Effective Monitoring Assistive System for Elderly and Disabled Individual

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***Abstract*— Effective Monitoring Assistive system is used to observe abnormal postures in elderly and disabled individuals to detect falls. Single camera is placed in a room environment to observe the normal activities of the individuals. The video is recorded with a camera and it is given as the input for further processing. The recorded video is automatically segmented which involves conversion of frames. The frames converted from the video are divided into macro blocks by using block matching algorithm. Joint adaptive block matching algorithm is used to differentiate between the static and motion block where even small movements can be detected easily. Codebook background subtraction is used to track the moving objects where it can cope with the illumination changes, adaptive and background motion over a high duration of time. The noise from the object is removed by using low rank detection in order to a get explicit view of the foreground objects. Ellipse fitting technique is used to track the shape of the human body where the features are extracted and given for further classification to detect fall. Online one class support vector machine is used to classify between normal and abnormal postures. When fall is detected in an elderly or disabled individual an alarm signal is given to the caregivers.**

Keywords*— *Block matching, joint Adaptive block matching, online one class support vector machine, fall detection.

I. INTRODUCTION

Population aging is increasing day by day where it refers to the assessment of a country's population towards older ages. There are many health related problems among aging society which among them are falls. Injuries related to fall are some of the important issues among elderly individuals. Falls may lead to major kind of injuries like hip fracture, laceration and head traumas which are very hazardous to health. Detecting falls is very important so that assistance can be provided immediately and injuries can be avoided. Elderly individual those who are living alone are in a greater risk and they are in need of medicate assistance. If the falls are not identified for a certain period of time then it may lead to higher risk for health. If assistive methods are used,an alarm signal will be given to the care givers by some mode of communication and the care givers will assist the individuals.

An effective fall detection system is useful for monitoring the individuals which saves life in some cases. The activities of the individuals are observed and fall is detected only when there is abnormal behavior and alert will be given to the assistance which is commonly done in hospitals or home care. Falls are classified into two main categories they are computer vision based methods and noncomputer vision based methods. Non computer vision based includes floor vibration sensors, accelerometers and acoustic sensors. Acceleration sensors were placed over the chest and the feet to distinguish the changes among the elderly people. The performance of the floor vibration sensors depends on the floor type. The falls are detected among the individuals based on measuring the acceleration along the vertical axis. Multiple accelerometers were also used in detection systems. This type of fall detection system can achieve minimum computational and consumption cost when compared to commercial fall detection systems. Even though noncomputer vision based methods may achieve good results of fall detection it is very inconvenient for the elderly people who should wear the acceleration sensors and they are easily affected by noise in the environment.

In Computer vision based methods, is used for fall detection system is determined by utilizing the video, camera and other image processing techniques. This is more comfortable since the elderly person need not wear any devices and gives comfort to the individuals. The 3d shape of the people is constructed using calibrated cameras and volume distribution is measured to detect the fall events. The system is allowed to be robust to lightning, environment and presence of multiple moving objects by extracting lightning feature silhouette feature and flow feature. Fall and nonfall activity are divided based on the recorded video. Fall is divided into four main categories they are prefall which refers to the daily life motions, postfall refers to the final position after the fall has occurred, critical which refers to the loss of balance and finally recovery which refers to the return to normal daily postures. In order to use supervised classifier large dataset has to be built for supervised fall detection. This type of supervised fall detection will be affected by occlusion in home environment.

Daily activity of elderly individual is recorded in a video to differentiate between normal and abnormal activities of individuals. Gaussian mixture model is used to describe a person's normal postures and which effectively classifies between the activities of the elderly individuals. GMM is used to represent the normal model. The normal activity of an elderly individual keeps on changing throughout the life so small changes must also be verified. So here we make use of automatic video segmentation where video is automatically segmented without any manual intervention where even small

movements can be observed and it will be easy to classify the postures. Online one class support vector machine is used to differentiate between fall and nonfall activities. Further processing of automatic video segmentation is done by using block matching algorithms. Joint Adaptive algorithm is used to differentiate between the various blocks. Human body tracking is done by using ellipse fitting technique. Shape structure and position feature are also extracted. False alarm rate is reduced effectively and performance is also improved.

