Optical Safety System

Dr. Ayad Z. Mohammed
Laser and Optoelectronics Engineering Department, University of Technology/Baghdad
Email: Baghdadayad_1967_2005@yahoo.com
Wadah Hatim Salim
Ministry of Science and Technology/ Baghdad
Email:Shamery77@ yahoo.com
Dr.Bushra R.Mhdi
Ministry of Science and Technology/ Baghdad
Email:boshera65m@gmail.com

Received on:22/11/2015 & Accepted on:22/6/2016

ABSTRACT

Laser fence is a mechanism used to detect objects that passes vision line between the laser source and optical detector. While, Motion detection theory is the operation of detecting a variation in the location of a body relative to its environment or a variation in the circumference relative to a body. Therefore, this work provides an intelligent link between those two methods using optical communication, by using a new method for detecting moving objects from static background based on different window frames, which achieves the most efficient security system based on high assessment. This assessment was achieved by using visual basic language to evaluate the system. The system program is by using c# as program language to detect a penetration.
Keyword: Laser Fence Technique, Motion Detection Theory, Smart Camera

INTRODUCTION

Laser beam crosses within long farness without dispersion influence and the beam is approximately secret. Accordingly, the laser safety system can create an unseen barrier of a sensitive zone [1]. Smart cameras can execute functions far beyond just obtaining images and registering videos. Smart cameras can discover motion, measure bodies, peruse car number plates, and also characterize human demeanors. They are indispensable elements to construct energetic and automatic predominance manners for many implementations, and they will form important effect in the everyday life [2,3].

As an example of using smart cameras, traffic road-signs contain useful information for the road users; the operation of many of modern applications like the automatic or smart vehicle requires an automatic discrimination of the texts of the traffic road-sign. Discrimination of text compose of several stages, the first of these stages is detection and extraction of the texts [4]. Also as an example, character recognition has been very popular and interested area for researches, and it continues to be a challenging and impressive research topic due to its diverse applicable environment [5].

A laser fence is a detection device for providing a warning signal in response to an intrusion by an intruder in a limiting area. A laser fence includes a laser generator for generating a laser beam. Also, first mirror is aligned with the laser beam for reflecting the beam to a second mirror. A second mirror is aligned with a third mirror for reflecting the beam to the optical detector [1]. Figure (1) has shown an example of this system.

https://doi.org/10.30684/etj.34.12A.4
2412-0758/University of Technology-Iraq, Baghdad, Iraq

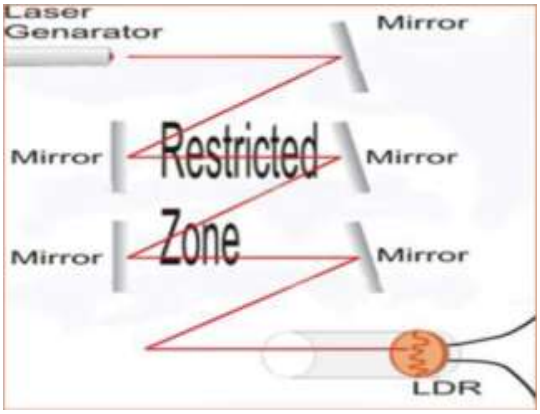


Figure (1): Laser Fence System

This method is one of the best manners that be used by programmers. This manner uses the principle of subtraction of the present picture and the background picture to discover movable bodies. The theory including the first scene picture is stowed as the reference picture. Then the present scene picture with the pre-stowed picture then outcomes in background subtraction, and if pixel picture is larger than confirmed value, then it defines pixel to pixel on movable bodies or as reference pixel [6,7]. The selection of specific value of background subtraction is highly significant to execute detection. If the threshold magnitude is very little, it will cause a lot of fake values on the background .If the threshold magnitude is very huge, it will lower the scope of variations in the motion. Therefore the selection of dynamic specific value would be opted [8,9]. The background subtraction manner is secondhand to discover movement by comparing the pixel magnitude of variation picture with threshold magnitude provided by programmer in the software. As exhibited in table (1), any person in movement is said to be discovered when pixel magnitude is more than the threshold magnitude. Threshold magnitude is supplied according to the requirements depending on ambience.

