

## Surveillance System based Motion Detection using the Image Sequence Difference Algorithm

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**Abstract:** Sometimes, there are cases in Intensive Care Unit (ICU) in hospital need to be monitored continuously to take a certain action in case of any movement by the patient such as coma cases and does not know when will happen. This study proposes a smart surveillance system for monitoring a coma patient in ICU by using frame difference algorithm to recognize any motion in front of web camera installed in ICU room to provide continuously watchful eye for patient, the idea of the proposed system is capturing a frame each 1 sec then comparing with previous adjacent one by making difference between them and doing decision depending on the comparison result, the surveillance system provides sound alert to call observers and then records streaming video in case of motion detected in order to provide a suitable treatment. The system programmed using Microsoft Visual Basic Net 2015 that runs on computer under Windows operating system, Windows 7 or higher.

**Key words:** Motion detection, web camera, USB camera, frame difference algorithm, ICU, surveillance system, Microsoft Visual Basic Net 2015

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### INTRODUCTION

Motion detection has becoming an important issue everywhere. The need for surveillance systems has been quickly grown from being specialized for high-risk areas (like banks, hospitals, companies, governmental institutions) to be demanded and available rapidly by the average public. In recent developments a function smart motion detection can be done without human intervention and the system would be an alternative for expensive motion detection systems being used in the present day (Alaeldden and Mohammed, 2017; Davidovic and Labus, 2015). The motion detection based on low computing system "Raspberry Pi" where USB camera used to capture image when detected the unauthorized activity using pyroelectric infrared sensors has been presented in (Alaeldden and Mohammed, 2017).

This system is suitable for small personal area surveillance offices/homes bank locker room, parking entrance. Whenever pyroelectric infrared sensor detects the motion, the image captured through camera and saved in the Raspberry Pi compute module and then send to email sever. Thus, the application of internet of things used to get notifications and view the images of the motion occurrence based internet through email server.

A real-time an automated video surveillance system for motion detection, analysis and tracking presented in

(Zarka *et al.*, 2008). This system is applied to find foreground-pixels based on the background subtraction algorithm and then noise removing and object detection have been used, followed by human modeling to recognize human activities in the term of human walking or running. Singh *et al.* (2014) proposed a motion detection algorithm which is independent of lighting and dynamic variations, noise and bootstrapping problems. The proposed system represented pixel based non-parametric algorithm using just one frame to build the model. The foreground and background detection started from second frame onwards. It used new object tracking algorithm to detect and delete ghost objects quickly and to preserve abandon objects from decomposing to the background. Motion detection approach for automatic video analysis is proposed by Gaba *et al.* (2016). The vital information according to the moving objects, extracted from sequences in the continuous image using surveillance systems. The detection of the foreground and background of the object which represents the surrounding of the environment starting once the subsequent frame is captured. The proposed approach presented a pixel-dependent and non-parameterized algorithm based on the first frame to construct the model. An effective and simple motion detection system was introduced by Hossen and Tuli (2016) using the motion vector estimation of the video surveillance frames. Motion is detected using the proposed algorithm based edge

region determination which made detection fast and then the surveillance video is processed for motion estimation based on optical flow with Horn-Schunck algorithm. A surveillance system is suggested by Chandana (2011) for detecting the motion in streaming video and recording the video when the motion is detected, also tracking moving object based on background subtraction algorithm utilizing video surveillance.

This study mainly emphasis on the motion detection of a patient when the observer is away from the place or ICU. The proposed system is based on the web camera to detect the motion detection of a patient by using frame difference algorithm. The proposed system programed using Microsoft Visual Basic Net 2015 that runs on computer under Windows operating system, Windows 7 or higher. Whenever a motion detection in the camera area, it provides alert in the term of sound to the observer.

**The image sequence difference algorithm:** The frame difference algorithm (image sequence difference algorithm, the adjacent frame difference algorithm, etc.) is the common motion detection algorithm and widely used to detect the moving objects from a series of frames that captured by a fixed camera, depend on pixel-based difference using a very small time intervals  $\Delta t$  of the two frames before and after the pixel based on the time difference and then thresholding to extract the frame region of the movement according to which changes in the difference as can be seen in flowchart in Fig. 1 (Alex and Wahi, 2014). The corresponding formula is as follows (Singla, 2014; Patil, 2015):

**Two consecutive frames difference:**  $I_k$  is the kth frame value in image sequences,  $I_{k+1}$  is (k+1)th value of the frame in image series. The absolute of the differential image is expressed as:

$$I_{d(k, k+1)} = |I_{k+1} - I_k| \quad (1)$$

**Absolute of differential image to gray image transformation:** In order to facilitate further operations, the absolute of differential image will be converted to gray image.

