HUMAN FALL DETECTION SYSTEM USING INTERNET OF THINGS AND MACHINE LEARNING

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ABSTRACT

Falls are the major obstacle for the people. Elders are mostly impacted due to the fall. Patients most have difficulties to control the balance of the body & fall. So falls should be tracked and watch should be kept to avoid major injuries. In this review paper, a fall detection system is proposed based on IOT and machine learning. The system does the image processing in the preprocessing part and then gathers input to be applied on CNN algorithm and if falls are detected caretakers will be notified. Machine learning algorithm CNN will be used in our system.

Keyword : *CNN, IOT, Machine Learning*

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1 INTRODUCTION

Emergencies can happen suddenly and without warning. As per the report of WHO Falls are the second leading cause of unintentional injury deaths worldwide. Each year an estimated 684 000 individuals die from falls globally of which over 80% are in low- and middle-income countries. Adults older than 60 years of age suffer the greatest number of fatal falls.
37.3 million falls that are severe enough to require medical attention occur each year. Prevention strategies should emphasize education, training, creating safer environments, prioritizing fall-related research and establishing effective policies to reduce risk. A fall is defined as an event which results in a person coming to rest inadvertently on the ground or floor or other lower level. Fall-related injuries may be fatal or non-fatal though most are non-fatal. Many falls do not cause injuries. But one out of five falls does cause a serious injury such as a broken bone or a head injury. These injuries can make it hard for a person to get around, do everyday activities, or live on their own.

In this work, a fall detection system is proposed. The system uses open source available dataset.. Machine learning algorithm, CNN is implemented and compared for better accuracy and performance.

This review paper segregates the section 2 for the evaluation of the past work in the configuration of a literature survey, and section 3 provides the proposed system. Finally, section 3provides the conclusion and the future work.

2 RELATED WORKS

YangsenChen , Rongxi Du, Kaitao Luo, Yuheng Xiao [1] proposes a method based on pose estimation and the auxiliary detection method based on yoloV5. First, extract video frames from different falling video sequences to form a data set; then, input the training sample set into the improved network for training until the network

converges; finally, test the category of the target in the video according to the optimized network model and locate the target.Activities of Daily Living (ADL) events in each frame of the image and give real-time feedback. The detection of falling behavior in the video further verifies the feasibility and efficiency of the recognition method based on our deep learning methods.

Hadir Abdo [2] proposes framework depends on RetinaNet for detecting humans with shorter computing time and higher accuracy compared with the traditional human detection methods. Then, the proposed framework relies on handcrafted features to represent shape and motion properties of the detected human. The proposed framework extracts aspect ratio and head position as shape features and motion history image as a motion feature of the detected human to create the feature map. This feature map is used in training MobileNet network to classify the human motion into fall or not-fall.
The proposed framework is evaluated using UR and FDD datasets and the experimental results proved the efficiency of the proposed framework achieving.

Mahesh Bundele, Harish Sharma [3] proposes conceptual technique, we have collected the Microsoft Kinect depth images of elderly fall event. After collecting the necessary depth images the background subtraction algorithm has been used to subtract the background and retain the subject. Segmentation and feature selection process have been applied on various daily activity to train the fall detection model. The model has been train using decision tree. To ensure the fall confidence, ground truthing technique has been used.

PrakrankiatYoungkong, PhD [4] Previously, a pressure sensor-based system called "NEF" was developed to monitor on-bed movements and send out alarming notifications to end-users when undesired events occurred. The system used only one pressure sensor that was placed on the bed or mattress. On-bed positions and patterns were classified with high accuracy. However, the fall event is actually very dynamic. Movements outside the bed shall be included. In this paper, a novel double pressure sensors-based system was proposed. Applying different machine learning techniques, random forest yielded the best fall detection model

Sunah Min, Jinyoung Moon Lt [5] introduce an attended memory reference network that detects a current action online for a given video segment consisting of past and current frames. To integrate contextual information used for detecting a current action, we propose a new recurrent unit, called an attended memory reference unit, which accumulates input information based on visual memory attended by current information. In an experiment using a fall detection dataset obtained from the abnormal event detection dataset for CCTV videos publicized by AI Hub, the proposed method outperforms state-of-theart online action detection methods.

