A STUDY OF ROAD SIGN IDENTIFICATION APPLICATION USING AUGMENTED REALITY AND IMAGE PROCESSING TECHNIQUE

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ABSTRACT: This paper deals with Road Sign Identification application using Augmented Reality (AR) and Image Processing. India is rapidly developing country as well as growing population country in the world. Many new vehicles are entering on the road. Road accidents are increasing day by day. Many peoples are injured and lost their life because they do not aware about meaning of road sign board. Road accident is national problem in the country. A lack of knowledge about road signs and rules has main reason behind road accidents. With the help of Augmented Reality (AR) technology can provide surrounding traffic information on the users view and keep drivers view on roads. Using Augmented Reality (AR) technology and on-board camera-based driver alert system can improve driving safety. Suppose camera can be mounted on top of vehicle. When camera captures road sign image through image processing technology. It will be checking which stored image matched with capture image .If capture image and stored image matched then driver hears sound that name of road sign board.

KEYWORDS: Augmented reality, Image pre-processing, Edge detection, Thresholding Method, SURF Features, Support vector machine.

INTRODUCTION

In recent years, many applications can be developed for transportation safety. Driver does not notice road sign board in traffic which may cause accident. Automatic traffic sign detection and recognition (TSDR) system has been introduced for solving road accident problem. Continuous changes in environment, lighting conditions, multiple traffic signs appearing at same time and blurring traffic signs is difficult for Automatic TSDR system to detect correct name of road sign board [1].

Navigation system can be developed for road sign board identification. But drawback of this system is requires internet connection for driver. When server lost then system does not work [2].

Using Augmented reality (AR) in image processing technique to solve problem of road sign identification. This application does not required internet connection. Blurred sign board can be virtually corrected through augmented reality (AR).Suppose camera placed on top of vehicle. Driver see road sign board then camera captures image through image processing and checks which stored image matched with capture image. Driver hears sound about name of road sign board in three languages like English, Hindi and Marathi[3].

A surrounding environment that constitutes real object is called real environment. When child plays video game on mobile, it is virtual environment and it does not impact on real world. A combination of real world and digital data is called Augmented Reality (AR). In recent years, Augmented Reality (AR) can be used in various games. A most popular example of Augmented Reality (AR) is Pokémon game in smart phone. Using Augmented Reality (AR), person can see more than others, smell more than others, touch more than others and hear more than others. Augmented reality (AR) can provide consumers an interactive environment [1].

IMAGE PROCESSING

In this section represent block diagram of road sign board and Image Processing applications.Figure-1.shows block diagram of road sign board in image processing [4].

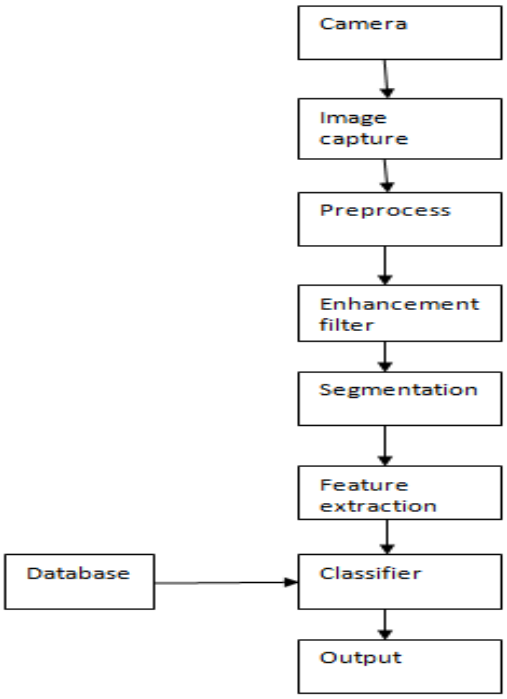

Figure-1Block Diagram of Road sign board in image processing

A. Pre-process

The real scene is captured using camera. Image pre-processing is improve the image data that suppress undesired distortions as well as enhances some image features which is important for further processing and analysis task. It includes color space conversion and image

enhancement. Noise removal, atmospheric correction and image transformation are included in image pre-processing. Image resizing, Top-hat and Bottom-hat filtering can be used in image pre-processing [4].

1) Resizing of Image: When we need to increase or decrease total number of pixels then image resizing is necessary. Images captured by digital camera are not in same dimension. Classification of image is difficult when images are not in same dimension. It is required that all images are in same dimension. Therefore, for simplicity purpose Image resizing is necessary [4].