**RGB to gray:**

$$Y \leftarrow -0.299 * R + 0.587 * G + 0.114 * B \quad (2)$$

**Filtering and binarizing of transformed gray image:** The gray image will be fed to the gauss low pass filter.  $I_{d1}$  image is found by filtering the gray image and then will be converted to binary image based on binary threshold, the obtained  $I_{d2}$  binary image can be express as follows.

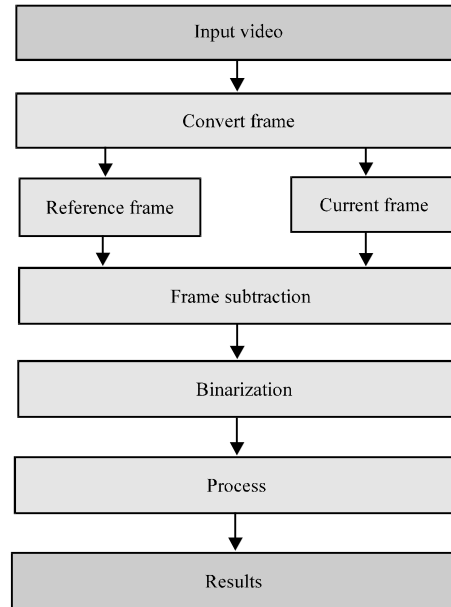


Fig. 1: Flowchart of frame difference algorithm

$$I_{d2}(x, y) = \begin{cases} 1, & \text{if } Id[x, y] > T \\ 0, & \text{Otherwise} \end{cases} \quad (3)$$

Where:

(x, y) = Represents an image pixel coordinates

T = Refers to threshold value

## MATERIALS AND METHODS

**Proposed system:** This system is proposed to be used in ICU at hospitals where doctors or nurses should treat important activities and need to leave the unit. It is also a 24 h monitoring watchful eye for patients who have fallen into a coma and do not know at what moment they will wake.

The proposed system uses a web camera installed in a room and operated by software installed on the PC and the internet used for communication. When camera detects any motion in front of its range. The software communicates to the observer based on internet network and at the same time it gives sound alert that fixed at the ICU door and records a video.

The proposed system programed using Microsoft Visual Basic Net 2015 that runs on computer under Windows operating system, Windows 7 or higher, this system needs USB camera to detect motion in a room, the system capturing images frequently each 1 sec and compares the new one with old and make decision according to matching using the frame difference algorithm if the two images are exactly the same this means no motion detected, else, if there is a simple difference the system would operate the alert that fixed at

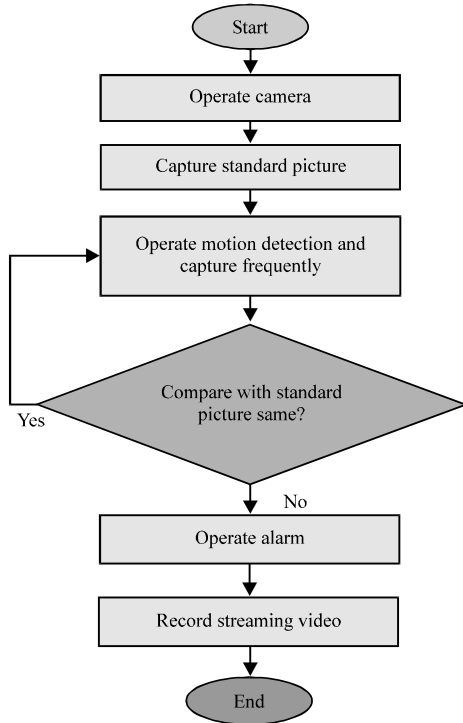


Fig. 2: Flowchart of surveillance system

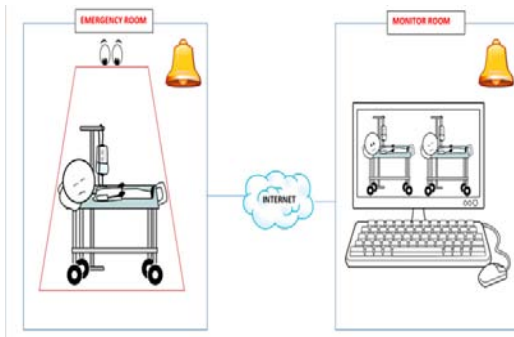


Fig. 3: Block diagram of detecting the surveillance system

unit room and monitor room and send email to relevant to tell the responsible person doctor, nurses there is motion detected inside ICU and from this moment there is video recorded to save the details. At the same time, the responsible persons can stop this system before enter the unit, in order to prevent the system to make alarm when he need to check patient. Flowchart in Fig. 2 shows the operation of the proposed surveillance system. This proposed surveillance system emphasises the real-time detection of any simple motion like eye blink as shown in the block diagram of Fig. 3.

