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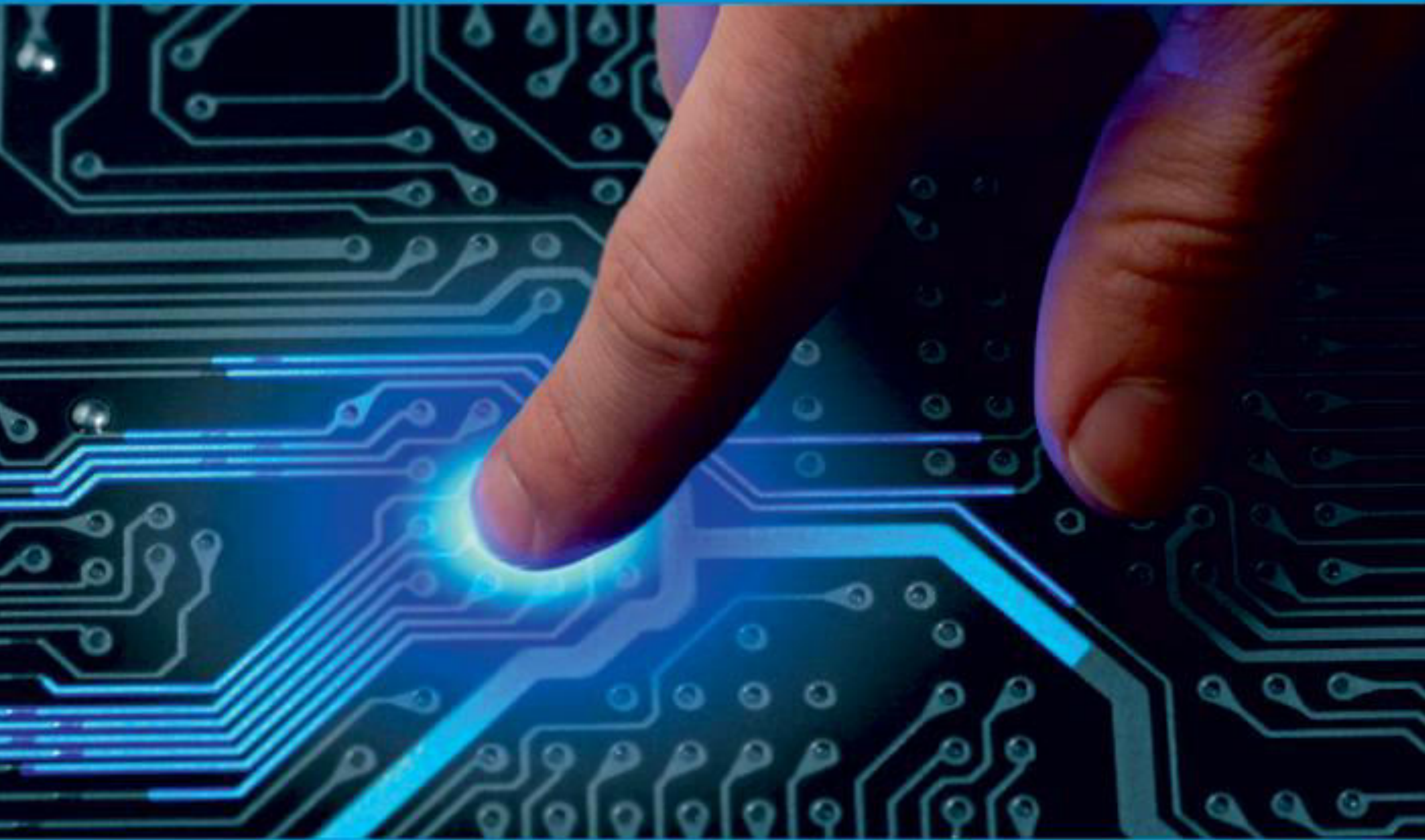

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Walking Towards Progress: Gait Analysis in the Path to Tomorrow

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ABSTRACT: This project introduces an innovative system to monitor and guide individual gait posture and to correct it effectively. This initiative aims to address health issues caused from poor posture, such as back pain, neck strain and reduced mobility, which is quite common in modern sedentary lifestyles and desk-bound work environments. The system is leading the way in technological advancements, providing real-time analysis of gait and posture by integratin compute vision technology and components such as vibration motor, and node MCU microcontroller. The Smart Gait Monitor project utilizes webcam video capture through OpenCV techniques and the MediaPipe framework to detect crucial body landmarks like shoulders, hips, and ears. This allows the system to track user posture in real-time, identifying deviations from optimal alignment and assists them to correct it accordingly by activating the vibrating motor using ESP266 microcontroller.

KEYWORDS: Gait analysis, posture correction, real-time monitoring, OpenCV, computer vision, MediaPipe, vibration motor, MQTT.

