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Smart Choice – Content Based Clothing Recommendation System

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***Abstract*:** Shopping has always been a basic necessity but also a time consuming nuisance. With the trending e-platforms, people are shopping on the go! In this ever growing technology, finding something with pattern of your choice is difficult. The plethora of options often gets the customers confused and eventually drops the idea. Our project will help the consumers to search for the clothes referring the pattern in the picture they upload on our platform. It aims at using image processing techniques to provide with much better results for our customers and aid them in shopping. Exploring choices become easy as the clothes having similar patterns will be shown as the result. Rather than searching for hours, our project will bring the searched results to them. The texture and print on the image of cloth will be analyzed for patterns like lines at different angles and circular designs. These identified patterns will help to find similar clothes which the customer may desire.

Keywordss: Image Retrieval, Shopping, Content based image retrieval, Gabor function, Circle Hough Transform**.**

I. INTRODUCTION

IN the present scenario, image plays vital role in every aspect of business such as satellite images, medical images and so on. Many Content Based Image Retrieval (CBIR) system prototypes have been proposed and few are used as commercial systems. CBIR aims at searching image databases for specific images that are similar to a given query image. It analyzes content of the image rather than the metadata like tags, keywords or description of the image. It also focuses at developing new techniques that support effective searching and browsing of large digital image libraries based on automatically derived imagery features.

In recent years, the demand for intelligent recommendation systems has been on the rise. These systems can aid in shopping as well. It can help the user find the right product. Shopping becomes a nuisance when the user has to choose from a never-ending range of clothes. An intelligent recommendation system which gives the result to the user based on an input image will make shopping a lot easier for users.

Different online sales portals use different recommendation systems. E-Bay, a online buying and selling store, shows search based on preferences of the user, history of the users. Mainly text based search techniques are used. Metadata query is used. Shopachu is another shopping website and has searches based on brands mainly. After login the user gets recommendation based on history and preferences. On the other hand, we plan to have a more intelligent system which searches purely based on the image to get accurate results.

In this project, we aim to develop a recommendation system that will take as input an image of clothing and output images of similar clothing items of the same texture type that the user may also like. We will use texture to determine similarity scores between pairs of images. The pattern on the cloth will be analyzed and results similar to these patterns will be provided. These patterns can be circular or can have various angular lines. The objective is to out the images with similar circular or angular line pattern.

II. LITERATURE SURVEY

a. Function for Line detection

i. Gabor Filter

A Gabor filter is a linear filter which is used in image processing mainly for feature detection or texture analysis as it detects edges. A Gabor filter encodes edges. Orientation of the edges can be given to the filter . Convolving an image with a filter bank of gabors, where each is sensitive to a different orientation and scale, generates multiple responses for all elements in the image that indicate the local orientations of the edges [1]. Gabor filters are a common model of simple cells found in the early stages of the visual cortex. Simple cells respond to the presence of oriented edges in the visual stimulus[2]. A Gabor filter is basically a Gaussian multiplied by a cosine that detects edges at a certain frequency and angle given by

$$G(x,y,\theta,f) = \exp\left(\frac{-1}{2}\left[\left(\frac{x'}{sx'}\right)^2\right]\right) cos2\pi fx'$$

$$x' = xcos\theta + ysin\theta$$
$$y' = ycos\theta - xsin\theta \quad (1)$$

ii. Hough Line Transform

In 1962 Paul Hough transformed patterns in an image and produced a method for detecting lines in images. The Hough transform is a feature extraction technique used in image analysis, computer vision, and digital image processing. The purpose of the technique is to find imperfect instances of objects within a certain class of shapes by a voting procedure [3]. This voting procedure is carried out in a parameter space, from which object candidates are obtained as local maxima in a so-called accumulator space that is explicitly constructed by the algorithm for computing the Hough transform. Rectangular and Gaussian windows are two pre-processing methods presented in for the high precision estimation of the HT line parameters [3].

In general, the straight line $y = mx + b$ can be represented as a point (b, m) in the parameter space. However, vertical lines pose a problem. They would give rise to unbounded values of

the slope parameter *m*. Thus, for computational reasons, Duda and Hart proposed the use of the Hesse normal form

$$xcos\theta + ysin\theta = r \quad (2)$$

where *r* is the distance from the origin to the closest point on the straight line, and θ (*theta*) is the angle between the *x* axis and the line connecting the origin with that closest point. It is therefore possible to associate with each line of the image, a pair (r,θ). The (r,θ) plane is sometimes referred to as *Hough space* for the set of straight lines in two dimensions[3].

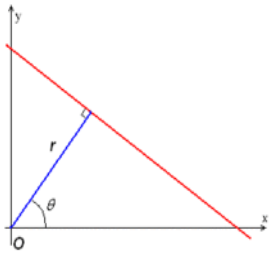

Fig. 1: Line in x-y plane making and angle θ with the origin at a perpendicular distance r.

