Doctoral Dissertation
Doctoral Program in Computer and Control Engineering (34thcycle)

eXtended Reality for Education and Training

By

Filippo Gabriele Pratticò

******

Supervisor(s):
Prof. Fabrizio Lamberti

Doctoral Examination Committee:
Prof. Sofia Seinfeld Tarafa, Referee, Universitat Politècnica de Catalunya, Spain
Prof. Lucio Tommaso De Paolis, Referee, Università del Salento, Italy
Dr. Giacinto Barresi, Istituto Italiano di Tecnologia (IIT), Italy
Dr. Fabrizio Nunnari, German Research Center for AI (DFKI), Germany
Prof. Andrea Bottino, Politecnico di Torino, Italy

Politecnico di Torino
2022

Declaration

I hereby declare that, the contents and organization of this dissertation constitute my own original work and does not compromise in any way the rights of third parties, including those relating to the security of personal data.

Filippo Gabriele Pratticò
2022

eXtended Reality for
Education and Training

Filippo Gabriele Pratticò

The last decade has witnessed unprecedented breakthroughs in the field of eXtended Reality enabling technologies, accompanied by a growing variety of cost-effective devices hitting the market, also at the consumer level. The increased accessibility and the disruptive potential of this family of immersive media are catalyzing the interest of both the academia and the industry, which are putting many efforts into helping them attain maturity and become commonplace in a wide range of application fields, encompassing arts, design, engineering, architecture, medicine, and so forth.

Undoubtedly, training and education were advocated as two of the most promising applications which can benefit from such immersive media, thus being the subject of studies since the early days of Virtual and Augmented Reality. Many advantages have been recognized to eXtended Reality training systems, such as the possibility to experience a given scenario under repeatable and controlled conditions even under circumstances that could be potentially hazardous, impractical, or very resource-intensive if recreated for real. With the advancements in the field, novel challenges to address and limitations to overcome emerged towards the seamless adoption of such training system at a mass scale.

The work that the author carried out during the Ph.D. period, partly presented in this thesis, was aimed at expanding the boundaries of eXtended Reality-based tools used in the education and training contexts. Specifically, the attention was focused onto three research directions: firstly, with the aim of supporting their deployment at scale, the employment of such systems with a self-learning approach, i.e., without the need for a human trainer to partake was explored; secondly novel ways to employ pedagogical agents in eXtended Reality training systems were investigated, both to ameliorate the social-related aspect of such experiences and to enable unconventional pedagogical models; lastly, the exploitation of eXtended Reality-based tools from the often-overlooked training provisioner perspective was considered.

It is the author's hope that the work presented in this document can offer interesting insights and pave the way for future research in the considered domain.