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Virtual Fitness Trainer with Spontaneous Feedback using a line of motion sensing input device Kinect Xbox 360

Mr. VRUSHABH JADHAV[1], Mr. GAURAV JAIN[2], Mr. ONKAR KHANDEKAR[3], Prof. Ms. SMITA BANSOD[4]

[1]Vrushabh Jadhav, Information technology Dept. of Shah and Anchor Kutchhi Eng. College, Mumbai, Maharashtra
[2]Gaurav Jain, Information technology Dept. of Shah and Anchor Kutchhi Eng. College, Mumbai, Maharashtra
[3]Onkar Khandekar, Information technology Dept. of Shah and Anchor Kutchhi Eng. College, Mumbai, Maharashtra
[4] Prof. Smita Bansod, Information technology Dept. of Shah and Anchor Kutchhi Eng. College, Mumbai, Maharashtra

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Abstract - Exercise plays an important role in our day to day life as it helps people remain in shape, fit and to prevent from many disease. Regular physical activities such as weight training and cardio exercises are part of everyday modern life. If performed correctly, it contributes to the health of a person. Exercises helps to prevent obesity and stimulate the immune system. Many people practice physical exercises without an assistance of an expert in home. This paper aims to present a software that offers virtual trainer with real-time feedback and the assessment score to different exercise postures presented by an animated 3D character using Kinect sensor. This tool allows people to observe the correct execution of each exercise. Recognition of the exercise has been performed using Random Forest (RF) classifier. The computer must first understand what a user is doing before it can respond. This has always been an active research field in computer vision, but it has proven formidably difficult with video cameras. With help of Kinect sensor, the computer directly sense the third dimension, making the task much easier

Key Words: Kinect xbox 360, Depth cameras, Skeletal Tracking, RMT, Random Forest Algorithm.

1. INTRODUCTION

1.1 Overview

The importance of exercising has been a common sense among people for a long time, but how to make them especially those white collars actively involved into those tiring practices is a big problem. Our daily life is more convenient than ever before because of the great progress of science and technology. However, the body building or fitness are always ignored in our daily life. People need going to fitness center or finding personal trainer to provide plans and instructions of their own fitness. Nowadays, people are becoming less active physically due to the advancement of convenient technology [1]. Lack of adequate physical exercise leads to unfitness and causes various illness. In everyday routine, exercise plays an important role as it helps people remain in shape and fit.

1.2 Health Problems

Research findings have revealed that physical activity can also boost self-esteem, mood, sleep quality and energy, as well as reducing the risk of stress, depression, dementia and Alzheimers disease.[2] In order to get fit, people need to go fitness centers However, due to unavailability of adequate fitness guides at affordable cost people tends to ignore health

1.3 Available Fitness Products

Current fitness guide products include book, video, mobile Apps etc., as shown in Figure a, most of which do not provide real time fitness guide or even do not support any interaction with users[1]. Typically, these products have several drawbacks. First, the whole purposes or main function of the products are too simple and dull, they only serves to give advice or some tips on the exercises without pertinence. Second, although some products aim at record the time or miles of how user walks and gives some values on how much calories has been consumed. Still, the accuracy is a problem

1.4 Virtual Personal Trainer

In this project, we propose a virtual trainer with real-time feedback and the assessment score through different exercise postures using Kinect sensor. Recognition of the exercise has been performed using Random Forest (RF) classifier [1]. The authors have utilized 20 joints of the 3D skeleton as features.

The Virtual Personal Trainer we build can provide real time visually action guide and action assessment during the fitness time of users using random forest algorithm

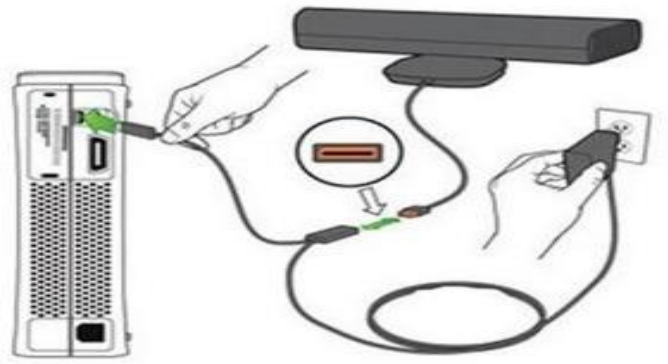
2. Proposed Methodology

Input data captures the motion of people using line motion sensing input device (Kinect xbox 360). In line motion input device, Input Data can be the color image, depth image, skeleton data and audio data.[1] In this paper, we only use skeleton data. Skeleton data is 3D skeleton of the human posture that consists of twenty 3D points has been extracted using the sensor's Application Programming Interface (API).

