View invariant person identification by gait

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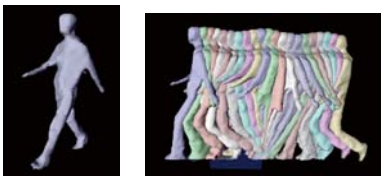
I. Introduction

This paper presents a spatio-temporal 3D gait database and a view independent person identification method from gait. In case that a target changes one's walking direction compared with that in a database, the correct classification rate is reduced due to the appearance change. To deal with this problem, several methods based on a view transformation model, which converts walking images from one direction to virtual images from different viewpoints, have been proposed[1]. However, the converted image may not coincide the real one, since the target is not included in the training dataset to obtain the transformation model. So we propose a view independent person identification method which creates a database with virtual images synthesized directly from the target's 3D model.

II. Outline of the proposed method

A. Spatio-temporal 3D gait database

In the proposed method, firstly we built a spatio-temporal 3D gait database using multiple cameras, which consists of sequential 3D models of multiple walking people. To reconstruct the 3D models of the target from walking images, firstly silhouettes from walking images are extracted by a background subtraction. Then the 3D models are reconstructed by the volumetric intersection technique.Figure 1(a) and (b) show an example of reconstructed 3D models, and an example of sequential 3D models of one gait cycle, respectively. The database contains 40 video sequences, which contain 10 different subjects with 4 sequences for every subject.



(a) (b)

Subject A

Fig. 1. (a): examples of 3D models, (b): examples of sequential 3D models.

B. View independent person identification method

We describe the main steps of the view independent person identification.

Step 1 Virtual images from an arbitrary viewpoints are synthesized from 3D models in the database.
Step 2 Affine moment invariants are calculated as gait features from synthesized walking images of one gait cycle.
Step 3 Repeat the Step 1 and Step 2 at all arbitrary viewpoints, and then create the database.
Step 4 In the identification phase, images of a target who walks in an arbitrary direction are captured with one camera, and the gait features of the target are calculated by the same procedure of Step 2.
Step 5 By comparing the gait features of Step 4 with those in the database, the target is identified and one's walking direction is estimated.

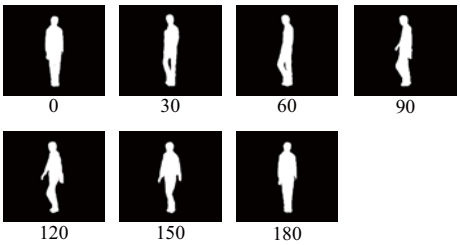


Fig. 2. Virtual images synthesized at arbitrary viewpoints

III. Experiments

We built the database with virtual images captured from 74 different viewpoints, which contain 37 different azimuth angles (every 5 from 0 to 180) and 2 different elevation angles (20 and 25). As test data sets, we used virtual images from 7 different viewpoints (azimuth angle: 0, 30, 60, 90, 120, 150, 180, elevation angles: 20) . Here, each test data set was not included in the database .TABLE I shows the correct classification rate (CCR) with respect to different viewpoints of the test data sets. From these results, we can see that the proposed method can identify people robustly against the walking direction change.

TABLE I

Correct classification rate with simulated images [%]

Virtual viewpoints [degree]						
0	30	60	90	120	150	180
97.5	90.0	100.0	100.0	100.0	97.5	100.0

IV. Conclusion

We proposed in this paper a spatio-temporal 3D gait database and a view independent person identification method from gait. From experiments with simulated images, we showed that the proposed method identified people with high correct classification rate robustly against the walking direction change.

References

[1] K. Sugiura, Y. Makihara, and Y. Yagi. Omnidirectional gait identification by tilt normalization and azimuth view transformation. Proc. of the IEEE Workshop on OMNIVIS, 2008.