Optical Flow-based Movement Alert System for Assisting Visually Impaired People

***Abstract*— The home security system is accepted as an important system and it benefits many people, especially visually impaired people. This is due to an increase in the number of home burglaries, incidents of theft which have made people more aware and vigilant regarding the same. In this work, we have used the optical flow method to track and detect the movement of objects precisely. The optical flow method is used to recognize the movement by observing video streams. Objects observed under surveillance in the surveillance area are studied and analyzed with reference to the surroundings. This provides a crucial element for detecting and predicting anomalies based on the behaviors of observed objects. An alarm system is proposed which can track the moving object and raise an alert.**

Keywords: Movement tracking, Optical Flow, Object Detection.

I. INTRODUCTION

A person is known as visually impaired when he or she suffers from a loss of vision that cannot be corrected to normal or even that person cannot see objects as clearly as a healthy person. Any kind of vision loss is considered as vision impairment whether it's someone who cannot see at all or someone with partial vision loss. According to new criteria bought by WHO in 2017 people who cannot count fingers from 3 meters are considered blind. Experience of visually impaired varies from person to person which depends on many factors like the availability of prevention, treatment interventions, and access to vision rehabilitation. Visual acuity information varies from person to person depending on a number of factors such as the availability of prevention, treatment interventions, and access to vision recovery. There are nearly 2.2 billion people who are visually impaired. Close to or at least 1 billion cases that could have been prevented or still need to be addressed.[1] Though half of the visually impaired people are above age 64 but as per many surveys reports people who are above age 80 to suffer more from this. Although vision loss can be seen at any age it is noticed that the frequency of visually impaired was found to be in people with the age group of 80 years (11.6%) and above, which is then followed by people with age group 70-79(4.1%), with 60-69 age group(1.6%) and people with age group 50-59 (0.5%).[2] According to Worldwide Statistics for vision loss and Visual Impaired people 36 million people were blind, while 217 million suffering from moderate to severe visual impairment (MSVI). People with range visual impairment account for 3.44 percent of the population, with 0.49 percent being blind and 2.95 percent having MSVI.[3] Also, 1.1 billion people are thought to be affected by functional presbyopia.

The biggest challenge for visually impaired people especially people who lost their vision completely is to steer around the places. They roam around in their house or any known places without any help because they are aware of those but the problem comes when they step out of their zone. Individuals who live with or visit blind people should avoid moving things around without alerting or asking the blind person beforehand. Tactile tiles can make commercial spaces more accessible for blind people.[3] Unfortunately, this is not the case in most places. This causes a significant challenge for blind people who may visit the location.

The eyes are considered the most important sense organ of people. A quick glance around us reveals how visual the majority of the information in our surroundings is. The majority of this material is inaccessible to the blind and visually impaired, limiting their independence. There are several challenges that blind or low vision people faces are due to lack of accessibility for the visually impaired [4]. Mostly it is seen that these people lack security when they are alone. Visually impaired people lose the ability to travel independently which can make them trapped at home and cannot enjoy their fulfilled life. There are many types of navigation systems which include acceleration-based, position-based, and velocity-based navigation.[5] In this system, a handle stick is easy to locate and provides buzzer feedback with displayed coordinates. It also has a panic button which helps in emergency conditions, but it is heavy to handle. So smart Blind Stick [6] is the easiest and cheapest device which we came through, built for guiding blinds by detecting obstacles. It is a handheld device of cane shape with an approximated cost of Rs.2000 which helps blind people to detect some obstacles, holes, etc. Its disadvantage is the detection of objects in only a single direction.

SriramaDivya et al. developed Smart gloves for blind people [7]. These gloves are used to measure the distance from some specific object, color recognition also with money and light intensity recognition. These gloves have a panic button which is for an emergency[8].

Visually impaired people need the assistance of others, or they need to depend on others for their mail-related work. A voice-based email is proposed as security system for the blind [9,10,11]. But sometimes, the voice is not clear and there are chances of misinterpretation. A mobile phone-based application is developed for the blind which enables them to carry out a number of tasks with the help of object detection (real-time) [12]. This app turns the visible world into an auditory one by alerting blind people to objects in their route. Though there are systems to detect suspicious movements they suffer with various limitations like increased cost, need of wifi connectivity, slow response time and inaccurate predictions. In this work a simple system is proposed to detect the movement and track object. The moving trajectory is plotted and audio alert is communicated to the visually impaired person. The paper is arranged as follows. Section II gives methodology of the system development.Algorithms are described in section III and results in section IV. Section V describes conclusion and future scope of work.

