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Fall Detection System using Accelerometer Principals with Arduino Development Board

Swapna Shivaji Arote[1]
Department of Information Technology,
Amrutvahini college of Engineering,
Sangamner (M.S) India-431005

R. S. Bhosale[2]
Department of Information Technology,
Amrutvahini college of Engineering,
Sangamner (M.S) India-431005

Abstract: ***Fall related accident and injury are one of the most common reasons to cause of death and hospitalization among elderly. Falls among older people become a major problem facing hospitals and nursing homes. An enhanced fall detection system is proposed for elderly person monitoring that is based on-body sensor. The on-body sensor which consists of accelerometer, GPS model and GSM model is used in this model. An accelerometer is connected with GPS and GSM instant messaging module which is real time and GPS is used for location purpose, portable, and wearable, low-cost and with high accuracy rate. This device can monitor the movements and send alerts in case of emergency. For seniors who prefer to stay at their homes and live independently, the device can communicate with care taker to request help if needed***

Keywords: fall detection, Kinect, older adults, Tri-axial accelerometer, GSM, GPS

I. INTRODUCTION

A fall is nothing but "accidentally coming to floor, or some lower level not as a outcome of sustaining a violent blow, loss of awareness, sudden onset of paralysis as in caress or an epileptic attack". [1] Something like 3% of all fallers stretches out for more than 20 minutes without exterior hold up. [2] The need of support in the case of unconsciousness or extreme injury is the main reasons why elders leave the comfort and privacy of their own home to live in an assisted-care environment (40% of nursing home patient are only because of fall accident). [1] 32% of elderly people aged over 75 years have ever fallen at least once a year, and along with them, 24% have dangerously injured. Fall related injuries are the leading source of death and hospitalization surrounded by the elderly. Falls among older people become a major problem facing hospitals and nursing homes.

People, who have earlier met this kind of accident often fear a lot and wish not to have a new fall accident again and this fear of another fall take them into idleness or a kind of social isolation, many of the times they wish to go out but can't really go just because of the fear of collapse. We thought of this savior problem and solution which can detect such kind of accidents and generate alert which can help them get immediate assistance. Specifically, fall detectors can have a direct impact on the reduction in the fear of falling and the rapid provision of assistance after a fall. In reality, falls and fear of falling depend on each other: an individual who falls may subsequently develop fear of falling and, vice versa, the fear of falling may increase the risk of suffering from a fall. This falls can be detected by 2 ways: First method is Visual observation with some visual device which can observe the person continuously and then image analyzer which can analyze the fall of the person and generate alarm. These systems use sensors deployed in the environment to detect falls. The main advantage of this system is the person does not need to wear any special device. The scope of this kind of device is limited to monitoring region (Majorly indoors) cannot be carried all the time with the person Information provided by device is quite accurate but such equipment will cost higher. But this kind of system can have some flaws like it will capture all the personal activities. Now a day, Microsoft launched its product the Kinect sensors [3] that include an IRFF projector and camera, thus this system functionally work as a vision-based sensor under all lighting conditions. It is useful to gathering activity data during all times of the day. Microsoft

kinect camera is enabling to gather information during night times. This is biggest disadvantage of this system. There are many vision based sensor most common is cameras, infrared sensors, microphones, pressure sensors and floor sensors,. Video-based systems can be considered as a subcategory in this group as they use computer vision techniques that differ from the rest of the detection methods.

Second method is through sensor to overcome the flaws of visual monitoring equipment we thought of devising electronic sensor which will important to detect fall and send out alert to call for help. If a fallen person is unconscious and unable to call for help it can lead to permanent injure and even death. Therefore there is a need of self-directed fall detectors that are capable of triggering an alarm automatically without any interference of the victim and transferring this information to a remote site. So that the fallen person should get immediate medical help. Based on these problems, the main aim, of then this system is to build up a small, comfortable, and user friendly device, and automatic fall detector system that will help older people to handle this problem. In this paper the fall detector system is a real time working model for detecting the fall, by using accelerometer. It will be accomplished for continuous fall detection and sending an alarm to a remote terminal. It will consist of GSM attached to this system to transfer the real time condition to the respective places (Care taker, Relatives , Family Doctor etc.) As for fall detection through an accelerometer, the scope of activity is relatively unrestricted; the device is easily attached to the human body, and the cost of system is low as compared to vision based method.

This paper is organized as follows. Section II discusses related work about fall detection mechanism. Section III presents the proposed system of fall detection. Section IV discusses result of the proposed scheme. Section V presents the conclusion this study.

