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A Review on Classification and Comparison of Automatic Logo Based Document Image Retrieval Methods and other Applications

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Abstract

In this paper we provided an effective categorization of vast number of methods, techniques, transforms, algorithms, approaches and schemes available for the purpose of logo detection in various image processing applications like Authenticity of documents, Security for information, Traffic Surveillance (Intelligent Transportation System), Pattern recognition, Marketing, Medical Imaging, Satellite imaging, Drones and Ocean Imaging. We have highlighted the mostly used Scale Invariant Feature Transform (SIFT) and Speed Up Robust Feature (SURF) Algorithms along with the comparison between these two (SIFT and SURF) algorithms.

Keywords: ART,AMI, RANSAC, RDHOG, RTMI, LPT FMT, GLOH.

INTRODUCTION

The logo is an Authentication, Trade mark, Discriminator and Uniqueness for the Institutions, Companies, Organizations and some agency respectively. Just by observing the logo in a document it can be decided that is belongs to a particular Institution or Company or Organization or some Agency. For example if we have an Apple image on any electronic gadget or document immediately we can say that gadget or document belongs to the Apple Company. In the present rapidly increasing data environment through Internet, The necessity for this data maintenance, accessing, security and transparency should be continuously increased. For this purpose the image processing techniques like Automatic logo or signature or image (which provides the identity, authenticity, trademark, easy discrimination and consists of large amount of information in minimum space-one image consists of 10000 words) based document retrieval methods plays a vital role. Using these automatic logo based document image retrieval methods the data management will become easy specifically in the indexing of website contents and their maintenance. Till now, very vast number of methods, techniques, transforms and algorithms were proposed for the automatic Logo based Document Image Retrieval and other applications.

In this paper, we covered almost all the methods, classified them into different categories based on their applications. And finally we have done the comparison of the mostly used and advanced methods with their basic versions. Remaining flow order of this paper was organized into as follows. In the next section global classification of logos was covered. Section III gives classification of all the methods, techniques, transforms and algorithms based on various applications. Section IV provides the comparison between most popularly used and advanced techniques. Section V Summarizes the related work done so far. The conclusion was given section VI and last section VII ends with acknowledgement.

GLOBAL CLASSIFICATION OF LOGOS

A logo is a two dimensional complex image with different shapes and may consist of textual, symbolic, graphical, colour and combination of all with some other features with various characteristic appearances also. Therefore the identification and extraction of this logos in documents is a very challenging task in almost all types of digital image applications. The images can be classified globally into three categories as Logos with only text, Logos with only symbols and Logos with text and Symbols based on the very fundamental characteristics: Text and symbols. More over the images can also be classified

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based on based the other features like shape, colour and graphical properties also as shown in figure1.

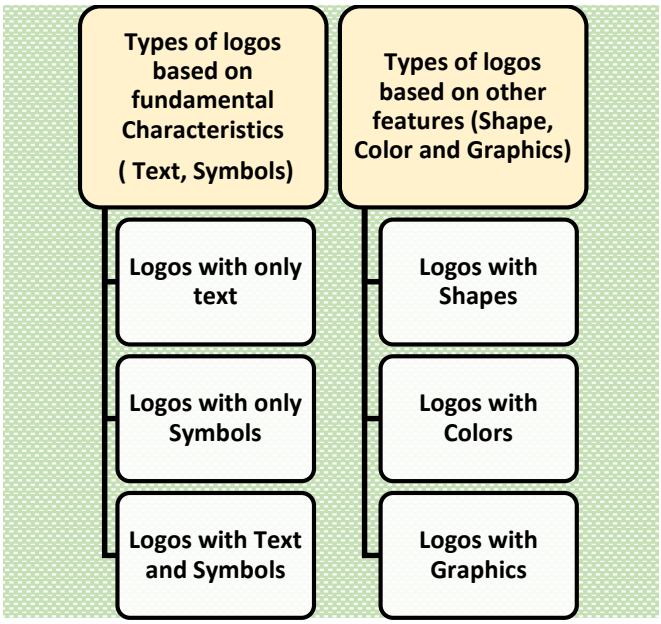

Figure 1: Classification of Logos

Classification of all Methods

The various methods, techniques, transforms, algorithms, Approaches and schemes covered in almost all the previous papers can be broadly classified into Three groups (i) For Document Retrieval Purpose, (ii) For Intelligent Transportation Systems and (iii) For Motional Video applications as shown in the figure 2.

