Silhouette based View embeddings for Gait Recognition under Multiple Views

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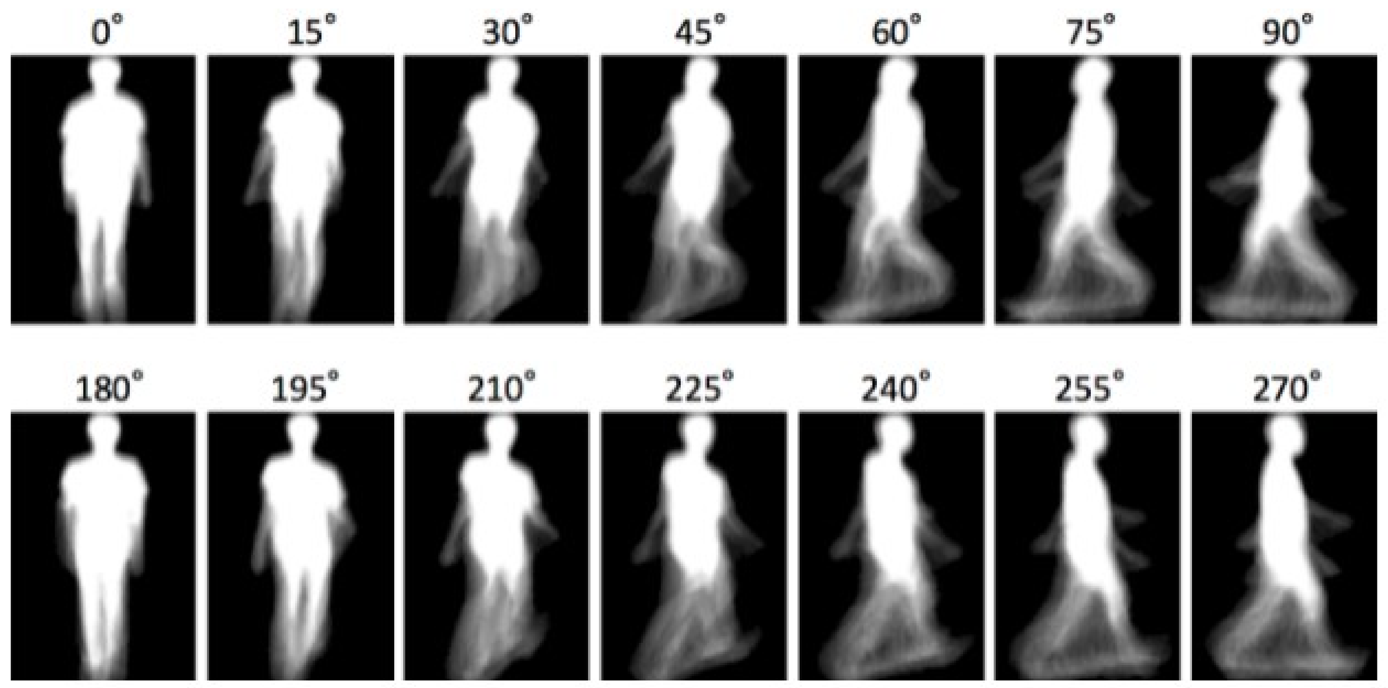
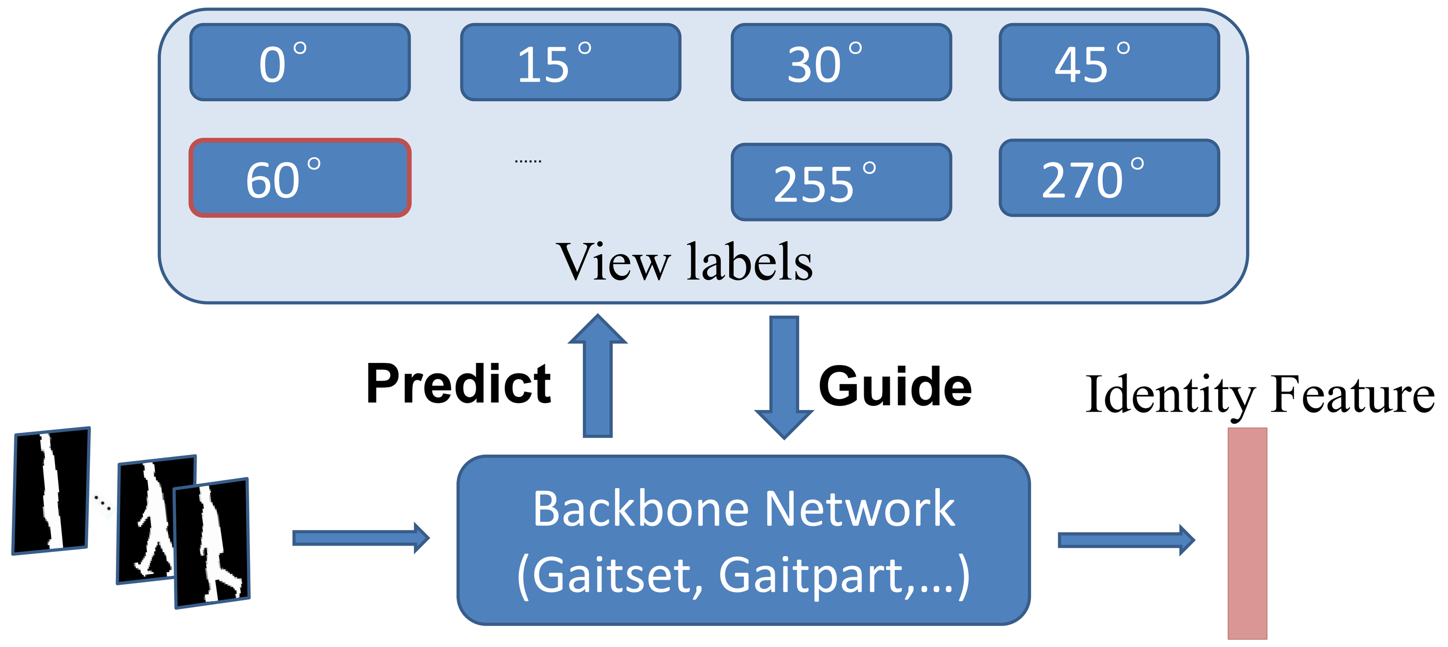
Introduction:

