BU MATCH FUNDED STUDENTSHIPS 2024 PROJECT DESCRIPTION

PROJECT TITLE

CfACTs Plus PhD: Advanced Non Player Character Systems for XR Healthcare Simulation (XR-NPC)

PROJECT SUMMARY

Single-user contemporary XR healthcare training simulations lack effective teamwork simulation and debriefing methods, compared to traditional high-fidelity manikin-based training which employs multiple human participants. While multiplayer XR simulations can naturally facilitate effective teamwork and debriefing due to their group nature, self-study / single player XR content does not. Better self-study options will be a major boon to XR healthcare training, allowing individual learners to gain confidence in a safe and repeatable environment; and allow training anytime, anywhere, without complex organisation / scheduling.

Non-Player Characters (NPCs) are used to bridge the gap between single player and multiplayer XR simulation content. i3 Simulations (https://i3simulations.com/) is developing systems for NPCs to carry out routine tasks, such as navigating the virtual emergency room and carrying out instructions effectively. The main aim of the XR-NPC project is to provide AI enabled NPCs that emulate human colleagues in multiplayer XR simulations, across the i3 Simulations product range.

The XR- NPC project will complement i3 Simulations NPCs by delivering the AI for NPCs to recognise and obey orders, display appropriate emotions, and provide accurate feedback to the single player. The AI for NPCs will parse orders from human users and translate them into NPC actions, and the associated emotional response will inform the visual appearances and behaviours of the NPC. E.g. The NPC has to *know* that it is doing an ordered task, which is either correct or incorrect for the simulation best outcome; and also respond in the correct emotional way when doing the ordered task (e.g. concerned; are you sure you want this (incorrect) procedure done now? Is this dose correct? etc).

While it will not be feasible to create perfect replacements for human colleagues, the NPCs should be effective enough to support the desired learning outcomes for working as a team to respond to medical emergencies, and the subsequent debrief after those emergencies.

On completion of the simulation, each NPC will contribute to feedback in the debrief stage. E.g. NPC says: Why did you ask me to do this procedure? It would have been better if you had asked me to do this (correct) procedure.

Once these NPC systems are in place, in addition to much stronger self-study options for i3 Simulations products, many new simulation opportunities that focus on communication skills will arise for experimentation, research and new content.

Project Aims:

1. Develop and Implement AI enabled NPCs to bridge the gap between single player and multiplayer XR simulation content.
2. Establish regional (UK, USA, European) simulation debriefing best practices, and how they should be functionally integrated within i3 Simulations products.
3. Implement debriefing best practice functionality within existing i3 Simulations single player products, where NPCs are already available; and into i3 Simulation's authoring tool 'i3 Nucleus', anticipated to be used for all future content development from 2025 onwards.

Objectives:

(O1) Review existing healthcare simulation debriefing methods both in the UK and internationally, and compile a report that documents these and makes recommendations for how these methods can be functionally implemented in i3 Simulations products.

(O2) Support i3 Simulations to implement best practice debriefing methods into i3 Simulations products.

(O3) Design and develop AI/LLM driven NPC systems, so that XR-NPCs can simulate multidisciplinary participants in a single player XR simulation. BU and i3 Simulations clinical experts will annotate i3 Simulations NPC simulations for LLM training. The NPC system should be independent of specific game engines such as Unity and Unreal Engine, so it can be applicable to both; and XR-NPC outputs should be compatible with character animation technologies, e.g. face / body animation.

(O4) Carry out experiments and testing to provide evaluation of the XR-NPC systems.

The candidate should demonstrate a solid understanding of mathematics, computer graphics, machine learning, and related subjects. Additionally, proficiency in Python coding and familiarity with VR/XR applications. Experience in an industrial setting and a proven ability to deliver research projects tailored to industry needs is also preferred.

ACADEMIC IMPACT
Hospitals and healthcare providers are increasingly deploying digital technologies, such as artificial intelligence (AI), smart sensors and robots, big data analytics, and Internet of Things (IoT), for improved quality of care and operational efficiency. We foresee this research will be a launch pad for BU's future research ventures by increasing its research power and capacities in related areas, fusing the excellences of multiple centres, promoting the wide adoption and employment of computer graphics, computer vision, VR/AR, NLP and AI technologies to benefit the healthcare sector.

SOCIETAL IMPACT
For transformative societal impact, we envisage the collaboration with department of nursing science will offer innovations in teaching delivery and holistic immersive training environment for student nurses, which will address the pressing issues of lack of skill training placements in clinical wards and improve the quality of teaching and learning. The project will engage clinical professionals through well-established connections with University Dorset Hospital (UDH) and NHS trusts to exploit the usage of tools and generate broader societal impact.

PGR DEVELOPMENT OPPORTUNITIES
Under the daily guidance of the research team, students will receive comprehensive doctoral training during the program. The research focus will be on natural language processing, virtual reality/mixed reality and machine learning algorithms.
Career growth opportunities: this program will provide successful candidates with good career development opportunities. After graduation, students can choose to work in research in universities, research institutes, or related companies, or they can work in companies or companies in the field of virtual human animation.
This program will provide successful candidates with good industry growth opportunities.

SUPERVISORY TEAM	
First Supervisor	Prof Wen Tang
Additional Supervisors	Dr. Michele Board, Dr. Ursula Rolfe
Recent publications by supervisors relevant to this project	Huang, D., Wang, X., Liu, J., Li, J. and Tang, W., 2022. Virtual reality safety training using deep EEG-net and physiology data. *The visual computer*, *38*(4), pp.1195-1207.
	Chen, L., Tang, W. and John, N.W., 2017. Real-time geometry-aware augmented reality in minimally invasive surgery. Healthcare technology letters, 4(5), pp.163-

	167.
	Chen, L., Tang, W., John, N.W., Wan, T.R. and Zhang, J.J., 2019. De-smokeGCN: generative cooperative networks for joint surgical smoke detection and removal. *IEEE transactions on medical imaging*, *39*(5), pp.1615-1625.

INFORMAL ENQUIRIES
Please contact the lead supervisor on the following email for informal enquiries: wtang@bournemouth.ac.uk
ELIGIBILITY CRITERIA
The BU PhD and MRes 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.

Candidates for an MRes Studentship should demonstrate outstanding qualities and be motivated to complete a MRes in 18 months and must demonstrate:

- outstanding academic potential as measured normally by an upper second class honours degree (or equivalent Grade Point Average (GPA)
- 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.

HOW TO APPLY
Please complete the online application form by **the deadline on the project webpage.** Further information on the application process can be found at: www.bournemouth.ac.uk/studentships