HYBRID APPROACH BASED FALL DETECTION:A SURVEY

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ABSTRACT

Falls are a significant health hazard for elderly persons who live in vulnerable communities. For over two decades, medical institutions have conducted substantial research on falls to limit their impact (e.g., loss of freedom, fear of falling, etc.) and minimize their consequences (e.g. Cost of hospitalization, etc.). However, the issue of elderly falling does not only concern health professionals; it has also piqued the scientific community's curiosity. Indeed, falls have been the subject of several scientific investigations and the inspiration for a plethora of commercial goods developed by academia and business. This research addressed the issue of fall detection by utilizing a range of sensor methods. Recently, researchers have moved their focus to fall prevention, intending to detect falls before they occur. Despite their limited use in clinical trials, early-fall prediction systems have begun to appear. Simultaneously, contemporary assessments in this field lack a consistent ground for classification. The article's primary contribution in this area is to provide an overview of senior falls and to suggest a generic classification scheme for fall related systems based on their sensor deployment. Based on this common ground classification, an extensive study scheme ranging from fall detection to fall prevention technologies has been conducted. In this paper, we have reviewed data processing techniques that are addressed in both the fall detection and fall prevention tracks. The purpose of this effort is to equip medical technologists working in the field of public health with knowledge about fall-related systems.

Keywords— Deep Learning, B.Transfer Learning, C.ResNet50, CNN, PCA

INTRODUCTION

In the last decade, an aging population has forced an increasing number of elderly people to live alone. The old age reliance ratio will skyrocket. Falls are also the tenth leading cause death in the US. We frequently tumble in our daily tasks. Aside from walking, many fall when sitting or resting. Patients, compared to healthy people, are more prone to losing their balance and falling, hence human falls occur frequently in medical settings. Accidental falls that do not result in quick medical attention can result in fractures, strokes, disabilities, and even death. Due to the presence of furniture, previous techniques are unable to detect falls in complex circumstances [1]. Wearable devices are insensitive to the environment and required periodic maintenance like batteries replacement or recharge which is sometimes forgotten by elderly people. The other disadvantage is to cause inconvenience in daily activity. Research studies indicate that elderly people do not

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prefer wearable devices instead they prefer non-wearable devices [2]. In this paper, we have proposed a hybrid-based fall detection system using machine learning and a PCA algorithm. We will train a machine to detect if any person had fallen. Live video recording will be provided to a machine that will be correlated to the video dataset and then the next step is prepossessing which is done using the Open CV library. Prepossessing phase is to remove the noise from the data, re-scale, resize from video. We used a machine learning classifier for the classification i.e. CNN and PCA algorithm. Classification is the process of categorizing and labeling groups of pixels or vectors within an image based on specific rules. An alarm will be generated and a notification will be sent to the concerned people.

LITERATURE REVIEW

In previous paper, authors have introduced the system that is beneficial for accurately detection fall behavior in surveillance video and timely feedback will effectively scale back the injury and even death of the aged people thanks to falls. For the advanced scenes in surveillance video and also the interference of multiple similar human behaviors, this paper proposes a method based on pose technique supported create estimation and also the auxiliary detection method supported yoloV5. First, extract video frames from totally different falling video sequences to make an information set; then, input the coaching sample set into the improved network mistreatment SVM algorithmic program for coaching till the network converge finally, check the class of the target within the video in line with the optimized network model and find the target[3]. IoT primarily based fall detection monitoring and alarm system for the elderly using 3-axis measuring system. Therefore, aim to style a system to find the fall and alert the health workers regarding the incidents of distress. The elderly patient's acceleration information is incessantly acquired by employing a wearable detector and kept on a cloud server, using an associate IoT board. To access the stored information, the associate android application is intended for the medical expert to look at the fall. However, this wearable device is tough to be wear by senior folks. A threshold-based approach for the autumn detection has been used to get the detector information and set the edge on measuring system readings. These sensors may price a high to the patient [4].

Previous paper considers the Microsoft Kinect depth pictures of aged people's fall events. Once a collection of the required depth pictures the background deduction formula has been accustomed subtract the background and retaining the topic. Segmentation and feature choice methods are applied to numerous daily activities to coach the fall detection model. The model has been trained exploitation decision tree. To make sure the fall confidence, the ground truthing technique has been used. The model has been trained using a decision tree and to make sure the fall confidence, ground truthing is additionally used [5]. Considering non wearable devices or systems, more than one technology, camera-based, and sensor-based are often investigated and enforced. The system used just one pressure sensor that was placed on the bed or pad. a unique double pressure sensors-based system was projected. They have proposed a method for automatic detection of pulmonary fissures in CT images using a deep learning framework. Fissure detection was found out with two