The linear Hough transform algorithm uses a two-dimensional array, called an accumulator, to detect the existence of a line described by the previous equation. The dimension of the accumulator equals the number of unknown parameters, i.e., two, considering quantized values of r and θ in the pair (r,θ). For each pixel at (x,y) and its neighborhood, the Hough transform algorithm determines if there is enough evidence of a straight line at that pixel. If so, it will calculate the parameters (r,θ) of that line, and then look for the accumulator's bin that the parameters fall into, and increment the value of that bin. By finding the bins with the highest values, typically by looking for local maxima in the accumulator space, the most likely lines can be extracted, and their (approximate) geometric definitions read off.

b. *Function for circle detection*

i. *Circle Hough Transform*

Circle Hough Transform (CHT) is a basic technique used in Digital Image Processing, for detecting circular objects in a digital image. It uses a preliminary edge detection technique such as Sobel or Canny. Additionally, it depends on a voting scheme. However, the CHT relies on the equation of circle having three parameters [3].

Canny edge detector: Canny edge detection is a technique to extract useful structural information from different vision objects and dramatically reduce the amount of data to be processed. It has been widely applied in various computer vision systems. Among the edge detection methods developed so far, canny edge detection algorithm is one of the most strictly defined methods that provide good and reliable detection. Owing to its optimality to meet with the criteria for edge detection and the simplicity of process for implementation, it became one of the most popular algorithms for edge detection [3].

In a two-dimensional space, a circle can be described by:

$$(x-a)^2 + (y-b)^2 = r^2 \quad (3)$$

where (a,b) is the center of the circle, and r is the radius.

If a 2D point (x,y) is fixed, then the parameters can be found according to (2). The parameter space would be three dimensional, (a, b, r). And all the parameters that satisfy (x, y) would lie on the surface of an inverted right-angled cone whose apex is at (x, y, 0) [3].

ii. *Gabor Annulus*

Gabor Annulus technique offsets the traditional Gabor filter by a radius which wraps around the origin, and is defined as follows:

$$G(x,y) = \frac{1}{2\pi\sigma r\,0}\; e^{-\pi\left[\frac{(r-r0)^2}{\sigma^2}\right]}\; e^{i[2\pi f\,0(r-r0)]} \quad (4)$$

where,

$$r = \sqrt{(x-x0)^2 + (y-y0)^2}$$

In this new filter σ specifies the standard deviation of the Gaussian envelope in the waveform direction, which now expands radially outwards from the centre of the filter. r0 specifies the radius of the 'annulus' shape. The second exponent is the complex plane wave with frequency f0 in the waveform direction. (x0, y0) specify the centre coordinates of the filter in the spatial domain [4].

The filter is similar to the original Gabor wavelet filter, but the complex plane wave now radiates from the centre of the filter (similarly to the CGF discussed earlier), and the Gaussian envelope is now centered around the radius of the filter. This creates a filter that responds to image features which are circular in form and consist of matching radial frequencies on their boundaries. The filter response will be strongest at the centre of a matching feature, giving a centre location *for* the circular image feature [4].

Similarly to traditional Gabor filters the new Gabor Annulus technique can use a single 'mother' filter to create a family of filters at various scales. These can then be used to match circular image features at various sizes within the image. As the filter is radially symmetric there is no need to also generate rotations at different orientations as in traditional Gabor wavelet filtering [4].

III. PROPOSED SYSTEM

a. *Functional Requirements*

i. *Capture Image*

The user captures image of the cloth through the camera and uploads it on our system. Image can be captured through the camera of laptop or phone.

ii. *Process on server*

The image uploaded will go to the server where it is processed on MATLAB software. User chooses whether lines or circles should get detected and according to the option user selects different algorithms are applied on the image. Required section gets detected.

iii. *Compare with database*

After a shape is detected it is compared with the database and the image closest to the input image is returned.

iv. Return Match

Image result should be shown back to the user through the system.

b. Non-Functional Requirements

i. Usability

The system should be user-friendly, easy to use and navigate.

ii. Responsive

The system should respond with appropriate results to the user with minimum latency.

iii. Compatible

The system should be compatible with all operating systems and platforms.

