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HUMAN IDENTIFICATION USING MOTION VECTOR ANALYSIS

Chris D'Souza
PG student, Computer Dept., Shree L. R. Tiwari College of Engg.,Thane, India.
Sharmila Gaikwad
Asst.Professor,ComputerDept.,RajivGandhi Institute of Technology,Mumbai, India.
VinayakShinde
HOD & Professor: Computer Dept., Shree L. R. Twari College of Engg., Thane, India.

Abstract

The field of human recognition has existed for past few decades, but gained popularity in recent years for its use in avariety of applications. In security industry, suspicious persons / activities could be detected in high-profile areas. In medical industry, systems could be trained to detect patterns of motion indicating painOR to detect a lack of motion if a person has fallen and unable to move. However, algorithms with reliable accuracy are difficult to implement in a real-time environment due to computational complexity and ambiguous decisions.

This work will develop an efficient way of extracting and using data from a walking style of human in a video frame to identify the human. Following background subtraction, a thinning algorithm offered a more robust feature such as motion vector extraction method. Training and testing approach which is a basic Neural network approach/ classifiers used to identify a number of activities, such as walking, running, waving and jumping. This entire human activity recognition system will be tested with a MATLAB implementation. The algorithm will be developed to achieve maximum classification accuracy in video feeds.

Keywords

Boundary Matching Algorithm, Gait Analysis, Morphological smoothening process, Motion Vector, Silhouette.

1. Introduction

Research in field of computer vision aim to reproduce the extremely intricate and complex pattern recognition capabilities of the human brain. The image understanding techniques on video sequences is used by the human identification system to detect and recognize a human subject by the way of their walk. This type of information is not easy to obtain both quickly and accurately, but it is of great value in many applications, particularly in the security industry. Human identification is one of the complex tasks the human brain does effortlessly, but presents many difficulties when a computer system attempts to automate the process. The vast amounts of data available in video streams often make it difficult for a computer system to make classification decisions in real-time environments due to the large processing requirements Real-time human identification systems are becoming increasingly important in the security industry, where it is important to identify suspicious actions and behaviours to avoid harm coming to others. People watching security videos may miss important occurrences, and in such situations, it would be helpful for a computer system to flag suspicious actions and behaviour and alert to possible dangerous or criminal situations. Such real-time systems are important not only to the security industry, but also for the medical industry. Motion patterns of humans could be examined to help patients that seem to be experiencing a dangerous condition, such as a seizure, heart attack, or serious fall. Proper medical personnel would be alerted to provide care to the person. Applications of this type of system are varied, but in all situations, a human activity recognition system would provide an extra layer of vigilance and security in real-time to alert people for the possible need to respond to an important situation that may otherwise be missed. A solution to this real-time problem is how to represent the human figure in the best possible manner within the computer system so that the data extracted from the video is limited, but can still be used in a classification system to accurately distinguish among different activities. The data extracted from video streams should all provide independent and unique information about the scene, and this information should characterize an activity and allow for individual differences for how people walk differently.

The framework in this work will implement a real-time human activity recognition system by reducing the data required for processing and classification so that only a few parameters of body positioning, orientation, and net motion in the XY plane are required for classifying the figure. This could be accomplished by representing the human figure as a streamlined skeleton and comparing relative position and orientation data of the subject's body and using this data in a classifier.

2. Literature Survey

The various techniques are discussed below:

a. Fusion of Gait and Facial Features using Coupled Projections for People Identification at a Distance: A novel feature level fusion scheme for people identification at a distance has been developed by coupling gait feature with facial feature. The proposedmethod which is based on coupled projections, first maps the heterogeneous features from gait and face into a unified subspace to minimize the distance between the two features extracted from the same individual.Limitation here is the concatenation of the feature is avoided which leads to the decrease in the performance of the classifier.

b. Automatic Identification and Classification of Freezing of Gait Episodes in Parkinson's Disease Patients

Freezing of gait (FOG) in Parkinson's disease (PD) patients occurs occasionally and intermittently, appearing in a random, inexplicable manner. In order to detect typical disturbances during walking, an expert system for automatic classification of various gait patterns is designed. The proposed method is based on processing of data obtained from an inertial sensor mounted on shank. The algorithm separates abnormal gait from normal using Pearson's correlation and describes each stride by duration, shank displacement, and spectral components. This was used to compare between a healthy person n unhealthy person which helped in recognition of the disease on long term.Limitation here is use of sensors made the area limited up to 30 m max.

c. Application of Gait Analysis for Hemiplegic Patients using Six-axis Wearable Inertia Sensors

Clinical applications to identify and quantify the lower body functioning impairment of patients. A gait analysis system based on 6-axis inertiamotion measurement is proposed. The system is specificallydeveloped for hemiplegic gait analysis application and utilizeda set of non-visual based wireless body sensor network for datacollection which is considerably less expensive and easier to setup and operate compared to its visual based counterpart.Limitationis use of wireless sensors limit the area from where it is being monitored.

