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AUTOMATIC CURRENCY RECOGNITION USING IMAGE PROCESSING

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Abstract

Currency recognition systems that are based on image analysis entirely are not sufficient. Our system is based on image processing and makes the process automatic and robust. Color and shape information are used in our algorithm. And also to matching the Indian currency, foreign currency by using SVM (Support Vector Machine) classification. Finally we measure the performance.The staffs who work for money exchanging have to distinguish different types of currencies. They use "Currency Sorting Machine" in the bank which works on Image acquisition and recognitions. This uses a technique named optical, mechanical and electronic integration, integrated with calculation, pattern, etc.

Keywords: SVM (support vector machine), currency sorting machine

1. INTRODUCTION

In [1 edges of the vehicle image are extracted by Sobel operator.] The proposed algorithm involves the following three steps. First, the vertical Second, HSV color space and integral image are employed to locate candidates in yellow license plates and non-yellow license plates. Finally, connected component analysis is to locate the region of license plate accurately. Experimental results on a large volume of natural-scene vehicle plate image sets, which are extracted from low-quality video sequences, demonstrate that our technique achieves a verification rate of around 95% on yellow license plates and 99% on non-yellow ones. The total time of processing one yellow image is less than 0.1s and the non-yellow one is less than 0.05s, meeting the requirements of real-time application. In [2] An automatic recognition method of a car license plate using color image processing is presented. At first, background colors of a plate are extracted from an input car image. A neural network is used for more stable extraction. To find a plate region, a fixed ratio of horizontal and vertical length of a plate is used. To recognize characters in a plate, template matching and post processing techniques are used. Since the proposed method does not depend on line information of a plate it is very robust to boundary deformation. Also, this method is strong enough to deal with a car's image which has many similar

regions with a plate. In [3] This work deals with problematic from field of artificial intelligence, machine vision and neural networks in construction of an automatic number plate recognition system (ANPR). This problematic includes mathematical principles and algorithms, which ensure a process of number plate detection, processes of proper characters segmentation, normalization and recognition. Work comparatively deals with methods achieving invariance of systems towards image skew, translations and various light conditions during the capture. Work also contains an implementation of a demonstration model, which is able to proceed these functions over a set of snapshots. The staffs who work for money exchanging have to distinguish different types of currencies. They use "Currency Sorting Machine" in the bank which works on Image acquisition and recognitions. This uses a technique named optical, mechanical and electronic integration, integrated with calculation, pattern, etc.

2. EXISTING SYSTEM

The size of the paper is different, the same as the color and pattern. The staffs who work for the money exchanging (e.g. Forex Bank) have to distinguish different types of currencies and that is not an easy job. They have to remember the symbol of each currency. This may cause some problems (e.g. wrong recognition), so they need an efficient and exact system to help their work. As we mentioned before, the aim of our system is to help people who need to recognize different currencies, and work with convenience and efficiency.

3. PROPOSED SYSTEM:

Our system is based on image processing, techniques which include filtering, edge detection, segmentation, etc. In order to make the system more comprehensive, we need to create a small database for storing the characteristics of the currency. The main working processes of "Currency Sorting Machine" are image acquisition and recognitions. It is a technique named "optical, mechanical and electronic integration", integrated with calculation, pattern recognition (high speed image processing), currency anti-fake technology, and lots of multidisciplinary techniques. It is accurate and highly-efficient. But for most staffs, they have to keep a lot of different characteristics and anti-fakes label for different commonly-used currencies in their mind. However, each of them has a handbook that about the characteristics and anti-fakes labels of some less commonly-used currencies. Even for that, no one can ever be 100 per cent confident about the manual recognition. Otherwise our system is based on image processing, techniques which include filtering, edge detection, segmentation, etc.In order to make the system more comprehensive, we need to create a small database for storing the characteristics of the currency. In our system, we take Chinese RMB and Swedish SEK as examples.