2) Top-hat Filtering: Top-hat filtering is an operation that extracts small elements and details from given images. Two types of top-hat filter : The white top-hat filtering is defined as the difference between the input image and its opening by some structuring element; The black (bottom) top-hat filtering is defined dually as the difference between the closing and the input image. Top-hat transforms can be used for image enhancement, background equalization and feature extraction. The top-hat is used for light objects on a dark background and the bottom-hat is used for dark objects on a light background. The white top-hat transform returns an image, containing those "objects" or "elements" of an input image that are "smaller" than the structuring element and brighter than their surroundings. The black top-hat returns an image, containing the "objects" or "elements" that are "smaller" than the structuring element and darker than their surroundings[4].

B. Image enhancement

To improve the interpretability or perception of information in image for human viewers is the aim of Image enhancement. The process of adjusting digital images so that the results are more suitable for display is called Image enhancement. To process a given image so that the result is more suitable than the original image is the principal objective of image enhancement. It sharpens image features such as edges, boundaries or contrast to make a graphic display more helpful for display and analysis[5].

Sometimes, the bit error and impulsive noise are entering into an image. These errors not only lower its perceptual quality but also make subsequent tasks such as edge detection and segmentation more difficult. Therefore, the removal of such noise is necessary pre processing step in image processing applications. Thus noise removal filters can be required. To remove impulse noise from corrupted image and to enhance image quality a large number of linear and non linear filtering algorithms have been proposed. These are Linear contrast adjustment, Unsharp mask filtering, Median filtering, Mean filtering and Adaptive Histogram Equalization (AHE)[5].

C. Image filtering

Median Filtering is nonlinear method used to remove noise from images. It is useful for removing the noise without actually blurring the object. The median filter works by moving

through the image pixel by pixel, replacing each value with the median value of neighbouring pixels. The median is calculated by first sorting all the pixel values from the window into numerical order, and then replacing the pixel being considered with the middle (median) pixel value. Median filtering is useful for removing noise while preserving edges[5].

D. Image Segmentation

Image segmentation is process used to simplify the representation of an image into something that is more meaningful object of interest from background and easier to analyze. A process of dividing image into multiple parts is called Image Segmentation [5].It is typically used to locate objects in images. Methods of Image segmentation are included like Edge based, Region based, Thresholding, Clustering and watershed method. Thresholding segmentation method can be used in this paper [6].

1) Thresholding method: It is simplest method for image segmentation. The method divide the image pixels with respect to their intensity level. The method is used over images having lighter objects than background. The purpose of thresholding is to extract those pixels from image which represent an object. It is process of converting input gray scale image into binary image[7]. This technique is based upon a simple concept. A parameter ɵ called the brightness threshold is chosen and applied to the a [x, y] as follows:

If a[x, y]> ɵ a[x, y] = object= 1
Else a[x, y] = background=0

This algorithm assumes that we are interested in light objects on a dark background. For dark objects on a light background we would use:

If a[x, y] < ɵ a[x, y] = object =1
Else a[x, y] = background =0

There are basically three types of thresholding: Global thresholding, Variable thresholding and multiple thresholding. Global thresholding method is used in this paper.

a) Global thresholding: This is done by using any appropriate threshold value/T. This value of T will be constant for whole image[7]. On the basis of T the output image b(x, y) can be obtained from original image a(x, y) as:

b (x, y) =1, if a(x, y) $T > 0$
=0, if a(x, y) $T \leq 0$

EDGE DETECTION

A process of locating an edge of an image is called Edge Detection of an image. Detection of edges in an image is a very important step towards understanding image features. Edges

consist of meaningful features and contain significant information. Edge detection is extensively used in image segmentation when images are divided into areas corresponding to different objects. Edge detection removes information that may be useless and reduces image size, thus preserving the important structural properties of an image. Sobel Edge detection method can be used in this paper [8].

A. Sobel Method

The Sobel edge detection operation extracts all of edges in an image, regardless of direction. The resulting image appears as an unidirectional outline of the objects in the original image. When changing brightness regions become highlighted then constant brightness regions become black, Derivative may be implemented in digital form in several ways. The advantage of sobel operator is providing both a differencing and a smoothing effect. The smoothing effect is particularly attractive feature of the Sobel operators [8].

