A Heuristic Model for Predicting Human Fall Detection using Machine Learning Techniques

Mohammed Inayathulla, PA Hima Kiran, M Chandana Sri, M Deepika

Abstract*: *It is very obvious that human fall due to unconsciousness is a very common health problem in every human being. With the evolution of many smart health devices, we should contribute the technological advancement of machine learning into it. Different techniques are already used in order to detect human fall detection in human beings. In this paper we have studied the patterns of falling of human through the fall detection dataset while this human was performing various motions. By understanding all these we have generated the prediction protocol which estimates the fall of a person using fall detection dataset. Machine Learning classifiers were used to predict the human fall and a comparative study of various algorithms used was developed to find out the best classifier.

Keywords*: *Classification, Fall Prediction, Machine Learning, Random Forest.

I. INTRODUCTION

The term fall can be defined as an unintentional event in which the body moves from its initial position to a lower level. This would cause some serious injuries also in adverse conditions. Hence a fall prediction system would be really useful in such conditions where it can predict the human fall prior to falling so that required remedies can be carried out. A fall detection system can be defined as a usable device whose main motive is to alert when a fall action has occurred. The fall alert detectors can estimate when the user was about to fall by detecting the sudden changes of body movements. Old age people have high degree of risk of death or injury resulting from falls. As the density of population is increasing human fall prediction system can be very handy. The aim of this paper is to implement a fall detection model by using different machine learning techniques. Human fall prediction can be considered as a typical classification problem of machine learning. To carry out this work data is collected from publicly available datasets. Supervised classifiers are then implemented on the collected data. All the features available in the dataset are used to build the classifier. After the classifier was built its accuracy was built on the unseen data. Several researchers have been working in this field to expose the importance of machine learning. As the current work is based on supervised schematic studies this also can be extended in computer vision where the data is collected by using visual sensors and based upon the data collected machine learning can be applied to identify the human fall detection. The structure of the paper is as follows in the next section related work is discussed then implementation details are discussed followed by results and conclusions.

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Mohammed Inayathulla1, Assistant Professor, Department of Computer Science & Engineering, Malla Reddy Engineering College (Autonomous), Hyderabad, Telangana, India. Inayathulla512@gmail.com.

PA Hima Kiran2, Associate Professor, Department of Computer Science & Engineering, Malla Reddy Engineering College (Autonomous), Hyderabad, Telangana, India. andrewshimakiran@gmail.com.

M Chandana Sri3, UG Student **,** Department of Computer Science & Engineering, Malla Reddy Engineering College (Autonomous), Hyderabad, Telangana, India. Mchandanasri99@gmail.com.

M Deepika4, UG Student Department of Computer Science & Engineering, Malla Reddy Engineering College (Autonomous), Hyderabad, Telangana, India. Deepika.m2989@gmail.com.

II. LITERATURE SURVEY

In [1] the authors worked on visual surveillance for detecting the fall detection. Their approach was a two step process ellipse approximation and motion history image. In [2] the authors used an embedded camera in human body to identify the joint movements and there by classifying whether the person will classify or not. SVM classifier was used by the authors. In [3] the authors proposed a step by step process for identifying the fall detection. The critical steps were feature extraction human identification and fall detection. Histograms of Oriented Gradients and Local Binary pattern were used in combination of deep learning techniques to expose the human fall detection by authors in [4]. In [5] the authors worked on mobifall dataset with five different classifiers and proved that KNN classifier outperformed the other classifiers used. In [6] the authors used a smartphone based approach to identify the fall detection and thereby generating an alarm to the responsible of the victim. Three point based technique was employed to identify the fall detection in indoor video surveillance[7]. CHLAC features with skeletal image sequences were extracted using a mobile robot and KNN algorithm was used as a classifier for fall detection [8]. Deep Learning LSTM neural network method was used [9] with a smart phone as a sensor for fall detection. Convolutional Neural Networks was used in [10] in order to identify the fall detection with respect to the furniture and human characteristic relationships.

III. PROPOSED METHODOLOGY

The aim of this paper is to implement the classification scheme to identify the fall detection of a person. The algorithms used are Random Forest, K-Nearest Neighbor, Decision Tree and Naive Bayes. Fall detection prediction system can be categorized into four stages: Data Collection, Data Cleaning, Implementation, Prediction.

