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Traffic Sign Detection and Recognition

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Abstract:
Through dealing with technologies and technology, in field use image processing in the systems of electronic Including smart driving systems for cars. In order to facilitate and improve the performance of electronic systems. Some mathematical concepts and algorithms are employed for this purpose. Where traffic Sign Detection and Recognition (TSDR) systems provide an additional level to driver assistance, leading to improve safety for passengers, road users and vehicles. As part of Advanced Driving Assistance Systems (ADAS), ADAS helps the driver to drive the car and leads to a better awareness on the road. proposed system for the detection of traffic signs, classification into danger, information, obligation and prohibition classes.
Through this research we aim to provide a system capable of taking images of traffic signals on both sides of the road, Analyze and recognition its and alert the driver to what the sign image mean. The driver will be able to act on the instructions in the traffic sign. The traffic system helps drivers recognize signs they did not recognize before. The operation is performed using a Similarity metrics were using correlation for Complete the matching process between the resulting image and the stored image in the database.

Keyword: Traffic sign, detection and recognition, gray level, RGB, a Similarity metrics, correlation Coefficient.

1. INTRODUCTION:

The sign which is placed at the side of roads to trasfer information to road users is known as road signs or traffic signs. There are four types of traffic signs that are shown in the traffic code: a) warning; b) prohibition; c) obligation; and d) informative. Depending on the form and the color, the warning signs are equilateral triangles with one vertex upwards. They have a white background and are surrounded by a red border. Prohibition signs are circles with a white or blue background and a red border. To indicate obligation, the signs are circles with a blue background. Informative signs. there are two exceptions: a) the yield sign, an inverted triangle; and the stop sign, a hexagon. To detect the position of the sign in the image, we must know the two properties i.e., color and shape**.** The applications and the difficulty of road sign detection make road sign detection an interesting problem. In terms of applications, road sign

detection is quite important for the road sign recognition problem, since it is the most important step for a road sign recognition syste [1].

The importance of road signs and traffic signals in daily life. They define a visual language that can be interpreted by drivers. They represent the current traffic situation on the road, show the danger and difficulties around the drivers, give warnings to them, and help them with their navigation by providing useful information that makes the driving safe and convenient [2]. The human visual perception abilities depend on the individual's physical and mental conditions. In certain circumstances, these abilities can be affected by many factors such as tiredness, and driving tension. Hence, it is very important to have an automatic road sign recognition system that can be a subsidiary means to the driver [3].Giving this information in a good time to the drivers can prevent accidents, save lives, increase the driving performance, and reduce the pollution caused by the vehicles [4, 5]. Road-sign detection and recognition has many advantages and applications. Driver Support Systems (DSS) can detect and recognize road-signs. This helps to improve the traffic flow and safety [6, 7], and avoids hazardous driving conditions, like collisions. Traffic sign detection and classification is one of the less studies subjects in the field of Driver Support Systems. Research have focused on other aspects, more related with such as detection of road borders or the recognition of obstacles in the vehicle's path such as other vehicles or pedestrians. For example, accidents can occur because drivers don't notice a sign in the proper time or by lack of attention at a critical moment. In bad weather conditions such as heavy rain showers, fog, or snow fall, sand starm, drivers pay less attention to the road signs and concentrate on driving. In night driving, visibility is affected by the headlights of traffic coming from the opposite side and drivers could easily be blinded by this light. All of these conditions make it desirable to develop a system to aid humans [7].

The system has two major steps: traffic signs detection consists pre-processing, segmentation and morphology. Recognition consist from sign extraction and classification them.

2.Iraqi traffic signal:

The Iraqi traffic signal is characterized by a white background with a red frame and black symbols for warning signals and a blocking signal. There is a blue background with a white frame and white symbols, which are the obligation signs the information signs, and there the order signs are red signals such as a stop and give way. Where the Iraqi database was used for 141 images of six types of each type includes a number of images. the Figure (1) shows some of them.

