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Fall Detection in Elderly Old people using the Convolution Neural network

Shraddha Gorthekar, Jaydeep Salaskar, Sandip Dhondge, Geetanjali Mahatme, Prof. Vrushali Kondhalkar

Department of Computer Engineering, Jayawantrao Sawant College of Engineering, Pune, India

Department of Computer Engineering, Jayawantrao Sawant College of Engineering, Pune, India

Department of Computer Engineering, Jayawantrao Sawant College of Engineering, Pune, India

Department of Computer Engineering, Jayawantrao Sawant College of Engineering, Pune, India

Department of Computer Engineering, Jayawantrao Sawant College of Engineering, Pune, India

ABSTRACT*:* Due to increase in nuclear families the elderly old person at home are having less attention towards their health. This leads to admit them into an old age home or they have to leave their life in loneliness. Due to this most of the time they have to take care of themselves in all the manner like taking medicine or doing daily chores and etc. This may lead to an accidental fall at home or at care centers. The unavailability of the help after fall may cause serious health issues or it may be fatal too. So to identify these falls using the image processing idea always boosts the noble cause of helping old age peoples. To provide the economically feasible solution for this, proposed system uses the concept of Convolution neural network in image processing. The proposed model maintains the vigilance on the lonely person through camera through frame by frame to monitor their falling. Region of interest and pixel displacement in temporal effect is being evaluated using the CNN to measure the fall. And the model intimates the nearest neighbor , relatives and doctor for the help through a mobile text message to save a precious life.

KEYWORDS*:* Fall Detection, Image Normalization, Convolution Neural network, Region of Interest.

I.INTRODUCTION

The region of Interest or ROI refers to the particular portion of the image that is of alleviated interest. This is particularly useful in the area of image processing as most of the images that are used for the purpose of evaluation tend to have various objects and areas that are relevant to the process. there are also a lot more areas that are evident in the image that are of no interest in that particular process and therefore need to be removed.

Keeping only the relevant parts of the image to perform processing is very optimal as it reduces the chances of a false positive being detected due to the presence of an unwanted region. The Region of Interest also narrows the field of view of the particular algorithm which results in an increase in the accuracy of the system overall. The exclusive nature of the Region of Interest application also reduces the time and space complexity for the system as the irrelevant parts are purged, which reduces the time is taken and overall efficiency of the system.

The region of Interest is one of the most important aspects of image processing as it enables a lot more optimized approach to image processing by only concerning with the useful parts and not wasting the computational power of the machine by utilizing it for processing the unnecessary parts of the image. More than one Region of Interest can be present in the image and can be used for filtering images efficiently.

CNN stands for Convolutional Neural Networks. They are a subclass of a broad range of algorithms based on the working of a Human Brain, Artificial Neural Networks. These types of networks are in use very popularly as they are designed after a human brain to enable a human-like response from a machine. As human brains have been the source of most of our inventions.

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The Artificial Neural Networks were completely modeled after the Human Brain. Therefore, it has characteristics pertaining to it, such as the basic unit of computation in the human brain is the neuron, which is the same as the Artificial neural network, which has its smallest computational unit as the neuron. The Neuron in the human brain can be stimulated with the help of input given through the sensory organs.

The neuron only fires when a certain threshold of simulation is reached, which is thoroughly adapted into the Neural networks. The human brain has an excess of 1 billion neurons that make up the working human brain which can think and make decisions. The artificial neural networks also employ a multitude of neurons that are layered and only fires when a pre-programmed stimulation threshold is reached.

Convolutional Neural Networks deploy a series of convolutional layers which act as independent filters. These filters are capable of analyzing the input thoroughly layer by layer and therefore turn into valuable control parameters that can determine useful data from the dataset. This property is very useful in the application of Convolutional Neural Networks for the purpose of image processing and recognition.

The Convolutional Neural Networks are quite powerful and they are predominantly used for solvingdescriptive and generative problems. These tasks value human-like behavior and therefore, the use of Neural Networks is preferred. These networks are capable of easily performing computer vision related tasks which can perform recognition on images as well as video.

A decision tree is one of the simplest and powerful method for prediction and classification of data. it has been in widespread use in a variety of classification applications. When the Decision Tree is plotted graphically, it looks like the branches of a tree. Each of the points where it branches out is known as a node.

Each node has a minimum of two possibilities that can exist. This is a very useful approach for classification as the data can be filtered according to the various complexities that are suited for each level. The branches can be innumerable in number and complex and detailed decision trees are known to provide a very accurate classification task. The decision treesisa very useful tool in machine learning and performing image classification tasks.

