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Survey on Colour, Texture and Shape Features for Person Re-Identification

E. Poongothai* and A. Suruliandi

Department of Computer Science and Engineering, Manonmaniam Sundaranar University, Tirunelveli - 627012, Tamil Nadu, India; poongothai.rp@gmail.com, suruliandi@yahoo.com

Abstract

Background: Re-identification is the pattern recognition problem which helps to identify the person in surveillance network. Feature plays an important role in person re-identification. **Objective:** The main objective of this paper is to analyze the properties of few existing features for person re-identification. **Methods/Statistical Analysis:** The features for re-identification is categorized into three groups namely colour, texture and shape. In this work various methods for extracting these features and their challenges are considered for survey and their properties, advantages disadvantages and applications are presented as a summary. **Findings:** From the analysis we found that colour and texture features outperform the shape feature. **Application/Improvements:** This analysis helps to understand the characteristics of the existing features and develop the new robust feature for improving the matching rate for person re-identification.

Keywords: Colour, Re-identification, Shape Feature, Texture

1. Introduction

Extraction of meaningful features from an image is necessary for all computer vision tasks. In particular person re-identification performs better depends on the selection of features from the person's visual aspect. The objective of re-identification system is to accurately recognize a person based on the identity from the cameras in a distributed network and take some actions on the output of the recognition process. The recognition process of any object is depends on the nature of available feature in the object. Every feature has its own properties to represent the information available from the image. Even though all the features perform better, still its fail to solve some issues occlusion and pose variation. Features are categorized into multiple groups such as texture, colour and shape based on the nature of the image. For some objects it is enough to extract single feature for better accuracy. But for some objects like person detection it is necessary to consider many features from the appearance of the same image. Based on the purpose of application, selection of feature and number of feature is varied. But still it is challenging and need to develop the new efficient feature to improve the identification accuracy by solving all the issues. For this purpose the survey is made in this paper.

1.1 Motivation and Justification of the Work

While many numbers of features has proposed so far for person re-identification, still there is a need to develop the efficient feature with the adaptability to challenging environments, noise affects, and computational needs. As of us now, previous literatures have considered only on appearance features to identify the person across disjoint cameras views. To overcome this issue, the author[1] proposed a compensate illumination variations using brightness transfer functions. But this approach is limited to compensate for variation of illumination in different regions. A temporal recursive method[2] is proposed to analyze and determine the trajectories of pedestrians that are captured by multi-camera in surveillance network. The trajectory gives the information of pedestrian's movements across the cameras.Every researcher proposed their own methods by varying the learning models and concludes that one method is better than

*Author for correspondence

the other one, hence the selection of an appropriate feature cause much variation in accuracy of identification.A discriminative appearance feature needs to be extracted which is robust to illumination problem and disturbance from other facts. Moreover, a discriminative geometrical feature which can adjust to the visual angle change expects more explorations. Motivated by this, study of various feature is done for re-identification. This study is initiated the researches to select the appropriate feature for person re-identification as well as other application. This work categorized into three classes includes color, texture and shape features according to the re-identification procedure. Each method has its own merits and demerits. Justified by this, the surveys on features are taken. It is used to find optimal solution and effectiveness of features for future enhancement.

1.2 Organization of the Work

The remaining section of the paper is formed as following sections. The surveys on texture shape and colour features from existing research are discussed in section 2. The characteristics of all the features are summarized briefly in Section 3. Finally, the section 4 is summarizing the conclusion and future scope.

2. Challenges in Re-Identification

There are varieties of challenges that arise during the process of re-identification. The primary challenges are intra class variation (i.e., different persons look same) and inter class variation (i.e., the same person looks different) when analysed from different views of camera. Generally, the variations between the pair of camera views are complex for the accurate matching. Minimum sample size is another challenging issue for learning, because re-identification needs to match single target image with the individual gallery images. Pose difference and viewpoint changes are the main challenges which affects the identification accuracy with major difference. Both of these facts are varied while the person is moving on floor and the changes occur in camera viewpoint setting. This makes the consistent variations in the person appearance. This leads insufficient data for learning a efficient method for intra-class variation of each person's in the view of classification. Long-term re-identification is the main problem which affects the identification accuracy more. The time and space detachment among different cameramay vary with many changes in clothes or the object carried. Another issue is occlusion. In many times the part divisions of a person fails to visible properly to the camera due to the problems of occlusions induced by other objects present in the camera view, other peoples overlapping view, and clothing. This causes the segmentation algorithm to fail in the process of classifying one person from the remaining available scene; consequently, image descriptors may be corrupted by the source. In different periods of time, the illumination conditions will change due to environmental conditions and affects the light source to the camea. Changes in colour response create the significant change in accuracy. Some cameras have a different colour settings that affects the colour properties from person appearance as well. Some database images with challenges are given in Figure 1.