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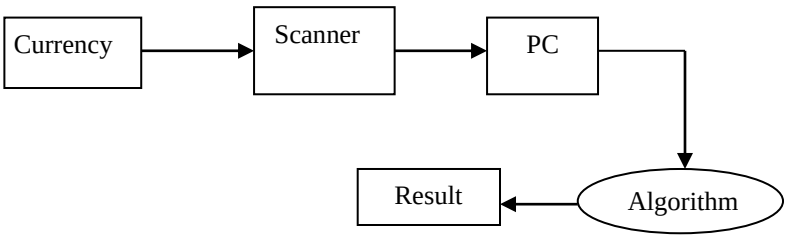
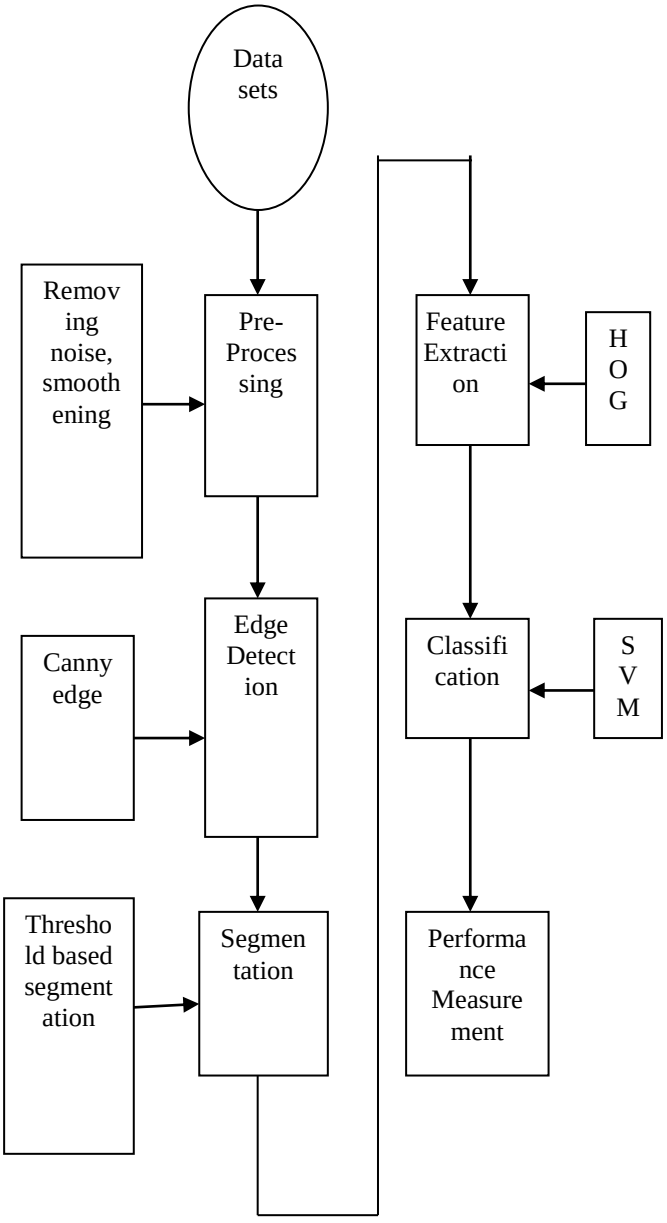
BLOCK DIAGRAM OF PROPOSED SYSTEM



FLOW CHART OF PROPOSED SYSTEM



THEORETICAL BACKGROUND

The major technique of this system is image analysis and image processing, which are part of cognitive and computer science. Image processing is a signal processing after pre-processing. The output can be either an image or a set of characteristics or parameters related to the image. Actually the image is treated as 2-dimensional signal and applies some standard signal processing techniques with image-processing techniques involved. Image analysis is a means that the meaningful information from an image is extracted mainly from digital images by means of digital image processing techniques. Image analysis tasks can be as simple as reading bar coded tags or as sophisticated as identifying a person from their face. In order to recognize the currency, the system should contain the techniques which include image pre-processing, edge detection, segmentation, pattern matching.

Pre- Processing

The aim of the image pre-processing is to suppress undesired distortions or enhance some image features that are important for further processing or analysis.

In our work, image pre-processing includes these parts

1. Image adjusting
2. Image smoothening(Removing noise)

When using a digital camera or a scanner and perform image transfers, some noise will appear on the image. Image noise is the random variation of brightness in images. Removing the noise is an important step when image processing is being performed. However noise may affect segmentation and pattern matching.

When performing smoothing process on a pixel, the neighbour of the pixel is used to do some transforming. After that a new value of the pixel is created. The neighbour of the pixel is consisting with some other pixels and they build up a matrix, the size of the matrix is odd number, the target pixel is located on the middle of the matrix. Convolution is used to perform image smoothing. . As the first step, we centre our filter over pixel that will be filtered. The filters coefficients are multiplied by the pixel values beneath and the results are added together.

Gaussian Filter

It is one of the filter whose impulse response is a Gaussian function. It modifies the input signal by convolution with the Gaussian function, this transformation is also known as weierstrass transform.

