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# A Survey on Monitoring and Fall Detection System for Old Aged Person

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***Abstract:*** ***Nowadays, as people around the world are so busy with day to day schedule and this makes impossible to spend time for the elderly person about their daily basis and activities in home. Rendering help to daily basis of elderly person is an important one when they are in emergency situation. so remote monitoring system to elderly person will provide assistance and deal with the challenges faced in aging for performing their daily activities in home environment. Due to advancement of technology, there are many approaches for monitoring system which involves employment of various sensors to the home environment in order to acquire the data to be monitored. Apart from that, only monitoring is alone not enough and providing timely help is an important aspect which fulfils the system in better way. Here a survey is made on various methods and fall detection system has been discussed.***

***Keywords: Monitoring, Fall Detection, Emergency, Sensor, Approaches.***

## I. INTRODUCTION

At present situation, people have to meet their financial commitment, working has become compulsory scenarios. Older persons have to do their day to day activities independently in home environment possess a major challenge to them .Another active problem is accidental fall . There are many researches in fall detection and to provide timely help in case of fall. A remote monitoring system was developed using various methodologies and approaches for detection of fall. As the accidental fall problem occurs for people around 65 years of age and for over 70 year. There are many approaches for a fall detection system development in order to provide solution for the fall causing serious injuries which may cause suffering to aged person.

## II. FALL AND ITS TYPES

Accidental fall are very common among old aged persons. But fall may cause serious injuries and fatal death which remains problem for person living independently in home environment. The fall types are as follows. They are

*A.* normal fall
*B.* falling forward
*C.* falling right
*D.* falling left
*E.* falling backward
*F.* falling due to unconscious state
*G.* falling due to obstacles (furniture)

## III. TECHNIQUES FOR FALL DETECTION SYSTEM

### *A. Acoustic & Ambience Sensor Based Technique*

Here sensors like microphone, infrared and vibration sensors are used to detect falls. This is analogous to the vision based technique in detecting the fall event. This technique gives inconspicuous way to monitor person and detecting fall events .The arrangement needed for this will be simple and cost effective. PC system and the sensors with the threshold based values are checked with condition will takes places to detect a fall occurred. This technique focuses on sound and movement of the person for detecting the fall event.

### *B. Visualization Based Technique*

This technique makes unremarkable manner of system for observing people. Several persons can be monitored with a single arrangement. This system of analysis based on video will have camera and computer system. Here recording video and sending them to computer system for analysis process. Taking from background first segmenting the single person and extracting the features and lastly fall discovery.

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*C. Kinetic Based Technique*

In this technique, accelerometer and gyroscopes are used in order to detect fall from other activities. Here data are collected from this sensors and PC or microcontroller are used as processing unit. This technique has advantage in operation range. This is used as wearable device for detection of fall event and easy for monitoring purpose.

## IV. SURVEY ON RELATED WORK

Here various topics related to fall detection system are surveyed and discussed in this section, fall detection is one of the research work undergoing currently in order to provide an efficient and cost effective one. Analysis of fall detection is as follows:

The paper which was suggested by Yun Li ; K. C. Ho ; Mikhail Popes cu [1] in 2012 gives the idea about the method of fall detecting system using sounds from the particular location. This system will detect a fall habitually and intimate quickly. It consists of microphone array in the form of circular shape placed in room to seizures sound. This pinpoints the source when sound is traced, in order to improve the signal acquired to identify by classifying into two categories whether fall is occurred or a non-fall. Phase transforms technique and the driven power response is used to trace the sound source. This method offers efficient performance of this system using simulation results.

