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Recognizing and Counting Repetitions of Exercises in Real Time Using Machine Learning Techniques

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ABSTRACT: Fitness exercises are very beneficial to personal health and fitness; however, they can also be ineffective and potentially dangerous if performed incorrectly by the user. Exercise mistakes are made when the user does not use the proper form, or pose. In our work, user introduce Pose Trainer, an application that detects the user's exercise pose and provides personalized, detailed recommendations on how the user can improve their form. Pose Trainer uses the state of the art in pose estimation to detect a user's pose, then evaluates the vector geometry of the pose through an exercise to provide useful feedback based. User record a dataset of over 5 exercise videos of correct form, based on personal training guidelines, and build geometric heuristic and machine learning algorithms for evaluation. A pose estimator called media pipe is used in this application. Media pipe is a pre trained model composed of a multi-stage RNN algorithm to detect a user's posture and counting the repetitions. This application then evaluates the vector geometry of the pose through an exercise to provide helpful feedback. This computer vision technique detects human posture in images or videos and shows the key points in the output image. The Pose Trainer application from a technical perspective as a pipeline system, consisting of multiple system stages. With the Pose Trainer application providing specific calorie burn data on the exercise form to the user and stored in the text file. 32 media pipe is both accurate and efficient, while also scalable to multiple people without scaling up the run-time.

KEYWORDS: Media pipe, RNN Algorithm, Exercise and Pose Estimator.

I. INTRODUCTION

Exercises like squats, deadlifts and shoulder presses are useful to health and fitness, however they'll even be terribly dangerous if performed incorrectly. This might be due to lack of formal coaching through classes or a personal trainer. For our course Paper, user tend to get to help users in playing the right posture for exercises by building Pose Trainer application that detects the user's exercise pose and provides helpful feedback victimization machine learning techniques.

I.I. OBJECTIVE

The objective of this Paper, user tend to present a Pose Trainer application using machine learning technique. This Paper involves detecting the user's predicted pose for a given exercise and repetition counting. It's used for the patients in absence of therapist. Our goal for Pose Trainer is to assist forestall injuries and improve the standard of people's workouts with simply a pc and its webcam.

II. LITERATURE REVIEW

- [1] Z. Cao, T. Simon, S. Wei and Y. Sheikh, "Real-time Multi-person 2D Pose Estimation Using Part Affinity Fields," 2017 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2017, pp. 1302-1310, doi: 10.1109/CVPR.2017.143.
- [2] K. Sun, B. Xiao, D. Liu and J. Wang, "Deep High-Resolution Representation Learning for Human Pose Estimation," 2019 IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 2019, pp. 5686-5696, doi: 10.1109/CVPR.2019.00584.
- [3] A. Bulat, J. Kossaifi, G. Tzimiropoulos and M. Pantic, "Toward fast and accurate human pose estimation via soft-gated skip connections," 2020 15th IEEE International Conference on Automatic Face and Gesture Recognition (FG 2020), 2020, pp. 8-15, doi: 10.1109/FG47880.2020.00014D. L. Wu, Wing W. Y. NG, Patrick P. K. Chan, H. L. Ding, B. Z. Jing, and D. S. Yeung, "Access control by RFID and face recognition based on neural network," in Proc. International Conference on Machine Learning and Cybernetics, July 11-14, 2016, pp. 675-680.

III. ALGORITHM

III.I. RECURRENT NEURAL NETWORK ALGORITHM (RNN)

Recurrent Neural Network (RNN) is a kind of Neural Network where the output from previous step are fed as input to this step. In ancient neural networks, all the inputs and outputs are independent to each other, however in cases like once it's needed to predict consequent word of a sentence, the previous words are needed and therefore there's a desire to recollect the previous words. Thus, RNN came into existence that solved this issue with the assistance of a Hidden Layer. The most vital feature of RNN is Hidden state that remembers some data about a sequence. RNN have a "memory" that remembers all data regarding that has been calculated. It uses an equivalent parameters for every input because it performs an equivalent task on all the inputs or hidden layers t turn out the output. This reduces the complexness of parameters, not like different neural networks.

