From Lab to Field: Demonstrating Mixed Reality Prototypes for Augmented Sports Experiences

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Figure 1: Different AR Prototypes for sport data visualisation. Left: Prototype used in the stadium. Middle: Indirect AR prototype. Right: Lab prototype visualizing past head-to-head scores.

ABSTRACT

Traditional sports events related data have no direct spatial relationship to what spectators see when attending a live sports event. The idea of our work is to address this gap and ultimately to provide spectators insights of a sports game by embedding sports statistics into their field of view of the game using mobile Augmented Reality.

Research in the area of live sport events comes with several challenges such as tracking and visualisation challenges as well as with the challenge that there are only limited opportunities to test and study new features during live games on-site. In this work, we developed a set of prototypes that allow for researching dedicated features for an AR sports spectator experience off-site in the lab before testing them live on the field.

CCS CONCEPTS

• **Human-centered computing → Mixed / augmented reality**.

KEYWORDS

Augmented Reality, Sport Events, Prototype Design

ACM Reference Format:
Wei Hong Lo, Stefanie Zollmann, Holger Regenbrecht, and Moritz Loos. 2019. From Lab to Field: Demonstrating Mixed Reality Prototypes for Augmented Sports Experiences. In *The 17th International Conference on Virtual-Reality Continuum and its Applications in Industry (VRCAI '19), November 14–16, 2019, Brisbane, QLD, Australia.* ACM, New York, NY, USA, 2 pages. https://doi.org/10.1145/3359997.3365728

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VRCAI '19, November 14–16, 2019, Brisbane, QLD, Australia
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ACM ISBN 978-1-4503-7002-8/19/11.
https://doi.org/10.1145/3359997.3365728

1 INTRODUCTION

As sports broadcasting has seen major technical advancements in recent year, more sports spectators tend to watch sports broadcast and stay in the comfort of their own home. This is partially due to viewers being able to get more statistics and interesting visualizations through sports broadcast, while getting constant view of the action. In contrast, improvements for on-site spectators seemed rather stagnant, with a decline in live sports spectators observed [Koba 2013]. Depending on where a spectator is seated and where the action is happening, the viewing experience and the lack of easy access to digestible game statistics might take away part of the whole experience. On the contrary, more and more data is collected in sports [Rein and Memmert 2016], but it is mainly presented on broadcast streams and game statistic websites rather than stadium spectators. We address this gap by investigating the usage of mobile AR as a novel interface for on-site sport spectators. Such an interface has the ability to provide spectators with statistics that are spatially related to the on-field action tailored to each spectator's perspective. This customised view for each spectator adds to the understanding of the presented data. However, research in the area of live sport events comes with several challenges, such as data availability, tracking, and visualisation challenges. In addition, there are only limited opportunities to test and study new features during live games on-site. This is particular a problem for user studies. In order to address this problem, we developed a set of different prototypes that share a common basis but can be used in the lab as well as for on-site testing.

2 BACKGROUND

Previous work investigated how to evaluate novel interface in different settings and compared lab studies with in-situ studies [Voit et al. 2019]. From this work, we can learn that depending on what we want to evaluate, the right method must be used as different

methods will yield different results. We tried to include these aspects when developing our overall system by integrating the overall approach into three different prototypes that differ on where they can be used and what aspects can be researched with them.

In particular, we are interested in investigating different visualisation techniques that are developed for on-site AR sports experiences. For instance, we are interested in studying situated and embedded visualisation in the context of sport visualisation [White and Feiner 2009; Willett et al. 2017]. These situated visualizations provide statistics to spectators, while still allowing them to enjoy the game via video-see-through (VST) with their mobile phones. Since we will evaluate different measures, such as usefulness of the situated visualisations and overall spectator experience, we need different types of prototypes for evaluation.

3 PROTOTYPES

We developed our AR prototypes with the mindset that spectators will utilise it in the stadium during breaks, pre and post-game, or just for additional information. However, as mentioned before, we will require different methods for different evaluations, thus, we implemented two other approaches for out-of-stadium demonstration and development purpose. The two other implementations are an indirect AR prototype and a lab version of the AR prototype. Details of each implementation are available in the subsections below. All the three versions of the prototype work in the same fundamental way of using 3D stadium models for placements of visualization. The detailed model allows us to find various canvas which are suitable for showing visualizations, with the field being the main canvas. Other examples of canvases include the crowd in the opposite stand, in between goal posts, banners etc. Apart from the indirect AR prototype and Lab prototype, most of the stadium model are hidden to increase the cohesiveness between reality and virtual content. With these prototypes, we research various kinds of visualizations, some only present in sports broadcast at the moment, to adapt to the characteristics of AR. The prototypes are developed on Unity 3D for Android and iOS.

3.1 On-site AR prototype

For the on-site AR prototype, users watch the game through the smartphones' camera, similarly to what they would see on screen when taking a video. However, through the AR interface, users will gain additional game information in the form of situated graphics. Current available visualizations include ruck visualization alongside with a field-side bar chart, past results visualizations, players initial positions, player statistics and spectators' crowd engagement. The AR prototype allows user to view the sport event related graphics with proper spatial context, while still allowing them to see what's going on in the background.

3.2 Indirect AR prototype

The indirect AR prototype is the main prototype used for out-of-stadium demonstration and lab studies. Within our development process, it is often used for development and testing of visualizations as it is independent of the challenges faced during an on-site testing environment. This indirect AR prototype features almost identical visualizations found in the on-site AR prototype. Instead of the camera feed from the mobile phone, users of our out-of-stadium demonstration will see a 360-degree panoramic picture of the stadium in which they can look around locally, simulating a spectator seated at the stadium watching a game. This provides the immersive experience of being in a stadium and is a close simulation of what the users of the on-site AR prototype would experience, in terms of the various visualizations. Users are able to browse and toggle different visualization techniques.

3.3 Lab AR prototype

The Lab prototype is a mini-scaled version of on-site prototype. Alongside the aid of a big A0 sized printed field, it allows the AR experience to be used in a defined lab setting. The Lab AR prototype provides user with a bird-eye view of the stadium model, while still allowing the various visualizations to be shown. Combined with the Indirect AR prototype, Lab AR prototype is a great tool in explaining and demonstrating what is augmented reality as the indirect AR is a form of virtual reality. It also serves as a good medium to conduct user evaluations for the various visualisation designed as we can conduct user studies in a lab setting with controlled conditions.

4 CONCLUSION AND FUTURE WORK

In this work, we discuss three approaches we have taken to develop, test and demonstrate a AR prototype for sport spectator experience. The main focus of this demonstration is on how to develop, investigate and show such an interface without being in the stadium. With the indirect AR prototype coupled with the Lab AR prototype, we were able to develop visualisation techniques targeting sports data in advance and only test it out on-site whenever the opportunity arises. This work also serves as a stepping stone for other similar projects involving large scale environment where on-site testing is not always feasible. The developed prototypes will serve as a basis for future work on visualisation techniques for AR for live sport events. Initial lab studies are ongoing and we will extend this work with on-site studies. This includes the consultation of experts on their opinions and shape the visualizations with feedback received.

ACKNOWLEDGMENTS

This project is supported by an MBIE Endeavour Smart Ideas grant. We thank Animation Research Ltd, Forsyth Barr Stadium, the Highlanders, Otago Rugby (ORFU) and OptaPerform for their support.

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