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# Computer Vision Based Human Fall Detection System for Elderly People & Old Age Homes

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**ABSTRACT:** Falls are generally threatens the health of elderly people in a serious manner. It is a major publish health risk for such people[1]. Such human falls if not responded on time, may lead to serious injuries and possible death of the person. This paper illustrates the need and development of a better fall detection system using Machine Learning and Artificial Intelligence technologies. The fall detection systems are generally classified into wearable and non-wearable categories. There are many existing wearable fall detection systems are available in market which are inadequate to meet the exact requirement. These systems uses Support Vector Machine and other Neural networks algorithms for fall detection. For a much better detection and alert system a novel architecture is proposed in this paper by using open source libraries like Open Pose. The proposed method in the paper comes under computer vision based human action recognition and has a wide spread attention.

**KEYWORDS**: Fall Detection; Support Vector Machine; Artificial Intelligence; Human Action Recognition; OpenPose

## I. INTRODUCTION

There are so many old people living in apartments or in small houses. This may be due to their children grown up and got a job abroad or they left home. Falling is a serious issue in such elderly people. It leads to death or serious injuries in 95% of the reported cases. As the population is increasing in a rapid manner, there is an emergency of developing the mechanisms to detect or prevent such accidents and injuries. According to a study made by the World Health Organization, in United States of America, 64600 numbers of falls are reported in a year in which majority of them are people having their age above 70 years. An interesting case is that the number of road accidents reporting in a year as per their study is near to 100000 and thus the accidents reported by falls is very next to the number of reports in road accidents. Generally speaking, fall is a major common problem for the elderly people. The injuries caused by the falls have many consequences to the person itself and to their families. Therefore a fall detection system is a must in developing countries like India.

There are several products are available in the marketplace to address the problem of fall detection and prevention[2]. The major problem with such products is that they require bulky hardware components and leads to high cost. Some of the systems work with base stations and Radio Frequency[3]. This base station, placed centrally in one's house and hardwired to a phone line, then phones a call centre for help. The disadvantage of these products is that they all require an intermediary call service which amounts to a heavy monthly fee[4]. Also, they are all limited to the range of one's house because they depend on the central base station for outside contact.

A new proposed model aims to work with post estimation models. Human Pose Estimation is an interesting and trending Artificial Intelligence area. Pose estimation is the process of localization of human joints from images or videos. The process takes human joints commonly known as key points into area of consideration and estimates the pose from a live video.

## II. RELATED WORK

There are many existing systems uses wearable devices for fall detection. Generally wearable fall detection based devices are electronic devices that can be fit on top of the people's clothes. These wearables include oscilloscopes, tilt-meters, accelerometers etc[6] to detect a fall. They use external sensors in the surviallence area to obtain the

environmental data. In recent years WiFi devices oriented fall identification mechanisms had received global attention but it also have the disadvantage of high cost. These wearable based systems has the disadvantage that the humans may possibly forget to wear the device on his body or may accidentally turn off the device. There for contact-free fall detection mechanism is much more popular.

Acoustic based fall detection methods are popular in some countries which uses devices like microphones to capture abnormal sounds[7]. Such fall detection systems install multiple microphones or other sound capturing devices in the user environment and capture the sound generated during falls. Some of such systems even uses machine learning and packages like Libroza to compare this sounds using ML based algorithms and to separate fall related sounds from others. Such systems also have some disadvantages. The sound generated by each fall depends on multiple parameters including human weight, age, distance to the floor, type of floor etc. So training all these sounds using Machine Learning techniques is a large task and is difficult to achieve.

There exists computer vision oriented methods for human fall detection. Plenty of researches are going on through that area .It has the advantages of high accuracy and user friendliness. In such methods the video data is collected and pre–processed locally and uploaded to server for further computer aided analysis. These methods are commonly known as vision based methods and still in developing stages.