3. Methodology and Implementation

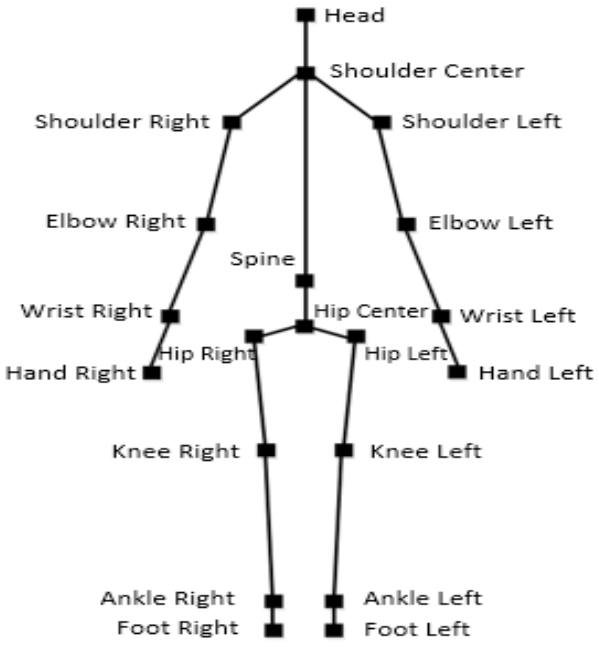
The method proposes to use skeleton tracking feature of Kinect sensor. Our system consists of Kinect sensor, connected to a System via adapter that help to connect xbox

360 with Laptop or pc. To get data from the sensor, we use C#, Kinect SDK and Visual studio software.



3.1 Tracking personal Skeleton

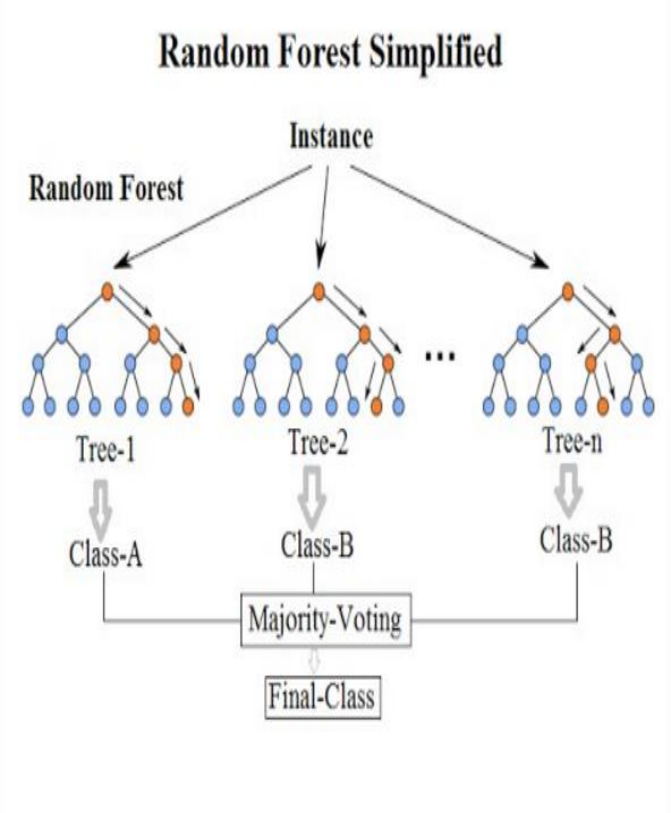
Purpose of this paper is recognition of action approach, With help of depth maps captured by Kinect sensor and are processed by a skeleton-tracking algorithm.[12][1] The Kinect xbox 360 skeleton-tracking module help for detecting the performing action and tracking a set of joints of his/her body. The Kinect for Windows SDK provides us with a set of APIs that allow easy access to the skeleton joints. The SDK supports the tracking of up to 20 joint points. Each and every joint position is identified by its name (head, shoulders, elbows, wrists, arms, spine, hips, knees, ankles, and so on), and the skeleton-tracking state is determined by either Tracked, Not Tracked, or Position Only. The SDK uses multiple channels to detect the skeleton. The default channel tracks all 20 skeletal joint positions with the Tracked, Not Tracked, tracking mode. The following diagram represents a complete human skeleton facing the Kinect sensor, shaped with 20 joint points that can be tracked by the Kinect[12][4]