II.RELATED WORKS

Reference [1] Liang wang proposed computer vision based fall detection system for elderly person in a home care. The activities of the elderly individual are observed for a certain period of time by placing a single camera in a room environment. The video is recorded and manually segmented into short video clips. The video clips consist of normal activities of the elderly individual. The human body silhouette is extracted from the video clips which are used as a dataset for normal activities. Codebook background subtraction is used to separate the foreground objects from background. The extracted posture silhouette is described by using Ellipse fitting technique. Online one class support vector machine was used to differentiate between normal and abnormal activities of the elderly individual.

Since Manual segmentation is done which includes the video clips small variations cannot be identified easily and it may lead to false alarm rates. Here the fall is detected only after the person had fallen down where it takes more time to give assistance to particular individual. Human intervention is needed for selecting and segmenting the video into video clips which is used for classification of activities. Gaussian mixture model is used to describe the person's normal activity. The fall is detected only when abnormal posture is observed for long period of time.

Reference [2] Miao yu proposed fall detection system based on posture recognition. The sounds are captured by using a circular microphone which is used to differentiate between fall and nonfall. The 3d shape of the people is got by using cameras place in a room. The foreground object is tracked from background object using codebook background subtraction algorithm. Mixture of Gaussian background subtraction is used in fall detection system. Classification is done by using directed acyclic graph which contains different postures and orientations. The extracted features are divided into four postures they are bend, sit, lye and stand.

The falls are classified based on different postures and observed for a certain period of time in an elderly person. Only postures are used for the classification of falls there may be more possibilities false detection rates. Since only floor information is derived it is not always possible to determine the right falls.

Reference [3] Yun Li proposed fall detection system based on Acoustic-FADE based on sounds that automatically detects falls and reports it directly to the care givers. To capture sounds in a room Acoustic-FADE is used which consists of eight omnidirectional microphone distributed along a circle of radius 25. Acoustic-FADE identifies the source, enhances the signal which finds the difference between fall and nonfall. The sound source is identified by using steered response power with phase transform technique. Beamforming technique is used for signal enhancement which can effectively reduce the interference such as TV, radio and phone ringing. Sound source localization is determined to find the source position and height is estimated depending on the threshold value. To identify the difference between the sounds among fall and nonfall mel scale frequency cepstral coefficient is used for speech and sound recognition.

Since identification of fall is done only based on the different type of sounds it is very difficult for situations such as multiple interferences and significant amount of reverberation. Locating the sounds is very complex since there may be occupied with the interferences in the room environment. The fall of sounds may not be same in all situations and determining of fall this way is not considerable and it may risk the life of elderly individual since it is determined only after the particular person has fallen down and when there is a large movement of sound towards the ground region. Though it uses circular microphone it highly focuses on only finding the sound but it does not use any method for improving the signals for better classification.

Reference [4] Franck Multon proposed a method for resolving fall based problems for elderly people living at home. Falls are detected here by using multiple cameras for reconstructing the 3d shape of the people. By using multiple cameras it will be able to overcome the limitations by offering several different points of view of the subject. 3d shape silhouette of the subject is extracted using multiple cameras. Volume distribution along the vertical axis is analyzed in order to detect the fall events. The occlusion resistant algorithm is used in order to detect if a person is lying on the ground even if some occlusions occur. Shape from silhouette approach is used to construct the 3-D volume of the person. To detect falls the cameras are placed in subject's environment by measuring movement or orientation of the human body. The Width and height of a person is observed by comparing the standing and lying person. Critical phase consists of detecting abnormal horizontal and vertical speeds or body silhouette changes.

Vertical volume distribution ration is very simple and robust and it used for detecting falls. The ratio is found by dividing the volume below a given height by the total volume. The ratio of a lying person is higher than the person standing up. VVDR consists of some inaccuracies because of too multiple occlusions and segmentation errors. There may be many occurrences of false position rates since only two positions are taken into attention such as lying region and standing region. Accessing of monitoring systems is also difficult.

