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Microsoft Kinect Sensor for Fall Detection in Homes of Older People

Arti Jagtap, Yogesh Angal

***Abstract*— Fall among older people is a major issue. Every year one out of three older adult fall. After fall there is immediate medical assistance is necessary. Due to fall people may get serious injuries such as heap fractures or people may lose their independence. In this paper one method is presented which detects human fall using Microsoft Kinect sensor. This sensor has depth imaging camera with the help of that correct fall decision is made. Kinect sensor gives real time depth images. Using MATLAB image processing toolbox, some processing is done on depth data to make fall decision. Once fall is made, control signals are to be send from software to hardware for medical assistance.**

***Index Terms*—Depth image, fall detection, foreground segmentation, Kinect sensor, SVM .**

I. INTRODUCTION

Millions of older people those are 65 and above falls each year. One out of three older people fall each year, but less than half tells their doctor. Falling once doubles the chances of falling again. Those who fall may suffer serious injuries, such as hip fractures and head traumas. Because of this they may reduce their mobility and independence, and lead to an increased risk of early death. In the U.S. the direct medical cost of falls among older adults in the year 2000 was more than $19 billion [1]. Older adults living alone are at great risk of delayed assistance following a fall. Studies have been found that an increased risk of physical and physiological complications is associated with long periods of lying on the floor following a fall, due to an inability to get up.

Fall of adult is increased so far, for that various techniques were introduced but none of them is capable of giving accurate solution. To rectify this problem this paper introduce Microsoft Kinect sensor and SVM by which fall detection can be done easily and with the help of GSM and alarm system immediate medical help will be provided.

This paper presents a method for detecting falls in the homes of older adults using an environmentally mounted depth imaging sensor, namely the Microsoft Kinect. First foreground objects are segmented from each depth image frame using a dynamic background subtraction algorithm.

***Arti Jagtap**, ME Student, Department of E&TC, JSPM's Bhivarabai Sawant Institute Of Technology and Research, Wagholi, Pune, India.*

***Yogesh Angal**, Head Of Department, Department of E&TC, JSPM's Bhivarabai Sawant Institute Of Technology and Research, Wagholi, Pune, India.*

Then set of features extracted from an on ground event to generate a confidence that a fall preceded it. In this paper velocity and acceleration functions are extracted. Using the support vector machine event is classified into normal and fall event. Then a system is used to send SMS using GSM module and microcontroller. After fall is detected SMS is sent to their relatives and doctors and alarm is on.

The remainder of this paper is organized as follows. First, a discussion of related work is presented. Second, methodology for detecting falls is presented. Third, experimental simulation carried out is presented. Finally there is conclusion.

II. RELATED WORK

There are many fall detection systems which use different technologies and techniques. In [5], wearable device has been used. In these methods automatically a fall is detected using sensors such as accelerometers. But, wearable devices must have to be continuously worn and they require batteries to be recharged. Person may be forgetting to wear the sensor.

In [4], multiple camera networks are used for reconstructing the 3-D shape of people. This method is based on two main ideas. The occlusion-resistant algorithm is introduced in order to detect that if a person is lying on the ground even if some occlusions occur. In [6], the researchers have looked the use of environmentally mounted sensors such as passive infrared sensor, floor vibration sensors to detect fall.

Traditional cameras have been used by some researchers to detect fall [3]. Person's silhouette is tracked along video sequence. A shape matching technique is used to track the person's silhouette along the video sequence. The shape deformation is then quantified from these silhouettes based on shape analysis methods. Finally, falls are detected from normal activities using a Gaussian mixture model.

III. METHODOLOGY

The proposed system uses depth imaging sensor named as Kinect sensor connected to PC. Complete image processing task is done in MATLAB to detect fall condition. Kinect studio v1.8.0 is installed in MATLAB to access depth and RGB data from sensor. After detection of fall condition message sending facility is available to get medical assistance. Fig.1 shows the proposed system.

