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Real Time Target Securing Based on Image Processing

Michael Daniel Nachipyangu
College of Electronics Engineering
Tianjin University of Technology and Education
Tianjin, P.R China

XueWen Ding, Shemsa Selemani Ngambeki
College of Electronics Engineering
Tianjin University of Technology and Education
Tianjin, P.R China

***Abstract*——- Real time target Securing based on Image processing provides the capability to ensure the safety of the immovable object with any intrusion or obstruction to the target. Immovable object on this topic refers to the objects which are rarely touched or visited but they have to be secured all the time such as shelves of money at the banks or any valuable assets which stay still. The designed system is able to detect if there is any obstruction or disturbance to the target and alert the operator with a message also showing the security level graphs which indicate the matching percentage of each frame as matched with the frame when the object is safe. Matching the frames is done by edge detection where number of white points and black points are used to measure the differences of the frames.**

I. INTRODUCTION

For many years monitoring of the behavior, activities, or other changing information has been a vital process, usually for the purpose of influencing, managing, directing or protecting people or valuable assets, in so doing different approach was used such as watch men, human intelligence agents later by the distant observation with the aid of CCTV(Closed Circuit Television). Despite the use of camera still there is a need of making the camera self working to accomplish the task of securing a certain target.

The aim of this paper is to give a practical overview of object securing technique for a live video feed from a fixed camera. The system is built with capability to analyze frame by frame and check whether the target has been disturbed or taken or obstructed. It uses the image processing technique to accomplish this task. The extraction of geometric features from the image with the use of Edge detection enables the system to make the camera more intelligent and accomplish the objectives of this work to design the system that will autonomously watch the target object.

II. EDGE DETECTION

Edge detection is the name for the collection of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges, with regard to the change in intensity at that point, if an appreciable change occurs at a given pixel in the image, then a black pixel is placed in the binary image, otherwise, a white pixel is placed there instead.

Fig 1. The picture of the mouse and its edge detected image

A. Prewitt Edge Detection

It is one of the edge detection techniques to an image, where it detects vertical and horizontal edges. Edges are calculated by using difference between corresponding pixel intensities of an image. All the masks that are used for edge detection are also known as derivative masks. All the derivative masks should have the following properties; opposite sign should be present in the mask, sum of mask should be equal to zero and more weight means more edge detection.

B. Prewitt Operator

The Prewitt operator is used in image processing, particularly within edge detection algorithms. Technically, it is a discrete differentiation operator, computing an approximation of the gradient of the image intensity function. At each point in the image, the result of the Prewitt operator is either the corresponding gradient vector or the norm of this vector. The Prewitt operator is based on convolving the image with a small, separable, and integer valued filter in horizontal and vertical directions and is therefore relatively inexpensive in terms of computations. On the other hand, the gradient approximation which it produces is relatively crude, in particular for high frequency variations in the image.

Mathematically, the operator uses two 3×3 kernels which are convolved with the original image to calculate approximations of the derivatives - one for horizontal changes, and one for vertical. If we define A as the source image, and G_x and G_y and are two images which at each point contain the horizontal and vertical derivative approximations, the latter are computed as:

$$G_x = \begin{bmatrix} -1 & 0 & +1 \\ -1 & 0 & +1 \\ -1 & 0 & +1 \end{bmatrix} * A \ \ and\ \ G_y = \begin{bmatrix} -1 & 0 & +1 \\ -1 & 0 & +1 \\ -1 & 0 & +1 \end{bmatrix} * A \qquad (1)$$

Where $*$ here denotes the 2-dimensional convolution operation.

Since the Prewitt kernels can be decomposed as the products of an averaging and a differentiation kernel, they compute the gradient with smoothing. Therefore it is a separable filter. For example, G_x written as;

$$\begin{bmatrix} -1 & 0 & +1 \\ -1 & 0 & +1 \\ -1 & 0 & +1 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} \begin{bmatrix} -1 & 0 & 1 \end{bmatrix} \qquad (2)$$

The *x*-coordinate is defined here as increasing in the "right"-direction, and the *y*-coordinate is defined as increasing in the "down"-direction. At each point in the image, the resulting gradient approximations can be combined to give the gradient magnitude, using:

$$\mathbf{G} = \sqrt{\mathbf{G}_x{}^2 + \mathbf{G}_y{}^2} \qquad (3)$$

Using this information, we can also calculate the gradient's direction:

$$\Theta = atan2(G_x, G_y) \qquad (4)$$

Where, for example, $\mathbf{\Theta}$ is 0 for a vertical edge which is darker on the right side.

III. IMAGE MATCHING

Image matching refers to the finding of parts of two image which matches, the extent of matching can be Image matching is one of the very useful techniques in image processing particularly in tracking and in manufacturing is used in quality control. Image matching technique described in this paper involves the use of edge detection to match two images and obtain the matching percentage.

