

Chapter 1

Illumination Independent Moving Object Detection Algorithm

ABSTRACT

A new, simple, fast, and effective method for moving object detection to an outdoor environment, invariant to extreme illumination changes, is presented as an improvement to the shading model method. It is based on an analytical parameter introduced in the shading model, background updating technique, and window processing.

1. INTRODUCTION

In recent years extensive investigations and analysis have been done in the domain of moving object detection. Detection of moving objects in video processing plays a very important role in many vision applications. The vision systems that include image processing methods are widely implemented in many areas as traffic control (Inigo, 1989), (Mecocci, 1989), (Rourke, 1990), video surveillance of unattended outdoor environments (Foresti, 1998), video surveillance of objects (Corall, 1991), etc.

The change detection algorithms implemented in these video systems provide low-level information that can be used by higher level algorithms to determine the information desired (the trajectory of an object, the control of traffic flow, etc). Methods for moving object detection must be accurate and robust so that complex video systems can operate successfully.

Most of the existing algorithms for moving object detection assume that the illumination in a scene remains constant. Unfortunately, this assumption is not valid, especially in outdoor environment. The efficiency of some of existing techniques diminishes significantly if the illumination varies.

There are two types of methods that realize moving object detection. One detects changes at pixel level and the other is based on feature comparison. The first method is better because of very fast detection of any kind of changes in the analyzed scene and it is implemented in the technique proposed in this paper.

Considering the fact that the image frequency in video sequence is 25 frames per second the real-time video processing demands simple and fast algorithms. Simple differencing methods or fixed background extraction realized by various operations related to threshold determination are thus dominating in applications. The efficiency

of these methods depends mostly on accuracy of background updating techniques and on the threshold choice.

A new, illumination independent method for moving object detection in outdoor environment, based on the shading model method (Faithy, 1995), is invented. Shading model method shows to be superior to other techniques if illumination is allowed to vary. The experiments were performed that apply this method to the whole image. Since this is time consuming, only two successive frames were included. There was just a slight illumination change between them and new objects appeared in the second frame.

In the new approach the shading model method is applied as a basis for moving object detection in video sequence with illumination changes. Two major improvements are proposed here:

- Processing of windowed segment of the image.
- Background updating technique.

Only windowed segments of images where the moving object is expected are processed. In this way the execution time is significantly reduced.

Background updating technique on a frame-by-frame basis is also introduced. According to the performed experiments, the shading model method is effective only when applied in parallel with background updating. An improvement of this method is introduced that makes it work well even when there is a moving object detected in the scene (when background updating is locked out which makes the algorithm susceptible to illumination changes in that period).

A range of experiments with different type of illumination changes has proven the efficiency of the proposed method.

2. THE SHADING MODEL METHOD

2.1. Moving Object Detection

Moving object detection algorithms usually take two consecutive images as input and return the locations where differences are identified. These differences can be caused by the motion of an object, (including its entering and leaving the scene), changes in illumination or noise. The aim of such an algorithm is to locate only the changes that are due to structural changes in the scene, i.e. a moving object. Moving object detection and extraction from the fixed background in the analyzed scene is mostly done by simple subtracting the current image and background image (that does not contain any moving objects), (Inigo, 1989), (Mecocci, 1989), (Rourke, 1990), (Foresti, 1998), (Corall, 1991), (Skifstad, 1989).

The applied subtracting operation finds an absolute difference for each pixel, thus detecting moving objects (that have brighter or darker gray value), which usually differ from the background. If the difference is below a certain threshold, there is no change in the scene and the observed pixel is regarded as if it belongs to the background. Otherwise, there has been a change and the pixel belongs to the moving object. The absolute subtracting algorithm can be presented by

$$\text{IF } D = | C - B | > T$$

$$O = 1 \text{ (object)}$$

ELSE

$$O = 0 \text{ (background)} \quad (1)$$

where C is the value of the corresponding pixel of the current image, B is the value of the corresponding pixel of the background image, D is the absolute difference of the current and back-

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