EFFICIENT BORDER DEFENCE SYSTEM USING IMAGE PROCESSING

Aswathy J R(jraswathy@gmail.com), Ann Jesuine Joseph(jesuineannjoseph@gmail.com), Rinna Sabu(rinnasabu@gmail.com), Vidya B(vidyavichu23@gmail.com).

Department of Electrical and Electronics Engineering, Lourdes Matha College of Science And Technology, Lourdes Hills, Kuttichal, Trivandrum, Kerala, India

ABSTRACT---India is widely believed to have arrived on the global state. India has successfully positioned herself as one of the core members of influential nations. But the security scenario of India has attracted more vulnerability and complexities like never before as India has the disadvantage of being situated in close proximity to what is being described as the epicenter of global terrorism.We aimed to find a suitable and effective solution for the above mentioned problems. Here by it clarifies the significance of an automatic firing system which will replace soldiers with its effective protective measures. Our defense system comprises of features like video recording, automatic human recognition, automatic motion sensing, automatic firing etc. this system, video cameras and mat lab processing in hand with embedded system can not only detect intrusion attempts, but also provide a video coverage of the suspicious area, for remote vigilance. Also our system can withstand extreme climatic condition, thus requiring less maintenance. In this concept we have designed a promising prototype, which on further development with sufficient time and resources, can be raised to international level.

Index terms--- defence, intrusion, embedded system, skin, RGB, image processing.

I. INTRODUCTION

Presently our borders are protected by iron spike fences and a watchtower containing soldiers, continuously flashing the light over the border area. Those persons are fully responsible to prevent any intrusion. This system will not fully remove the responsibility of the soldiers, but manages to take the maximum responsibility and thus reduces human mistakes on the border. The basic purpose of the paper is to enhance the border security electronically with automation and with that to reduce the work load and responsibility of the soldiers who has to work continuously on the border [1].

To accomplish this we propose a mechanism which will employ image processing in which a camera will be continuously observing the area under surveillance [2]. This data will be then processed by a MATLAB code, which will be running on a computer and will be able to detect the presence of intruder inside the border. Depending on this processed data the information about the intruder location will be sent to a microcontroller (PIC16F877A) [9] through the serial port and then a servomotor controlled gun will be used to point in the direction of the intruder. This mechanism will be online, that is the gun will be continuously pointing the direction of the intruder [10]. Further depending on range, that is distance from the gun it can be activated and the target will be shooted down.

II. PROPOSED BORDER DEFENCE SYSTEM

The block diagram of the proposed system is shown in figure 1.

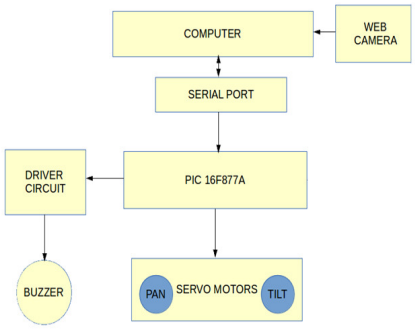

Figure 1: Block diagram of proposed system

The block diagram represents the components of the proposed system, which includes the web camera, computer, serial port, microcontroller, servomotors, buzzer and driver circuit for activating it. Web camera is for the purpose of recording and monitoring .When an intruder crosses the border, web camera identifies and gives the video input to the computer. Computer processes the video by using the mat lab program and determines the X-Y position coordinates of the intruder and the angles to which the servomotors has to be moved to focus the intruder. Computer gives this data to the

microcontroller, which is linked with the computer through a serial port enabling the communication of signal processing unit with the microcontroller. For the working of the microcontroller, a program has to be installed in it and that we have done using mp lab software. According to the signal obtained from the computer, microcontroller controls servomotors (pan and tilt) and buzzer [3]. Microcontroller activates the servomotor to which the gun is attached and it will be delayed by the pulse width obtained after processing the data from the mat lab in the microcontroller. Here pulse width is taken into account because servomotor is a pulse activated motor. After determining the pulse width microcontroller activates the buzzer through a driver circuit, informing that there is someone inside the border. Now the gun in the servomotor shoots the intruder.

III.PROCESSING OF VIDEO SIGNAL

After receiving the video from the camera, computer performs following operations for processing the video signal for the purpose of human identification [7].

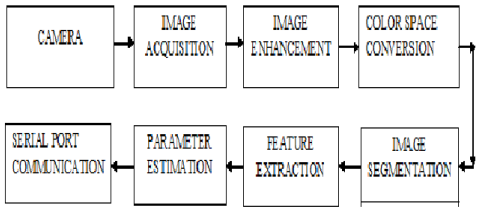

Figure 2: Block diagram of video signal processing

A. IMAGE ACQUISITION

The process of obtaining an image from a hardware based source, after which it can be passed through whatever processes need to occur afterward is called image acquisition in image processing. It is always the first step in the image processing. The image that obtained will be completely unprocessed and is the result of whatever hardware was used to obtain it. So it will be easier to locate and eliminate the abnormal factors present in the image reproduced when a source of input is operated within controlled and measured guidelines.