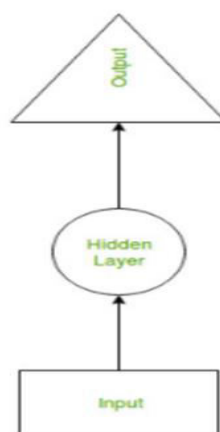


Figure 1: Block diagram of Recurrent Neural Network Algorithm (RNN)

A Recurrent neural network (RNN) is a category of artificial neural networks where connections between nodes form a directed or undirected graph on a temporal sequence. Derived from feed forward neural networks, RNNs will use their internal state (memory) to process variable length sequences of inputs. The back propagation algorithm of an artificial neural network is modified to include the unfolding in time to train the weights of the network. This algorithm is based on computing the gradient vector and is called back propagation

in time or BPTT algorithm for short. However, RNNs suffer from the matter of vanishing gradients that hampers learning of long knowledge sequences. The gradients carry data utilized in the RNN parameter update and once the gradient becomes smaller and smaller, the parameter updates become insignificant which suggests no real learning is finished. The RNN unit in Tensor Flow is termed the “RNN cell”. It retains data from one-time step to a different flowing through the unrolled RNN units. Every unrolled RNN unit encompasses a hidden state. This time steps hidden state is calculated victimization data of the previous time step's hidden state and therefore the current input

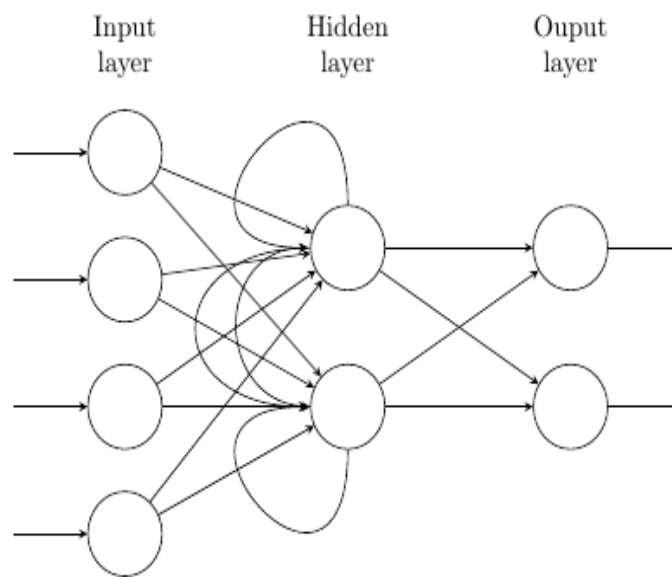


Figure 2: Layers of Recurrent Neural Network

Convert abstracts from list of strings into list of lists of integers (sequences)

- ✓ Create feature and labels from sequences.
- ✓ Build LSTM model with Embedding, LSTM, and Dense layers.
- ✓ Load in pre-trained embedding's.
- ✓ Train model to predict next add sequence.

In a nutshell, RNN is explained because it contains some internal state that gets updated every time step. During output sequence prediction, the information of the past is employed through hidden states. It finds its application in areas like speech recognition, language modelling, AI, building chatbots.

III.II. MEDIA PIPE

Media Pipe is an open-source framework from Google for building multimodal (e.g., video, audio, any statistic data), cross platform (i.e. Android, iOS, web, edge devices) applied ML pipelines. Its performance is optimized with end-to-end on device logical thinking in mind. Media Pipe is ready to realize its speed due to the utilization of GPU acceleration and multi-threading. The multi-threading and GPU acceleration enable newer

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phones to run away with frames, typically being at Federal Protective Service too high to examine with the human eye. Media pipe could be a cross-platform library developed by Google that gives superb ready-to-use ML solutions for laptop vision tasks. OpenCV library in python could be a laptop vision library that is widely used for image analysis, image process, detection, recognition, etc. Roughly a year past, Google open-sourced Media Pipe, a framework for building cross-platform AI pipelines consisting of quick logical thinking and media process (like video decoding). Media Pipe is ready to realize its speed due to the utilization of GPU acceleration and multi-threading. The multi-threading and GPU acceleration enable newer phones to run away with frames, typically being at Federal Protective Service too high to examine with the human eye.