d. Integrating Face and Gait for Human Recognition at a Distance in Video

This paper proposes an innovative video-based fusion system, which aims at recognizing non cooperating individuals at a distance in a single-camera scenario. Information from two biometrics sources, side face, and gait, is combined using different fusion methods. Side face includes the entire side views of eye, nose, and mouth, possessing both shape information and intensity information. Therefore, it has a more discriminating power for recognition than face profile.Limitation is the match score fusion cannot rectify the misclassification achieved by both of the face classifier and the gait classifier.

e. A System for Dissecting the Video for Tracing Multiple Humans in Multifaceted Situation

The work is described on segmentation and tracking of multiple human in complex situations. This approach can successfully handle shadow, reflection, multiple humans in one moving blob and occlusion. The contribution of our work lies in the employment of appropriate models and knowledge to robustly solve a difficult and useful problem. To use a background appearance model to focus our interest by throwing away the static regions. Limitation is abetter optical flow algorithm needs to be devised. Additional study can be done to determine the minimum number of frames needed for verification. It's also needed to automatically decide the time to do human detection when a human or a group of human entirely enters the image.

f. Human Identity and Gender Recognition From Gait Sequences With Arbitrary Walking Directions

When a gait sequence is collected from random walking directions, we first obtain human silhouettes by background subtraction and then group them into several clusters. For each cluster, compute the cluster-based averaged gait image as features. A sparse reconstruction based metric learning method is then used to study a distance metric in order to minimize the intra-class sparse reconstruction errors and maximize the inter-class sparse reconstruction errors at the same time, so that the discriminative information can be utilized for recognition. Limitation of this approach is that itcould fail if the walking style in the test sequence is significantly different from that of training sequences.

3. Problem Statement and Motivation

Nowadays, closed-circuit television (CCTV) cameras are widely installed in public places such as airports, banks, government buildings, etc. for the purposes of crime prevention, law enforcement, access control and searching for missing people. The demand for automatic human identification systems is acute, since it is costly for sufficient manpower to supervise such a large number of CCTVs. In practice, the performance of the automatic human identification system may be limited by the covariate factors such as variations of viewing angle, clothing, shoe types and carrying condition and ambiguity in taking decision based on gait-energy approach. Similarly, the performance of the automatic face recognition system is limited by the factors like low resolution, varying illumination, multiple poses and blur or occlusion.

The two traits may be complemented for human identification:

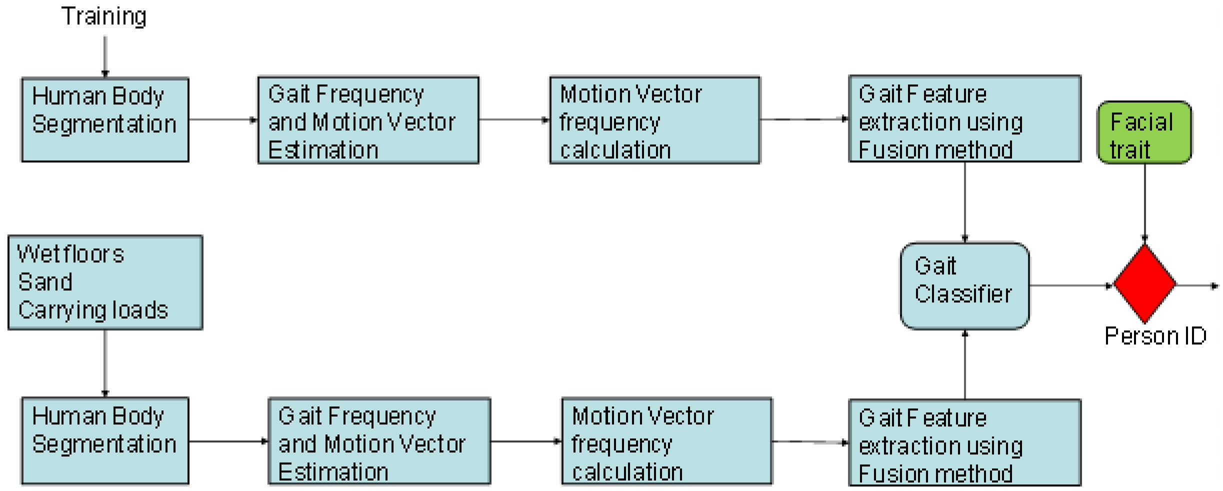
a. Since gait is less sensitive to the factors which affect face recognition, such as low resolution and varying illumination.
b. While face is robust to covariates that affect gait recognition, such as walking surface, clothing and carrying condition.

Thus, a motion vector is the key element in the motion estimation process. Hence in human identification, a motion vector will play an important role in the motion estimation process.

4. Methodology

Here, the human identification will be done using "Motion Vector Analysis". A process, which uses gait cues from video sequences, will be a potential approach to accomplish the task of human recognition. Motion vectors are used creatively to detect and track motion and to find an alternative to traditional video decoding. Motion vectors are typically used to compress video by storing the changes to an image from one frame to the next.

