MOTION DETECTION USING WEBCAM

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Abstract. This paper focuses on detecting motion in a live streaming video using optical flow algorithm. Technology in the modern world has grown rapidly, the technique used by thieves for robbery have been improved. So there is a need for surveillance system which is affordable to even common man. By using this method, it is possible to monitor and capture any motion within the area of interest in live streaming video. Once the motion is detected warning will be sent to user in the form of a message using modem. MATLAB will be used for implementation of the project.

Keyword. Live Streaming Video, Motion Detection, Optical Flow, Segmentation; etc.

INTRODUCTION --In recent years, motion detection has attracted a great interest from computer vision researchers due to its promising applications in many areas, such as video surveillance, traffic monitoring or sign language recognition.

Motion detection is the process of identifying a change in position of an object relative to its surroundings or the change in the surroundings relative to an object [6]. There is no perfect system or method which can overcome the various issues that are faced during the process of detection. The problems are generally associated with lighting condition of the surrounding, illumination of the object itself which is to be detected, speed of its movement or the type of object, appearance of a moving object can make a big influence on the instantaneous rate of change between the foreground motion information and the accumulative background optical flow information [7].

Among different techniques for motion detection i.e. temporal differencing [1], background subtraction[11] and optical flow[2], we choose to implement optical flow. Optical flow is an estimation of the local image motion and specifies how much each image pixel moves between current frame and reference frame. Optical flow is the distribution of apparent velocities of movement of brightness patterns in an image. Optical flow can arise from relative motion of objects and the viewer.

Thus we have aimed to build such a surveillance system, which can not only detect motion, but will

a) Warn the user of the intrusion by message and

b) Take picture and store it

Papers surveying the state of the art in the area appear every two to three years and provide good summaries of incremental developments in the field while serving as starting points for further reading.

METHODOLOGY
OPTICAL FLOW
The term optical flow denotes a vector field defined across the image plane. Optical flow calculation is a two-frame differential method for motion estimation. Optical flow technique is to estimate the motion vectors in each frame of the live video sequence. Estimating the optical flow is useful in pattern recognition, computer vision, and other image processing applications.

The method based on optical flow is complex, but it can detect the motion accurately even without knowing the background. Once the motion vectors are determined, we draw it over the moving objects in the video sequence. Storing the frames on the memory if motion is detected .The result of optical flow is shown as a binary image and the adaptive threshold is selected to distinguish the moving pixel from the still pixel. The pixels whose optical flow values are greater than threshold will be considered as moving pixels and are shown with motion vector

Out of the many methods and algorithms involved there are three main conventional approaches to motion detection-

Table 1.comparison of three conventional methods [8]

| *Methods*	*advantages*	*disadvantages*
Temporal differencing	Adaptive to dynamic environments	Poor job of extracting since it is not easy to obtain the complete outine of the moving object.
Background subtraction	Provides the most complete feature date with respect to the background.	Sensitive to the dynamic scene changes due to lighting and extraneous activites.
Optical flow	Detects independently moving objects	Cant be applied to full frame video streams

Two methods to calculate optical flow are:

Horn and Schunk[9] use derivatives to calculate the constraint on the flow vector, and then solve for the orthogonal component using a global method of minimizing a smoothness constraint.

 Lucas and Kanade[10] use a local method which calculates the flow vector using the constraints of a neighborhood around the pixel.

Equation

$$0 = I_t + \nabla I \cdot [u \quad v]$$

(1)
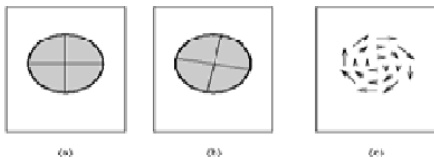
Fig 1.1 Optical Flow: (a) Time t_2, (b) Time t_2 ,(c) Optical Flow