This research paper dedicates section 2 for analysis of past work as literature survey, section 3 deeply elaborates the proposed technique and whereas section 4 evaluates the performance of the system and finally section 5 concludes the paper with traces of future enhancement.

II.LITERATURE SURVEY

This section of the literature survey eventually reveals some facts based on thoughtful analysis of many authors work as follows.

J. Lee [1] There has been the rapid growth from the last decade in fall detection method due there are many death causes because of the falls mostly in older people. The researchers are attention has been increased towards the fall detection. There are various type falls sun falls, ADL fall, noone falls this are various fall, which was very hard to predict the real fall, which can cause the death or injury, so the first the vertical velocity based wearable sensor is proposed. Then the velocity is counted between the fall, ADL, non-fall the accuracy rate of high fall is predicted as the real fall which can cause the injury

K. Cocoa [2] There has a major problem in older ages people there fall and there with no one to help them some time. Thus, this paper is a solution for this I which there are major steps taken for fall detection and fall prevention. There are many methods invented to predict fall detection by using the sensing method. But later most of the researcher shifted towards fall prevention. Fall prevention means the fall should be predicted before the event happen. This is done by using the common ground classification is used. This fall detection and fall prevention tracked by using data processing

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B. So [3] Human falls have been the major issue nowadays mostly in old peoples. In this paper, they have used Wavelet transform to detect the human falls using the ceiling mounted Doppler range control radar. This radar senses the motion of any falls and the moon falls by using the Doppler effect. Thus, this is an elder care application which is a promising technique to detect the fall detection The first stage is the prescreen stage in which there use the coefficients, in which the time locations is given in which the fall can occur and this method is one best method.

N. Otanasap [4] There is the following incident not only with the old ones but also with the young ones, this may cause serious injury or also the death. If fall can be predicted before the fall phase or before profile, then it can reduce the impact of a fall is useful such as the airbag. There is various detection method using the threshold value, but they have used after the fall detection. In this paper there is a threshold value is predicted before falling there several instances are adjusted with both male and female. Thus the accuracy rate of the is above 95%.

T. Nguyen [5] In this paper there is a mobile waist device implemented which monitor I [the subject means the humans if any fall activity event is going to occur it will send the message the on mobile by using the CDMA module. It also produces the sound of 50 Hz, so that the subject can stand or sit. Kionix KXM52-105 tri-axial accelerometer and a Bellwave BSM856 CDMA this mode are used to predict the fall events. Thus, this solution can prevent death by using this unsupervised learning

L Kau [6] In this paper the novel architecture for the accident the fall detection is used by using the smartphone by using the 3G networks. When the fall detection, the incident takes place the global positioning system (GPS) or the assisted position GPS the user position is acquired and sent to rescue center so that they may get help from the medical side. In this paper, the proposed cascaded classification architecture because of thus the computational burden on the smartphone can reduce. This method is better than the previous researches.

J. Chua [7] Fall detection is one of the most serious things to take the measures decision against it. Thus, this updated propose of fall detection, which is done usinga camera. This fall detection method of the human shape analysis and human head detection to detect the normal daily activities. To detect the fall detection the tow novel head shape model is proposed to detect the head of the person. The proposed method result is able to achieve high detection accuracy.

C. LAN [8] The proportion of the senior citizen is more among the global population. Fall is often the cause of the death of old people. In real time fall can occur in four directions that is forward, backward, rightward or leftward. But only there is a difference in the accuracy rate of falling that will detect it serious fall which is serious that can cause death or it is a daily activity. This real-time fall will also contain the home server and the GSM which will send the full alert for emergency help.

A. Poonsri [9] As per the report of the Central of disease and Prevention there is adult fall down in every second.The fall detection method is nothing but detecting the fall accident and informs the elderly person for help via message. There are three methods used in this first Methi is Gaussian distribution it is used background subtraction, then it compared with an average filter model to implement the subtraction results, then secondly feature extraction is used as an aspect ratio and area ratio is calculated by using principal component Analysis. Lastly is majority voting the results of finally performed.

W. Shieh [10] The population of youth is growing very fast nowadays. This fall event may occur in on staircases or in the long corridor if there is not a proper time as early possible there will a very serious injury. There is traditional video surveillance that only records the video this proposed method will add the additional methodology to detect the fall detection, which will take the care of staff and of elder. The result of this show improvement by every above ninety percent every time.

