EIT Digital – Industrial PhD position proposal

2020-06-01-Milan-Polimi-TIM-1

"ART: a framework to support development of Mixed Reality services and applications for interaction-intensive environments "

Partners Information

Industrial partner	**Telecom Italia – TIM**

Academic/research partner	**Politecnico di Milano**
Academic advisor	**Prof. Franca Garzotto** Head of i3Lab (Innovative Interactive Interfaces Laboratory) Department of Electronics, Information and Bioengineering Politecnico di Milano http://i3lab.polimi.it

PhD project information

Title PhD Thesis	**ART: a framework to support development of Mixed Reality services and applications for interaction-intensive environments**
Short summary	This PhD will develop ART: an innovative methodological and technological framework to help in the design and development of interaction intensive Mixed Reality (MR) environments that offer the "right" interaction affordances and contents to users, allowing them to experience a real-virtual mix in a natural and effective way. This PhD activity will be strongly connected to the EIT Digital funded Digital Cities Innovation Activity 21273 "ART" – focusing on MR in the tourism domain, coordinated by TIM and PoliMI as main partner. A Mixed Reality (MR) environment can be everything that integrates physical and digital interactive materials. MR involves multiple interaction modes (touch, gestures, manipulation, natural language) and exploits a gamut of technologies ranging from Multimedia to IoT, AI, and Computer Graphics. One of main limitations in current approaches is the lack of "natural perception" when users interact with the mixed (digital / physical) space and its components. The first goal of this PhD research is to identify interaction models and mechanisms that fill this gap. Then the research activity will provide modular software prototypes composed of layered building blocks integrated in a framework that supports faster design and development of MR experiences, for different application domains.

	To better shape this new way of communication and adapt future business offerings around it, it is important to understand which interactions users will prefer and how to make the experience more effective and natural in different scenarios. It's also important to provide tools to design the interactions and simplify the creation of new experiences for different domains.
No. of PhD positions	1
PhD duration	3
Innovation Focus Area	Digital Tech

DTC location	Milano

Co-finance scheme for the Industrial Doctoral Programme Costs	The industrial doctorate will be co-funded by TIM and EIT Digital

PhD thesis motivation and I,nnovation valorisation

Rationale/challenge	While Virtual Reality (VR) experiences involve digital reality only, Augmented Reality (AR) experiences take place in the physical reality that is "augmented" by means of computer-generated overlaid on the view of the surrounding space. Mixed Reality (MR) refers to the richest form of AR experiences. The exploitation of MR for large scale business is limited by a number of challenging problems that are still open, and concern two main dimensions: Interaction Design and Technology. *Interaction Design* Demo applications developed so far highlighted the need of defining, implementing, and assessing design solutions and guidelines concerning: i) appropriate digital contents; ii) appropriate design solutions for interaction; iii) interaction mechanisms that are easy to learn and simple to use. *Technology.* MR applications are intrinsically complex from a technological perspective, and, are quite expensive to develop; they require a high level of ICT know-how in this specific field, and are typically created from scratch every time, "tailor-made" for each customer. This scenario highlights the need for a well-structured layered frameworks for MR applications that raises the abstraction level of the implementation work, and supports quick prototyping.
Innovation – *describe <u>what</u> is the intended solution and how the problem would be solved*	This PhD will collaborate with TIM in the development of "ART": a framework for the development of Mixed Reality (MR) services that is innovative from a methodological, technological, and business perspective. The main contribution of the PhD candidate will be in the design and development of

