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AN EFFICIENT GAIT RECOGNITION FOR KNOWN AND UNKNOWN COVARIATE CONDITIONS

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ABSTRACT
Gait is a unique non-invasive biometric form it we can make the use to recognize persons, even when they prove to be unhelpful. Computer aided gait recognition systems generally use image sequences without considering covariates like clothing and possessions of carrier bags whilst on the move. Similarly, in gait recognition, there may exist unknown covariate conditions that may affect the training and testing conditions for a given every individual. A common techniques for gait recognition and measurement need a degree of intervention leading to the introduction of unknown covariate conditions, and hence this significantly limits the practical use of the present gait recognition and analysis system. To overcome these key issues, we propose a method of gait analysis for both known and unknown covariate conditions. For this purpose, we propose two methods A) Convolutional Neural Network (CNN) based gait recognition for known covariate conditions. This method can handle known covariate conditions efficiently B) Discriminative features-based classification method for unknown covariate conditions. It will focus on identifying and selecting unique covariate invariant features from the gallery and probe sequences. Here we can use some analysis like Local Binary Patterns (LBP), Histogram of Oriented Gradients (HOG), and Hara lick texture features. Furthermore, we will use another analysis is the Fisher Linear Discriminant Analysis for dimensionally reduction and selecting the most discriminant features. Gait recognition under strict unknown covariate conditions are three types namely Random Forest, Support vector machine (SVM), and Multilayer Perceptron. We evaluated our results using CASIA and OUR-ISIR datasets for both clothing and speed variations. As a result, we report that on average we obtain an accuracy of 90.32% for the CASIA dataset with unknown covariates and similarly

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performed excellently on the ISIR dataset. Therefore, our proposed method out performs existing methods for gait recognition under known and unknown covariate conditions.

Introduction

Gait is a biometric trait that depicts and measures how people move. Over the decades, gait analysis has been successfully used in different domains including biometrics and posture analysis for health care applications. It has also been used in human psychology where gait analysis using point lights employed for recognition of emotional patterns the same idea was extended and ultimately resulted in the development of gait signatures through which the identification of individuals can be performed from this computer vision based approaches have also used motion analysis and human movement modelling for person identification. In the early days of gait recognition, the focus was to identify and classify the different movement patterns such as walking jogging and climbing. Gradually, the focus shifted towards human identification and has become an active area of research. As compared to other biometric traits such as finger print and iris, gait recognition can work without the cooperation of a person. Moreover, it can work without interfering with a persons activity. This makes gait more suitable for different real-time applications like surveillance and long distance security. Existing techniques employed for gait analysis are divided in to model-based and appearancebased. Model-based approaches use the parameters of the body and appearance-based approaches on the features extracted directly from image sequences of gait. The simplicity of appearance-based based methods and their robustness against noise make them more suitable for real world scenarios. Appearance-based methods rely on silhouettes extracted from a gait sequence silhouettes contain important information about the stance and shape of the human body. Gait representations used in appearance-based approaches include frequency-domain features, chrono-gait images, features extracted from silhouettes (Gait Energy Image(GEI)) , and Gabor GEI's. GEI is popular and creates a single gray scale image from the normalized binary frames over a complete gait cycle and is not susceptible two segmentation errors. It is reported that, in the absence of covariates , direct matching with GEI templates exhibits excellent results. However, in a real-world scenario , the absence of covariates is not always feasible, which makes gait recognition a challenging task. A covariate is a condition when a person appears with a carrying conditions i.e., bag or clothing condition like coat or .long coat, and the system is trained with only normal walk data. To handle this issue ,various techniques are used to capture discriminant information from GEI's. One such scheme is proposed in, which uses principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA) for feature extraction. A similar approach is adapted in were Discriminant Locally Linear Embedding (DLLE) based frame work is used for preserving the local structure. However, the main draw back of appearance-based approaches is that they are sensitive to covariate conditions. The success of gate as a biometric is largely affected due to covariate factors. Some of these factors are clothing, camera view point, carrying conditions, walking style, shoe wear, and walking surface. Some of the examples of clothing and carrying covariate conditions. Currently, most of the gait analysis applications use gait sequence under normal conditions in the training phase and must deal with gait sequences under variable covariate conditions in the testing phase. Owing to this ,the performance of these methods for gait recognition under covariate conditions remains unsatisfactory in real world conditions. The unsatisfactory performance is related to the changes in the underlying representation caused by these conditions.

