International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 3 March 2023, pp: 1448-1451 www.ijaem.net ISSN: 2395-5252

Study of Self-Workout Trainer System Using Ai/Ml

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Date of Submission: 16-03-2023 Date of Acceptance: 28-03-2023

ABSTRACT
Exercises for fitness are very good for one's health and fitness. If used improperly by the individual, they may also be ineffective and even hazardous When a person doesn't adopt the right pose during an exercise, errors can be made. In our work, we present a software program that recognizes the user's exercise posture and offers customized, in-depth suggestions on how the user can correct their form. People are more likely to exercise unsupervised and alone as self-management for the therapy of musculoskeletal diseases becomes more popular. However, it is dangerous to attempt these exercises without feedback, as it can be difficult to realize when one is performing the exercise incorrectly. This could lead to further injury. Through an application that detects the user's posture using state-of-the-art pose estimation, we draw attention to these issues and attempt to offer the best answer. We then assess the vector geometry of the pose through an exercise to give helpful feedback.

I. INTRODUCTION

Algorithms for artificial intelligence and machine learning can be used to address a variety of problems that come up in daily life. Artificial intelligence and machine learning algorithms can be used to quickly and effectively handle many issues that arise in daily life.

One of those problems is posture estimation during exercise because during lockdown this problem has been underlined among people who exercise at their home without the supervision of any professional trainer, it became very challenging for them and also it can be difficult to realize when one is performing the exercise incorrectly.

When compared to people who are not physically active, those who engage in mild to vigorous levels of exercise have a reduced mortality rate. By lowering the propensity for inflammation, moderate amounts of exercise have been linked to delaying the ageing process.

1.1 Existing Technologies/Tools/Software

1.2.1 Open pose: It is the first real-time multi-person system that jointly identify key locations on the human body, hands, facial expression, and feet on a single image. Researchers at Carnegie Mellon University came up with the idea. These have been made available in the form of Unity, C++ implementation, and Python code.

1.2.2 Open CV: A free and open-source software library for computer vision and machine learning is called OpenCV. In order to speed up the incorporation of artificial intelligence into commercial goods, OpenCV was created to offer a standard infrastructure for computer vision applications. OpenCV makes it simple for businesses to consume and alter the code because it is a BSD-licensed product.

More than 2500 optimised algorithms are available in the collection, including a wide range of both traditional and cutting-edge computer vision and machine learning techniques. These algorithms can be applied to a variety of tasks, including the detection and recognition of faces, the identification of objects, the classification of human actions in videos, the tracking of camera movements, the tracking of moving objects, the extraction of 3D models of objects, the production of 3D point clouds from stereo cameras, and the stitching together of images to create high-resolution scenes.

Features of OpenCV:
1.Cross-platform: Enables installation in various settings (operating systems).
2. Transferable: Useful on any computer that can run C.
3. Open source: Under the Apache 2 License, OpenCV is available without charge for use.

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4. Quick: NumPy routines are used and OpenCV is substantially optimised.
5. Ample algorithms: The OpenCV packages include almost 2500 algorithms.
6. Quick prototyping is used for creating real-time apps.
7. Widespread use: Used by several businesses and organisations.

II. LITERATURE REVIEW:

The primary goal of the LR is to offer a methodical and scientific evaluation of how a Self-Workout Trainer can be utilised to avoid accidents and muscle fatigue when performing exercises. Because to the risk of injury to the muscles and joints from poor posture, many beginners begin their exercise regimens without it. To maintain their health during the COVID-19 pandemic, people made it a habit to exercise or practise yoga, both of which put their bodies through risky stretching.

Fitness activities are tremendously beneficial to one's health and fitness, but if they are carried out improperly by the user, they can also be inefficient and even harmful. When a user does an exercise incorrectly, they are not using the right form or posture. Hence, we developed the concept of a Self-Workout Trainer.