Liang Liu, Mihail Popescu, Marilyn Rantz, Marjorie Skubic [2] in 2012 developed a system namely dual Doppler radar. A precise detail as sign using Mel frequency cepstral coefficients was created by this system to make consideration with the help of classifier regarding each action of the person to determine fall event from non –fall. Fusion methodology is employed in order to take decision from the dissimilar classifier with the choquet integral for identification of fall event. In 2012[3] presented the well establishment of using smart phone advanced technology to implement in fall detection system. In 2012 [4] designed a fall detection based on spatial segmentation capable of sensing prototype. A wireless sensor node established using zigbee protocol to identify the fall using Passive Infrared sensor nodes. In 2012[5] established a fall detection system by differentiating the different kinds of positions of the person using the association of directed acyclic graph support vector machine classification and information of the floor. Brad Mager, Neal Patwari, and Maurizio Bocca[6] in 2013discussed a fall detection system by employing RF sensor nodes in room with help of signal loss due to person to identify their position vertical and horizontal and has a consistency of 100% as result without the non- fall event. [7] in 2013reported classification of activities and detecting the fall as the approach in the form of wearable cameras . This works as with the aim in acquiring the images and processing edge orientation and strength in the histogram technique with a method to classify the activities in optical flow basis. After testing and with the obtained results proven to be suitable for obtaining the healthy system for detecting the fall events as well as other activities.

In 2013 [8] presented a concept which involves action of person has the nature of varying with time of Doppler sign were demonstrated with analysis of signal of time frequency made to give actual fall event Sokolova, Marina V. Serrano-Cuerda, Juan Castillo, Jose Carlos Fernandez-Caballero, Antonio[9] in the year 2013 proposed a fall detection system using fuzzy model in infrared video which is based on the tracking of human fall using kinectic parameters and geometric features .an algorithm based on infrared video with segmentation and tracking of fall is done. This system is accomplished in discovering the actual fall and false fall. Fuzzy models are used and fall pointers are involved. [10] in 2013 provides a methodology using multiple cameras to capture the fall event but has disadvantage of privacy concerned.[11] discussed about the combination of both vision based and wearable based technique.[12] shows the work of new vision based technique compared to traditional technique.

Erik E. Stone; Marjorie Skubic [13] in 2014 have introduced the fall detection system using Microsoft kinetic and usage of two steps. The proposed system involve by one state characterizing from the depth image frames about the vertical state of the person, next comes with the computation of fall on ground part using decision tree .Data are collected from the various performed datasets for fall detection system to obtain the improved results. [14] Reported the usage of single depth camera following the movement in body for determination of fall.

Georgios Mastorakis Dimitrios Makris [15] in 2014 presented an innovative system for detection of fall based on kinetic sensor .as this system will be capable of detecting the fall measure truly without any intervention of false fall event. Calculations are done by taking the two parameters as velocity and idleness. The basic approach behind was measurement of velocity by contracting and expanding the width, height and depth of the 3d bounding box. Based on this algorithm the obtained sets of detected event provide the enough information for this detection system. [16] gives a ideas for reduction in power consumption among the signals between triaxial accelerometer and barometer pressure which are analysed in detecting the fall with efficient system.[17] in 2014 designed an system using 2 dimensional camera for detracting background data for detecting movement.

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Chokemongkol Nadee; Kosin Chamnongthai [18] in the year 2015 stated the detection system based on usage of ultrasonic sensors. Multiple sensors are employed for transmission and reception with the connection to microcontroller thereby sending to processing unit using Wi-Fi. The basic setup of the room was with the sensor arrangement along wall and ceiling. Various activities are detected and sensing the distance and analysing the person for recognition. This system provides enhanced accuracy for detection of fall event. Xuebing Yuan, Shuai Yu, Qiang Dan, Guoping Wang, Sheng Liu 2015[19] developed system comprising a combination of accelerometer , gyroscope and magnetometer with the aim of differentiating actual fall from other activities related to fall like jumping , walking. [20] in 2015 proposed a system with the mixture arrangement of two android device communicating through Bluetooth technology means fall happened at that time or not at all. Lih-Jen Kau., Chih-Sheng Chen [21] proposed a system consists of detector with the smartphone and GPS technology for location. Wei-Han Chen and Hsi-Pin [22] in 2015discussed in order to get 3 dimensional with the usage of dual infrared sensor to the interior of the room.[23] in 2015 introduced new model for fall detection system which follows vision based techniques. In this system, required features are taken for analysing the sequence of the video frame.

