DigitalXR: XR-Driven Digital Transformation of Design, Training, and Education

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***Abstract*—This paper summarizes six presentations in a session of the track "XR-Driven Digital Transformation of Design, Training, and Education". Topics of the included research work are listed as following items:**

- **A novel VR interface called *Make OS Home* that introduces a home-like operating system in virtual reality.**
- **A series of case study plans for digital transformation from traditional education towards VR education.**
- **A thorough study of the heuristics about arcade game design in a comfortable rhythm.**
- **A decision tool based on mobile sensing for social anxiety disorder among University of Virginia (UVA) students.**
- **A study on evaluating the machine learning classifiers used for detecting glaucoma based on deep Convolutional Neural Network (CNN).**
- **An interactive digital painting tool called *IslandPaint* used for digital painting floating island design.**

***Index Terms*—digital transformation, eXtended Reality (XR), XR systems, XR designs, XR education, XR tools, XR games,**

I. Introduction

In the 21st century, the digital transformation of our society becomes an inevitable trend to change the way people are thinking, working and learning. Especially, as the advanced technologies in Virtual Reality (VR), Augmented reality (AR), and Mixed Reality (MR) are becoming democratic, eXtended Reality XR(VR/AR/MR) somehow reshapes the activities relating to different aspects of peoples' life. Therefore, it is our opportunity and responsibility to brainstorm how to welcome such a digital transformation of our society through these advanced XR technologies.

Therefore, through this special track, we are trying to collect contributions on discussing how XR technologies influence our lives and how to apply XR technologies in different fields, such as XR-based interfaces for artistic or industrial designs, XR-driven approaches for training, and XR-directed educational programs, etc. Nowadays, the challenges of developing user-friendly or human-centered XR programs are about how to introduce a smart interface between humans and computers to improve interactive efficiencies. For example, how to employ optimization-based approaches to help people automatically design things in XR platforms. Or, how to use machine learning (ML) and artificial intelligence (AI) to synthesize scenarios in XR to help people train themselves efficiently.

Furthermore, accurate mathematical model-based scientific simulations on XR platforms can be used to educate students about science-related courses such as physics, chemistry, and geology. Also, text-based interface, parametric models, procedural modeling, vision or audio processing, and natural language processing can also be combined with XR technologies to design, model, or improve digital things such as digital communications, digital transportation, digital architecture, and digital multimedia designs, etc.

As XR technologies open the doors to a wide range of opportunities and new challenges that we would like to address, in this special track, we have selected some successful submissions ranging from case study plans, technical approaches, applications, and implementations, etc.

II. Submission

The first paper presented by Li et al. [1] is talking about a novel VR interface called *Make OS Home* that introduces a home-like operating system in virtual reality. With the rapid development of Virtual Reality (VR) technologies in recent years, VR displays become more and more popular, democratic, and attractive for users. Therefore, academic researchers are exploring the way to employ advanced VR technologies to achieve a smooth digital transfer from traditional user interfaces towards VR interfaces. In this paper, what is presented is Make OS Home: a digital transformation implementation prototype from a traditional 2D-screen-based operating system towards a home-like immersive 3D operating system in virtual reality. Through the implementation presented in this paper, a desktop of the standard Windows 10 operating system will be transformed into a virtual desktop in a home-like environment through virtual reality. At meanwhile, details are presented on how to implement the interactions between users, VR controllers, and the operating system to achieve such digital transformation on operating systems.

The second paper presented by Li et al. [2] is talking about a series of case study plans for digital transformation from traditional education towards VR education. As virtual reality (VR) technologies become popular and democratic within recent years, academic researchers are exploring the way to employ advanced VR technologies in traditional education and edutainment. This paper presents a comprehensive digital transformation case study plan about how to apply VR technologies to modern educations. In this proposal, the teacher standing in front of a blackboard is teaching in a classroom in a traditional way, while after the digital transformation through

our case study plan, the teacher will teach in virtual reality and students will present in a virtual classroom. This paper explores the important considerations taken into account for achieving such a goal through this case study plans.

The third paper presented by Li et al. [3] is talking about a thorough study of the heuristics about arcade game design in a comfortable rhythm. This paper is going to present a case study on the way of producing a comfortable environment for arcade game players who want to have a positive user experience after playing this game. The arcade games aim to please the players in public places, so they have to make themselves easy to learn, but because of their purpose of gaining profit, they need to let players insert as many coins as possible and therefore they cannot be too easy. So it needs to discover the real "art" behind the designing principles. First of all, it is discovered that the difficulty of the game is in many aspects. On top of that, it has been discussed the indispensable and proper elements in user interfaces of the arcade games. Finally, we need to know the way to try to give players hints at the whole process to make them learn how to learn the game in an implicit way. The conclusion from this paper is that the essential idea of designing is to create an appropriate and reasonably unstable rhythm that results in various feelings of players and eventual pleasure because of these feelings.

The fourth paper presented by Li et al. [4] is talking about a decision tool based on mobile sensing for social anxiety disorder among University of Virginia (UVA) students. In recent years, it is high time that we should pay attention to the treatments of individuals who have social anxiety disorders. In this paper, the authors collected physical and physiological data of 6 subjects from Shimmer 3 ECG and GSR sensors and extract features to identify the activity recognition accuracy by selecting the best classification model. Then authors chose some treatment methods to provide interventions for these subjects according to their social interaction anxiety scale (SIAS) score changes. Finally, the authors evaluate the accuracy of score changes prediction with the best regression model. The result shows that the Random Forest Classifier can lead to the best performance in terms of accuracy, and the Linear Regression model can yield the best prediction in terms of the Root Mean Square Error (RMSE). But there is a lot of future work to deal with, for instance, we need to collect data from more subjects, to test these models on a larger scale. Some former studies showed that virtual reality exposure therapy is one of the most efficient and cost-effective ways to handle a larger-scale experiment, with promising feasibility.

The fifth paper presented by Li et al. [5] is talking about a study on evaluating the machine learning classifiers used for detecting glaucoma based on deep Convolutional Neural Networks (CNN). Glaucoma is a chronic and neurodegenerative ocular disease that is the second cause of blindness all over North America. This paper provides a way to diagnose glaucoma using digital fundus images. The authors try to apply image processing techniques on the digital fundus images to classify normal eyes and glaucomatous eyes. Images pre-processing techniques of Convolutional Neural Networks (CNN) and Grey Level Co-occurrence Matrices (GLCM) for feature extraction, along with three machine learning techniques for image classification are used here. All these techniques are implemented with python and Random Forest (RF) model gets the best outcome, but all models have difficulty in identifying the glaucomatous fundus images.

The sixth paper presented by Li et al. [6] is talking about an interactive digital painting tool called *IslandPaint* used for digital painting floating island design. In this paper, the authors present a smart digital design interface, IslandPaint: digital painting floating island design. Through IslandPaint, users can design 3D floating islands with simple 2D single-view conceptual digital paintings. After the procedural modeling process proposed by the authors, 3D floating islands look like the original 2D paintings will be automatically generated. Given this proposed interface, floating islands design will become easier for digital art designers, digital multimedia producers, digital movie makers, and digital game authors.

III. Future Work

As future works, lots of possible extensions can be added to the existing works. For example, Make-OS-Home [1] can be extended with new system features such as moving folders, adding 3D start menu, and adding hardware/network configurations, etc. Case study plans [2] for digital education transformation can be implemented in VR for real-case studies. Heuristics [3] about arcade game design in a comfortable rhythm can be studied for XR games, etc. All of these presented papers open infinite opportunities for future study.

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