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# Tracking passenger movement with infrared video data

Masanobu Nakamura, Huijing Zhao, Ryosuke Shibasaki

Shibasaki Laboratory Institute of Industrial Science University of Tokyo

Address: 4-6-1 Komaba, Meguro-ku, Tokyo 153-8505 Japan

Tel & Fax: +81-3-5452-6417

E-mail: masanobu@iis.u-tokyo.ac.jp

JAPAN

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**Abstract**

Analysis or monitoring of human activities, such as counting the number of passengers or measuring their trajectories, is considered very useful in various fields such as building security, marketing and automated operation of building facilities. So far, motion analysis with video data has been a major method to collect such a data, but it has some problems to track passenger movement. For example, when passengers are crossing, their images overlap which results in difficulties in separating individual trajectory. To avoid the overlaps, position and viewing angle of video camera is so limited. By using infrared video camera, which can be purchased at a reasonable price, however, each person can be tracked more effectively and can mitigate the crossing problem because the infrared video camera enables us to easily detect warm surfaces such as human face. In this thesis, we compared two case, ordinary video and infrared video method to explore the possibility of infrared video's method.

## 1.Introduction

Tracking human activities is considered very useful in various fields. In retail, compared with ordinary counting method, it can optimize the number of cashier because we can grasp real state of customers' activities. In similar, we can optimize the allocation of commodities. In security and safety, we can check in-coming and out-going people. But method of tracking passenger movement is very labor-demanding, such as counting a passenger one by one when they walk in front of counter. Such kinds of works need high concentration, and counting passengers for a long time is the sequence of simple but boring work, so need considerable endurance. Enumerators are apt to make some errors for such a reason. So the automation of tracking moving objects is needed today.

So far, motion analysis with video data has been a major method to collect such a data automatically, but it has some problems to track passenger movement. For example, when passengers are crossing, their images overlap which results in difficulties in separating individual trajectory. And it cannot get a clear picture when the space is dark. By using infrared video camera, reacting to a temperature, which can be purchased at a reasonable price, however, the problem can be mitigated. For example, it can get a clear image data regardless of the brightness and by setting a target on human face the restriction of camera position can be mitigated more or less. To explore a possibility of infrared video, we conducted an experiment of extracting and tracking moving people.

## 2. Experiment

Experiment has an important meaning to confirm the availability of infrared video. First, we set up an ordinary video and an infrared video at the corner of the hall, where an event was being held, and track passengers for three hours.

We used this data for the abstraction of background. Second experiment is to provide a variety of situations to examine the possibility of infrared video. For example, the case when passengers are crossing, the case when and where affected by shadows and other changes in lighting, climate and so on. As the case may be, we are going to try various kinds of situations.

### 3.Methodology of analysis

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The process of analysis is as follows. At first, we acquired the background images, and next step is that we subtract background images from the original data. So we can track only moving object. After this process, we compared two different data.

### 3.1 Acquiring background images

We used the data that we mentioned first of third chapter as the sample of acquiring background images. Figure1 and Figure2 are the start and end files of motion picture. The length of time in the final presentation, we should process longer movie file. During this span, the man in front of camera wearing white jacket were moving from left to right. The others did not move noticeable.

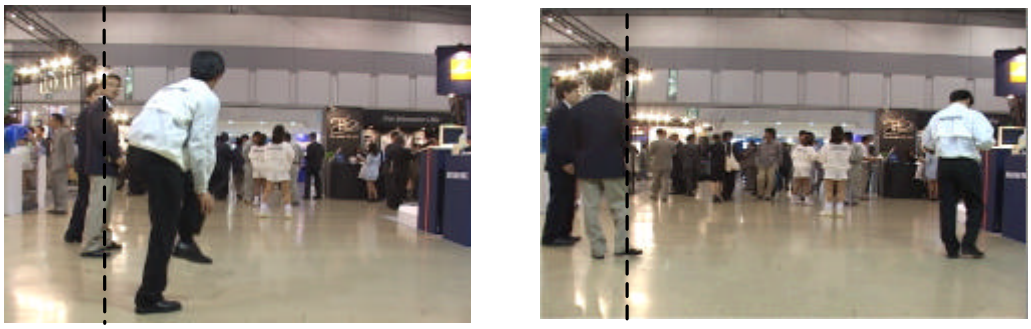

Fig.1: Start and End picture of motion picture (ordinary video)

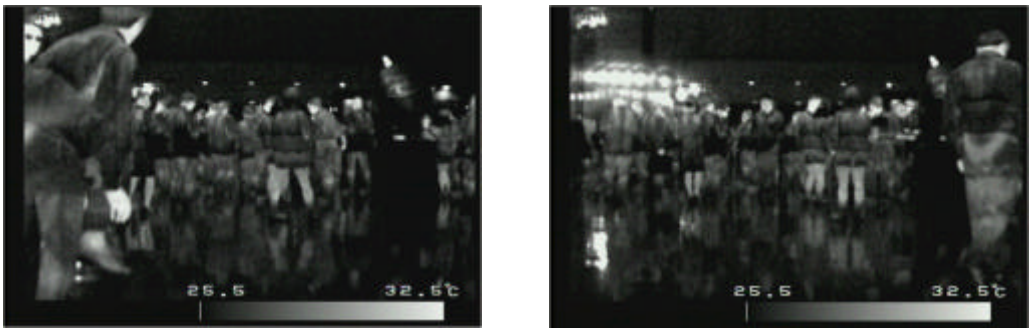


Fig.2: Start and End picture of motion picture (infrared video)

