Invited Papers

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Background Image Generation Keeping Lighting Conditions of Outdoor Scenes

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Abstract

In the Sensing Web project, we have proposed the concept of "Henshin" camera, which is a kind of cameras and outputs only privacy-invasion-free information in order to open and share this information in the Web. The information thus should not contain appearances of people in the captured scene but just their positions and the background image of the scene. In this paper, a novel method is proposed to generate the verisimilar background image which well expresses the weather and the lighting condition of the scene. This method collects a huge number of images by super long term surveillance, classifies them according to their time, and applies the eigenspace method so as to reproduce the background image without any appearances of the people in it. We experimentally evaluate the results of this approach using data of several surveillance cameras.

Keywords: Background Generation, Super Long-Term Surveillance, Eigenspace Method

1. Introduction

To open and share real-time sensory data, we have started the Sensing Web project [1]. Once such real-time sensory data is opened and shared in the Web, it will be useful for many purposes. However, the data, especially that obtained by cameras, includes privacy information which we can identify them. Therefore, privacy protection of sensory data is an important topic for this purpose.

"Hensin" Camera is a one of the fundamental technique in the Sensing Web for privacy protection. This camera aims that anyone can get real-time information of the observed area from anywhere through the Internet. Therefore the output of the camera must keep as much information of the scene as possible while insuring privacy-protection. It is realized by generating a background image which includes completely no people, and overlaying symbols which give detected people positions onto the generated background image for each frame. For this process, people detection and background generation is required. In this paper, we concentrate a background generation for generating the verisimilar background image. In the outdoor scene, there are shadows with sharp edges and its movement caused by solar position. Therefore, keeping lighting conditions is necessary for conveying much real-time information like weather.

Pixel-wise temporal median for image sequence is applicable for the background generation. In order to follow the background changing, short term image sequence is used for the background generation. However, people who stop for the term appear in the generated image. For generating the background, we, therefore, have to analyze images collected by much longer term than people might stop. The eigenspace method is often used to analyze images collected by long term surveillance. Using the eigenspace method, we can analytically generate the background images [2]. If there are only luminous variations in the background, we can easily generate the background by the linear sum of a few eigenvectors in a small dimensional eigenspace which calculated by the

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eigenspace method. For the gradual changing of sharp shadow edges, however, it is difficult to generate the background by linear sum, so that keeping lighting conditions like sharp shadow edge is difficult (Fig.1).

Fig.1. Eigenspace method could not reflect sharp shadow edges.

In this paper, we propose a background generation technique the shadow movement accurately in outdoor scene. We realize it by the eigenspace method with collecting the images which observed in the same time of the other days based on super long term surveillance.

2. Eigenspace Method for Background Generation with Super Long Term Surveillance

The traditional eigenspace method is not applicable for keeping the gradual variation, because moving sharp shadow edges correspond to the bases of small eigenvalues in the traditional method. We assume that the shadows appear in the same position if it is observed in the same time of different days. We collect images with super long term surveillance and classify them by the same time of different days. These image sets include the images which have same spatial appearance of shadows.

We apply the eigenspace method to the image set, and then we can get the background keeping lighting conditions for each target frame.

We experimentally evaluate the results of the traditional eigenspace method and our proposed method comparing the generated background images.

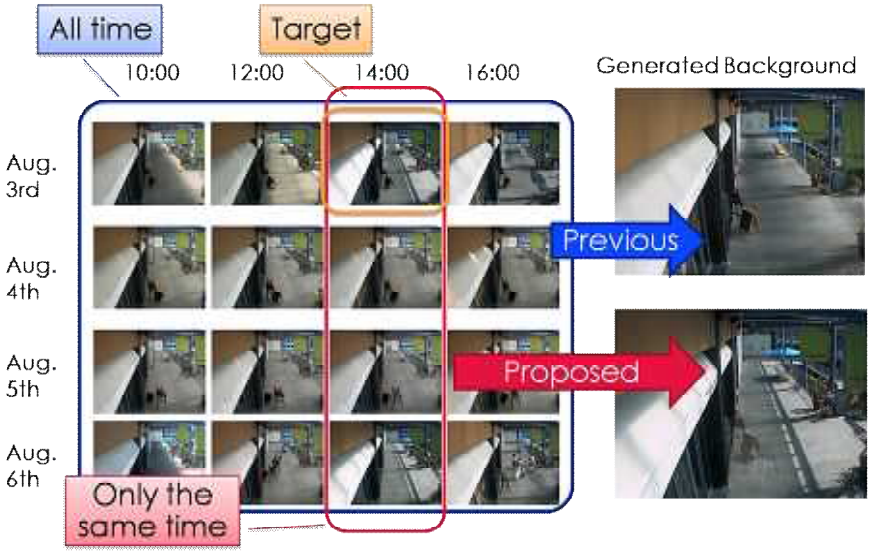

Fig.2.This is the background generation process. We applied the eigenspace method and our proposed method to the image observed at 14:00 Aug.3rd and got the backgrounds. We generated the eigenspaces with 1 month images. For our method, we use images 5 minutes around 14:00 of everyday. The shadows appear clearly in the result of our method, while the shadows do not appear clearly in the result of the previous method.

References

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