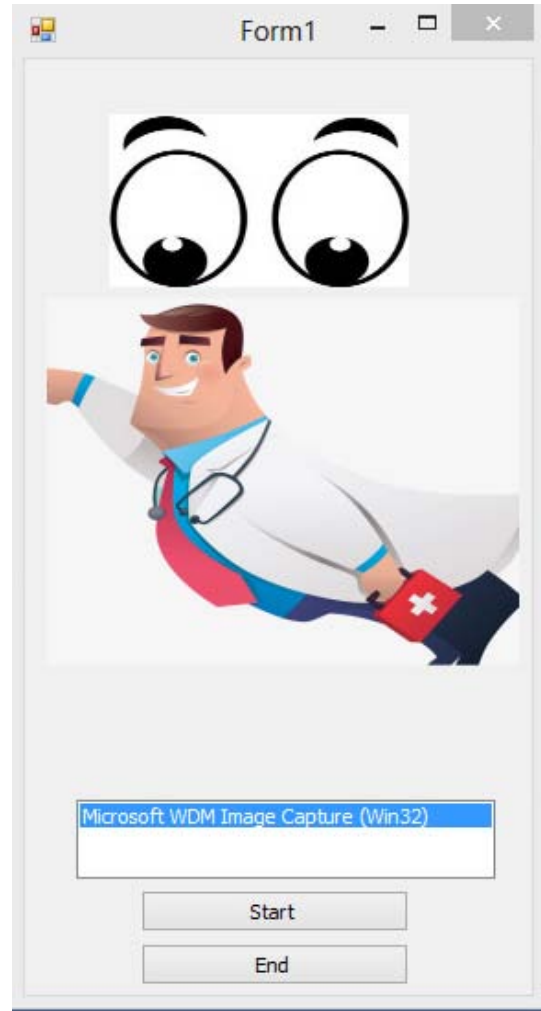


Fig. 4: GUI of surveillance system

## RESULTS AND DISCUSSION

The Graphical User Interface (GUI) of the proposed system is shown in Fig. 4 which is programmed as windows application in Visual Basic Net 2015 after running the program, the observer chooses the camera to be used in monitoring and then triggers the “Start” button to make the system does his work and later “End” button to end it. The proposed system is tested on the bed room (which is shown in Fig. 5). Where the child was sleeping and when he starts to open his eyes, the alarm operated and streaming video recorded. As long as the child is asleep without movement, the system will continue to monitor, until it senses any movement within the specified range it will send a sound alarm and then records a video, Fig. 6 shows some of the recorded video frames.

## CONCLUSION

The main objective of the project which is the design and implementation of surveillance system to be displayed through web based application has been done successfully. The system can be used in different environments and several places like houses, banks, hospitals, labs and other automated systems. But the system needs to be monitor always to keep connected to provide information to the user about what is happening in monitoring by sending alarm indication. This research presents possible solutions to the real-time problem of monitoring are valuables in observer's absence and provide storing video after motion detected in order to make right conclusion about it. Moreover, a low cost, no maintenance, easy to use, reliable work and important to depend the surveillance system. Human requirements never achieve a saturation point; everyone needs something more than what they have.