Two important factors involved in image acquisition are the initial setup and long-term maintenance of the hardware which is used to capture the images. Here the actual hardware device used is camera. If the camera is not properly configured and aligned, then visual artifacts may be produced that can make the image processing complicated. Also it may provide such low quality images so that they cannot be extracted even with extensive processing.

. In real time image acquisition images are obtained from a source that captures images automatically and creates a stream of files that can be automatically processed and queued. One common technology that is used with real-time image processing is known as background image acquisition, which describes both software and hardware that can quickly preserve the images flooding into a system.

B. IMAGE ENHANCEMENT

Image enhancement improves the interpretability of information in images and provides better input for other automatic image processing techniques [4]. In image enhancement the principal objective is to modify attributes of an image to make it more suitable for a given task and a specific observer. During this process one or more attributes of the image are modified. Choice of attributes and the way they are modified are selected depending on the task. The image enhancement methods are broadly classified into the following two categories:

1. Spatial Domain Methods

2. Frequency Domain Methods

Spatial domain techniques directly deal with the pixels in image. Here pixel values are changed to achieve required enhancement. In frequency domain methods, the image is first transferred in to frequency domain. Here at first the Fourier Transform of the image is computed. Then in the Fourier transform of the image all the image enhancement operations are carried out. Then the Inverse Fourier transform is determined to get the resultant image. Enhancement operations are done to modify the brightness of images and contrast or the distribution of the grey levels. As an outcome the pixel value of the output image will be modified according to the transformation function applied on the input values. Here spatial domain methods of image enhancement are used.

C. COLOR SPACE CONVERSION

Using RGB color space or HSV color space color vision can be processed. RGB color space describes colors in terms of the amount of red, green, and blue present. HSV color space describes colors in terms of the Hue, Saturation, and Value. The HSV color model is often preferred over the RGB model in situations where color description plays an integral role. The HSV model

describes colors similarly to how the human eye tends to perceive color. RGB defines color in terms of a combination of primary colors, whereas, HSV describes color using more familiar comparisons such as color, vibrancy and brightness [11].

• Hue is representation of the color type. It can be described in terms of an angle on the above circle. The hue value is normalized to a range from 0 to 255, with 0 being red.

• Saturation is representation of the vibrancy of the color. Its value ranges from 0 to 255. Lower the saturation value, more gray is present in the color.

• Value is representation of the brightness of the color. Its value ranges from 0 to 255, with 0 being completely dark and 255 being fully bright.

• White is having an HSV value of 0-255, 0-255, 255. Black is having an HSV value of 0-255, 0-255, 0.

D. IMAGE SEGMENTATION

Image segmentation refers to the separation of an image into a set of regions that covers it. Groups of pixels having both border and a particular shape are known as regions. When the interesting regions do not cover the whole image, we can think about segmentation.

Segmentation has two objectives. The first objective is to classify the image into parts for further processing and analysis. The second objective of segmentation is to perform a change of representation. Image pixels must be organized into higher-level units that are more efficient for further analysis.

E. FEATURE EXTRACTION

It starts from an initial set of measured data and builds features intended to be informative, non redundant, facilitating the subsequent learning and generalization steps, in some cases leading to better human interpretations. It is also related to dimensionality reduction [5].

It deals with the reduction of amount of resources required to describe a large set of data. Analysis with a large number of variables generally requires a large amount of memory and computation power which over fits the training sample and generalizes poorly to new samples. To get around of these problems feature extraction is a general term giving data with sufficient accuracy.

$$I=R+G+B \quad (1)$$

Each color component value can be normalized with the brightness value I as follows:

$$r = R / I,\ g = G / I,\ b = B / I \quad (2)$$

$$\text{where } r + g + b = 1 \quad (3)$$

$$H1 = COS^{-1}\frac{0.5[(R-G)+(R-B)]}{\sqrt{(R-G)^2+(R-B)(G-B)}} \quad (4)$$

$$H1=\begin{cases} H1 & \text{if } B\le G \\ 360°-H1 & \text{if } B\ge G \end{cases} \quad (5)$$

$$V=\frac{Max(R,G,B)}{255} \quad (6)$$

$$S=\frac{(Max(R,G,B)-Min(R,G,B))}{(Max(R,G,B))} \quad (7)$$

Condition for skin:

$0 \le H \le 50$

$0.2 \le S \le 0.68$

$0.35 \le V \le 1$

$0.396 \le r1 \le 0.496$

$0.28 \le g1 \le 0.36$

F.PARAMETER ESTIMATION

In parameter estimation the pan and tilt angle position of the intruder is calculated using MATLAB commands.

