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Image Features Matching and Classification Using Machine Learning

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Abstract - *In the image matching various feature points of digital images are extracted and then matched to check the duplicity of objects in the images. For feature-to-feature matching algorithm should be automatic so that it can detect the same object in different images. There are various ways to detect feature points in images and also their matching. Local descriptors, Harris descriptor, Corner detector and other various algorithms are used for extraction of features of objects in the digital images. In this proposed research work a new way of finding or matching the features of images and their classification based on machine learning is proposed. One of the important aims of the methodology is to improve the accuracy and achieving the robustness in the feature extraction and matching of objects in two digital images. All the experiment will be performed either in the Python-OpenCV software which has inbuilt machine learning and image processing toolbox for image acquisition. The proposed methodology of image feature matching will be compared with the other known algorithms.*

Key Words: Image features, feature matching, classification, machine learning, accuracy

1. INTRODUCTION

Computer vision falls under the artificial intelligence category of computer science. It utilizes various types of digital images and videos from cameras and with the help of machine and deep learning the computer machines can detect or identify as well as classify the various objects present in the digital data. Scale invariant feature transform (SIFT) is one of the famous feature detection algorithms in computer vision. It is generally used for detecting as well as describing local features in digital images. In the above figure two same set of cards in the same order are matched with the SIFT algorithm and results are quite great. [10]

Machine learning is way of analysis of any kind of data which is used for model building. Here the machines can learn or interpret from the data and can recognize various patterns and then can take decisions and all of this without intervention of human. Actually, it has a different way of solving problems in comparison to computer vision. There is no need to code every rule into the applications.

1.1 LITERATURE SURVEY

S. Eqbal et al. [1] in 2021 proposed a modified approach of finding local features in digital images with the help of SIFT transform. Author first of all extracted all the features present in the sample digital images. These extracted features were remained same even if there was rotation of image, noise present in the images, light variations, cropped images. Author used to know SIFT algorithm for extraction of all the keypoints features of the digital images. For keypoint extraction author had used the Harris Corner Detection algorithm. Further author had created Difference of Gaussians which further enhanced the features in the images. From the experiments author had showed the accuracy of more than 94 percent in matching of various features in various digital images. Author had not compared the proposed method with any of the other standard feature matching methods.

Z. Wang et al. [2] in 2020 worked in the area of feature extraction and matching which was broadly utilized in recognition of faces and many more. Author had worked in the improvement of the well-known algorithm Oriented FAST and rotated BRIEF (ORB). Author had figured out the concern of matching accuracy of featured keypoints of ORB algorithm. To overcome these problems author had used affine based transformation with the ORB algorithm. In the first stage author had detected various descriptors in the various objects present in the digital images. Then affine transformations were used to extract various feature points from the descriptors. After this step various stable bits were extracted from the feature points so that best feature matching could be done. Author compared the proposed improved algorithm with the conventional ORB and with the LATCH feature matching methods. From the experimental results author had showed that the proposed algorithm had good time and as well as matching accuracy.

L. Ying et al. [3] in 2020 worked in the reconstruction and feature matching of three dimensional aerial digital images. To overcome the limitations of the matching and pairing of features of high-resolution aerial images author had proposed a robust, more accurate and dense feature matching algorithm for sparse images. In the first step author had tried to reach on a tradeoff amid feature matching time of computation and the count of matching pairs by lowering the resolution of the input digital image. In the next step author had used a feature scanning method which was relied on the similarity measurement of local area which further omitted the mismatches. In the last step all the existing matched feature pairs were restored from low resolution digital images to the original digital images. Author had compared the proposed algorithm with the SURF with RANSAC

algorithm. From the experiments author had showed that proposed algorithm worked better in comparison to other algorithm and effectively helpful in reducing the matching time.

