Statement of Work: Posture Detection/Correction using OpenPose

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**Introduction:**

Poor sitting posture is known to contribute to various health issues, including lower back and neck pain, musculoskeletal imbalances, and reduced flexibility. These adverse effects can be improved by adhering to the following good-seated posture components: 1) Avoid crossing the knees or ankles, 2) place the ankles in front of the knees, 3) relax the shoulders, 4) sit up straight and look forward without straining the neck, and 5) keep feet flat on the floor. Currently, people who suffer from back and neck pain do not have an easily accessible tool that enables them to fully assess their posture. In this project, a UI will be created that will enable users to input a photo of their posture and receive recommendations for what they are doing right in their sitting routines and what they could improve on. Neck and back pain will be reduced for people that utilize this resource.

**Objectives:**

This project will aim to minimize the risk of neck and back pain by assessing elements of seated posture, including the alignment and position of the back, feet, knees, and neck, in a model. This model will provide personalized recommendations for posture improvement based upon the model’s results. Using this model, a UI will be created that will enable users to input a photo of them sitting at their desk, and output their postural results and recommendations.

**Scope:**

This project will focus on assessing seated posture by detecting key body points using a trained Keras model of OpenPose. This project was inspired by Seated Posture Recognition source code on GitHub that determined back position (straight, hunchback, reclined), hand position (folded vs not folded), and kneeling (feet curled behind the knees). We intend to improve upon this source code by adding additional posture components such as neck position, feet placement, and the detection of crossed legs.

**Data Sources:**

This project will utilize a trained Keras model of OpenPose to detect keypoints of the human body. As such, we will need to obtain data that will test the (already created) trained model. The Seated Posture Recognition source code that inspired this project tested their data using a self-made image dataset of one person sitting at a desk. The project owners took 13 pictures, which included the following: hunchback, hunchback flip, hunchback hands folded, hunchback hands folded flip, kneeling, kneeling flip, recline, recline flip, recline hands folded, recline hands folded flip, straight flip, straight hands folded, and straight hands folded flip. Our team will recreate the aforementioned images and also account for the following posture components in additional images: feet on the ground, the crossing of legs, and neck position.

**Methodologies:**

The project will utilize Vue.JS, a JavaScript framework for building user interfaces for web applications, for frontend methodology. For a backend database, this project will utilize Firebase, which will enable us to utilize a real-time database to store our UI’s data. To create a model that will accurately analyze posture, we will leverage OpenPose. Our project will use OpenPose to detect and track keypoints of the human body from images, including for the head, shoulders, elbows, wrists, hips, knees, and ankles. This project will add neck position, feet placement, the detection of crossed legs, and recommendations to the Seated Posture Recognition source code. To do so, we will add new code to the model and posture\_image source code. We will also create our own test dataset to account for the images taken by the source code’s authors and our postural additions.

The model code defines the functions and model architecture needed to evaluate posture and detect keypoints using the Keras library. Functions include in the source code include Relu, Conv, Pooling, VGG-Block, Stage1\_block, StageT\_block, Apply\_mask, Get\_training\_model, and Get\_testing\_model. The source code utilizes a Convolutional Neural Network (CNN) architecture with VGG-like blocks and stages for detecting keypoints and estimating poses. The posture image code utilizes the model source code to process the source code author’s input images and detect the corresponding keypoints using OpenPose. The posture image source code utilizes a Process function that performs multi-scale inference, detects keypoints, and checks posture positions on the images inputted. It then displays the processed image with keypoints and outputs the postural results findings.

**Timeline:**

Below are preliminary project completion dates for various elements. We reserve the right to adjust these dates based on how successful we are at implementing new additions.

2/5/2024: Complete self-made seated posture dataset images.

2/19/2024: Complete additions to source code.

3/4/2024: Complete testing of dataset in model.

3/18/2024: Complete development of UI.

4/2-end of term/2024: Complete any class presentation elements.

**Source Code:**

<https://github.com/nvinayvarma189/Sitting-Posture-Recognition/tree/master>