Flowchart Based Storyboard System for Authoring Visual Contents in Mixed Reality Space

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***Abstract*—This paper presents a flowchart based storyboard system that facilitates user in creation, systemization and analysis of story visualization. The proposed storyboard system has the ability to display complete story in a single view by connecting various scenes of the story. It can handle complex scene using scene inside scene. The proposed system has three modes 1) visual, 2) description, and 3) title that help users in understanding a story context very easily. Peer feedback can be easily incorporated to enhance structure of the story. The output-file (i.e. .xml file) of the proposed storyboard can be used as an input to the content-authoring tool. Using the information mentioned in the xml file, content-authoring tool builds virtual contents for mixed reality space accordingly. The proposed storyboard has been compared with recent state-of-the-art storyboards by considering the strengths and weaknesses of each underlying system. Extensive comparisons with existing systems highlight the importance of the proposed storyboard.**

***Index Terms*—flowchart, mixed reality, storyboard system, virtual reality**

I. Introduction

Storyboard system is widely used for art work such as creation, systemization and analysis of ideas. It is used in software development, education [1], [2], film and animation [3], theatre, animatic, comics, business, and novels. It is used as an e-learning tool in education [4] and also works as a requirement elicitation tool in software engineering by visualizing the underlying system before implementation. Medium Shin *et al.* [5] proposed augmented reality storyboard system (AR storyboard) specifically for augmented reality to compose 3D scenes using interfaces of real environment. Recently many storyboard systems have been developed such as Toon-boom [6], Storyboard-that [7] and Storyboard-quick [8]. These storyboard systems are used to minimize the gap between user and requirement engineers (RE) whose task is to formulate, document and maintain software requirements. They can also be incorporated for creation, conceptualize and analysis of ideas.

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Toon-boom has rich drawing toolset to create visual stories and provide easy interface for interaction. Story can be generated as a pdf-file in order to share with peers and get their feedback. Storyboard-that is used for collaboration and entertainment. It provides two separate versions for educational and commercial use. Storyboard-quick also claims that it is easy to use and has rich drawing options. The main drawback of all these tools is the lack of ability to display complete story in a single view. In case of more than one scene, there is no option to demonstrate the coherent flow of the whole story between various scenes in a single view. Another drawback of the existing systems is the incompetency to add description and title with each scene mentioned in the story. Moreover, they are unable to add description of the complete story.

To cope with the above mentioned drawbacks, we have proposed a novel storyboard system that covers maximum functionalities required in the specified applications. The proposed storyboard system has been incorporated in virtual interaction physical space (VIP) successfully to generate visual contents according to the mentioned story. Due to its vital role in creation visual contents for VIP, the proposed storyboard is labelled as VIP-Storyboard. VIP-Storyboard has the ability to create descriptive pictorial stories for various complex scenes and can show them in a single view. The flowchart used in the VIP-Storyboard has unique features for the description of relation among the various scenes of the story. VIP-Storyboard also has a distinct property of handling nested scene (scenes inside scene) in case of coherent complex scene. VIP-Storyboard consists of distinct features that enable the story-maker to easily formulate and translate his thoughts in the form of flowchart based storyboard. It easily visualizes the story and provides a prompt feedback from the users. Extensive comparisons with other state-of-the-art systems validate the effectiveness and distinction of the VIP-Storyboard.

The rest of the paper is organized as follows. Section 2 presents the proposed system framework. Section 3 describes the system implementation and its working and finally in Section 4, we conclude the paper.

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II. Proposed System

In this section, the VIP-Storyboard is described in detail. In section 1, we mentioned that the existing systems do not have the ability to display complete story in a single view, because the relation among various scenes are not specified. This drawback creates hurdle to understand the complete story. Moreover, the existing systems do not possess various scene composition interfaces and functionalities. Therefore we have designed VIP-Storyboard system that minimizes the drawbacks of the existing systems.