Table (1): Comparison of threshold value and movement disclosure

Comparison of threshold magnitude and pixel magnitude	Movement Detection
Pixel magnitude < threshold magnitude	Movement is not present
Pixel magnitude > threshold magnitude	Movement is present

The detection processes are:

- **Difference of Two Successive Frames[10]:**

I_M is assumed to be the magnitude of the reference scene. I_{M+1} is the magnitude of the scene in picture series. The Pixels Variant (σ) is definite as follows:

$$Id\ (M, M+1) = |I_{M+1} - I_M| \quad \ldots\ldots\ldots (1)$$

- **Comparison with threshold value[7]:**

The program compares the pixels variant values (σ) with a given threshold (T) .This research takes the threshold value (T) to be (0.001).

- **Transformation of Unambiguous Differentiation picture to Gray picture [9,10]:**

There are apertures in animated body zone, and circumference of animated body is not shut. The unambiguous differentiation picture is converted to gray picture to ease other processes. The gray pixel value is defined as follows:

$$Y = 0.299*R + 0.587*G + 0.114*B \quad \ldots\ldots\ldots (2)$$

Where: R, G and B are the red, green and blue color components.

The ideas of smart webcam and laser fence systems have made an important role in all practical researches during the past twelve years. Many security systems have focused on this approach. Many researches around the world have investigated advantages which exploit the computer programs specialties with a view to develop new security system. In 2012, D. Paul *et al.* [1] introduce laser security systems that have high technical creativity for protection. The plain design makes this project in low budget. The characteristics of the system can be development more of traditional protection systems. The technical innovations make this system one between affordable security system options.

In 2013, Cy. Tuscano *et al.* [2] demonstrated that smart webcam system is a safety system that can be of efficient where safety is a problem of disturbance. The motion detector patches up for the need of an inexpensive safety system in everyday life. Electronic security can develop a lot with the upcoming future. Security system is promising and easier with innovative technologies. Also, Sa. Aminu *et al.* [3] has explicated that the MDSS would demand lesser requirements for it to operate as anticipated due to the motion detection rule. The program records just when it discovers motion, therefore, averting stockpiling of needless. This enterprise too warns and informs the viewer of motion in order to he is conscious of a motion in the place.

In 2014, M. P. Lavanya [6] used an unprecedented manner to discover motion exploiting the algorithm. Video surveillance and detection method was thus progressed happily. The enterprise primally equips a competent style for supervision intents and is directed to be greatly useful for any user. This system is adaptable to the webcam that were shown as discovered motion in another styles due to their over susceptibility. Experiential consequences revealed that this style is more competent in outer space as it can evade the commotion in motion detection. Also, Ni. Singla [7] used the manner of motion detection that categorizes of scene variation style and formal processes. The apparent aim of the doing is learning the rule of scene variation style and to process the several complications.

In 2015, P.Lalitha Devi and S.Srividya. [9] used each possible background pixel that can be chosen to carefully upgrade the suitable background form at each scene. Moreover, this style uses the cauchy forms to discover animated bodies. Subsequently, generate the exact motion detection. Furthermore, this style can be handily applied in supplied manners with finite sources for the sight oriented implementation of the smart transfer manner.

The aim of this work is to achieve an efficient security system depending on specific assessment and quantitative evaluation. The other project aims to convert webcam to smart camera as well as the technique of communication optically as computer interface. An interconnection between motion detection (by camera) and laser fence (by control circuit) is optically by using only LED. Therefore, the optical communication is a new idea to reduce the required cost. Also, this project has programs to achieve holistic system optically, electronically and programmatically. The first program is used to detect the security breach and the second is used to evaluate the system performance by utilizing the c# and the visual basic.