Figure(1): type of traffic signs

3. Traffic Signs Properties:

Traffic signs have been designed using special shapes and colours, very different from the natural environment, which make them easily recognizable by drivers [9]. They are designed, manufactured and installed according to stringent regulations [11]. Distinguishable from the natural and/or man-made backgrounds [13], they are designed in fixed 2-D shapes like triangles, circles, octagons, or rectangles [14]. The colors are regulated to the sign category (red = stop) [15]. A sign can have three colors; a

border, background and a pictogram colors. The tint of the paint which covers the sign should correspond to a specific wavelength in the visible spectrum [10,11]. The signs are located in well-defined locations with respect to the road, so that the driver can, more or less, expect the location of these signs [15]. They may contain a pictogram, a string of characters or both [11]. 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 [11, 14].

4. Traffic Signs Potential Difficulties:

Due to the complex environment of roads and the scenes around them, the detection and recognition of road and traffic signs may face some difficulties. The colour of the sign fades with time as a result of long exposure to sunlight, and the reaction of the paint with the air [16]. Visibility is affected by weather conditions such as fog, rain, add to sand and sand storms, especially in iraq, clouds and snow. The colour information is very sensitive to the variations of the light conditions such as shadows, clouds, and the sun. [11, 15]. It can be affected by the illuminant colour (daylight), illumination geometry, and viewing geometry [17]. The presence of objects similar in colours to the road signs in the scene under consideration, like buildings, or vehicles. Signs may be found disoriented, damaged or occulted. If the image is acquired from a moving car, then it is often suffering from motion blur and car vibration.

Figure (2): Potential Difficulties Traffic Signs

5. System Overview:

The identification of traffic signs is usually accomplished in two main phases: detection and recognition. In the detection phase can distinguish the following steps: pre-processing, feature extraction, and segmentation. As can see a whole chain of image processing steps are required to finally identify the traffic signs. The first step in the detection phase is pre-processing, which may include several operations. These operations correct an image which is influenced by noise, motion blur, out-of-focus blur, distortion caused by low resolution, etcetera. Step, feature images are extracted from the original image. These feature images containing relevant information of the original image, but in a reduced representation. Thereafter, the traffic signs have to be separated from the background. Meaning that regions of constant features and discontinuities must be identified by segmentation. This can be done with simple segmentation techniques and with the more sophisticated segmentation techniques. After the segmentation phase follows another feature extraction part, but this time based on high level image analysis. In the last part of the detection phase are the potential traffic signs detected from the segmented images, by using the extracted features of the previous part Thereafter, in the recognition phase, the detected traffic signs can be classified into the necessary categories [18].

6.Methodology:

The proposed system, Figure 3, starts by taking an image by a camera mounted in a car. This image is an RGB image. As it will be shown in the following sections, RGB color space is not suitable for detecting road signs in outdoor images because it is variance to the level of illuminations. The image is, therefore, converted into color color image; gray scale image by using the equation (1) [19].

Gray scale image=(0.3R+0.59G+0.11B) ……. …. (1)

Then enhanced by the median filtering, So we have applied this technique on the image which is in gray scale level and after that we have applied the gaussian process of filtering which used and applied on the photo which resulted from the step of enhancing the image in order to decrease the noising in order to increase the contrast of the resulted image and this was the first step as we said for enhancing the image by using the equation (2) [20]:

$$G(x, y)= \frac{1}{2\pi\sigma^2} exp(\frac{x^2+y^2}{\sigma^2}) \text{ ……..…(2)}$$

and after that we are going to exchange the pixels of photo which are higher and equal the threshold value to value 1 which is the white color and the other pixels of photo will be changed to value 0 which is the black color and this step will give us the binary photo and in this binary photo we can notice that the black color will represent the background of the photo and the white color in the photo will represent the shape or the object by using the equation (3) [20]:

$$q(x, y) = \begin{cases} 1 & if \quad p(x,y) \geq T \\ 0 & if \quad p(x,y) \prec T \end{cases} \quad (3)$$

and after that can be are detect region of interest in the binary image that contain of traffic signs depending on the region of interest determination algorithm and after can be are using morphology operations to determine traffic signs shape in binary image by using structure element. Morphology is a broad set of image processing operations that process images based on shapes. Morphological operations apply a structuring element to an input image, creating an output image of the same size. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors. The most basic morphological operations are open and close. Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries [21].