B. Cui et al. [4] in 2019 proposed a feature detection method in image matching. Authors first used the Laplacian filters to enhance and sharp the images. Then authors used local entropy calculation method which was relied on Marr wavelets. Author prime aim was to enhance the accuracy of the feature matching of digital images with the comprehensive set of various features of objects. Authors combined mesh division methodology and nearest neighbor approach with a stage of feature selection. Authors used the dataset of Oxford university which had thirteen various distinct classes of objects. Authors compared the proposed methodology with the various methods like conventional method, corner detector, Harris and Gilles detector and SIFT or other detectors. From the experiments author proved the authenticity of the proposed algorithm which had high matching recall parameter value for the different images. Also, the computation time taken by the proposed algorithm is effective in comparison to other algorithms.

Akmal et al. [5] in 2019 utilized region graph adjacency to match the regions of the digital images. Authors used the minimum spanning tree algorithm to segment the graphs from the images. Since this method was able to separated objects into various regions so that it was easy to detect vertices as well as edges in the graphs. Authors recognized it as region adjacency graph. With the help of it authors performed the graph matching process in the digital images. Authors used the well-known VF2 and graph edit distance algorithm to perform the image matching. From the experiments author showed that the VF2 algorithm performed better than graph edit distance algorithm. F score value of VF2 algorithm was near to 90 and precision or recall values were 96 and 84 respectively. While in case of graph edit distance f score was near to 59 percent. While the values of precision and recall for the graph edit distance was 47 and 60 percent. Overall, the proposed algorithm showed the good results and proved the reliability and efficiency of the proposed methodology.

3. METHODOLOGY AND PROPOSED ALGORITHM

In this section research methodology and the proposed algorithm steps are discussed.

3.1 Methodology

The following strategy will be followed to get the desired results.

Step 1. Input two images and preprocess the image to remove any type of noise

Step 2. Apply the contrast and brightness enhancement technique so that maximum information can be available for further processing

Step 3. Apply the image segmentation algorithms to separate various objects present in both the images

Step 4. Apply algorithm to extract the features of both the images and save it

Step 5. Use the feature matching algorithm to identify the common features of both the images

Step 6. Correlate the common objects in both the images based on feature matching

Step 7. Create a machine learning model that can detect the number of objects in a class of the objects like human

Step 8. Test the developed framework on the different dataset of images

3.2 Proposed Algorithm

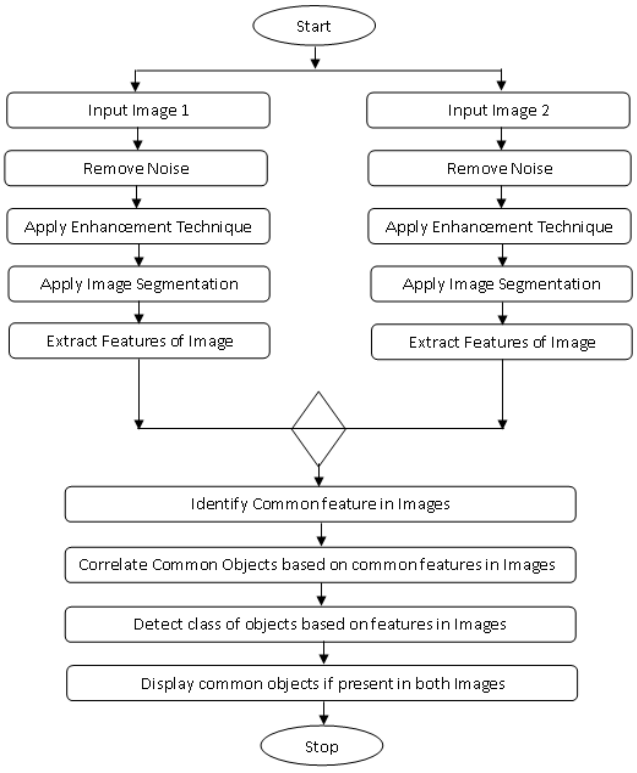

Fig -1: Proposed algorithm

3.3 Objective Parameters

Precision, recall and F1-score are taken as the objective parameters for evaluation.

