**OpenPosture Technical Report**

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**Abstract**

The OpenPosture project is at the forefront of ergonomic technology, aiming to alleviate discomfort associated with prolonged sitting by leveraging advanced computer vision techniques and deep learning algorithms. Through the integration of OpenCV, Keras, and TensorFlow, this framework detects and evaluates key points on the human body to assess and improve seated posture. This paper details the recent advancements made to the OpenPosture system, including a refined approach to keypoint detection and a sophisticated feedback mechanism, which together create a seamless user experience for posture improvement.

1. **Introduction**

As digital workspaces continue to proliferate, the importance of maintaining proper seated posture has become paramount to prevent chronic pain and discomfort. The OpenPosture project, evolving from the pioneering "Seated-Posture-Recognition" initiative, employs computer vision and machine learning to detect and correct suboptimal seating postures. With OpenCV's keypoint detection at its core, supplemented by Keras and TensorFlow's powerful machine learning capabilities, OpenPosture stands as a cutting-edge solution for posture-related health issues.

1. **Methodology**

**2.1 System Dependencies and Configuration:**

Our system's foundation lies in its configuration, meticulously fine-tuned through 'config\_reader' parameters such as Model ID, Box Size, Stride, and Pad Value. These parameters are pivotal for tailoring the OpenCV model to the nuanced task of keypoint detection, translating pixel data into a coherent representation of body part spatial relationships.

**2.2 Keypoint Detection and Analysis:**

The accuracy of posture detection hinges on our system's ability to correctly identify and track keypoints. By processing these points through the established parameters, our system can discern between different postures, such as leaning forward, reclining, or maintaining a straight back, as well as the position of limbs.

1. **Model Architecture and Implementation**

Leveraging a pre-trained OpenCV model, OpenPosture utilizes VGG blocks within our Keras-powered deep learning architecture to extract key features from input data. This architecture includes convolutional layers and max-pooling, intertwined with ReLU activation functions and weight decay mechanisms. The configuration ensures that our model is adept at memorizing posture data without overfitting, making our system robust against diverse seating positions.

**3.1 Advanced Model Inference Techniques:**

The system's advanced inference capabilities, such as predicting Part Affinity Fields (PAFs) and generating confidence maps, are testament to the intricate design of branching and Lambda layers. These components divide the prediction task into discrete segments, enhancing the model's precision in locating and connecting keypoints for comprehensive posture analysis.

**3.2 Real-time Posture Analysis:**

Our codebase includes modules such as 'posture\_image' and 'posture\_realtime', which process input images and videos to provide real-time posture assessment. Through a sequence of functions that calculate angles and relative positions of body parts, OpenPosture can distinguish between an array of postures, visualizing the results for user review.

**4. Feedback and Recommendation Algorithm**

OpenPosture's feedback system compiles posture data and evaluates it against optimal posture metrics. Based on this assessment, the system offers customized recommendations, from simple adjustments to targeted exercises, all designed to guide the user toward an ergonomically sound seating posture.

1. **User Interface and Experience**

**4.1 Intuitive User Interface:**

The development of our user interface is a testament to our commitment to an accessible user experience. The UI displays analyzed posture data and offers actionable recommendations, engaging users in a journey towards better health.

**4.2 Visualization and Engagement:**

Through visual feedback and a suite of interactive features, OpenPosture not only demonstrates the current posture but also tracks user progress, encouraging continuous engagement with the platform.

1. **Conclusions and Future Directions**

The OpenPosture project has made substantial strides in the domain of health informatics. By providing a detailed analysis of sitting posture and actionable feedback, we aim to make a lasting impact on the ergonomic health of seated individuals. As we look forward, our focus will be on enhancing our detection algorithms, including the identification of crossed legs and other subtle postural nuances, and refining the user interface for even more intuitive interactions.

Our ongoing work will delve into optimizing the camera setup for data capture, ensuring comprehensive visibility of the user's posture, and potentially incorporating real-time object detection for a more contextual posture evaluation.

1. **Workflow diagram**