Based on the nature of application features are affected while extracting from the image of the person. In order to tackle these challenges, many person re-identification algorithms concentrate on combining different types of features based on the purpose of applications. The main objective of this paper is to make a survey on recently used colour, texture and shape features and their characteristics for person re-identification. The various applications of all features also discussed to understand the performance of given features in various application. The common process for re-identification is given in Figure 2.

Figure 1. Sample images with different issues.

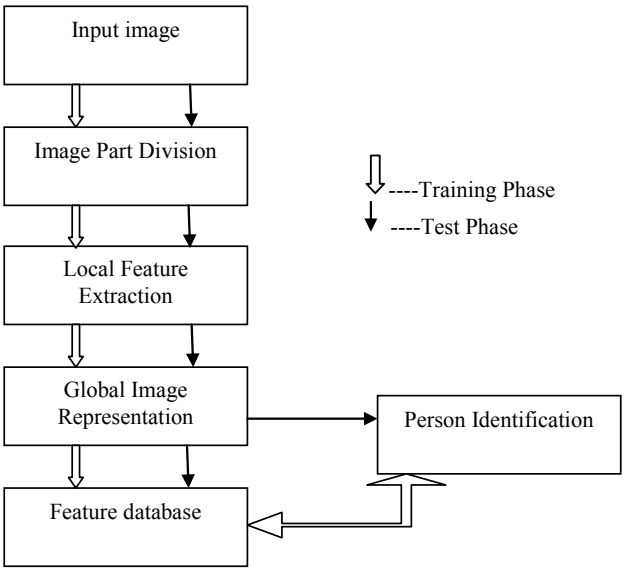

Figure 2. Process flow for person re-identification system.

3. Analysis on Features

3.1 Analysis of Texture and Shape Feature Representations of Re-Identification

Texture features used for re-identification are categorized into two major parts. One is representation of sparse and other one is dense representations. By using this interest point detector the corners and blob structures on a image are identified insparse feature representations. SIFT[3] and SURF are the texture, shape and sparse parts-based representation[4] which are used popularly. These representations of features are createdfrom the patch of each point and the pixels around the point of the image. A brief evaluation of sparse feature representations is given.The most commonly used texture and shape feature representations such as Haar-like features, HOG[5], EHOG[6–8] Feature Context[9] and LBP[10–12] plays a important role over the past years for the person identification. The extension of SIFT also has proposed for the both representation of dense and sparse[13] namely Dense SIFT. Gabor and Schmid[14,15] filter improves the performance of re-identification accuracy well than all other features. It is rich to solve the problems of the variations in illumination and contrast. Many learning methods for person re-identification discussed in the problem of local distance comparison in[16,17] using the Local Fisher Discriminant Analysis[18]. Mahalanobis[19] metric has been proposedfor the person feature space matching and it reduce the computational costs. A texture based metric learning approach is proposed with dissimilarity measureand applied successfully in person re-identification. Re-identification method mainly focusing the robust shape and appearance features for some specific scenarios. However, there is a limitation; it only applied height as shape feature without considering the limitation of height of person beings close resemblance of many human in a same environment. Re-identification method proposed 3D shape[20] model to evaluates the color discrimination and edges from the person's background.

3.2 Analysis of Colour Features for Re-Identification

Person re-identification using color information takenfrom the cloth of person become animportant research task in automatic video surveillance. RGB, HSV,YCbcr, YIQ color spaces[21,22] were analysed for Re-identification. The analysis shows that, color of the person consist of complementary information of their appearance. Accuracy of identification is impacted by the selected colour space. The effective and efficient combination of spectral components[23] over various color spaces are encountered to enhance the performance of identification accuracy. A new color space[24] is introduced, where the combination of colour channels R, Cb and Cr are taken from RGB and YCbCr and then it is combined. In[25] proposed three new color representations. A fusion of color and frequency based feature is proposed for color identification, which fuses the constituents of RGB and YIQ colour space of the image and the chromatic components. The authors in[25] proposed the identification method which integrates the local and global representations of features computed from the multiple color space. From the comparison of reported results[26], it declared that color based identification method risen the performance of Re-Id by means of fusing three color space similarities. The authors proposed multiscale color based LBP operators with the combination of opponent and opponent LBP operators. Although the existing research in color feature based methods have successfully addressed the problems of color information, in order to gain the improvement in performance, it needs global colour representation with the dimensionality reduction. The main techniques are DCT and PCA[27]. This work is the combination of color and shape information to resolve the re-identification problem of pose and illumination variation in the current research method. The database images with all the issues are given in a survey[28].

