Abstract

Human gait recognition is a biometric method used to identify individuals based on their unique walking style. However, this is a challenging task due to covariate issues such as changes in appearance caused by clothing or carrying conditions, as well as variations in viewing angle. While current gait recognition methods work well in controlled environments, they perform poorly in practical conditions where covariate factors can affect performance. This thesis proposes methods for gait analysis using both model-free and model-based approaches to address these challenges.

The investigation of covariate issues in gait analysis is considered in two scenerios - one where covariate factors are known and the other where covariate factors are unknown. A literature survey is conducted on parameters, feature representation, datasets, and classification techniques for both the approaches. An experimental analysis is carried out using a model-free approach with different conventional classifiers to address view angle variation with clothing and carrying conditions. The fused gait representation is used in this analysis, which combines GEI and Gait Gaussian information extracted by applying Gaussian blur followed by morphological edge detection operator. The experimental analysis indicates that model-free approaches are sensitive to unknown covariate issues, as shown by different test results obtained from the analysis. The issues with known covariates are simple to deal with using model-free approach with high test accuracies.

Additionally, an experimental analysis is performed on fusing dynamic and static features to address the unknown covariate issues. A pre-trained VGG-16 model is used for dynamic feature extraction, while a Histogram of Oriented Gradients (HOG) feature descriptor is used for static feature extraction. The fused features are trained and validated, and the test accuracies obtained using Support Vector Machine (SVM) with radial basis function (rbf).The experimental results show a significant improvement over similar early studies. All experimental analysis is carried out using CASIA-B, a standard dataset.

Furthermore, a Convolutional Neural Network (CNN) model with basic hyper-parameter tuning is proposed to classify subjects irrespective of covariate issues using the same dataset. The proposed CNN model has higher accuracy than a few existing gait recognition algorithms that use the same gait templates.

Moreover, this work presents a model-free gait analysis approach for human identification using under walking surface covariate conditions with varying viewing angles using a new dataset proposed in this work. The proposed dataset differs from the existing benchmark datasets in several aspects such as data acquisition setting, background settings, covariate conditions. Object detection from a walking sequence and processing for a specific application is a challenge in real-world scenarios where human movement can be observed in crowded areas with various objects in the background. Adaptive background segmentation algorithms such as Mixture of Gaussian (MOG), K-nearest neighbor (KNN), and Gaussian Mixture Model(GMM), as well as the Deep Convolution Neural Network (DCNN) model, are used for object detection.The performance of the segmentation methods are compared using performance metrics such as Performance of Correct Classification (PCC), F1 Score, and precision-recall. DCNN image detection with image morphological operations is found to be a more effective and accurate background segmentation technique for images with complex backgrounds.

Finally, a pose-based human gait analysis is studied to address clothing, carrying, and viewing covariates. The Blazepose human pose estimation (HPE) algorithm is applied to the video sequences to the extract body keypoints, which are represented as coordinates and used to evaluate distances and angles between the keypoints. In this work, dynamic keypoints, which consider the lower body keypoints to generate a unique gait signature of a person, are used to create a feature vector. In addition to dynamic keypoints, two additional features are assessed: the knee angle and the maximum foot distance in the initial stance phase. In this work, a proposed framework utilizing these parameters is suggested as an effective method for representing gait patterns for handling covariate issues. Further validation of this framework for gait analysis, particularly in addressing covariate issues, can be explored in subsequent research.