II. METHODOLOGY

This paper presents motion detection alarm system which tracks or traces the movement of the object. Figure 1 shows basic building blocks of the proposed system. Camera captures the real-time footage of the environment.This acts as an input to the processor. The processor performs image processing, feature extraction and tracking operation. It sounds the alarm when object movement is detected.

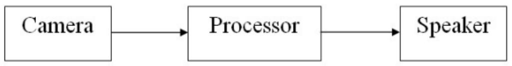

Fig1: Block diagram for the system.

The proposed system uses the following techniques – a) Gaussian blurring b) Thresholding c) Contour detection d) Optical Flow e) Tracker.
The complete system development flow is shown in figure 2.

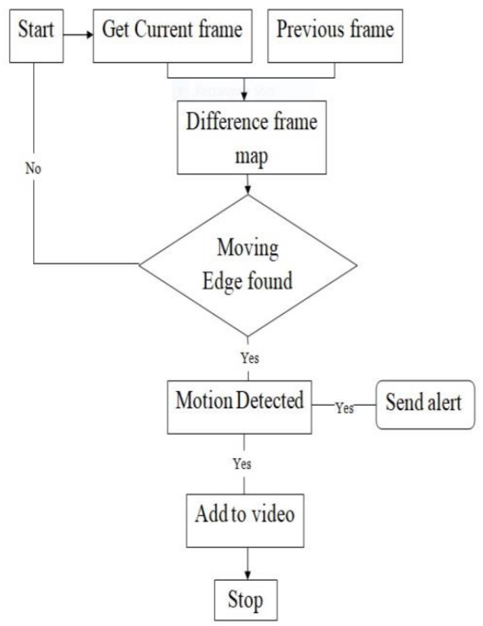

Fig 2: Flowchart for movement detection.

a) Gaussian Blurring:
Gaussian blur is used to reduce clarity of images.Blurring involves shifting a rectangular group of pixels surrounding a pixel that is being filtered. This group of pixels are referred to as the kernel. It is also used for noise reduction and to make the image distinct.
b)Thresholding:
Image thresholding is mainly applied for isolating the object from its background. Basic technique of binary thresholding is used in this project. Each pixel of the image is then compared with specified value which is set at a minimum of 255.If pixel value is of the image is greater than or equal to the specified, then that pixel will be assigned white colour.Else that pixel is assigned the black color. Binary image of the two colors is then generated.Figure 3 shows the block diagram of image thresholding.

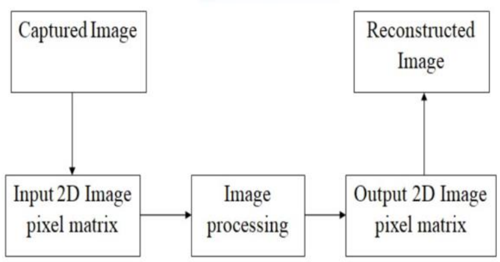

Fig 3: Image Thresholding

By applying thresholding, the images are converted into binary for better accuracy.It is also used as a preprocessing stage before applying any machine learning or deep learning models.

c)Contour Detection:

The binary image is processed to find the contour around the detected object.A curve joining continuous points along the boundaries of objects (of same color and intensity) called contours is used for object detection. If the number of pixels in the contour area are greater than 5000, then the object is detected, and a bounding box is drawn around the object. 'RETR' function enables us to get the outermost contours in case one contour is crossing over another (like concentric circles). The outline is a useful tool for shape analysis and object detection. Four corner points of the boundary are selected to define the contour. Once movement is detected the status is updated to '1' and alarm is sounded.

d)Optical Flow:

Optical Flow is used to separate the object moving in the front from its background, creating a field vector of optical flow for the moving object. *Jing Chen et al.* proposes an optical flow method that computes the movement between two frames taken at various periods of time for each pixel that exists inside the outline [14]. Various techniques are available in the assessment of optical flow. Phase-based techniques give great results but are very complex and difficult to execute. The Lucas-Kanade differential techniques is utilized as it is the mean between computational complexities and expenses [19]. Figure 4 shows the different Optical Flow methods.

