher than 99 percent on scanned documents. Structural and temporal information can be used as constraints can be applied for more accuracy purpose. Automatic Signboard detection method is very important for future for the purpose of autonomous vehicles.

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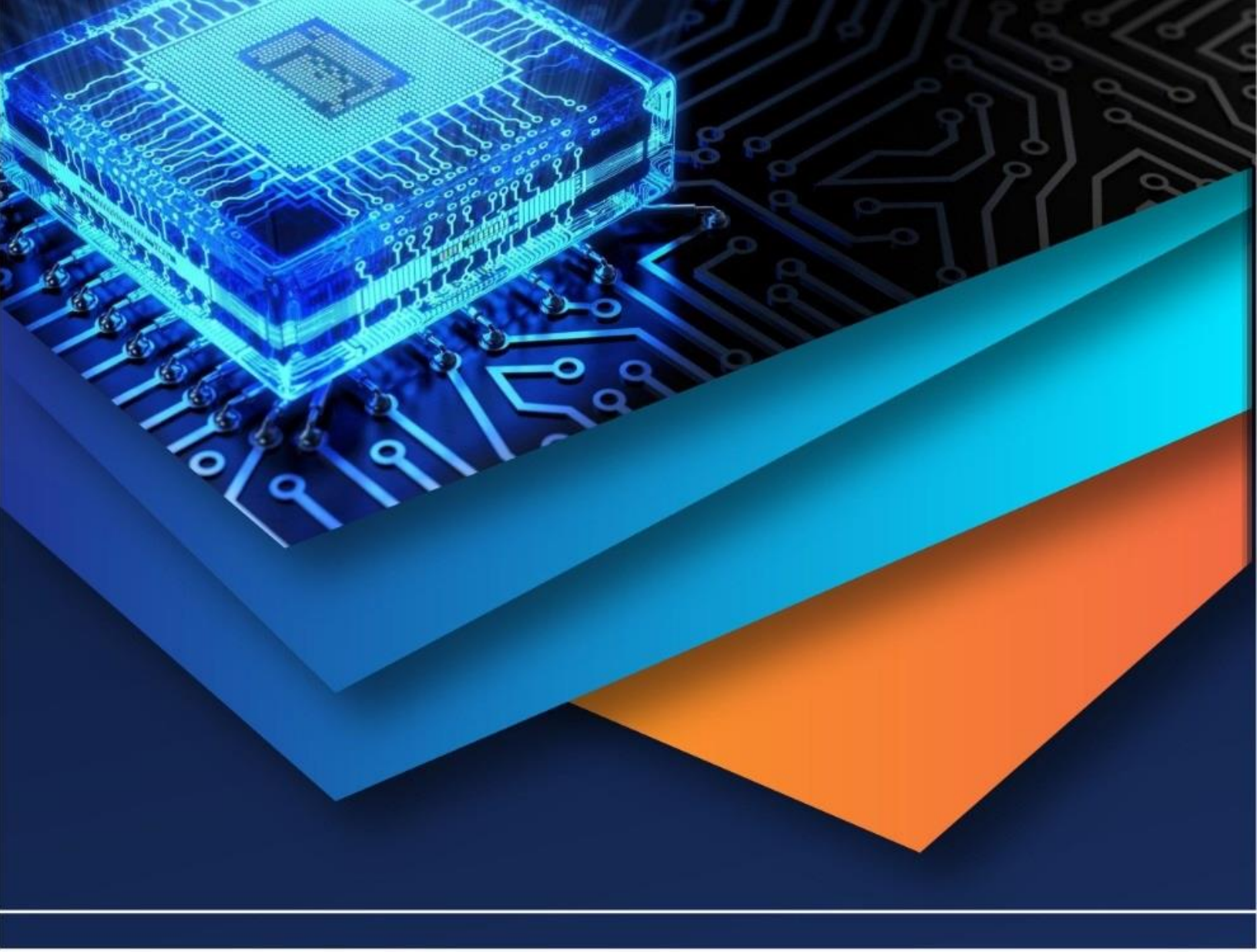

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