Experimental work

The electronic system circuits consist of two parts. The first is transmitter and the second is receiver. A transmitter circuit has been built with a laser pointer at wavelength (650nm) which has an output optical power (5mW), 3 volt D.C. source, and a control switch. In the receiver circuit, there is a centering LDR detector to discover the laser ray constantly. The LDR detector also carries with a holder and it is correlated with the prime control circuit. If anyone crosses the invisible beam, the control circuit will discover the severance by LDR and operate the warning element. This enterprise has constructed with lower expenditure and more fulfillment. The power exhaustion of the system is highly little.

This system is a safety ingredient that comprises the use of motion detection as a safety management. It exploits the webcam as video provider, checks the scenes, and verifies if there is motion, then it causes the video recorder, which spontaneously commences registering the video. It compresses the video so as to minimize the hard disk size consuming and write down it bit by bit so as to characterize the time handily. The system too causes an alarm to award warning of security breach in the region under control. The language C# was employee in the updating of the enterprise. The system was examined by using another program for making sure that every the requisites are operating faultlessly as anticipated. The system program allows for the watcher to use the webcam as smart camera. The interface allows for a watcher to record the video of a specific camera to a specific file in a computer disk. The watcher can at any time set his eye on any camera. For each camera, the program can enable the motion detection, alarm sound on motion and automatic recording on motion.

The figure (2) shows cameras operating exhibition while it was registering due to the motion detection. It is the shape that arises when the implementation is operated; all works are started from this frame.

Figure (2): Main Form (System Program)

The system program activates the motion storage on a video form in hard disk, thereby reduces the video volume that will store. The Figure (3) shows below the program algorithm:

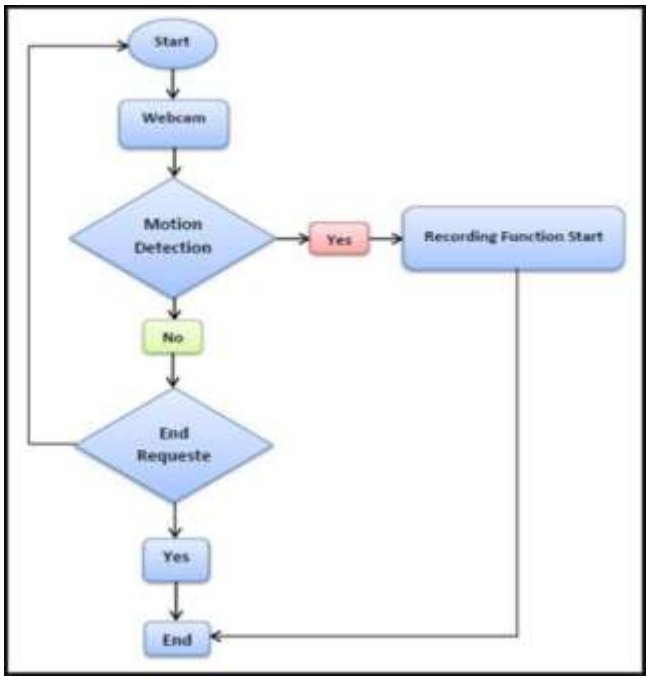


Figure (3): Program Algorithm

This research introduces simulator system model over area of ($0.5m^2$), as shown in Figure (4). It has been relying on automatic man to be caused the penetration in this simulator model. The purpose of this model is to clarify the idea of laser fence system by simple manner.

Figure (4): Simulator System Model

An interconnection between motion detection (by camera) and laser fence (by detection circuit) is optically by using only LED with the near the camera lens for providing interface with computer, as shown in figure (5). The optical communication is a new idea special for this work to reduce the required cost and increase the communication speed.

a. LED is not radiant when the laser fence has not been penetrated. **b. LED is radiant when the laser fence has been penetrated.**

Figure (5): Optical Communication

The experimental data explicate that the change in the pixel different means movement had occurred from the present frame to reference frame. If the pixel variant was zero from the present to reference frame, movement would not appear. In this work, the language visual basic was used in the examination and assessment of the work. The figure (6) below shows the prime form of the examination program.