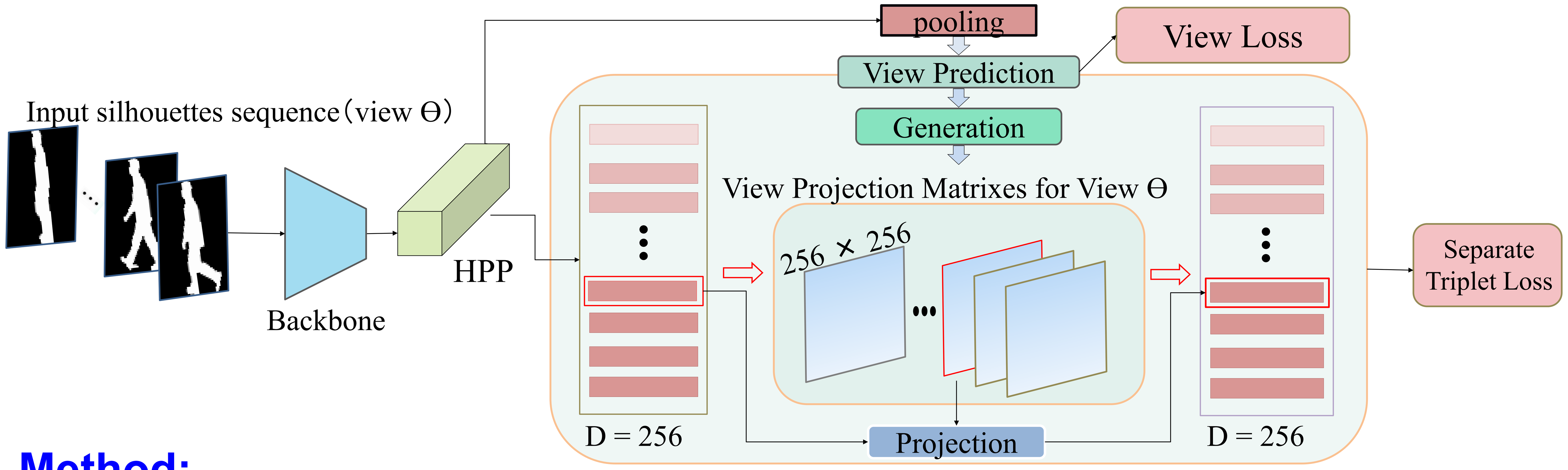
- Gait is a biometric presenting the walking style of people and has an edge over other biometrics because it can be recognized at a distance with much less cooperation.
- Viewpoint differences is a very tricky problem, because it may bring greater visual differences than the identity.



- Many methods have been proposed based on silhouette image sequences, for example, GaitSet, GaitGL, GaitPart.
- However, all of these methods mainly focus on how to extract features through spatial-temporel modeling. None of them take view itself into consideration.



- In this paper, we proposed a general framework for multi-view gait recognition by explicit view angle embedding, based on which, two state-of-the-art gait recognition backbones, i.e.Gaitset and GaitGL are enhanced. Compared with the original ones, the enhanced ones, improve the performance. The effectiveness is well demonstrated by the experiments on CASIA-B and OUMVLP datasets.