- The component of the flow in the gradient direction is determined

- The component of the flow parallel to an edge is unknown

Technique

Assume Intensity changes in consecutive frames is due to moving frame .Let I denote the pixel intensity at location *(x, y)* at time *t* .Let us say that at time *t + dt*, the region at *(x, y)* undergoing a small translation *(dx, dy)*.The location *(x, y)* will now be occupied by the pixel that occupied *(x-dx, y-dy)* at time *t*. the intensity of that pixel is

$$I= \partial I/\partial x \; dx - \partial I/\partial y \; dy \tag{2}$$

The rate of change of intensity at (x, y) will be given by

$$\partial I/\partial t = -\partial I/\partial x \; dx/dt - \partial I/\partial y \; dy/dt \tag{3}$$

Denoting the flow that is *(dx/dt, dy/ dt)* as *(u, v)* ,we have the brightness constraint which is an equation that the components of the flow that satisfy at each pixel :

$$\partial I/\partial t + \partial I/\partial x \; u + \partial I/\partial y \; v = 0 \; , \tag{4}$$

although *(u, v)* is unknown .the partial derivatives can be solved by using the method of finite differencing.

For human body segmentation, these regions correspond to moving body part.[3]

CODING LANGUAGE

MATLAB is a computer program that provides the user with a convenient environment for performing many types of calculations[4].

Advantage of MATLAB:

a) Easily affordable.
b) Programming skills are not required.
c) MATLAB allows its users to accurately solve problems, produce graphics easily and produce code efficiently.
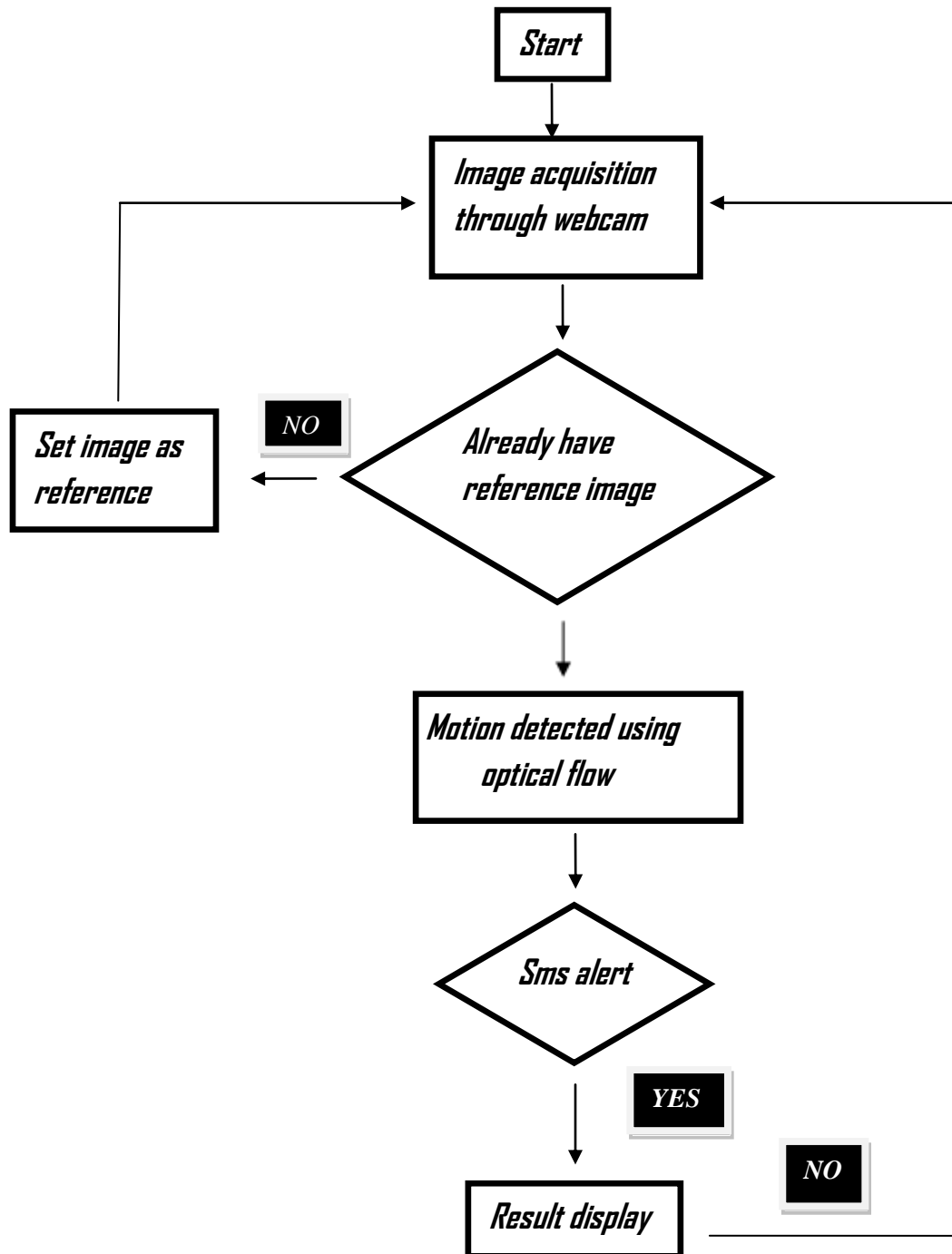
AT(attention) COMMANDS