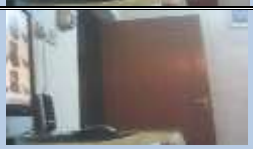
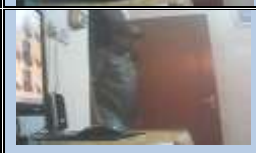
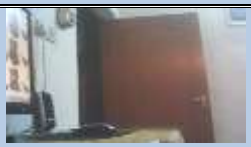
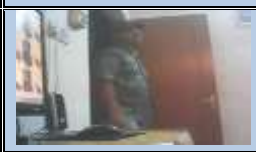
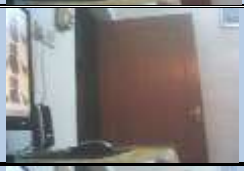
Figure (6): Main Form (Assessment Program)

Results and discussion

This work introduces a laser fence circuit (transmitter, receiver) and connects it to the system computer and check for input each period of time. If there is any input then run the record program and start to capture video. Additionally, the system program takes an image from a webcam every period of time (make it the present image) and compare it with a reference image .If the program detect a big variation among them, it will start to store video.

The system Program compares the pixels variant values (σ) with a given threshold (T) .This research takes the threshold value (T) to be (0.001). Here has been taken nine consecutive frames for assessing this system. The experimental data are shown in the table (2) which related to this project.

Table (2): Pixels variant values for nine pairs of frames

Frames No.	Pixels Variant (σ)	Reference Frame	Different Frames	Conclusions
0 and 1	0			A movement of person is nonexistent.
0 and 2	0.2540			A movement of person is existent and increasing by comparing with the former frame.
0 and 3	0.2603			A movement of person is existent and increasing by comparing with the former frame.
0 and 4	0.2571			A movement of person is existent and decreasing by comparing with the former frame.
0 and 5	0.2805			A movement of person is existent and increasing by comparing with the former frame.
0 and 6	0.2881			A movement of person is existent and increasing by comparing with the former frame.
0 and 7	0.2205			A movement of person is existent and decreasing by comparing with the former frame.
0 and 8	0.2662			A movement of person is existent and increasing by comparing with the former frame.
0 and 9	0.2916			A movement of person is existent and increasing by comparing with the former frame.

The relation between motion and frame for nine pairs of sequent frames is resumed of graph in the figure (7).

