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Research paper



Shape based Object Retrieval Technique for Vehicular Spare Parts

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Abstract

Shape based object retrieval technique is an application used for the automatic retrieval of vehicular spare parts based on the input image, this application can be useful in the automobile industry/shop for the retrieval of specific object from the group of objects. For the retrieval process first the database has been designed to store different shapes of nuts that are hexagon and square. With the application of median filter and wiener filters in the preprocessing step, the canny edge-detector for identifying the edges and to ascertain shape of the input and database images the convex hull approach is applied. This system is successful in retrieving the shape of the images which already exist in the database and the method results with the accuracy of 82.1875%

Keywords: *Shape, objects, Vehicular parts, retrieval, automobile, edge.*

1. Introduction

The shape-based object retrieval system is an application used for automatic retrieval of vehicular spare parts. The automatic retrieval of the vehicular spare parts in the automobile industry is one of the important needs, because searching of the specific part from the group of the objects consumes more time and energy. The smart system in the automobile industry will be used to separate the different spare parts of the vehicle. Instead of manual searching we can make the automatic search by using this application this reduces the human effort and saves time. We can specify the shape based object retrieval technique as the system for fetching the images from the database of the automobile industry/shop, the database consisting of the different images of the vehicular spare parts of different shapes of nuts such as hexagon and square. The earlier image retrieval techniques use the text for the retrieval process, in the text based approach the search is done through keywords which will not provide accurate results. In the later days content based approach has been developed, which work on the observable characters of the image and the characters are color, shape and texture. Among all the three contents important character for the retrieval process is shape, hence in the proposed work the shape is considered as the one of the important feature for the retrieval of the vehicular objects. For the preprocessing step median filter or wiener filter is used depending on the noise present in the image, then edge based segmentation is performed by using canny-edge detection algorithm. As compared to other edge identification techniques, this approach provides better edges including both strong and weak edges. After applying the canny edge mechanism it provides the distinct edges which are already exist in the image and then by applying convex hull method the shape is obtained from the image. Images which already exist in the database are retrieved when shape of the input and database image are matched.

The automatic retrieval of the vehicular spare parts in the automobile industry/shop is one of the important needs. Manual searching is the drawback so to overcome that, this application has been designed by considering one of the important content of the image, which is shape. The retrieval process is carried out by considering the shape, block diagram and algorithm discussed above show the working procedure of the proposed work

2. Literature Survey

[1] Image retrieval can be performed by using different contents of the image like color, texture and shape are used. By observing these contents shape is one of the important content for retrieving the images. In the proposed method image retrieval is done by applying 2-D Fourier transform the Fourier descriptor (FD) is used on the polar shape image.

[2] The technique which works on the content of the image treats shape as one of the feature among the other features which are used for retrieval. In the proposed method two important shape descriptors are used for retrieving the shape of the image, the descriptors are region based and contour based. By using these procedures retrieval procedure is performed.

[3] In the different types of applications like remote sensing, crime prevention, for searching browsing and retrieving the images the different devices are required. Because of this the various approaches are introduced. In the earlier days the text based ap-

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proach is developed for the image retrieval afterwards the content-based approach has been developed. If the characteristics are used like keywords and text descriptors then the human effort is required for understanding the images and for the similarity measurement. But if we use the low level image character then they are automatically extracted the human effort is not required.

[4] In the proposed work it involves two Adaptive filtering methods for removing the salt and pepper kind of noise. The algorithms used are the interactive Adaptive switching median filter (IASMF), it works on the images that are corrupted at the low rate and Adaptive-threshold based median filter (ATMF) algorithm works on images that are highly corrupted for giving the better quality output. Experimental results show that as compared to the other filtering technique it gives better result.

[5] To show the characteristics of the image the visual descriptor is used, which is located close to sector and appearance of the curved lines. In the proposed descriptor two component feature vectors are used. In the first component the local section is partitioned into Zone and their orientation values, incline magnitude are selected. In the second component the local shape features are selected using contour lines.

[6] In the proposed image retrieval technique all the three characters color, shape and texture are combined to execute retrieval procedure. To obtain the color feature color quantization algorithm is used then the steerable filter decomposition is used to select the texture feature. Lastly the pseudo Zernike moments are used for the shape descriptor.