4. Quantative Analysis of Colour, Texture and Shape Features

Table 1 and Table 2 gives the summary of common colour, texture and shape features used in re-identification problem with its merits, de-merits and applications. In this section, their characteristics are summarized based on their performance in all re-identification methods. The feature extraction is done as training phase and test phase. The features are extracted from the parts of the

Table 2. Quantitative analysis of colour features

Sl.no.	Colour features	Properties	Advantage	Disadvantage	Application
1	RGB	It is based on the colour channels of Red, Green and Blue variation. Default colour model for all the objects	No transformations required to display information on the screen, for this reason it considered as the base color space for various applications. Used in video display because of additive property.	It is not ideal for some high quality applications. Components of RGB color space have lighting and color properties together. Human vision is different to color and lighting. Non useful for objects specification and recognition of colors. Difficult to determine specific color in RGB model.	Computer graphics Object detection Video analysis Person detection
2	Lab	L-Lightness of the colour a-Position between magenta and green b-Position between yellow and blue	Lab colour is designed to approximate the human vision It aspires to perceptual uniformity and its L component closely matches to human vision.	The gamut is larger than most output devices can reproduce.	
3	YCbcr	Y-Variation of luminance Cb- Variation of blue Cr- Variation of red	Luminance independent The use of Y means that directly tothe eye/brain is more sensitive to changes in Y than in CbCr. Reduced dimension because of compression	The displayed color depends on the primaries RGB that displayed the signal. Information compression required for the for displaying the image as video.	
4	HSV	Hue is a measurement of the brightness of a colour of the image Saturation- percentage of that colour value Value- variation in the perception of a colour or colour spaces brightness	Robustness to lighting changes and removing shadows. It is closer to human vision. Each of its attributes corresponds directly to the basic color concepts, which makes it conceptually simple	Saturation attribute varies corresponds to tinting, so desaturated colors have increasing total intensity. Changing any dimension results in non-uniform changes to all three perceptual dimensions, and distorts all of the color relationships in the image.	Robot vision Object recognition Content-based image retrieval; Medical imageanalysis.

Table 1. Quantitative analysis of texture and shape features

Sl.no	Texture and Shape	Properties	Advantage	Disadvantage	Application
1	LBP (Local Binary Pattern)	Two dimensional surface textures can be described by local spatial patterns and gray scale contrast.	Its usage in interest region is tolerance against illumination changes Computational simplicity Very fast to compute Do not require many parameters to be set	The recognition speed is slow on large-scale database; Under some certain circumstance it miss the local structure Sensitive to noise Large number of dimensions is required.	Computer vision Face recognition Background subtraction Biometrics Gait recognition Facial age classification
2	SIFT (Scale Invariant Feature Representation)	Gradient orientation and magnitude-based feature is extracted	Robust to change of intensity Illumination, scaling and rotation. Easy to localize the pixels	Slight variations in luminance will produce for key points similar to those produced by large variations	Object recognition, Image stitching, 3D modelling Video tracking
3	SURF (Speeded Up Robust Feature)	It a detector and a descriptor for points of interest in images where the image is transformed into coordinate, using the multi-resolution pyramid technique.	Extraction of interest points is faster Best for scale and Illumination variation Easy to localize and find correspondence between frames Robust to large, unpredictable inter frame motion	View dependent Extraction of sufficient number of key frames is difficult in 3D environment Time consuming Appearance of key point can change over frames	Object Recognition and Tracking. Robot Localization and Mapping Image Registration. Image Retrieval
4	GLOH (Gradient Location and Orientation Histogram)	Extension of the SIFT descriptor Histogram based gradient orientation is used	Best on the structured scene Robust to illumination changes	It perform worse for computed on scale invariant regions The edges disappear in the case of a strong blur	Object Recognition and Tracking. Image Registration. Image Retrieval
5	Gabor Filters	Frequency and orientation representations based filter. Similar to those of the human visual system.	Robustness against varying brightness Invariant to Contrast of images, Illumination variation and rotation	When Gabor filters are applied to each pixel of the image, the dimension of the filtered vector can be very large. Expensive computation storage cost.	Face recognition Traffic measurement and management, Traffic surveillance,
6	Schmid	Similar to those of the human visual system.	Reduction in computational complexity.	Only keep track of the effect of the bias on the true error distribution.	Traffic surveillance, Pedestrian detection
7	HOG (Histogram of Oriented Gradient)	The local object appearance and shape of an image can be described Based on intensity gradients or edge directions. The HOG descriptor is thus particularly suited for human detection in images.	Invariance to local geometric and photometric transformations Better able to deal with moving body parts and handle occlusions, overlaps	Translations or rotations make little difference if they are much smaller that the local spatial or orientation bin size.	Person detection Object Detection Pedestrian detection

person image. From the Table 1 and Table 2, it is observed that all the given colour and texture features performs better for identification based on their properties and the nature of application. Another observation is that, there is no new texture or colour feature proposed recently for re-identification to overcome all the issues.

5. Conclusion

Most of the researcher focuses on feature representation and re-identification metric learning. In this survey the, review on colour, texture and shape features for re-identification are given. This work summarized the advantages and disadvantages of all the features and their other applications. This survey will help to enhance the identification accuracy in person in Re-Identification process by developing new robust feature or re-identification procedure in future. In future the work will be extended to develop a new robust feature to solve all the issues in re-identification problem.

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