

Chinese Character Factory—A Design of Children’s Chinese Character Construction Enlightenment Game Based on Augmented Reality Technology

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ABSTRACT

Children’s educational products based on augmented reality technology have important innovative significance for children’s thinking development. Because of its interactive nature, rich teaching content presentation, and the ability to mobilize children to perceive information in all directions, it greatly stimulates children’s interest in the learning process and brings a new experience to teaching. This paper explores the practical application of augmented reality technology in the design of children’s Chinese character construction games at the object level, education level, game level, and technology level. On this basis, this paper discover the significance and opportunities of introducing augmented reality technology into the field of children’s Chinese character education through technical research. Taking Chinese Character Factory as an example, this paper specify its design and development process, and provide reference ideas and strategies for improving the application of augmented reality technology in children’s education.

Keywords: Augmented reality technology, Chinese character learning, Chinese character construction game, Enlightenment education

INTRODUCTION

At the beginning of the 13th Five-Year Plan, the government further adjusted the fertility policy and fully liberalized the birth of two children. From ancient times to the present, Chinese always have an ideology that emphasizes education, and the influence of the traditional concept that parents want their children to become excellent has made children’s early education being more and more emphasized. Studies have found that the age of 3-6 is a critical period for developing preschoolers’ reading skills, and “literacy” is an important part of children’s ability to read on their own (Hou, Yuanqi, 2017). Nowadays, there is a common phenomenon in Chinese character education in China, which is to simply pursue the speed and quantity of children’s literacy while neglecting the most essential goals (e.g., developing children’s thinking and phonological skills, understanding of Chinese culture, etc.). Therefore, the educational concepts of “phonetic engraving”, “shape engraving”, and “scene engraving” (Hou Yuanqi, 2017) have emerged.

The application of AR technology to children's education is a positive attempt and an important exploration of a new way to teach children Chinese characters, which can build a new learning environment, cultivate good habits of active learning, and transform children from a passive learner to an active learner who loves learning.

APPLICATION OF AUGMENTED REALITY TECHNOLOGY AND THE DEVELOPMENTAL CHARACTERISTICS OF CHILDREN'S VISUAL PERCEPTION

Augmented Reality Technology in the Field of Education

Augmented Reality (AR) is a technology that seamlessly integrates the real world with the virtual world, and the core content of AR technology is instant interaction and presentation of three-dimensional effects (Zhao Yanqin, 2016). With the help of mobile devices, users can immerse in an environment that combines virtual and reality, and they can feel the multi-sensory experience of seeing, hearing, speaking, touching and thinking.

In recent years, AR technology has been widely used in children's education, including AR Doodle series, Journey to the West series, Chinese Year for Chinese Children series, and Chinese Character Adventure series. In teaching applications, Li Tie Meng's team from Beijing University of Posts and Telecommunications developed AR literacy system for kindergarten children to learn Chinese characters and English (Li Tie Meng, 2015), and Cai Su's team from Beijing Normal University developed "Happy Word Remembering" software (HE J, REN J, ZHU G, et al, 2014), etc.

Different from traditional education products for children, AR education products weaken the one-way infusion process of knowledge and information, and add interactive parts to stimulate children's subjective initiative. The teaching content will be presented in various ways such as text, pictures, sound, film, animation, etc. Children can intuitively perceive information through visual, auditory and tactile senses in all aspects. At the same time, AR technology can provide a rich interactive experience of learning, adding to the fun and interactivity of learning and improving children's learning initiative (Cai, Su, Wang, Peiwen, Yang, et al., 2019).

Developmental Characteristics of Children's Visual Perception and Cognitive Ability

Early childhood is a period of rapid development of word cognition and a very effective period of word learning (Mason.J.M, 1980). At present, research on children's word awareness generally adopts the "three stages" theory, which are the overall shape processing stage, the local composition rule processing stage, and the orthographic rule processing stage (Li, D., 2016). In early period, children only have a pictorial impression of Chinese characters, and they see no difference between words and pictures. And with the development of recognition, children can gradually distinguish between words and pictures and gradually grasp the Chinese character recognition rules. According to the findings of Zhao, Jing, and Li, Rev. of children aged 3 to

6 years old, children aged 2 to 4 years old are in the embryonic state of Chinese character recognition, children aged 5 years old can already distinguish Chinese characters from pictures, and at the age of 6 years old, they already have a good ability to discriminate Chinese characters (Zhao, Jing, and Li, Rev. 2014).

