Detection and Ignorance Method of False Targets during Object Detection

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ABSTRACT
Detecting areas of change in various images of the same scene taken at different times is of broad interest due to a large number of applications in sundry areas, including remote sensing, surveillance, medical diagnosis and treatment, civil infrastructure, and underwater sensing.
In video surveillance systems very often other than target objects are observed (hereinafter false targets), which are of no importance for the surveillance and disturb the detection of real targeted objects.
There are private systems of video surveillance, where it is important to consider the possible appearance of false targets beforehand to ignore them.
This article presents the development of general steps for ignoring false targets and the rules of main distinction for the above mentioned private systems of video surveillance.

Keywords
Change detection, video surveillance, false targets ignorance, predictive target areas

1. INTRODUCTION
Detecting areas of change in images of the same scene taken at different times is of broad interest due to a large number of applications in various areas. Important applications of change detection include video surveillance [1], [2], [3], remote sensing [4], [5], [6], medical diagnosis and treatment [7], [8], [9], [10], [11], civil infrastructure [12], [13], underwater sensing [14], [15], [16] and driver assistance systems [17], [18]. Despite the different types of applications, change detection researchers apply a lot of general processing steps and core algorithms.
The presence of false targets leads to wrong results of object detection and waste of time of the algorithm.
This article aims at

1. Search for the false targets
2. Foresee the appearance of potential false targets (by using Kernel Matrix Method)
3. Ignore the false targets while detecting the real target

Here we concentrate on the private systems of video surveillance, where the detection and the ignoring of false objects are important.
In private spaces, where the penetration of an object is forbidden, surveillance cameras are installed with the help of which the space is being watched. Different objects can penetrate into these places, for instance cars, people, animals, tractors and other objects. In these cases it is impossible to foresee and distinguish the type of the object. With the help of the method described in the article "Hidden and Unknown Object Detection in Video", it is possible to detect any object which will appear in the area, as the algorithm fixes any change in the field of view [2]. In open areas under surveillance, such as yards, farms, the presence of such objects, which can move in natural climatic conditions, is possible. For instance, in areas under surveillance the presence of a tree is probable which can sway in case of a wind. As a result of a sway, the movement generated by a tree will lead to a change of pixels of the image. The change being immediately fixed by the algorithm will lead to the sign of the appearance of a new object. The changed area will be marked as a new object. This will bring two problems:

- The detection of an additional object will lead to a wrong result
- Waste of time of the algorithm

2. PROBLEM DESCRIPTION
Let us consider a case when with the help of a camera an area is being watched where the penetration of an object is forbidden (Image 1).

Image 1. The area under surveillance

Image 2. The presence of an object

Any object can penetrate into the area under surveillance and the person or the group responsible for the surveillance of the area cannot foresee what objects can appear in the area. In Image 1 the detection of an object is of utmost importance in the railway station. As the area under surveillance is open it is possible to have a change of intensity of light in the image because of change of the position of the sun or weather. At that time the penetrating object is vague and by implementing the method described in the article "Hidden and Unknown Object Detection in Video", any object can be detected [2].
The object will be detected (as can be seen in Image 3) once the algorithm is implemented in Image 1 and Image 2.

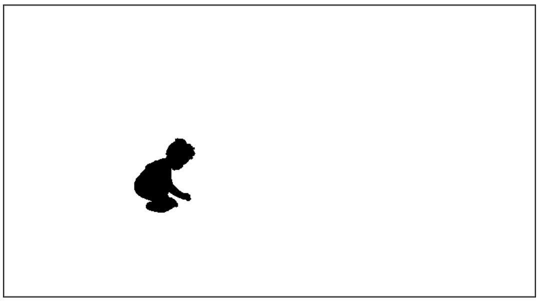

Image 3. The detection of the object in the area under surveillance

Nonetheless, let us consider an area where there is, for instance, a tree. (Image 4). During the day even from a very mild wind in the area under surveillance the tree will start to move.