3.3.1. Precision

$$\text{Precision} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Positive}}$$

3.3.2. Recall

$$\text{Recall} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Negative}}$$

3.3.3 F1 Score

$$F1 \text{ Measure} = 2 \text{ X } \frac{\text{precision X recall}}{\text{Precision} + \text{recall}}$$

4. RESULTS

The proposed algorithm is compared with the conventional standard Scale Invariant Feature Transform algorithm. Algorithms are contrasted on the basis various objective parameters like precision, recall and F1-score. Various types of graphs are created that demonstrate the comparison of the objective parameters for both the proposed and the standard feature matching algorithms.

Fig -4.1 (a, b): First original and flipped image

Fig -4.1 (c): Feature matching results with standard technique on first image

Fig -4.1 (d): Feature matching results with proposed technique on first image

Fig-4.2 (a, b): Second original and flipped image

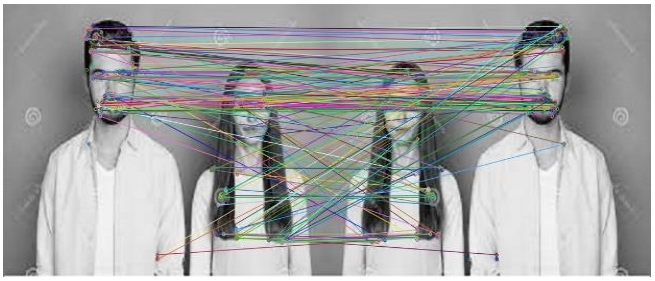

Fig-4.2 (c): Feature matching results with standard technique on second image

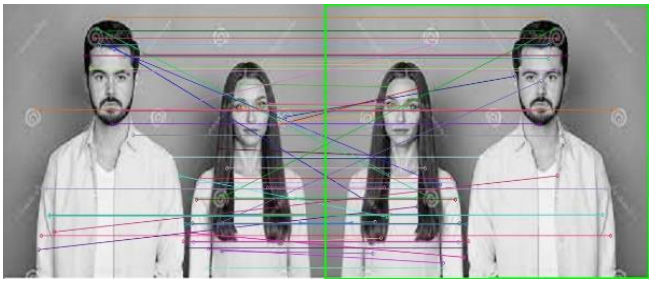

Fig-4.2 (d): Feature matching results with proposed technique on second image


Fig-4.3 (a, b): Third original and flipped image

Fig-4.3 (c): Feature matching results with standard technique on third image

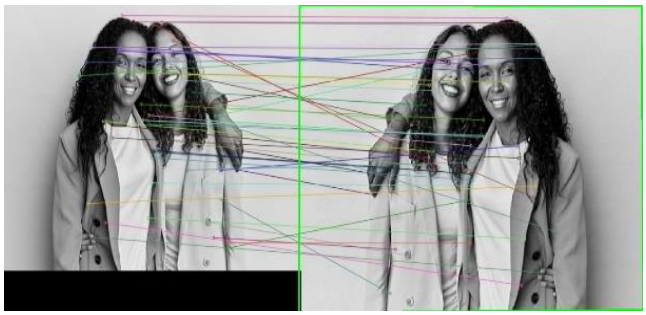

Fig-4.3 (d): Feature matching results with proposed technique on third image

Fig-4.4 (a, b): Fourth original and flipped image

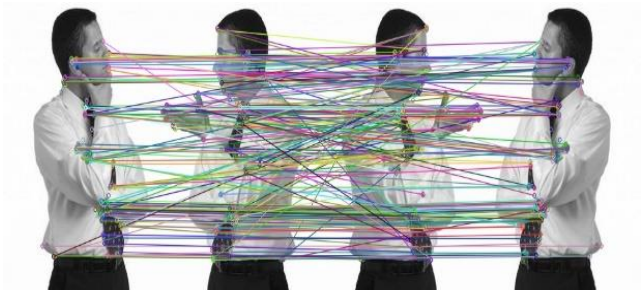

Fig-4.4 (c): Feature matching results with standard technique on fourth image

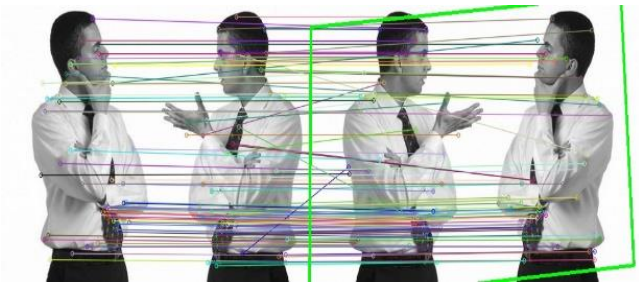

Fig-4.4 (d): Feature matching results with proposed technique on fourth image

Table – I: Number of features extracted from standard and proposed techniques