Branka Jokanovic ; Moeness Amin ; Fauzia Ahmad[24] in 2016 chosen a method using radar signals as major part for time frequency analysis . This involves approach of deep learning with the velocity components in order to determine the possessions of parts of body during motion. And this step will give the idea of frequency time marks for classification of features using principal component analysis technique for selecting important features for examination. [25] in 2016 reported an enhanced detail of system in identification of fall event along with the interpolation and commonly using the wireless sensor network technology.[26] demonstrates about the accelerometer and gyroscope sensors used for development of fall identification with Intel Galileo board which consists of a sensor MPU6050. Here non-fall event are rejected after analysis of the system is made. [27] in 2016 discussed about the consumption of energy by the each sensor node for detecting the fall using wireless network. [28] in 2016 proposed floor system using pressure of fibres sensors for identification of fall. [29] in 2016discussed with the fall identification system based on IOT and reported that energy consumed by each sensor node to provide a competent system.

Hao Wang ; Daqing Zhang ; Yasha Wang ; Junyi Ma ; Yuxiang Wang ; Shengjie Li[30] in 2017 gave a home environment based fall detection system using Wi-Fi devices. This system provided a cost effective, contactless in real time environment. Without any interruption by design detects the fall and making comfortable state to continue their activities on daily basis. This works on two important features. Phase difference of the two antennas is considered primarily for recognising activity for division of fall and as like related activities. Yuan-Tsung Chang ;Timothy K. Shih[31] in the year 2017 focussed on using ultrasonic array sensors signals for detecting fall with the pattern matching of events. This gives details about the algorithm for omission detection of event pattern matching. But the putting in practise of ultrasonic array sensors is difficult. Fall event based on support vector machine model is used to determine and verifying for actual falls without false fall. The obtained results show the enhanced presentation of the used algorithm**.**

Yuxi Wang ; Kaishun Wu ; Lionel M. Ni [32] in year 2017 given a model for efficient fall detection system based on WiFi with the pointer to activities using physical layer channel state information with the 3 indoor scenes arrangement of transmitter and receiver links. The achievement of the system give improved accuracy at greater than other system for a particular person. The performance is analysed using random forest algorithm involving support vector machine of single classifiers with the precision at the average rate. [33] Gave an innovative method for predicting the fall activity with the help of APPs created in smart phone for recording walking manner of the person. [34] introduced a system with a technique silhouette orientation volume used mainly for classification in order to determine the fall events. In 2017[35] demonstrated an advanced system which uses profound floor sensor for identification of fall with the aspect of piezoelectric sensible nature as well as machine learning methods. Without making use of power supply falls can be determined with the greater accuracy compared to other detection system.[36] presented a system based on sensing nature of the array of Nano generators with the help of pressure to identify the fall event.

Ahsan Shahzad; Kiseon Kim [37] in 2018 suggested a paper with the concept of development on smartphone using algorithm for detecting the event of fall with the help of signals of accelerometer. Here innovative approaches followed by algorithm namely threshold and multiple kernel learning support vector machines with the intension to lessen false warning. This method gives the accuracy of fall events with consumption of low power usage. Xue Li, Lanshun Nie, Hanchuan Xu and Xianzhi Wang [38] in 2018 proposed a method of detection stage on combination of 2 systems namely using mobile phone with threshold and usage of kinetics based on support vector machine with the mixture of acquired data and analysing with another method namely D-s evidence mixture based and logic rules. Based on this method the accuracy has been achieved compared to other existing methods. Tao Xu and Yun Zhou [39] in 2018 gave a brief detail about accidental fall detection using Microsoft kinetic. Its base lies on acquired 3 dimensional skeleton data. The main features like dissimilar segments of body and skeleton data influencing accelerated velocity of center of

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mass were taken into account. This method implements long short term memory networks for identification of fall occurrence. Being privacy protection and independent system gives advantage and efficient result in analysing fall behaviours.