	innovative methods and technologies to enable more effective Mixed Reality services and be integrated as software components in the target framework. The PhD work will also result in at least two prototype applications where multiple characters (real end-users and "bots") interact through different interfaces exploiting several paradigms: touch, gestures, manipulation, natural language. During the PhD work the student will identify two main use-cases in different domains (for example tourism and entertainment).
Expected academic - outcomes (e.g. publications, presentations in conferences, thesis)	The minimum expected outcomes required for the candidate are: - 3 publications per year starting M12 (total 6) at top-level international conferences in the areas of VR, Multimedia and Computer graphics, Human-Computer Interaction - 2 publications in top-levels international journals - a final thesis, reviewed by a review committee composed by PoliMI faculty members and reviewers from universities abroad
Concrete innovations expected as the outcome of the proposal - Describe some of the potential innovative outcomes of the PhD work. For instance: • patents prototypes • new products • improved products • business plan • start-up/spinoff creation Include for the innovation outcomes a short explanation on how it will be developed, tested and/or verified, if there will be proof of concepts, pilot tests. Also mention if the testing phase will be conducted at the industry/company premises or with clients.	The industrial doctorate student will share its time between Politecnico di Milano and the TIM Open Innovation Lab in Milano. To create a successful collaborative project between TIM and Politecnico di Milano, work will be mainly done on-site in strong collaboration with the industrial partner team, already developing in MR technologies and services. In addition to scientific publications results, required towards the degree, the main concrete outputs of this PhD will be: - contribution to the **development of the ART framework** to support fast creation of interaction-intensive MR applications and services. Multiple releases are planned M6-M36. The framework will be developed on top of well-known development tools (e.g. Unity engine) and is meant to offer easy-to-use components enabling interaction-intensive features. - **2 running MR-enabled application prototypes** developed using the framework and addressing two different domains (M12 and M24). The two identified services will address **Digital Tourism** (e.g. a group of people can enjoy a touristic visit of a place interacting each other and with a virtual guide) and **Digital Entertainment** (e.g. people can virtually attend together events like concerts, sport matches, etc.). - **validation of the solution through 1 pilot** involving real customers, providing to the student exposure to business aspects and interaction with potential customers/users of the technology, to collect valuable feedbacks (M24). Testing phase will be the final part of the PhD work and used as validation of the student results.
Expected impact of the PhD outcomes with respect to their business line – Describe the relationship ot the outcomes of the PhD project into the current or future business lines of the	This PhD grant offer is part of "UniversiTIM", a new initiative by TIM involving top universities in Italy to enhance the collaboration between the company and the academic world, aimed at promoting advanced technological research and innovation and scouting of new talents in emerging tech fields. As part of this program, together with other PhD students, the candidate will be offered several opportunities organized by TIM to understand better the digital sector and its business. The foreseen collaboration between EIT Digital, TIM and Politecnico di Milano will lead to a unique knowledge exchange in the area of Advanced User

company/industry. For instance: • if the topic will bring new customers through a new offer of services • the company will have a leading position over competitors • the company will lead in the creation of new standards • a new portfolio of services/products will expand to new markets	Interaction applied to Mixed Reality services and the business lines and customers of TIM.

PhD thesis milestones

Deadlines/milestones (Gantt chart)	- Review state-of-the-art techniques for advanced user interaction approaches and Mixed Reality solutions - Proposal of most promising approaches to improve state-of-the-art - ART MR framework: requirements collection
	- design of a service scenario ("service1") addressing a first use case (tourism): requirements, user experience, UI mock-up - selection of devices and technologies to be integrated - ART MR framework v0
	- release of "service1" running prototype, integrated with TIM assets - ART MR framework v1
	- approach refinement and validation through real pilot of "service1" and exploitation of the MR framework to design a second service scenario ("service2") addressing a different use case (digital entertainment) - implementation of "service2" - ART MR framework v2
	- final release of ART MR framework - installation of "service1" and "service2" on TIM infrastructure as permanent demos - PhD thesis finalization
	The PhD student is expected to be involved in at least 3 publications/year in relevant international venues. Collaboration with the industrial team/advisors is expected for the preparation and authorship of some of these publications.
International mobility plan	- Technical University of Berlin - VR/AR Lab led by Prof. Dr.-Ing. Sebastian Möller - University of Nottingham – UK, Mixed Reality Laboratory: Professor Steve Benford - University of Illinois in Chicago – at the Electronic Visualization Laboratory led by prof. A. Johnson - Columbia University – New York, Computer Graphics and User Interfaces Laboratory: Professor Steven K. Feiner