Mining Sport Activities

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INTRODUCTION

For many people todays, sport is one of the stress relieving activities. People usually get involved in sport to achieve attractive shape, healthy lifestyle and better feeling. However, some people get involved in sport to compete professionally. Competitions were recently reserved for the professionals only. Few years ago, the professional community became more open to amateur athletes whose main objective is not competing. Nowadays, these can join to professional sports communities (Rauter, & Doupona Topič, 2011). Especially in massive sports events (running marathons, triathlons, cycling competitions), organizers give the opportunity to amateurs for competing with professionals in the same competition.

Amateurs need to train properly in order to fulfill their competition goals. Performing hard training is difficult not only for amateurs, but even for professionals. Athletes usually train at different stages and places to improve the effectiveness of training – gym, fitness, swimming pool, road, macadam, etc. Another obstacle that usually makes planning sports training sessions difficult for amateurs are properly balancing the two typical training phases, i.e., resting and eating that accompany each end of the training session. Consequently, athletes need to hire personal sports trainers in order to continuously improve their performance. Unfortunately, this hiring becomes very expensive after some time for amateur athletes.

Recent expansion of smart sports watches and smart phones allow athletes to carry out the sports training sessions smarter. Usage of mobile devices (Baca, Dabnichki, Heller, & Kornfeind, 2009, Baca, Kornfeind, Preuschl, Bichler, Tampier, & Novatchkov, 2010) typically causes production of the dozens of activity datasets containing data about athlete's position, speed, hearth rate and power rating over the sports training sessions. Analyzing these activity datasets enable an athlete to gain the deeper insight into every training session. Furthermore, a computer program using the latest data mining methods is even able to extract athlete's habits during sports training. Moreover, it may notify the athlete for possible over-training syndrome to prevent injury, advice nutrition using prediction and in the end, generate various sports training plans by clustering similar activities together.

Consequently, there is a lot of possibilities how to use these data for a further analysis and apply them for improving the athlete's performances. In a nutshell, these activity datasets offer an infrastructure for developing the artificial sports trainer (AST) as proposed by (Fister, Ljubič, Suganthan, Perc, & Fister 2015) that will be capable to help athletes during all sports training phases. Unfortunately, the most of athletes (especially amateurs) are not familiar with sports training theory and thus every assistance in any phase of sports training is welcome. As a matter of fact, the proposed AST computer framework based on Computational Intelligence (CI) algorithms that is open and therefore suitable for incorporating the new features easily.

The primary objective of the AST is to generate the sports training sessions of similar quality as a real trainer. At the moment, the AST serves as a

Figure 1. Illustration of training plan generation in the past and future
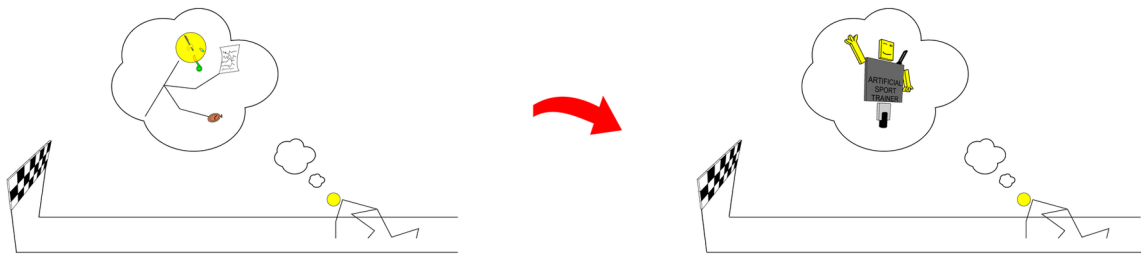
framework in which a various features covering different phases of sports training are incorporated especially in individual sports disciplines, where a lot of sports activities have been tracked using the wearable mobile devices. It definitely will present a bright star in planning, performing, controlling and evaluating phases of the sports training also in team sports disciplines in the future.

In this chapter, we focus on opportunities of data mining in sports. In line with this, the association rule mining method is proposed that was applied up to the present for solving two problems, i.e., discovering hidden habits of athletes in sports training and detecting the over-training syndrome. The results of both applications showed a true potential of these methods for data mining the sports activities. However, both applications can be incorporated in the AST framework as the features in the future.

Organization of this chapter is as follows. The next section is devoted to highlight background and fundamental information. In line with this, sports trackers and data mining paradigm are discussed. Then, the principles of data mining the sports activities are clarified. After that, the current applications in mining the sports activities are discussed shortly. The article concludes with a discussion and future research directions.

BACKGROUND

Sports Trackers

In order to track athlete's sports activities in the past, running athletes had worn very simple watches (later renamed to simple sports watches). These watches allowed to monitor only time and were therefore used for analyzing the duration of workouts and interval trainings. One of the pioneers of sports watches, the finish manufacturer Polar, released first sports watch enabled measuring and monitoring the heart rate in 80's. Heart rate monitors allowed heart rate measurements in a real-time, thus allowing athletes to adjust performance in training/race. Hearth rate was also stored into sports watch's memory suitable for the later analysis. Consequently, all measured data helped athletes to perform better training and competition by achieving much better results. At the beginning of the last century, the huge expansion of cycling sensors for measuring a speed and cadence in real-time emerged. The manifestation of those sensors improved also cyclist's performance. Today, modern sports bike is equipped with so called power meter. Power meter offers real-time power monitoring, and nowadays presents the state-of-the-art technology in cycling.

Another revolution was born with an emergence of mobile and pervasive computing. The mobile devices have been renamed to sports trackers when a massive production of smart phones and appropriate software applications has started. Sports tracker is basically an application running on the smart phone in order to track a sports training session (Fister, Fister, Fister, & Fong, 2013). These mobile devices obtain information from a global positioning system (GPS). There is a lot of sports watches on the market equipped with GPS that behave almost the same as the sports trackers (e.g. Garmin Forerunner, etc.). Consequently,

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