Method:

- The feature map X_f is calculated form the input X_{in} using the backbone E as well as the view feature f_v:

$$X_f = E(X_{in}) \;\; and \;\; f_v = F(P_{Global\_Avg}(X_f))$$

- Especially for Gaitset, there is another feature map X_g, then the view feature is defined as:

$$f_v = F(P_{Global\_Avg}([X_f; X_g]))$$

- Where F denotes a fc layer. Then the predicted view can be expressed as:

$$\hat{p} = W_{view} f_v + B_{view} \;\; and \;\; \hat{y} = \arg\max_i \hat{p}_i$$

- Where $\hat{y} \in \{0,1,2,\dots M\}$ and M is the number of views (10 for CASIA-B and 14 for OU-MVLP). The corresponding set of projection matrixes is:

$$Z_{\hat{y}}| = \{W_i | i = 1,2,\dots,n\}$$

- Assuming the feature obtained after HPP module are:

$$f_{HPM} \in \mathbb{R}^{n \times D}$$

- Then the final Identity feature is:

$$f_{final,i} = W_i f_{HPM,i}$$

$$f_{final} = [f_{final,1}, f_{final,2} \dots, f_{final,n}]$$

- The joint loss is

$$\mathcal{L}_{CE} = -\sum_{i=1}^{N}\sum_{i=1}^{M} y_j log(p_{ji}) \;\; w.r.t. \;\; p_{ji} = \frac{e^{\hat{p}_{ji}}}{\sum_{i=1}^{M} e^{\hat{p}_{ji}}}$$

$$\mathcal{L}_{trip} = \frac{1}{K}\sum_{i=1}^{K}\sum_{j=1}^{n} max(m - d_{ij}^{-} + d_{ij}^{+}, 0)$$

$$\mathcal{L} = \lambda_{CE}\mathcal{L}_{CE} + \lambda_{trip}\mathcal{L}_{trip}$$

Experiments:

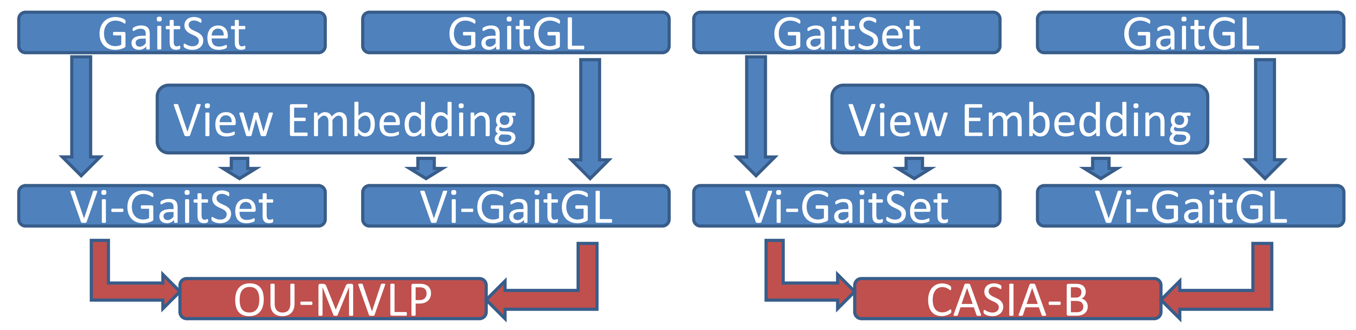


Table 2. Rank-1 accuracy (%) on OU-MVLP under 14 probe views excluding identical-view cases.

Probe angle	Gallery All 14 views					
	GEINet	Gaitset	Vi-Gaitset	GaitPart	GaitGL	Vi-GaitGL
0°	11.4	79.5	**81.8**	82.6	84.3	**85.6**
15°	29.1	87.9	**89.2**	88.9	89.8	**90.2**
30°	41.5	89.9	**90.5**	90.8	90.8	**91.2**
45°	45.5	90.2	**90.5**	91.0	91.0	**91.5**
60°	39.5	88.1	**89.2**	89.7	90.5	**91.1**
75°	41.8	88.7	**89.5**	89.7	90.5	**90.9**
90°	38.9	87.8	**89.0**	89.9	90.3	**90.4**
180°	14.9	81.7	**83.9**	85.2	88.1	**88.3**
195°	33.1	86.7	**88.1**	88.1	87.9	**88.7**
210°	43.2	89.0	**89.7**	90.0	89.6	**90.6**
225°	45.6	89.3	**89.8**	90.1	89.8	**90.6**
240°	39.4	87.2	**88.6**	89.0	88.9	**90.1**
255°	40.5	87.8	**88.5**	89.1	88.9	**89.9**
270°	36.3	86.2	**87.6**	88.2	88.2	**89.4**
mean	35.8	87.1	**88.3**	88.7	89.1	**89.9**

（More experiments of dataset CASIA-B can be find in the paper)

Conclusion

- Combined the task of view prediction and gait recognition.
- Proposed a general view embedding framework for improving multi-view gait recognition.
- The proposed framework with GaitSet and GaitGL as the backbone meets the state-of-the-art on two large-scale public gait datasets.