

# Taekwondo Athletes Evaluation Real-time System : Project overview



## Abstract:

Assessing athletes' performance is a constant challenge for coaches, whatever the sport is. In some sports there are no technological solutions to assist coaches in this task. This is the case of Taekwondo, where currently the methods used are mainly manual. This PhD project main objective is the development of a friendly and low-cost system for assessing the performance of Taekwondo athletes in real time. The system uses a 3D camera with depth sensor, a computer and software developed for data collection and processing. The system also provides the inclusion of Inertial Measurement Units (IMUs). The system allows an accurate feedback for the correction or improvement of the athlete's techniques, enabling an increase in the athlete's performance in a shorter period of time. In all, the project intend to contribute to the evolution of the techniques used during Taekwondo training, as well as to the technological development in the practice of Taekwondo.

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## Introduction

In sport, the evolution in movement analysis has allowed the development of technological solutions that help athletes. Assessing the performance of athletes is a complex and difficult task in any sport. The inclusion of motion analysis in the practice of sport came to assist in this task. Some of the systems developed to perform the evaluation allows to obtain relevant information of the athlete's performance like velocity, acceleration, force, displacement, among other features [1] [2] [3] [4].

In Taekwondo martial art, the evaluation athletes' performance is still carried out by traditional methods, by viewing videos of the training sessions or in loco of the athletes' movements in real time. This is time consuming for the coach and delays the feedback for athlete improvements. This project aims to contribute with a new method of identifying and quantifying the movements performed by the taekwondo athlete during training sessions using deep learning methodologies applied to the data collected from the taekwondo athletes' movements in real time.

## Project Development

This project aims to contribute with a technological solution that allows the assessment of the performance of Taekwondo athletes in real time during training sessions. The main outputs of system will be statistics, biomechanics and motion analysis. The statistical analysis, will be made with the results obtained through the identification and quantification of the movements performed by the athlete, allowing to assess the evolution over time of the training sessions. And the biomechanics and motion analysis, will allow to calculate acceleration, velocity and the applied force of the athlete's movements.

The overall system is composed by a framework, Inertial Measurement Units (IMUs) and two apps.

