HT algorithm uses an array called accumulator to detect the existence of a line. For each pixel and its neighborhood, HT algorithm determines if there is enough evidence of an edge at that pixel. A voting procedure is carried out in the parameter domain. The number of dimensions of the parameter space equals to the number of parameters needed to fully define the curve or line as seen in equation (6) that line is represented by two parameters r and theta.. The circle is mathematically expressed using equation (7)

$$(x - x_0)^2 + (y - y_0)^2 = r^2 \quad (7)$$

These three parameters that are used in the equation representing circle form the accumulator array. A voting procedure is carried out in the parameter domain and. combinations with the highest values of votes are more likely to represent circles [2]. Thus, implementation of the Hough transform helps in the validation of the above color segmented output to decide whether it is a possible candidate region which can be further sent for the recognition procedure. The complete sign detection after the color filtration and shape filtering can be shown in figure 7 with a bounding box highlighting the road sign that is detected.

Figure 7: Traffic sign detected

3.2 Sign Recognition

The last stage of the algorithm is the recognition of the traffic signs. The key principle is to match the detected signs to a database (library) of traffic sign templates. Several techniques can be used for this purpose. The target of the recognition procedure is to assign each region of interest to the class that it belongs. If the match is found sound notification is given to the driver, interpreting the meaning of the candidate sign. . If the ROI does not match with any of the templates in the database (library) of traffic sign templates, the Candidate image is discarded. But the false rate is generally less since the candidate images with no blobs have already discarded using the noise removal and also the shape classification.

For the recognition stage, regions of interest are represented using Histogram of Oriented Gradients (HOG) proposed by Dalal and Triggs (2005) [7]. Initially, HOG descriptors have been applied specifically for pedestrian detection. HOG features have been widely used for object recognition, as they are robust to scale. Histogram of Oriented Gradients (HOG) is feature descriptors. The traffic sign candidate extracted have distinguishing shape and color features hence HOG is used as it is used generally for capturing color and shape as one feature. HOG is that in which local appearance and shape within an image can be described by the distribution of intensity gradient. The implementation of algorithm requires dividing the images into small connected region called cells. The horizontal and vertical derivatives are obtained from a gradient detector, the components of magnitude and orientation for each pixel will be given. The gradient at each pixel is the gradient with the greatest magnitude among the gradients computed on each of the channels. Then rescaling each region in to 64*64 pixels and describe it by 16x16 blocks of 8x8 cells with 8 pixels. Extracted output from HOG is given to SVM classifier to analyze and recognize patterns and used for classification. Finally, after the classification is done the driver is provided a voice acknowledgement of the sign being recognized.

4. Conclusion

In this paper, a methodology for road sign detection and recognition is presented and described, taking into consideration different factors. The system detects the traffic sign and recognizes the traffic sign and finally gives a sound notification. The proposed algorithm is based on HSV color space, morphological functions, shape analysis using Hough transform, feature extraction using HOG descriptors and classification of traffic sign. The method is fast as the system discards the images having signs of shapes other than the basic shape at the initial phase. As the future scope, increment in the robustness of the system can be done so that it can perform better in all kinds of atmospheres and luminance conditions.

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