Image 4. The area under surveillance

Image 5. The tree at the moment of movement

In Image 5 the tree is depicted at the moment of movement because of wind.

As a result of the movement of the tree the pixels in the image change. If we compare the initial image, where the tree was static, with the current image with the principle of XOR bitwise comparison we will have the black space as illustrated in Image 6.

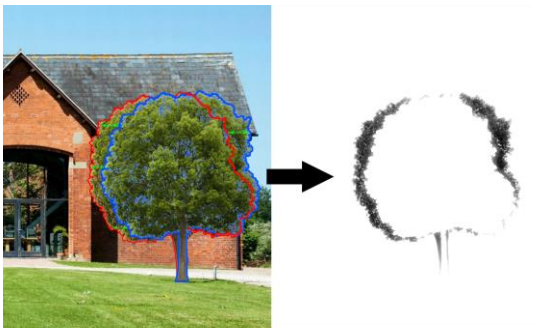

Image 6. The result of the comparison

Image 7. The presence of the object in the area under surveillance

As it can be seen in Image 6, we got black pixels which form black spaces altogether, which we will call “detoured” areas (which are considered to be false targets in our case).

Provided, after some time of surveillance, an object appears, which is an animal, for instance a horse (Image 7).

As we got convinced from the previous example of the case of the absence of a tree, the considered object, the horse, would immediately be detected after the comparison. In case of the presence of a horse, along with the presence of the horse we will have the aforementioned detoured areas as a result (Image 8).

Image 8. The presence of detoured areas in case of the detection of the object.

As we could see additional areas appear which leads to: first- a flaw in the functioning of the algorithm of object detection, second- the waste of time.

It is obvious how fatal can be the quick and accurate detection of an object for preventing threats for human lives in such places as, for instance, railways and railway stations.

3. SUGGESTED METHOD

A method has been developed to detect and ignore the detoured areas (false targets) to ensure the accurate detection of objects. The areas containing false targets in the image will be called areas of errors.

It is evident that the detection of areas of errors has an important role, as while comparing the images the real object can be detected only due to ignorance of the error areas.

3.1. Detection of false targets

In open areas, even when there is no wind, the objects potentially subject to movement, do not stay totally static, for instance, in case of trees, leaves can have slight movement.

While installing the surveillance camera for the first time, the first image is fixed automatically, which will be saved by the system as an initial image.

According to the method described in the article "Hidden and Unknown Object Detection in Video" while recording a new image is taken every second and is compared with the initial one.
The aim is to detect detoured areas and to ignore those areas every time while executing a comparison.
After saving the initial image, the recording continues for 30 minutes (the mentioned time span is designed for configuration) and the system fixes the objects which are inclined to move and cause the appearance of detoured areas.
During the surveillance every second an image is taken and saved. The object generating detoured area is detected and fixed at the moment of its greatest movement. After the surveillance the saved images are compared with the initial image one by one, with the help of which the image with the greatest deviation is detected. The comparison method described in the article "Hidden and Unknown Object Detection in Video" is executed for the comparison. The image containing the utmost number of black pixels will be the image with the greatest deviation. The latter will be chosen again automatically by the system. We will call it an error image. The numeric matrix of the error image will be marked with Latin letter W.

3.2. The principle of expanding the area of error

As different weather conditions can lead to greater amplitude of tree fluctuation (the latter will bring the expansion of the error area) and in the course of short-term surveillance it is impossible to distinguish the area of error accurately, then the next important step will be the expansion of the area of error. This will help the system to foresee the possible area of error.
To expand the area of error, the following matrix method will be implemented for matrix W.
This is being done in the process of image comparison to eliminate the factor of error. This will contribute to the more accurate detection of the real object penetrating into the area in the future.

