Chapter 4

Gait Analysis Using Principal Component Analysis and Long Short Term Memory Models

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ABSTRACT

Human analysis and diagnosis have become attractive technology in many fields. Gait defines the style of movement and gait analysis is a study of human activity to inspect the style of movement and related factors used in the field of biometrics, observation, diagnosis of gait disease, treatment, rehabilitation, etc. This work aims in providing the benefit of analysis of gait with different sensors, ML models, and also LSTM recurrent neural network, using the latest trends. Placing the sensors at the proper location and measuring the values using 3D axes for these sensors provides very appropriate results. With proper fine-tuning of ML models and the LSTM recurrent neural network, it has been observed that every model has an accuracy of greater than 90%, concluding that LSTM performance is observed to be slightly higher than machine learning models. The models helped in diagnosing the disease in the foot (if there is injury in the foot) with high efficiency and accuracy. The key features are proven to be available and extracted to fit the LSTM RNN model and have a positive outcome.

INTRODUCTION

When we look at the way a person is walking or running, we can detect the subtle movements of individuals, determine normal walking patterns, detect and diagnose problems causing pain, as well as applied and examine treatments to correct abnormalities. Human analysis and diagnosis have become attractive technology in many fields. In digital imaging, a person can be analyzed by his or her unique facial features, iris, hair, a particular region of the eyes, gait, smell, finger, and palm. Gait defines the style of movement. Gait analysis is a study of human activity to inspect the style of movement and related factors used in the field of biometrics, observation, diagnosis of gait disease, treatment, and rehabilitation, etc. Gait recognition can be done through involvement and inefficiency-personal involvement in the recognition process. In the case of personal involvement, the person is directly contacted in the recognition system with the help of a separate sensor, accelerometer, Gyroscope, or monitoring devices. The exclusion method uses the remote camera to identify a person's identity with or without their knowledge based on its performance. Gait analysis is more common than other features because the features can be removed from the low resolution and without the involvement of any person. The biggest restriction and limitation with advancement in gait analysis technology is not the ability to produce high-quality data but to know how to use the data in the best way for the benefit of patients suffering from abnormalities or any injuries. Clinical studies investigate the movement pattern using one of two given ways: movement analysis or visual perception. Gait analysis is best for treating any kind of disorder faced by the person which leads him/her to walk properly. Whenever a person faces any problem in moving then through this analysis one can know about the injury before it can lead to permanent injury or issue. Using this analysis one can get cured from any time of difficulty faced while moving the body. The movement of the foot section in a particular direction while walking is something that no one probably doesn't think about too much. As it is just a basic way of walking or moving on a surface, but if a person is not able to walk properly then this can lead to a drastic change in one's life. And so it can affect one's freedom and create serious health issues. Most people can continue surviving with unusual gait patterns for years and years without symptoms. On the other hand, whenever one experiences injury or pain in one's body, normal gait patterns can be disrupted, leading to abnormal gait patterns thus leading to serious health problems. This is why Gait analysis is so important.

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