

# Traditional Sports and Games: A New Opportunity for Personalized Access to Cultural Heritage

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**Abstract.** Sport is the most universal of cultural pursuits – it is accessible and of interest to all. Traditional Sports and Games (TSG) are as diverse as our cultures. TSG organisations work tirelessly to promote participation in their sports, but also act as custodians of custom, language and history. However, trends in globalisation have led to a convergence of the majority of spectator interest to just a few mainstream sports with culturally homogenous identities. In this position paper, we present the case for preservation of TSG using both existing state of the art 3D digitisation technology but also highlight the need to develop low-cost personalisable solutions. This dual approach would potentially allow the styles of play of elite sportspersons (national heroes) to be captured with precision for posterity, and amateur sportspersons (local heroes) to be captured with inexpensive setups to ensure personalized accessible solutions.

**Keywords:** Intangible cultural heritage, motion capture, 3D digitisation

## 1 Introduction

The history of sport can be traced back to the existence of human civilisation itself. It is a key part of cultural identity, and a mechanism for the protection and promotion of cultural diversity. Thus, retaining knowledge of our traditional sporting practices is vital in terms of preservation and promotion of sport as an expression of *Intangible Cultural Heritage* [1][2]. Worldwide there is a staggering cultural richness of indigenous, traditional, historical, and regional folk sports and games from different nations and ethnic minorities, many of which are fascinating not only for their differences, but also for the similarities of shared common features. The Encyclopaedia of World Sport<sup>4</sup> includes over 3000 traditional

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<sup>4</sup> See: <http://www.sportencyclopedia.com/>

sports and games from all around the world. European examples include Gaelic games (hurling, football, camogie, handball) in Ireland, Basque Pelota (and local variants) in Spain, Longue Paume in France, Tamburello in Italy among many others. The importance of traditional sports and games to our cultural heritage and the need for preservation has been officially recognized by UNESCO<sup>5</sup>. Despite this, this important cultural heritage domain has yet to receive significant attention from the research community.

## 2 The Threat of Globalization

Many traditional sports and games are already lost and those that have survived are in danger of disappearing, owing to the various tendencies of globalisation, and convergence in the rich diversity of sports heritage toward a small set of culturally homogenous sports. This has occurred because of the globalisation of communication networks by an ever decreasing number of media organisations whose legitimate aim is to gain as large a readership or viewership as possible via minimum expenditure. This is achieved by appealing to the mass market which favours mainstream sports. In this environment, soccer has become the dominant world spectator and participative sport. The “Beautiful Game” however is culturally homogenous and its identity is arguably indistinct.

In contrast, traditional sports almost exclusively have an amateur ethos and their associations lack significant financial resources, albeit with a small number of notable exceptions. In conjunction with this amateur ethos, traditional sport associations are altruistic in their support of other traditional sports. This rich collective heritage is managed by sporting organisations and governing bodies with few salaried employees and relies on volunteers working tirelessly to retain and promote their sport as a social duty. In addition, traditional sports and their organisational structures are a central nurturing hub to retain, promote and pass on more widespread non-sporting aspects of cultural heritage (e.g. language, dance, music, storytelling).

## 3 National and Local Heroes

Interest and participation in a particular sport or sports club is significantly dependent upon a person’s affinity to their sporting heroes. But national sporting heroes are not only a means of promoting participation; they themselves are part of the cultural heritage. They have unique patterns of movement and skill execution, handed down through successive generations, that have taken years to master. Unlike other forms of cultural heritage, there is no tangible artefact to hold (e.g. a sculpture, a relic) but the grace, fluency and precision of their movements are evident. A particular flick of the wrist, a strike of the ball, or a side-step on the field, the synergy between players all constitute unique movement signatures that are as worthy as the brush stroke of a painter. There is a need to

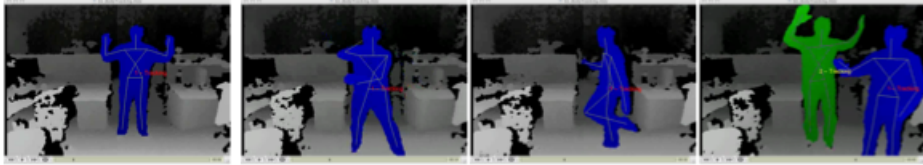
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<sup>5</sup> See: <http://unesdoc.unesco.org/images/0014/001428/142825e.pdf>

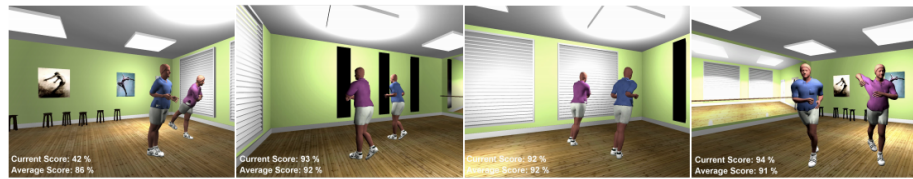
capture and preserve these movement signatures. However, as heroes have become more international, the sport itself loses its attachment to a local/national cultural heritage and thus there is a clear need to continue to promote the local heroes within “grass roots” communities.



(a) Full body motion reconstruction using a small number of cheap accelerometers, from [3]. Motion is synthesized by using low-dimensional signals from wearable accelerometers to index into a motion graph created using optical motion capture.



(b) Kinect-based sensing of human motion using publicly available APIs.



(c) Automatic comparison of movements between a dance teacher and student, from [4]. A dancer’s “score” is computed based on the modulus of the quaternionic correlation coefficients for joint positions and velocities combined with 3D motion vector analysis.

