From Paper Book to Game Book

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Abstract: In this paper, we propose an idea called "game book" as a new form of educational medium. Game book is an idea that integrates paper book, APP, game and doll together. By using MR (Mixed-Reality), game book let paper book become a playground with characters, events, episodes, combats, gifts and skills, like an RPG (role-playing game). Game book consists of a paper book with QR-code, AR-code, animate classmate agent, AR testing agent and real doll teacher. Through the APP which interacts with the paper book, students can observe the learning progress and outcomes. Hence, the knowledge in the books will become more clearly presented and more interesting to students. This research focuses on how to design a game book with QR-code and AR-code located on books and to teach students with intelligent doll.

Keywords: Game Based Learning, Mobile Learning, Mixed-Reality

1. Introduction

Traditionally, educational materials are printed materials, mostly paper books. Paper books are designed according to author's knowledge structure. However, a good book should also be designed for the readers. Paper books can be read anytime, anywhere, but learning problems occurred during book reading become ubiquitous. (Chuang, Chen 2010) If no one can help students solve these problems it will cause flaws in learning. So, providing assistance when reading paper book is important.

M-learning can provide mobile accessibility to information beyond the paper book. (Chuang, Chen 2010) APPs had been extensively used in m-learning researches; for example, APP in smart phone (Lee, Song 2012), APP in iPad (Huang, Chao 2012). According to Yahoo news, smart-phone users in Taiwan are about 56.8%, and pad users are about 24%, which show that using smart-phone and pad to implement M-learning is applicable. (Yahoo 2012) In spite of communication, the most popular activity on smart-phone and pad is gaming. Recently, game-based learning has been implemented on m-learning, too. A mobile game-based learning can make the learner feel more interesting, immersive, and continue to learn. (Lu, Chang et al. 2011)

On the other hand, intelligent tutor can also help student increase the learning effective. (Lin, Chen 2008) Real tutor has more affective influences on students than virtual agent does. (Jo, Park, Kim 2009) Therefore, we design an intelligent doll as a real intelligent tutor, which can communicate with the APP running on mobile devices through wireless connection and interact with the students through voices, lights, and emotional expressions.

To summarize, in this research, we propose an idea called "game book" to become a new form of educational medium. Game book is an idea that integrates paper book, APP, game and doll together. By using MR (Mixed-Reality), game book let paper book become

a playground with characters, events, episodes, combats, gifts and skills, like an RPG (role-playing game). Game book consists of a paper book with QR-code, AR-code, animate classmate agent, AR testing agent and real doll teacher. Through the APP which interacts with the paper book, students can see the learning progress and outcomes in the APP. It makes the knowledge in the books become more clearly presented and more interesting to students. This research focuses on how to design a game book with QR-code and AR-code located on books and to teach students with intelligent doll.

2. The idea of Game Book

Game based learning (GBL) is a branch of serious games which are designed to balance the subject matter with the game play and the ability of the player to apply the subject to the real world. (Wiki, 2012) GBL is believed to cause the continuing interest and motivation of learners, to increase their attention and to make them feel immersed in the effects of GBL. (Jian, Wu, Hong 2010) A game is generally defined as a structured playing, usually undertaken for enjoyment and sometimes used as an educational tool. (Wiki, 2012) Baidu has classified computer game into several categories: RPG (role play game), AVG (adventure game), SHT (shooting game), SLG (strategy and simulation game), ACT (action game) and others (ETC). (Baidu, 2012)

Among the above game categories, RPG contains the elements of characters, events, episode, enemy, gift and NPC (Non-Player Character). (Rollings and Adams, 2003) The most important elements in RPG are characters, episodes, enemies and gifts which make players gain judgments, reactions, achievements and foster them understanding domain knowledge comprehensively during the game play journey, which make RPG a genre for educational purpose. (Lu, Chang et al. 2011)