### III. PROPOSED ALGORITHM

A. *Design Considerations:*

The proposed design is a two stage detection system in which on the first stage, the image is extracted from the video and stored after pre-processing and on the second stage the current human action is identified using the OpenPose techniques. In the proposed system, the most important design consideration is about how to collect image features. From the collected image features. Fall detection is separated from the user's Active Daily Activities(ADA) and generates necessary alerts.
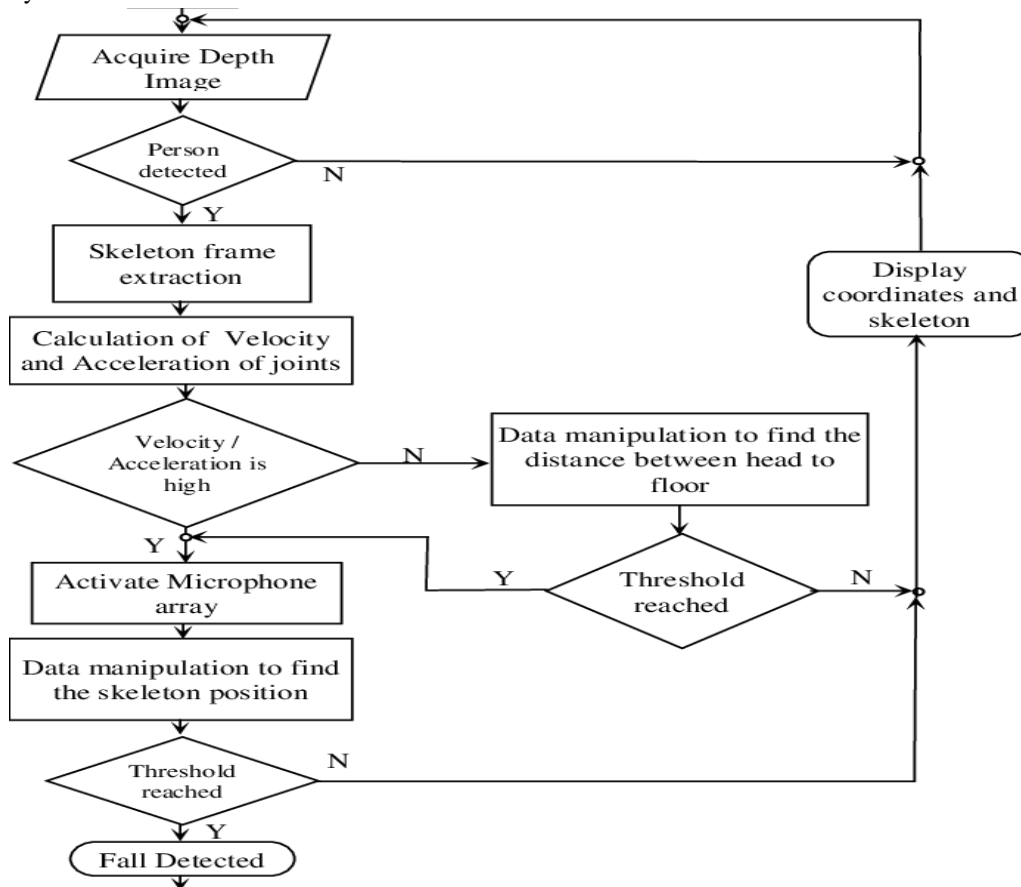
*Description of the Proposed Algorithm:*

Step 1: Identify and extract human part from the live captured-video:

The user's image is captured from the camera connected to the system and it uses OpenCV based techniques to detect the human and separate it from the environment.

Step 2: Image Pre-processing:

The captured image is converted into RGB format and makes it ready for processing. The image is converted into 250x 250 pixels for processing.

Step 3: The key points are extracted using OpenPose and key features such as spine deflection angle, thigh deflection angles, calf deflection angles, and spine ratio are identified to characterize human posture.

Step 4:OpenPose[8] uses the COCO dataset[9] and obtain 25 key points of human body from 2D image as shown in the fig(1). It then compares the features extracted from the previous step to identify whether the current action is a fall or not.
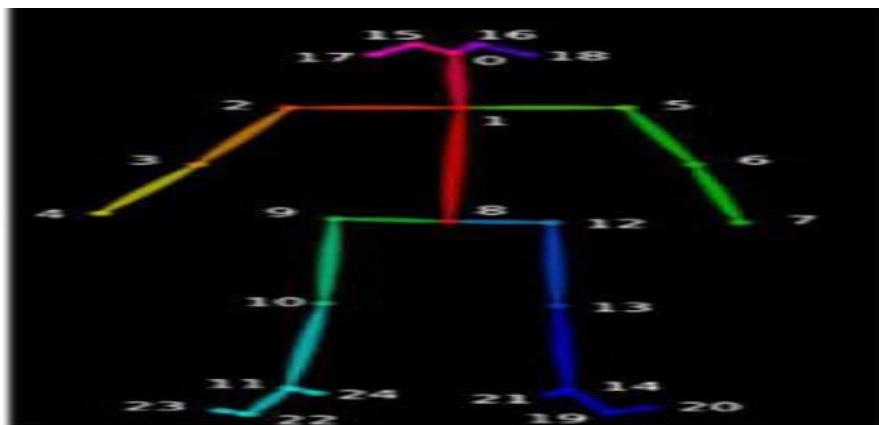


Step 5: The system then generates necessary actions to generate alerts and warnings.

## IV. PSEUDO CODE

Step 1: Define Current Action (CA) and Fall Action (FA)
Step 2: Start the video capture
Step 3: Start the Openpose library
Step 4: Capture the video and draw key points on the human body
Step 5: Connect the keypoints altogether and generate the current action, CA.
    if (CA==FA)
Generate alert
    else
    Continue capturing the video until a fall is detected.

Step 6: End.

## V. CONCLUSION AND FUTURE WORK

The advancement in technologies lead to the development of intelligent systems .Any intelligent fall detection system, whether it is a wearable one, or a non-wearable one, or a computer vision based one, can be combined with

machine learning and artificial intelligence technologies to make it worthy for end users. There exists some issues with wearable systems and non wearable systems such that in case of wearable devices , the human may forget to wear the device physically on the cloth and in non-wearable devices it lacks accuracy. The proposed systems uses computer vision technologies together with artificial intelligent libraries like openpose and opencv[10] to detect human falls and to alert the users on time without causing a lag.We can assure that the system produces the output with highest accuracy.

As a future work we can make this software application available for mobile and hybrid devices and there by making it more reachable to common people. Similarily a little more memory optimization can be made to increase the speed and performance.

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