Reference [5] Jean Meunier proposed a model to detect certain uncommon events such as fall. It is mainly focused on shape deformation of a person for detecting falls. Shape matching technique is used to track the shape of the person which can be done along with the video sequence. The shape deformation is specified from the silhouettes which are based on shape analysis methods. Background subtraction method is used to extract the silhouette. Some of the problems that are included in computer vision are the realistic video data should contain occlusion, object carrying and different viewpoints. Background subtraction method is used for comparing the current image with the background image. Gaussian mixture is used to find difference between fall and nonfall activities which is based on shape deformation. Shape recognition is done by using shape context matching. The two successive silhouette of a person is compared for further processing. The two successive images extract the moving edge points and they are matched using shape context technique. The lack of significant movement is also important for robustness after the fall is detected when the occlusion occurs.

Shape deformation through a video sequence assumes that fall will increase the shape deformation with time. Shape context is the shape descriptor and it is used for encoding the local information about each point relative to its neighbors. Shape of the body keeps on changing and it is very difficult to cope with the changes in human body where differentiation based on only shapes is not always feasible which may lead to higher false detection rates.

Reference [6] Ya-Li hou proposed reliable people counting and human detection in visual surveillance. An effective method is used for estimating the number of people and locates each individual in a low resolution image with complicated scenes. Background subtraction is used for detecting the people who are moving only slightly. Monitoring the people in public areas is important for safety control and urban planning. Real scenes consist of moving and stationary human beings. Expectation maximization is used for locating the individuals in low resolution scene. The current image is subtracted from the background image to get the foreground image. Cluster model is used for representing each person in the scene and it seems to be more definite in counting and detection. Before estimation is done in order to get specific results the crowd is disjointed into components based on their moving directions. In real time for estimating number of people and to find the relationship with the foreground pixels neural networks are used. Foreground pixel and closed foreground pixel is used for people counting. Closing operation is done to reduce the difference between the stationary people and moving people.

Getting a fixed background in the scene is very complex due to the illumination changes, camera movements and objects removed from or introduced into the scene. Inadequacy of feature points must be avoided on human beings. To handle denser crowds higher resolution video must be needed to provide sufficient data.

III.SYSTEM DESIGN

The architecture diagram for effective monitoring assistive system is shown in fig 1.

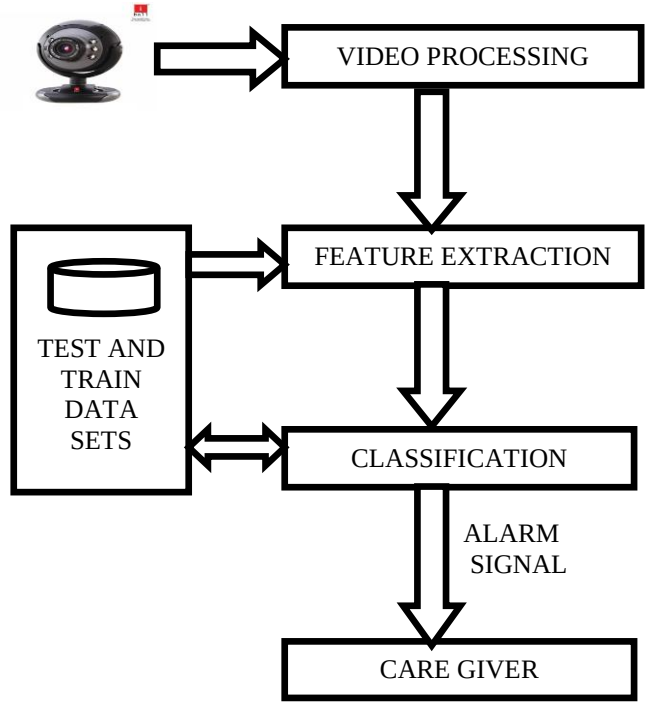

Fig1.Architecture Diagram

The web camera is placed in a room environment and the video is recorded accordingly and it is given as the input for further processing. In video processing the video is automatically segmented and it is converted in to frames. The frames involve conversion of macro blocks which is done by using block matching algorithm. The joint adaptive block matching algorithm is used to differentiate between the macro blocks. By converting the frames into blocks all movements can be identified easily.

In Feature Extraction we are extracting the features of the elderly individual. Low rank detection is used to remove the noise from the objects. Codebook Background subtraction is used to separate the foreground object from the background objects. Ellipse fitting technique is used to track the shape of the human body. This involves separation of human shape of the body from other objects. The posture of the elderly individual is tracked and it is given for further classification.