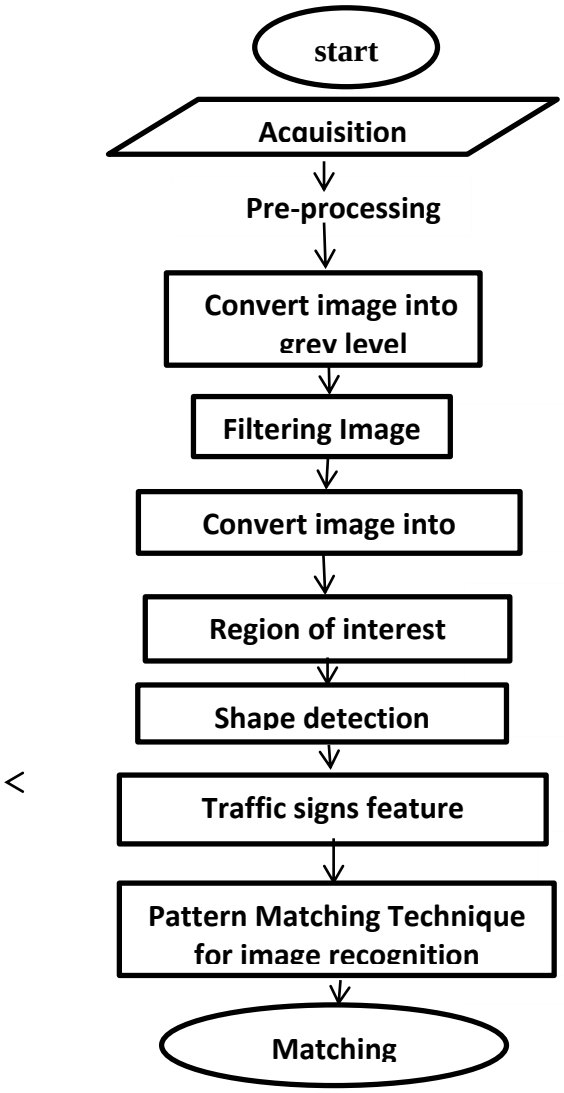

Figure (3): system flow chart system

7. Recognition phase Traffic signs

pattern recognition and image processing, feature extraction starts from an initial set of measured data and builds derived values (features) intended to be informative and non-redundant, facilitating the subsequent learning and generalization steps, and in some cases leading to better human interpretations. Feature extraction is related to dimensionality reduction. When the input data to an algorithm is too large to be processed and it is suspected to be redundant (e.g. the same measurement in both feet and meters, or the repetitiveness of images presented as pixels), then it can be transformed into a reduced set of features (also named a feature vector). Determining a subset of the initial features is called feature selection. [21] The selected features are expected to contain the relevant information from the input data, so that the desired task can be performed by using this reduced representation instead of the complete initial data. Then can be identify the traffic signs by matching the template using correlation coefficient (Pearson Correlation coefficient) by using the equation (4) [23].

$$\mathbf{Px,y=}\frac{E[(x-mx)(y-my)]}{\sigma x \sigma y} \quad \text{.....(4)}$$

Which can consist of the process by input the source image of the object for the purpose of comparison with the matching image by calculating the correlation coefficient between the two images., which corresponds to the image with the matching image of the same shape and that classification of the picture according to the matching types.