Because of the mobility and prevailing usage of smart phone and pad, using these devices to create a mobile game based learning system is suitable. QR code, invented in 1994, Japan, is a two dimensional matrix code which correspondingly can hold more information than barcode and can be decoded with the camera of smart phone and pad. (wiseGEEK 2012) Using QR-codes can make paper book goes interactive, because it can augmented the knowledge in the paper book and coordinate the mobility of paper book and mobile device. Virtual reality (VR) is a computer-simulated environments and can simulate physical presence in places in the real world, as well as in imaginary worlds. (Wiki, 2012)

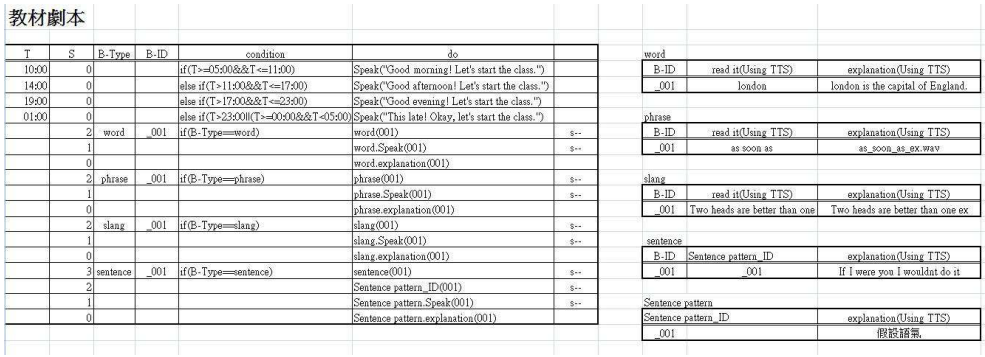
For most games, virtual reality is a way to create more joyful playing environment. There is a connection between virtual environment and real environment, which called augmented reality (AR). (Milgram et al., 1994) An AR environment can be generated through the equipments such as desktop computer, smart phone (pad), simulator, or (3D) projector (Chang, 2009), and AR environment possesses the properties of immersion, interaction and imagination. (Burdea, 1993) Combining the virtual reality (VR) and real realities (RR) and operating with 3D environment. (Azuma, 1997) And according to other research, AR environment provides interaction, perception feedback, spatial relationship, and novelty for learning, that make AR-code become a good teaching tool. (Kikuo and Tomotsugu, 2005)

An intelligent tutoring system (ITS) is a computer system teaching without intervention from a human teacher which aims to provide immediate and customized instruction or feedback to learners. (Wiki, 2012) Intelligent tutor can help student increase the learning effect. (Lin, Chen 2008) With all elements above, this paper proposes the game book system which consists of QR -code on paper book, AR-code, GBL App on

mobile device, an intelligent tutor with intelligent tutoring system to create a mobile game based learning system, and apply to an English course.

3. The Script of Book Learning

A paper text book is made up of chapters, sections and paragraphs, each of which have some specific main purpose of topics or goals. As these goals are analyzed manually, there are two main kinds of modes, teaching mode and testing mode, can be built up. At teaching mode, the learner can be taught by a companion intelligent doll like a simple tutor, which means QR-codes are located in book like a short class; it might mean a pattern of grammar, or a paragraph of article. And the program shows on mobile device is making paper book goes interactive. At testing mode, the learner takes a test by an AR testing agent like a real proctor which means AR-codes are located in the test part of paper book to create a monster lived in the book, which makes every practice and test become checkpoints. That makes the response, interactive happen in the real time line.