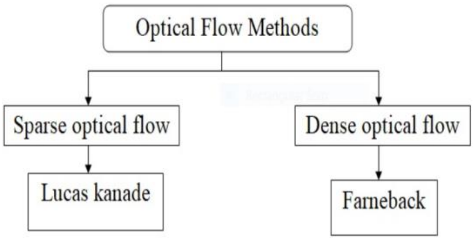

Fig4: Optical Flow methods.

If an item is moved by a distance δa in the x-axis and δb in the y-axis in time δt[17]. The brightness in the background is said to stay steady. The condition is determined condition which relates the adjustment of the brightness of the picture at a highlight, that points to the brightness pattern of the movement. Let us consider the picture's brightness or the point (a, b) in the picture plane at the signified time by I (a, b, t). When the pattern moves the brightness of a specific point such that di/dt=0.[18] The 2D dynamic brightness function of I (a, b, t) is address by the expression known as the Taylor series. By involving Taylor series extension, it simplifies the right side of the expression, and we can derive $I_x V_x + I_y V_y = - I_t$ [14].

e)Tracker:

The tracker is used to store the co-ordinates of the bounding boxes around the object. And as the object moves, its path is plotted in the window. Figure 5 shows the block diagram for movement tracking.

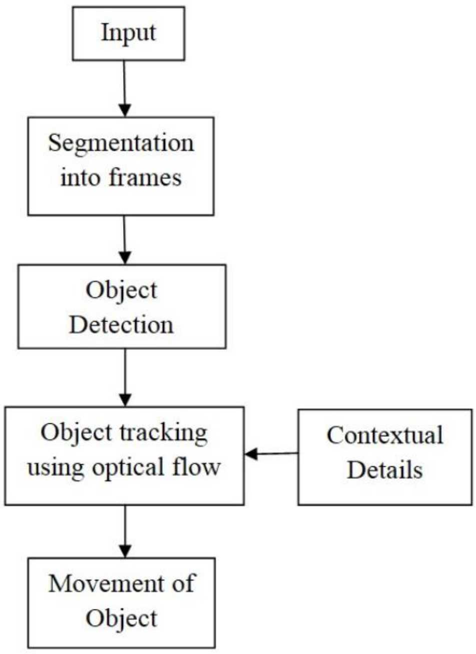

Fig5: Flowchart for object detection.

III. Algorithms

Algorithm 1: Object Detection

1:Alarm sound parameters are set.
2:iframe =**None;** //initialize frame
3:while true //until no motion is detected
4: frame = read frame; status = 0;//convert to gray frame
5: grayframe = (25,25); blurframe = (5,5);
6: **if**
7: diff=initialframe – blurfame;

```
threshold = (diff, 35, 255)
for
    if area of bounding box< 5000
        continue
    status = status +1;
    rectangle(frame,(x,y),(x+w, y+h), (0,255,0), 1)
    if status_list[-1]>=1 and status_list[-2]==0:
    //start alarm
    // display motion detector frame
        break
```

Algorithm 2: Tracking the object.

```
if
    ix,iy = x,y
    k = -1   //ix,iy,k = 200,200,1
    Video capture
while true
    frame = new window
    if k == -1,convert to new frame
    break
oldpoints = newpoints array [[ix,iy]]. reshape
while true
    frame2 = read frame
    newpoints,status= calcOpticalFlowPyrLK.
    newpoints.ravel      //converting into 1d array
combine = (frame,frame2)      //show window
    if video release
    break
```

IV. RESULTS

This frameworkhas successfully provided a system for the blind that enables them to understand the infringement by an unwanted object.

Step 1: Objects come into the frame. Figure 6 shows a person is detected by the system and a bounding box appears around it.

