# Performance Comparison for Skeleton-based Action Recognition by Machine Learning Algorithm

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**Abstract**. Regular exercise gives strong and healthy body in day-to-day life. Most of the people have lack of knowledge of exercise and they didn't think their doing exercise pose whether it is right or wrong. While doing different kind of exercise sometimes mistakes are happened, which mistakes can break our bones or muscle spasm, etc. To overcome with this, we need to create awareness of exercise and teach to human whether they are doing exercise right position or not. This study deals with this issue and to solve with the help of artificial intelligence. In OpenPose algorithm, camera has taken as input and to produces the output of classifying human exercise recognition. The procedure of the system is, data collection, step 2 is preprocessing, step 3 is feature extraction and classification using machine learning algorithm. The following detection accuracy of skeleton-based action recognition was discussed in result and conclusion.

**Keywords:** Skeleton-based action recognition, OpenPose algorithm, Machine learning algorithm.

## 1.  Introduction

Regular exercise gives strong and healthy body in day-to-day life. Most of the people have lack of knowledge of exercise and they didn't think their doing exercise pose whether it is right or wrong. While doing different kind of exercise sometimes mistakes are happened, which mistakes can break our bones or muscle spasm, etc. To overcome with this, we need to create awareness of exercise and teach to human whether they are doing exercise right position or not.

The proposed method deals with this issue and to solve with the help of artificial intelligence. The proposed method deals with skeleton action recognition based on camera using OpenPose algorithm. Multi-camera scenario deals with multi-persons such as occlusion, pose variance and action interaction, those are challenging task in real time. In OpenPose algorithm, camera has taken as input and to produces the output of classifying human exercise recognition. The procedure of the system is, initially to collect different human exercise pose images such as Head Dumbbell, High Knees, Lateral Dumbbell, and Biceps. Step 2 is preprocessing the data such as scale the coordinates, discard frame if no head or thigh, and filling in the pose of missing joints, step 3 is feature extraction and classification using machine learning algorithm. The following detection accuracy of skeleton action recognition was discussed in result and conclusion.

## 2. Related Works

Vasanth Ragu et al, were presented the development of skeleton action recognition to secure human using artificial intelligence [1]. Tamam Alsarhan et al, published the enhanced discriminative graph convolutional network with adaptive temporal modelling for skeleton-based action recognition [2]. Based on the above related works, this method is proposed to develop the skeleton-based action recognition to exercising safely using artificial intelligence.

## 3. Proposed Methods

The input to the system is a video stream, it comes from camera. Then the OpenPose algorithm is adopted to detect the human skeleton from the images. The key idea of OpenPose is using CNN to produce two heatmaps, one for predicting joint positions, and the other for associating the joints into human skeletons [3].



Fig 1. Images that show various exercises

OpenPose algorithm detects skeleton and each skeleton has 18 joints and 36 coordinates, the joints are head, neck, arms, legs, etc. All the skeleton data are aggregated and make it as a single file based on their classes. Subsequently, these skeleton data are preprocessed and used for feature extraction, which are then fed into a classifier to obtain the final recognition result. Figure 1 shows for exercise data and figure 2 refers for skeleton data.
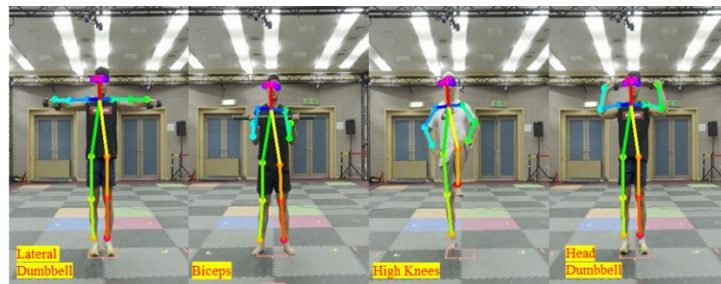


Fig 2. Images shows for detecting skeleton in exercise dataset using OpenPose algorithm

## 4.  Experimental Results

Figure 3 the result shows recognizing various exercise in real-time. In figure 3, four kind of results attached in single image such highknees, head dumbbell, biceps, and lateral dumbbell. Table I, shows for comparing training and testing accuracy of various algorithms.



Fig 3. The result shows for skeleton exercise recognizing in real-time

TABLE I. TABLE SHOWS FOR COMPARING TRAINING AND TESTING ACCURACY OF VARIOUS ALGORITHMS.

| Machine Learning Algorithm | Training Data | Testing Data | Training Accuracy (%) | Testing Accuracy (%) |
|---|---|---|---|---|
| KNN | | | 96.9 | 94.8 |
| Random Forest | 15892 | 6812 | 99.9 | 95 |
| RBF SVM | | | 93.9 | 93 |
| Neural Network | | | **99.8** | **96.8** |

The training images are 15892 and testing images are 6812. The training model of k-nearest neighbor (KNN), Random Forest (RF), Radial Basis Function (RBF) SVM, Neural Network (NN) and their corresponding accuracy values are 96.9%, 99.9%, 93.3% & 99.8%. The testing model of KNN, RF, RBF SVM, NN and their corresponding accuracy values are 94.8%, 65%, 93%, & 96.8%. Based on the above results, NN model gives best performance and high accuracy values in exercise data.

## 5.  Conclusions

The Proposed method deals with skeleton action recognition based on input camera using OpenPose algorithm. In OpenPose algorithm, camera has taken as input and to produces the output of detecting human exercise recognition. Subsequently, these skeleton data are preprocessed and used for feature extraction, which are then fed into a classifier to obtain the final recognition result. Therefore, in experimental results, NN is the best classifier for action recognition in this study. This system successfully achieves their goal for secure human from false exercise. In future, this system will improve strategies and add more entity such as automatic exercise pose correction, teaching exercise etc. to secure human from false exercise.

## Acknowledgment

## References

[1]  Vasanth Ragu, Jongcheol Lee, and Hyunki Lee*, "Development of Skeleton Action Recognition to Secure Human using Artificial Intelligence", *Participated and Presented on International Symposium on Innovation in Information Technology and Application (ISIITA 2021)*, Yeosu, Korea, Aug 2021.

[2]  Tamam Alsarhan, Usman Ali, and Hongtao Lu, "Enhanced discriminative graph convolutional network with adaptive temporal modelling for skeleton-based action recognition", Computer Vision and Image Understanding, vol. 216, pp. 103348, Feb 2022.

[3]  Multi-person Real-time Action Recognition Based-on Human Skeleton, wehsite: https://github.com/felixchenfy/Realtime-Action-Recognition