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new rule-based and learning-based methods. Fissure Net excellently performed U-Net as it was capable of learning larger-scale global features. Fissure Net achieves high sensitivity for fissure detection while producing very few false positives, allowing for straightforward post-processing to obtain a final lobar segmentation [6]. In this paper, they introduced an attended memory reference network that detects a current active online for a given video segment consisting of past and current frames. To integrate discourse data used for detecting a current action, they have a tendency to propose a replacement perennial unit, referred to as an attended memory reference unit, that accumulates input data supported visual memory attended by current data. In an associate degree experiment employing a fall detection dataset obtained from the abnormal event detection dataset for CCTV videos publicized by AI Hub, the projected methodology outperforms progressive online action detection strategies. The sensors devices prevent seniors from living an independent life and they are forced to wear medical devices all the time. But, it may be dangerous to the life and health of others and also had accuracy problems as well as dataset problems [7].

In preceding paper, authors have proposed an approach to perfectly using a model of the spatio-temporal features using a fall motion vector. First, they construct a Gaussian mixture model (GMM) called the fall motion mixture model (FMMM) using histogram of optical flow and motion boundary histogram features to implicitly capture motion attributes in both the fall and non-fall videos. The FMMM contains both fall and non-fall attributes resulting in a high-dimensional representation. They perform factor analysis on FMMM to get a low-dimensional representation known as a fall motion vector. Using a fall motion vector, they are able to efficiently identify fall events in varieties of scenarios, such as the narrow-angle camera, wide-angle camera, and multiple cameras. Aims to explore a novel prior knowledge retrieval and representation paradigm. But, it had accuracy problems, dataset problems, and had less physical activity, depression, and lower quality of life [8]. In this paper, they have a tendency to propose a fall detection technique using IR array sensors. The tactic permits for fall detection that's cheap and capable of privacy protection in a very non-wearable type. Also, they had analyze temperature distributions using machine learning to change faster and a lot of correct fall detection. They had measure multiple rules of machine learning to pick the best algorithm. Then, classifiers are created to support these algorithms. Calculate and compare the accuracy of those classifiers. One among the educational information may be a series of temperature distribution information for two seconds. The fall detection method acquires a plurality of temperature distributions and detects a fall using the created classifier [9]. GoodEye proposes a footing device that predicts or detects falls supported by image orientation and physiological sensors exploitation the Internet- of-Medical-Things (IOMT). Using junction rectifier lights, the user is notified with the choice of fall prediction and detection if the determined amendment is larger than a group threshold. At the side of a camera hooked up to the wearable, the Good- Eye system proposes an overseas off-line on-wall camera to form additional correct prediction and detection of falls. The sensor input data are processed in the physiological sensor unit. The picture input data is processed to mention the changes in the environment and the orientation of figures at on-site and off-site cameras. As per the set threshold

ranges, the compared and analyzed data along with the decision are sent as notifications to the users [10]. This paper presented a method for fall detection based on combining convolutional neural networks Retina Net and Mobile net in addition to handcrafted features. This human detection method may result in human shape difficulty which affects the performance of the fall detection technique. Therefore, the proposed framework depends on Retina Net for detecting humans with shorter computing time and higher accuracy compared with the traditional human detection methods. Then, the projected framework depends on handcrafted options to represent the form and motion properties of the detected human. The projected framework extracts ratio and head position to form options and motion history image as a motion feature of the detected human to form the feature map. His feature map is employed in training the Mobile internet network to classify human motion into fall or not-fall. The planned framework is evaluated mistreatment metropolis and FDD datasets and also the experimental results established the efficiency of the planned framework achieving up to 98 percent accuracy compared with the progressive method [11].

Earlier paper presented a method for fall detection based on an intelligent video surveillance system is designed in this research. CMOS camera captures video and then transmits the video to ZYNQ hardware platform for real-time fall. The ZYNQ in each room is marked with the location information of the room, which can locate the location of the fall of the elderly. It also uses CNN (Convolutional Neural Network) image classification algorithm and hardware acceleration technology are used to process images and identify whether the elderly have fallen. When the elderly person comes under any incident, the system immediately transmits a message about the elderly to the caretaker via 5th generation mobile networks (5G).The results of the experiment show that system has a low false alarm rate and meets the real-time requirement. And the experiments also demonstrate the accuracy of this fall detection system is about 92percent only [12]. The present paper considers the usage of deep learning and transfers learning techniques in fall detection by suggesting that of surveillance camera processing. As a dataset, an associate degree open dataset gathered by the Laboratory of natural philosophy and Imaging of the National Center for a research project in Chalon-sur-Saone was used. The architecture of the CNN AlexNet, which was used as a starting point for the classifier, was adjusted to solve the fall detection issue. The proposed technique was tested on a dataset of 30 records including a single fall episode each. They had achieved Cohen's kappa of 0.93 and 0.60 for the fall –non-fall category for the known and unknown for classifier enveloping conditions, respectively. It is essential to provide first aid as soon as possible to prevent the negative consequences associated with hypothermia [13]. As falling is the most critical issue that faces elderly people all over the globe, this paper proposes a detection method for falling based on Machine Learning (ML). In the proposed system, a dataset of videos including falling activities has been utilized via separating each video into many pictures that are therefore being converted into gray-level pictures. Then, for catching the moving objects in videos, the foreground is firstly detected, then bluster and shadow are deleted to witness the

