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Computer vision based fall detection for elderly person using HOG descriptor and HAAR feature extractor

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***Abstract* – In this paper, an image based fall detection system for elder person who alone at home is introduced. It is novel computer vision based fall detection system using deep learning method to analyse posture in smart home environment. First, background subtraction is employed to extract the foreground human body. Then global local features of human body postures are extracted by HOG (Histogram of Oriented Gradient) and HAAR extractor. After deep learning classifier applied for posture classification. After that certain rules are set to detect falls. Experimental result indicate that the proposed method can realizes human fall detection.**

Keywords- Fall detection, computer vision, support vector machine (SVM), deep learning classifier, Histogram of Oriented Gradient (HOG), HAAR.

INTRODUCTION

Among the biggest worries of working couples today is day care for children and now, elders. while good day care centres, although expensive, are available for children, such facilities absent for elders. Working couple constantly worry about the safety of the elder at home. So their safety becoming a big challenge. In this case , it is very important to design a system that can be used to generate an alarm when it detect the falling of human beings so that they can gain help from others like doctor and guardian.

LITERATURE SURVEY

Posture recognition based method for fall detection is proposed and builds upon [1]. Features from static postures are extracted, and then an improved version of DAGSVM is applied for posture classification.Ellipse fitting is used to describe the silhouette obtained from codebook background subtraction [9] in a "global" way.
A novel computer vision-based fall detection system based on posture analysis and employing deep learning methods for analysis and classification of postures. After which the features of the four postures in the room environment (standing, sitting, bending and lying) are extracted from a recording of a real home care environment and classified by using both restricted Boltzmann machine and deep belief network[2].

Using locally normalized histogram of gradient orientations features similar to SIFT descriptors in a dense overlapping grid gives very good results for person detection, reducing false positive rates by more than an order of magnitude relative to the best Haar wavelet based detector[6].

Yoosuf Nizam proposed Fall detection using velocity and position of the subject from depth images,extracted from kinect sensor[3].Apart from this Ning Jia shows that falling status can be effectively detected with the proposed solution,based on the ADXL345[5].

Different Techniques :
These are some vision based technique to detect the fall. 1)Skeleton based(kinect sensor) 2)Vision based(frame based) 3)Using vision based and acoustic sensor Skeleton based(kinect sensor):

This algorithm consists of two parts, which are moving target depth of image acquisition, processing of depth image and identification of human skeleton. The realization of the detection algorithm is based on the tracked key joints acquired from the Kinect sensor. Two parameters are extracted, by comparing these values with the threshold, the system judges whether human falls down. In this method accuracy rate is very high.method uses deep learning method.this is best for video based.It work on both 2D and 3D sources. 3D source generate more accuracy. But it take high computing power and very Time consuming. A fall detection and reporting system using Microsoft Kinect sensor presented by Kawatsu et al, uses two algorithms.The first uses a single frame to determine fall and second uses time series data to

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distinguish between fall and slow lying down on the floor.[11].

2)Vision Based: For computer vision based systems, some researchers have extracted information from the video and set is a fall or not, some researchers have extracted some important features from the frames and perform classification of fall and non-fallevents. For example,Yuetal. proposed a system which is based on posture recognition using a single camera to monitor the person in the room environment [1]. In this work, firstly, the features were extracted from an ellipse fitted to the human profile and a projection histogram, then a multiclass support vector machine was used for classification purpose,which is a scheme to combine multiple SVMs,it can be used to solve two-class classification problems, to achieve multiclass classification [10].It generate result frame by frame.Each frame is processed independently and It take less computing power. But it is less accurate and Overlapping.

3) Vision based and acoustic sensor:- Vision based and acoustic sensor gives more accuracy among all methods. Because this method give feature rich information about human activity. In previous method we only use vision as a feature. Sometimes vision based method gives wrong information about human activity. Because vision based method is totally depended on angle of a camera and on capturing environment, but sometimes environment is not appropriate, vision based information may vary in different environment like in lightning and dark, inside and outside the home environment. So we propose a new system which take feature from acoustic sensor along with vision based sensor. Fall result is confirmed by using both result. If fall is detected in vision based system then it should also be detected by acoustic sensor.

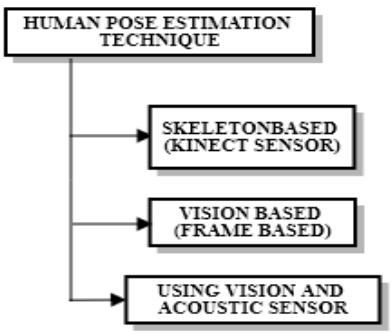

Fig.1 Techniques for human pose estimation

Table 1 : Literature Survey analysis

Sr. No	Literature Survey		
	Methods	***Advantages***	***Disadvantages***
1	deep learning analysis & classification of postures	1.Richer information about observed data by capturing interaction of many different levels through hierarchical learning & benefits from larger training sets.	1.More training data would be necessary to improve accuracy. 2.There are still unnecessary components in environments which influences result.
2	Depth images using position & velocity of subject using kinect sensor	1.Accurately identifies fall for single person within view of sensor. 2.Clear up gap between activities that possesses similarly velocity pattern	1.Specificity lacked because system misinterpreted some lying down on floor as a fall. 2.System lacks in classifying activities that possesses similar pattern 3.viewing frustum of sensor.
3	Posture Recognition based fall Detection system	1.unintrusive 2. not affected by noise.	1.DAGSVM structure is fixed & chosen randomly. 2. Degenerates the generalisation performance.