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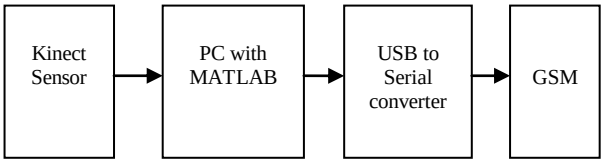

Fig.1 System Block Diagram

Kinect sensor's output is RGB and depth image. The depth sensor of Kinect consists of IR laser projector and an IR camera. With the help of projector and camera depth map is created, which gives the distance data between the object and the camera.

Output of sensor is feed to the PC having MATLAB. Using image processing tools fall decision is taken. For that first foreground segmentation is used to detect the moving object from running video frame. In foreground segmentation background subtraction is used is and mean ratio difference image is calculated.

Then velocity and acceleration features are extracted from moving object. These features are used to take decision of normal or fall event. For that Support Vector Machine (SVM) is used as a classifier. Once fall condition is detected SMS is send to the relatives of older adult. So that immediate medical help will get.

IV. FLOWCHART

The flowchart of the system is shown in below fig.

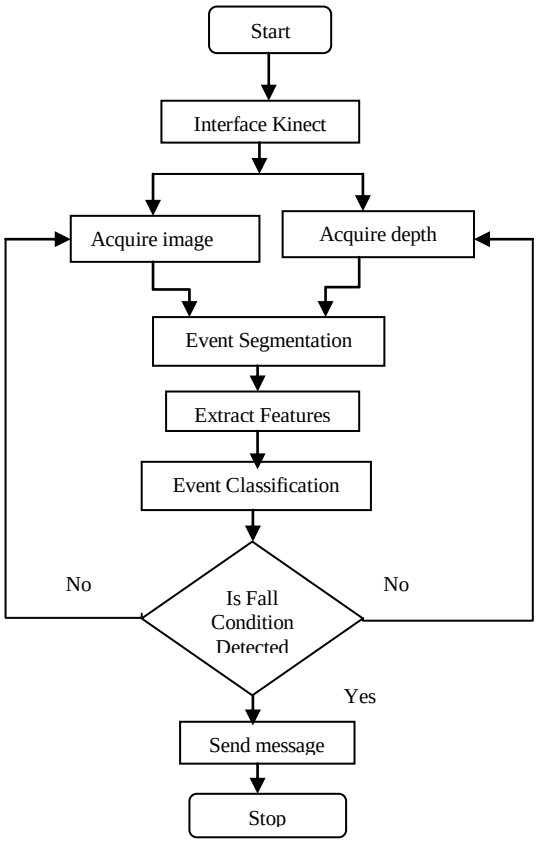

Fig. 2 Flowchart

V. SIMULATION RESULTS

For the simulation Kinect sensor is placed in apartment below the ceiling few inches at corner. Velocity and acceleration is calculated.

A. *Ground event segmentation*

Ground event segmentation is done to detect moving objects from video. For this background subtraction algorithm is used and means ratio difference image is calculated. For this following calculations are made.

Consider I_1 = reference image or background image and I_2 = current frame

Mean of $I_1 = \mu_1$

Mean of $I_2 = \mu_2$

$$\mu_1 = \frac{1}{R \times C} \sum_{n=1}^{R} \sum_{m=1}^{C} I_1(n,m) \quad (1)$$

$$\mu_2 = \frac{1}{R \times C} \sum_{n=1}^{R} \sum_{m=1}^{C} I_2(n,m) \quad (2)$$

$$\text{Mean Ratio Difference Image} = \left(\frac{I_1}{\mu_1} - \frac{I_2}{\mu_2}\right) \quad (3)$$

B. *Velocity*

Velocity calculation is done with help of background and current frame's centroid. Centroid of background and current image is measured and difference among them is the X and Y motion.

X_Motion=diff1= |centr(1) - old_centr(1)|

Y_Motion=diff2= |centr(2) - old_centr(2)|

$$\text{Velocity} = \sqrt{\text{diff1}^2 + \text{diff2}^2} \quad (4)$$

Fig. 3 and fig.4 shows the GUI in normal event and fall event respectively.