Chalavadi Vishnu, Rajeshreddy Datla, Debaditya Roy [6] propose an approach to efficiently model the spatio-temporal features using fall motion vector. First, we construct a Gaussian mixture model (GMM) called 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 nonfall attributes resulting in a high-dimensional representation. In order to extract only the relevant attributes for a particular fall or non-fall videos, we perform factor analysis on FMMM to get a low dimensional representation known as fall motion vector. Using fall motion vector, we are able to efficiently identify fall events in varieties of scenarios, such as the narrow angle camera (Le2i dataset), wide angle camera (URFall dataset), and multiple cameras (Montreal dataset).

Yuya Ogawa [7] proposes a fall detection method using IR array sensors. The method allows for fall detection that is inexpensive and capable of privacy protection in a non-wearable form. Also, we analyze temperature distributions using machine learning to enable quicker and more accurate fall detection. We evaluate multiple algorithms of machine learning to select best algorithm. Then, classifiers are created based on these algorithms. We calculate and compare the accuracy of these classifiers. One of the learning data is a series of temperature distribution data for 2 seconds. One temperature distribution is acquired every 0.1 seconds by IR array sensors installed on a ceiling.

Laavanya Rachakonda, Saraju P. Mohanty [8] It is important to be able to reduce the frequency of elderly falls and their disastrous effects. Good-Eye proposes an edge device which predicts or detects falls based on image orientation and physiological sensors using the Internet-of-Medical-Things (IoMT). Using LED lights, the user is notified with the decision of fall prediction and detection if the observed change is greater than a set threshold. Along with a camera attached to the wearable.

Xue Yang ,Shiping Tang, Tiankeguo , Kesheng Huang , Jiaxiong Xu [9] Intelligent video surveillance system is designed in this research. CMOS camera transmits the collected video to the video processing module based on ZYNQ(ARM+FPGA). CNN (Convolutional Neural Network) image classification algorithm and hardware acceleration technology are used to process images in real time and identify whether the elderly have fallen.

Sejal Badgujar , Anju S. Pillai [10] a fall detection system is proposed based on machine learning. The system detects falls by classifying different activities into fall and non-fall actions.
The dataset SisFall with variety of activities of multiple participants is used to calculate features. Machine learning algorithms SVM and decision tree are used to detect the falls on the basis of calculated features.

3 PROPOSED SYSTEM

CNN algorithm will be used to train our system and if fall is detected by our system notification will be sent to caretaker. When if person enters in camera range we will detect him and will start focusing on him.

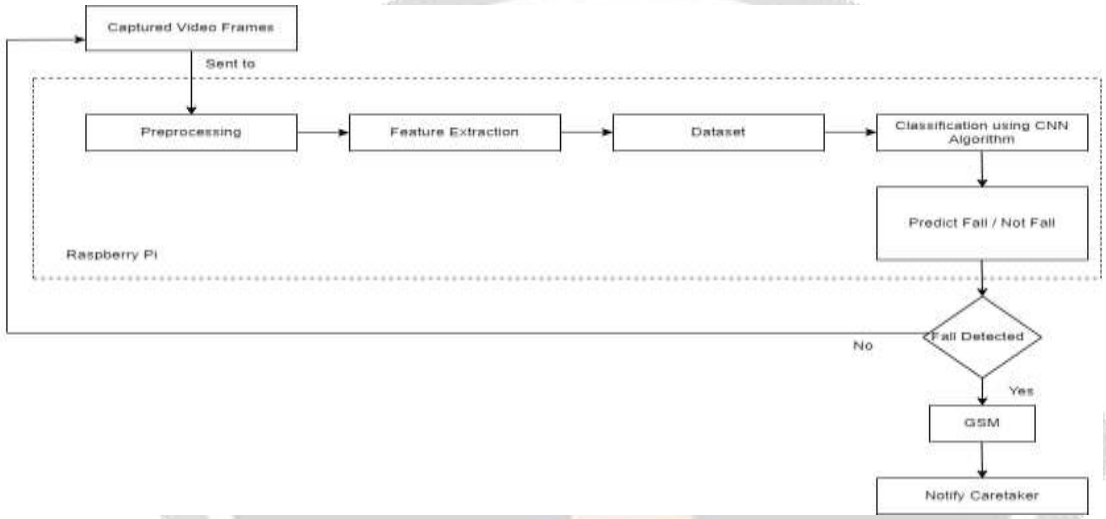

Fig 1.1 Architecture Diagram

3.1 Internet of Things:

The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. IOT devices share the sensor data they collect by connecting to an IOT gateway or other edge device where data is either sent to the cloud to be analyzed or analyzed locally. Sometimes, these devices communicate with other related devices and act on the information they get from one another.

