平成22年度博士論文

題目：Study on Object Tracking Under Outdoor Environments Using Video Cameras

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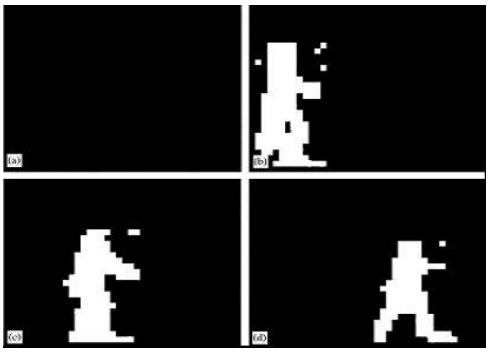
In this thesis, we investigated the development of the object tracking system including object detection, object tracking and object identification/recognition and related issues. We explored the related object tracking system methodology and the future development of the tracking system. We have presented various recent methodology of the tracking system including object detection, object tracking and object recognition. On each methodology, we presented detail methodology with the weakness and the strong points. Furthermore, we presented also the future development of the tracking system.

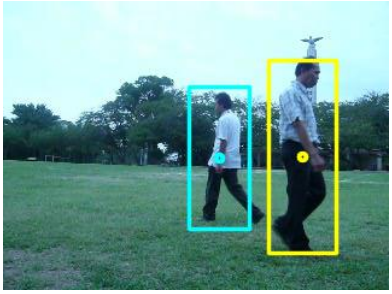
In this thesis, our proposed method is applied into two categories of object tracking system that based on deterministic algorithm and stochastic algorithm. On the first approach, we divide our study on three main categories for building an automated tracking system, which can be listed as object detection, object tracking and object identification. We introduce our proposed method on each category. We propose low resolution image on frame difference to detect the moving object. We proposed a block matching based on PISC image to track the interest object. In addition, to evaluate the method, we proposed an identification method based on the color and spatial features. Our proposed method can achieve satisfactory result with the identification rate of 92.1[%] in average. In order to increase the field of view of camera, we propose also object tracking using multi-camera. We implement the multi-camera system under LAN environment which each camera connected to each PC. We successfully track the interest object using two camera and we obtain the wider view of camera. Our proposed method can achieve the detection rates of 97.23[%] and accuracy of 96.98[%] in average.

On the second approach, we proposed a color-based particle filter for single object and multiple objects tracking. On this approach, we rely on the color likelihood as an image measurement to estimate the state of the moving objects. In addition, to handle the appearance change and background clutter, we proposed also model updating. We analyzed the effect of the number of particles and number of histogram bins to the processing time and tracking accuracy. We obtained that the processing time is related to the number of particles and number of histogram although the tracking accuracy increase also. The experimental results show the algorithm can successfully track the single moving object based on known and unknown initial position and object appearance. Finally, we proposed to expand the color-based particle filter algorithm to track multiple objects in the presence of occlusion. We proposed to handle occlusion by redefining the resample and model update step. The

occlusion itself is predicted based on the estimated position and likelihood measurement. We implemented our proposed algorithm to track two and three moving object which has individual template and independent motion and the satisfactory results are achieved. We found also that the processing time is related to the number of the objects to be tracked.

The tracking system which was proposed in this thesis can be applicable in various applications such as surveillance system, smart room, intelligent transport system, etc. In surveillance system, we can use our proposed system to detect and recognize the anomaly behavior of the people in some area for example airport, supermarket, playground of kinder garden school and so on. Our system can handle the object occlusion and implemented in multi-camera system. So, it makes easier to detect and recognize the anomaly behavior in the crowded environment. For example, we can install our system as surveillance system in the playground of the kinder garden. As our system is based on the color feature and the kinder garden student has different color of hat for different grade, we can detect and track the student based on their hat. If there is anomaly behavior such as, fight between students, the students fall down, etc, the system can detect and recognize it and send the information to the teacher to do an action. In smart room application, for example we can install our system in a hospital in order to recognize and analyze some interactions between the patients and the real environment. We can monitor the actions of the patients using multi-camera system such as sleeping, walking, falling down from bed and other abnormal actions. If the abnormal action happens, the system will send the signal to the operator to make any decision or action. We believe that the application of our developed system can make the society become better.





実験結果