**Fig. 1.** Illustration of various technology components that can be leveraged to perform low-cost motion capture, analysis and visualisation

## 4 Current Technology: A Partial Solution but a Way Forward

To increase engagement, participation and interest in national, regional and local sports, and their associated cultural heritage, connections need to be forged between the sport and their potential membership. This may be achieved by creating interactive media of local/regional/national heroes that gains a person’s interest, especially children. Cultural heritage would be further enhanced

if information on these heroes is retained to span generations. Furthermore, the technology should encompass the principle that children want to “**play like**” and “**play with**” their heroes, strengthening traditional sports’ already strong focus on participative sport irrespective of gender.

Whilst capture of national heroes and other aspects of traditional games is non-trivial, the technology exists – high-cost optical motion capture is used to great effect to capture subtleties of human motion, not just in sport, but also in the movie industry<sup>6</sup>. Thus, what is needed here is a considered and comprehensive capture strategy. However, considering their cost, such solutions are not realistic for TSG local heroes within amateur voluntary organizations. Unfortunately, low-cost solutions that can be personalized for local heroes do not yet exist and this is a key challenge for the research community.

To address this, we propose the vision of a low-cost capture and visualization platform suitable for use in TSG, in which the tools and visualization mechanisms can be personalized to an individual user. We propose a virtual immersive environment in which an end user can manifest him/herself via full 3D reconstruction or via an artificial avatar that can be personalized based on his/her preferences. Within this environment, the user performs key movements guided by a 3D representation of the national hero that has been captured using full body scanning and optical motion capture and that is displayed via high-fidelity rendering. In this way, the user *plays with* his/her hero. Of course, in theory the hero need not even be a currently popular athlete, but could be a rendered version of a recognised master practitioner from the history of the game in question captured based on imitating his/her characteristic style of play (a process that would need to be guided by the cultural custodians of the sport). Real-time feedback should be provided based on detailed comparison of the user’s movements to their hero indicating how well they *play like* their hero i.e. how close their movements are to those of their hero, where the differences are, how substantial these are, etc.

Recent research results indicate that much of what is needed for the various different components required to realize such a platform is either already available or starting to mature. We outline some of the key technology components required for this in the following and show some illustrations of potential solutions from existing work in Figure 1.

- **Low-cost motion capture using emerging cheap sensor devices, such as MS Kinect and wearable accelerometers.** Significant advances have been made recently in using cheap wearable inertial sensors to synthesize full body motion tailored to an individual and some of these can achieve very low joint angle error [5][3]. Of course, motion capture using the Kinect is currently an extremely hot topic in computer vision.
- **3D photo-realistic visualization of human’s performing motion.** The Kinect sensor provides a cheap way not only to track motion but also a way to create full 3D mesh-based reconstructions of humans. Using multiple

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<sup>6</sup> E.g. Optical motion capture systems from Vicon, <http://www.vicon.com/>

Kinects, techniques have been developed that can start to approach the quality of expensive full body scanners [6].

- **Algorithms to compare human motion from low-cost sensors to gold standard.** Two ACM Multimedia Grand Challenges<sup>7</sup> have been run in recent years that call for solutions for comparing dance movements between teachers and students based on an extensive dataset of human motions [7]. A number of different solutions have shown the feasibility of this [4][8].
- **3D scanning of sport implements (e.g. racquets, balls, etc) and apparel.** 3D scanners are becoming more common with even desktop products now available at reasonable cost<sup>8</sup>.
- **Avatar authoring tools.** Web-based tools are starting to appear to enable even inexperienced users to create avatars of themselves using a small amount of manual editing. A good example is the RAAT (REVERIE Avatar Authoring Tools) produced by the REVERIE EU project<sup>9</sup>.
- **Navigable virtual immersive environments for optimum end-user experience.** For this we can take inspiration from many cultural heritage research projects that have investigated the use of virtual or augmented reality – the Archeoguide project is one of the earliest and most notable successes in this regard [9]. More recently, computer vision advances for 3D imaging and increasing availability of 3D viewing technology makes it feasible to create extremely realistic representations of real-world environments that can be interfaced with computer game engines for ease of navigation, e.g. [10].

## 5 The Opportunity

In this position paper, we present the case for the urgent need for research effort towards preservation of TSG using existing state of the art 3D digitisation technology whilst also highlighting the need to develop low-cost personalisable solutions. The former would potentially allow the styles of play of elite sportspersons (national heroes) and the evolution of the games and their accoutrements to be captured with precision for posterity using existing high-end 3D capture equipment. The latter, on the other hand, would allow amateur sportspersons (local heroes) to be captured with inexpensive setups to ensure personalized accessible solutions that truly engage the local community.

Recent technological advances mean that it is now potentially possible to digitally capture various aspects of traditional sports although further research is required to produce robust low-cost platforms that integrate these existing techniques in an effective manner. In conclusion, we believe that there is a key opportunity for technology development for capturing a key aspect of our collective cultural heritage that has been overlooked to date. Furthermore, we should not be complacent in this task. Some TSG are under real threat – a variant of

<sup>7</sup> See: <http://www.3dlife-noe.eu/3DLife/emc2/grand-challenge/>

<sup>8</sup> E.g. NextEngine 3D Laser Scanner, <http://www.nextengine.com/>

<sup>9</sup> See: <http://www.reveriefp7.eu/resources/demos/reverie-avatar-authoring-tool/>

Longue Paume died out only in the last 20 years or so – so the time to act is now.

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