Image No	Standard	Proposed
4.1	3347	240
4.2	705	265
4.3	1029	232
4.4	662	249

Table – II: Time taken by standard and proposed techniques

Image No	Standard	Proposed
4.1	1.556409	1.248370
4.2	1.285524	1.240879
4.3	1.347381	1.259006
4.4	1.316856	1.312188

Table – III: Characteristics of labeled training and test set

Database	Classes	Total Images
1	1	200
2	2	400

Table – IV: Result obtained on the test set by standard feature matching technique

Database	Precision	Recall	F1 Score
1	0.861	0.903	0.883
2	0.902	0.941	0.923

Table – V: Result obtained on the test set by proposed feature matching technique

Database	Precision	Recall	F1 Score
1	0.991	0.992	0.992
2	0.972	0.983	0.974

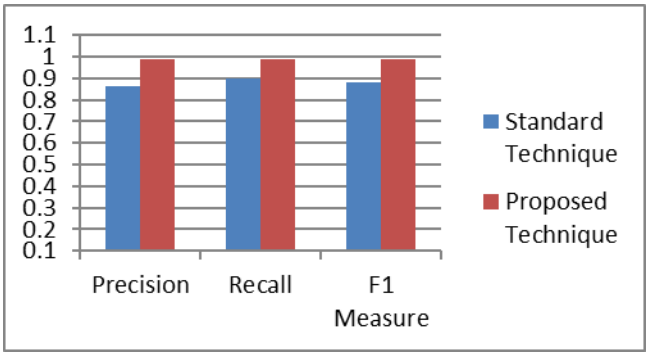

Fig-4.5: Graph for database 1

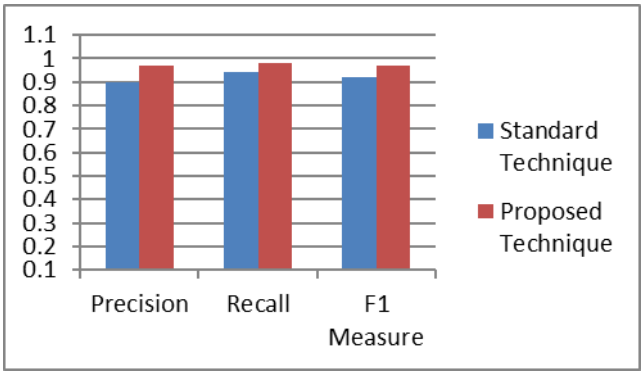

Fig-4.6: Graph for database 2

5. CONCLUSIONS

From the outcomes of the proposed research, it is revealed that the proposed technique of feature matching performed better than conventional Scale Invariant Feature Transform technique. The values of objective parameters like precision, recall and F1-score for both the datasets is always better for the proposed method. Also, number of features which are important are quite less in comparison to old techniques. The proposed system also took minimum time for computation of the results in comparison to standard algorithm for feature matching.

In the future work proposed algorithm can be compared with the other known feature matching algorithms like SURF, LEACH and others. Further the proposed technique can be modified to get more fine results and results can also be evaluated by different others objective parameters like entropy, correlation and many more.

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BIOGRAPHIES

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