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Editorial

VR, AR, and 3-D User Interfaces for Measurement and Control

Annalisa Liccardo * and Francesco Bonavolontà *

Department of Electrical Engineering and Information Technology, University of Naples Federico II, Via Claudio 21, 80125 Naples, Italy

* Correspondence: annalisa.liccardo@unina.it (A.L.); francesco.bonavolonta@unina.it (F.B.)

Abstract: The topics of virtual, mixed, and extended reality have now become key areas in various fields of scientific and industrial applications, and the interest in them is made tangible by the numerous papers available in the scientific literature. In this regard, the Special Issue "VR, AR, and 3-D User Interfaces for Measurement and Control" received a fair number of varied contributions that analyzed different aspects of the implementation of virtual, mixed, and extended reality systems and approaches in the real world. They range from investigating the requirements of new potential technologies to the prediction verification of the effectiveness and benefits of their use, the analysis of the difficulties of interaction with graphical interfaces to the possibility of performing complex and risky tasks (such as surgical operations) using mixed reality viewers. All contributions were of a high standard and mainly highlight that measurement and control applications based on the new models of interaction with reality are by now increasingly ready to leave laboratory spaces and become objects and features of common life. The significant benefits of this technology will radically change the way we live and interact with information and the reality around us, and it will surely be worthy of further exploration, maybe even in a new Special Issue of Future Internet.

Keywords: augmented reality; mixed reality; virtual reality; advanced interfaces for interaction with cyber physical systems; advanced interfaces for IoT-based monitoring

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1. Introduction

The world is experiencing a deep gap between the huge amount of digital data already available and the physical world in which they are exploited. While reality is three-dimensional, a huge amount of data and information useful to its description remain trapped on two-dimensional pages and screens. This discrepancy between the real and digital world limits our ability to exploit the information and indications generated by billions of intelligent and interconnected devices spread all over the world. New visualization technologies that superimpose digital data and images on the physical world promise to fill this gap and release the unexploited and exclusive capabilities of human beings. New communication interfaces will arise in the coming years and transform our current approach to learning, communicating, and interacting with the physical world. These technologies will also change companies' approaches to customer service, employee training, product design and creation, and value chain management.

With the above considerations taken into account, this Special Issue intends to collect and readily make available information on the most recent advancements in the multidisciplinary approach to research in the AR and MR fields.

2. Contributions

The papers included in this Special Issue of the *Future Internet* journal highlight some of the emerging issues related to innovative interfaces for control and monitoring, based on Augmented Reality, Virtual Reality and Mixed Reality.

In [1], the new features of virtual worlds and emerging requirements are analyzed, including infrastructure mobility, content diversity, function interconnectivity, immersive environment, and intelligent agents.

The study of the market/industry trends helps to define new design requirements. Then, in a literature review, the authors discuss the requirement satisfaction of existing system architectures and highlight their limitations. Finally, a new architecture developed in an ongoing study, called Virtual Net, is discussed, which can provide higher resource sufficiency, computing reliability, content persistency, and service credibility.

The study in [2] is focused on the adoption of the Technology Acceptance Model (TAM), an approach used to predict and evaluate the benefits due to new technology tools. In particular, the external variables associated with e-learning, agriculture and virtual reality applications are examined, in order to measure the potential acceptance of an e-learning tool designed for European farmers and agricultural entrepreneurs within the project "FARMER 4.0—Farmer teaching and training laboratories". The two primary used parameters in the TAM are Perceived Usefulness (PU) and Perceived Ease Of Use (PEOU).

The authors demonstrate that PU is mainly influenced by PEOU, followed by system and content quality and perceived enjoyment. As for PEOU, it was significantly influenced by self-efficacy, followed by perceived enjoyment and experience. The authors believe that the results obtained from the TAM provide a methodology for designing FARMER 4.0 in the most satisfactory way for the users.

The automation of design and validation of user interfaces for human–computer systems is essential. Effective organization of the interaction necessitates that human needs and limitations, particularly in the cognitive aspects, are expressed quantitatively and are properly accounted for. Therefore, in [3], the authors explore different predictors that characterize the difficulty of tasks engaging Visual-Spatial Working Memory (VSWM), which are rarely covered in the currently existing computational models of user behavior, if compared to visual attention or visual complexity. The following two groups of factors have been considered as predictors of user performance: (1) the metrics based on compression algorithms (RLE and Deflate) plus the Hick's law, which are known to be characteristic of visual complexity, and (2) metrics based on the Gestalt groping principle of proximity, operationalized as von Neumann and Moore range 1 neighborhoods from the cellular automata theory.

Ref. [4] considers the possibilities, prospects, and drawbacks of the mixed reality (MR) technology application found in mixed reality smartglasses Microsoft HoloLens 2, to allow surgeons to conduct operations using mixed reality on a large scale.

Two tasks of MR are considered. (1) the MR is exploited to visualize CT/MRI data as well as information about the patient's condition through a series of virtual screens, which eliminates the need to use multiple monitors, thereby optimizing the space in the operating room; (2) MR glasses are used to compare a virtual model of the patient's anatomy, which was built based on MRI and CT data, with the real condition of the patient. This is achieved by superimposing these data onto the patient's body and creating the effect of "X-ray vision". Research was conducted in three clinical cases, with two median neck and one branchial cyst excisions.

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References

1. Shen, B.; Tan, W.; Guo, J.; Cai, H.; Wang, B.; Zhuo, S. A Study on Design Requirement Development and Satisfaction for Future Virtual World Systems. *Future Internet* **2020**, *12*, 112. [CrossRef]
2. Castiblanco Jimenez, I.; Cepeda García, L.; Violante, M.; Marcolin, F.; Vezzetti, E. Commonly Used External TAM Variables in e-Learning, Agriculture and Virtual Reality Applications. *Future Internet* **2021**, *13*, 7. [CrossRef]

3. Bakaev, M.; Razumnikova, O. What Makes a UI Simple? Difficulty and Complexity in Tasks Engaging Visual-Spatial Working Memory. *Future Internet* **2021**, *13*, 21. [CrossRef]
4. Ivanov, V.; Krivtsov, A.; Strelkov, S.; Kalakutskiy, N.; Yaremenko, A.; Petropavlovskaya, M.; Portnova, M.; Lukina, O.; Litvinov, A. Intraoperative Use of Mixed Reality Technology in Median Neck and Branchial Cyst Excision. *Future Internet* **2021**, *13*, 214. [CrossRef]