According to Piaget's theory of cognitive development stages, preschoolers at the preoperational stage, a stage in which children can establish symbols to represent external things, have a strong imitation ability, and are able to use the representation of objective things to think, but unable to think abstractly. In terms of thinking characteristics, preschoolers are predominantly concrete-image oriented, and intuitive and visual things are more attractive to their attention. Children in this age group have developed a great deal of ability to apply symbolic representations and can train their thinking ability with the help of some products that contain realistic interactive three-dimensional games (Li, Xiaojing, Zhang, Yimin, 2018).

AR GAME DESIGN FOR CHILDREN BASED ON AUGMENTED REALITY

Design Strategy Layer

"Chinese Character Factory" is based on augmented reality technology and consists of three main systems: the Chinese character experiment system, the medal collection system and the entertainment interaction system, with a view to stimulating children's perceptual system through the combination of these three systems, enabling them to memorize Chinese characters while developing the creative thinking of experimenting with all things, and acting on the reaction and evaluation to use the incentive mechanism of the game to stimulate children's creative thinking (as shown in Figure 1).

Design Framework Layer

The design of augmented reality game products not only needs to balance the educational nature of learning content and the entertainment nature of interactive games, but also needs to fit the cognitive developmental characteristics of preschool children. Based on relevant educational game theories and preschool children's cognitive development theories, Tian Yuan et al. from Huazhong University of Science and Technology proposed a hierarchical element design strategy model for mobile augmented reality educational games with four levels plus a unifying principle (Tian Yuan, Zhou Mi, Xia Dan, et al., 2019). This paper continues the framework of this design strategy model and improves it by combining the educational principles of children's literacy with new technological capabilities, and completes the design and development of Chinese Character Factory, an AR literacy game for preschool children (as shown in Figure 2).

(1) Object layer: The main consideration is to establish the intuitive function and attractive form, which needs to meet the cognitive demand characteristics of children.

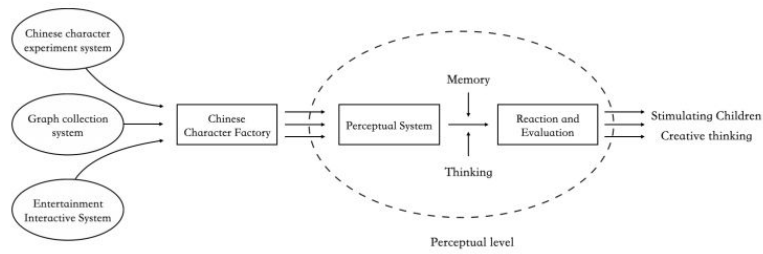


Figure 1: Game Design Strategy Map (Self-drawn).

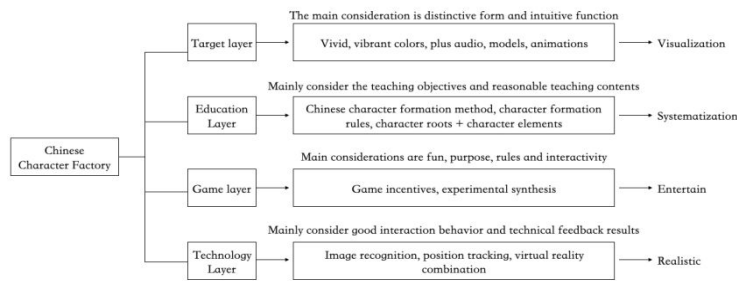


Figure 2: Design framework model (Self-drawn).

In order to strengthen children’s observation and memory, the whole Chinese character card deck design extracts the main three natural colors brown, blue and green, and derives a small amount of auxiliary colors outward, weakens the background elements with low saturation and high brightness colors, so that the visual center of gravity focuses on the main process; moreover, various content presentation methods such as audio, model and animation are added. For example, when the camera recognizes the Chinese character “马”, a 3D model of a horse will appear, and children can clip the model through the Chinese character clip to make the audio sound of “Ma~”; and if “马” and “虫” are clamped into the synthesizing machine at the same time, click on the start button, there will be an animation of the synthesis of the machine, and the successful synthesis will issue a victory audio and synthesize the new 3D model “蚂” and the card “蚂”. Preschool children’s sensory and perceptual development is relatively rapid, unconscious attention dominates, and is largely influenced by visual images and concrete and vivid external environment (Zhang, 2014), and this level leads children to active learning with distinctive forms and intuitive functions.

(2) Educational layer: It meets the teaching objectives and develops reasonable and professional teaching contents.

“Chinese Character Factory” takes the teaching requirements of the “Guidelines for Children’s Learning and Development between the ages of 3 and 6” as the teaching objectives of the literacy game. 500 commonly used characters for children are used as the source of Chinese learning in the game, and they are classified into animal, family, nature and life categories according

to the classification of Chinese characters in Tang Han's book "Chinese Character Code".

