A Searching and Automatic Video Tagging Tool for Events of Interest during Volleyball Training Sessions

Fahim A. Salim
Dees B.W. Postma
Robby van Delden
Dennis Reidsma
Bert-Jan van Beijnum
University of Twente, the Netherlands
f.a.salim@utwente.nl

Fasih Haider
Saturnino Luz
University of Edinburgh, UK

Sena Busra Yengec Tasdemir
Abdullah Gul University, Turkey

Vahid Naghashi
Bilkent University, Turkey

Izem Tengiz
Izmir University of Economics, Turkey

Kubra Cengiz
Istanbul Technical University, Turkey

ABSTRACT

Quick and easy access to performance data during matches and training sessions is important for both players and coaches. While there are many video tagging systems available, these systems require manual effort. This paper proposes a system architecture that automatically supplements video recording by detecting events of interests in volleyball matches and training sessions to provide tailored and interactive multimodal feedback.

CCS CONCEPTS

• **Human-centered computing** → **Interactive systems and tools**; • **Interaction paradigms** → *Web-based interaction.*

KEYWORDS

Human-Media Interaction, Multimodal Feedback, Gestures Analysis

ACM Reference Format:
Fahim A. Salim, Dees B.W. Postma, Robby van Delden, Dennis Reidsma, Bert-Jan van Beijnum, Fasih Haider, Saturnino Luz, Sena Busra Yengec Tasdemir, Vahid Naghashi, Izem Tengiz, and Kubra Cengiz. 2019. A Searching and Automatic Video Tagging Tool for Events of Interest during Volleyball Training Sessions. In *2019 International Conference on Multimodal Interaction (ICMI '19), October 14–18, 2019, Suzhou, China.* ACM, New York, NY, USA, 3 pages. https://doi.org/10.1145/3340555.3358660

ICMI '19, October 14–18, 2019, Suzhou, China

ACM ISBN 978-1-4503-6860-5/19/10…$15.00
https://doi.org/10.1145/3340555.3358660

1 INTRODUCTION

Access to performance data during sports matches and training sessions is important for both players and coaches. Analysis of video recording showing different events of interest may help in getting insightful tactical play and engagement with players [3] and video edited game analysis is a common method for post-game performance evaluation [4].

Accessing events of interest in sports recording is of particular interest for both sports fans e.g. a baseball fan wishing to watch all home runs hit by their favorite player during the 2013 baseball season [5], or a coach searching for video recordings related to the intended learning focus for a player or the whole training session [4]. However, these examples require events to be manually tagged which not only requires time and effort but would also split a trainers attention from training to tagging the events for later viewing and analysis.

The proposed system automatically supplements video recording by detecting events of interests in volleyball matches and training sessions to provide tailored and interactive multi-modal feedback to coaches and players by utilizing an HTML5/JavaScript application.

2 SYSTEM COMPONENTS

In addition to video camera(s) to record video. The system has the following components.

Sensors on Player Wrist(s): During a training session or a match, players wear a wireless sensor such as an IMU (Inertial Magnetometer Unit) [1, 6] on one or both wrists. Features are extracted from the IMU signals to train machine learning models to recognize volleyball actions and non-actions. The machine learning is performed in two steps as shown in Figure 1, first we recognize if a frame (0.5 seconds

