International Journal of Engineering and Information Systems (IJEAIS)
ISSN: 2643-640X
Vol. 5 Issue 7, July - 2021, Pages: 79-82

Morse code Letters through Different Features Comparison

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Abstract: *Comparison of four types of features (Color , HOG , Shape ,surf) For a synthetic images of Morse code letters in different circumstances are discussed in this research, as a first step of building automatic recognition system using matlab functions where accuracy metric was used to compare our results in order to determine the efficiency of the features used .*

Introduction:

Extract image features is an important step of building machine vision system

It's represent methods that select and/or combine variables into features , effectively reducing the amount of data that must be completely describing the original data set [1] , The goal of feature extraction is to obtain compact, perceptually relevant representation of an image .There are a lot of Feature extraction techniques provided by computer vision and image processing include , Histogram of Oriented Gradients (HOG), Local binary pattern (LBP), Shape features, color features.

1.1Color Features

All image color information needs to go through a process to determine the color value of each pixel in the image regardless of each image meaning, typically color images are stored in a composition of three colored channels red, green and blue, each channel represented as a matrix in range of 0-255.

1.2 Histogram of Oriented Gradients (HOG)

Gradients are extremely important for checking for image edges and corners in (through regions of intensity changes) since they often will pack much more information than flat regions. So histogram of gradient has been considered in this feature after dividing each image into small connected regions called cells. [2]

Figure (1) shows the implementation of HOG features in our work

Figure(1) Hog features on Morse code image

1.3 SURF (Speeded Up Robust Features)

SURF is one of the fast and robust algorithm for local, similarity invariant representation and comparison of images, the algorithm proposed by Hrebert Bay[3] in 2008. The extracted feature describes the local texture features of key points in different directions and scales of the grayscale image, by applying approximate Gaussian second derivative mask to an image at many scales and direction ,So it can maintain invariance to rotation, scaling, and brightness changes.it also has good stability for affine transformation and noise, and it is more than other methods in the aspects of uniqueness and robustness, and it greatly improves the computational efficiency.

1.4 Shape features

The features of the shape that depend on the geometric image are very important because they are the nearest way of human perception. Many shape analysis techniques have been proposed over decades. Loncaric (1998)[4]
had presented An extensive survey of shape matching in computer vision . Image shape features are depend on the nature of the images used , as it may vary according to the images to be distinguished once by finding center of gravity and another by calculating circularity ratio also by ellipse variance and many others.

2. Morse code

Is one of the oldest methods of encoding messages whereas , each alphabetic characters is represented by a different arrangement of dots and dashes **(_ .)** this means that each characters has its own encoding .

According to the percentage of repetition of letters in the English language , dots and dashes were distributed on them . For example , the letter **E** is one of the most frequent letters in the English language , so it is encoded with a dot **(.)** only , as well as for each of the letter **I** and **S** ,where the letter I was encoded with two dots and the letter S with three dots , while the letter **Q** is one of the least frequent letters so it was encoded by **(_ _ . _)** .

The purpose of assigning more dots to the most frequent letters in the language is to help shorten the length of the message . [5] many researchers have dealt with the issue of building an automatic recognition system for this kind of coding ,starting with building a software system to generate images representing these codes as in [6] moving to systems that aim to decode these encoded symbols as in [7].

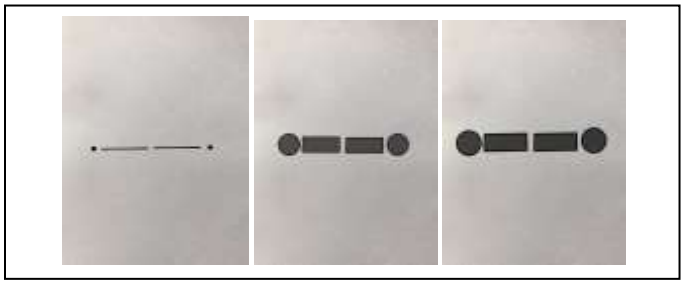
3. Proposed System

We can explain the proposed system as in diagram of figure (2)