IV. HARDWARE IMPLEMENTATION

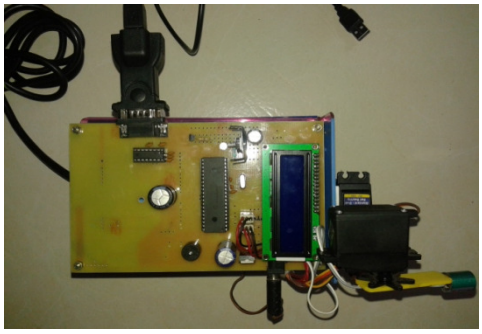

Figure 3: Hardware implementation

Output from the computer is transferred to the microcontroller through a serial port. Here the heart of the controlling unit is the microcontroller (PIC16F877A). As explained in the above section, the location of the suspected object is determined by the image processing algorithm. When the object is detected, the micro-controller performs two functions. First is to activate the peripheral device buzzer, to indicate the presence of the object. Secondly, to take the decision in order to control the movement of the gun that is attached on the servomotors.

After receiving the pan and tilt angle from the mat lab, microcontroller activates the buzzer through the driver circuit. Since servomotor is a pulse activated motor, microcontroller determines the pulse width corresponding to the pan and tilt angles obtained from the mat lab. Then the servomotors are moved according to these pulse width values. After aiming, the microcontroller triggers the gun.

In this system there are two servomotors: Pan servomotor and tilt servomotor. Pan servomotor makes the movement of gun in the horizontal position and tilt servomotor in the vertical position. Compared to other motors servomotors are having several advantages like: high torque, high precision in position control, fast operation etc. In the proposed system, rotation is limited to 180°. Therefore servomotors are more suitable [6], [8].

V. RESULTS AND DISCUSSIONS

Figure 4: Output obtained from MATLAB

Figure 4 shows the output obtained from MATLAB. In the figure red box indicates the bounding box showing the skin portion and the blue sign indicates the centroid of the portion.

VI. CONCLUSION

This paper presents an intelligent border defence system with automatic aiming, targeting and triggering. This system will reduce the work effort of soldiers in the border. Since it is a fully automated system there will not be any manual error and hence it is more accurate. By using night vision cameras it can work continuously. It is not so expensive and requires less maintenance. It can also withstand extreme climatic conditions. In this concept we have designed a promising prototype, which on further development with sufficient time and resources, can be raised to international level.

VII. ACKNOWLEDGEMENT

We would like to acknowledge our project guides in Institute of Human Resources and Development, Trivandrum for graduate assistantship and providing facilities for the research. Also we would like to thank our guides in Lourdes Matha College of Science and Technology, Trivandrum who have been of immense help and support throughout this work.

VIII. REFERENCES

[1] Shoaib Mughal, Tahir Qadri, M.Tayyab, M. Shiraz Alam Khan and Zia Mohy Uddin, “Automated Gun Security System”, International Journal of Advanced Research , Volume 2, Issue 3 , 244-249, Pakistan(2014).

[2] Laxmi Nidhi, Pratyusha Roy, Srishty Nayak, Rajine swetha R, “Unmanned gun control mechanism”, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 2, Issue 5, May 2013

[3] Bartosz Tworek, Alexandre Bernardino and Jose Santos-Victor , “Visual Self-Calibration of Pan-Tilt Kinematic Structures” (2006).

[4] S.S. Bedi, Rati Khandelwal , “Various Image Enhancement Techniques- A Critical Review”, India (2013).

[5] Wei Ren Tan, Chee Seng Chan, Member, IEEE, Pratheepan Yogarajah, and Joan Condell, “A Fusion Approach for Efficient Human Skin Detection”, Vol. 8, No. 1, February 2012, pp.138-147,(2012).

[6] Harsh Kotak Dhruv Mehta ,D.J Sanghvi, “Automatic targeting system”, International Journal of Electronics and Communication Engineering (IJECE), India.(2013).

[7] Swapnil V. Tathe and Sandipan P. Narote, “Real-Time Human Detection and Tracking”, India, Annual IEEE India Conference (INDICON), 2013.

[8] Shih-An Li, Chung-Wei Weng, Yi-Hong Chen, Chia-Hung Lo, Min-Hao Yang, Yi-Chun Lin, Ming-Hua Hsieh, Ching-Chang Wong, “Servo motor controller design for robotic manipulator”, IEEE International Symposium on Intelligent Signal Processing and Communication Systems (ISPACS), 2012, pp.254-257.

[9] Osman Kalender, Yavuz Ege, “A PIC Microcontroller Based Electromagnetic Stirrer”, IEEE Transactions on Magnetics, Vol. 43, No. 9, September , 2007, pp.3579-3585.

[10] Robert M. DeMarco, Florence B. Chua, Michael T. Bergen ,Kenneth R. Short, Richard J. Servatius, “Virtual Targeting in Three-Dimensional Space”, IEEE, 2015, pp.1-2.

[11] Leyuan Liu, Nong Sang, Saiyong Yang and Rui Huang, "Real-Time Skin Color Detection under Rapidly Changing Illumination Conditions", IEEE, 2011, pp.1295-1302.