In classification the extracted feature is classified. It is done by using online one class support vector machine. It is used to differentiate normal and abnormal activities of the elderly individual. The comparison is done based on the features stored in test and train data sets. When a fall is detected an alarm signal will be given to the care givers.

IV.IMPLEMENTATION WORK

A.VIDEO PROCESSING:

The video processing involves the video which has been recorded from the web camera and it is given as the input for further processing. It is done by using automatic video segmentation.

Automatic Video segmentation

The video is automatically segmented without any manual intervention which involves the conversion of frames. The frame conversions are shown in fig 3. Since there is no manual intervention even large and small movements can be differentiated. Small variations can be identified easily as they are being converted into frames. The slight changes in the movement of the elderly individual are taken into notification to avoid false alarm rates. Frames per second are the frequency rate at which it produces consecutive images which are called as frames. Frame rate is the number of frames displayed per second.

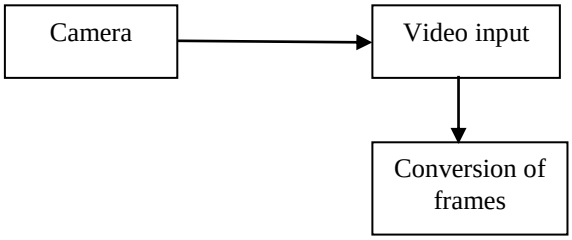

Fig2.Automatic Video Segmentation

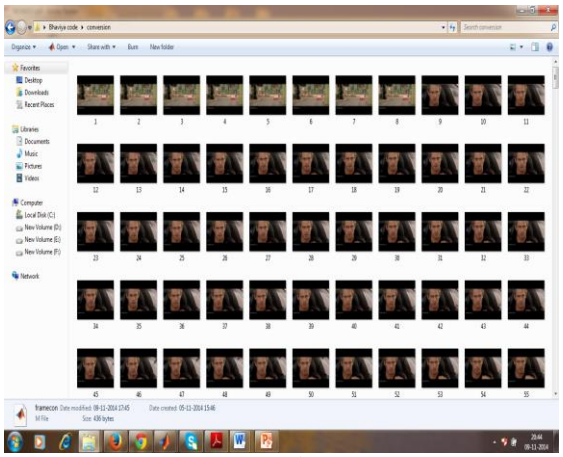

Fig 3.Converted frames

B. FEATURE EXTRACTION

The feature extraction involves the feature to be extracted from the video processing. The frames are converted into macro blocks by using block matching algorithm. Block matching algorithm are more efficient for macro block conversion which divides the frames into blocks and it is used for comparison. To find the difference in the macro blocks joint adaptive block matching algorithm is used. Low rank detection is used to remove the noise from the objects present in the blocks and separates the moving objects from the background objects. Codebook background subtraction is used to differentiate between the foreground and background objects. Ellipse fitting technique is used for tracking the human body shape. The posture of the elderly individual can be extracted only from the shape of the human body and it is given for further classification.

Block Matching Algorithm:

The block matching algorithm is used to convert the frame into macro blocks. It divides the current frame into matrix of macro blocks. Each macro block is compared with the corresponding block and its adjacent neighbor in the previous frame to create vector that designates the movement of the macro block. Each block is viewed as an independent image and such that it searches for the best match between the current block and in a confined area of a previous frame. The created vector captures the movement of the macro block from one location to another in the previous frame. Motion estimation for the current frame is identified. For a search of best match the parameter p is identified where p is the number of pixels on all the four sides of the macro block in the previous frame. The parameter p is used find the measure of motion. Matching of macro block with another block is done by cost function. They are done by using mean absolute difference and mean squared error. Block matching algorithm makes use of joint adaptive block matching algorithm to differentiate between the blocks and to effectively to find the difference in the movement of human body

Joint adaptive block matching algorithm:

It takes each macro block of size NXN(16X16) in the current frame and this current frame is compared with the shifted regions of macro block from the previous frame. It is used to identify the difference between the static block and motion block as shown in fig 4. The small and large movements can be identified easily. The process of a normal movement and the movement in an undesirable way can be found. The difference in the movement of the macro block is done by using zero motion prejudgement(ZMP). Matching error is identified between the current block and block on the same location. The current block is compared with the threshold value if it is smaller than the threshold value then the current block will be the static block.