教材劇本

T	S	B-Type	B-ID	condition	do	
10:00	0			if(T>=05:00&&T<=11:00)	Speak("Good morning! Let's start the class.")	
14:00	0			else if(T>11:00&&T<=17:00)	Speak("Good afternoon! Let's start the class.")	
19:00	0			else if(T>17:00&&T<=23:00)	Speak("Good evening! Let's start the class.")	
01:00	0			else if(T>23:00||(T>=00:00&&T<05:00)	Speak("This late! Okay, let's start the class.")	
	2	word	_001	if(B-Type==word)	word(001)	s--
	1				word.Speak(001)	s--
	0				word.explanation(001)	
	2	phrase	_001	if(B-Type==phrase)	phrase(001)	s--
	1				phrase.Speak(001)	s--
	0				phrase.explanation(001)	
	2	slang	_001	if(B-Type==slang)	slang(001)	s--
	1				slang.Speak(001)	s--
	0				slang.explanation(001)	
	3	sentence	_001	if(B-Type==sentence)	sentence(001)	s--
	2				Sentence pattern_ID(001)	s--
	1				Sentence pattern.Speak(001)	s--
	0				Sentence pattern.explanation(001)	

word

B-ID	read it(Using TTS)	explanation(Using TTS)
_001	london	london is the capital of England.

phrase

B-ID	read it(Using TTS)	explanation(Using TTS)
_001	as soon as	as_soon_as_ex.wav

slang

B-ID	read it(Using TTS)	explanation(Using TTS)
_001	Two heads are better than one	Two heads are better than one ex

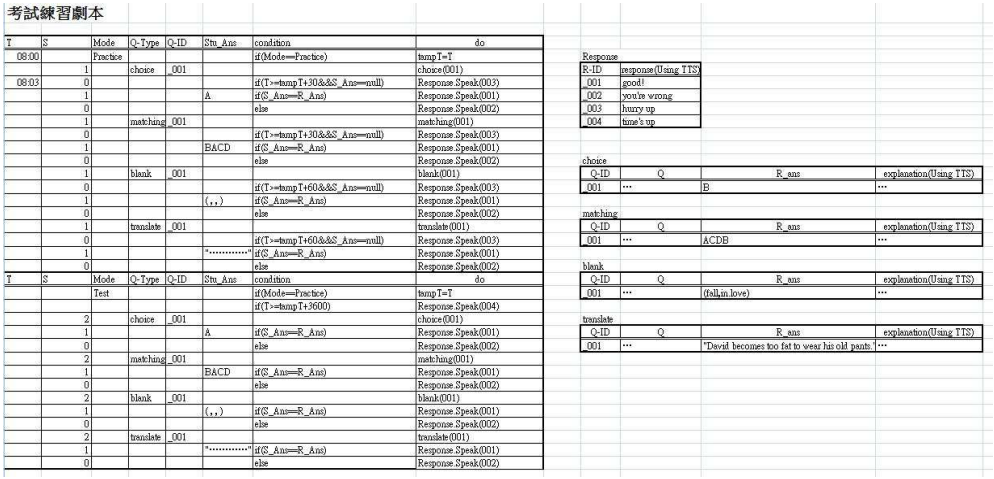
sentence

B-ID	Sentence pattern_ID	explanation(Using TTS)
_001	_001	If I were you I wouldnt do it

Sentence pattern

Sentence pattern_ID	explanation(Using TTS)
_001	假設語氣.

Figure 1: the teaching script



考試練習劇本

T	S	Mode	Q-Type	Q-ID	Stu_Ans	condition	do
08:00		Practice				if(Mode==Practice)	tempT=T
	1		choice	_001			choice(001)
08:03	0					if(T>=tempT+30&&S_Ans==null)	Response.Speak(003)
	1				A	if(S_Ans==R_Ans)	Response.Speak(001)
	0					else	Response.Speak(002)
	1		matching	_001			matching(001)
	0					if(T>=tempT+30&&S_Ans==null)	Response.Speak(003)
	1				BACD	if(S_Ans==R_Ans)	Response.Speak(001)
	0					else	Response.Speak(002)
	1		blank	_001			blank(001)
	0					if(T>=tempT+60&&S_Ans==null)	Response.Speak(003)
	1				(,,)	if(S_Ans==R_Ans)	Response.Speak(001)
	0					else	Response.Speak(002)
	1		translate	_001			translate(001)
	0					if(T>=tempT+60&&S_Ans==null)	Response.Speak(003)
	1				"..."	if(S_Ans==R_Ans)	Response.Speak(001)
	0					else	Response.Speak(002)
T	S	Mode	Q-Type	Q-ID	Stu_Ans	condition	do
		Test				if(Mode==Practice)	tempT=T
						if(T>=tempT+3600)	Response.Speak(004)
	2		choice	_001			choice(001)
	1				A	if(S_Ans==R_Ans)	Response.Speak(001)
	0					else	Response.Speak(002)
	2		matching	_001			matching(001)
	1				BACD	if(S_Ans==R_Ans)	Response.Speak(001)
	0					else	Response.Speak(002)
	2		blank	_001			blank(001)
	1				(,,)	if(S_Ans==R_Ans)	Response.Speak(001)
	0					else	Response.Speak(002)
	2		translate	_001			translate(001)
	1				"..."	if(S_Ans==R_Ans)	Response.Speak(001)
	0					else	Response.Speak(002)

