GAIT ANALYSIS USING ARDUINO AND BLENDER INTEGRATION

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ABSTARCT

Gait analysis is the systematic study of animal locomotion, more specifically the study of human motion, using the eye and the brain of observers, augmented by instrumentation for measuring body movements, body mechanics, and the activity of the muscles. Gait analysis is used to assess and treat individuals with conditions affecting their ability to walk. Motion capture refers to the process of capturing, processing and trans- lating real motions onto a 3D model. Not only in the movie and gaming industries, motion capture creates an indispensable realism of human and animal movement.. This project is intended to do the GAIT analysis of humans. GAIT analysis helps us to predict any problem related to our posture. In this project we will be using Arduino, arduino is an open-source hardware i.e single-board microcontroller which will be placed on the joints present in the Human body e.g. neck, elbow, shoulder etc. To simulate the movements of the Human body we will do the animations in Blender Software which is completely free of cost and open source 3D computer graphics software toolset .The major focus of this project is to make a low-cost system as this project is intended for Indian citizens who are more conscious of the monetary issues.

1 INTRODUCTION

The term 'Gait Analysis' refers to the scientific investigation of animal locomotion, particularly the human locomotion[1]. Determination of gait functionalities, irregularities, and classifications are the main target of gait analysis so that better treatment is possible to provide for non ambulatory patients and also to provide gait enhancement facilities for military or disaster recovery applications. Several techniques are used in gait analysis such as optical system, inertial system, force plate mechanism, force shoes, foot planter presser sensor, electromyography, goniometric measurement system, magnetic system, acoustic tracking system, medical imaging technique, and uses of portable media devices such as smart phones.Human gait is the identity of a person's style and quality of life. Reliable cognition of gait properties over time, continuous monitoring, accuracy of evaluation, and proper analysis of human gait characteristics have demonstrated their importance not only in clinical and medical studies, but also in the field of sports, rehabilitation, training, and robotics research[3]. Focusing on walking gait, this study presents an overview on gait mechanisms, common technologies used in gait analysis, and importance of this particular field of research. The desire to understand human and animal locomotion and movement been existing for centuries. It is, that only during the last decade with the development of computer science and 3D display technologies, the methods necessary for studying human motion not only in theory but also in praxis, where finally provided. However, controlling the movements of objects is a skill which has become easier, but not easy, and still requires a lot of time and effort. Especially if the animator strives for realism. Most of the time, data retrieved by the capture system still needs to undergo several fine-tuning steps to get optimal results.To study on impact transmission of human musculoskeletal system, kinematic and kinetic information are required. Basically the kinematic and kinetic data describe the locomotion pattern of human musculoskeletal system in two-dimensional (2D) or three-dimensional (3D) environment Kinematic analysis represents the position, motion, and trajectories of interest points of the subject to describe the locomotion pattern.

2 Motivation/Problem Statement

Gait analysis is a very important component of competitive and recreational running performance. However it is often a last option when analyzing performance, and completed only after injury has taken place. Preventative gait analysis should be a critical component of performance analysis, as it could be used to optimize form, efficiency, energy expenditure,and to potentially decrease injury risk. A properly designed strength and conditioning program can be developed from data that can be provided by blender integration using arduino. Gait analysis is an important component of analyzing running performance. It is necessary, and will aid in determining how to correct mechanics to optimize running efficiency/economy, and to prevent injury and prolong career.Gait analysis is expensive and not practical, and is often an overlooked variable that could help increase performance. Gait analysis using arduino and blender integration is a product that can bring gait analysis to runners without the need for expensive, time-consuming laboratory equipment that requires an expert in order to test and analyze[6]. It enhance running performance and potentially prevent injury. Running performance is improved through gait analysis feedback. Despite the fact that many motions can be realized with the use of this programs and database, not all of them can, so the need to acquire own captured data is still existed, especially in the professional area. A huge field where the real time motion capture variant is required, is virtual reality. Not only can gestures be transfered to robots for handling dangerous situations or situations to difficult to be done without a human directing the movements, motion tracking is also essential for developing autonomous robots[8].

3 Literature Survey

3.1 Human Movement Analysis

It has been reported by different researchers that one of the main benefit of gait recognition over other biometrics is its nonintrusive nature Hence forth, the analysis of the covariate factors becomes essential to the understanding of the uniqueness of gait recognition[5].

3.2 Structure-free Methods

These methods characterize the motion of the body, without regard to its underlying structure. They can be further divided into two main classes. The first class of methods consider the movement to be comprised of a sequence of poses of the moving person and hence recognize it by recognizing a sequence of static configurations of the body corresponding to each pose The second class of methods characterizes the spatiotemporal distribution generated by the motion in its continuum, i.e. without decoupling the spatial and temporal dimensions of the motion[10].