Self-workout The user's pose is detected by the trainer using state-of-the-art pose estimation technology, and the vector geometry of the pose is assessed through an exercise to provide helpful feedback. Based on personal training standards, we used a collection of more than 250 workout photographs of proper and improper form to develop geometric heuristic and machine learning algorithms for evaluation. Pose Trainer supports any Windows or Linux computer with a GPU and works with four standard routines.

III. DEEP POSE:

Deep learning was utilised in the first notable paper, Deep Pose, to determine human position. It appeared in the 2014 CVPR. It achieved SOTA performance in 2014 and exceeded the most recent models. In order to estimate some poses even when some joints are hidden, the model has an Alex Net backend and a holistically calculated pose.

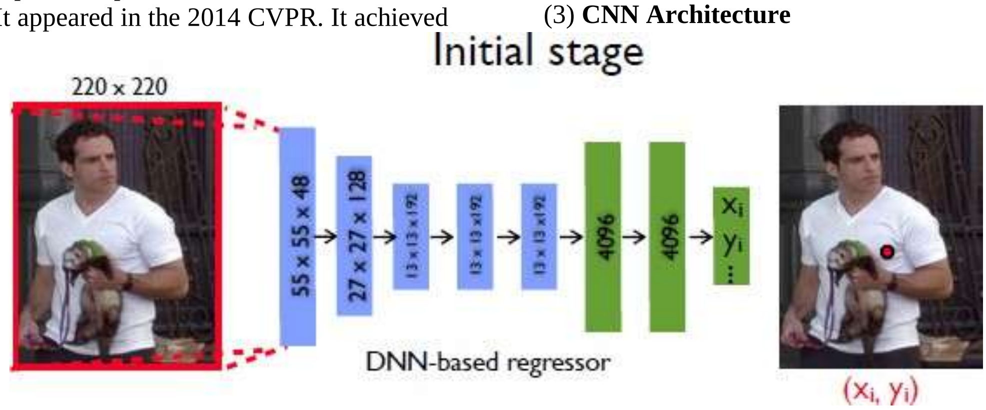
By using Deep Learning (CNN) for posture estimation, the article served as a catalyst for further study in the field. For some regions' XY coordinates in the model, regression was used. As a result, performance suffered due to increased complexity and poorer generalisation.

Google researchers recommended Deep Pose for Posture Estimation at the 2014 Computer Vision and Pattern Recognition conference. They make an effort to frame the pose estimation problem as a body joint regression problem based on DNN. They include a number of DNN regressors that generated incredibly precise pose assessments

IV. ARCHITECTURE:

4.1 Pose Vector:

• The authors of this study encoded the positions of all k body parts into joints in order to represent the human body as a posture. A posture vector is described in the sentences that follow.
(1) Shows the x and y coordinates of the bodily joint's position.
• The pair (x, y) is used to represent the image, where x stands for the image data and y for the ground truth posture vector data.
• Because these coordinates refer to an absolute, full-size image. Resizing the image can be difficult. So, we normalised the coordinates in relation to a bounding box (b) that includes the entire human body or certain parts of it. The centres of these boxes serve as a representation; b = (,). It consists of the height, breadth, and centre of the enclosing box.
• We normalised the coordinates for the location using the formula below.
(2) The last item we get are the normalised Pose vector coordinates.
(3) **CNN Architecture**



The CNN architecture used by the author of this paper is Alex Net, which delivered outstanding outcomes for the Image Localization challenge. Denormalizing the output yields the anticipated result y *, where theta stands for the trainable parameters (weights and biases), shi for the neural architecture used to transform the normalised posture vector N(x), and ().