It is evident from that major changes are seen in portions of the representation that belong to non-moving regions. This leads to the observation that dynamic information is more important as compared to static part of the representation when models are trained with covariate conditions and testing is performed as similar covariate conditions, it is known as unknown covariate conditions. GEI is a compact representation of a gait sequence representing it in a single image. It is considered a good candidate to extract gait features. Under real-world conditions, the covariate conditions are unknown for the gallery and probe set. However, the known covariate conditions are relatively easy to handle. From this line of research, we propose two methods for gait recognition- one for known covariate conditions and the second for unknown covariate conditions. The first method only takes GEI as input and CNN is used for gait recognition. The second method uses a unique set of features extracted from the ROIs extracted from GEI, which excludes clothing or carrying conditions. The feature set includes Local Binary Patterns (LBP), Histogram of Oriented Gradients (HOG), and Haralick texture features. Fisher Linear Discriminate Analysis is used for dimensionality reduction and selecting the most discriminate features. Three classifiers- Random Forest, SVM, and Multilayer Preceptor are used for gait recognition. The objective of this proposed work is to extract discriminative features for unknown covariate conditions. The two standard datasets CASIA and OURISIR are used to evaluate the performance of the proposed work. There are different and complex covariate conditions available in both these datasets, which include clothing and speed variations. The experiments include an extensive set of covariate possibilities for both clothing and speed variation to show the performance of the proposed work under difficult conditions. The results for both these datasets are good and outperforms existing published literature on covariate based gait recognition. The proposed work has the following contributions: _ A CNN based method to efficiently handle known covariate conditions using only simple GEI _ A discriminative feature learning-based method to handle unknown covariate conditions _ The extraction and selection of discriminative features from ROIs to identify and select unique covariate invariant features from the gallery and probe sequences.

LITERATURE SURVEY

A survey of behavioral biometric gait recognition:

In today digital society, vulnerability to person authentication is a serious issue in real time scenarios like (airport, hospital, metro stations, etc.). This issue has increased the growth of video surveillance security systems. In recent decades behavioral biometric trait gait has emerged as a potential surveillance monitoring system because of its inconspicuous and unperceivable nature. Even more human gait has a benefit that it can be tracked at a distance and under low resolution videos. Finally, it is difficult to impersonate gait features. In this article, we comprehensively investigate the past and current research development in vision-

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based (VB) gait recognition. We give a brief description of feature selection and classification techniques used in gait recognition. The article extensively investigates feature representation techniques, classified into model-based and model-free. The article also provides a detail description of databases that are available for research purposes classified into two categories: VB and sensor-based. We extensively examine factors that affect gait recognition, and current research was done to cope with these factors. Moreover, this article proposes future perspectives after investigating stateof-art literature that can be more helpful to experts and new comers in gait recognition. In last, we also give a brief description of the proposed workflow.

The relationship between 2D static features and 2D dynamic features used in gait recognition:

In most gait recognition techniques, both static and dynamic features are used to define a subject's gait signature. In this study, the existence of a relationship between static and dynamic features was investigated. The correlation coefficient was used to analyze the relationship between the features extracted from the "University of Bradford MultiModal Gait Database". This study includes two dimensional dynamic and static features from 19 subjects. The dynamic features were compromised of Phase-Weighted Magnitudes driven by a Fourier Transform of the temporal rotational data of a subject's joints (knee, thigh, shoulder, and elbow). The results concluded that there are eleven pairs of features that are considered significantly correlated with ($p<0.05$). This result indicates the existence of a statistical relationship between static and dynamics features, which challenges the results of several similar studies.

These results bare great potential for further research into the area, and would potentially contribute to the creation of a gait signature using latent data.

Gait as evidence:

This study examines what in Denmark may constitute evidence based on forensic anthropological gait analyses, in the sense of pointing to a match (or not) between a perpetrator and a suspect, based on video and photographic imagery. Gait and anthropometric measures can be used when direct facial comparison is not possible because of perpetrators masking their faces. The nature of judicial and natural scientific forms of evidence is discussed, and rulings dealing with the admissibility of video footage and forensic evidence in general are given. Technical issues of video materials are discussed, and the study also discusses how such evidence may be presented, both in written statements and in court.

Gait verification system for criminal investigation:

This paper describes the first gait verification system for criminal investigation using footages from surveillance cameras. The system is designed so that the criminal investigators as non-specialists on computer vision-based gait verification can, independently, use it to verify unknown perpetrators as suspects or ex-convicts in criminal investigations. Each step of the gait verification process is proceeded by interactive operation on a graphics-user interface. Eventually, for each pair of compared subjects selected by a user, the system outputs a posterior probability on a verification result, which indicates that compared subjects are the same, with the consideration of various circumstances of the subjects such as the size, frame-rate, observation views, and clothing of subjects. One gaitspecialist and ten non-gait-specialists participated in operation tests of the system using five different datasets with various types of

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scenes, each of which contained two or three verification sets. It was shown that all the non-gaitspecialists, as well as the gait-specialist, could obtain reasonable verification results for almost all of the verification sets.

