iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** V **Month of publication:** May 2022

DOI: https://doi.org/10.22214/ijraset.2022.42702

www.ijraset.com

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue V May 2022- Available at www.ijraset.com

Bicep Curl Count: Computer Vision Based Counting

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Abstract: ***Gym is a place which is mostly used by everyone these days. It is important to have a good trainer in order to guide you so that you can avoid injuries. Gym machines are getting upgraded at a high pace like Flexnet, which provides us with a AI based virtual assistant. Virtual assistant is used by mostly everyone in daily life like while walking to count steps, or the use of SIRI or ALEXA which are also an example of virtual assistant. These assistants are required in gym to count our repetitions while we are exercising. So this project uses MediaPipe and its inbuilt libraries with the help of Computer Vision to get the best result. With the help of this project we are marking the various coordinates of our body and then calculating the angle of our left arm to measure our arm angle and then counting the repetitions of it.***
Keywords: AI, Virtual Assistant, ALEXA, SIRI, Repetitions, Computer Vision.

I. INTRODUCTION

In this project we have used MediaPipe library and its function which focuses on the different coordinates which our body has to calculate the angle and count the repetitions according to it. It increases the count when you are doing it with the proper form. Performing exercises with proper form also helps in prevention of injuries.

Most gyms have advanced machines and trainers to guide people about the correct form but it is also necessary to count the repetitions performed in the particular exercise. So, this project aims to count the repetitions performed while performing bicep curls.

II. LITERATURE OVERVIEW

There are various other research based on this like by Z Cao [1], which used OpenPose to detect the posture. V Gupta [2] which used deep learning model for it. Another famous research was done by F.Zhang [3], he used MediaPipe on a device for real-time hand tracking. A research was done by A.Tagliasacchi [4] was done using Robust articulated-icp for real time hand tracking. A Deep Pose project based on human pose estimation with the help of Deep Neural Networks was done by A.Toshev [5] in 2014. A COCO Key Point Detection Task [6] was also performed in 2020. A project of Pose Trainer was done, it's main task was to correct exercise posture which was performed by S.Chen [7] using Stanford University. A project done by V.Bazarevsky [8] was done for neural face detection on mobile detection.. Composite fields for human pose detection was done by S Kreiss [9] in 2019 via IEEE Conference on Computer Vision. A study on common based objects was done by T Y Lin [10] in 2014 via Springer. A pose estimation using stacked glass networks was done by A Newell [11] in 2016 via Springer. At last a study on 3d pose estimation in single depth images using single view CNN to view multiple CNN was done by L.Ge [12] in 2016 via IEEE Conference on computer vision and pattern recognition. The above based researches has its own positive and negative sides. The researches described above were costly and it required a group of people to perform those researches. It required many other external resources also and the cost required to maintain them was also very high. Our research uses the webcam of the device which marks the various coordinates of the body required to calculate the angle and then gives us the total count according to it. It does not require any other material which can cost the user and also does not need any maintenance. It is eco-friendly and can be used by anyone

III. DATASET USED

First we require to align our body in front of our webcam. Using our webcam and with the help of MediaPipe library the various coordinates present in our body (i.e 33 coordinates) will be marked. We can consider various test cases here like:-

1) If our body is fully visible then catching the left hand coordinates can be difficult,
2) If we are showing right side then our project should not give any output as it not able to acquire the left coordinates
3) If are showing the left side then it should give accurate answers.

These three are the major type of datasets which will help our project to work better.

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IV. IMPLEMENTATION

In this project we have used Media Pipe as a library and also used Open Computer Vision which helps us to access webcam easily. The MediaPipe pose estimation consists of 33 coordinates which are marked using our webcam and these points can be used calculate angles according to our use.

The image detected is in BGR format which has to be converted into RGB format to extract the required landmarks and then has to be reconverted back into BGR format to make it easy for the computer to calculate things easily.