A. How to obtain Percentage of Matching

The two pictures are undergoing edge detection and obtain the binary image which has black and white points. Picture 1(x, y); x, y is the coordinates which shows the position of pixels which are either black or white.

Picture 1(x, y) **Picture 2(x, y)**

The number of white points are calculated for the picture1, the second picture Picture2(x, y) is matched with picture1 by calculating the number of white points that correspond to both pictures at the same point (x, y).below is the formula used

$$Percentage\ Of\ matching = \frac{Number\ White\ points\ on\ Picture1}{Number\ Matched\ white\ points}\ X\ 100\% \qquad (5)$$

In this paper the picture1 is obtained by capturing the first frame and save it, picture2 are the proceeding frames where the matching percentage is calculated with each proceeding frame.

The threshold is used to determine whether the two images matches or not, in this paper according to the experiments it is set 50%, this is the amount which found to meet the criteria where there is threat or not to the object, if the matching is 50% and above then the object is safe and below it the object is in danger.

IV. PRACTICAL IMPLEMENTATION AND RESULTS

The designed system has the Graphical User Interface for the easy to use and to be more realistic instead of being for laboratory use and studying. The GUI gives the view of security level of the object and the target object secured also start and exit buttons

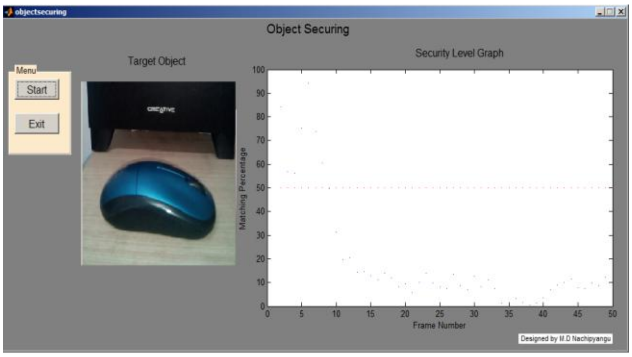

Fig 2. The picture of the interface of the system

The results obtained after starting the system is the graph which shows the security level and the message which alert the operator on the threat to the target or update on the safety of the object.

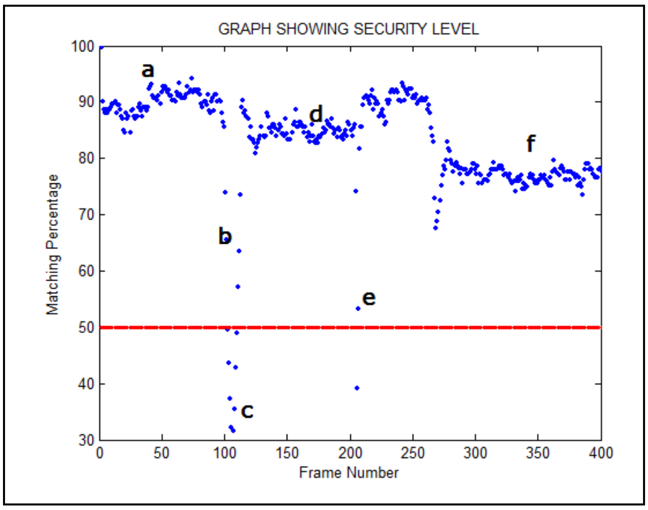

Fig 3. Graph showing security level of the object for the first 400 frames processed with the red line showing the threshold.

```
total_matched_percentage =

   47.5098

Alert =

 Target in danger, DIFFERENT PICTURES

total_matched_percentage =

   92.7261

Update =

 Target secured, SAME PICTURES
```

Fig 4. The message received by the operator.

The message the operator is updated for each processed frame, the message is according to the matching percentage if it is 50% and above it says target secured, same picture and if it is below it says target in danger different pictures.

(a) (b) (c)

(d)(e)(f) Fig 5. The frames showing different status of the target object which correspond to the above graph as indicated with letters a, b, c, d, e and f respectively

V. CONCLUSION AND FUTURE WORKS

The system is working fine as it can alert any intrusion, obstruction or when the target object to be secured is taken, this mark the other use of image processing technique in securing stationary objects with fixed camera. Despite the system working fine below are my recommendations for the future work; The system should first detect the target object then process the frames to avoid the false threat detection to the target object when an object just a appear on the picture but does not touch the target object, with this model used in this project that will appear as a threat but it is not. The object can be taken and returned shortly but with model it will present as a threat to the target object but it is not. These are among the tasks that the future work should consider improving the system.

Lastly the system will be more valuable when built in an independent hardware and use big screen TV to show graphs and message for alert.

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