3.2 Random Forest

Random forest algorithm can use both for classification and the regression kind of problems. Random forest algorithm is a supervised classification algorithm. As the name suggest, this algorithm creates the forest with a number of trees. In general, the more trees in the forest the more robust the forest looks like. In the same way in the random forest classifier, the higher the number of trees in the forest gives the high accuracy results.

As shown in below figure from each decision tree based on conditions value will be selected which will be then passed to majority voting system where classification and regression tasks will be performed to get accuracy result as final class



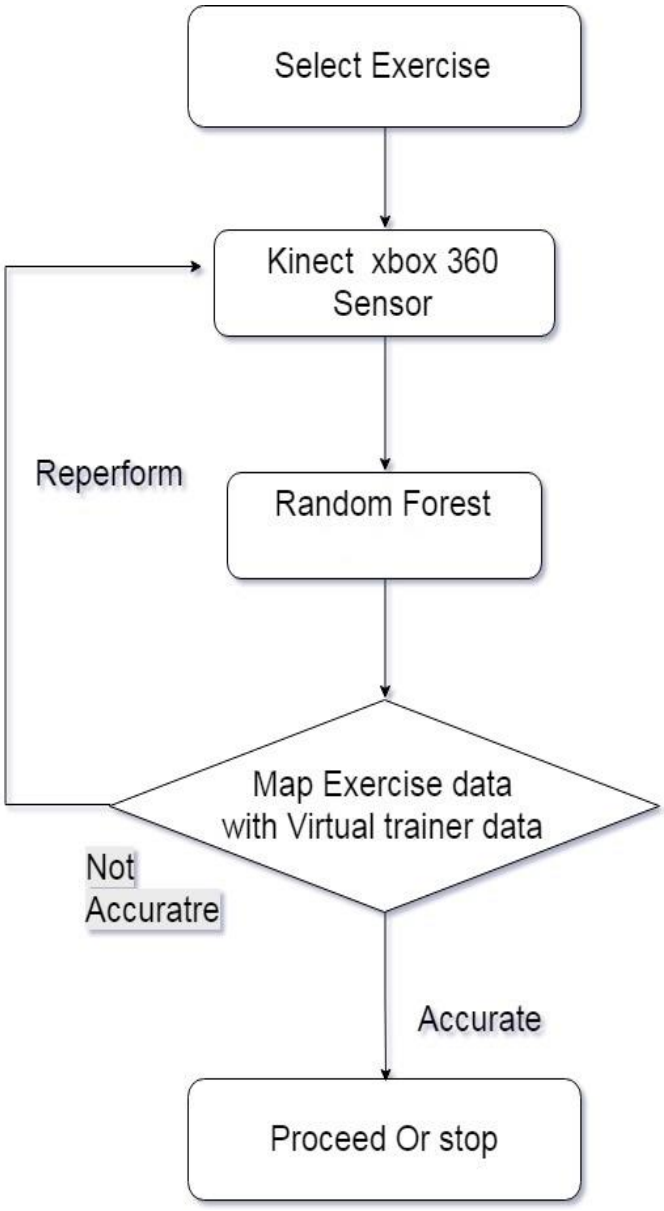
Random forest combine simplicity of Decision tree with flexibility resulting in vast improvement accuracy. While creating a dataset we will consider 2 variable of each type Specifying certain conditions and traversing through tree or dataset checking condition at each and every step and traverse the tree till last where random forest will provide us the predicted result.