The main recognition of this paper is to identify the sophisticated among those mentioned classification algorithms. The methodology is described in figure 1.

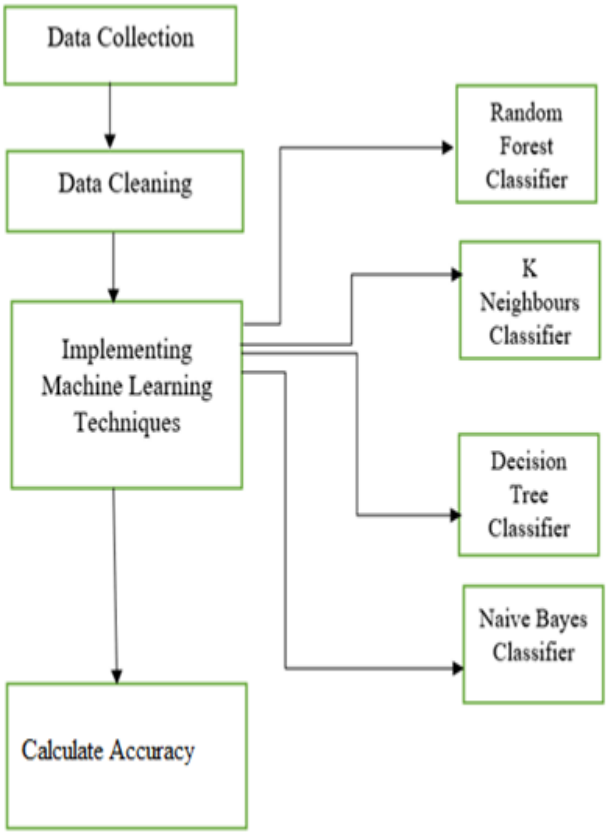

Fig 1: Fall Detection Prediction Model

Data Collection:

The "fall detection" dataset[11]is used for fall detection prediction which is used has the China Activity of elderly patients along with their medical information". The dataset consists of following features: Time, Sugar level, EEG monitoring rate, Blood pressure, Heart beat rate, Blood circulation.

Data Cleaning:

Data cleaning is the important phase as the erroneous data would significantly impact the overall performance of the system. In this phase data is thoroughly inspected to find out any missing values null values and standard statistical measures are used to deal with the null values and missing values.

Implementation and Accuracy:

Fall Prediction Model was implemented in python. After loading the dataset split the data into training and testing data. Using the training dataset train the model using the machine learning classifiers. Confusion matrix is used to test the model. All the features were used to built the classifier. The data split was performed in the ratio of 80 and 20 were 80% was used to training and 20% for testing. For decision tree entropy was used as the splitting criteria. In KNN 7 neighbours were worked for each unseen instance. When building random forest 500 trees were grown. Accuracy was computed based on the confusion matrix which is the familiar metric to evaluate the classifier and the accuracy values of each classifier are shown in the table 1.

IV. RESULTS

Table: 1 Accuracy scores of various classifiers used.

Classifiers	Accuracy
Naive Bayes Classifier	0.83
Decision Tree Classifier	0.89
K NN Classifier	0.7
Random Forest Classifier	0.92

The above table shows the accuracy values of each classifier and Random Forest has outperformed the other classifiers used with an accuracy of 92%. For every classifier the train test split ratio was 80 and 20 respectively as mentioned above.

