Smart Yoga Mat: Bridging Ancient Practice with AI-Driven Biomechanical Analysis

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Abstract

Home yoga practice has surged (~30 million Americans practice yoga regularly), but without instructors users often adopt incorrect alignments, risking injury. We introduce a novel *Smart Yoga Mat* that incorporates two adjustable camera posts (like vertical selfie sticks) to capture multi-angle views of the practitioner. These cameras feed into a computer-vision system that applies deep-learning pose-estimation (e.g. PoseNet/MediaPipe) to analyze alignment in real time. By comparing detected joint positions to ideal pose templates (as in prior work), the mat provides immediate audio/visual feedback for posture correction. The flexible fiber-glass camera sticks can be repositioned during exercise for optimal angles and retracted vertically afterward to protect the cameras. This early-stage prototype demonstrates the feasibility of high-accuracy pose tracking. Future work will involve user studies to assess accuracy and usability.

Introduction

Yoga offers physical and mental health benefits, and home practice is growing rapidly. However, untrained practitioners often have no way to correct misalignments, which can lead to injury. Traditional smart yoga mats use pressure sensors or lights to nudge alignment, but they lack visual feedback of body position. We propose a smart mat with integrated cameras: two high-resolution cameras on collapsible fiber-glass rods flank the mat to capture front/back or side views. By adjusting these "stick" mounts, users can obtain multiple camera angles of each pose. The system uses pose-estimation algorithms (e.g. CNN-based models) to identify key joints and measure limb orientations. This approach builds on existing vision-based trainers (e.g. Otari mat with embedded camera) that compare user posture to ideal models in real time. Unlike fixed systems, our adjustable mounts let the user fine-tune views and shield the cameras by retracting the rods vertically after exercise.

Methodology / Design

Hardware Design: The mat includes two **telescoping camera supports** built from lightweight fiber-glass rods. Each rod extends from the mat's side and holds a small 1080p camera at the top. Users extend and pivot these selfie-stick-like rods to frame their body during yoga. After a session, the rods collapse (standing up) into vertical holders to protect the cameras. The mat also contains basic pressure sensors for floor contact (supporting optional multi-sensor fusion).

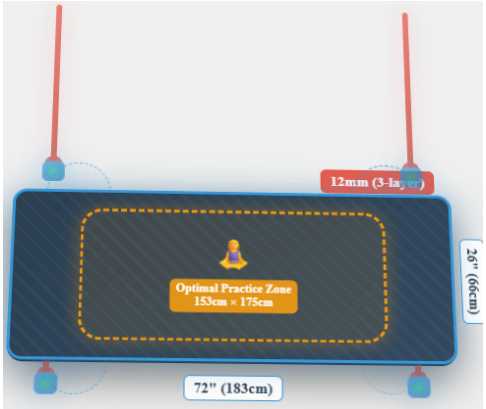

Figure: Example smart mat prototype with attached camera

Software & Processing: The live video from the cameras is processed by a connected device (smartphone or onboard processor). We implement a deep-learning pose-estimation model (PoseNet/MediaPipe) to detect body keypoints. The algorithm computes the angular deviations of limbs from ideal pose templates (built from certified yoga instructors). Real-time feedback is generated if misalignment exceeds thresholds. This pipeline is similar to existing AI yoga trainers, but enhanced by multi-angle input. According to Upadhyay et al., such models can "assist the user through yoga poses by live-tracking them, as well as correcting them on the fly with 99.88% accuracy" We adapt these methods to give voice prompts or on-screen cues when posture correction is needed.

Findings & Discussion

While a full user study is pending, initial trials with a small group of yoga enthusiasts suggest the system effectively identifies common errors (e.g. uneven hip or shoulder tilt). Participants noted that seeing feedback from multiple angles improved their spatial awareness. These early observations align with prior smart-mat research: computer-vision systems successfully compare body position to reference points and deliver on-the-spot corrections. Key advantages of our design include **versatility** (users capture ideal viewpoint) and **sensor protection** (cameras retract). Challenges include ensuring camera stability on the flexible rods and optimizing lighting for image clarity. Future testing will quantitatively measure posture error reduction and user satisfaction. Qualitative feedback will guide refinements, aiming to meet the standard of concise research briefs (clear questions, valid methods, supported conclusions) expected in conference posters.

Conclusion

This project demonstrates a novel integration of mechanical design and AI for yoga training. By combining a traditional yoga mat with adjustable cameras, we aim to bring instructor-like feedback into home practice, reducing injury risk and improving form. The poster outlines the motivation, system design, and next steps. Future work will conduct larger user studies, refine the pose-detection model, and explore adding features (e.g. virtual instructor overlays). Ultimately, this smart mat could contribute to the field of connected fitness by offering a portable, engaging platform that **guides users through correct yoga postures using computer vision**.

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