



BU STUDENTSHIPS 2021

PROJECT DESCRIPTION

PROJECT DETAILS

PROJECT TITLE

A Semantics Framework for Authoring Context-aware Augmented Reality Applications

PROJECT SUMMARY

Augmented Reality (AR) applications can enhance user surroundings by superimposing computer-generated graphics, audio-haptics and other modalities with a spatial-temporal consistency that renders these interactions more believable in their environment respectively. The AR industry currently has over 1.5 billion active users and it is a growing industry, forecasted to be \$72.7 billion dollar market by 2024. Various application domains are adopting AR technologies for their products, experiences, and manufacturing processes, but there are still many challenges in place in order to improve usability and adaptive capabilities within application contexts.

More specifically, this project is focused on improving development process for authoring AR applications that account for real-world uncertainties. A major challenge for AR authoring is linking parameters within the development framework to real-world scene and contextual understanding. Having a system understand high-level contextual information can lead to advanced meaningful and rich user interactions in the environment for all types of mobile applications.

This match-funded PhD project between Bournemouth University (academic partner) and Phantom Technology Ltd. (industry partner) will investigate various state-of-the-art semantics labelling methodologies to segment point datasets into meaningful scene and object classifications. The aim is to abstract meaningful real-world data to provide a framework for authoring adaptive AR applications, using natural language processing (NLP), computer vision and machine learning (ML) techniques. The solutions are required to be integrated with the PhantomEngine software development kit (SDK), as part of Phantom Technology's proprietary AR engine. As part of the project, solutions will be required to run on iOS and Android mobile devices (a further technical challenge to the project). AR prototypes will be developed at each stage in order to test the efficacy of the solutions composed and will be integrated with mobile AR gaming projects (developed by Phantom Technology's current industrial partners) with a potential of reaching commercial users.

This project will lead to a major contribution for AR applications, related to a variety of fields around computer vision, digital games, productivity plus utility and, finally, emerging HCI frameworks for its exploration of context-awareness and adaptability around user surroundings. It will improve a vast amount of associated immersive software applications for years to come, related to AR, VR and, ultimately, the umbrella field of "spatial computing". The impact will further extend to a number of established research and industrial communities tackling some of the biggest challenges amongst computer interactions and interface design. The immersive technology industry is a significant proportion of the UK's economic and cultural footprint, and through the successful development of these areas, the leading industries can be perpetuated further.

ACADEMIC IMPACT

As described above, the project outlines abstracting real-world semantics for the purpose of providing a framework for authoring context-aware AR applications. Context awareness for mobile AR applications in an effective manner is far from a resolved problem in terms of computer vision issues (notably accuracy is an area which needs improvement), but also usability of a given prototype. The work will build on existing literature and results in the area of multimodal system interactions, computer vision and natural language processing (NLP) techniques.

Other aspects involved in this project will explore usability of the software development framework when deployed in real-world commercial games development environments. It is envisaged that the work will be eminently publishable as result and we already have in mind the following journals: ACM's Transactions on Graphics, Computer Graphics Forum, IEEE Computer Graphics and Applications and IEEE Transactions on Visualisation and Computer Graphics. As far as conferences are involved SIGGRAPH, SIGGRAPH Asia and also Eurographics are the ones we intend to target with the results of this work. All of these are high-impact factor publications in computer graphics and achievable should the results be realised (especially in the technical areas we are to work on). In terms of the next REF this could also potentially form an impact case study, especially considering the very applied research nature the results could take when added to a mobile AR prototype (but also the Phantom Technology potential promising trajectory as a company). This would be for UoA 11 (Computing) or potentially UoA 32 (Art and Design).

SOCIETAL IMPACT

The project, as is clear from the description above has a strong focus on a prototype development challenge but with this implemented successfully, i.e. offering a semantics framework for authoring context aware AR applications and being able to enhance an AR prototype with this in a significant manner, many opportunities for contributions are opened up, and thus the resultant impact, in so many different domain areas. The gaming industry is one (and one Phantom Technology is very interested in this specifically as they have industrial partnerships in this area already) but effectively anything which relates to enhancing the quality of life for someone through the use of physical play would effectively be applicable. Some examples could be the elderly, people with mobility problems and even the partially sighted; all of these parts of the population could use software prototypes where the technical contribution of the work can enhance their operation towards a meaningful implementation of a feature set not possible before. Another example, very different to the ones listed above, could be the area of interactive storytelling for enriching landmarks and physical spaces (where the main supervisor already has carried out interactive storytelling and in-situ multimodal interactions-related work, see the publications of this form for more details).