3.3 Whole-body Movement Analysis

The study of whole-body human movement spans several areas of computer vision mainly, including:

1. Human detection that detect and locate any moving person in video.

2. Activity recognition, that recognize different movement or activity types such as walking, running, limping, dancing and throwing.

3. Biometric identification and verification that determine or validate the identity of a moving person from their gait in some database.

3.4 Holistic Approach

Body movement is characterized by the statistics of the spatiotemporal patterns generated in the image by the moving silhouette. They hence obviate the need to track image features byinstead computing these correspondence-free features. These features are inherently appearance-based extracted four silhouette signatures of a moving person, two of which correspond to the outer boundaries of the person and the other two to the inner edges of each leg. Each signature is normalized, via spatial and temporal alignment and scaling.These normalized signatures define a spatiotemporal sheet over the entire image sequence. Gait recognition is done by matching these sheets for the model gait and input gait[7]. There are two main approaches for gait recognition, namely model-based and appearance based. The model-based approach

explicitly models the human body based on body parts such as foot, torso, hand and leg. Model matching is usually performed in each frame to measure the shape or dynamics parameters.

4 Proposed system

GAIT Analysis using Arduino and Blender Integration are worked on blender software in which the motion is analysed by arduino and send this data to computer. The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware. Blender is a professional, free and open-source 3D computer graphics software toolset used for creating animated films, visual effects, art, 3D printed models, interactive 3D applications.Blender is used for Microsoft Windows, MacOS and Linux, as well as a port for Free BSD, are available in both 32-bit and 64-bit versions. Though it is often distributed without extensive example scenes found in some other programs, the software contains features that are characteristic of high-end 3D software.

5 Conclusion

GAIT analysis arduino and blender integration is a valid alternative to other expensive techniques. It provides an effective technique for real time motion capture, It provides a higher range and flexibility of movement and usage in outdoor environments..For the future of gaming, then virtual reality in a sense that players really become their characters, comes to mind. This includes moving a character around as one moves in reality as well as having a more realistic experience by ”feeling” things happening. To accomplish that purpose one would have to wear a special suit most definitely as well as a head mounted display. Tracking the players motion in that kind of scenario is predefined to use sensor based motion capture, also in regard to marketing, because in that case, if a player has to buy a suit anyway, the costs for adding additional tracking features to the suit would me marginal in comparison to buying a camera based system.

6 References

[1]. Davis, R.B., Õunpuu, S., Tyburski, D., Gage, J.R.: A gait analysis data collection and reduction technique. Hum. Mov. Sci. 10, 575–587 (1991)
[2] H. Weiming, T. Tieniu , W. Liang, and S.Maybank, "A survey on visual surveillance of object motion and behaviours," IEEE Transactions on Systems, Man, and Cybernetics, Applications and Reviews., vol.34, no. 3, pp. 334-352, 2004.
[3] J. Robert, and G. D. Abowd. "The smart floor: a mechanism for natural user identification and tracking,"CHl’00 extended abstracts on human factors in computing systems., pp. 275–276, 2000.
[4] M. Gleicher, “Animation from observation: Motion capture and motion editing,” ACM SIGGRAPH Computer Graphics, vol. 33, no. 4, pp. 51– 54, 1999.
[5] D. J. Sturman, “A Brief History of Motion Capture for Computer Char- acter Animation,” ACM SIGGRAPH ’94, vol. Cours Notes: Character Animation Systems, 1994.
[6] M. Field, D. Stirling, F. Naghdy, and Z. Pan, “Motion capture in robotics review,” in Control and Automation, 2009. ICCA 2009. IEEE International Conference on, pp. 1697–1702, IEEE, 2009.
[7] W. Li, Z. Zhang, and Z. Liu, “Expandable data-driven graphical model- ing of human actions based on salient postures,” IEEE transactions on Circuits and Systems for Video Technology, vol. 18, no. 11, pp. 1499–1510, 2008.
[8] N. C. Perkins, “Electronic measurement of the motion of a moving body of sports equipment,” June 26 2007. US Patent 7,234,351.

[9] D. Vlasic, R. Adelsberger, G. Vannucci, J. Barnwell, M. Gross, W. Ma- tusik, and J. Popović, "Practical motion capture in everyday surround- ings," in ACM transactions on graphics (TOG), vol. 26, p. 35, Acm, 2007.

[10] M. Loper, N. Mahmood, and M. J. Black, "Mosh: Motion and shape capture from sparse markers," ACM Transactions on Graphics (TOG), vol. 33, no. 6, p. 220, 2014.