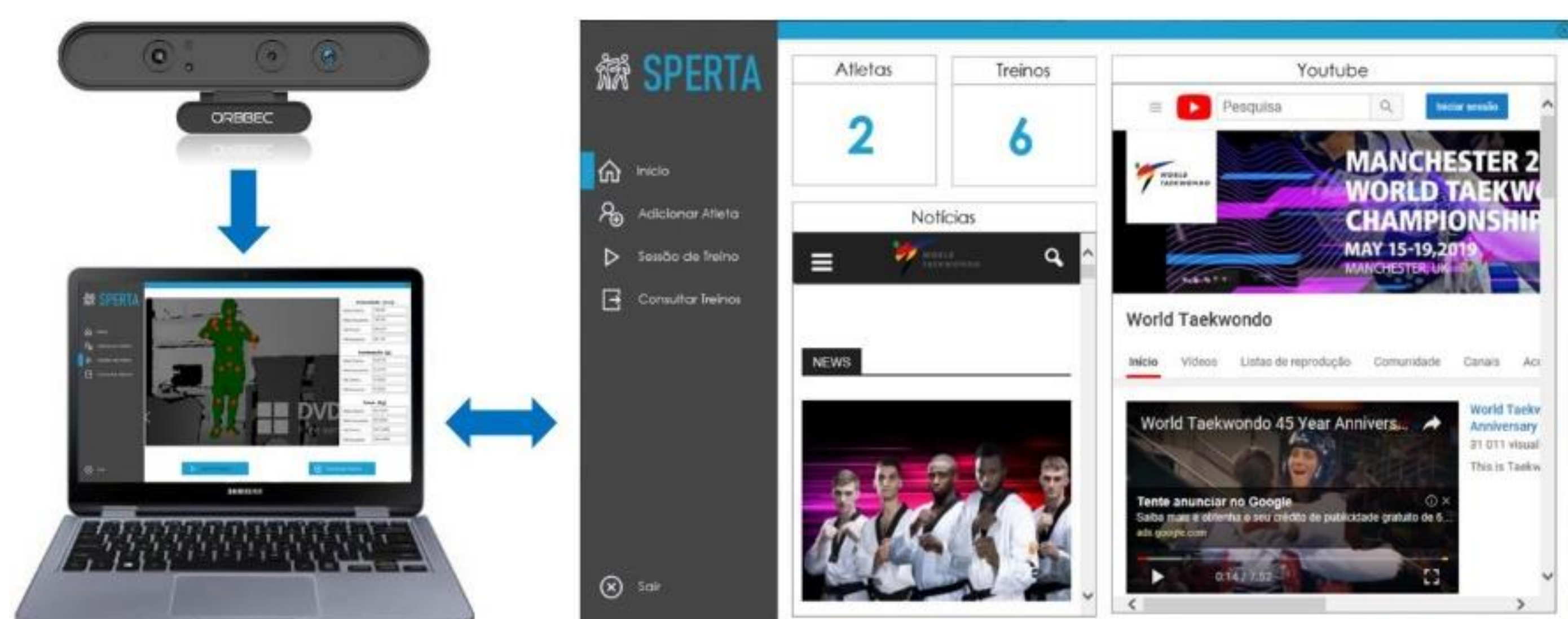


Fig. 1 Framework structure components [2].

The framework is composed by a 3D camera Orbbec Astra, a computer and a software developed to integrate the project features (figure 1), that allows to collect data on movements performed by Taekwondo athletes during training sessions, calculating and presenting the values of speed, acceleration and applied force of the athlete's hand and feet in real time [2].



Fig. 2 Deep learning methods testing system diagram [3]

In order to identify and quantify the movements performed by Taekwondo athletes during training sessions, motion analysis is performed according to skeleton-based action recognition, through deep learning methodologies (figure 2). The developed dataset with information about the Taekwondo athletes' movements is used for training deep learning classification methods [3].

In order to overcome data movements occlusions, the addition of motion sensors, more specifically the inertial measurements units, was foreseen. They will be positioned on the extremities of the upper and lower limbs, hands and feet. For data processing and transmission, it was selected the Wemos D1 mini

based on ESP-8266 (figure 3 a)). To obtain the acceleration and gyroscope data was the GY 521 MPU 6050 (figure 3 b)), which is a three-axis gyroscope and acceleration module, with standard communication I2C [4].

The mobile app is intended to be a friendly tool that can be used by the trainer during training sessions. It will allow to manually enter the movements performed by the athlete, with the objective of providing a fast feedback to the coach and athletes so that they can analyze, correct and adapt the training method to improve their performance. Another app is in development to allow trainers and athletes to have access to personal data collected and obtained during training sessions and check your personal evolution over time, among other features.