The whole design revolves around the concept of "experiment". Through research, it's found that the thinking of Chinese character creation is very similar to the synthesis process of chemical experiments, and the elemental law of "character root + character element" matches extremely well with "chemical element + chemical element". For example, "马+主=驻" means a horse stopping in front of a house, and similar formulas are "马+又=驭", "马+口=骂", and "马+竹=笃". The level design also follows the concept of combining sub-goals (short-term learning) and main goals (long-term learning). Levels 1 to 3 are for animal roots combined with elementary combinations, while levels 4 to 12 are for the more difficult nature, family, and life categories. For example, in AR mode, clicking on the icon in the upper right corner of the chart will bring up the final synthesis card, and clicking on the combination word card "骂" ("scold") will bring up the corresponding synthesis recipe while playing an explanatory audio "Two horses tearing and arguing is scolding".

(3) Game layer: The game layer needs to reflect the fun, purpose, rules and interactivity, and provide timely feedback for learners.

A perfect feedback mechanism can stimulate users to generate continuous experience fun and effectively promote the learning effect of learners (Xuan Wang, 2020). Referring to the classic model of Classic Conditioning, the combination of cards to be given is collected and presented to children under the condition of successful experimental synthesis, so that the process of children's play is a process of obtaining rewards. Moreover, the feedback loop should be followed in the feedback, and only the combination of a series of positive and negative feedback can help the game to advance. For example, when synthesizing "马+人" ("horse + human"), there will be a failure animation and a failure audio, which is negative feedback of encouraging; meanwhile, when synthesizing "犬+人" ("dog + human"), there will be a successful synthesis animation, a At the same time, when "犬+人" ("dog + human") is synthesized, there will be a successful synthesis animation, a "伏" ("voodoo") model and a successful audio, which is positive feedback of a celebration. That is, whether it is positive feedback or negative feedback, its related dynamic presentation, in the design should try to maintain a balance.

(4) Technology layer: The technology layer uses augmented reality technology.

The AR virtual learning environment provides learners with good interactive behaviors and technological feedback results, which is in line with the stimulus-response (S-R) connection formula when learning as identified by behaviorism (Cai, Su, 2016). AR experience design is an advanced form of interaction design, which emphasizes the good coordination between physical and virtual. Based on the Unity3D engine, Chinese Character Factory utilizes the ARFoundation and related APIs and SDKs to recognize and track Chinese character cards and output virtual and real scene images through real devices.



Figure 3: Screenshot of the game design interface of “Chinese Character Factory”

Design Framework Layer

“Chinese Character Factory” is based on Unity3D engine and can run on IOS platform and use iPad for game experience.

The Chinese character experiment system mainly includes card recognition, character selection, and Chinese character synthesis functions; the map collection system includes stamp incentive, Chinese character map, and voice reading functions; the entertainment interaction system includes laser sweep, laser word elimination, Chinese character clip, and finger touch functions.

The machine selection button can be recognized by placing the matching paper map on a flat desktop with iPad camera alignment; the corresponding Chinese character model can appear after the card recognition; clicking on the Chinese character clip in the lower right corner can select and move the Chinese character model; the correct Chinese character can be synthesized by placing the corresponding Chinese character into the correct machine.

Clicking on the atlas in the upper right corner opens the kanji collection system and incentive mechanism; clicking on the kanji deck plays professional explanations; the laser symbol in the lower left corner allows you to click to sweep the model and long press to eliminate the kanji model, and the finger in the lower right corner also allows you to touch the kanji model (as shown in Figure 3).

The final AR game is developed based on Unity 3D, and the AR foundation technology realizes the AR part of the work implementation.

CONCLUSION

This study introduces augmented reality technology into the product design of children's Chinese character construction education and enlightenment, which deeply explores the development characteristics of children's Chinese character enlightenment, and improves the singularity of the research on children's Chinese character enlightenment at the theoretical level; at the practical level, it makes up for the deficiency of augmented reality technology in the field of children's education, and helps children grow and develop better through reasonable and effective design means to bring into play their initiative. The research is based on the following principles The technical route mentioned in this study, combined with the characteristics of children's visual perception, can provide some reference for subsequent related research.

ACKNOWLEDGMENT

I would like to thank the BiBoBox studio at Shanghai Jiao Tong University for their great support during the design and writing process. Thanks to Yue Shi for modeling the 3D model and coordinating with me on concept improvements. Thanks to Xu Meng for illustrations and ideas for the game. Yuanlu Wang for suggesting ideas to improve the program. I would also like to thank my supervisor, Associate Professor Bo Liu from Shanghai Jiaotong University, who gave me valuable theoretical advice and technical support.

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