Proposed System :

In this paper, we propose a Computer Vision based Fall detection System which is based on posture analysis using single camera to monitor an elderly person who lives

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alone at home. First features are extracted from source image using HOG(Histogram of gradients) descriptor and HAAR, then required silhouette is extracted from image as a feature. Then these silhouette is fed into deep learning classifier and particular silhouette is classified as human posture in room environment. From these silhouette some silhouette decide human fall.Here Deep learning classifier is used because it provides richer information about the observed data by capturing interactions of many different factors on different levels through hierarchical learning and benefits from larger training sets. In proposed system first system gets input from camera then it is divided into two frames.Then video frame is applied one by one in opencv learning library for future purpose.First phase is background subtraction.In this phase foreground is extracted from background.Each frame is compared with previous frame(base frame) to extract differences.Now in post processing shadow or any external noises are removed.This is done with the help of Mixture of Gaussian (MOG). Next phase is Feature Extraction,in this human feature is extracted from foreground.We extract global local features from static postures and an improved Histogram of Oriented Gradient(HOG) is applied for posture classification.Then classification is used to classify different human postures. Then last phase is decision making, to detect human fall SVM classifier is used.If system detect any human fall then alert signal is generated.

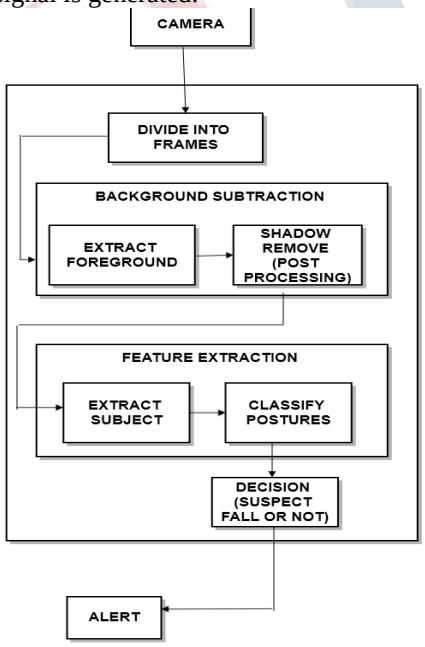

Fig. 1 Architecture of proposed system

Algorithm

[1] BACKGROUND SUBTRACTION

A motion detection algorithm begins with the segmentation part where foreground or moving objects are segmented from the background.

Video sequence is denoted by V(x,y,t) and Background is denoted by B(x,y,t). Here, (x,y) represent pixel value & Time dimension is denoted by t.

Step 1: Using frame differencing

Take an image as background B and take the frames obtained at the time t, Here using simple arithmetic $\boldsymbol{P[F(t)] = P[I(t)] - P[B]}$ though, we have removed the background,

Step 2: Threshold: After that Threshold will be applied to improve subtraction result.

$$|\boldsymbol{P[F(t)] - P[F(t+1)]|} > \boldsymbol{Threshold}$$

Step 3: Mean Filter: For calculating the image containing only the background.

$$\boldsymbol{B(x,y,t)} = \frac{\mathbf{1}}{\boldsymbol{N}}\sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \boldsymbol{V(x,y,t-i)}$$

thus foreground is,

$$|V(x,y,t) - B(x,y,t)| > Threshold$$

[2] HOG (Histogram of Gradients) :

Step 1: Preprocessing :HOG feature descriptor used for pedestrian detection is calculated on a 64×128 patch of an image. The only constraint is that the patches being analyzed have a fixed aspect ratio 1:2.

For example, they can be 100×200, 128×256, or 1000×2000 but not 101×205.

Step 2: Calculate the Gradient Images : To calculate a HOG descriptor, we need to first calculate the horizontal and vertical gradients.

-1	0	1

-1
0
1

Next, we can find the magnitude and direction of gradient using the following formula

$$g = \sqrt{gx2 + gy2} \qquad \theta = arctan\frac{gy}{gx}$$

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the x-gradient fires on vertical lines and the y-gradient fires on horizontal lines. The magnitude of gradient fires where ever there is a sharp change in intensity.

Step 3: Calculate Histogram of gradients(HOG) in 8x8 cells :
The image is divided into 8×8 cells and a histogram of gradients is calculated for each 8×8 cells. . An 8×8 image patch contains 8x8x3 = 192 pixel values. The gradient of this patch contains 2 values (magnitude and direction) per pixel which adds up to 8x8x2 = 128 numbers. By the end of this section we will see how these 128 numbers are represented using a 9-bin histogram which can be stored as an array of 9 numbers. then gradient angle and gradient magnitude is calculated of each cell in the block.
Step 4: 16 x 16 block normalization :
In previous step we created histogram based on the gradient of the image. Gradient of an image is sensitive to all lighting. If you make image darker br dividing each pixel by 2. Gradient magnitude changed by half and therefore histogram value changed by half. We want our descriptor independent of lighting variant In other words, we would like to "normalize" the histogram so they are not affected by lighting variations.
Step 5: Calculate the HOG feature vector :
The HOG descriptor of an image patch is usually visualized by plotting the 9×1 normalized histograms in the 8×8 cells. See image on the side. You will notice that dominant direction of the histogram captures the shape of the person, especially around the torso and legs.

Fig.3 Human detection by HOG.

CONCLUSION AND FUTURE WORK

In proposed computer vision fall detection system based on posture analysis and employing deep learning method for analysis and classification of posture. We use HAAR and HOG as extracting human body posture. If HOG detects human body then there human face should be detected. When HAAR is used with the traditional HOG method, we find that our human detection system achieves better performance with a detection rate of 66% with a low false detection rate 3.7% and the results can be improved with additional parameter training.

In future system will take feature from acoustic sensor along with vision based sensor. Fall result is confirmed by using both result. If fall is detected in vision based system then it must be detected by acoustic sensor.

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