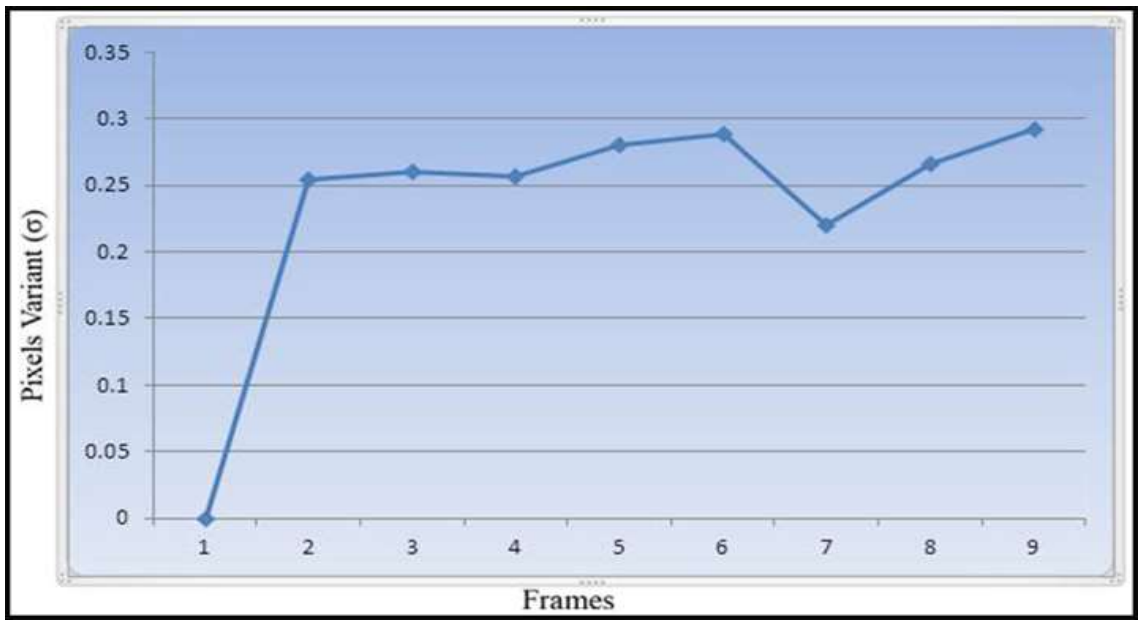


Figure (7): Graph of Motion Detection

Conclusions

The following conclusions for all the processes drawn from this work are listed here:

1- The system detects the person that jumps over or under the laser fence. This is a security system that can easily be controlled by watcher.

2- The simple electronic design makes this system in lower budget. Therefore it will be the first among cheaper security systems.

3- There are two special programs for this project by using C# and visual basic as programming language.

4- The system consumes low power.

5- The system features are a high life time, low cost and low demands in service and maintenance.

6- The supreme system features is that the communication between computer and detection circuit is optically by using only LED with the near the camera lens. This optical communication is new idea special for this project to reduce the required cost and increase the communication speed.

7- The laser fence is really virtual invisible fence that appoints penetration site.

8- The system program executes many actions such as the basic DVR functionalities, reduce the video storage volume in hard disk and can avoid the noise in movement detection that helps to reduce the number of wrong positive alarms.

REFERENCES

[1] D. Paul, Md. Shohel Rana and Md. Mokarram Hossain, "A preview on experimentation on Laser security system", IRACST – Engineering Science and Technology: An International Journal (ESTIJ), Vol. 2, pp. 359-366, April 2012.

[2] Cy. Tuscano, B. Lopes, S. Machado and Pr. Rane, "Smart Web Cam Motion Detection Surveillance System", International Journal of Modern Engineering Research (IJMER), Vol.3, pp. 1169-1171, March-April. 2013.

[3] Sa. Aminu, Ib. Muhammed Abba, Ba. Isa Dodo, M. Torres-Dela Cruz and U. Eaganathn,"Motion Detection Security System (MDSS) in Live video stream", Proceeding of the International Conference on Artificial Intelligence in Computer Science and ICT (AICS 2013) , Vol.1, pp. 188-197, November 2013.

[4] A. Rahma, T. Wala Aldeen Khairi," A Novel Algorithm To Detect and Extract The Texts of Road-Sign Plates in Video Scenes", Eng. &Tech.Journal, Vol.34, Part (B), No.2, pp. 180-193, 2016.

[5] L. Fayeq Jalil, M. Mohsen Mohammed," A Modified Back Propagation Algorithm for Assyrian Optical Character Recognition Based on Moments", Eng. &Tech.Journal, Vol.34, Part (B), No.2, 2016.

[6] M. P. Lavanya," Real Time Motion Detection Using Background Subtraction Method and Frame Difference", International Journal of Science and Research (IJSR), vol. 3, pp. 1857-1861, June 2014.

[7] Ni. Singla," Motion Detection Based on Frame Difference Method", International Journal of Information & Computation Technology, Vol.4, pp.1559-1565, 2014.

[8] F. Hassan AL_Kathy , "Digital Video Automatic Segmentation Algorithms Using Edge Detection", Eng. & Tech. Journal, Vol.28, No.12, 2010.

[9] P.Lalitha Devi and S.Srividya," BMM Based Cauchy Distribution (BMMC) Method for Motion Detection", International Journal of Emerging Engineering Research and Technology, Vol. 3, PP 86-92, April 2015.

[10] Bi. Wang, Ji. Pan and Ya. Liang, "Video image motion detect based on Matrox card", Proceeding of Northwest University, Vol. 2, pp. 38-45, 2004.