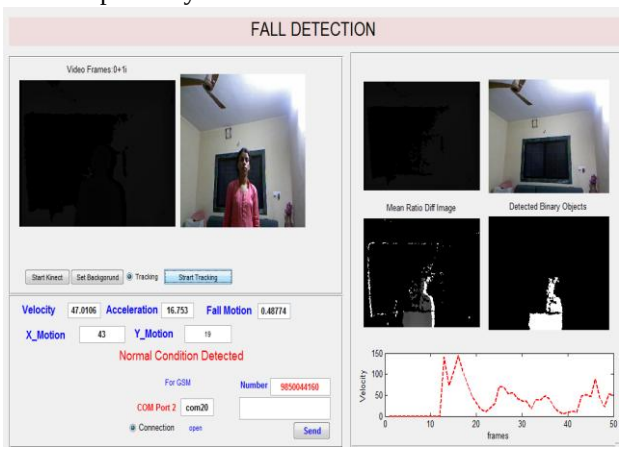

Fig. 3 Normal condition detected

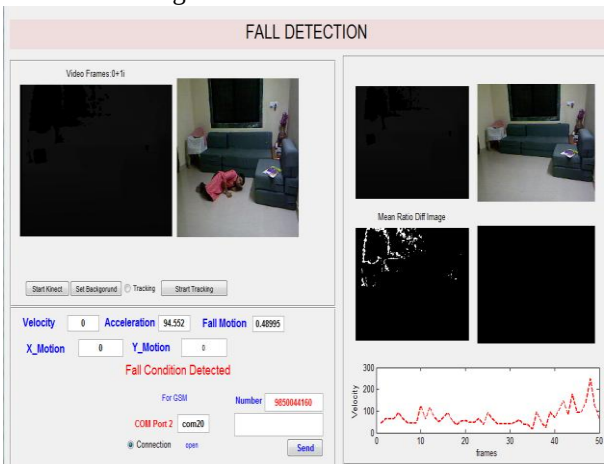

Fig.4 Fall condition detected

VI. CONCLUSION

A fall detection system using Microsoft Kinect sensor has been designed. The system is highly reliable and robust because it works on the real time data instead of database. Fall detection system provides the immediate medical help which will helpful in reducing the death of older people and reducing the chances of major injuries.

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REFERENCES

[1] J. A. Stevens, P. S. Corso, E. A. Finkelstein, and T. R. Miller, "The costs of fatal and non-fatal falls among older adults," Injury Prevention, vol. 12, no. 5, pp. 290–295, 2006.
[2] G. Mastorakis and D. Makris, "Fall detection system using Kinect's infrared sensor," J. Real-Time Image Process., Mar. 2012. DOI:10.1007/s11554-012-0246-9.
[3] C. Rougier, J. Meunier, A. St-Arnaud, and J. Rousseau, "Robust video surveillance for fall detection based on human shape deformation," IEEE Trans. Circ. Syst. Video Technol., vol. 21, no. 5, pp. 611–622, May 2011.
[4] E. Auvinet, F. Multon, A. Sait-Arnaud, J. Rousseau, and J. Meunier, "Fall detection with multiple cameras: An occlusion-resistant method based on 3-D silhouette vertical distribution," IEEE Trans. Inf. Tech. Biomed., vol. 15, no. 2, pp. 290–300, Mar. 2011.
[5] N. Noury, A. Fleury, P. Rumeau, A. K. Bourke, G. O. Laighin, V. Rialle,and J. E. Lundy, "Fall detection-principles and methods," in Proc. IEEE 29th Ann. Int. Conf. Eng. Med. Biol. Soc., 2007, pp. 1663–1666.
[6] Y. Zigel, D. Litvak, and I. Gannot, "A method for automatic fall detection of elderly people using floor vibrations and sound—Proof of concept onhuman mimicking doll falls," IEEE Trans. Biomed. Eng., vol. 56, no. 12,pp. 2858–2867, Dec. 2009.
[7] Erik E. Stone, "Fall Detection in Homes of Older Adults Using the Microsoft Kinect," IEEE Journal of Biomedical and Health Informatics, Vol.19, No.1, January 2015.