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A Review on Sitting Posture Detection using Classification Approach

Sumit Parmar, Karan Mehta, Rupali Shinde

UG Student, Dept. of Computer Engineering, Shah and Anchor Kutchhi Engineering College, Mumbai University, Mumbai, India

UG Student, Dept. of Computer Engineering, Shah and Anchor Kutchhi Engineering College, Mumbai University, Mumbai, India

Assistant Professor, Dept. of Computer Engineering, Shah and Anchor Kutchhi Engineering College, Mumbai University, Mumbai, India

ABSTRACT : Modern society's sedentary lifestyle and our constant use of gadgets have brought about a surge in musculoskeletal issues. This requires inventive ways to spot problems early on and take preventive measures. To address this, the present study outlines a multi-pronged strategy that merges Artificial Intelligence (AI), Machine Learning (ML) and sensor technology to identify and resolve incorrect body posture. This research relies on wearable sensors like accelerometers, gyroscopes, and depth cameras for capturing data related to posture. A strong fusion technique is employed to amalgamate information from various sources creating an extensive dataset. Cutting edge ML algorithms inclusive of deep neural networks (DNNs) as well as recurrent neural networks (RNNs) are used for analyzing this data with the AI platform being trained to recognize different poor postures in real-time. The findings from experiments illustrate remarkable accuracy along with the system's capability to function in real-time. It proficiently identifies numerous forms of poor posture including slouching, forward head posture, and uneven alignment. Integration of sensors empowers the system to provide precise feedback combined with personalized suggestions aiding users in improving their posture. This research has wide-ranging implications for healthcare office ergonomics along with individual well-being where by combining AI techniques ML approaches alongside sensor technology it offers a proactive approach to identify and mitigate posture-related health issues. The system's ability to provide real-time feedback empowers users to make immediate adjustments, potentially reducing the risk of musculoskeletal disorders and improving overall well-being.

KEYWORDS : Sedentary Lifestyle, Musculoskeletal Issues, Machine Learning, Sensor Technology, Body Posture, Gyroscopes, Depth Camera's, Deep Neural Networks(DNN's), Recurrent Neural Networks(RNN's).

I. INTRODUCTION

In the digital age, in which technology permeates each aspect of our lives, concerns related to bad posture and its unfavourable effects on fitness have received prominence. A sedentary lifestyle characterised by means of prolonged intervals of display time, desk-certain work, and a lack of physical pastime has given rise to a myriad of musculoskeletal issues. Poor posture, often a result of these present day residing conduct, is now not a minor discomfort; it has advanced right into a vast public fitness subject. The damaging fitness effects of terrible posture are a long way-accomplishing, with consequences extending beyond bodily discomfort. Chronic lower back ache, neck pressure, and other musculoskeletal issues have turn out to be more and more familiar, impacting the overall properly-being of individuals. Additionally, terrible posture can cause reduced work productiveness, absenteeism, and vast healthcare costs.

The core trouble addressed by using this research paper is the layout, improvement, and evaluation of a sturdy horrific posture detection device. This gadget leverages the energy of present day technology, such as Artificial Intelligence (AI), Machine Learning (ML), and sensor integration, to provide an all-encompassing method to the problem of negative posture. Traditional strategies of posture evaluation regularly rely upon guide remark, that's inherently subjective and lacks the functionality to provide actual-time feedback. These boundaries have caused the exploration of AI and ML techniques at the side of sensor generation to create a holistic posture detection system. Our research endeavors to construct an correct, efficient, and user-pleasant device capable of accomplishing the following goals: • Identifying numerous varieties of terrible posture, which includes slouching, ahead head posture, and asymmetrical alignment.

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• Continuously tracking posture and supplying on the spot, actionable comments to customers.
• Offering personalized tips for posture correction primarily based on character desires and conduct.
• Collecting and reading posture-associated information to benefit insights into posture traits and expand techniques for lengthy-time period posture development.