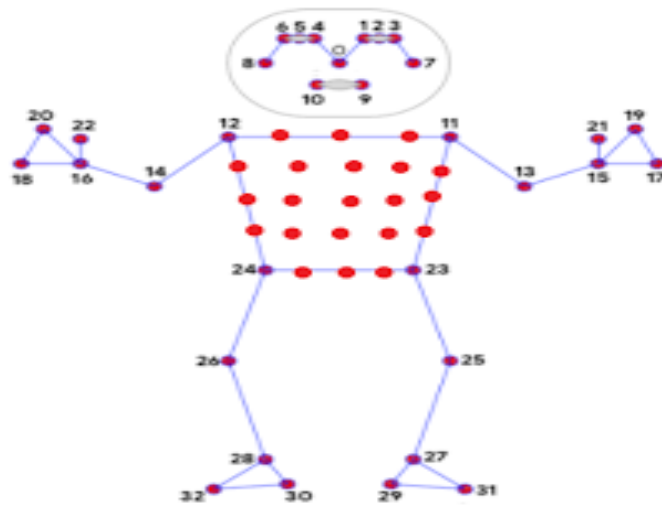


Figure 3: Structural diagram of Media Pipe 32.

III.III. POSE TRACKER

Pose tracker to spot and track user to apply the algorithmic rule, exercise recognition to discover the name of the appeared exercises and counter to count and indicate the right and incorrect repetitions. Pose Tracking is that the task of estimating multi-person human poses in videos and distribution distinctive instance IDs for every key purpose across frames. Accurate estimation of human key point-trajectories is helpful for act recognition, human interaction understanding, motion capture and animation.



Figure 4: Example of Pose Tracking

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IV. PROGRAMMING AND SOFTWARES

IV.I.PYTHON

Python is a high-level, general-purpose programming language. Its design philosophy emphasizes code readability with the utilization of great indentation. Its language constructs and object-oriented approach aim to assist programmers write clear, logical code for small- and large-scale comes. Python is dynamically-typed and garbage-collected.

Python 3.0, free in 2008, was a significant revision that's not fully backward-compatible with earlier versions. Python two was discontinued with version two.7.18 in 2020. Python's giant customary library, ordinarily cited joined of its greatest strengths. Provides tools suited to several tasks. For Internet-facing applications, several customary formats and protocols like MIME and HTTP area unit supported. It includes modules for making graphical user interfaces, connecting to relative databases, generating pseudorandom numbers, arithmetic with arbitrary-precision decimals. Manipulating regular expressions, and unit testing.

Some components of the quality library area unit coated by specifications—for example, the online Server entranceway Interface (WSGI) implementation follows ginger 333.—but most area unit such as by their code, internal documentation, and take a look at suites. However, as a result of most of the quality library is cross-platform Python code, solely a number of modules would like sterilization or revising for variant implementations. Python is often used for developing websites and software system, task automation, information analysis, and information mental image. Since it's comparatively simple to find out, Python has been adopted by several non-programmers like accountants and scientists, for a spread of everyday tasks, like organizing finances.

IV.II. PYCHARM

PyCharm is an integrated development environment (IDE) utilized in programming, specifically for the Python programming language. It is developed by the Czech company Jet Brains (formerly referred to as IntelliJ). It provides code analysis, a graphical computer programmer, associate integrated unit tester, integration with version management systems (Vase's), and supports internet development with Django in addition as information science with Eunectes merinos. PyCharm is cross-platform, with Windows, macOS and UNIX system versions. The Community Edition is free underneath the Apache License and there's conjointly skilled Edition with further options – free underneath a subscription funded proprietary license and conjointly an academic version.

IV.II.I. FEATURES OF PYCHARM

- ✓ Project and code navigation: specialized project views, file structure views and fast jumping between files, classes, strategies and usages
- ✓ Python refactoring: includes rename, extract methodology, introduce variable, introduce constant, pull up, cut down etc.,
- ✓ Support for internet frameworks: Django, web2py and Flask [professional edition only]
- ✓ Google App Engine Python development [professional edition only]
- ✓ PyCharm provides an API so that developers will write their own plugins to extend.
- ✓ Many plugins from different Jet Brains IDE conjointly work with PyCharm.
- ✓ There are more than 1000 plugins that are compatible with PyCharm.
- ✓ PyCharm skilled Edition has many license choices that dissent in their options, price, and terms of use.