Using these data we analyzed. First, we divided these motion pictures into still pictures in the form of BMP file. A second motion picture was divided into 30 still pictures. Second, we counted pixel data in every pixel (Fig.3), and

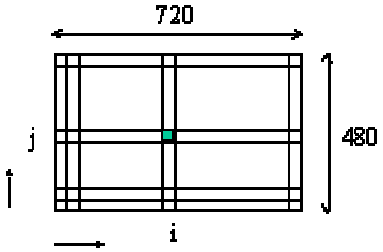


Fig.3: pixels of BMP file

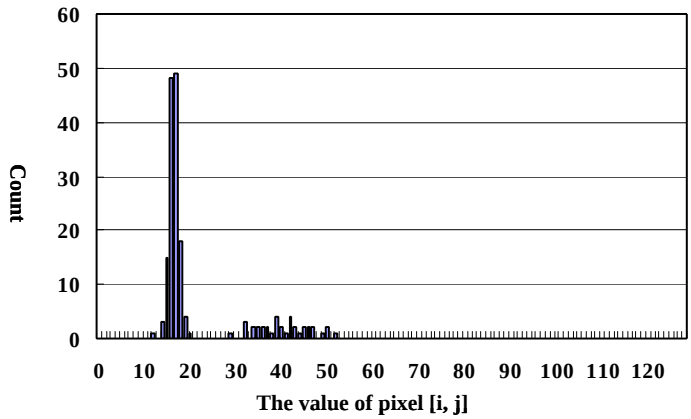


Fig.4: Histogram of the value of pixel [i,j]

made a histogram such as Fig.4. The value of pixels is the average of R, G, and B colors value. By using this graph, we determined the peak of the histogram as the value of background picture. By subtracting background, we could obtain the data of moving object by oneself.

**3.2 Tracking passengers**

After subtracting background, we label moving object. The method of tracking moving object is yet to be determined.

**4. Result**

The results of abstracting background images are as follows (Fig.5 and Fig.6). In case of ordinary video method, the area near the frame, where passengers did not emerge, is clearly abstracted as we had expected.


Fig.5: Background image (ordinary video and infrared video)

People who did not move noticeably are recognized as background because the time span of measuring was too short. So this problem will be settled if you measure for a long time. The aim of this test is the abstraction of the man who passed in front of video. And there are some white colored noises, because the man who we focused stopped at the center of this image for a while. Picture on the right hand is infrared video data. In similar, People who did not move noticeably are recognized as background, and the solution is the same. People, light and the hot area warmed by light are abstracted as white.

By subtracting background from original picture, we acquired the image of moving objects (Fig.6 and Fig.7). Figure6 is the image of ordinary video data. In this case, the crucial point is the shading contrast of background and moving objects. When the contrast is not remarkable, therefore, binarization is not so easy. In the case of infrared video data (Fig.7) shading is dependent on temperature, so it is easy to determine threshold value by focusing on the value of skin, especially on face and binarization becomes easier, too. But, this method has a problem that it is difficult to abstract objects when there are heat sources behind them.

Fig.6: Subtracting background image (ordinary video)

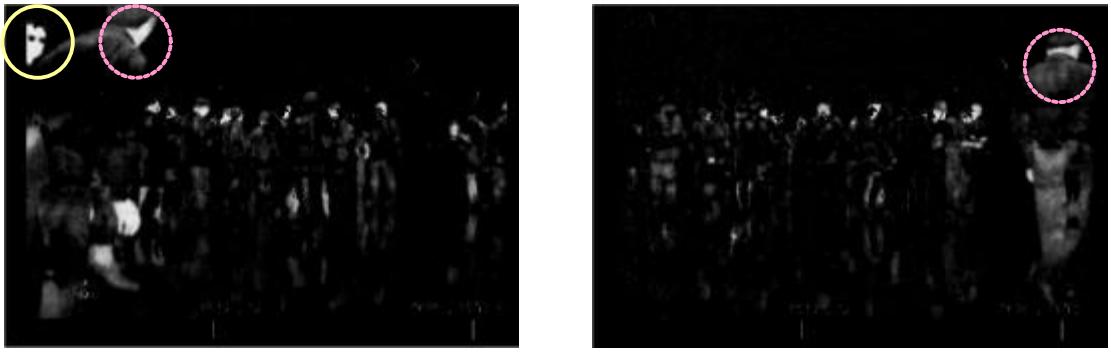

Fig.7: Subtracting background image (infrared video)

**5.Conclusions**

In this experiment, we have just extracted moving objects both from infrared and ordinary video data. Because the infrared image, surface with relatively high temperature can be extracted by simple threshold techniques, labeling moving objects will be easier than in case of ordinary video. At the conference, we will present full results ranging from the extraction of moving objects to the tracking through experiment designed to highlight the difference between infrared video and ordinary video.

**6. Reference**

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