A Gait Analysis Software as a Service

Roberto Aguiar Lima, Vera Regina Da Silva Maraes, Jairo Simao Santana Melo, and Lourdes Mattos Brasil, *Member, IEEE.*

***Abstract*—This paper describes the first implementation version of a human gait analysis Software as a Service (SaaS). This approach has as advantage, the software availability at web. After the software is implanted at a web server, users can access him from a recent web browser with support to HTML5. The software objective is to minimize the code development necessities by gait analysis researchers, as well as be a useful tool for health professionals interested in human gait analysis. The software allows import positionals data from a third party motion captures system, that uses surface markers and video cameras, to plot markers spatial progression, angles, angular velocities and angular accelerations. Furthermore, it is possible to see and to interact with a 3D animation from markers. The software source code is available as free software, often receive new features and a new community is being created to maintain him.**

***Index Terms*—Gait analysis, software as a service, SaaS.**

I. Introduction

WITH the software web advent now is possible to create services, put them at central web servers and use them from any part of world. Furthermore, modern web browsers have become a truly platform, allowing rich interfaces creation, including graphics presentation and 3D animations, without the necessity of plugins installations. These two technologies, web browsers and web servers, can be used to build what is known as Software as a Service (SaaS). The SaaS advantages for customers and software developers are [1]: customers do not need to install the application; data associated with the service is kept centralized, so it is more protected; data can be collectively accessed by a group of users; big datasets and data that is frequently updated, are kept centralized and remote access to them are offered; only a single copy of the server software runs in a controlled hardware and operating system environment, which avoids compatibility problems, in addition, new versions of the software can be tested with a small fraction of the real customers without disturbing most customers.

Although there was gait analysis advancements by the middle of century XX, clinic gait analysis became broadly available only with the modern computer advent [2]. Actually there are a lot of software packages for this finality [3], but until now at century XXI, no software provider committed to deliver a gait analysis SaaS, in other words, health professionals or gait analysis researchers who want use software, have to use software installed at specifics hardware and operating systems, they have to be responsible by data backup, if new features are incorporated to new software versions, the software must be installed again, if they want share data, they must copy and send them to the destiny and others security concerns must be addressed too. All these problems can be minimized or until eliminated with a SaaS.

To build a software it is necessary collect requisites, and a certain domain of the field must be addressed, at this case gait analysis. Thankfully, nowadays, the theme is quite documented [4], [5], [6], [7], [8], [9], [3], [9], [10], [11]. Moreover, there are health professionals at the development team with much experience in gait analysis. With all this in mind, this paper describes the first implementation version of a gait analysis SaaS [12]. This software version can import data from a third party motion capture system, at this case data collected from video cameras using surface markers, the software also can name markers, define angles, using data from the markers, and plot markers progression at space, angles, angular velocities and angular accelerations. Moreover, the software presents a 3D animation from data and allows user interact with the animation.

R. A. Lima, V. R. S. Maraes and L. M. Brasil are with Biomedical Engineering Post Graduate Program, Faculdade Gama / Universidade de Brasilia, Gama, DF.

J. S. S. Melo is whit Tribunal de Justia do Distrito Federal, Brasilia, DF.

Manuscript received October 23, 2015; revised December 1, 2015.

II. Materials and Methods

Two researches environments were used to undertake the project. One was the Laboratrio de Performance Humana (LPH) at Faculdade Ceilandia (FCE) / Universidade de Brasilia (UnB), and the other was the Laboratrio de Informatica em Saude (LIS) at Faculdade Gama (FGA) / UnB. At LPH data was collected and at LIS the software version was developed.

The next subsections presents the process for data acquisition, the development process and the software architecture general view.

A. Data Acquisition

The data are acquired by sixteen Qualisys Oqus MRI cameras, using the Qualisys Track Manager Software (QTM). The data are relative to surface markers along a patient body.

For this paper a healthy patient, male, with age between 20 and 30 years old was selected. Fig. 1 summarizes the data acquisition process. First markers positions are defined. For this paper only the left trochanter, left knee and left tibia positions were considered. So the surface markers must be fixed at defined positions on patient body. The next step is acquire data using the cameras and QTM software. In this step the patient executes a comfortable gait cycle in front cameras. Five gait samples were acquired. The last step is convert the acquired data to MATLAB format using the QTM software. It is necessary because this is the pattern of choice for the gait analysis software.