## REFERENCES

- Alaeldden A. and E. Mohmmed, 2017. Smart motion detection. IOSR. J. Electr. Electron. Eng., 12: 53-58.
- Alex, D.S. and B. Wahi, 2014. BSFD: Background subtraction frame difference algorithm for object detection and extraction. J. Theor. Appl. Inf. Technol., 60: 623-628.
- Chandana, S., 2011. Real time video surveillance system using motion detection. Proceedings of the 2011 Annual IEEE India Conference, December 16-18, 2011, IEEE, Hyderabad, India, ISBN:978-1-4577-1110-7, pp: 1-6.
- Davidovic, B. and A. Labus, 2015. A smart home system based on sensor technology. Facta Universitatis Ser. Electron. Energetics, 29: 451-460.
- Gaba, N., N. Barak and S. Aggarwal, 2016. Motion detection, tracking and classification for automated video surveillance. Proceedings of the 2016 IEEE 1st International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES), July 4-6, 2016, IEEE, Delhi, India, ISBN:978-1-4673-8588-6, pp: 1-5.
- Hossen, M.K. and S.H. Tuli, 2016. A surveillance system based on motion detection and motion estimation using optical flow. Proceedings of the 2016 5th International Conference on Informatics, Electronics and Vision (ICIEV), May 13-14, 2016, IEEE, Dhaka, Bangladesh, ISBN:978-1-5090-1270-1, pp: 646-651.

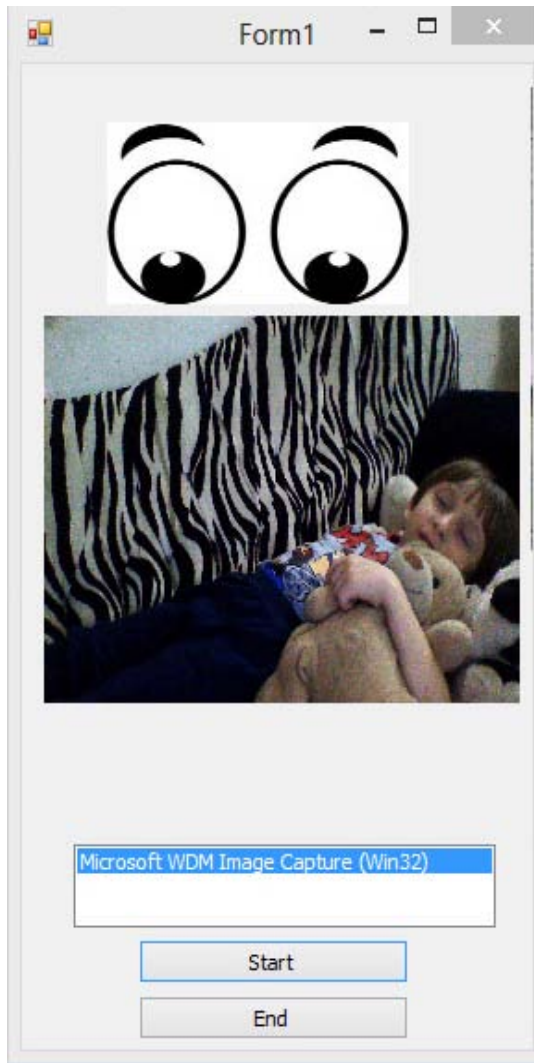


Fig. 5: Triggers the surveillance system

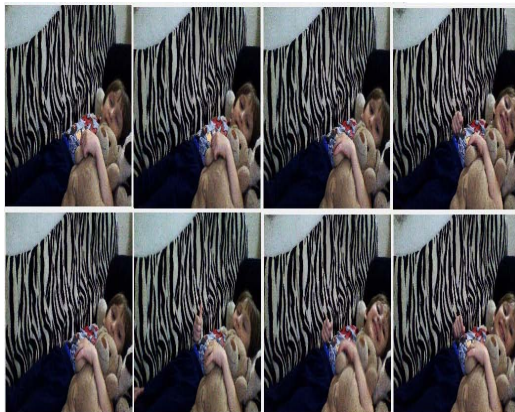


Fig. 6: Streaming video frames

- Patil, S.P., 2015. Techniques and methods for detection and tracking of moving object in a video. *Intl. J. Innovative Res. Comput. Commun. Eng.*, 4: 8116-8121.
- Singh, B., D. Singh, G. Singh, N. Sharma and V. Sibbal, 2014. Motion detection for video surveillance. *Proceedings of the 2014 International Conference on Signal Propagation and Computer Technology (ICSPCT 2014)*, July 12-13, 2014, IEEE, Ajmer, India, pp: 578-584.
- Singla, N., 2014. Motion detection based on frame difference method. *Intl. J. Inf. Comput. Technol.*, 4: 1559-1565.
- Zarka, N., Z. Alhalah and R. Deeb, 2008. Real-time human motion detection and tracking. *Proceedings of the 2008 3rd International Conference on Information and Communication Technologies: From Theory to Applications*, April 7-11, 2008, IEEE, Damascus, Syria, pp: 1-6.