Abstract:
Motion analysis is a key issue for trainers as they can improve technical skills by correcting the trainee’s motion of the body when performing the movement. Presently, it does not exist an automatic system to perform real time analysis in Taekwondo or in martial arts in general. The analysis of the athlete’s movements and positioning valuable information for the trainees and athletes during the training, adapting their strategy or body movements during the combat. This project proposes a new methodology and system that allows analyzing and quantifying the performance of the athlete in real time. The developed system will allow a posture analysis of the athlete, a statistical analysis of some parameters, kinetic parameters and combat patterns analysis, in training environment.

Introduction:
Presently, it does not exist an automatic system to perform real time analysis in Taekwondo or in martial arts in general. Statistical analysis is performed by the trainers through visual inspection during the match or through video analysis to evaluate how many points were obtained with which leg or in what body part the point was successful, among other aspects. This is a time-consuming method and prone to error analysis. The proposed system includes the development of a methodology for real-time pattern movement analysis, evaluation and correction and the design and implementation of a non-invasive device (portable, wireless, flexible and robust).

The main outputs of this framework are:
• Statistical analysis. This module must be able to output the identification and quantification of the movements performed by the athlete during the athlete's training sessions. Analyze the evolution of the athlete's performance by analyzing the data collected over time.
• Biomechanics and motion analysis. This module must be able to output the motion analysis model including acceleration, velocity and the strength of each kick;
• Pattern recognition analysis. This module must be able to output the pattern of the athlete movements.

To achieve the objectives, it will be necessary to acquire the skeleton of the athlete using 3D camera, motion sensors, wireless and compact wearable sensors to acquire data.

Methods:
This project runs with the direct support of the Sport Club de Braga and the National Technical Team of the Portuguese Federation of Taekwondo. And proposes a methodology for improve the trainers and trainees work as it will allow a real-time analysis and evaluation of athlete’s performance. In order to achieve the goal and the final results of the project several tasks were and will be carried out For the execution of the project will be carried out.

The first task performed was to define image and video capture features, through the study of 3D Camera, motion sensor, hardware and the conditions to obtain the image and video acquisition features in real time. Simultaneously, was analyzed and studied the hardware and the conditions to obtain the image and video acquisition features, namely: the skeleton of the athlete, identifying joints, joints orientation, the best camera resolution, as well the illumination requirements. After the analysis the Orbbec Astra was chosen for present the best results in terms of reliability in data collection, athlete detection range, system requirements and cost [1]. As a result, a software was developed capable of collecting data from the athletes and their training sessions, more specifically the cartesian coordinates of the athlete’s various joints during the movements. The data is stored in a database and can be consulted later. Subsequently, the functionality of displaying the speed, acceleration and strength values of both athlete’s hands and feet in real time was added to the software. As well as consulting the training carried out by an athlete and the possibility of exporting the data collected in each training session to an Excel file. That along with the 3D Camera Orbbec, a computer and the developed software constitutes the data acquisition system (figure 1).

The methodology of motion analysis is under development, using deep learning methodologies for this purpose. With the objective of identifying and quantifying the movements performed by the athlete, through the analysis of the data collected in real time. That will be integrated into the software developed so that the analysis is carried out simultaneously during data collection. Wearable and motion sensors will be design and developed, that will allow the collection of movement data through accelerometers and gyroscopes giving rise to data that will serve to make the acquisition of movement data more robust, bypassing the possible moments of data occlusion during movements when using only the 3D camera. These data will also be used during the movement analysis performed by the system.

During the course of the project will be carried out trials and tests of the overall system for assessing the proper functioning of the system. This task should act in an iterative approach with the other tasks in order to allow optimizing the system, whether considering software, whether considering hardware.

Final Remarks
This project intend to reinforce the research on motion-analysis, targeting the improvement of the athlete’s performance and the establishment of a new level of training and competition, contributing to sport modernization and development. In the end, a new, automatic, low-cost and stand-alone system to analyze the performance of the Taekwondo athletes in real-time in training scenarios will be accomplished. We believe that the proposed system will be well accepted, besides the Portuguese Taekwondo Federation, in the other international federations as the methodology used to improve the monitoring and control of game movements during training as well as in competition. Although this system is initially focused in Taekwondo, it may be tested with other types of martial arts and sports, where kinematics, biomechanics and motion analysis are of major importance.

References:

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