[7] The technique which is situated upon the content of image uses the in-variant image moments. Moment-Invariant (MI) and Zernike-Moments (ZM) are good for representing shape but they are not efficient for orthogonal moment, Therefore Legendre Moments are used they are orthogonal and efficiently faster. In the proposed work Exact Legendre Moments (ELM) are utilized for the retrieval mechanism.

[8] In the proposed work the shape features are selected from the image by using the Polar Raster Sampling Signature algorithm. By using Euclidian distance similarity whether the images are similar or not is checked, the images present in the database are retrieved when it is appropriate to the input image.

[9] In the proposed work group of approaches are used by using the weighted sum rule. This rule is based on the extensively used shape descriptor, for example inner distance shape context, height function. By converting shape descriptor into matrix the features are selected, from which a set of text descriptors are selected.
The literature review summarizes that in the earlier days image retrieval is performed by using text based approach which consumes time and human effort. In the later days the content based approach is came into existence. From the different research work it shows that many techniques used shape for the retrieval of the images by using different shape representation algorithms. We can say that shape is major element used for the retrieval process, hence in this application it is used.

3. Proposed Work

3.1. Methodology

3.1.1. Image Acquisition

The acquisition process is defined as the action of obtaining the picture from some source normally the hardware based source, so that any next process can follow afterwards. Image acquisition should perform in the first step because images are very important for the next process, if images are not there next process will not start. In this application the image acquisition is done by collecting the different images of spare parts from camera and from search engines and stored in the database.

3.1.2. Preprocessing

After collecting the images in the image acquisition step, the next step is preprocessing in the preprocessing step the images that are collected and stored in the database are passed as input. Depending on the noise, filtering techniques used are median filter and the wiener filter.

3.1.3. Segmentation

The edge based segmentation is performed on the images by employing canny method, when compared with other techniques it is very good at ascertaining the edges and comprises both the strong and the weak edges present in the image. For all the images edges are detected and stored in the edge folder.

3.1.4. Feature Extraction

Feature extraction is done by using convex hull method, which is good for describing the shape of the image. In the proposed method retrieval technique is situated on picture shape. System generates the shape characters for both query and database image.

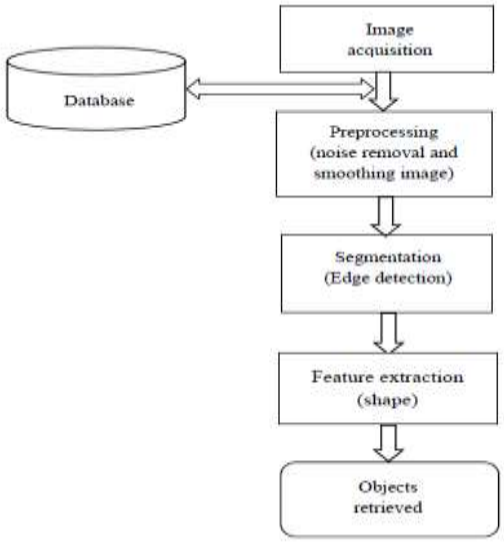


Figure 3.1: Block Diagram of Proposed method

The above figure shows the intended scheme which is shape based object retrieval technique, the flow of this block diagram are explained here first it starts with reading the images from the database and the input image is preprocessed by using median or wiener filtering techniques, the preprocessed image is then passed for the segmentation here edge based segmentation is performed by employing the canny edge detection procedure. The shape feature is extracted in the feature extraction stage by using convex hull method. If input image shape and images which already exist inside the database are similar at that instant images are retrieved.

3.2. Proposed Algorithm

Input: images of vehicular spare parts
Output: objects retrieved based on the shape
Methodology:

Step 1: [image acquisition]
Images of vehicular objects are collected
Step 2: read image
Step 3: [Preprocessing]
Step 3.1: [noise removal]

By using median or wiener filter depends on noise present in the image
Apply median filter
Calculate MSE
Apply wiener filter
Calculate MSE
If (MSE (median)>MSE (wiener)) then
Select median filter
Else
Select wiener filter

Step 3.2: preprocessed image
Step 4: [segmentation]
Edge based segmentation using canny edge detection technique
Step5: [Feature extraction]
Shape feature is extracted by using convex hull geometry
Step 6: [object matching]
Object matching is done when both input and database-image are identical.
Step7: matched objects are retrieved

4. Experimental Results

4.1. Selecting Suitable Filter for Reducing Noise

The MSE is abbreviated as the Mean Square Error This is used to compare between original image and compressed image, if we get lower MSE value then the error rate is low.

$$MSE = \frac{1}{m\,n}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j) - K(i,j)]^2$$

The PSNR is abbreviated as the Peak Signal to Noise Ratio and it is estimated in decibels (DB).this is utilized for the quality estimation among original image and the regenerated image, if we get large PSNR value then quality of the re-established or reconstructed image is better.