Y. Angal [11] As fall detection is one of the major issues among in old adults. It may cause the major fractures in the weak parts of the body or it may even cause death. There is a sensor called a Kinect sensor developed by Microsoft. Basically, this software has two parts the first one is to detect the fall and the second one is send the message for help. The ground segmentation is used to detect the moving object activities by using the feature extraction and event classification.After the fall detection initially the message will be sent to a registered number for help.

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Bhavya. KR [12] This paper presents the fall detection approach by using the motion vector and the accumulated image map. It consists of some steps human is an object region of extraction based on the background subtraction method. The k nearest neighbor is used to find him fallen detection of the paper with an estimated motion vector. The results of this showthat this experiment is successfully implemented.

III PROPOSED METHDOLOGY

The proposed methodology for fall detection identification in elderly old person is depicted in the figure 1. And the steps that involve in this process is broadly explained with the below narrated steps.

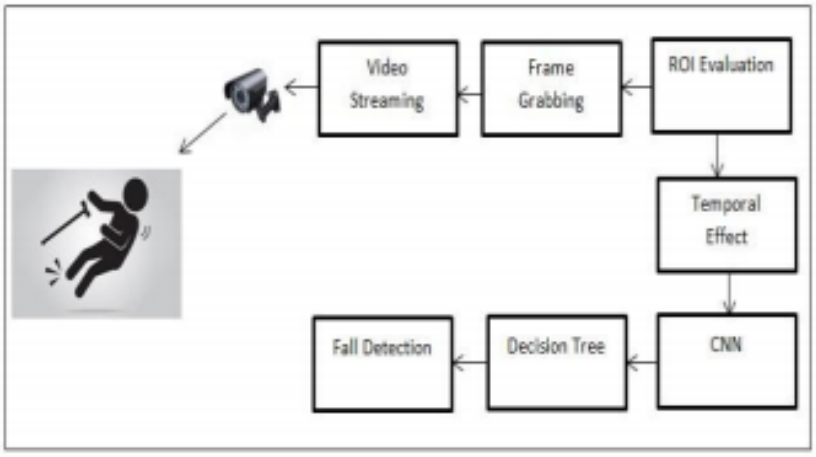

Figure 1: Proposed Methodology System Overview

Step 1- Setup and Frame Grabbing- To setup the experiment of Fall detection a web camera of a laptop is being used, which is powered with 1.3 mega pixel of depth. The System is strictly designed for the single, lonely person staying at home. The proposed model uses the Java media file API to setup the camera setting of the laptop. Then a time slice of 1 second is set to capture the frames using the Frame grabbing controller mechanism of the Java Media files (JMF) continuously till the system is kept on. Once these frames are captured, they are keep stored in background directory and their respective paths are added into a Queue.

Step 2: Region of Interest Evaluation- This is the step where the extracted frames from the camera in the given time slice of 1 second is being removed from the frame queue by extracting its path. These frames have to normalize according to the first frame. This is because in the proposed model first frame of the input image is considered as the model image. So, according to this only all the successive images are normalized So that all the other image should have uniformity in the process of fall detection.

Due to this a uniform light is distributed over all the pixels, and this can be achieved by applying the mean difference of the model image and the other queue image into the queue image. This process can be shown in the below shown algorithm 1.

To achieve this proposed model first evaluate the mean RGB of the model and queue images, this can be shown in the below equation 1.

$$\mu = \frac{(\sum_{i=1}^{n} RGBi)}{n} \quad \text{_____(1)}$$

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Where

μ - Mean of the RGB RGB_i- RGB of instance pixel n - Number of pixels in the image

This mean difference is estimate to apply on the RGB values of all queue images to get a best normalized queue image. Which will be enhanced according to the model image to provide best results in fall detection system.

Step 4: Temporal Effect - This is the step where each and every frame is maintained for their temporal changes of the pixels. For each of the iterations from the queue these temporal changes from the current frame and the past frames are being transitioned smoothly. This is achieved by assigning the current value of the frame to the past value and again regaining the new current value for the comparison. This is handled by the convolution neural network more efficiently.

Step 5: Convolution Neural Network (CNN)- *First Layer* -This is the crucial step of the proposed model where each of the instance image from the queue is converted into the average gray scale. This is achieved by averaging the values of the RGB channels of each pixel of the image into one. And then adjusting these values to the original pixels to get the grayscale image. The converted average grayscale image is then converted into the binary image based on the threshold of 125.
This can be more clearly depicted in the algorithm1.