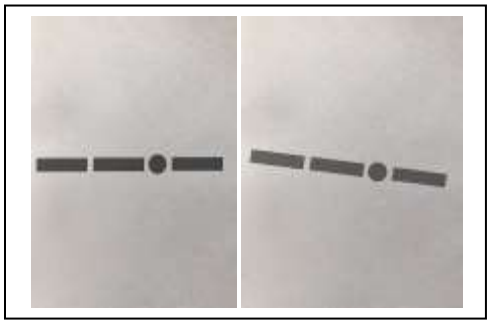
Figure (2) proposed system diagram

3.1 Synthetic images

The images presented in this research are Morse code letters which drawn using the ibis Paint X application . Which represents 26 colored images with English letters of 5 examples of each letter to sum up to 130 different images taken a size of 1280x1280,figure (2) (a),while figure(2) (b) gives an example of Morse code of letter P ,this images were initially collected and labeled in Pc hard disk ,in order to build a comparison system a pepper noise in specific ratio was added to each image additional to image rotation .



(a) synthetic Morse code of letter P



(b) original and rotated image
Figure(2) sample of synthetic Morse code

3.2 Feature Extraction

Different kind of features of features has been considered in our comparison

3.2.1 color

The image, with all its color value in RGB , has been reshape and considered as features after resized it to be 64X64.

3.2.2 HOG features

Here the function of extractHOGfeatures has been used with cell size of 32x32.

3.2.3 SURF Features

Image gray value is supposed to use as input to the function of detectSURFFeatures to get surf features

3.2.4 Shape features

binary image is considered to describe circles and rectangles that presented in all the images used ,in our work we consider Area, Centroid, and BoundingBox number of objects within every image with the help of regionprops function.

3.3 matching Measurement

Distance (1) equation was used to detect the nearest matched images

$D=\sum_{i=1}^{n}(Xi - Yi)$……(1)

For the purpose of evaluating our matching system we use accuracy measurement as a metric as in (2)

Accuracy= (No. of correct match\ Total No. of Samples) x 100….(2)

As a result of matching proposed system a Comparison tables has been conducted as follows:

Table (1) comparison when of noise rate 0.001 and rote angle 10

Feature type	Image type	Noise rate/Rotate angle	Accuracy
color	Noise	0.001	100
color	Rotate	0.001	100
Hog	Noise	0.001	100
Hog	Rotate	10	68.64
Shape	Noise	0.001	12.30
Shape	Rotate	10	72.30
Surf	Noise	0.01	62.3
Surf	Rotate	10	13.84

Table (2) comparison when of noise rate 0.01 and rote angle 45

Feature type	Image type	Noise rate/Rotate angle	Accuracy
color	Noise	0.01	100
color	Rotate	0.01	100
Hog	Noise	0.01	4.61
Hog	Rotate	45	3.8
Shape	Noise	0.01	0.76
Shape	Rotate	45	56.9
Surf	Noise	0. 1	19.2308
Surf	Rotate	45	4.6154

Table (3) comparison when of noise rate 0.5 and rote angle 60

Feature type	Image type	Noise rate/Rotate angle	Accuracy
color	Noise	0.5	58.46
color	Rotate	0.5	100
Hog	Noise	0.5	0.76

Hog	Rotate	60	3.84
Shape	Noise	0. 5	0
Shape	Rotate	60	47.69
Surf	Noise	0. 5	0
Surf	Rotate	60	0

Conclusion

We have studied the effectiveness of image noise and rotation on different image features using matlab functions of different features ,we proved practically that surf feature is rotate invariant to specific angle rotation degree and not for all ,as it can lose its work at large degree of rotation, while

We noticed the effect of increase in the noise percentage in the image on the efficiency of the shape features. These features were also affected by changing the rotation angle of the image, as it also tends to fade in the case of rotation at a very large angle, while the color features were the best when dealing with noise and rotation compared to the rest features.

We aspire to have a powerful image features that are powerful towards recognizing rotated images and high_noise images.

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