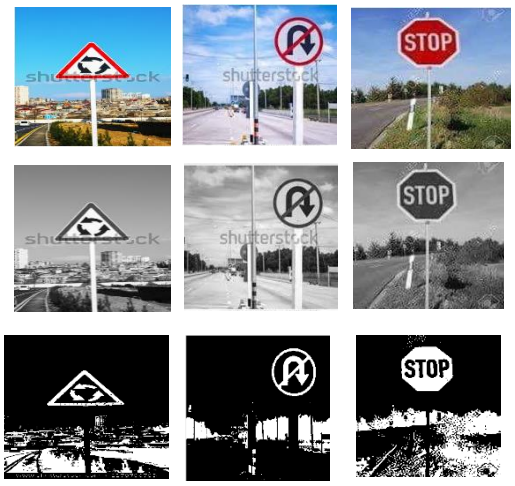

Figure (4): Detection phase of traffic signs

8.Experiment Result:

In this paper used method to detect and recognize traffic signs. using Iraqi traffic signs that consists from 141 signs images for different types. The template matching was used for the traffic signs using Pearson Correlation coefficient between two images.

Result detection:

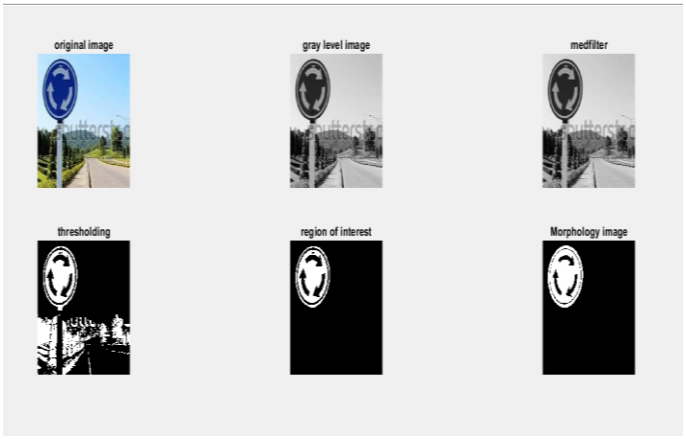

Figure (5): Stages of the traffic signal detection process

Result recognition:

The ratio of recognition to all the images was 98% according to the equation (4) and correlation coefficient mentioned in section one The results were obtained in Table (1) Shows the number of components of each image and the percentage of recognition for each image.

Table (1): results of the recognition

Traffic signs type	NO. Image	Correct result	Error result
Mandatory signals	6	100%	0%
order signals	36	100%	0%
prohibitory signals	57	96%	4%
end point blocking signals	6	100%	0%
Information signals	2	100%	0%
Warning signals	34	100%	0%
Total Number	141	98%	2%

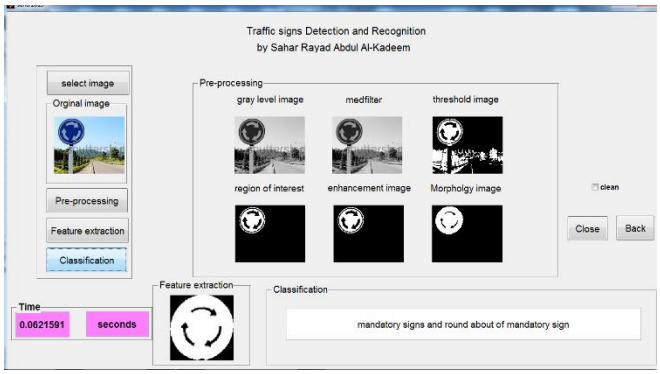

Figure (6): matching process of traffic signs

9.Conclusions:

Can be developed a system that recognizes traffic signs using morphology for detect traffic signs and template matching for classification. This paper proposed traffic sign detection, classification into four different classes (danger, information, obligation, and prohibition) and also recognition system The results obtained from the the system is satisfying.

10.FUTURE WORK:

Further improvements of the system should include a larger number of supported traffic sign classes. Where This work has been applied on the six different types of the traffic signs. The scope of the project for the other traffic signs can be enhanced in the future. The other signs may include the cross-bars (Ground traffic signs) and the Adding light signs in future work.

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