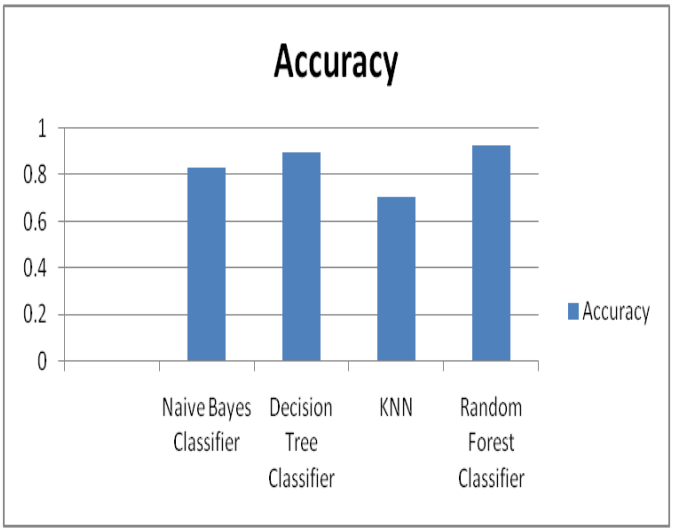

Fig 2: Comparision Chart of accuracy of classifiers

V. CONCLUSION

Out of the four learning algorithms used Decision tree and Random Forest have shown the better results. In future fall detection prediction system can be used to work in real time with regularly modernized datasets from distinct devices in various conditions. Deep Learning Techniques can be used to explore the surveillance data collected of various patients thereby predicting the human fall detection in real time.

REFERENCES

1. G M Basavaraj, Ashok Kusagur "Vision Based Surveillance System for Detection of Human Fall", 2nd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT) 2017.
2. Zhen-Peng Bian, ,Junhui Hou, ,Lap-Pui Chau, Nadia Magnenat-Thalmann, "Fall Detection Based on Body Part Tracking Usinga Depth Camera", IEEE Journal Of Biomedical And Health Informatics 2014.
3. Subhash Chand Agrawal, Rajesh Kumar Tripathi, Anand Singh Jalal, "Human-fall Detection from an Indoor Video Surveillance", 8th International Conference on Computing, Communication and Networking Technologies (ICCCNT) 2017.

4. Kun Wang, Guitao Cao, Dan Meng, Weiting Chen, Wenming Cao, "Automatic fall detection of human in video using combination of features", IEEE International Conference on Bioinformatics and Biomedicine (BIBM) 2016.
5. Pranesh Vallabh, Reza Malekian, Ning Ye, Dijana Capeska Bogatinoska, "Fall Detection Using Machine Learning Algorithms", 24th International Conference on Software, Telecommunications and Computer Networks (SoftCOM) 2016.
6. Tran Tri, Hai Truong, Tran Khanh, "Automatic Fall Detection System of Unsupervised Elderly People Using Smartphone ",International Journal of Advanced Computer Science and Applications, Dec 2016.
7. Jia-Luen Chua, Yoong Choon Chang, Wee Keong Lim, :A simple vision-based fall detection technique for indoor video surveillance", Springer-Verlag, Vol. 9, 2015.
8. Takumi Kaneko, Meifen Cao, "Human fall detection using CHLAC features with skeletal image sequences", IEEE International Symposium on Robotics and Intelligent Sensors (IRIS) 2016.
9. Anahita Shojaei-Hashemi , Panos Nasiopoulos , James J. Little , Mahsa T. Pourazad, "Video-based Human Fall Detection in Smart Homes Using Deep Learning", IEEE International Symposium on Circuits and Systems (ISCAS) 2018.
10. Weidong Min , Hao Cui , Hong Rao , Zhixun Li , Leiyue Yao , "Detection of Human Falls on Furniture Using Scene Analysis Based on Deep Learning and Activity Characteristics", IEEE Access Recent Advantages of Computer Vision based on Chinese Conference on Computer Vision (CCCV) 2017.
11. https://www.kaggle.com/pitasr/falldata

AUTHORS PROFILE

Mohammed Inayathulla having more than 5 years of teaching experience in Computer Science and Engineering in India. He has been awarded with Masters Degree in Computer Science and Engineering from Jawaharlal Nehru Technological University (JNTU) Anantapur. He has published 6 papers in various International / National Journals, Conferences. His area of interest includes Data Mining, Machine Learning. He is having professional membership in CSI and ISTE associations.

P.Andrews Himakiran having more than 11 years of teaching experience in Computer Science and Engineering in India. He has been awarded with Masters Degree in Computer Science and Engineering from Acharya Nagarjuna University(Guntur). He has published 5 papers in various International / National Journals, Conferences. His area of interest include Data Mining, Computer Networks. He is having professional membership in CSI and ISTE associations.

M Chandana is currently pursuing IV year B.Tech in Computer Science and Engineering at Malla Reddy Engineering College(A) Hyderabad. Her area of interest includes Machine Learnning, Artificial Intelligence and Cyber Security.

M Deepika is currently pursuing IV year B.Tech in Computer Science and Engineering at Malla Reddy Engineering College(A) Hyderabad. Her area of interest includes Machine Learnning, Artificial Intelligence and Cyber Security.