3.3 Dataset Description

In this work, we will selected 5 basic exercises that should ideally be performed by everyone in daily life. We will enrolled 3 volunteers which are Fitness trainers for the dataset preparation. [1][4]And also referred internet to Know the steps involved in exercise for data set preparation Rest of the participants are students volunteers we have

used data who will perform exercise so as to evaluate the performance of the system. [1]

3.4 Project flow



Flow Chart

The Kinect sensor first takes input from its depth camera and infrared camera. The exercise that a user performs in front of Kinect sensor is considered as input. Then, the system uses Random Forest classifier to identify the correct exercise by mapping it with its Virtual trainer data set. Exercises that user performs are mapped with virtual trainer data using Classifier algorithm. If user is performing exercises in wrong manner, it tells user and user can re-perform exercise

3.5 Feedback Mechanism

This paper solution was developed to make physical therapy more engaging, efficient, and successful by using the Line motion input device (Kinect Xbox 360) sensor and software development kit (SDK), which helps patient to measure patient progress by comparing it with Virtual trainer. Patients can perform therapy at home. This can tell if patients are doing exercises in proper manner and whether patients perform exercises with accuracy[1]. Virtual trainer provide to real-time feedback to patients for exercise .Our helps motivate patients to do physical therapy and the data set we gather demonstrate what form of therapy is most effective, what types of patients react better to what type of therapy, and how to best deliver that therapy. [4]

4. Experimental Results

We performed our project on Visual studio 2017, 64 bit. The input line motion device ie. Kinect Xbox 360 used in this project, is Microsoft Kinect, 30 FPS and 16 KHz used for Xbox 360 gaming console. The time required to process an image is around 0.173 sec. We performed this project from a distance 1.2 to 3 meters from the input line motion device. The x-axis of the absolute maximum represents the position of the obstacle (left, right, middle), and the y-axis of the absolute maximum represents the distance between the object and user.

We have used Kinect Xbox 360 model to perform this project ,in which it can only track two human bodies at a times. This technology is helpful to detect 20 Joints of human body. Instead of Kinect 360, Kinect V2 can also be used which can track six human bodies at a time .Kinect V2 is based on time-of-flight technology. A time-of-flight camera emits light signals and then measures how long it takes them to return. With such measurements, the camera is able to differentiate light reflecting from objects in a room and the surrounding environment. That provides an accurate depth estimation that enables the shape of those objects to be computed.

5. Related Work

5.1. Sign Language Word Recognition using Kinect

Currently, it is said that there are about 360 million people with hearing disability people in the world close this file and download the Microsoft Word, Letter file. Some hearing disability people use sign language as a communicate way with others Many hearing disability people use sign language as a communicate way with others. y. In order to solve these problems, sign language recognition (SLR) aimed at supporting the communication between them are addressed [2].we employed two datasets, one is the 100 Japanese sign language words dataset named J100words dataset, collected by ourselves, and the other is a public available dataset called ChaLearn dataset.

5.2 Blind Navigation System for Visually Impaired Using Microsoft Kinect Camera

Obstacle avoidance and navigation are major problems for blind people. They require help to pass safely .In this work an obstacle avoidance system for blind people using Kinect depth camera. This assistive technology recognizes the medium in front of the user using Kinect depth camera. The system receives the depth images from the Kinect camera and processes it using a windowing-based mean or average method to recognize obstacles in the scanned environment. When the system recognizes an obstacle, it sends a voice feedback to the user through earphones. The testing is done with blindfolded persons. It shows that this device could successfully guide them to bypass obstacles safely

6. CONCLUSIONS

Our purpose of this paper is to provide smart gym in which users can perform exercises under Virtual personal trainer in anywhere. With help of this Paper, we are reducing travelling time of users to travel to the gym to perform basic routine exercises. This Paper is applicable to all kind of users i.e. beginners to experts. Here we are eliminating the possibility of injuries during workout that may be caused due to incorrect form exercise.

In this paper, we did not get the highest accuracy. The future task is to improve the method to obtain high recognition accuracy with help of Proposed Method. The number of tracked bodies and joints in our proposed method is less. This is not a sufficient number of tracked bodies and joints assuming actual use. Increasing the number of tracked bodies and joints is also a future tasks.

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