Response

R-ID	response(Using TTS)
_001	good!
_002	you're wrong
_003	hurry up
_004	time's up

choice

Q-ID	Q	R_ans	explanation(Using TTS)
_001	...	B	...

matching

Q-ID	Q	R_ans	explanation(Using TTS)
_001	...	ACDB	...

blank

Q-ID	Q	R_ans	explanation(Using TTS)
_001	...	(fall,in,love)	...

translate

Q-ID	Q	R_ans	explanation(Using TTS)
_001	...	"David becomes too fat to wear his old pants."	...

Figure 2: the testing script

After the analysis of learning materials, the learning instructions of learning script in Figure 1 can be controlled by four parameters: T, S, B-Type, and B-ID, with correspondence to five kinds of buttons. (1) The parameter T means time, which indicates the execution of the instruction depends on the time line in real world. (2) The parameter S means under the same condition, how many instructions should be execution in sequences. If S is not equal to zero, then the next instruction has to be executed continuously unless S=0 happens. (3) B-Type is the button types which can be one of the following types: word, phrase, slang, or sentence pattern. When a word, phrase or slang button is pressed,

its explanation will be shown. When a sentence pattern button is pressed, its structure, grammar and explanation is displayed. (4) B-ID is the ID of a button, which can be a B-Type. B-ID can make the button point to the corresponding position to make sure all buttons can do the correct events.

For testing mode script in Figure 2, two extra parameters, Stu_Ans, are added to four similar parameters: T, S, Q-Type and Q-ID. The functions of parameters T and S are the same as above. Similar to B-Type and B-ID in teaching mode, the buttons of Q-Type and Q-ID indicate the buttons of to question. Furthermore, Stu_Ans are the parameters to record the student's answer and correct answer, respectively. These testing mode scripts can be classified according to four kinds of questions: multiple-choice, matching, blank-filling, and translation. Multiple-choice type can be used for single answer questions, multiple answer questions, true or false questions. The alternative item can be a string or a picture. Matching can be used to be Matching and Item-linkage. Blank-Filling can be created to Blank-Filling and Guided Translation. Translation can be created to Translation, Situational Problem, and Sentence Merging. More trials will be developed, including practice and test, which provide more question types.

4. Design of Game Book System

MR (mixed-reality) is a technology that contains VR (virtual reality), AR (augmented reality), PR (playground reality) and RR (real reality). (Heh et al., 2012) Game book (PR = AR + Book) is designed as an MR game-based learning environment. As a result, game book combines the MR technology, GBL and the educational content to become a new form of educational medium. Based on manual analysis, the topics of the chapters and lessons of the content, pre-created communications among doll and learner, and virtual learning environment are built into the game App.

Each QR-code and AR-code is associated to a specific teaching mode or testing mode and attached on the paper book. AR-code is a technology which based on AR, the most important different between these two is AR is located with GPS, but AR-code can be located in everywhere which has an AR-code just like QR-code, but using AR. This kind of technology has been widely used in magazines these days. (Gamer 2012) Both of it can interact with the game App, thus transform the paper book to be a playground.