In 1981, Hayes developed the **Hayes Smart modem**[12].AT commands are also called as Hayes command. It was possible to send commands to the modem to configure it, to execute certain operations (such as dialing a number, quieting the speaker, hanging up, etc.), and to read the current status of the connection[5].we use AT commands for sending SMS to user's mobile.

Table 2 showing a list important AT commands used for this project for writing and sending SMS messages.[13]

AT command	Meaning
+CMGS	Send message
+CMSS	Send message from storage

AT command	Meaning
+CMGW	Write message to memory
+CMGD	Delete message
+CMGC	Send command
+CMMS	More messages to send

DATA FLOW DIAGRAM

Start

Image acquisition through webcam

Already have reference image

NO

Set image as reference

Motion detected using optical flow

Sms alert

YES

NO

Result display

RESULTS AND DISCUSSION
An optical flow algorithm for motion tracking using SMS alert has been presented on MATLAB. This has been achieved by comparing two different frames**.** If there is a motion it is detected in the form of vectors and image will be saved to the designated folder and user of the system is informed by an SMS alert .

To achieve the results --1) An inbuilt webcam of a PC is used to acquire the images, where the first frame is taken as a reference . The personal computer consists of inbuilt USB controllers which will control externally connected hardware devices
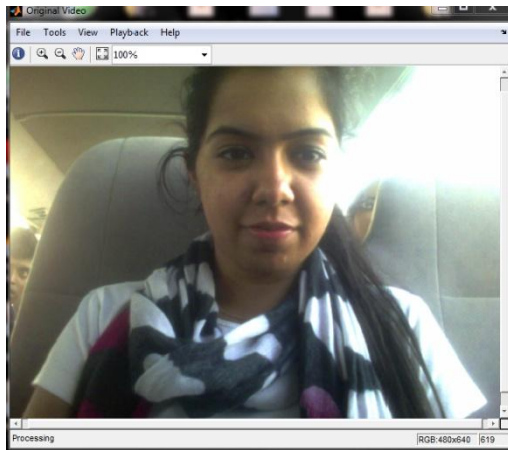2) Creates a System object to estimate direction and speed of object motion from one video reference video frame to another using optical flow.[14]
3)A processing loop is performed in the input video which processes for first 100 frames showing any changes of motion detection in the area, with the help of Image Acquisition Toolbox
4)Once the motion is detected ,the results are displayed in the from red motion vectors on the monitor. however if the sum of the pixels is less than the threshold value then it exits the loop and no motion is detected.
5) The serial port of the PC is accessed through MATLAB to activate the GSM modem which will send the alert text message, once the motion is detected.