IV.III.GUI (PYQT5 DESIGNER)

PyQt5 is that the latest version of a user interface widgets toolkit developed by riverbank Computing. It's a Python interface for Qt, one in all the foremost powerful, and widespread cross-platform user interface libraries. PyQt5 could be a mix of Python artificial language and also the Qt library. This introductory tutorial can assist you in making graphical applications with the assistance of PyQt. Our tutorial on earlier version - PyQt4 is obtainable here. PyQt could be a user interface widgets toolkit. It's a Python interface for Qt, one in all the foremost powerful, and widespread cross-platform user interface library. PyQt was developed by riverside Computing Ltd. the newest version of PyQt will be downloaded from its official web site web site riverbankcomputing.com PyQt API could be a set of modules containing an oversized variety of categories and functions. Whereas QtCore module contains non-GUI practicality for operating with file and directory etc., QtGui module contains all the graphical controls. Additionally, there square measure modules for operating with XML (QtXml), SVG (QtSvg), and SQL (QtSql), etc.

A list of often used modules is given below -

- ✓ QtCore - Core non-GUI categories employed by different modules
- ✓ QtGui - Graphical programmer parts
- ✓ QtMultimedia - categories for low-level multimedia system programming
- ✓ QtNetwork - categories for schedule
- ✓ QtOpenGL - OpenGL support categories
- ✓ QtScript - categories for evaluating Qt Scripts
- ✓ QSql - categories for info integration exploitation SQL
- ✓ QtSvg - categories for displaying the contents of SVG files
- ✓ QtWebKit - categories for rendering and written material HTML
- ✓ QtXml - categories for handling XML
- ✓ QtWidgets - categories for making classic desktop-style UIs
- ✓ QtDesigner - categories for extending Qt Designer

IV.IV. DATA BASE MANAGEMENT SYSTEM

Database management system is a software that is employed to manage the database. For example: MySQL, Oracle, etc are the popular databases that is employed in several applications. database management system provides an interface to perform numerous operations like DB creation, storing data in it, change data, making a table within the data and plenty a lot of. It provides protection and security to the data. Within the case of multiple users, it additionally maintains knowledge consistency.

DBMS permits users the subsequent tasks:

- ✓ Data Definition: it's used for creation, modification, and removal of definition that defines the organization of information within the info.
- ✓ Data Updation : it's used for the insertion, modification, and deletion of the particular knowledge within the info.
- ✓ Data Retrieval: it's wont to retrieve the info from the info which might be utilized by applications for numerous functions.

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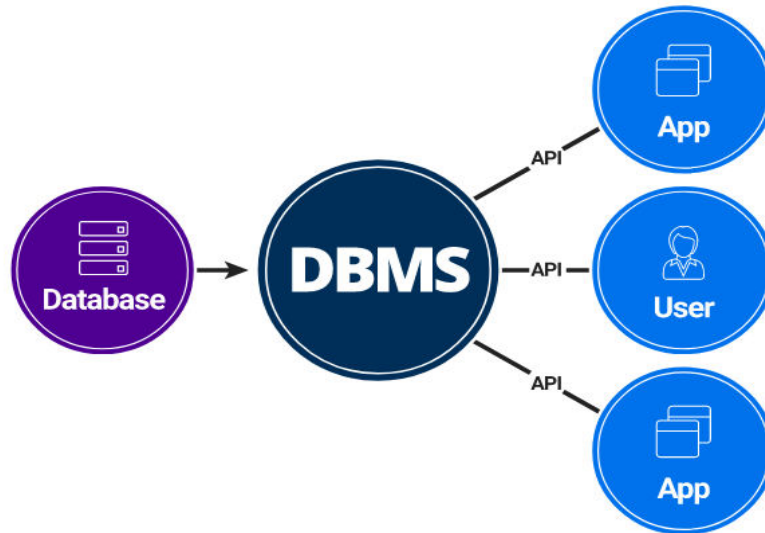


