

Magic Cubes for Social and Physical Family Entertainment

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ABSTRACT

Physical and social interactions are constrained, and natural interactions are lost in most of present digital family entertainment systems [5]. Magic Cubes strive for bringing the computer storytelling, doll's house, and board game back into reality so that the children can interact socially and physically as what we did in the old days. Magic Cubes are novel augmented reality systems that explore to use cubes to interact with three dimensional virtual fantasy world. Magic Cubes encourage discussion, idea exchange, collaboration, social and physical interactions among families.

ACM Classification Keywords

H.4 Information Systems Applications: Miscellaneous; H.5.1 Multimedia Information Systems: Artificial, augmented, and virtual realities; H.5.2 User Interfaces: Prototyping

Author Keywords

Interactive Entertainment, Augmented Reality (AR), Tangible User Interface (TUI)

INTRODUCTION

In our childhood, we have been enjoying ourselves listening to the stories, playing doll's house and board game with our elders and other kids. In the past decades, the advancements of computer technologies have brought us graphical fantasies and sophisticated games. However, in most cases, players are staring at the screen and interacting passively to the screen outputs with little social interaction and movement.

Entertainment with interactivity and sociality are becoming important as reflected in the growing popularity of online games [3]. However, online games do not address actual physical movement or social interaction together in the physical world which was found to be essential for human enjoyment of life [1]. Family entertainment systems need to have more social and physical interactions. Meanwhile, we should notice that children enjoy very much virtual fantasies. Therefore, Magic Cubes combine the excitement of the digital fantasy world with the physical world by applying augmented reality (AR) and tangible user interface (TUI) technolo-

gies. On the one hand, Magic Cubes replace the paper paddle (Figure 2-a) commonly used in AR applications [2] with a cube which is more graspable, more robust for tracking, and having more affordances for TUI design. The system uses our lab developed software MXR-Toolkit, which is available as an open source software package [6]. On the other hand, AR allows 3D visualization of digital information on physical cube, whereas in most of previous TUIs only one dimensional or two dimensional information is linked.

Magic Cubes strive for bringing the computer storytelling, doll's house, and board game back into reality so that the children can interact socially and physically as what we did in the old days. We choose to use cube as the interaction tool because humans have been familiar with this basic geometry form since childhood.

DESCRIPTION AND NOVELTIES

Magic Cubes aim at designing AR family entertainment systems especially for children using cubes: storytelling, doll's house, and board game. There are several novel aspects:

Firstly, Magic Cubes upgrade the traditional AR interfaces [2] which uses two-dimensional paddle for object manipulation by using the three-dimensional foldable cube as the handle, as shown in Figure 1. Compared to turning the pages in traditional book interface, unfolding the magic cube to explore the story contents brings more fun for kids. More importantly, the cube allows kids and their parents/friends to discuss together how to unfold the cube and hence explore the story stage by stage, in a social and physical manner.

Secondly, Magic Cubes make better use of the physical affordances provided by the cube. Apart from tracking the position of the cube [4], Magic Cubes can detect the states of the cube (i.e. which surface is turned up). Different cube states can be used to define different interactions. As shown in Doll's House (Figure 2-b), the child can rotate the cube to navigate through the doll database when a specific pattern is shown as the top surface. Doll's House allows children to play and discuss together in the design process. Using cube as a the interaction tool makes it easier for them to exchange their design idea (by passing cube to others), quickly navigate through the database, and have more complex interactions such as moving, resizing, and deleting ob-

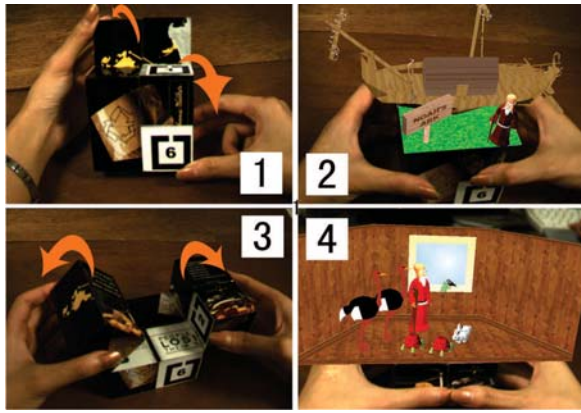


Figure 1. 3D “Noah’s Ark” Story: the child can use both hands to unfold the cube and explore the contents of the story include 3D animation, sound, and human narrations.

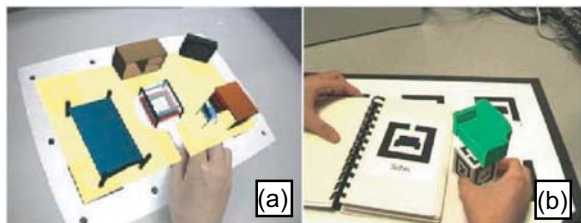


Figure 2. (a) Using the paddle to rotate the object is restricted by the degree of freedom allowed by our wrist [2] (b) Cube is graspable and can be easily turned and rotated by fingers.

ject (by turning the cube to show different top surfaces which are linked with different interactions). Compare to real doll’s house, Doll’s House of Magic Cubes is similar but has the advantages of any fantasy house can be made, whereas making a house scene on PC is not similar, not tangible and not social.

Thirdly, Magic Cubes can visually track the spacial layout of multiple cubes hence can define more interactions. Tracking the interactions between cubes allows multiple players to interact with each other in a physical manner. For example, in the Board Game, a child can add fruits into the cart by stacking his/her own cube onto the other kid’s cube (Figure 3-a). The child can also use his/her own cube to view the video clip (of the spot where he/she is stopping at) shown on the other cube (Figure 3-b). These designs encourage the social and physical collaborative interactions between players although they are opponents in the game.

Fourthly, computer board games can now be played in a novel and tangible way by rolling the *physical* cube to move the chessman. As shown in Figure 4-b, apart from being an interaction tool, now the cube becomes the essential element of the board game - dice. Unlike the computer board game which requires player to click

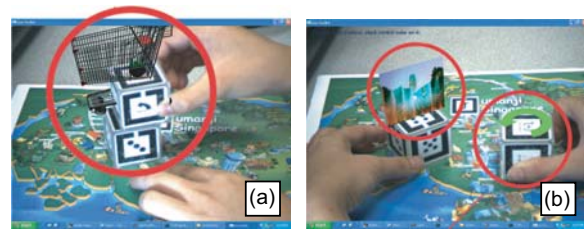


Figure 3. (a) Stacking the cube to add fruits into the cart (b) Rotating the right cube to fast forward the video shown on the left cube

the mouse or press the keyboard, now Magic Cubes allow player to physically roll the dice. The metaphor of the player will move accordingly on the 3D virtual game board viewed through the head mounted display (Figure 4-a). Passing the turn between players is now realized by *physically* passing the dice to each other. Social and physical interactions are highly encouraged.

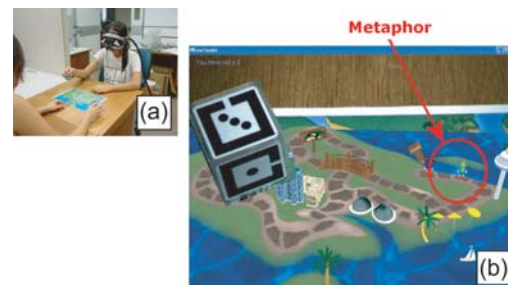


Figure 4. (a) Board game physical setup: player wears a head mounted display (HMD) and views the 3D AR game scene (b) Player rolls a “3” and the metaphor moves on the AR game board.

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