Fig 2.1 Original video ---   **Fig 2.2 motion detection video**
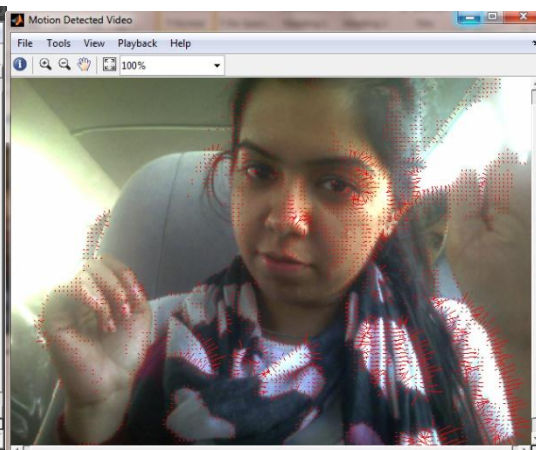
Fig 2.1 the input frame that has to be kept under surveillance for any motion Fig 2.2 shows the detection of movement using optical flow where detected pixels were highlighted in red with the help of motion vectors.

Fig 2.3 once the motion is detected ,an alert message is sent to the mobile through a GSM modem.

FUTURE DIRECTIONS OF PROJECT

1)In future, along with SMS, an MMS(multimedia messaging service) can also be sent to show a proof of who intruded the monitored area.2)only a certain portion of the room can be kept under surveillance.3)An efficient alarm system can be generated to alert anyone near the area of intrusion4)Email services can also be made use of to send the saved snapshot inclusive of the alert message of motion detection.5)Because the approach of optical flow can sometimes have a slow processing speed, GPU(graphics processing unit)can be made use of with their parallel processing methodologies for faster optical computations.[5]

CONCLUSION

This approach is applied to detect moving objects in real-time videos which can cater to the needs of the day-day to life when further modified with additional features to this webcam motion detection technology for home/office based surveillance system. It meets the needs for small and cheap security based system , alerting the concerned people of any activity that could created a change in and around the surroundings of the area being observed. Optical flow was used because it gives accurate motion detection results as compared to the other motion tracking and detection algorithms in today's times, without any necessary information about the background.

REFERENCES
[1] Wei Shuigen,Chen Zhen, Dong Hua,Motion detection based on temporal differencing and optical flow method, May 2009
[2] Berthold K.P. Horn and Brian G. Rhunck,Artificial Intelligence Laboratory, Massachusetts Institute of Technology, Cam bridge, MA 02139, U.S.A
[3]Vasudev Parameswaran,VIEW-INVARIANCE IN VISUAL HUMAN MOTION ANALYSIS,Doctor of Philosophy, 2004 pg(28-29)
[4] Waleed K. Ahmed, Advantages and Disadvantages of Using MATLAB/ode45 for
Solving Differential Equations in Engineering Applications, Faculty of Engineering/ Engineering Requirements Unit, UAE University,Abu Dhabi,Al-Ain, 15551, UAE pg (2)
[5] Samuel Kim and Vincent Kee, Optical Flow Based Navigation, Department of Cognitive and Neural Systems, Boston University, Boston, MA Department of Electrical and Computer Engineering, Boston University, Boston, MA
http://samhykim.files.wordpress.com/2011/09/research-paper2.pdf, ,pg(1)
[6] "Motion Detection." Internet: http://en.wikipedia.org/wiki/Motion_detection,
May 20, 2012 [Jun. 16, 2012],
[7] Problems with motion detection -www.iwatchlife.com.
[8]Computer Vision ,http://www.societyofrobots.com/programming_computer_vision_tutorial_pt4.shtml
[9] Horn and Schunk - http://en.wikipedia.org/wiki/Horn%E2%80%93Schunck_method
[10]Lucas and Kanade algorithm- http://www.cse.psu.edu/~rcollins/CSE486/lecture30_6pp.pdf
[11]Background subtraction -http://en.wikipedia.org/wiki/Background_subtraction
[12] Wikipedia "Hayes command set" Internet:http://en.wikipedia.org/wiki/Hayes_command_set,
November 2009
[13] www.developershome.com/SMS/howtosendSMSFromPC.asp.
[14] Mathworks.com
[15] Motion Analysis ,Optical Flow http://www.engineering.uiowa.edu/~dip/LECTURE/Motion2.html
[16] http://www.cs.umd.edu/~djacobs/CMSC426/OpticalFlow.pdf