moving object. But also the sensors devices prevent seniors from living an independent life and they are forced to wear medical devices all the time [14].

A. *Fall Detection*

The safety and rescue of elderly people and patients from death and injuries become an urgent goal of computer vision and modern technologies. Elderly people are often not able to get up after their fall. Therefore, fall detection technology is typically developed. If a person falls unconsciously without getting emergency treatments, irrevocable consequences such as fracture, stroke, disability and even death may occur. Nowadays, falls are threatening the health and lifestyle of victims. There are two categories of devices, i.e. wearable and non-wearable. Among wearable technologies a variety of fall sensors have been developed for example accelerometers, gyroscopes, RFID and smart wristbands. Furthermore, In U.S falls are considered as the eighth leading cause of death.

B. *CNN (Convolutional Neural Network) and PCA (Principal Component Analysis) Algorithm.*

A Convolutional Neural Network (CNN) is a Deep Learning algorithm that takes input as an image, assigns importance measurable weights and biases to different objects in the images, and be able to differentiate from each other. The processing method required in a CNN is much lesser as compared to other classification algorithms present in today's generation. While in primary methods filters are manually handled, with enough training module, CNN have the ability to learn these filters/characteristics with proper specialization.

The principal component analysis is an unconquered learning algorithm in Machine Learning. PCA is a way of identifying patterns among data and points out the similarities and differences in the data. Since similarities, patterns in data can be difficult to find because of high dimensionality means a data set having a greater number of features then, PCA comes to our rescue because we cannot use graphical presentation for analyzing data. PCA is a analytical process that converts a dependent set of features to a set of independent features. PCA has its major uses in dimensionality reduction by removing the redundant (repeated) features without loss of information. It will be widely used in image compression. PCA is used to remove the noise from the data set. Image compression and Data visualization and interpretation and also visualize the relationship between populations. PCA uses Eigenvectors and Eigenvalues in its computation.

C. *Waterfall Model*

As shown in fig.1, the waterfall model is a breakdown of project activities into linear sequential stage, where each stage depends on another stage to complete a task. The approach is typical used for certain areas of engineering design. In software development, it tends to be flexible approaches, as progress flows in vast in one direction ("downwards" like a waterfall) through the stages of conception, initiation, analysis, design, construction, testing, deployment .The model is used in the manufacturing and construction industries; where the highly structured physical environments meant that design is made and became prohibitively expensive much sooner in the development
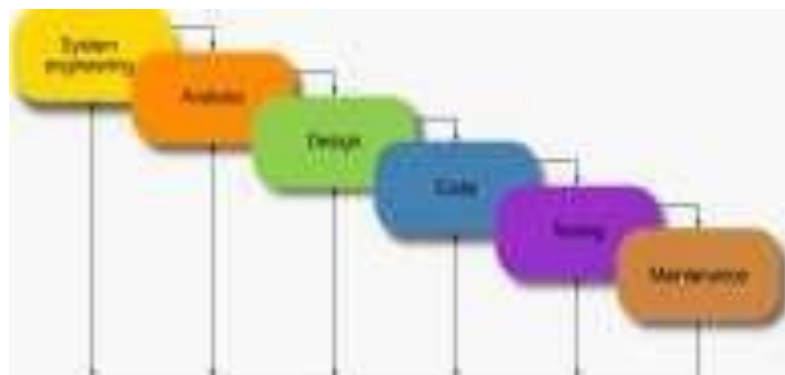
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process.

Fig.1. Waterfall Model

D. *Feature Extraction*

Feature extraction is nothing but the method of transforming raw information into numerical data that can be processed while preserving the data in the original database. It gives the best results by applying machine learning algorithm directly to the raw data. In this system, we have extracted features like edges, size etc. from dataset.