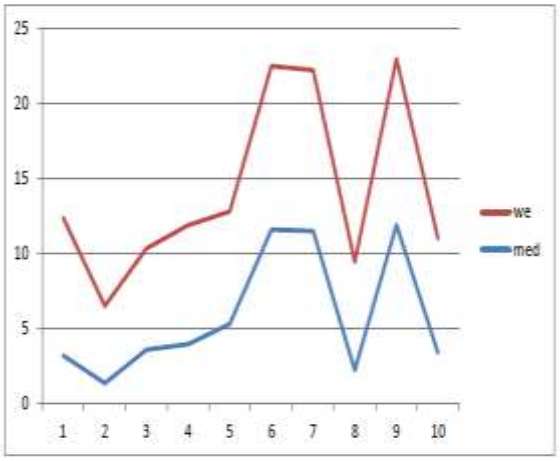
Table 4.1: Results obtained on applying Median and Weiner Filter

$$PSNR = 10.\log_{10}\left(\frac{MAX_I^2}{MSE}\right)$$

$$= 20.\log_{10}\left(\frac{MAX_I}{\sqrt{MSE}}\right)$$

$$= 20.\log_{10}(MAX_I) - 10.\log_{10}(MSE)$$

S.no	Number of Images	Median	Wiener
1	10	3.23	9.19
2	10	1.38	5.15
3	10	3.61	6.75
4	10	3.98	7.94
5	10	5.32	7.51
6	10	11.61	10.93
7	10	11.53	10.73
8	10	2.24	7.22
9	10	11.93	11.1
10	10	3.39	7.62



Graph 4.1: Comparison between Weiner and Median filters

4.2. Performance Measures

Formulas for the Precision and Recall and Accuracy

$$Precision = \frac{TP}{TP + FP}$$

$$Recall = \frac{TP}{TP + FN}$$

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

Where,

TP – True Positive

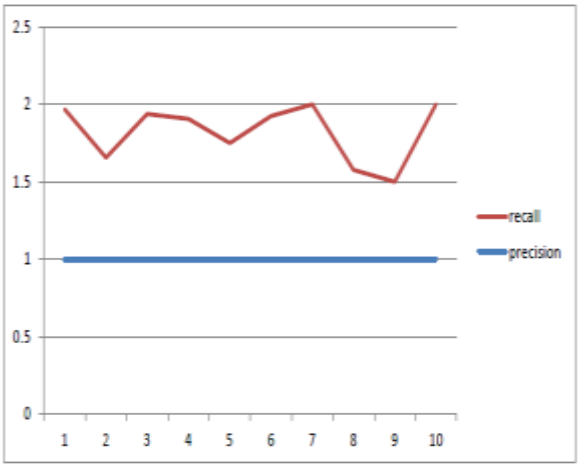
TN – True Negative

FP – False Positive

FN – False Negative

Table 4.2: Evaluation of Precision and Recall factors

S.no	Number of Images	Precision	Recall
1	25	1	0.96875
2	25	1	0.65625
3	25	1	0.9375
4	25	1	0.90625
5	25	1	0.75
6	25	1	0.923977
7	25	1	1
8	25	1	0.576923
9	25	1	0.5
10	25	1	1