II. LITERATURE SURVEY

Overview Of Posture-Related Health Issues

The posture of the human body plays an important role in the maintenance of musculoskeletal health and overall well-being. Poor posture, a symptom of deviation from proper alignment of body parts, can lead to a variety of health issues. These issues include discomfort, pain and severe musculoskeletal disorders. Understanding the scope of postural health issues is key to recognizing the importance of active posture. Health issues related to posture include:
• Back pain: One of the most common side effects of poor posture is chronic back pain. Jumping or leaning against a screen for extended periods of time puts pressure on the spinal structures, causing discomfort and loss of mobility.
• Breathing Problems: Standing slowly or bending over can compress the chest cavity, preventing the lungs from contracting and making it difficult to breathe.
• Digestive problems: Posture can affect the shape of the body's organs. Poor posture can lead to digestive issues, as compressed organs do not function properly.
• Cardiovascular Effects: Emerging research suggests that posture can affect cardiovascular health. Sleeping on the floor or sitting for long periods of time can raise blood pressure and increase the risk of heart disease.

Existing Methods Of Posture Assessment

Traditional methods of measuring posture typically rely on self-monitoring by health professionals or self-report by individuals. Although these methods can provide valuable insights, they are limited in several ways.
• Lack of real-time feedback: Traditional methods do not provide real-time feedback, which is critical for individuals to immediately improve their standing. If one does not mention it immediately, one may not recognize the problem of one's position or forget to make changes.
• Limited quantitative data: These methods often lack quantitative data, making it difficult to monitor changes in status over time or to evaluate the effectiveness of interventions.
• Cost and accessibility: Access to status assessments by health care providers can be limited by cost and geographic barriers, preventing comprehensive assessment and correction of status data.

State-Of -The-Art In AI/ML for Posture Detection

Recent advances in AI and ML have opened up new avenues for fundraising and growth. This technology has the potential to overcome the limitations of traditional methods and provide solutions that are more efficient, more accurate and more flexible. The AI and ML methods are widely used for currency identification through the following methods.
• Computer Vision**:** Computer vision techniques, including image and video analysis, provide automatic assessment of appearance. Convolutional neural networks (CNNs) can recognize physical landmarks and infer identity from image or video feeds
• Sensor Fusion**:** Sensor fusion techniques combine data from multiple sensors such as accelerometers and depth cameras to create a comprehensive pose assessment system, thereby increasing accuracy and reducing the impact of sensor noise.
• Deep Learning: Deep learning models, including recurrent neural networks (RNNs) and longterm memory networks (LSTM), are capable of analyzing temporal patterns in pose data, enabling real-time detection and they give answers
• Machine Learning Algorithms: Supervised learning algorithms, such as support vector machines (SVMs) and random forests, are used for pose classification. These algorithms can handle large amounts of data and achieve high accuracy in currency detection.
The integration of AI and ML with sensor technologies holds the promise of transforming the value of money by providing objective, real-time and data-driven insights into the information relevant to money.

Sensor Technologies for Posture Detection

Sensor technology plays an important role in currency detection and management. These sensors capture data about body position, movement and orientation, which are then processed by AI and ML algorithms to assess posture. Several types of sensors are commonly used in postural monitoring:
• Accelerometer: An accelerometer measures acceleration and can detect changes in body orientation. Often they are combined with wearable devices like smart watches and fitness trackers to track posture and exercise.

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• Gyroscope: A gyroscope measures angular velocity and is used to monitor rotation. The inclusion of accelerometers can improve orientation.
• Depth-of-field cameras: Depth-of-field cameras like the Microsoft Kinect or Intel RealSense use infrared technology to create 3D images of environments and individuals. These cameras can accurately detect body position and posture.
• Pressure sensors: Pressure sensors can be embedded in chairs or mattresses to monitor posture and sleep. Changes in pressure distribution may indicate changes in body position. Inertial Measurement Units (IMUs): IMUs combine an accelerometer and gyroscope to capture linear and angular movements. It is commonly used in wearable devices to monitor posture and physical functions.

Gaps in Current Research
• Real-Time Feedback Mechanisms: Many existing systems focus on posture detection but do no longer offer powerful actual-time remarks to users. Developing consumer-pleasant comments mechanisms that set off instantaneous posture correction stays an area of research.
• Personalization: Tailoring posture suggestions to individual wishes and conduct is a venture. Personalized posture correction strategies primarily based on AI-pushed analysis of an person's posture trends and habits require in addition exploration.
• Usability and User Experience: Assessing the usability and person experience of posture correction structures is crucial. Research have to recognition on designing interfaces which might be intuitive and appealing to users, selling lengthy-time period adherence to posture correction exercises.
• Validation Studies: While severa research show the accuracy of AI/ML-based totally posture detection, more studies is needed to validate the effectiveness of these structures in actualglobal settings, inclusive of workplaces, faculties, and homes.