3.3. The Matrix method

As a basis of the algorithm of implementing Blur on images is the principle of the usage of Kernel Matrix. To expand the area of error a similar principle is executed. It is possible to take Kernel Matrix of any size, but in this case let us consider the matrix of 3x3 size for accuracy.
Going through every pixel of the area of error saved by the system (W matrix) we check whether the given pixel is white or black. If the pixel is black then we execute the matrix method (Image 9).

i-1, j-1	i-1, j	i-1, j+1
i, j-1	i, j	i, j+1
i+1, j-1	i+1, j	i+1, j+1

Image 9. The Matrix Method of supplementing the range of pixels with black pixels

We consider -i, j- the current position of matrix W and we blacken the surrounding $(i-1; j-1), (i-1; j), (i-1; j+1), (i; j-1),$ $(i; j+1), (i+1; j-1), (i+1; j), (i+1; j+1)$ pixels.

The values of the newly gained domain are saved in the new W matrix.
By blackening all the white pixels surrounding the black ones the area of black pixels expands (Image 10).

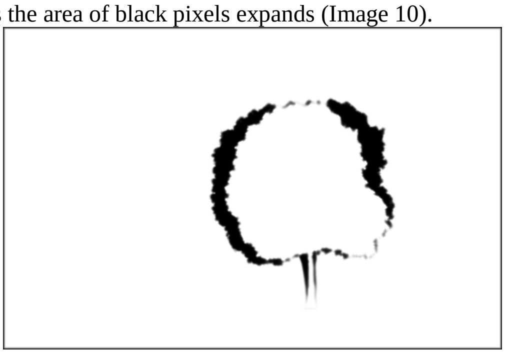

Image 10. The expanded area

Afterwards, we are going to try to find an object in the current image by ignoring the previously detected area of error (black pixels of W matrix). Once the recording starts, the initial image is fixed by the system. It will be noted with Latin letter A, and the current image with the letter C. –A- matrix is of n, m size. It is obvious that the sizes of matrices C and W are also n and m.
Any pixel (i; j) of matrix W is a three-dimensional vector (1).

$$W'_{ij} = (r_{W'ij}; g_{W'ij}; b_{W'ij}) \quad (1)$$

The comparison algorithm of images through ignorance of error areas of block scheme (Image 11).

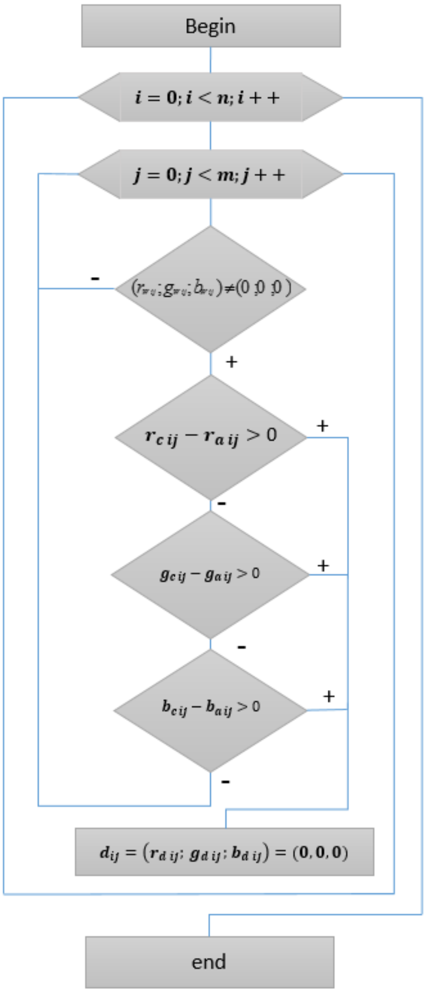

Image 11. Block-Scheme

4. CONCLUSION

Thus, a method has been developed for surveillance systems based on the principle of change detection, where it is important to ignore the possible appearance of false targets. For the implication of the method, the following steps have been developed: 1-search for false targets.2-algorithms for considering the appearance of potential false targets. 3- the algorithm of ignoring false targets.

The developed method contributes to accurate and comparatively quick functioning of surveillance systems.

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