DEVELOPMENT OPPORTUNITIES

The student will benefit significantly from taking on this project; first of all he/she will be in a vibrant academic environment (the Department both has approximately 25 students currently, dedicated research seminar sessions for them, an annual networking event etc.) which will be stimulating both in terms of the research work to be carried but also on a social level too because of the existing community. The student will be able to attend Doctoral College development sessions (there are many of them and many can be applicable to this project, for example the ones on statistical analysis or indeed qualitative experiment design), will potentially be offered (if they are interested and have the time, the research work will always be the priority) some teaching time within the Creative Technology Department (both academic supervisors are placed there and we have over 500 students studying in very relevant areas to this project such as games development), will be able to sit in the many industry talks we have for our undergrad student cohorts (last year we had companies such as Unity, Microsoft's Playground Games, Climax

Studios and others visit us already) and, finally, amongst many other development opportunities, will be able to attend onsite international conferences which often take place here at BU in this area (in 2020 alone we had the ICIDS 2020 and CASA 2020 conferences, organised by members of the Creative Technology academic Department and happening on site, both are very established conferences in the fields of interactive storytelling and animation respectively).

SUPERVISORY TEAM	
First Supervisor	Dr Fred Charles
Additional Supervisors	Professor Christos Gatzidis
Recent publications by supervisors relevant to this project	<p>Barnett, L., Harvey, C. and Gatzidis, C., 2018. First Time User Experiences in mobile games: An evaluation of usability. Entertainment Computing, 27, 82-88.</p> <p>Yovcheva, Z., Buhalis, D., Gatzidis, C. and Van Elzaker, C.P.J.M., 2014. Empirical evaluation of smartphone Augmented Reality browsers in an urban tourism destination context. International Journal of Mobile Human Computer Interaction, 6 (2), 10-31.</p> <p>Yovcheva, Z., Buhalis, D. and Gatzidis, C., 2012. Overview of smartphone augmented reality applications for tourism. e-Review of Tourism Research, 10 (2), 63-66.</p> <p>C. Hargood, B. Hicks, F. Charles, S. Lynch, and W. Tang. Snow white is missing: An interactive locative story for dementia patients. In F. Tian, C. Gatzidis, A. El Rhalibi, W. Tang, and F. Charles, editors, E-Learning and Games, pages 85-92, Springer International Publishing, 2017.</p> <p>J.-L. Lugin, M. Cavazza, F. Charles, M. Le Renard, J. Freeman, and J. Lessiter. Immersive FPS games: User experience and performance. In Proceedings of the 2013 ACM international workshop on Immersive media experiences, pages 7-12. ACM, 2013.</p> <p>J.-L. Lugin, F. Charles, M. Cavazza, M. Le Renard, J. Freeman, and J. Lessiter. CaveUDK: a VR game engine middleware. In Proceedings of the 18th ACM symposium on Virtual reality software and technology, pages 137-144. ACM, 2012.</p> <p>M. Cavazza, J.-L. Lugin, D. Pizzi, and F. Charles. Madame bovary on the holodeck: immersive interactive storytelling. In Proceedings of the 15th ACM international conference on Multimedia, pages 651-660. ACM, 2007.</p> <p>F. Charles, M. Cavazza, S. J. Mead, O. Martin, A. Nandi, and X. Marichal. Compelling experiences in mixed reality interactive storytelling. In Proceedings of the 2004 ACM SIGCHI International Conference on Advances in computer entertainment technology, pages 32-40. ACM, 2004.</p> <p>M. Cavazza, O. Martin, F. Charles, X. Marichal, and S. J. Mead. User interaction in mixed reality interactive storytelling. In The Second IEEE and ACM International Symposium on Mixed and Augmented Reality, 2003. Proceedings., pages 304-305, Oct 2003.</p>

INFORMAL ENQUIRIES
Please contact the lead supervisor on the following email for informal enquiries: cgatzidis@bournemouth.ac.uk

ELIGIBILITY CRITERIA

The BU PhD Studentships are open to UK, EU and International students.

Candidates for a PhD Studentship should demonstrate outstanding qualities and be motivated to complete a PhD in 4 years and must demonstrate:

- outstanding academic potential as measured normally by either a 1st class honours degree (or equivalent Grade Point Average (GPA) or a Master's degree with distinction or equivalent
- an IELTS (Academic) score of 6.5 minimum (with a minimum 6.0 in each component, or equivalent) for candidates for whom English is not their first language and this must be evidenced at point of application.

ADDITIONAL ELIGIBILITY CRITERIA

- An independent engineer who's comfortable working in a small industrial team alongside their time at the university.
- 4+ years of total programming experience in research or industry.
- Advanced software engineer with the ability to write production-quality object-oriented code in C++ or C#.
- A strong maths or physics background.
- Good oral and written communication.
- Practical experience working with machine learning or NLP.
- Interest in emerging technologies and commercialisation.

HOW TO APPLY

Please complete the online application form by **31st January 2022**

Further information on the application process can be found at: www.bournemouth.ac.uk/studentships