II. Related Work

Marker less computer vision technique is planned to follow normal elements on the individual's body surface . This method implements the approximation of rotation; scaling and translation, by means of a maximum possibility come near to carried out in the Gauss–Laguerre transform domain [4]. Mostly this approach is suitable for person movement analysis in hospitals contexts, where kinematics is performed by means of marker-based systems. For performing marker less human motion analysis GLT-based motion estimation method is incorporated to present a novel method. In this paper STS (sit to stand) task has been chosen for marker less analysis. STS is a general functional activity performed daily life. The main rotations associated with the STS movement mainly involve the sagittal plane, where ankle plantar flexion and dorsiflexion and hip and knee flexion–extensions can be observed. The estimation obtained from hip and ankle flexion–extension trajectories, the resultant angular velocities, and the task duration, it is possible to identify and quantify differences in the strategy between young people compared with the elder people. In this case results introducing the marker less motion capture based on the GLT algorithm as a suitable and feasible way out for the kinematic study of STS tasks.

In this paper, authors describes how intellectual video processing and unbroken video monitoring were used for older person for independent living of elders and to get better the effectiveness of older care practice. In general, authors developed an automated activity analysis and summarization for eldercare video monitoring [5]. Authors developed an accurate and robust silhouette extraction and human tracking algorithm which is used to effectively remove shadow and handle dynamic background changes in an indoor living environment. They developed an adaptive learning and fuzzy assumption structure to estimate objective locations and moving speeds of persons from a single camera view without calibration. They developed an adaptive feature selection and human action recognition scheme to extract important activity statistics and functional assessment data from continuous activity monitoring videos for this purpose they used hierarchical decision tree and dimension reduction methods. For Silhouette extraction, purpose, segmenting a person body from a background, is the initial task for numerous advanced vision analysis tasks, like public tracking, video examination, and activity recognition. For effective privacy protection and accurate activity analysis. The silhouette extraction must be accurate and robust. For effective silhouette

extraction purpose these three fields must be accurate time-varying light conditions, strong shadow, and dynamic background changes.

For activity monitoring person through video for eldercare deal with the some issues. First, activity monitoring should be unobtrusive and privacy-protecting. For unobtrusiveness, the size and total number of cameras need to be as small as possible so that they can be easily and hidden in the living environment. In this paper, author installs a single small fisheye camera in the living room. For privacy protection, they develop a fast and efficient silhouette extraction algorithm to extract and block-out the person in the video frame. In this paper author developed an accurate and robust silhouette extraction and human tracking algorithm which is used to effectively remove shadow and handle dynamic background changes in an indoor living environment. System for capturing regular, in-home step measurements using an environmentally mounted depth camera, the Microsoft Kinect, is presented. In This paper a one Kinect sensor and computer were used for person tracking purpose. This system is fixed at older person's home of older. For the purpose of continuous monitoring. In this paper have investigated algorithms for measuring gait parameters using the Kinect sensor without the use of skeletal tracking, validating the measurements against a Vicon marker-based motion [6] is confine system in a laboratory setting, and this approach is designed to track gait in real-world, dynamic environments, specifically the homes of older adults.

III. Proposed Fall Detection Methods

Accelerometer [7] has been used in various studies and applications to objectively monitor a range of human movement, for example to measure metabolic energy expenditure, physical activity levels, balance and postural sway, gait, and to detect falls.The monitoring system show in figure1. These system having hardware part .It will attachable on the waist of the person and a microcontroller is used for classify person's actions and detecting any possible falls.

In case of the falls, the system also sends out an alarm to the appropriate response unit. The first part of the system includes a fall-detecting band for extracting and processing signals obtained from the triaxial accelerometer. In this system an accelerometer ADXL335 is used for the fall detection purpose on X, Y and Z axis. Here these sensors will send the analog signal to the microcontroller for its logical manipulation for detecting the real time status of the body to the home server to update the display information. The device also includes an emergency help button display the fall alert and emergency signal. The second part of the system consists of a GSM modem system that will be attached with the microcontroller for sending the message to the respective places along with the location of user. The server first received a fall alert, and then it generates alarm.

In fall detection technique, the values of accelerometer are the input to microcontroller i.e to Arduino board for computational purpose. The three axes i.e. x, y, z will each produce a different acceleration value, based on these value use stage analysis to evaluate users movement signals. Movements of person will be classified into normal movements and abnormal movements. According to acceleration values from accelerometer, normal actions will be continuous and cadent movement signals, while irregular actions shall be recognized as fall signal. In this method check the value of three axes with respective defined threshold. If value is below the threshold then generate alarm. It's ability to determine different activities under different environments. Speed up the activity state identification process and lead to faster fall detection.