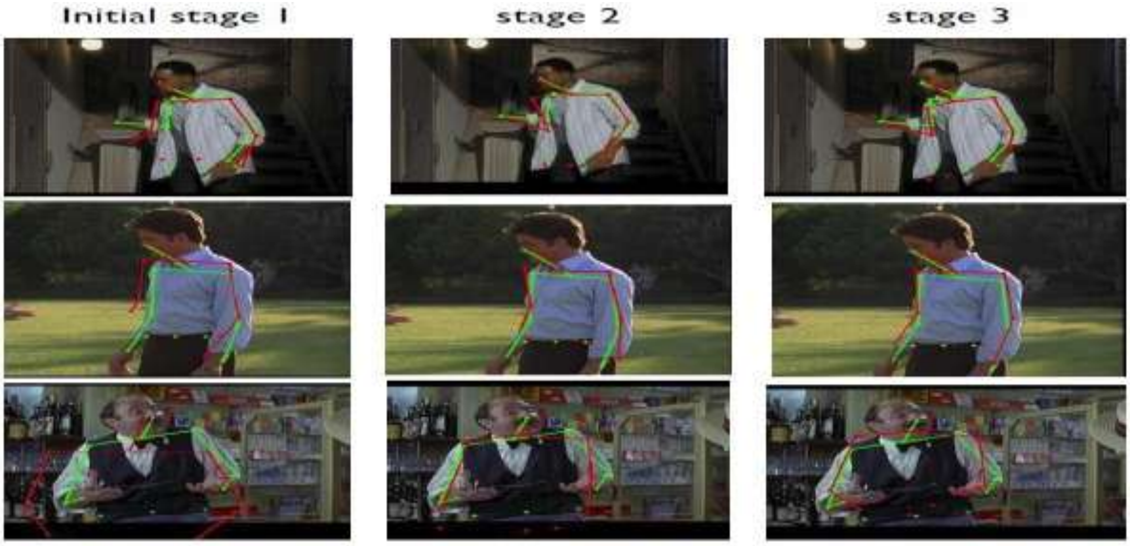
• This neural network design uses a 4 stride on a 220 by 220 pixel picture.
• This neural network design adds a 4 stride to an image of dimension 220 by 220.
• The CNN architecture contains 7 layers which can be listed as C(55×55×96) — LRN — P — C(27×27×256) — LRN — P — C(13×13×384) — C(13×13×384) — C(13×13×256) — P — F(4096) — F(4096)
• Where **C** is the convolution layer which uses ReLU as an activation function to introduce non-linearity in the model, **LRN** is local response normalization, P is the pooling layer, and F is the fully connected layer.
• The architecture's final stage produces 2k joint coordinates.
• There are 40 million factors in all.
• The distance between projected coordinates and the ground truth loss function is minimised by the design using the L2 loss function.

(5) Where k represents how many joints there are in the picture.

DNN regressor:
• It is difficult to raise the input size because doing so will result in an increase in the already significant number of factors. So, it is suggested to improve the posture estimation by using a chain of pose regressors.
• Now, the solution below represents the first step.

(6) Where denotes a complete picture or bounding area that a person detection has produced.
• Now for the subsequent stages s>= 2:

(7) Where diam(y) is the measured distance between opposite joints, such as the left shoulder and right hips? diam(y).
• The accompanying pictures show how the accuracy was enhanced by a DNN regressor cascade.



V. CONCLUSION:

In this report, we introduce our plan to provide fitness enthusiasts with an AI-enabled feedback system to correct their posture. Via crucial points in human pose, we assess exercise photos using the result of pose estimate. We use machine learning techniques to automatically verify posture correctness by only accepting labelled input datasets, as well as geometric heuristic algorithms to deliver individualised feedback on particular exercise gains. The development of this programme is currently in its early phases. We are currently focused on the plank exercise dataset only, but our plans include many exercise and yoga poses.

VI. FUTURE SCOPE:

The programme offers bicep curl recognition and posture analysis for recorded films. The reps are correctly counted, and the feedback method is suitable. Soon, we suggest pursuing the following objectives:

1. Train the front-raise and shoulder-press models separately to incorporate such exercises as well.
2. Develop a web application to enable cloud access to this service.

3. Redesign the user interface of the application and add a button that allows users to switch between recorded recordings and the live camera stream.

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