I. INTRODUCTION

The Smart Gait Monitor project is a cutting-edge system which is designed to assess and analyze human posture in real-time, providing feedback to users about the quality of their gait. By leveraging computer vision techniques, and intelligent algorithms, this project aims to promote healthy posture habits and prevent musculoskeletal issues caused by poor posture.

The core of the Smart Gait Monitor system is its ability to analyze human posture using computer vision techniques. By processing video input from a camera module in real-time, the system can accurately detect key landmarks on the human body, such as the shoulders, hips, and ears. This enables the system to dynamically monitor the user's posture and detect deviations from ideal alignment in real time.

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Once the pose landmarks are detected, the system applies a posture analysis algorithm to assess the quality of the gait, the algorithm calculates various postural metrics, including angles of inclination for neck and torso, which are indicative of good or poor posture. Based on predefined thresholds and criteria, the system categorizes the user's posture into different gait positions, ranging from Gait 1 (optimal posture) to Gait 3 (poor posture).

The Smart Gait Monitor provides real-time feedback to the user based on the posture analysis results. Visual cues, such as text overlays and color-coded indicators, are displayed on the screen to inform the user about their current gait position. Additionally, a vibrating motor embedded in a wearable device, such as a shoulder strap, provides tactile feedback when the user's posture deviates from optimal alignment. This multisensory feedback mechanism helps users develop awareness of their posture habits and encourages them to make corrective adjustments.

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II. OBJECTIVES

- To develop a cutting-edge system designed to assess and analyze human posture in real-time.
- To provide feedback to users about the quality of their gait, promoting healthy posture habits.
- To prevent musculoskeletal issues caused by poor posture through the use of computer vision techniques and intelligent algorithms.
- To detect key landmarks on the human body, such as shoulders, hips, and ears, and dynamically monitor the user's posture.
- To categorize the user's posture into different gait positions based on predefined thresholds and criteria

III. LITERATURE SURVEY

This literature survey covers various methods and approaches to gait analysis and recognition, highlighting advancements in the field across different applications.

[1] Gait Recognition Using Image Self-Similarity
This research outlines a robust, correspondence-free approach to gait recognition based on image self-similarity, showcasing its effectiveness with low-resolution videos across diverse datasets. The method is resilient to variations in clothing, lighting, and segmentation errors.

[2]Analysis of Gait Pattern to Recognize the Human Activities
This paper introduces a model-based technique for recognizing human activities through gait analysis, demonstrating high accuracy in identifying different activities in both indoor and outdoor environments using extensive datasets.

[3]Toward Pervasive Gait Analysis With Wearable Sensors: A Systematic Review
The review explores various methods to extract relevant gait features using wearable sensors, highlighting the potential for continuous and portable gait analysis in medical research without the need for laboratory settings
.
[4]Human gait analysis for osteoarthritis prediction: a framework of deep learning and kernel extreme learning machine
This study integrates deep learning with feature engineering to detect abnormal walking patterns indicative of osteoarthritis, validated using the CASIA B gait dataset.

[5]Evaluation of a Gait Analysis Tool Using Posture Estimation Technology in Clinical Rehabilitation
The paper details the development of a gait analysis tool using OpenPose for posture estimation, which helps in clinical rehabilitation by accurately identifying gait abnormalities and improving treatment effectiveness.

[6]A smart phone-based gait monitors system
This study describes a Smartphone-based system for collecting and analyzing gait parameters, featuring a fall detection function and demonstrating high accuracy and reliability in experimental tests.

[7]Gait analysis for recognition and classification
The research presents a gait appearance representation for identifying and classifying individuals based on video silhouettes, suggesting enhancements for improving recognition accuracy under varied conditions.

Existing System
Traditionally, posture and gait assessment are performed by healthcare professionals through manual observation and assessment. This method relies on the expertise and subjective judgment of the practitioner, leading to potential variability and inconsistency in the assessment. Wearable devices like smart watches, fitness trackers, and posture-correcting gadgets use accelerometers and gyroscopes to monitor movement and provide basic posture feedback. However, they typically lack comprehensive real-time analysis and detailed posture correction guidance.

IV. METHODOLOGY

Video Source Initialization
The system begins by initializing the video source, which could be a webcam or any other camera device, ensuring the camera settings such as resolution and frame rate are correctly configured and the camera is connected and operational for capturing real-time data.

Captures User's Posture in Real-Time
Once initialized, the video source continuously captures the user’s posture, streaming the captured frames into the system for immediate analysis, ensuring a smooth data flow for **real-time processing.**

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Human Pose Estimation Using MediaPipe and CNN
The captured video frames are processed using MediaPipe, a framework developed by Google, in conjunction with Convolution Neural Networks (CNNs) to detect and map human body joints and key points accurately in each frame, leveraging machine learning models to predict the position of various body landmarks.

Identify Key Landmarks
From the output of the pose estimation, key landmarks such as the shoulders, neck, and hips are identified, focusing on specific points that are crucial for determining the user's posture, filtering out irrelevant data to retain only the coordinates of critical landmarks.