Figure 5: Block diagram of Data Base Management System

V. BLOCK DIAGRAM

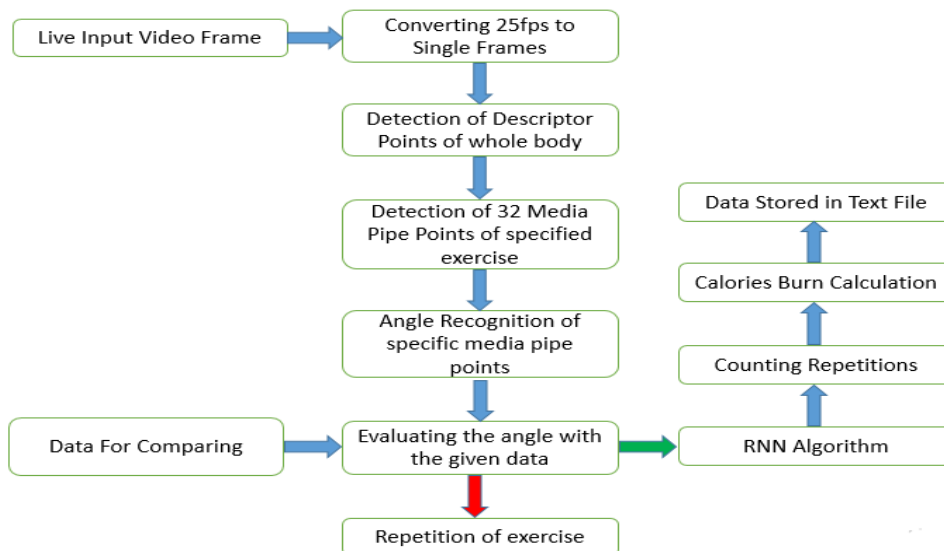


Figure 6: Block Diagram of the proposed system

VI. WORKING

- ✓ In this Paper, user present a Pose Trainer application based on machine learning technique
- ✓ First, the user make a position of themselves performing a selected exercise in front of the camera. The video

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is recorded from a particular perspective that allows the exercise to be seen.

- ✓ However, there are no requirements on camera type or distance from camera, the user only needs to make sure that their body is visible.
- ✓ The input video is now converted into multiple frames to extract the key points of the whole body. After the key point's extraction, pose training starts from the user recording a video of an exercise and ends.
- ✓ Pose Trainer system with 32 media pipe mark the points of the estimated exercise and then using angle calculation method, the performed exercise is evaluated.
- ✓ Repetition counting is done only after the evaluation return true by using RNN algorithm compared to dataset. After the successful repetitions the calories burnt is calculated and stored as a text file.
- ✓ The Five exercises that can be able to evaluate are:
 1. Both hands up and down.
 2. Left leg up and down.
 3. Right leg up and down.
 4. Fly both hands.
 5. Lift hands towards body.

VII. OUTPUT

From this Paper user expect a software package application that intake the live input of the user while he/she is taking some specific exercise. Whereas the angle between the media points is calculated and then evaluated with the dataset provided, if the angle is evaluated properly then the user is doing well and therefore the exercise is taken to the count, the calories burnt throughout the exercising is calculated and stored in text file. Else that specific instance is unnoticed so the user is asked to try and do that exercise properly.

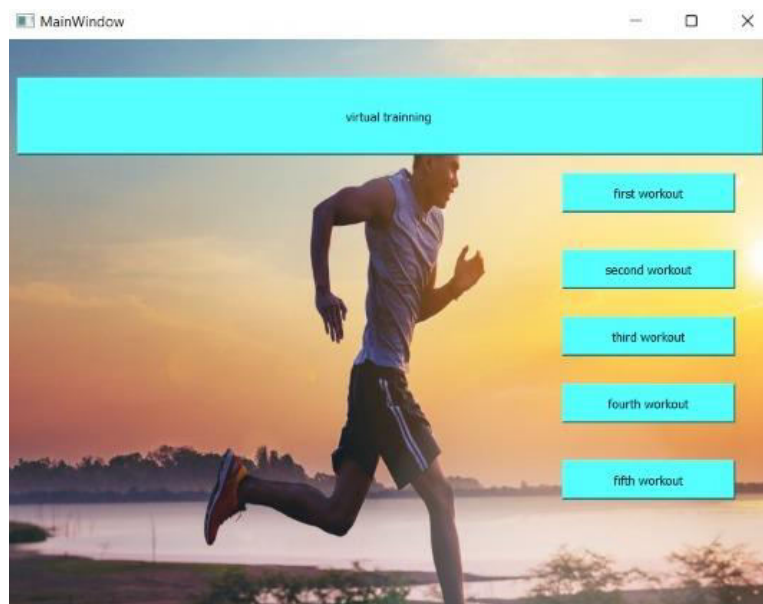


Figure 7: User Interface of an Application

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Figure 8: Output Screen while taking the exercise