ALGORITHM 1: Average Grayscale Conversion and Binary Conversion

// Input: Normalized Image N_{IMG} // Output: Binary
acvGrayScale_BinaryConversion(N_{IMG})
1: Start
2: BIN_{IMG}= Ø
3: **for** i = 0 to size of Width of N_{IMG} 4: **for** j=0 to size of Height of N_{IMG}
5: P_{SIGN} =$N_{IMG(ij)}$ RGB
6: R= P_{SIGN} >> 16 & H_D
7: G= P_{SIGN} >> 8 & H_D
8: B= P_{SIGN} >> 0 & H_D
9: AVG=(R+G+B)/3
10: IF(AVG>125)
11: SET $BIN_{IMG(i,j)}$ RGB → (255,255,255)
12: ELSE
13: SET $BIN_{IMG(i,j)}$ RGB → (0,0,0)
14: END IF
15: **End for**
16: **End for**
17: **return** BIN_{IMG}

The reason behind the conversion of the threshold image is to estimate the pixel numbers as the human enters or leaves the surveillance area of the camera.

Deep Layer AndDicision Tree - Here each of the frames are normalized and converted into binary image so that that black pixel count is estimated in the binary image. The temporal effect is being applied to keep a vigil for the sudden drop

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in black pixel count in the binary image of the current frame by comparing it with the past frame. This sudden drop in the black pixel count is happening only when the person falls immediately.

As the fall is detected the proposed model rises three voice alarms to the person to standup so that the alarm can be stopped. Even though on intimating the person three times, if the person is not standup. Then the system sends the text messages to the neighbor, Hospital and relatives whose numbers are already stored in the database for the helping the elderly old person.

IV RESULT AND DISCUSSIONS

The proposed system for fall detection in the elderly old person is deployed in real time using the windows based Laptop. This laptop is equipped with the 1.3 Mega pixel of the web camera. To deploy the model proposed system uses the Java Programming language and Netbeans as the standard IDE along with Mysql as the database server. To measure the efficiency of the system, proposed model is put under the hammer for some tests as discussed below.

To measure the effectiveness of the proposed model Root mean square error (RMSE) is used. RMSE indicates the effective difference between the two continues correlated entities. Here in this experiment two continues correlated entities are actual fall and detected fall by the system. To measure this the proposed model conducts 5 sets of trails, Where each trail consists of 10 sets of experiments. The recorded result is shown in the table 1 and the plot in figure 2. The RMSE can be shown in the equation 3.

$$\mathrm{RMSE}_{fo} = [\sum_{i=1}^{N} (z_{f_i} - z_{o_i})^2 / N]^{1/2} \quad _(3)$$

Where

Σ - Summation

Σ

$(Zfi - Z_{oi})^2$ - Differences Squared for Actual no of falls and detected number of falls N - Number of samples or Trails

Table 1: Recorded Mean Square Error Rate (MSE)

Trail no	No of Experiments	Actual number of fall	Detected number of fall	MSE
1	10	6	5	1
2	10	4	2	4
3	10	3	3	0
4	10	5	5	0
5	10	4	3	1

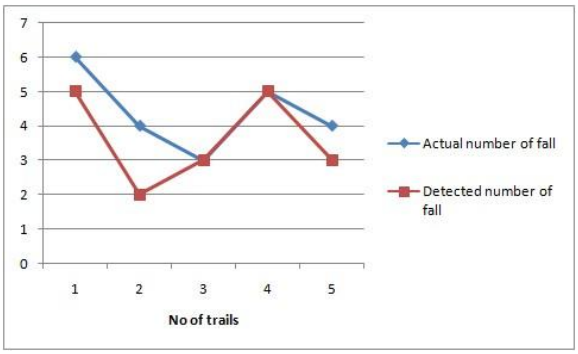

Figure 2: MSE Difference between the No of actual fall v/s detected fall

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The values in table yield average MSE of around 1.2 and this yields RMSE of around 1.1. This is actually a low error rate that indicates the proposed model yields the best results in a constrained environment for the fall detection.

V CONCLUSION AND FUTURESCOPE

The proposed model for the Fall detection using the video surveillance is deployed in the constrained environment of a web camera of a laptop, which is having around 1.3 Mega pixels of depth. The model is designed for the lonely person who is staying in the home, when a sudden fall occurred and on not getting immediate help this may lead to serious injuries or it may be fatal too. The model keeps a vigil on the person by normalizing the frames which are collected in the time slice of1second. These normalized frames are subject to the temporal effect using the CNN to detect the fall. On detection of the fall the proposed model sends a text message on the stored number of the relatives, Hospital and neighbors for the immediate help to save a life.

In the future this system can be implemented in the real time surveillance of CC TV cameras and also it can be enable to detect the fall at night time too.

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