PROPOSED SYSTEM

To handle this issue, various techniques are used to capture discriminant information from GEIs. One such schemeis proposed, which uses Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) for feature extraction. A similar approach is adopted where Discriminant Locally Linear Embedding (DLLE) based framework is used for preserving the local structure. However, the main drawback of appearance-based approaches is that they are sensitive to covariate conditions In proposed system we have used two algorithms such as CNN for gait recognition for known covariate and features classifiers such as SVM, MLP and Random Forest to classify unknown covariate such as Clothes, Bags and walking style by using Gait Energy images. When models are trained with covariate conditions and testing is performed on similar covariate conditions, it is known as known covariates. While on the other hand, when models are trained only with simple GEI of a normal walk and tested on different covariate conditions, it is known as unknown covariate conditions. CNN algorithm get train on GEI (Gait Energy Images) to recognized person ID and then features will be extracted by using HOG, LBP and Haralick algorithms and then apply Fisher Linear Discriminant Analysis algorithm to reduce features size. Reduced features will be trained with SVM, MLP and Random Forest algorithms and then evaluate performance of this algorithms in terms of accuracy, precision, recall and FSCORE.

Advantages:

1. Accuracy is more

Modules:

To implement this project we have designed following modules 1. Upload Gait Images Dataset: using this module we will upload GAITB dataset to application 2. Pre-process Dataset: using this module we will read all images as Grey Scale and then normalize all images to train with Known CNN Recognition

3. Train CNN Gait Recognition: using this module we will input all process images to CNN and then trained a gait recognition model and this model can be used to predict person ID from test images

4. Train SVM with HOG, LBP, Haralick & Fisher Features Reduction: using this module we will apply HOG, LBP and Haralick features extraction technique and then apply Fisher algorithm to reduce image features and then trained SVM algorithm with reduced features and then calculate accuracy.

5. Train Random Forest with HOG, LBP, Haralick & Fisher Features Reduction: using this module we will apply HOG, LBP and Haralick features extraction technique and then apply Fisher algorithm to reduce image features and then trained Random Forest algorithm with reduced features and then calculate accuracy.

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6. Train MLP with HOG, LBP, Haralick & Fisher Features Reduction: using this module we will apply HOG, LBP and Haralick features extraction technique and then apply Fisher algorithm to reduce image features and then trained MLP algorithm with reduced features and then calculate accuracy. This trained models can be used to classify various features such as BAGS, Clothes and walking. 7. Accuracy Comparison Graph: using this module we will plot accuracy graph of all 3 algorithms for selected features 8. Predict Gait from Test Image: using this module we will upload test image and then using CNN model we will recognized Known GAIT and then using SVM, Random Forest and MLP we will classify Unknown GAIT such as bags, clothes and walking.

CONCLUSION

Gait recognition without the subject's cooperation remains one of the most challenging research areas in the field. The covariate conditions, including clothing and speed variations, are still difficult to handle in realistic experimental setups. The existing solutions perform poorly when subject cooperation is not possible, and there are changes in covariate conditions, making them unsuitable to deploy for practical purposes. The emergence of deep learning approaches has made computer vision tasks easier. However, there are certain scenarios where pre-processed data can further improve the performance of these deep learning methods. In this work, we have developed a gait recognition method that extracts features from ROIs of the gallery and probe gait GEI sequences. The unique covariate condition invariant feature-based gait sequences used with RF, SVM, and MLP performed very well for covariate conditions. The results demonstrate the overall superiority of our approach over the existing approaches. It is pertinent to mention that the feature selection method deals only with changes in different covariate conditions and has no effect on gait itself. The proposed method handles covariate conditions by selecting the discriminative covariate invariant features and removes the occluded part of the body. The aim is to remove the body part, which is affected by covariate conditions, especially for bags and coats. The same technique can be used on other datasets with similar covariate conditions. The proposed method can be used to handle dynamic covariates like putting on a coat and taking out a coat as the occluded and affected part of the body remains the same for these conditions. The ROIs can still be used for unique covariate invariant features. In future, the ROI selection process can be improved for automatic candidate selection.

The algorithm can be extended to design zero-shot learning-based algorithms to work in real-time data. The latest zero-shot training-based algorithms and proposed discriminative feature learning can be combined to handle covariate conditions in real-time.

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