-1	0	+1
-2	0	+2
-1	0	+1

Gx

+1	+2	+1
0	0	0
-1	-2	-1

Gy

Figure-2 Convolution Kernel

The operator consists of a pair of 3×3 convolution kernels as shown in Fig. 2. The kernels can be applied separately to the input image, to produce separate measurements of the gradient component in each orientation (Gx and Gy) [8]. An approximate magnitude is computed using:

$$|G| = |Gx| + |Gy|$$

FEATURE EXTRACTION

In Image features usually include color, shape and texture characteristics. The repetitive image presented as pixels, then it can be transform into reduced set of feature [9].SURF Features is used in this paper.

A. SURF Features

Speeded up robust features (SURF) is used for image classification. It is local feature detector and descriptor. Interest point detection, local neighborhood description and matching are three main parts of SURF algorithm.To find points of interest SURF uses a BLOB detector which is based on the Hessian matrix. The surrounding region in digital images that difference in properties such as brightness or color. SURF uses the wavelet responses for feature description. The key point is selected around neighborhood and divided into sub regions and then for each sub region the wavelet responses are taken and represented to get SURF feature descriptor. With the help of sign of Laplacian underlying interest points in detected. For reverse case, bright blobs on dark backgrounds distinguishes the sign of Laplacian. For faster matching same type of contrast (based on sign) are compared with matching features [9].

CLASSIFICATION

Road sign images are saved in database. When camera captures image then classifier checks capture image match with which saved image [4]. As the features are extracted, a suitable classifier must be chosen. To classify a particular kind of feature vectors depending upon their characteristics a Support Vector Machine (SVM) classifier can be used [10].

Classification process consists of following steps:

1. **Pre-processing :** Noise removal, image transformation, main component analysis etc.
2. **Detection and extraction of a object :** Detection includes detection of position and other characteristics of moving object image obtained from camera.
3. **Training :** Selection of the particular attribute which best describes the pattern.
4. **Classification of the object :** By using suitable classification method that compares the image patterns with the target patterns [10].

A. Support Vector Machine

Support vector machine (SVM) method constructs a set of hyper planes in a high dimensional space which is use for classification or regression SVM handles more input data efficiently because it uses non-parametric with binary classifier approach [11].

Using linearly separable classes is easiest way to train SVM. If training data with k number of samples is represented as

{X i , y i }, i = 1, . . ., k where k is an N-dimensional space and is a class label then these classes are considered linearly separable if there exists a vector W perpendicular to the linear hyper-plane (which determines the direction of the discriminating plane) and a scalar b showing the offset of the discriminating hyper-plane from the origin. Class 1 represented as -1 and class 2 represented as +1, two hyper-planes can be used to discriminate the data points in the respective two classes. Fig.2 shows optimal separating hyper plane between separable samples and non-separable data samples. The distances between two closest points called margin [11].These are expressed as:

$WX_i+b \geq +1$ for all y = +1, i.e. a member of class 1.

$WX_i+b \leq -1$ for all y = -1, i.e. a member of class

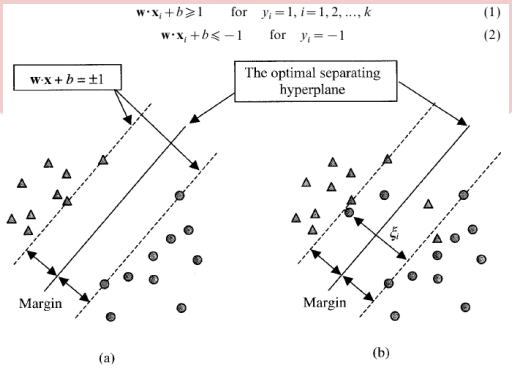

Figure-3 The optimal separating hyper plane between
(a) separable samples and (b) non-separable data samples

CONCLUSION

The aim of this paper is to reduce road side accidents with help of Augmented Reality (AR) and image processing. Today, most of people do not care about road sign when they drive or walk on road. Using road sign identification we can understand proper meaning of road sign board as well as to avoid road accidents.

Resizing of image is necessary for simplify operations such as Image segmentation and enhancement. We conclude that median image filtering is removed noise without actually blurring the object. Thresholding image segmentation is simplest method Sobel Edge detection is useful for locating an edges of image. Speeded up robust features (SURF) are extracted image features. Support Vector Machine (SVM) is suitable method for image classification. Support Vector Machine (SVM) delivers unique solution and very efficient image classifier method.

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