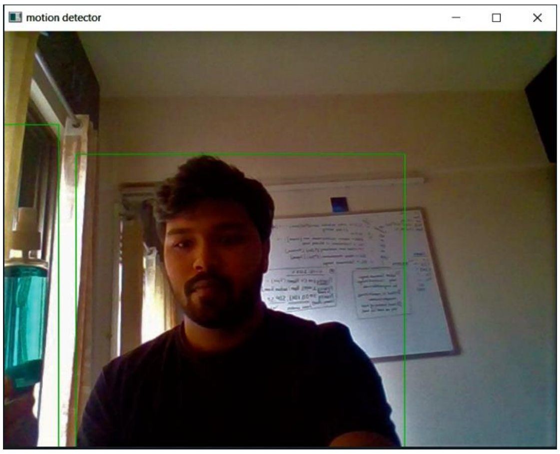

Fig. 6: Object comes into the frame.

Step 2: Alarms starts to ring.

Step 3: Trackingthe movement of the object. Figure 7 & figure 8 shows the change in the movement of the person from standing to kneeling.

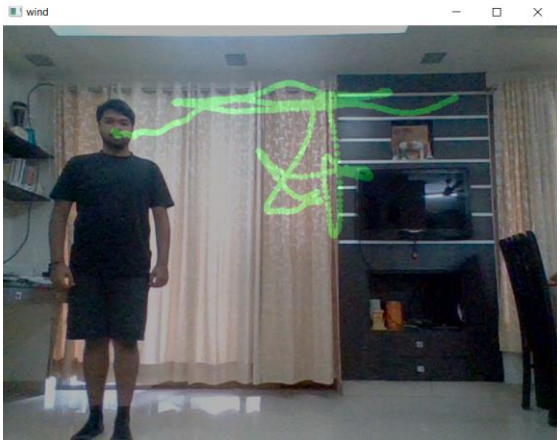

Fig 7: Tracking movement of the object.

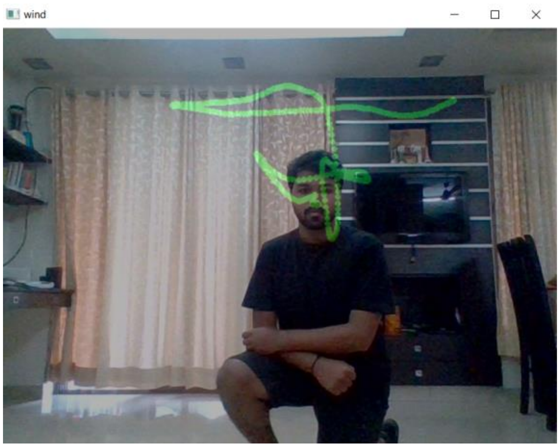

Fig 8: Tracking the movement of the object.

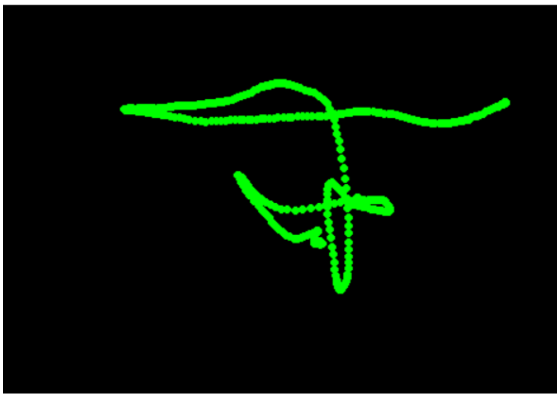

Fig 9: Tracing of path following fig7 and 8.

As soon as the object isdetected the buzzer or alarm will start to go off for the required/set amount of time. Then the path of the object is traced on the tracking screen to keep note of the whereabouts of the object.

V. Conclusion

This paper presents a movement detection system on the basis of estimation of the movement captured from various webcam sequences. The computational speed of the project is faster than the existing system. This gives a high density of movement vectors and is easy to execute. This system is designed to operate with reduced computational complexity and is immune to changes in light intensity. The system is also able to handle the artifacts generated by moving camera conditions. The implementation of this system will help visually disabled people by notifying them of intruders and unwanted objects. Typically, the optical flow changes dramatically in highly textured regions, around moving boundaries, and at depth. For future scope we will try to implement 3D approximation of movement, tracking and its direction.

VI. References

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