Cubios Transreality Puzzle as a Mixed Reality Object

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ABSTRACT

The author proposes to establish a separate class of electronic mechanical puzzles being the object of “mixed reality”, presents a self-engineered example of such a device, and reviews similar devices produced by other developers. Close relationships of such devices with tangible user interfaces are described. A Cubios device is presented as an illustration of a mixed reality puzzle along with its variants developed by the author. The purpose of this paper is to present a new mixed reality device, review similar devices, propose the classification of such devices, identify their relationships with tangible user interfaces, and discuss the prospects of their development.

KEYWORDS

Education, Games, Mixed Reality, New UI

INTRODUCTION

The result of ubiquitous application of microelectronics and global computerization is that computers are present everywhere. They are built in all things, and people are surrounded by them (Weiser, 1991). The concept of the Internet of Things (IoT) means that micro-controllers are built into all household items, from door locks to hair dryers, and connect them in common networks. At the same time, permanent reduction of prices of electronic devices and children’s interest in all things electronic give rise to new toys and construction sets using built-in microprocessors.

Pervasive gaming connects the gaming world with reality (Montola, 2005). Such games and devices are connected with omnipresent games, augmented and mixed reality games, transreality games, affective games, virtual reality games, smart toys, games based on positioning and localities, etc. (Nieuwdorp, 2007; Montola et al., 2009).

The “mixed” gaming process takes place in physical and virtual reality simultaneously (Bonsignore et al., 2012). According to Souza de Silva, the typical characteristic of such games is the “absence of basic gaming space; such games are played in physical and digital spaces at the same time” (de Silva et al., 2009). “Virtuality continuum” or the mixed reality scale was proposed by Pal Milgram and is presented in Figure 1 (after Milgram et al., 1994).

Two techniques are used frequently in mixed reality games:

1. The game receives a signal from a video camera and superimposes additional elements on the image of real environment. Alternatively, it may distort images of real objects, e.g., by changing human faces heavily using digital filters;

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Figure 1. Reality-Virtuality Continuum (adapted from (Milgram et al., 1994))

2. Location-based services are used to place virtual objects and gamers among real objects and terrains. For example, the Pokémon Go game, which became extremely popular in 2016, uses the both techniques.

However, along with games, there exist electronic devices, which have properties of virtual reality objects and are real physical devices at the same time, and their digital and physical representations are directly related. The author proposes that such items should be called “transreality puzzles”. They fall within the domain of mixed reality in Figure 1 and, according to the scale proposed by Paul Milgram, are located in the augmented reality (AR) zone. In what follows, the author lists such devices and projects.

In literature, there is a description of an interreality pendulum consisting of a real physical pendulum and its virtual counterpart (Gintautas and Hübler, 2007). This system has different states: asynchronous double reality, where the motions of the pendulums are not correlated, and mixed reality, where the pendulum swings are phase-correlated.

A hypothetical puzzle from the augmented reality category is shown in Figure 2 (only its physical representation). The physical aspect of the puzzle can have tags (e.g., QR codes on the sides of Rubik’s Cube in Figure 2), which are recognized using computer vision and replaced with game characters and game situations. For example, in a similar project called inSide, the AR effect was achieved by using projectors (Tang, Sekikawa et al., 2014).

The same result can be achieved by using displays installed on all surfaces of a puzzle and displaying virtual objects. A puzzle equipped with displays are easier to hold and observe, as compared with observing images on a computer display or a special head-mounted display (VR helmet).
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