First Report of Pedestrain Counting

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1. **Introduction**

   Pedestrain detection and counting has been heavily researched in the last few years and people have made great improvement. Dalal's HoG (Histogram of Gradients) operator has been widely used in pedestrain detection with SVM, AdaBoost or other machine learning algorithms, which we use as the basic detector in our project.

   However, detection is not enough to count the pedestrains in the ROI, therefore we have to track each person. Our basic idea is to use particle filter to track each specific person.

   Particle filter is an approximation of Bayes inference and is widely used in tracking. Compared with Karman filter, it can simulate any probability distribution. However it's main drawback is the high complexity of computation. Which we will try to optimize with multiple threads.

2. **Basic Plan**

   Here is our basic plan for this project.

   - Code Reconstruction

     The code offered by the teacher is not object-oriented, and is very difficult to modify and extend. Hence our first goal is to reconstruct the program so that we can easily build our particle filter on it.

     Besides, while reconstructing the program, we rewrite some parts of the program in a more memory friendly way, which leads to quite tremendous improment. The original video detector on the first training video takes 212s, while our reconstructed program takes 66s with one main thread. After optimizing some parameters it reduces to 27s without deteriorating its precision.

   - Merge Paritcle Filter

     The main idea is from [1], in which there are mainly two new ideas. The first one is that instead of using one offline trained general classifier, they train one online classifier for each detected pedestrain and the classifier is only updated on non-overlapping detections. Secondly, the detections are used to guide the particles' propagation which is implemented to estimates the conditional likelihood of the new observation .

     – Data Association Problem ¡¡¡¡¡¡¡ Updated upstream
       The data association problem is solved by a greedy algorighm. A matching score is calculated for each pair of detection and pedestrain, then we selected the max matching score and delete the coresponding row and column of this pair. Last, only matching pairs that above some threshold is used to guide the particles of that pedestrain. =======
       Use the greedy algorithm to find the $pair(t_r, d)$ with maximum score in the matching score matrix and delete the columns and rows belonging to tracker t_r^* and d
       ¿¿¿¿¿¿¿ Stashed changes
     – Online Boosting
       The online boosting classifier for each pedestrain is similar to that in [2] and we will select some features to train it.

   - Optimization

     With multiple threads or even GPU programming, we may archieve the real time interactive result.

References

[1] Michael D. Breitenstein, Fabian Reichlin, Bastian Leibe, Esther Koller-Meier, and Luc Van Gool. Robust tracking-by-detection using a detector confidence particle filter. In *IEEE International Conference on Computer Vision*, October 2009.

[2] Helmut Grabner and Horst Bischof. On-line boosting and vision. In *Proceedings of the 2006 IEEE Computer Society Conference on Computer Vision and Pattern Recognition - Volume 1*, CVPR '06, pages 260–267, Washington, DC, USA, 2006. IEEE Computer Society.