Forensic Similarity for Digital Images Using Deep Learning

Ranjitha H S , Dr. Kiran V

Department of Electronics and Communication
RV College of Engineering
Bangalore, India -560059

ABSTRACT: Forensic similarity, which determines whether two image patches contain the same forensic trace or different forensic traces by using ORB algorithm [Oriented Fast and Rotated Brief] comparing with threshold value. One benefit of this approach is that prior knowledge, example training samples. This system maps pairs of image patches to a score indicating whether they contain the same or different forensic traces.

Keywords—ORB algorithm, Deep learning, Similarity, Feature extraction, Threshold value.

I. INTRODUCTION

A digital image is a representation of a real image as a set of numbers that can be stored and handled by a digital computer

Figure [1]: Digital images

Digital image forensics is a method to investigate if the image is tampered or not.

Trustworthy multimedia content is important to a number of institutions in today's society. Including news outlets, courts of law, police investigations, intelligence agencies, and social media websites. These forensic approaches operate by detecting the visually imperceptible traces, or "fingerprints," that are intrinsically introduced by a particular processing operation.

ORB is a fusion of FAST keypoint detector and BRIEF descriptor with some added features to improve the performance. FAST is Features from Accelerated Segment Test used to detect features from the provided image. It also uses a pyramid to produce multiscale-features. Now it doesn't compute the orientation and descriptors for the features, so this is where BRIEF comes in the role.

ORB uses BRIEF descriptors but as the BRIEF performs poorly with rotation. So what ORB does is to rotate the BRIEF according to the orientation of keypoints. Using the orientation of the patch, its rotation matrix is found and rotates the BRIEF to get the rotated version. ORB is an efficient alternative to SIFT or SURF algorithms used for feature extraction.

OpenCV is a massive open-source library for various fields like computer vision, machine learning, image processing and plays a critical function in real-time operations, which are fundamental in today's systems. It is deployed for the detection of items, faces, Diseases, lesions, Number plates, and even handwriting in various images and videos. With help of OpenCV in Deep Learning, we deploy vector space and execute mathematical operations on these features to identify visual patterns and their various features.

II. EXPERIMENTAL PROCEDURE

This work concentrates on the similarity of digital images using
ORB algorithm.

System Architecture

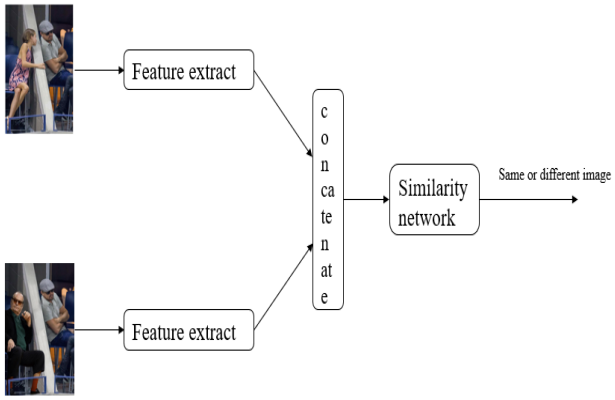


Figure [2]: System Architecture of proposed system

In System Architecture, we are comparing two image patches by using ORB algorithm and openCV.

In Figure [2], feature extraction and similarity checks using ORB algorithm and similarity depend on the similarity value.

USE CASE DIAGRAM

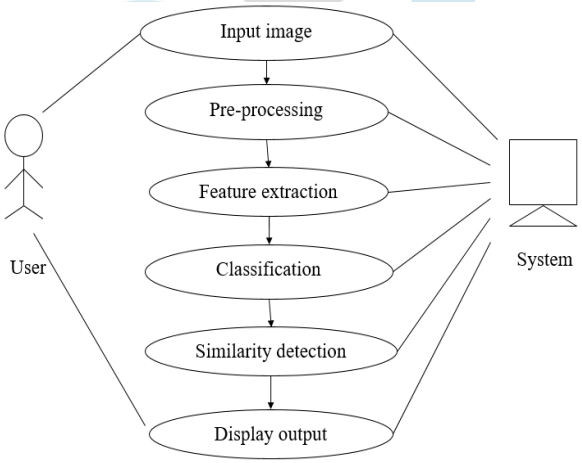


Figure [3]: Use case diagram

Figure [3] explains the use case of the ORB algorithm in which the user will be providing the two image patches and the pre-processing will takes place using Oriented fast and rotated brief is a local feature extractor and detector.

DATA FLOW DIAGRAM

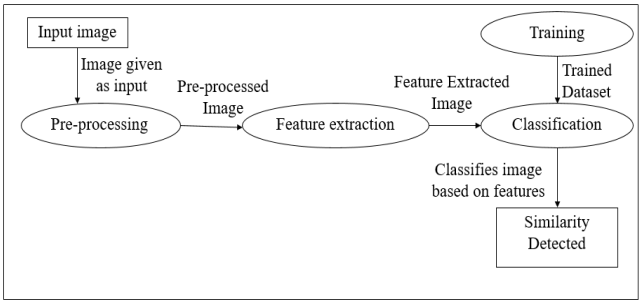


Figure [4]: Data flow diagram

Figure [4] explains the data flow of the experimental procedure used for the ORB algorithm and also this experiment uses openCV procedures for the image patches to define the similarity in digital images.In this experiment, here concentration is mainly on the key point in the ORB. Key Point is a region of an image which is particularly distinct and identifies a unique feature and this Key Point region is used to identify the object and clarification also based on this Key Point.In this experiment, ORB is a fusion of fast key point detector and brief descriptor with many modifications to enhance the performance. So by using this ORB algorithm here in this experiment as shown in the Figure [4] the images are being trained by supervised deep learning and images will be labeled so it is easy to classify and results will be displayed based on the threshold of digital similarities.