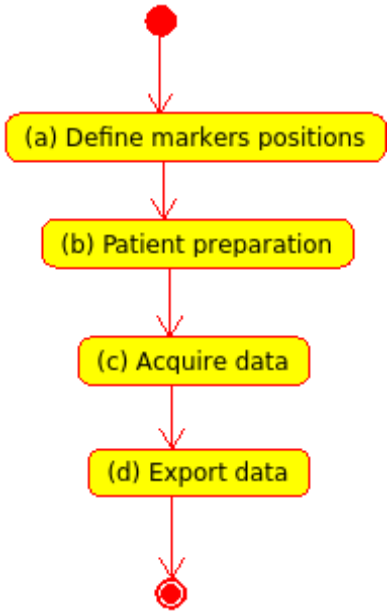

Fig. 1. Data acquisition process. (a) Positions of markers to be fixed in patient body are defined. (b) Markers are fixed at defined positions. (c) Patient executes some comfortable gait cycles in front of cameras. QTM software is used; (d) Data acquired are converted to MATLAB format using QTM software.

The process for data acquisition was approved by Faculdade de Saude da UnB ethics committee, process number N11911/12.

B. Development Process

III. Conclusion

The conclusion goes here.

Acknowledgment

The authors would like to thank...

References

[1] A. Fox and D. Patterson, *Engineering Long-Lasting Software: An Agile Approach Using SaaS and Cloud Computing*. Strawberry Canyon LLC, 2012.
[2] R. Baker, "The history of gait analysis before the advent of modern computers," *Gait and Posture*, vol. 26, no. 3, pp. 331–342, 2007.
[3] J. Moraes, S. Silva, and L. Battistela, "Comparison of two software packages for data analysis at gait laboratories," *Proceedings of the 25th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (IEEE Cat. No.03CH37439)*, vol. 2, pp. 1780–1783, 2003.
[4] J. Perry and J. M. BurnField, *Gait Analysis Normal and Pathological Function*, 2nd ed. SLACK Inc., 2010.
[5] M. W. Whittle and D. Levine, *Whittle's Gait Analysis*, 5th ed. Churchill Livingstone, 2012.
[6] J. P. Ferreira, M. M. Crisostomo, and a. P. Coimbra, "Human gait acquisition and characterization," *IEEE Transactions on Instrumentation and Measurement*, vol. 58, no. 9, pp. 2979–2988, 2009.
[7] A. Vieira, H. Sobral, J. P. Ferreira, P. Ferreira, S. Cruz, M. Crisóstomo, and A. P. Coimbra, "Software for human gait analysis and classification," in *4th Portuguese BioEngineering Meeting*, no. February, Porto, 2015.
[8] a. Duhamel, J. L. Bourriez, P. Devos, P. Krystkowiak, a. Destée, P. Derambure, and L. Defebvre, "Statistical tools for clinical gait analysis," *Gait and Posture*, vol. 20, no. 2, pp. 204–212, 2004.
[9] S. Ghoussayni, C. Stevens, S. Durham, and D. Ewins, "Assessment and validation of a simple automated method for the detection of gait events and intervals," *Gait and Posture*, vol. 20, no. 3, pp. 266–272, 2004.
[10] a. Moreno, I. Quiñones, G. Rodríguez, L. Núñez, and a. I. Pérez, "Development of the spatio-temporal gait parameters of Mexican children between 6 and 13 years old data base to be included in motion analysis softwares," *2009 Pan American Health Care Exchanges - PAHCE 2009*, no. 2, pp. 90–93, 2009.
[11] S. Beynon, J. L. McGinley, F. Dobson, and R. Baker, "Correlations of the Gait Profile Score and the Movement Analysis Profile relative to clinical judgments," *Gait and Posture*, vol. 32, no. 1, pp. 129–132, 2010. [Online]. Available: http://dx.doi.org/10.1016/j.gaitpost.2010.01.010
[12] R. A. Lima, "Implementando um Software como Serviço para Análise e Simulação de Marcha Humana," 2015.

PLACE PHOTO HERE

Michael Shell Biography text here.

John Doe Biography text here.

Jane Doe Biography text here.