V. BLOCK DIAGRAM AND COORDINATES

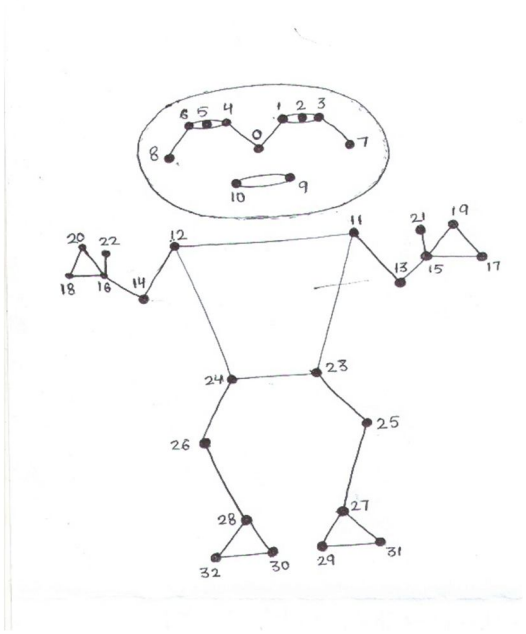

Figure 1: Depicting various coordinates in our body

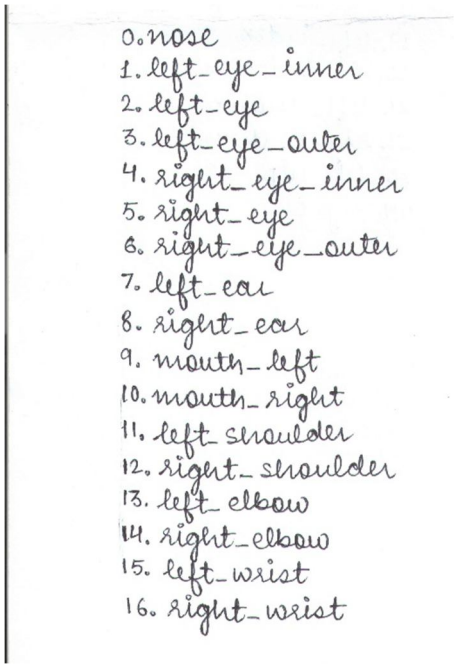

Figure 2: Coordinates

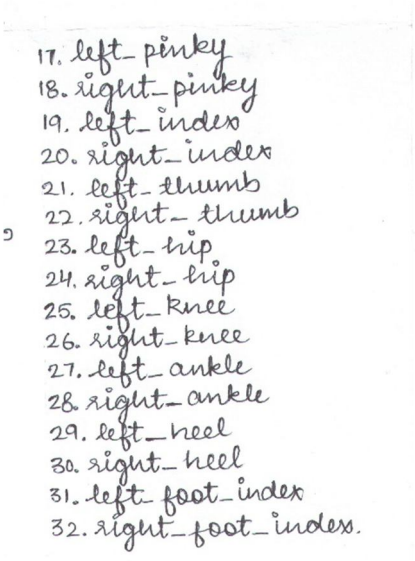

Figure 3: Coordinates

These are the 33 different coordinates which are used by MediaPipe library to mark the various coordinates in our body and help us achieve the result we want.

VI. APPROACH

We are basically marking the required coordinates and then calculating the angles which are required by us. We have tried using all the different angles to see whether our coordinates are getting marked or not. Then with the help of the formula(which is mentioned below) we were able to calculate the angle into radians and then converted the angle into degrees to obtain our desired results.

VII. FORMULA USED

radians = np.arctan2(c[1]-b[1], c[0]-b[0]) - np.arctan2(a[1]-b[1], a[0]-b[0])
The angle initially is calculated into radians and is then converted into degrees.

Converted back into degrees:-
angle = np.abs(radians*180.0/np.pi)
After converting the angle into degrees it makes our calculation easier and we are easily able to calculate the angle we want to calculate.