E. *Segmentation*

Segmentation comes into picture when input is divided into the marketplace i.e. parts, or segments, which are definable, accessible, actionable, and profitable and have a growth potential. For example- a company would find it difficult to compare with the entire market, because of time, cost and effort restrictions and also due to confusion. It needs to have a'definable' feature - a mass of people who can be identified and targeted with reasonable effort, cost and time.
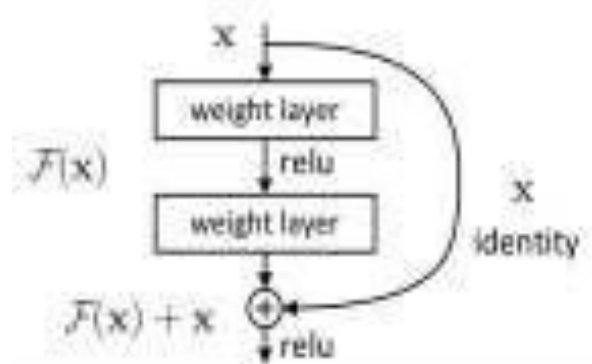
F. *ResNet50*

Fig.2.ResNet50

In fig.2. ResNet50 is a variant of Res Net model. It has 48 Convolution layers along with one

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MaxPool and one Average Pool layer. There are 3.8 x 10^9 floating points operations. Res Net model is one of the widely used model and else we have explored ResNet50 architecture in depth.

G. *Dataset*

figure(per 16 frames)	Le2i-processed	SisFall-processed
Blank	7	7
Fall	68	15
Likefall	83	13
Lie	11	17
Stand	84	9
sum	253	61

Fig.3.Dataset

A dataset is a group of data. As shown in fig.3, a data set corresponds to the contents of a single database table, and a statistical data of matrix, where each column represents a particular variable, and each row given member of the data set in question .Data sets can also consist of a collection of documents .Data set is used to measure the information released in a open data repository, its used to train the model and get desired output. The training data set is the one used to train an algorithm to understand how to produce the output and also how to apply the concepts as neural network and get the desired output. It includes input data and desired output. The test data set is used to calculate how your algorithm was trained with the data set training. Every member you add make the data size bigger with the help of it the machine is trained well and also the output gets more better than expected.
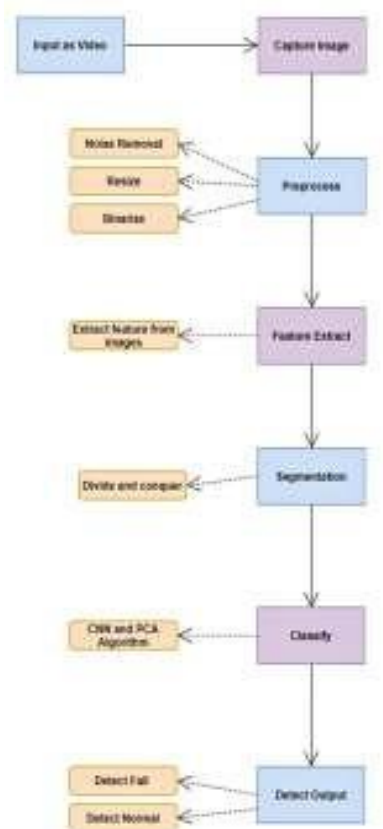
Fig.4. System Architecture for Fall Detection

PROPOSED SYSTEM

According to fig.4, we have proposed a system using CNN (Convolutional Neural Network) And PCA algorithm. CNN algorithm is a Deep Learning algorithm. Also it can take an input image, assign importance (learn able weights and biases) to various objects in the image and be able to differentiate one from the other. Firstly, separate the data set into X and Y. X will be the training set and Y will be the validation set. Then, take two dimensional matrix of independent variables X. Rows are representing data items and columns are representing features. Then, take the matrix Z, transpose the same matrix and multiply it by Z. The resulting matrix is the Convariance matrix of Z, up to a constant. Convariance of Z = ZZ. Evaluate the corresponding eigenvalues of ZZ and their corresponding eigenvectors. Hence finally, the eigende composition of ZZ is where we decompose ZZ into PDP[1]. After all the training phases done, machine create model, then that model goes to testing phase and then output provide to user. Output is to Detect whether a person is fall or NOT. Then alarm will be generated and family members which are far from home will be notified using email.

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CONCLUSION AND FUTURE SCOPE

Aging is unavoidable, and it is always decent to age with good quality of life. To achieve this goal, health practitioners and scientists must work together to address public health challenges. In this regard, we have reviewed an old-new problem in public health: geriatric falls. There were two research tracks: fall detection and fall prevention. The article explained geriatric falls, their causes and consequences. This paper's key contribution is a four-level common ground classification of fall related systems into wearable, non- wearable, and fusion. The suggested common ground scheme gives a global overview of systematic investigations related to geriatric falls, focusing on fusion systems. This analysis included smartphone and alarm based solutions were also considered in this classification. Finally we look forward to replace some of the current heuristics with learned models that are able to more accurately differentiate between true falls and non-falls that is bending over. We started testing an on-device transfer learning approach using TFLite Model Maker.

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