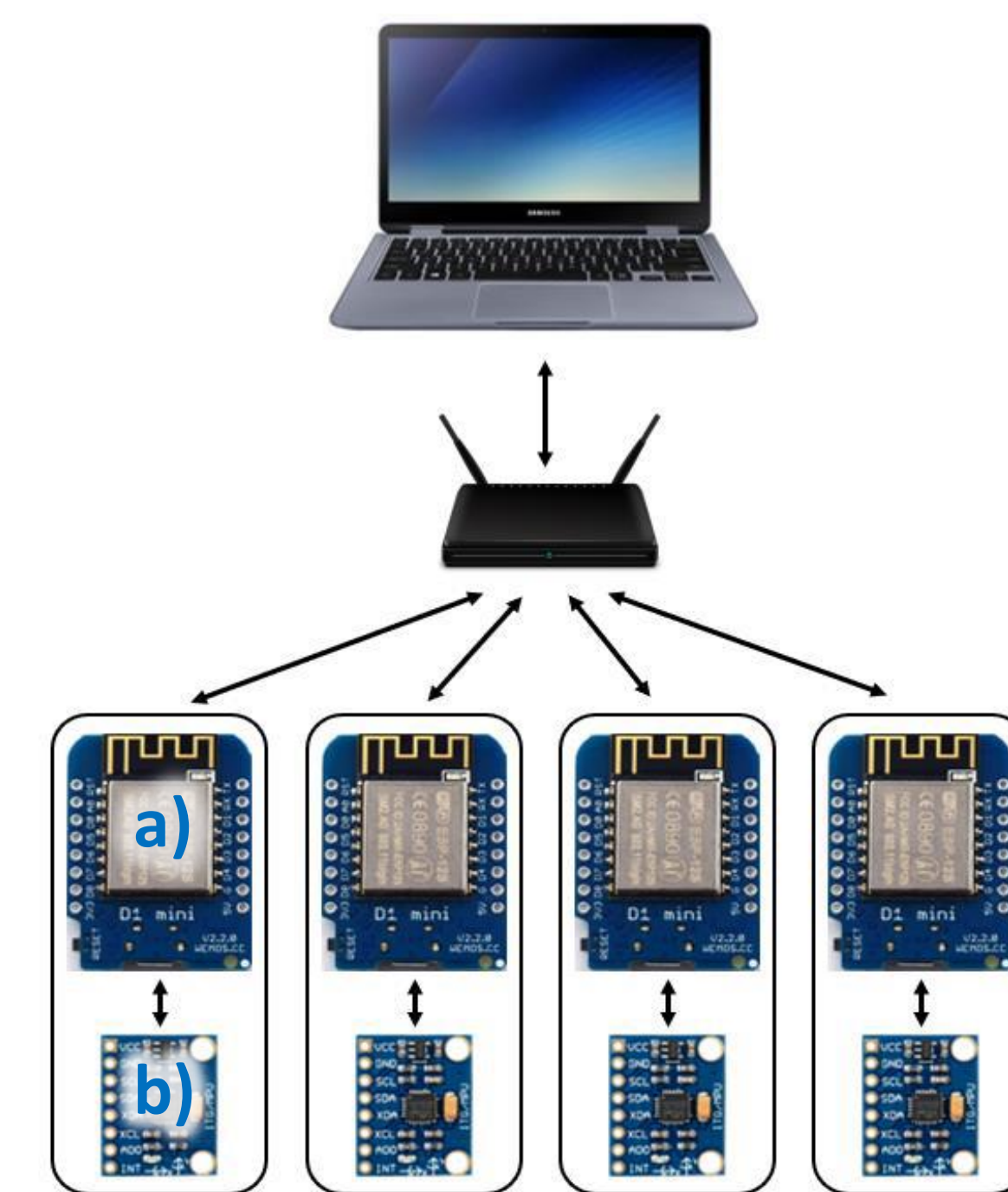


Fig. 3 : Motion sensors system architecture diagram [4]



Fig. 4 : Mobile app training session interface [4]