Figure 1: Basic Flow-chart of human identification



The data collected from feature extraction consists of the distance and angle of displacement measurements of the feet from their corresponding hip marker, as well as the X and Y axis delta values from the motion calculations. To train/test whether this data is sufficient for the classification process, classifier such as pattern recognition where motion vector feature-weights are getting compared will be used in prototyping – artificial neural network (ANN). To test the capability of classification using the extracted data from the video sequences, a MATLAB prototype of the system will be implemented and used with the blank data set. This data set will contain sequences of three activities performed by individual subjects/same subject. This data set will be chosen because the camera will be moved very little during the taping of the sequence, making non-adaptive background subtraction very easy.

Figure 1 gives the flowchart of proposed model for human identification using motion vector analysis. This algorithm is widely used to detect moving objects by subtracting the reference frame from the current frame to capture the human silhouette.

The extracted silhouette may have some spots or noise on account of influence by shadow or illumination due to ambient condition. To address these spots or noise issue we will do the double differentiation of position history for dynamic analysis of gait. Measurement of frequency domain characteristics of signal and noise are both required to quantitatively asses errors in raw, filtered, and dynamic gait data to avoid aliasing. The loss of accuracy in image due to this noise can be reduced by:

a. Using filters to ensure that noise frequencies do not overlap the signal frequencies and
b. Sampling the data more than twice the highest frequency in composite signal.
c. Using Morphological smoothening process.

4.1 Gait Analysis Algorithm

a. Prepare the database of Walking video of finite count of human. Store in .mp4 video format.
b. Convert .mp4 videos into image frames (.jpg) with constant frames rate. (say 25 frames per second)
c. Crop video/ select frames of one complete walking cycle of each human gait patterns.
d. Obtain the motion vector of each consecutive frames using apply Full search Boundary Matching Algorithm.
e. Combine each motion vectors in horizontal and vertical direction and get separate .mat file of each human walk. These .mat files are the training feature set of each human walk.
f. Obtain the test human walk for comparison in video format. Repeat step 2 to 5 for test walk to obtain .mat files as motion vector features.
g. Subtract each frame-set of MV's of the test gait pattern to the every database frame-set of MV's.
h. Obtain the weight matrix of each walk after comparing test walk.
i. From weight matrix, find Average weight of each walk patters.
j. Minimum value of Average weight will decide the best match.
k. Optional Step: The threshold weight can be trained to decide the test walk belongs to the database or not (so as to identify even unknown human being whose data is not available in data base).
l. Display the name of the best match human.

5. Results

Using the above algorithm various data is been collected which is shown below

Figure 2:Human silhouette obtained by background subtraction

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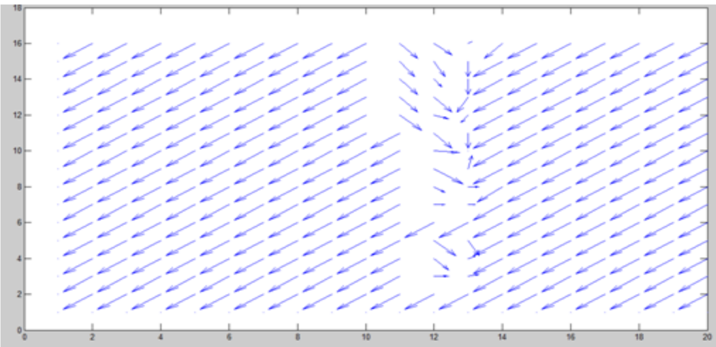
Figure 3:Motion Vector



Average weight feature obtained by comparing weight matrix of test walk with weight matrix of every walk.

Figure 4:Display weight of every walk.

Wa	<38x38 double>	0	4365
Wb	<38x38 double>	0	4315
Wc	<38x38 double>	0	4324
avgA	815.1620	815....	815....
avgB	840.6551	840....	840....
avgC	778.0706	778....	778....

Finally display the best match .The best match is the person with minimum weight.

6. Conclusions

Human Motion Analysis is gaining wide attention across the world from the computer vision scholars. This wide interest is motivated by wide spectrum of its application such as in closed-circuit television (CCTV) surveillance, due to its high potential in unconstructive individual recognition from a distance. It's usability in commercial visual surveillance can be utilized in several areas like security systems, namely banks, airports, military-based areas, public transportation like railway- stations and bus- stations, shops and malls, and car-parking monitoring systems. One of the major reasons for increasing need of human identification is due to increasing number of piracy, theft and unauthorized access cases across the globe. Thus, it is paving a great achievement in technology field for the upcoming computer vision researchers. This paper mainly contributes towards the study of various approaches for gait analysis which can be used to identify humans.

Using Motion Vector Analysis, Human Identification can be possible. As biometrics gait trait of a person is also unique which could be used to identify, as different person will have different walking style. Further biometrics can also be added to improve the identification process to more accuracy.

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