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Real Time Exercise Feedback Based on Radar and Video Using Artificial Intelligence

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Real Time Exercise Feedback Based on Radar and Video Using Artificial Intelligence

BACKGROUND

Exercising in an environment where a participant cannot easily get feedback from other persons is becoming more common. For example, more people are now exercising in their homes, rather than traveling to a gym or studio to take a class in a group setting or for a one-on-one session with a trainer. While working out at home may be more convenient, improper form can lead to injuries and a reduced benefit from performing the exercise.

DETAILED DESCRIPTION

According to embodiments detailed herein, a user's health-related or exercise-related activity, such as yoga, barre, cardio, weightlifting, pilates, stationary cycling, treadmill running, or some other activity that involves posing or remaining in proper form can be monitored by radar (e.g., using 60 GHz Soli radar technology by Google). Such radar technology can allow for monitoring to occur in three dimensions, including depth. A video camera may additionally or alternatively be used to capture video of the user while performing the activity. One or more on-body sensors could be used for gathering further information (such as based on Jacquard, a technology by Google) that can also be used to facilitate determination and tracking of the user’s body position.

An artificial intelligence (AI)-based computing arrangement can be used to analyze the data obtained by the radar sensor. Such an AI-based computing arrangement may include a machine-learning (ML) model. The AI/ML model may be implemented to process the acquired data for the purposes of giving real-time feedback to a user on how they are doing a pose or activity, with the goal of having the user correct or improve toward a known optimal pose or form.

Video of the user captured using a video camera may be output on a display (e.g., television, computer display, smartphone, tablet computer) that is positioned to allow the user to view while in the pose or while performing the activity. In some embodiments, the display may be holographic or implemented on a wearable VR headset.

Display output 1 shows video captured using the video camera of a user's current pose. The video can be augmented based on an analysis of the video and/or radar data by the AI/ML System. The AI/ML system may have been trained to perform two tasks: first, detect a pose or position which the user is attempting to perform; and second, the AI/ML system may then identify portions of the pose or position that the user is doing well, average, or poorly. For example, the AI/ML system may augment output video to indicate portions of a pose at which a user is doing well (e.g., green), is doing average (e.g., yellow), or is doing poorly (e.g., red). In some embodiments, the AI/MP system can determine the pose which a user is attempting to enter based on a live or prerecorded class which the user is participating in; the pose the instructor is currently performing would be the same that the user is attempting to perform. Training may be performed using a set of training data that includes tagged images of persons correctly and incorrectly performing various poses. Based on the ground-truth data of this set of training data, the AI/ML system can detect imperfections in the user's poses. Recommendations on how to correct such poses can be given as feedback to the user.

For instance, in display output 1, the user's rear arm is too far below parallel and the user's front knee is not directly above her front ankle – such errors are emphasized in red to draw the user's attention. Additionally or alternatively to video feedback, audio feedback, such as in the form of synthesized speech may be provided. Similar feedback to that provided visually can be output, such as: “For the warrior two pose, your front knee needs to be directly above your front ankle” and “Your rear arm should be moved upward to be parallel with the ground.”

In response to the user seeing and/or hearing the feedback, the user may correct her pose. The augmented real time video, as shown on display output 2, may be updated to indicate that the user is doing a more positive job of positioning herself in the pose. For example, portions of the user’s body that were previously out of position, and indicated in yellow or red, may now be emphasized in green to indicate that the user has done an adequate job correcting her position. If the user has the entire posture correct, an overall message may output, such as “great!” or via audio: “Nice job properly making the warrior two pose!”

In some embodiments, when the user properly achieves a pose or position, a pleasing audible sound may be made, like the click of a camera or a “bing.” An outline around the entire user (e.g., in green) may be provided to emphasize how the user’s body is properly in the correct position.

Such feedback has been found to be especially effective, as it can be reminiscent of positive, success-has-been-achieved feedback given in other modern contexts not traditionally associated with physical exercise. By way of example, some mobile banking apps for smartphones have a paper check deposit feature in which the user hovers their phone camera over the check and moves it back, forth, toward, and away from the check with the goal of getting a legibly focused and properly framed image. Responsive to the mobile banking app automatically recognizing when the position is optimal, the mobile banking app freezes the image, takes the picture, and provides a satisfying loud “camera shutter” sound to let the user know they have achieved success in this data-capturing effort. For the present invention, even though the user is doing something substantially distinct from manual data-capture tasks such as taking a check image, he or she is provided with an intuitive, satisfying, and fun sense of achievement that even further promotes progress toward healthy outcomes.