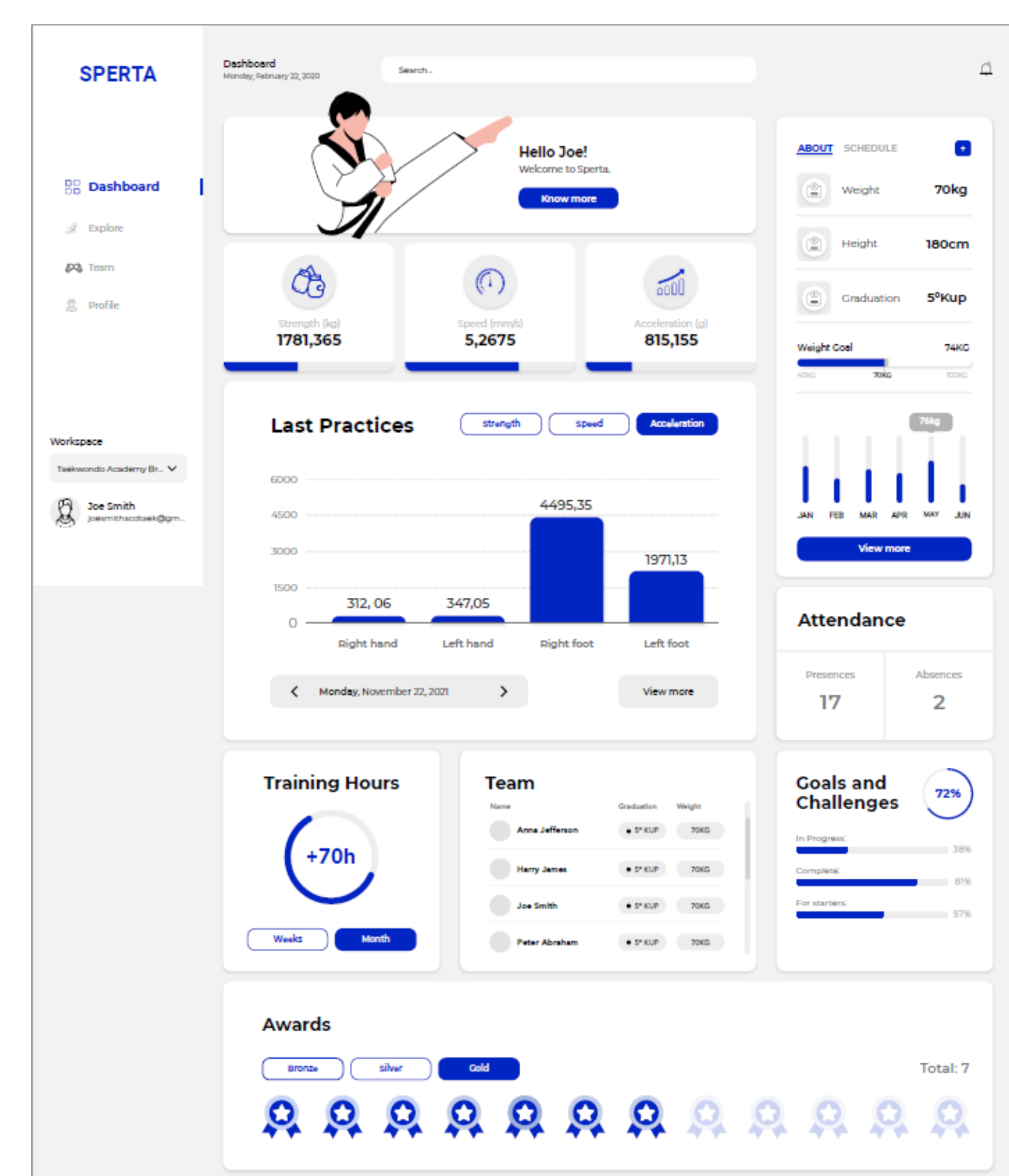


Fig. 5 : App dashboard athlete personal data interface

## Final Remarks

This project intends to design and implement a friendly and low-cost system for assessing the performance of Taekwondo athletes in real time. The system should have the lowest level of intrusion to athletes during the practice of Taekwondo. The framework developed, allowed the creation of a dataset with data on the movements of Taekwondo athletes, that makes possible to conduct a study on deep learning methodologies in order to define the best method to identify athletes' movements. For promoting the inclusion of technological tools in Taekwondo training sessions and taking advantage of the easy access to mobile devices, an app was developed for help the trainer to register data of the athlete during the training sessions. Being in development another for allowing both athletes and coach to access the athletes' individual data regarding the trainings performed and its evolution over time.

## References

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