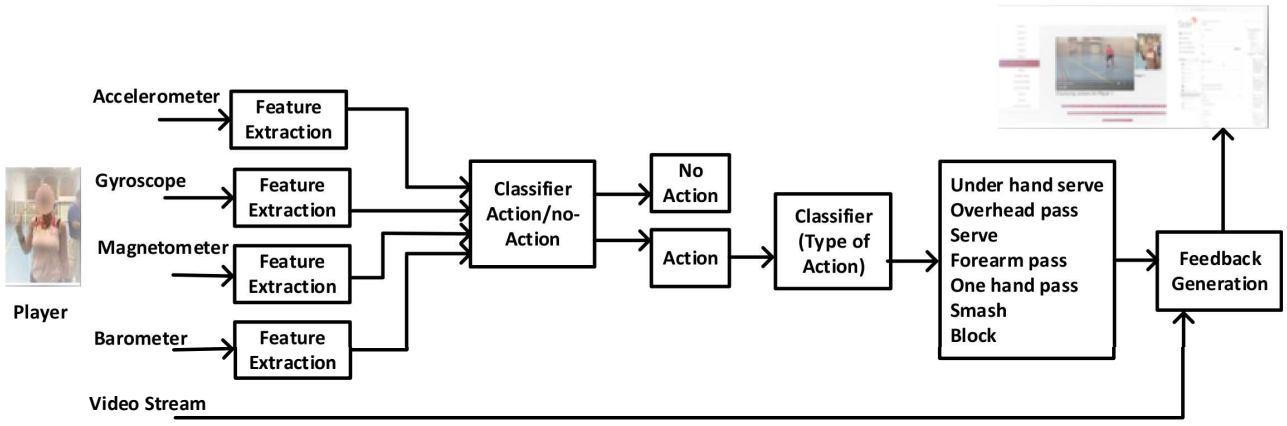

Figure 1: Proposed System Architecture

in length) of sensor data belongs to a volley ball action or not. If it belongs to an action then we further classify it into types of actions. The machine learning models provides a results of around 86% for the first step (action or no action) using a data-set from 8 different players in leave-one-subject out cross validation setting [2]. For type of actions, the ML models provides around 81% in subject dependent settings using data-set of three players.

Once the actions are identified, its information along with the timestamp is stored in a repository for indexing purposes.

Repository: Information related to the video, players and actions performed by the players are indexed and stored as documents in a tables or cores in Solr search platform [7]. An example of Smash indexed by Solr as follows:

Table 1: Sample Solr structure

```
"id":"25_06_Player_1_action_2"
"player_id":["25_06_Player_1"],
"action_name":["Smash"],
"timestamp":["00:02:15"],
"_version_":1638860511128846336
```

Web Application: The interactive system is developed as web application. The server-side is written using asp.net MVC framework. While the front-end is developed using HTML5/Javascript.

The player list and actions list are dynamically populated by querying the repository. The viewer can filter the actions by player and action-type (e.g. over head pass by player 3). Once a particular action item is clicked or taped, the video is automatically jumped to the time interval where the action is being performed.

3 CONCLUSION

A prototype has been developed for providing an interactive feedback to coaches and players about the actions. The machine learning models are under development. In future work we intend to conduct detailed evaluation of the these models both intrinsically and extrinsically, in system use for volleyball training.

ACKNOWLEDGMENT

This work is carried out as part of the Smart Sports Exercises project funded by ZonMw Netherlands and the European Union's Horizon 2020 research and innovation program, under the grant agreement No 769661, towards the SAAM project. Sena Busra Yengec Tasdemir, is supported by the Turkish Higher Education Council's 100/2000 PhD fellowship program.

REFERENCES

[1] Giovanni Bellusci, Fred Dijkstra, and Per Slycke. 2018. Xsens MTw : Miniature Wireless Inertial Motion Tracker for Highly Accurate 3D Kinematic Applications. *Xsens Technologies* April (2018), 1–9. https://doi.org/10.13140/RG.2.2.23576.49929

[2] Fasih Haider, Fahim Salim, and et al. 2019. Evaluation of Dominant and Non-Dominant Hand Movements For Volleyball Action Modelling. In *ICMI*.

[3] Stephen Harvey and Christopher Gittins. 2014. Effects of integrating video-based feedback into a Teaching Games for Understanding soccer unit. *Agora para la educación física y el deporte* 16, 3 (2014), 271–290.

[4] Jeroen Koekoek, Hans van der Mars, John van der Kamp, Wytse Walinga, and Ivo van Hilvoorde. 2018. Aligning Digital Video Technology with Game Pedagogy in Physical Education. *Journal of Physical Education, Recreation & Dance* 89, 1 (2018), 12–22. https://doi.org/10.1080/07303084.2017.1390504

[5] Justin Matejka, Tovi Grossman, and George Fitzmaurice. 2014. Video Lens : Rapid Playback and Exploration of Large Video Collections and Associated Metadata. In *Uist*. 541–550. https://doi.org/10.1145/2642918.2647366

[6] X-io Technologies. 2019. NG-IMU. http://x-io.co.uk/ngimu/

[7] Ryan Velasco. 2016. *Apache Solr: For Starters.* CreateSpace Independent Publishing Platform.