3.1.1 Raspberry Pi :

Raspberry Pi (RPi) defines as a series of single-board computers that are now increasingly being used to connect IoT devices. RPi can be plugged into a computer monitor. It is a capable little device that enables people to explore computing and learn how to program in languages like Scratch and Python. It is also capable of performing everything users expect from a computer. Raspberry Pi can interact with the outside world. It is being used in various areas of digital maker projects, including music machines, parent detectors, weather stations and much more

3.1.2 GSM:

A customised Global System for Mobile communication (GSM) module is designed for wireless radiation monitoring through Short Messaging Service (SMS). This module is able to receive serial data from radiation monitoring devices such as survey meter or area monitor and transmit the data as text SMS to a host server.

3.1.3 Camera:
Camera is used to capture the video required for our system . With the help of camera we are going to take the video input for our system.

3.2 Machine Learning:
Machine learning (ML) is a type of artificial intelligence (AI) that allows software applications to become more accurate at predicting outcomes without being explicitly programmed to do so. Machine learning algorithms use historical data as input to predict new output values.

3.2.1 Convolutional Neural Network (CNN):

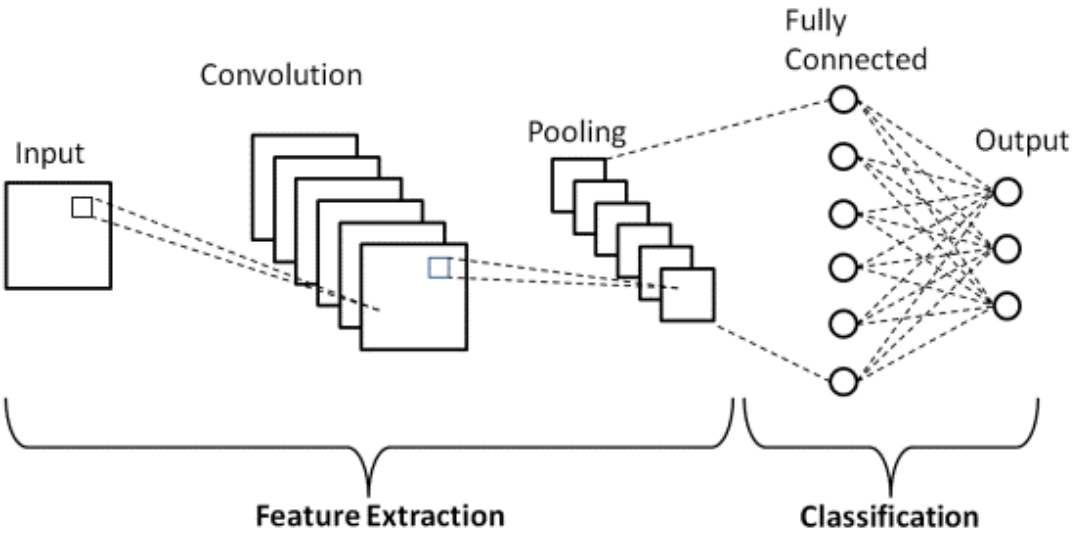

Fig 1.2 Convolutional Neural Network Diagram

A Convolutional Neural Network (ConvNet/CNN) is a Deep Learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other.

The architecture of a ConvNet is analogous to that of the connectivity pattern of Neurons in the Human Brain and was inspired by the organization of the Visual Cortex. Individual neurons respond to stimuli only in a restricted region of the visual field known as the Receptive Field. A collection of such fields overlap to cover the entire visual area

Three layers in CNN algorithm:

1)Input Layer: It's the layer in which we give input to our model. The number of neurons in this layer is equal to total number of features in our data (number of pixels incase of an image).

2)Hidden Layer: The input from Input layer is then feed into the hidden layer. There can be many hidden layers depending upon our model and data size. Each hidden layers can have different numbers of neurons which are generally greater than the number of features. The output from each layer is computed by matrix multiplication of output of the previous layer with learnable weights of that layer and then by addition of learnable biases followed by activation function which makes the network nonlinear.

3)Output Layer: The output from the hidden layer is then fed into a logistic function which converts the output of each class into probability score of each class.

4 CONCLUSION

Our review paper presents IOT and Machine Learning based fall detection system. Therefore after studying we came to the conclusion that compared to the algorithm in the existing systems, our proposed system can work more efficiently on CNN algorithm and provide best accuracy. In addition to the proposed system, when the fall has been detected notification can be sent to the caretaker.

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