VIII. TABLES AND BAR CHART

SNo.	Method	Yoga	Yoga	Dance	Dance	HIIT	HIIT
1.	BlazePose GHUM Heavy	67.1	95.4	72.0	95.2	73.0	95.5
2.	BlazePose GHUM Full	61.6	94.5	66.4	92.3	67.0	95.7
3.	BlazePose GHUM Lite	44.0	90.2	51.6	90.5	52.8	91.5
4.	Apha Pose Res Net 50	62.4	95.0	55.8	95.5	61.4	95.0
5.	Apple Vision	33.8	80.7	33.4	91.4	42.5	87.6

Figure 4:Comparing various techniques

These are the comparisons done with other existing technologies using 17 coordinates and setting up the webcam at a particular distance like 2-3 meters to get the best result.

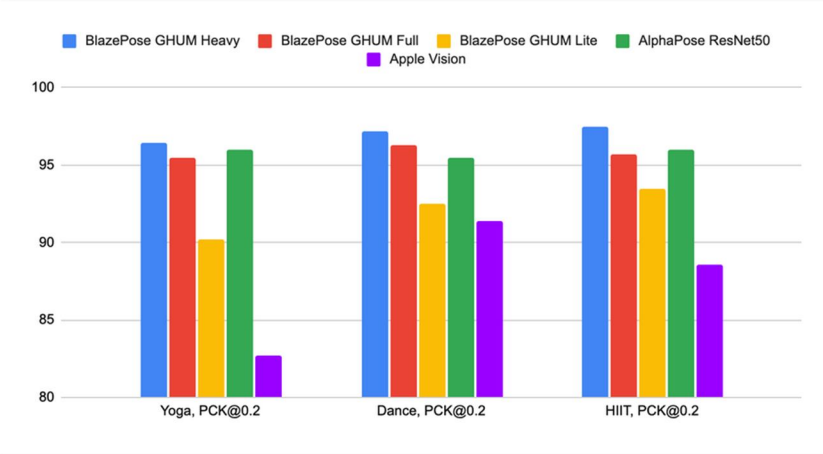

Figure 5:Quality evaluation with above techniques

Our model is developed in such a way that it works in real time on majority of modern devices as shown below:-

SNo.	Method	Latency
1.	BlazePose GHUM Heavy	53 ms
2.	BlazePose GHUM Full	25 ms
3.	BlazePose GHUM Lite	20 ms

Figure 6:Latency calculated

IX. CONCLUSION AND FUTURE WORK

These days due to busy life schedules people are unable to find a way to stay fit and healthy. Being fit is not only good for health but it also avoids diseases. Applying artificial intelligence is a new way to ignite the urge in people to start doing exercise and stay fit. In this process we learnt how to use MediaPipe, Computer Vision and get the best out of it.

This project till now only consists of counts of our bicep curls and this can be upgraded as it has a lot of scope in it It tells us whether our arm is up or down and number of repetitions we have done which makes our work a lot more easy.

Future may hold many more exercises in it like squats and bench press. Also the movement of camera vertically or horizontally can also be added to capture another variety of exercises with different angles.

#Author Contribution : Conceptualization, Jatin Goel and Harshita Jain. ; funding acquisition, Jatin Goel and Harshita Jain. ; investigation, Prabhjot Kaur. ; project administration, Harshita Jain. ; supervision, Prabhjot Kaur. ; writing original draft, Jatin Goel and Harshita Jain. ; writing-review and editing, Prabhjot Kaur, Harshita Jain and Jatin Goel.

#Funding : This research received no external funding.

#Acknowledgement : The authors would like to thank the staff in Inderprastha Engineering College, Abdul Kalam Technological University, Uttar Pradesh, India and the participants for their support to conduct the experiments.

#Conflicts of Interest : The authors of this manuscript have no conflicts of interest relevant to this work.