EDGE DETECTION

Edge detection is used for finding the object boundaries in images. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges.

CANNY EDGE ALGORITHM

It is an edge detection operator that uses a multi stage algorithm to detect a wide range of edges in images.

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HOW IT WORKS

The Canny operator works in a multi-stage process. First of all the image is smoothed by Gaussian convolution. Then a simple 2-D first derivative operator (somewhat like the Roberts Cross) is applied to the smoothed image to highlight regions of the image with high first spatial derivatives. Edges give rise to ridges in the gradient magnitude image. The algorithm then tracks along the top of these ridges and sets to zero all pixels that are not actually on the ridge top so as to give a thin line in the output, a process known as non-maximal suppression. The tracking process exhibits hysteresis controlledbytwothresholds: T1 and T2,with T1>T2. Tracking can only begin at a point on a ridge higher than T1. Tracking then continues in both directions out from that point until the height of the ridge falls below T2. This hysteresis helps to ensure that noisy edges are not broken up into multiple edge fragments.

CANNY EDGE DETECTOR USE

The effect of the Canny operator is determined by three parameters --- the width of the Gaussian kernel used in the smoothing phase, and the upper and lower thresholds used by the tracker. Increasing the width of the Gaussian kernel reduces the detector's sensitivity to noise, at the expense of losing some of the finer detail in the image. The localization error in the detected edges also increases slightly as the Gaussian width is increased. Usually, the upper tracking threshold can be set quite high, and the lower threshold quite low for good results. Setting the lower threshold too high will cause noisy edges to break up. Setting the upper threshold too low increases the number of spurious and undesirable edge fragments appearing in the output.

Advantages:

It works fine under noisy conditions. Better localization.

High efficient when compared to other edge algorithms.

SEGMENTATION

Segmentation is the process of partitioning a digital image into multiple segments (i.e. set of pixels, also known as super pixels).The goal of segmentation is to simplify or change the representative of an image into something that is more meaningful and easier to analyze

COLOR

Color is a property of enormous importance to human visual perception. Hardware will generally deliver or display colour via an RGB or HSV model.

RGB model is often used in computer graphics as the basis of a colour space

The RGB model is an additive colour model based on primary colours red, green and blue. Each colour appears in its primary spectral components.

The main purpose of the RGB colour model is for the sensing, representation, and displays of images in electronic systems, though it has also been used in conventional photography.

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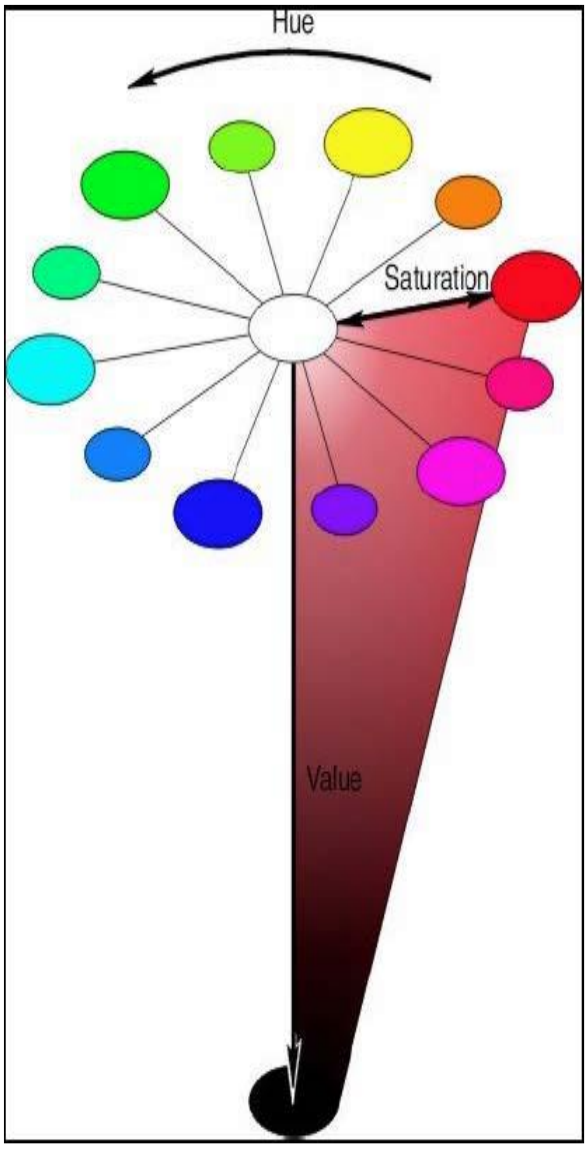
HSV model is one of several colour systems used by people to select colours from a colour wheel or palette. This colour model is considerably closer than the RGB model in the way how humans experience and describe colour sensations.