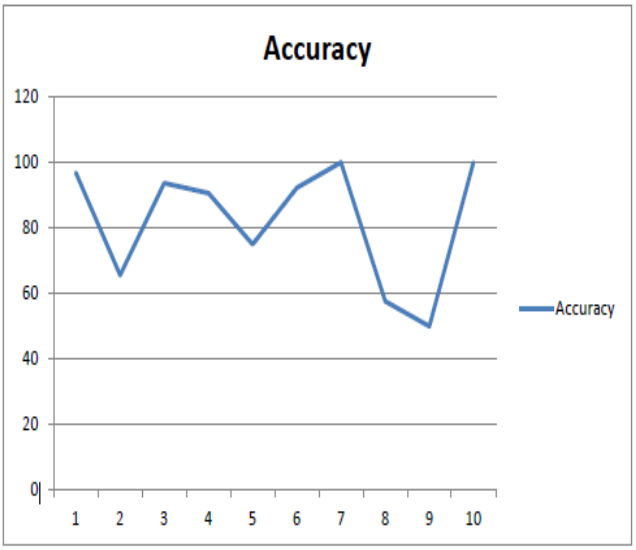


Graph 4.2: comparison between Recall and Precision factors

As shown in the above figure Precision and Recall values are varies for different images.

Table 4.3: Evaluation of accuracy

S.no	Number of images	Accuracy
1	50	96.875
2	50	65.625
3	50	93.75
4	50	90.625
5	50	75
6	50	92.30769
7	50	100
8	50	57.69231
9	50	50
10	50	100



Graph 4.3: Showing the accuracy for nuts with its detection of edges



Figure 4.1: Collection of nuts used for experimentation



(a) (b)

Figure 4.2: View of results during pre-processing step (a) Hexa shaped (b) Square shaped

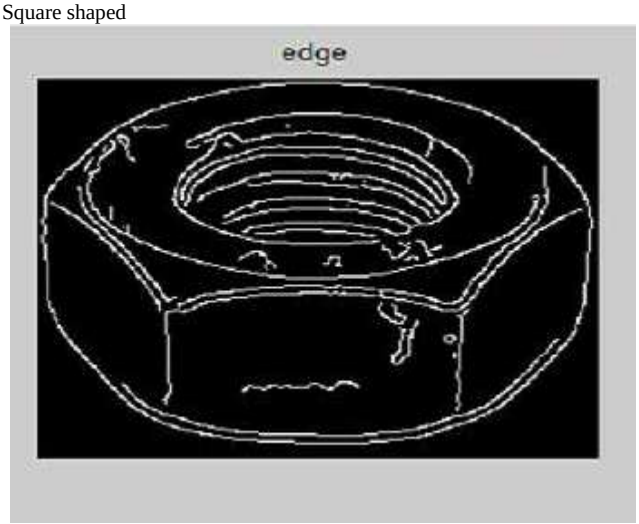


Figure 4.3: Edge detection of a Hexa-shaped nut



Figure 4.4: Results obtained during edge detection of Hexa and squared nuts

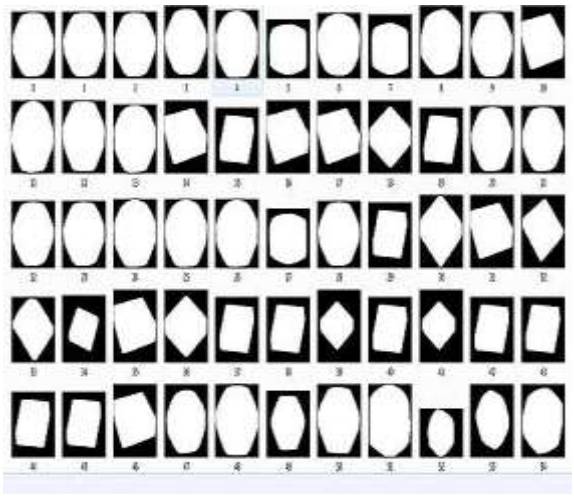


Figure 4.5: Results stored in the database for comparison

The above discussion shows the experimental results of the proposed work. Different evaluation measures are used for observing the results like precision and recall against number of images and Accuracy Vs total number of images. The system is successful in retrieving images with the accuracy rate of 82.1875

5. Conclusion

In the proposed work, the image retrieval is done for the vehicular object nut, for the two different shapes hexagon and square based on the important low level content shape. In the automobile industry the automatic retrieval of the vehicular objects is one of the important needs. Through the image acquisition stage different images of nuts are collected and they are stored in the database. Shape of the image is identified by using convex hull algorithm, retrieval of the objects is done based on the shape of the image and the system is successful in retrieval process with the accuracy of 82.1875.

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