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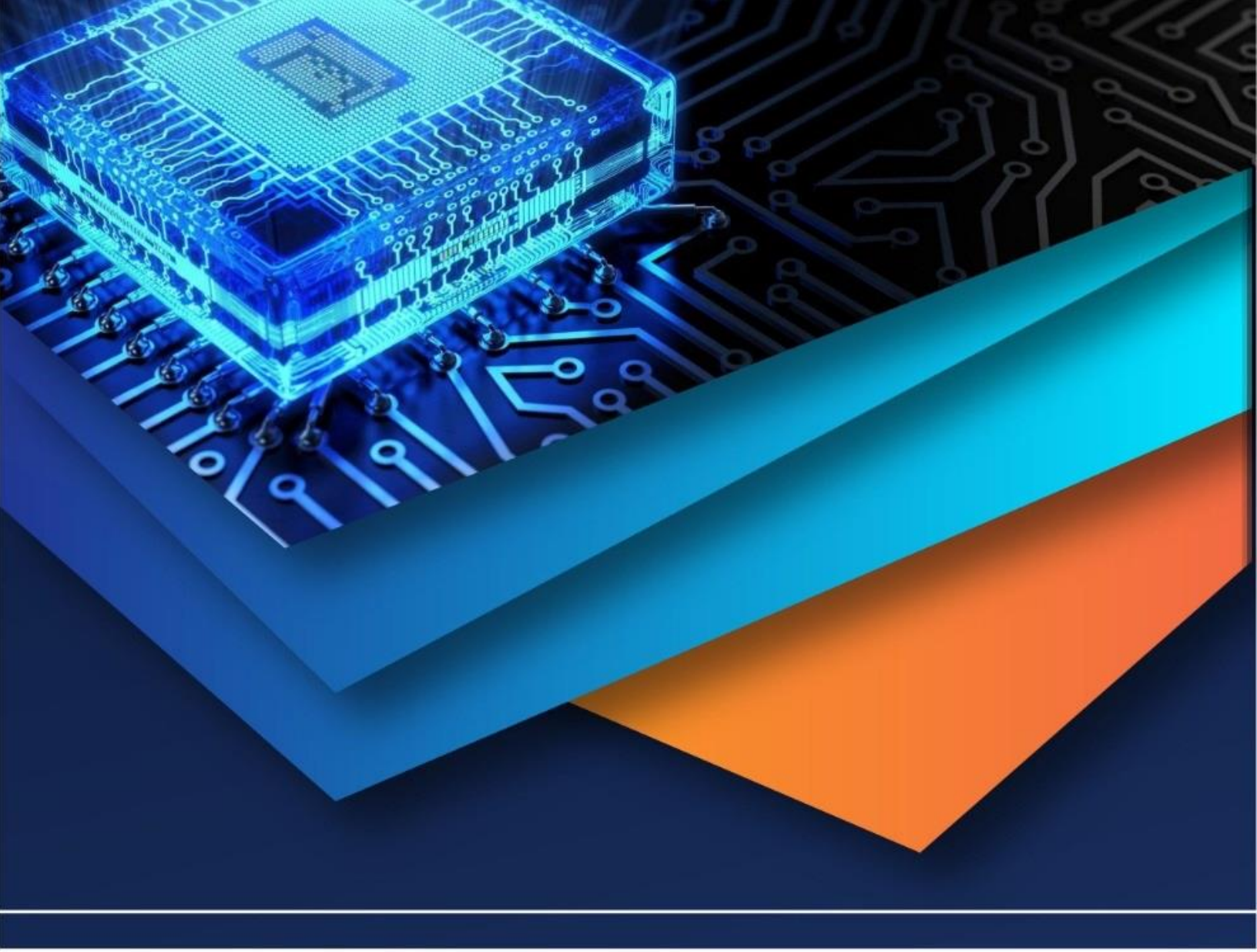

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