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Action Modelling for Interaction and Analysis in Smart Sports and Physical Education

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ABSTRACT

This paper briefly overviews the first workshop on Action Modelling for Interaction and Analysis in Smart Sports and Physical Education (MAISroPE). It focuses on the main aspects intended to be discussed in the workshop reflecting the main scope of the papers presented during the meeting. The MAISroPE 2020 workshop is held in conjunction with the 22nd ACM International Conference on Multimodal Interaction (ICMI 2020) taking place in Utrecht, the Netherlands, in October 2020.

CCS CONCEPTS

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

KEYWORDS

machine learning; behaviour analysis; action recognition; multi-player action modeling; human-media interaction; multimodal feedback; gestures analysis; social network analysis; wearable technologies; multimodal systems

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1 INTRODUCTION

The workshop “Action Modelling for Interaction and Analysis in Smart Sports and Physical Education” (MAISroPE) brings together the research in Machine Learning & Interactive Technology, Sports

& Movement Science and Physical Education and Pedagogy to propose multimodal and interactive systems which can be utilized by coaches/trainers and players during their routine training sessions to analyse performance and provide real time interactive feedback [3, 6, 7].

Sports performance depend on training programs designed by highly specialised team staff, with a regime of physical, technical, tactical and perceptual-cognitive exercises. Depending on athletes’ performance, exercises are adapted and exercise programs may be redesigned. State of the art data science methods have led to ground breaking changes. Data is now being collected from a variety of sources such as tracking positions and motion of players in team sports such as volleyball [3], baseball & football match statistics and basketball. It is not just limited to professional sports training; but can also be extended to any physical exercise based activity such as dance lessons, aerobics or yoga, among others.

The workshop aims to fill the gap between the state of the art in technological development and the state of the art in sports and physical education. We aim to bring together the researchers from these areas and solicit ideas regarding, how the recent technological advances can be applied in real life sports and physical education (PE) scenarios in a multidisciplinary and user centric way and enhance the overall user experience with PE.

To this end, submissions were made and each submission was reviewed by reviewers representing the three main aspects of the workshop i.e. machine learning & interactive technology, sports & movements sciences and Physical Education & pedagogy in order to get different perspectives. The reviewers were encourage to give feedback from their perspective so that the authors can get a better understanding on how best to evolve their systems and methodologies in order to make them more applicable in different domains.

Section 2 summarizes the accepted papers of the workshop.

1.1 Workshop Organisers

see authors list.

1.2 Program Committee

- Albert Ali Salah, Utrecht University, Utrecht, the Netherlands
- Abhinav Dhall, CHIC, Monash University, Melbourne, Australia

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- Soumyabrata Dev, University College Dublin, Dublin, Ireland
- Jamie McGann and Johann Issartel, School of Health and Human Performance, Dublin City University, Dublin, Ireland
- Wytse Walinga, Ivo van Hilvoorde and Jeroen Koekoek, Physical Education & Sport Pedagogy, Windesheim University of Applied Sciences, Zwolle, the Netherlands
- Robby van Delden and Dees B.W. Postma, HMI, University of Twente, Enschede, the Netherlands
- Till Utesch, University of Münster, Münster, Germany

1.3 Review Process

All accepted papers received at-least two double-blind reviews. For this, we would like to thank all PC members for their time and helpful contributions.

2 CONTRIBUTIONS

This section briefly describes the proceedings of the MAISroPE'20 proceedings.

Scalable infrastructure for Efficient, Real-time, Privacy-preserving Sports Analytics: With recent advances and accessibility of IOT devices and personal health tracking monitors, the challenge is no longer to obtain enough data from athletes but how to collect this in a non-invasive, timely, secure and privacy preserving manner. Johansen *et al.* present PMSYS a scalable data collection system for logging multidimensional data from athletes and trainers to prevent and manage injuries in elite sports. The contribution also includes an initial experiment using AI and machine learning, more specifically Long Short-Term Memory (LSTM) to predict future health and fitness states of players with initial encouraging results. They proposed PMSYS system is currently in use in international projects covering Norwegian female elite league and some international teams in Denmark and Portugal [4].

Autonomous and Remote Controlled Humanoid Robot for fitness training: With current ageing of world population and ongoing worldwide restrictions leading to new difficulties in care and assistance; Antonioni *et al.* proposed the use of humanoid robots (here NAO v6) to encourage elderly to perform movements by demonstrations and using voices of loved ones. This paper presents a theoretical system enabling the use of NAO robots for fitness training of the elderly. They present 2 different exercise modes, autonomous and remote, with some interesting considerations for enabling remote supervised exercise and physiotherapy with vulnerable adults[2].

Physical Exercise Form Correction Using Neural Networks: This paper proposes an automatic system for the identification of correct body posture for static exercises (e.g. Plank and Holding Squat) using visual information. It also introduces a dataset of 2400 images where the postures are labeled as correct, too low or too high. The convolution neural network is evaluated for different background, lighting conditions, outfit and hyper-parameters [1].

Climbing Activity Recognition and Measurement with Sensor Data Analysis: This paper proposes a system for automatic detection of action during climbing (i.e. rope pulling or not rope pulling). The authors collected datasets using accelerometers. The climbing activities are performed by two climbers (A and B) on four lines (i.e. four datasets) in two climbing gyms. Later time domain and

frequency domain features are extracted over a time window and then the authors use random forest, Catboost, Adaboost and logistic regression classifiers for rope pulling detection system. It is found that the random forest classifier provides the best precision and recall of 0.85 and 0.87 respectively. The authors also provide further insight of random forest results on each data set and reported an average Jaccard index of 0.93. One of the limitation of this work is the small nature of dataset in terms of number of subjects, type of rope pulling and quantity (i.e duration) of dataset [5].

3 CONCLUDING REMARKS

We believe that the future of sports training and physical education possess a wider role of technology and artificial intelligence. To maximize the effectiveness and adaptability of the technological enhancements; there is a need to design systems that are user centric from the ground up and are founded in learning theories and pedagogical frameworks. It is our contention that events like the MAISroPE workshop will provide essential platforms to connect researchers for such multidisciplinary exchange of ideas. We hope that this will inspire researchers and practitioners to develop new systems and theoretical knowledge to create sports training and physical education environments of the future.

4 ACKNOWLEDGEMENTS

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