Taylor R. Mauldin, Marc E. Canby, Vangelis Metsis, Anne H. H. Ngu, and Coralys Cubero Rivera [40] in 2018 gave a work related to estimating the fall event using the application created in smartphone and the smartwatch which gives information credited with the help of support vector machine and deep learning model.

## V. SUMMARY

From the above surveyed paper, various techniques are used for identifying the fall events for old aged person and informing to family members or to care unit during critical situations. The techniques include sensors using floor, pressure, ultrasonic, infrared as well as wearable cameras, Wi-Fi devices, smartphone based kinetic sensor and each has some advantages and disadvantages in terms of measured parameters for fall detection events. Firstly technique based on sensor technology will not provide accurate fall event and many non-fall events which leads to be non-effective system. Next comes to vision based technique , using cameras will give actual fall but it leads to issues in terms of cost, power consumption and privacy. Recently sensor-video integration technology will be preferred in order to avoid detecting the non -occurred fall event.

## VI. PROPOSED SYSTEM

In this section, the proposed system consists of wearable accelerometer sensor for collecting data and camera for capturing the event of fall is used for designing the fall detection system. Phone call as well as live video feed is provided with the detailed information using GSM technology finally to the users or to care unit during emergency situation. Block diagram for proposed system in shown in figure1.

### *A. Components Used*

1) *Accelerometer sensor*: This helps in identifying the fall event by giving the difference in the acceleration of various activities of the monitoring Person.
2) *Magnetic door sensor*: This is used to provide details about the door open and close activities.
3) *Camera*: This is used only to capture if the fall event is occurred in order to provide the video feed for the user gives the status of recovery for the person to be engaged.

### *B. Communication Module*

1) *GSM module*: This module for mobile communication establishment with the information conveyed in the form of short message for intimation to rescuers.
2) *Wi-Fi module*: This helps in establishing a connection to WiFi network for internet connection.

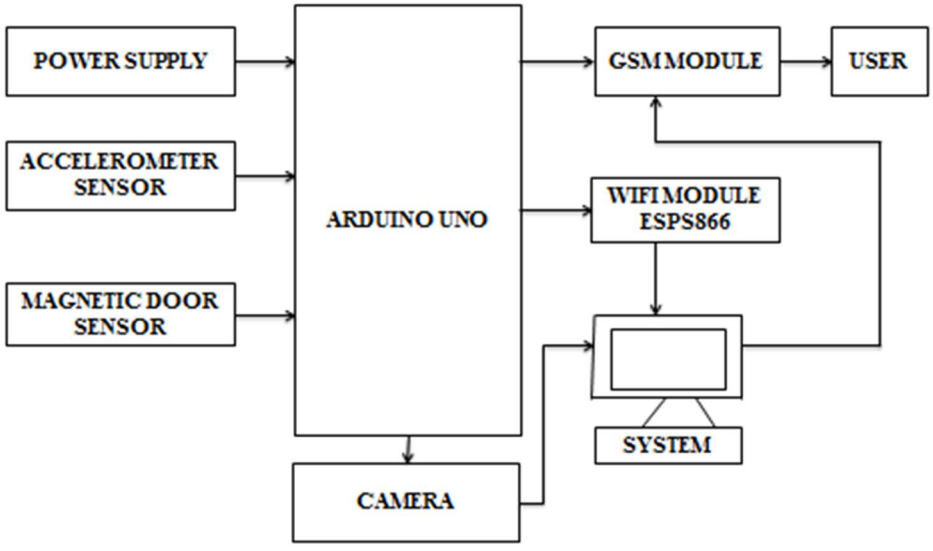


Fig 1: Block Diagram of Proposed System

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## VII. CONCLUSION

Here the related papers work has been reviewed and discussed about various fall detection systems with different methodologies and technologies. As fall being the main issue concerned to elderly person health wise. The proposed fall detection system will provide a better solution to that of other method followed. This gives advantages in terms of cost, size, and privacy protection and in comfortable manner for the old aged person. This system provides timely help to them with the live video feed for the rescuers.