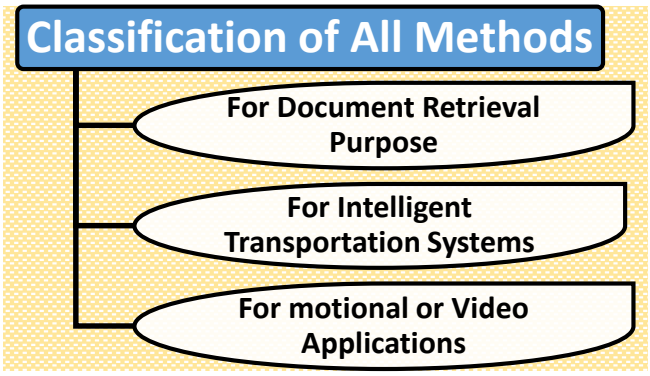

Figure 2: Classification of all Methods

(i). For Document Retrieval Purpose:

- Segmentation techniques
- Wavelets(DWT,DCT,FFT)
- Scale Invariant Feature Transform(SIFT)
- Speed Up Robust Feature(SURF) Algorithm
- Binary Robust Independent Elementary Features(BRIEF)
- Oriented FAST and Rotated BRIEF(ORB)
- Local Binary Patterns(LBR)
- Synthetic Context Logo (SCL) Image generation.
- State Vector Machine (SVM)
- K-Nearest Neighbours(KNN)
- Histogram Oriented Technique(HoG)
- Context Dependent Similarity(CDS)
- RANdom SAmple Consensus(RANSAC)

(ii) For Intelligent Transportation Systems (ITS):

- Logistic Regression(LR)
- Histogram of Oriented Gradients(HOG)
- Pyramid of Histograms of Orientation Gradients (PHOG)
- Relative Discriminative extension to HoG (RDHOG)
- SIFT&SURF Algorithms
- Regions with Convolutional Neural Networks(R-CNN)
- Support Vector Machine (SVM)
- Latent Support Vector Machine(LSVM)
- Conjugate Gradient Descent(CGD)
- Multi-scale Block Local Ternary Patterns(MB-LTP)
- Iterated Conditional Mode(ICM) Algorithm
- Markov Random Field(MRF) frame work
- Gaussian Mixed Model(GMM)
- Kernel Density Estimation(KDE)
- Principal Component Analysis-SIFT(PCA-SIFT)

(iii) For Motional and Video Applications:

- SIFT&SURF Algorithms
- Support Vector Machine (SVM)
- Method of Moments
- Angular Radial Transform(ART)
- Affine Moment Invariant(AMI)
- Zernike Moments(ZM)
- Tchebichef Moments (TM)
- Radial Tchebichef Moments (RTM)
- Radial Tchebichef Moment Invariants (RTMI)
- Krawtchouk Moment(KM)
- Krawtchouk Moment Invariants(KMI)

- Legendre Moment(LM)
- Zernike Moment(ZM)
- Pseudo-Zernike Moment(PZM)
- Voting based Decision Scheme
- Hough Transform
- Color Edge Co-occurrence Histogram(CECH)
- Spatial Connected Component Descriptor(SCCD)
- Auto associator based Artificial Neural Networks(AANN)
- Outer Contour Strings(OCS)
- Log-Polar Transform(LPT)
- Fourier Mellin Transform(FMT)
- Gradient Location-Oriented Histogram(GLOH)

Comparison of Advanced Methods

Even though there are vast number of methods, techniques, transforms, algorithms, approaches and schemes covered in the previous papers, the mostly used are SIFT, SURF and Moment Invariant methods only with some enhanced characteristics for almost all types of applications due to their high performance nature. The Scale Invariant Feature Algorithm (SIFT) was first introduced by David G.Lowe in the year 2004 and became very popular because of it high performance index with respect to scale, rotation, intensity and illumination properties of the logo or image of both static and dynamic (moving) forms. The SIFT consists of four major steps as (i) Scale Space Peak or Extreme Points Detection, (ii) Localization of Key Points, (iii) Orientation Assignment and (iv) Generation of Descriptor as shown in the figure 3.