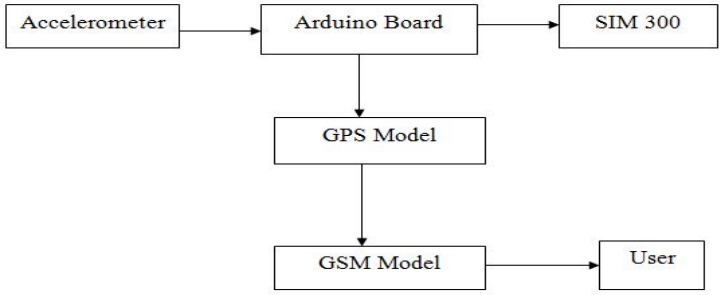

Figure 1 : Block diagram of the proposed fall detection system.

Object can be monitor behind the wall unlike Kinect system. The Kinect SDK having the limited range of the skeletal tracking, approximately 1.5 to 4 meters from the Kinect. That's the reason behind for not using kinect device.

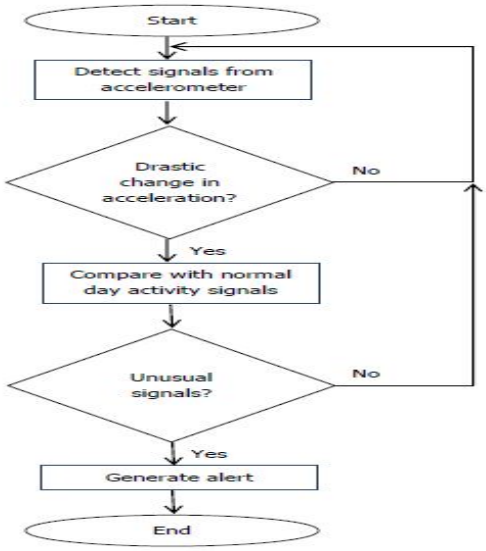

Figure 2: Flow chart of Fall detection System

IV. RESULTS

Following fig 3. show the acceleration values of accelerometer

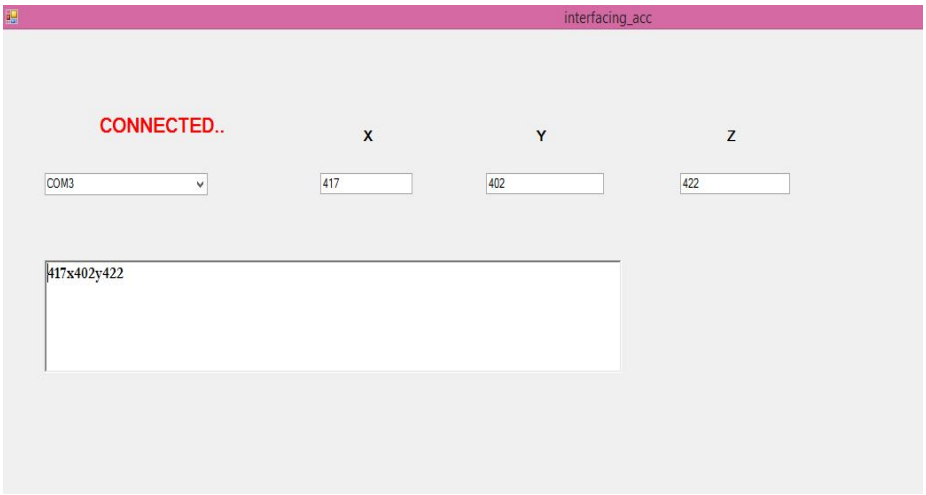

Figure 3: Acceleration Values

Following fig 4.shows message sent from Arduino board with the help of GPS model .Message contain latitude and longitude of person location.

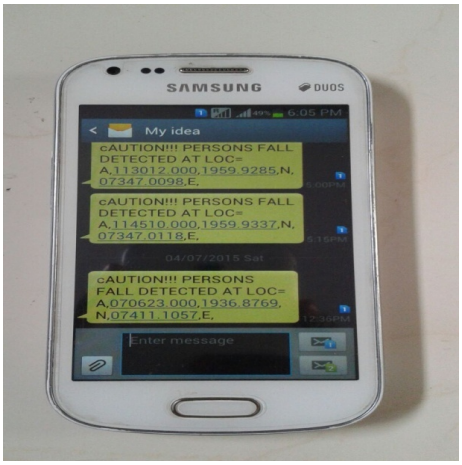

Figure 4: Message Sending

V. CONCLUSION

There is various fall detection systems detect effectively, but not Suitable for real time application. The proposed system will be a portable device mounted on the waist of user, having sensors consisting of accelerometer. The propose fall detection system can be regarded as alternative device to the existing detection approaches, since the device provides the comfortable wearing, is less complex as compared to other devices, fast fall response and will be more accurate and economical. These systems overcome the limitation of limited range of object tracking.

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