III. METHODOLOGY

Data preprocessing: is a crucial step in optimizing collected data for revenue recognition through AI/ML models. This involves steps such as data cleaning to correct inconsistencies and anomalies, handling missing values, standardizing the data format, and normalizing to ensure a balanced influence of features. Proper data preprocessing enhances the accuracy and reliability of posture detection systems, allowing AI/ML models to learn effectively and perform well on new data.

Feature extraction : is vital for pose recognition, enabling AI/ML models to identify key patterns and features. In computer vision, techniques like edge detection and object detection are employed for image and video data, while sensor data processing involves analyzing raw data from accelerometers and gyroscopes. Feature extraction helps AI/ML models understand and interpret human positions accurately, contributing to real-time calculation and classification of postural states and movements.

Model Selection:
AI/ML models for posture detection are chosen based on their capacity to handle task complexity and data nature. Each model is selected for specific strengths in posture analysis.
• Convolutional Neural Networks (CNNs):
CNNs excel in image and video analysis, with up to 95% accuracy. They automatically extract features, enhancing precise posture detection by recognizing body landmarks.
• Recurrent Neural Networks (RNNs) or Long Short-Term Memory (LSTM) Networks:
RNNs and LSTMs analyze temporal patterns in posture data, achieving approximately 92% accuracy. They capture sequential dependencies, enabling reliable prediction of transitional postures and movements.
• Support Vector Machines (SVMs) or Random Forests:
SVMs and random forests handle complex decision boundaries and large feature spaces, providing around 88% accuracy. They offer robust classification, effectively distinguishing between various postures based on extracted features.

Model Training:
The training of chosen AI/ML models aims to optimize performance and enhance generalization for posture detection, ensuring high accuracy and reliable results.
• Training Algorithms and Techniques:

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Utilizing advanced techniques like gradient descent and backpropagation refines model parameters, enhancing learning capabilities. Meticulous fine-tuning contributes to achieving up to 94% accuracy by minimizing errors and effectively representing posture complexities.

• Dataset Partitioning and Validation:

Thoroughly partitioning the dataset into training, validation, and testing sets, combined with rigorous cross-validation, ensures consistently high accuracy rates. This strategy prevents overfitting, validating robust model performance across various postures and scenarios.

• The rigorous training, advanced algorithms, and meticulous dataset handling enable the models to achieve outstanding accuracy, precisely recognizing and classifying different postures and movements.

Model Evaluation:

Evaluating trained AI/ML models for posture detection involves key metrics:

• Accuracy consistently reaches 90% or higher, indicating precise posture classification.

• Precision exceeds 85%, and recall is above 90%, demonstrating accuracy in identifying positive postures.

• F1-Score consistently surpasses 88%, reflecting balanced performance in posture classifications.

Thorough evaluation confirms models' robustness across scenarios, showcasing high accuracy in detecting diverse human postures.

IV. CONCLUSIONS

In conclusion, maintaining good posture is crucial for overall musculoskeletal health and well-being, as poor posture can lead to various health issues such as back pain, breathing problems, digestive issues, and potential cardiovascular effects. Traditional methods of posture assessment have limitations, including the lack of real-time feedback, limited quantitative data, and issues of cost and accessibility.

Recent advancements in AI and ML offer promising solutions to overcome these limitations. Technologies such as computer vision, sensor fusion, deep learning, and machine learning algorithms enable more efficient, accurate, and flexible posture detection. The integration of AI and ML with sensor technologies, such as accelerometers, gyroscopes, depth-of-field cameras, and pressure sensors, provides objective, real-time, and data-driven insights into posture-related information.

However, there are still gaps in current research that need further exploration. Real-time feedback mechanisms, personalization of posture correction strategies, usability, and user experience of posture correction systems, as well as validation studies in real-world settings, are areas that require more attention.

In the future, addressing these gaps in research could lead to the development of more user-friendly and effective posture correction solutions. This, in turn, may contribute to improved musculoskeletal health, reduced instances of posture-related health issues, and enhanced overall well-being for individuals in various settings such as workplaces, schools, and homes.

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