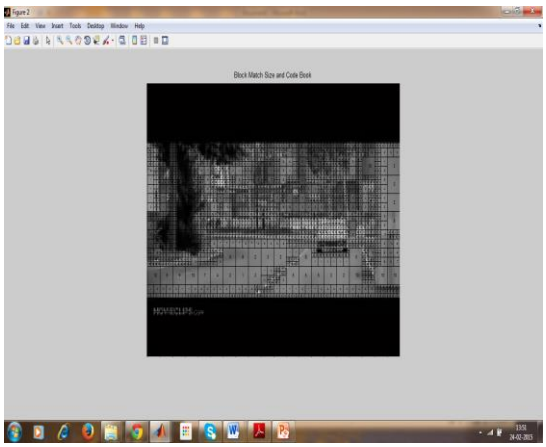

Fig 4.Blocks displayed by applying block matching algorithm

Background subtraction

It is used for separating the foreground object from the background object in video surveillance systems. The codebook background(CB) subtraction is used here for discriminating the moving objects. It has the capability of coping with the illumination changes. It can capture the background motion effectively continuously for a long duration of time under less memory. This method is used for both color and gray scale images. The training datasets consists of N number of images and they are associated with the single pixel (x,y). Codebook background is composed for this particular pixel and it will have certain number of code words. Each consists of a vector v and they are into RGB. The codewords in the CB method is compared with the pixel f(x,y) to determine whether it is a foreground or background pixel. It is declared as the foreground pixel if f(x,y) is not matched with any of the codeword.

Ellipse fitting technique:

The human body is extracted by using ellipse fitting technique. To fit the ellipse a moment based method is used here. The center of the ellipse is identified by using the first and zero order spatial moments. The orientation of the ellipse is found by using the angle between the major axis of the person and the horizontal axis. The central moment of the ellipse must also be calculated. The major and the minor semi axis are also determined by finding the greatest and the least moments of inactivity of the human body. Ellipse fitting is used to track the shape of the human body and the postures are extracted. The extracted postures are shown in fig 5. The extracted posture is got by identifying the shape and structure of the human body. The posture is given for further classification purpose to identify the fall activities of an elderly individual.

Fig 5.Tracking done using ellipse fitting and foreground object seperated from background by using CB

C.CLASSIFICATION

The extracted posture is given for classification to identify the difference between fall and nonfall activities. The extracted posture is compared with the test and train data sets, Classification is done by applying online one class support vector machine using the train data sets given below in fig 6.

Online one class support vector machine (ocsvm)

Description of data in the feature space can be done in a more flexible way by using OCSVM. Nonlinear decision boundary can be created by projecting data to a space with higher dimension through a linear function. Data points may be separated by mounting to a feature space where a straight hyper plane is present to separate the data points from one class to another. The OCSVM is mainly useful for adapting new postures from that of trained normal model. It can provide large training data sets in a faster way. The postures are extracted and it is compared with the values in the training data sets and the events are classified as either fall or non fall. When a fall is detected from the classification process an alarm signal will be given to the care givers.

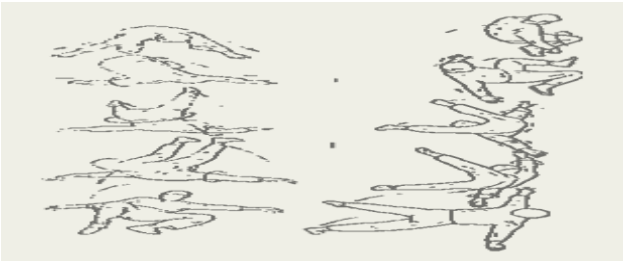

Fig 6.Different classification of falls
(Training Data Sets)

V.CONCLUSION

A single camera is placed in a room environment to observe the activities of the elderly individual. The video is given as the input for further processing of video where it is automatically segmented and involves conversion of frames. The small changes in the movement of the elderly person can be found easily since there is no manual intervention during the conversion. Block matching algorithm is used to convert the frames into macro blocks where processing of each frame could be identified and posture can be extracted from the ellipse fitting technique. When the posture is extracted it is given for classification for differentiating between the fall and nonfall events based on the posture of the elderly and the disabled individual. An alert will be given to the care givers when a fall is detected for an elderly individual. The comparison done in classification is fully based on the extracted values stored in the test and train data sets.

VI.REFERENCES

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