III. REULTS & DISCUSSION

The results from the experiment performed are as follows in this part. Classification of the digital image similarity is determined using the ORB algorithm and openCV.Case [1]: If threshold value is near to 100%, then both the digital images are similar


Image 1 Image 2

In Case [1], Image 1 and Image 2 are similar thus the threshold value which will be obtained by ORB algorithm similarity is near to 100%

Case [2]: If threshold value is near to 50%, then both the digital images orientation might be different or image position will be different


Image 1 Image 3

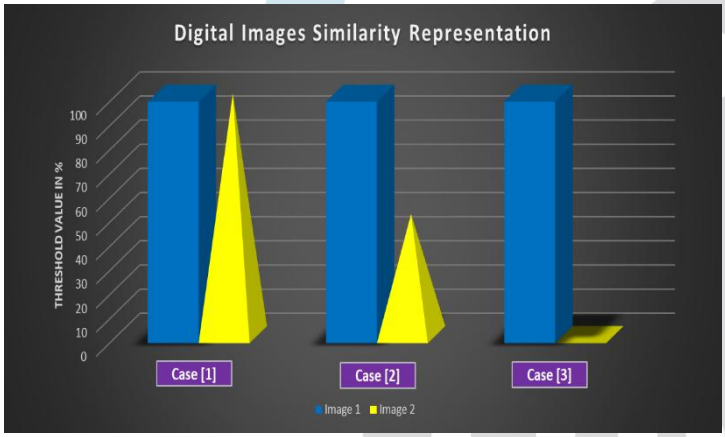
In Case [2], Image 1 and Image 3 are not in the similar orientation due to the image 3 180deg rotated thus the threshold value which will be obtained by ORB algorithm similarity is near to 50%.

Case [3]: If the threshold value is near to 0%, then both the digital images are dis-similar


Image 1


Image 4

In Case [3], Image 1 and Image 4 are not similar thus the threshold value which will be obtained by ORB algorithm similarity is near to 0%.
In all these example experiments Image 1, 2, 3 is labeled as “Monkey” and Image 4 as “Dog”
Digital Images Similarity Representation in graphical overview as follows:



IV. CONCLUSION

The proposed project has a new digital image forensics technique, called forensic similarity, which determines whether two image patches contain the same or different forensic traces. To do this, two parts deep-learning system composed of a Oriented Fast and Rotated Brief algorithm based feature extractor and a OpenCV platform, which maps pairs of image patches also provides threshold value which intern determines the two digital images are same or different forensic traces. The experimentally evaluated performance of this approach on forensic scenarios, which showed that our proposed system was accurate based on the output value which is threshold.

REFERENCES

[1] M. C. Stamm, M. Wu, and K. Liu, “Information forensics: An overview of the first decade,” Access, IEEE, vol. 1, pp. 167–200, 2013.
[2] J. Chen, X. Kang, Y. Liu, and Z. J. Wang, “Median filtering forensics based on convolutional neural networks,” IEEE Signal Processing Letters, vol. 22, no. 11, pp. 1849–1853, 2015.
[3] B. Bayar and M. C. Stamm, “On the robustness of constrained convolutional neural networks to jpeg post-compression for image resampling detection,” in ICASSP, 2017 IEEE. IEEE, 2017, pp. 2152–2156.
[4] J. Bunk, J. H. Bappy, T. M. Mohammed, L. Nataraj, A. Flenner, B. Manjunath, S. Chandrasekaran, A. K. Roy-Chowdhury, and L. Peterson, “Detection and localization of image forgeries using resampling features and deep learning,” in Computer Vision and Pattern Recognition Workshops (CVPRW). IEEE, 2017, pp. 1881–1889.
[5] X. Zhu, Y. Qian, X. Zhao, B. Sun, and Y. Sun, “A deep learning approach to patch-based image inpainting forensics,” Signal Processing: Image Communication, 2018.
[6] Z. Chen, J. Zhu and J. Zhang , "The Forensicability of Operation Detection in Image Operation Chain," in IEEE Access, vol. 10, pp. 68557-68569, 2022.

[7] S. Walia, K. Kumar, M. Kumar and X.Z. Gao , "Fusion of Handcrafted and Deep Features for Forgery Detection in Digital Images", in *IEEE Access*, vol. 9, pp. 99742-99755, 2021.
[8] A. Kumar, G. Singh, A. Kansal and K. Singh, "Digital Image Forensic Approach to Counter the JPEG Anti-Forensic Attacks," in IEEE Access, vol. 9, pp. 4364-4375, 2021.
[9] O. Mayer and M. C. Stamm , "Forensic Similarity for Digital Images," in IEEE Transactions on Information Forensics and Security, vol. 15, pp. 1331-1346, 2020.
[10] G. Boato, D. -T. Dang-Nguyen and F. G. B. De Natale , "Morphological Filter Detector for Image Forensics Applications," in IEEE Access, vol. 8, pp. 13549-13560, 2020.
[11] L. Verdoliva , "Media Forensics and DeepFakes: An Overview," in IEEE Journal of Selected Topics in Signal Processing, vol. 14, no. 5, pp. 910-932, 2020.