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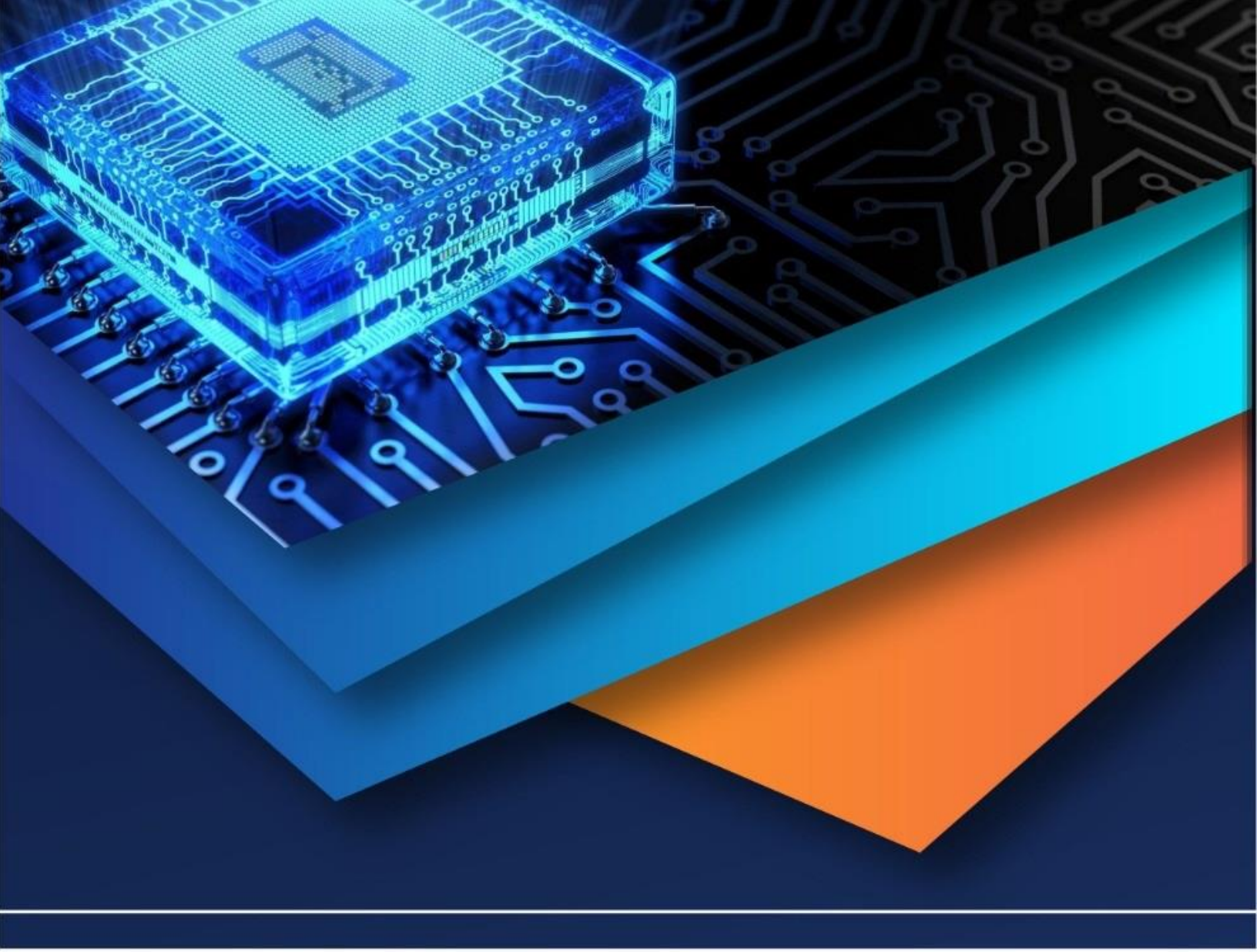

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