c. Architecture

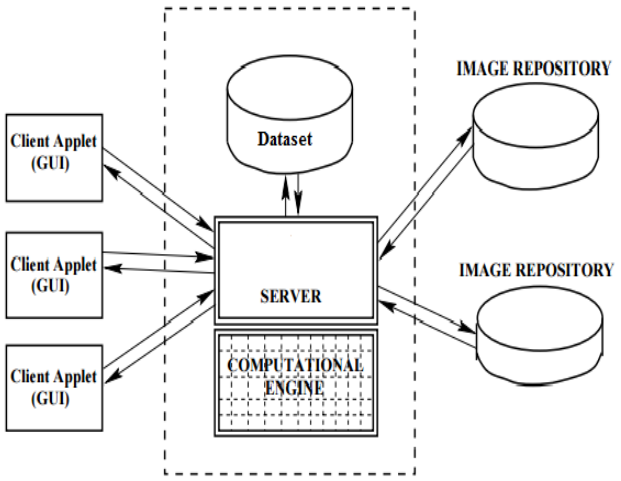

Fig. 2: Architecture of proposed system

d. Constraints

1) If the image taken is not clear, the system won't detect the shapes properly.
2) If the cloth is not kept straight then the system might detect edges which are not present.
3) Only lines and circles are detected.
4) Complex patterns can create a problem as system can detect more or less edges and match will get the wrong result.
5) Varying lighting and poses in the image can create a problem as they might interfere with the pattern detection.

e. Algorithm Used

i. Gabor filter for line detection

Gabor filter is preferred over Hough line transform because of the latter's limitations. The size of bin in Hough Transform should not be too small such that votes fall in neighboring bin reducing the visibility of main bin, while there is no such limitation to Gabor filter. Use of the Hough transform on noisy images is a very delicate matter and generally, a denoising stage must be used before. To avoid such limitations Gabor filter is used.

Algorithm

- Take center section of image and convolve with conjugate of each Gabor filter. Calculate mean and standard deviation of each image to obtain Gabor coefficients.
- For the image in question, we take a square from the center of it. This is because we do not want background or edge texture to bias our results, and we assume the center texture represents the texture for the entire object.
- We then convolve this square with the conjugates of each Gabor filter, and then calculate their means and standard deviations (Gabor coefficients), which make up the elements of our descriptor vector.
- To compare images, we take the difference of their two descriptor vectors, which gives us a measure of distance. To give a measure of similarity, we negate all the similarity scores to reverse the order and subtract the minimum to make the scores positive.

ii. Circular Hough Transform

The algorithm of CHT is more efficient and well defined than Gabor Annulus. Gabor Annulus is merely described theoretically while CHT is already used practically for various purposes [3].

Algorithm:

- Extract edges of the image e.g. using Canny detector.
- Create a 3D Accumulator Array of zeros, A[x,y,r] for center locations and radius values according to image dimensions.
- For each edge point,(xi,yi) in the image:
  - For each candidate radius r :
    - For each candidate x for center horizontal location:
      - Find each possible y verifying the equation: $(xi-x)^2+(yi-y)^2 = r^2$
      - Increment the cell: A[x,y,r]=A[x,y,r] + 1
- Search for local Maxima in A[x,y,r], to obtain the center locations and the radii of the circles in the image.

IV. IMPLEMENTATION

MATLAB is used for implementing the proposed system. Digital image processing is the use of computer algorithms to create process, communicate, and display digital images. MATLAB and Simulink toolbox are used for the purpose of processing the image and displaying result.

The expected result of clothing recommendation system is shown below.

a. Input image b. Output Image

Fig.3: Expected result of proposed system

Snapshots of the system show the input image and recommended images for both lines and circle. The input images in both the algorithms are cropped and resized so as to get the center of image to remove the background which is not needed.

The input image after cropping and resizing for algorithm of line is given below.

Fig. 4: Input Image

Recommended images give by the system is shown below.

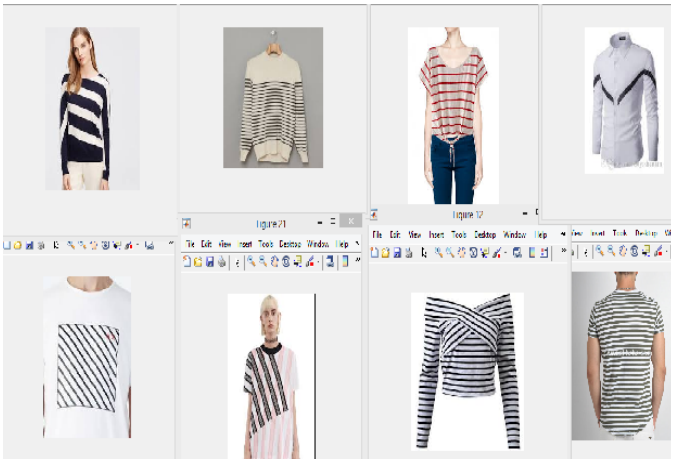

Fig. 5: Output Images

Input image after cropping and resizing and output images to show the working of circle algorithm.

Fig. 5: Input Image

Fig. 6: Output Images

V. CONCLUSION

Clothing recommendation system is proposed for shopping. The system will be built based on extracting and comparing main property of clothing images, mainly texture and print. This system detects texture and print on the cloth analyzing line, circles. The user uploads image to our system and after computation on the image database receives similar clothes through our system.

VI. ACKNOWLEDGEMENT

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VII. REFERENCES

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