Image Processing
The system then processes the images to enhance landmark detection and accuracy, employing techniques such as noise reduction, contrast adjustment, and edge detection to improve the clarity of the landmarks, making it easier to calculate angles and distances.

Calculate Angles and Distances
Using the identified landmarks, the relative angles and distances between them are computed to derive meaningful metrics that describe the user's posture, applying trigonometric formulas and coordinate geometry to calculate, for example, the angle between the neck and torso or the distance between the shoulders.

Max Pooling
To ensure consistency and accuracy, the system aggregates data from multiple frames through maxpooling, smoothing out anomalies and getting a stable reading of the posture by averaging over a set number of frames to account for minor fluctuations.

Physical Structure and Mapping to Find Pose
The calculated angles and distances are used to map the user's physical structure and determine their overall pose, creating a model of the user's posture from the geometric data to allow for a clear understanding of their gait.

Map Angles to Gait Positions
Based on the calculated angles, the system categorizes the posture into one of the four gait positions (Gait 1 to Gait 4), using predefined thresholds for the angles and distances to classify the posture from ideal (Gait 1) to poor (Gait 4).

Alerts user
When the gait position is poor the message will be sent via MQTT to activate vibration motor and assist them to correct

V. RESULT

The screenshot shows the detected gait positions with their neck and torso inclination and the vibration motor which is connected to ESP8266 which activates when the gait position is greater than or equal to two.

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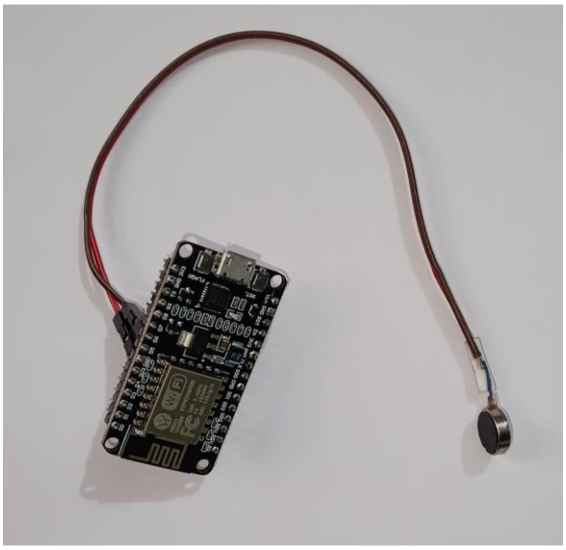

VI. CONCLUSION AND FUTURE ENHANCEMENT

The Smart Gait Monitor project represents a significant advancement in posture assessment technology. By employing computer vision and intelligent algorithms, it offers real-time analysis of human posture, identifying key body landmarks and providing immediate feedback to users. This capability not only promotes healthy posture habits but also aims to prevent musculoskeletal issues associated with poor posture. As technology continues to evolve, innovations like the Smart Gait Monitor contribute to improving personal health and well-being through proactive posture monitoring

Future enhancements for this system could focus on integrating additional sensors, such as IMU (Inertial Measurement Unit) and flex sensors, to improve the precision of posture detection and gait analysis. Combining IMU data with visual input from the camera can offer more comprehensive insights into body orientation and movement dynamics, enhancing the robustness of the posture detection algorithm. Flex sensors could provide real-time feedback on joint angles and flexibility, allowing for a more detailed assessment of posture and movement. Expanding the system to include real-time data fusion from these sensors would enhance accuracy and responsiveness. Furthermore, integrating machine learning models trained on diverse datasets could refine posture and gait analysis, while incorporating cloud-based analytics for long-term tracking and personalized recommendations could provide users with deeper insights into their posture and movement patterns.

REFERENCES

1. Gait Recognition Using Image Self-Similarity by Chiraz BenAbdelkader, Ross G. Cutler, Larry S. Davis
2. Analysis of Gait Pattern to Recognize the Human Activities by Jay Prakash Gupta , Pushkar Dixit , Nishant Singh , Vijay Bhaskar Aemwal
3. Toward Pervasive Gait Analysis With Wearable Sensors: A Systematic Review by John Lach, Benny Lo, Shanshan Chen
4. Human gait analysis for osteoarthritis prediction: a framework of deep learning and kernel extreme learning machine by Muhammad Attique Khan, Seifedine Kadry, Pritee Parwekar.
5. Evaluation of a Gait Analysis Tool Using Posture Estimation Technology in Clinical Rehabilitation by Kanae Nishizaki , Tatsuki Izumiura, Hiromitsu Nishizaki
6. Part-based gait identification using fusion technique by Md. Rokanujjaman, Md. Altab Hossain, Md. Azmal Hossin
7. A smart phone-based gait monitor system By Dong Qin et al
8. Gait Identification using Deep Convolutional Network and Attention Technique by Iman Junaid, Irshad Ali, Narayan Prasad Sharma, Samit Ari

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