ABSTRACT

Radar and/or video data is used in combination with a machine learning model to detect an exercise pose or position that a user is attempting to achieve. Feedback is provided in visual or audio form indicating how the user should correct his or her position. When the user properly achieves a position, positive feedback is provided, such as a pleasing auditory sound or a visual indication that the user's body is in the proper position.

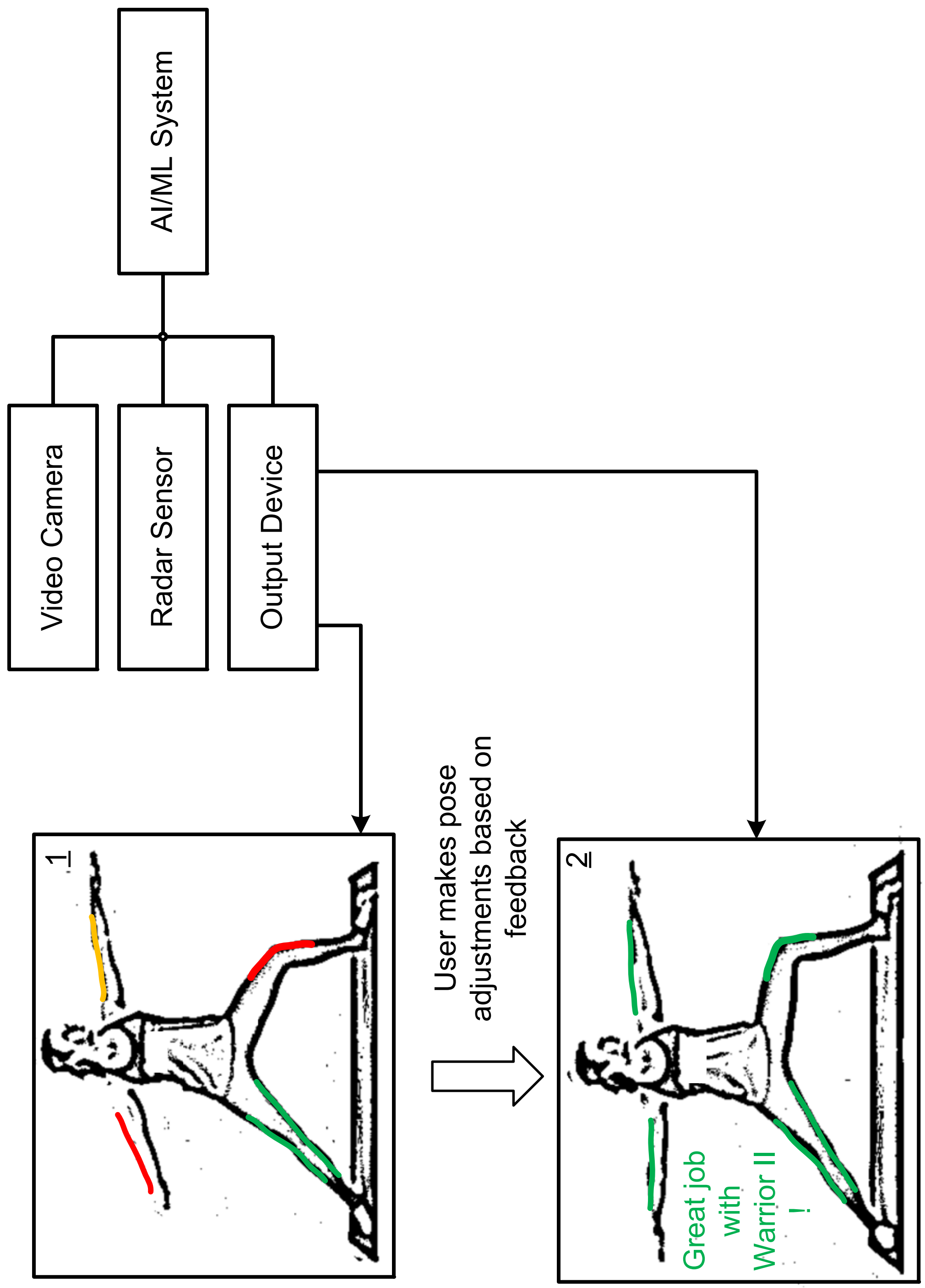
AI/ML System
Video Camera
Radar Sensor
Output Device
1
User makes pose adjustments based on feedback
2
Great job with Warrior II !

FIG. 1