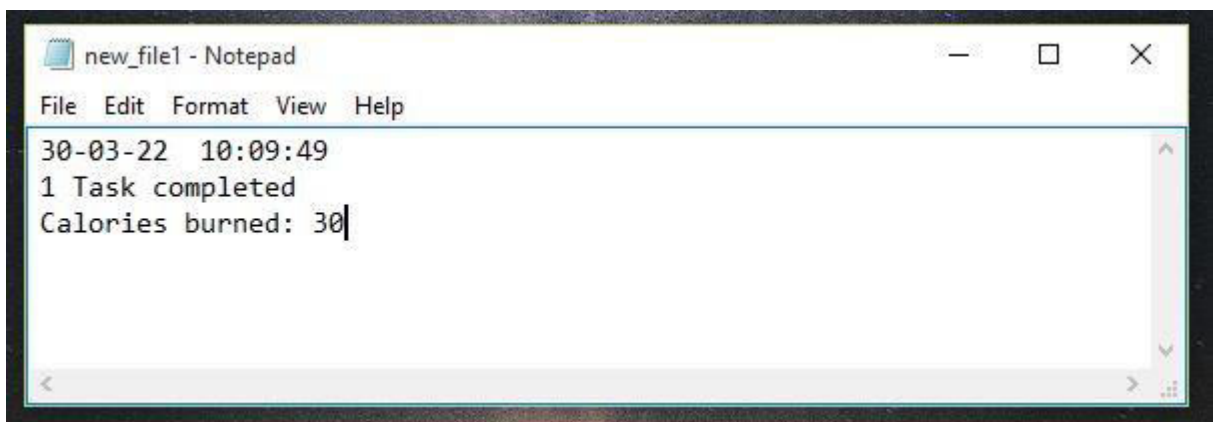


Figure 9: Output Text file of Calories Burnt after completing the exercise

VIII. RESULT AND CONCLUSION

In this Paper, user introduce pose Trainer an end-to-end laptop vision application that uses pose estimation, repetition counting, visual geometry and machine learning to supply personalized feedback on fitness exercise form. Here, user is enhanced to work with 5 completely different exercises. The training videos of every exercise is evaluated by geometric algorithms to supply personalized feedback on specific exercise and machine learning algorithms are used to automatically determine posture estimation and repetition counting using only labelled input videos.

IX. FUTURE ENCHANCEMENT

- ✓ The obtained calorie knowledge will be hold on within the on-line platform like cloud and send their exercise feedback report back to the user's mobile.
- ✓ It will be extended for a bigger range of exercises and poses.

- ✓ It will be enforced in hospitals to treat and defend the therapy patients from doing improper exercises.

REFERENCES

- [1] J. Shotton, A. Fitzgibbon, M. Cook, T. Sharp, M. Finocchio, R. Moore, A. Kipman, and A. Blake. Real-time human pose recognition in parts from single depth images. In CVPR, 2020
- [2] Ranjani MB, Poovendran R (2016) Image duplication copy move forgery detection using discrete cosine transforms method. Int J Appl Eng Res 11(4):2671–2674
- [3] X. Chen, and A. Yuille. "Articulated Pose Estimation by a Graphical Model with Image Dependent Pairwise Relations." Eprint Arxiv(2020):1736-1744.
- [4] T. L. Munea, Y. Z. Jembre, H. T. Weldegebriel, L. Chen, C. Huang and C. Yang, "The Progress of Human Pose Estimation: A Survey and Taxonomy of Models Applied in 2D Human Pose Estimation," in IEEE Access, vol. 8, pp. 133330-133348, 2020, doi: 10.1109/ACCESS.2020.3010248.
- [5] A. Newell, K. Yang, and J. Deng. Stacked hourglass networks for human pose estimation. In ECCV, 2019.
- [6] J. Shotton, A. Fitzgibbon, M. Cook, T. Sharp, M. Finocchio, R. Moore, A. Kipman, and A. Blake. Real-time human pose recognition in parts from single depth images. In CVPR, 2019.
- [7] X. Chu, W. Ouyang, H. Li and X. Wang, "Structured Feature Learning for Pose Estimation," 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2019, pp. 4715-4723, doi: 10.1109/CVPR.2016.510.
- [8] F. Bogo, A. Kanazawa, C. Lassner, P. Gehler, J. Romero, and M. Black. Keep it smpl: Automatic estimation of 3d human pose and shape from a single image. In ECCV, 2019.
- [9] A. Newell, K. Yang, and J. Deng. Stacked hourglass networks for human pose estimation. In ECCV, 2018
- [10] Steven Chen & Richard Yang (2018). Pose Trainer: Correcting Exercise Posture using Pose Estimation.
- [11] [12] J. Tompson, A. Jain et al. "Joint Training of a Convolutional Network and a Graphical Model for Human Pose Estimation." Eprint Arxiv(2018):1799-1807.

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