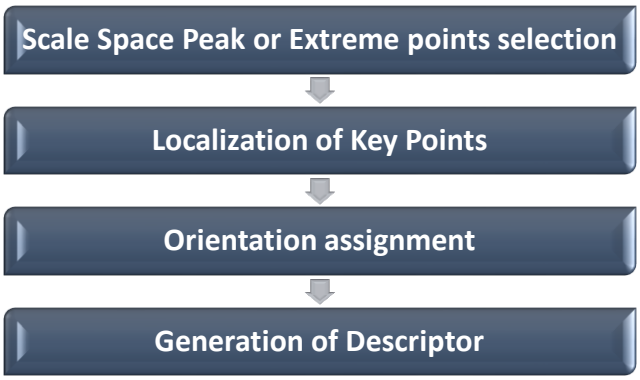

Figure 3: SIFT Algorithm

The SUFT consists of six major steps as (i) Fast Hessian Detection, (ii) Construction of Scale Space, (iii) Localization of Accurate Interested Points, (iv) Interested Point Descriptor, (v) Orientation Assignment and (vi) Descriptor Components as shown in the figure 4.

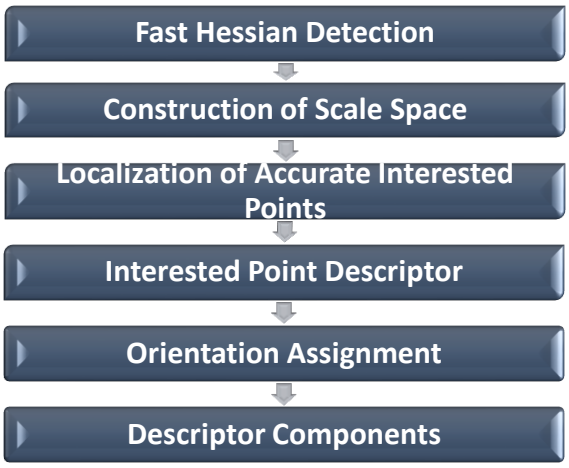

Figure 4: SURF Algorithm

SURF is enhanced version of SIFT and performs faster than SIFT without any reduction in the quality of the interested points. Binary Robust Independent Elementary Features (BRIEF) is an alternative of SIFT with somewhat less complexity. Oriented fast and Rotated BRIEF (ORB) is also another alternative for SIFT and SURF. In all these methods the difference is how they will identify the key points in the logo or image which are invariant to scale, rotation, intensity and illuminations using different techniques like K-Nearest Neighbours (KNN), State Vector Machine (SVM), Wavelet Transforms, Filters and algorithms depending on the particular application. For applications like Intelligent Transportation Systems (Vehicles Identification, Number plates recognition, Traffic Surveillance, Road Surveillance etc.), Television Videos, Sport Videos, Animations, Drones and other movement related areas or applications the above methods can be used in association different moment Invariant properties detection techniques which include Radial Tchebichef Moment Invariants (RTMI), Radial Tchebichef Moments (RTM), Tchebichef Moment (TM), Krawtchouk moments (KM), Krawtchouk moment Invariants (KMI), Legendre Moment (LM), Pseudo-Zernike Moments(PZM), Zernike Moments (ZM) and Affine Moment Invariants (AMI).

RELATED WORK

In [1] Ruilong Chen, Olga Isupova and Hao Zhu applied Cauchy Prior Logistic Regression (CPLR) method combined with Conjugate Gradient Descent (CGD) for the Online Vehicle Logo Recognition and got an accuracy of 98.8% for both small and large data sets.

In [2] Kazunori Aoki and Tsu-Shi Proposed the method Maximally Stable External Regions (MSER) along with

gradient histogram and System Vector Machine (SVM) for automatic extraction and recognition of shoe logos effectively.

In [3] Afsoon Asghari Shirazi, Alireza Dehghani, Hasan Farsi and Mehran Yazdi used Local Binary Pattern features for the recognition of Persian Logos with their experimental result accuracy of 98%.

In [4] Hang Su, Xiatian Zhu and Shaogang Gong used Synthetic Context Logo (SCL) image generation method for deep learning of logo detection models.

In [5] Ma'moun Al-Smadi, Khairi Abdulrahim and Rosalina Abdul Salam provided a detailed review on computer vision techniques used for Traffic Surveillance and monitoring systems.