Figure 3: teaching mode

Figure 4: testing mode (practice)

In teaching mode, when the learner uses camera of the mobile device in the game App to capture the QR-code on the paper book, a content page associated with that QR-code will display in the App and an animate classmate agent will appear on the content page (ie. in the virtual environment) and interact with the learner. (Figure 3 teaching mode) The animate classmate agent will help the learner by providing suggestions, hints, or asking questions according to the content, and becomes a learning companion of the

learner.

5. An Experiment System

A game book system is constructed by paper book with QR-codes and AR-codes (Figure 5), APPs running on smart phone or pad (Figure 6), and a real intelligent doll teacher (Figure 7). The constructing flow is shown in Figure 8. First, a paper book will be analyzed by human teacher and built into an APP, and then the learning material with the APP can be downloaded through Internet. Second, after the printing and installation, students can learn with game book everywhere.

Figure 5: paper book

Figure 6: APP

Figure 7: intelligent doll

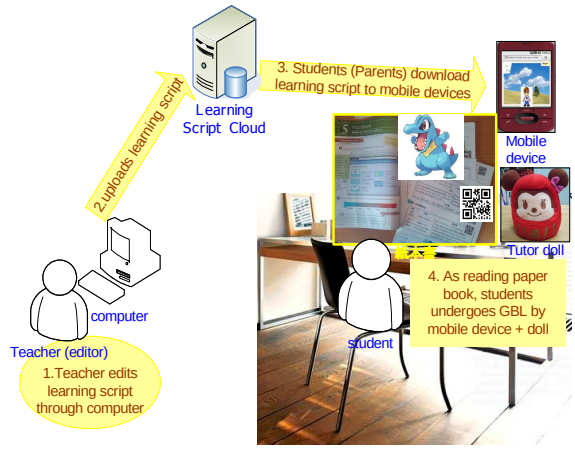


Figure 8

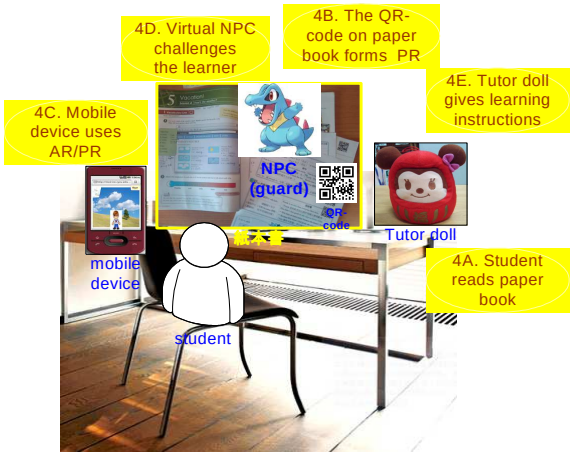


Figure 9

The learning flow in the game book environment is shown in Figure 9. When student is reading the paper book (A) with QR-code and AR-code on it (B), they can use the camera on mobile device to capture the codes (C), and the teaching or testing mode shows up (D, E), then the classmate agent or the intelligent doll will start teaching and acting.

6. Conclusion

In the future, a website can be set up to let teachers create their own textbook. In order to improve manual analysis, a script generating engine could be built to automatically analyze learning mistrials to decide where the QR-codes or AR-codes should be located. A game generating engine may also be established to generate gaming background, storyline, NPCs and combats.

On the other hand, in the hardware part, the function of the intelligent doll could be

extended to body movement, more interaction, speech recognition and alarm clock to make the intelligent doll become not only a passive teacher but also a learning companion, which make the doll more like a friend.

Consisting of software and hardware, game book can go further to be a modularized and generalized system which can transform more kinds of textbook into game book, and students can casually download the book and APP, and enjoy the new learning style of game book.

Acknowledgements

This research is supported as part of project “NSC 101-2531-S-003-CC2” by National Science Council, Taiwan, Republic of China

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