HSV is abbreviated to Hue, Saturation and Value. Hue is pure colour and is measured by degrees or percentage. Saturation is the radius in the circle. Value (V = 1 or 100%) corresponds to pure white (R = G = B = 1) and to any fully saturated colour.

Gray describes the colors ranging from black to white. Gray paints are created by mixing the two colors. A gray scale image is the value of each pixel which is a single sample. That means it carries only intensity information



THRESHOLD BASED SEGMENTATION

It is the simplest method of image segmentation. It is the process of assigning each pixel in the source image to two or more classes. From a gray scale image, thresholding can be to create binary images. Binary images are produced from color images by segmentation

HOG (Histogram of gradients)

It is a feature descriptor used in image processing for the purpose of object detection. HOG which divides the image into small connected regions called cells, and for each cell compute a histogram of gradient directions or edge orientations for the pixels within the cell. Discretize each cell into angular bins according to the gradient orientation. Each cell's pixel contributes weighted gradient to its corresponding angular bin.

Groups of adjacent cells are considered as spatial regions called blocks. The grouping of cells into a block is the basis for grouping and normalization of histograms. Normalized group of histograms represents the block histogram. The set of these block histograms represents the descriptor

CLASSIFICATION

The learning of the hyper plane in linear SVM is done by transforming the problem using some linear algebra, which is out of the scope of this introduction to SVM A powerful insight is that the linear SVM can be rephrased using the inner product of any two given observations, rather than the observations themselves. The inner product between two

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vectors is the sum of the multiplication of each pair of input values. For example, the inner product of the vectors [2, 3] and [5, 6] is 2*5 + 3*6 or 28.
The equation for making a prediction for a new input using the dot product between the input (x) and each support vector (xi) is calculated as follows:

f(x) = B0 + sum(ai * (x,xi))

This is an equation that involves calculating the inner products of a new input vector (x) with all support vectors in training data. The coefficients B0 and ai (for each input) must be estimated from the training data by the learning algorithm

EXPERIMENT AND RESULT

INPUT CURRENCY :(foreign currency)

OMAN (1/2) half rial
OMAN (100) Baisa
UNITED ARAB EMIRATES (10 DIRHAMS)
BAHRAIN (1 DINNAR)

INPUT

1. OMAN (1/2RIAL)

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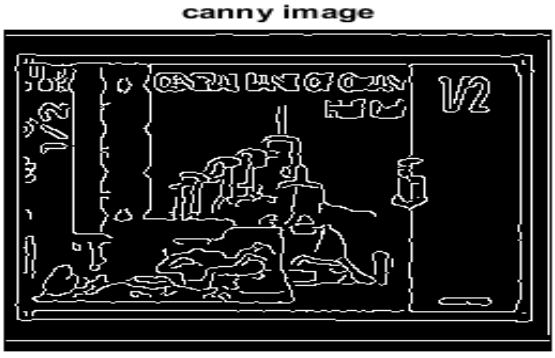
2. BAHRAIN (1DINAR)

3. OMAN (100 BAISA)

4. UNITED ARAB EMIRATES (10DIRHAMS)



1. INPUT IMAGE

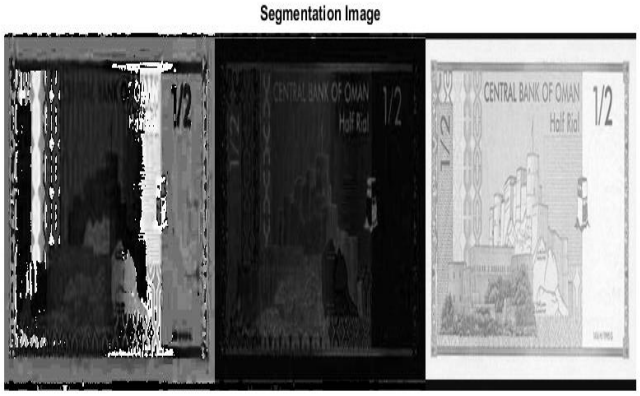
2. RESIZE IMAGE

3. FILTERED IMAGE

4. CANNY IMAGE

5. SEGMENTATION IMAGE

6. CONVERTION OF CURRENCY MESSAGE BOX



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