In [6] Yizhang Xia, Jing Feng and Bailing Zhang used Multi-task Learning with CNN (ML-CNN) for vehicle logo recognition and prediction of attributes and achieved overall accuracy of 98.14%.

In [7] B.V. Dhandra, Sridevi Soma and Gururaj Mukarambi worked on Identification of Institutional logos using DWT and FFT features with SVM Classifiers to identify the logos in large number of data sets.

In [8] Ms.Sushma H.Bailmare and Prof.A.B.Gadicha done a review on vehicle number plate recognition using Segmentation method.

In [9] N.Vinay Kumar, Pratheek, V.Vijay Kantha, K.N. Govindaraju and D.S.Guru used KNN Classifier for the classification of logos into pre-defined classes.

In [10] Sina Hassanzadeh and Hossein Pourghassem proposed a novel fast method using morphological features and decision tree classifier for logo detection.

In [11] Cong Chen, Xiaobo Lu, Shengqin Jiang and Jiaji Song used two feature extraction methods Pyramid of Histograms of Orientation Gradients (PHOG) and Multi-scale Block Local Ternary Patterns (MB-LTP) for the effective recognition of road surveillance images.

SIFT and SURF algorithms were used in [12] to [20].

In [12] Sheena S and Sheena Mathew compared SIFT and SURF algorithms for the iris recognition along with KNN algorithm for classification.

In [13] Qin Gu, Jianyu Yang, Guolong Cui, Lingjiang Kong, Huakun Zheng and Reinhard Klette used a directional SIFT flow parsing method for multi scale vehicle logo recognition and obtained the evaluated performance of about 97.4%.

In [14] He Jingmeng, Xie Yuxiang, Luan Xiado, Niu Xiao and Zhang Xin used SURF and Bag-of-Words method for TV Logo detection and recognition with the support of KNN and SVMs.

In [15] Mrs. Poonam Kondekar and Prof. Priti Shende recognized the logos using Context dependent criteria by using Context Dependent Similarity (CDS-SIFT) and CDS-RANSAC (RANdom Sample Consensus) algorithms and finally stated that the accuracy of RANSAC method is more than CDS-SIFT.

In [16] Ebrahim Karami, Siva Prasad and Mohamed Shehata compared the performances of SIFT, SURF, BRIEF and ORB methods for distorted images based on the parameters: number of key points, matching rate and execution time required.

In [17] Chinmoy Biswas and Joydeep Mukherjee used SIFT, SURF and HOG descriptors for the logo recognition.

In [18] P M Panchal, S R Panchal and S K Shah compared SIFT and SURF algorithms

In [19] Nagham Hamid, Abid Yahya, R.Badlisha Ahmad and Osamah M. Al-Qershi used and compared SIFT and SURFs for characteristic region based image steganography with 1-level DWT and 2-level DWTs for Lena, Bridge and Pepper images.

In [20] Prof. Mrunalinee Patole and Meera Sambhaji Sawalkar used CDS-SIFT method in their improved approach for logo detection and recognition.

In [21] Zili Zhang, Xuan Wang, Waqas Anwar and Zoe L.Jiang compared the performances of almost all types of moments for the logo recognition.

In [22] Wei Zhang Q.M.J Wu,Guanghui Wang and Xinge You proposed a night time traffic surveillance system for vehicle headlight detection, tracking and pairing using Laplacian of Gaussian (LoG) filter, Markov Random Field (MRF) frame work and Iterational Conditional Mode (ICM)Algorithm.

In [23] Omar Mahammed Wahdan, Khairuddin Omar and Mohammad Faidzul Nasrudin developed a system for logo recognition using Angular Radial Transform (ART) along with Eucledian Distance as a similarity measuring parameter.

In [24] Serge Belongie, Jitender Malik and Jan Puzicha presented a novel approach for measuring similarity between shapes for object recognition.

In [25] Souvik Ghosh and Ranjan Perekh proposed an automated system for rotation and scale invariant color recognition using first and second order Invariant moments and also with four color moments: mean, standard deviation, skewness and kurtosis for the recognition of color logo images.

CONCLUSION

In this paper we reviewed almost all types of methods, techniques, transforms, algorithms, approaches and schemes with an effective classification and comparison between the mostly used two methods: SIFT and SURF in more number of Image Processing applications. And we hope that this detailed review on all methods will definitely create a road map for further research in latest advancements like Animation, Web Indexing and Drones.

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