Fig. 1 shows the main interface of the VIP-Storyboard consists of rich GUI. Fig. 1 shows pictorial description of the story Wrestling-club. It is obvious from the Fig. 1 that how it clearly connects different scenes of the same story using flowchart. VIP-Storyboard has three modes 1) visual, 2) description, and 3) title that help users in understanding a story context very easily. Visual-mode explains the story pictorially depicting the description of each scene following the well-known adage: a picture is worth a thousand words. In visual-mode, user can easily understand each part of the story with the help of pictures by clicking the corresponding node of the flowchart as shown in Fig. 2. Each node in the flowchart explains one scene and the link between two nodes describes the relation between the scenes. To further augment the understanding level of the VIP-Storyboard more precisely, user can switch to the description-mode to read the textual information of each scene as shown in Fig. 3. Now the user has textual description in addition to pictures to understand the story. Moreover, the user can switch to the title-mode to briefly read the story in short time. Fig. 1 shows the title-mode of the VIP-Storyboard. The distinct and important feature of the VIP-Storyboard is to handle nested-scene. VIP-Storyboard breaks down the complex scene into more than one scene by embedding them inside a main scene. This process facilitates the user to easily understand the complex scene because now user can visit each embedded scene separately. Fig. 4 shows a nested-scene example related to Wrestling-club story. Nested-scene has all modes like main scene, this further enhance the readability of the VIP-Storyboard. An xml file is generated on completion of story. This output file contains the whole information related to story. The content authoring tool (VIP content authoring tool) [9] use this xml file to author visual contents. These generated contents are used in virtual interaction physical (VIP) space. The contents displayed in VIP space are interactive that can be changed and divided dynamically according to user interaction [10]. Fig. 5 shows the flow of data from the user to the VIP space.

III. System Assessment

This section presents the implementation of the VIP-Storyboard. The story of Wrestling-club is used to evaluate the effectiveness of the VIP-Storyboard. Description of the story in title-mode is mentioned in Fig. 1. In story, a person wakes up and realizes that he got late to visit wrestling club. He comes outside and tries to find some taxi. Scenes related to hire taxi have been elaborated for reader understanding in Fig. 4. In short, he arrived to wrestling club and takes decision to fight or not. After spending some time in wrestling club, he comes back to his house. To create this story in VIP-Storyboard, a flowchart is drawn. Each scene in the flowchart has its visual, description, and title mode. Using these modes of the VIP-Storyboard, user can easily understand the story pictorially and descriptively. To handle complex scenes such as hire-taxi, a nested-scene functionality of the VIP-Storyboard is incorporated. This makes the creation and understanding of the scene precise and easy.

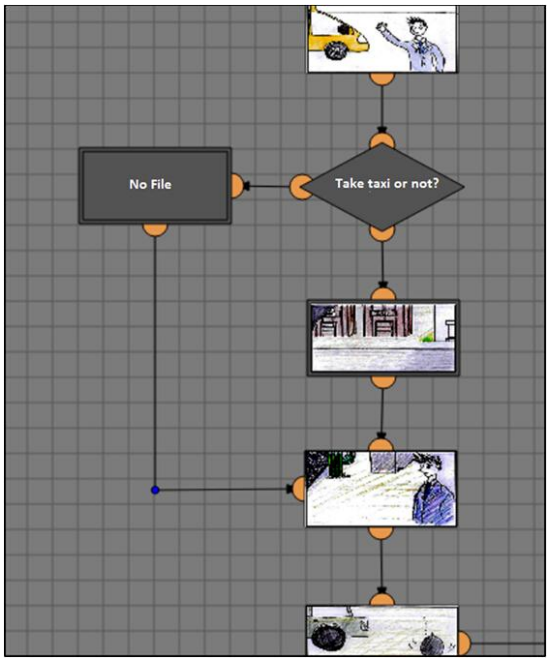

Figure 1. Atomic view of the complete complex story connecting all scenes a particular scene can be seen by clicking as shown at bottom-right corner

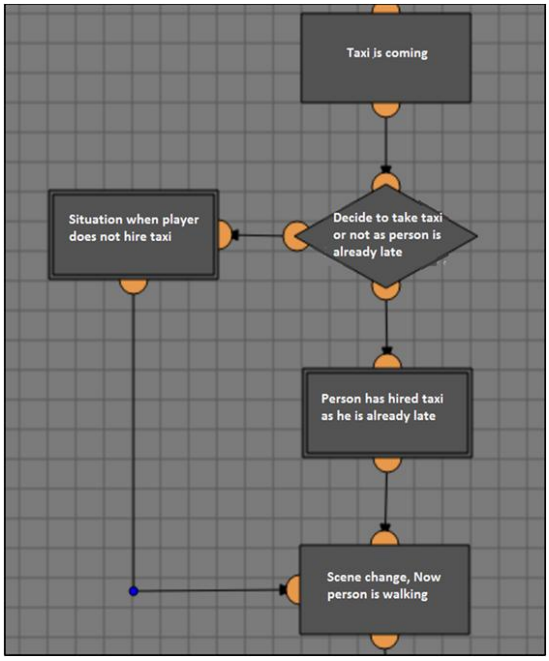

Figure 2. Visual-mode of the VIP-storyboard

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VIP-Storyboard generates the xml file of the completed story. The output xml file contains information as mentioned in Table I. Output-file possesses all those information of the story that is related to type, title, description, and image of scene. VIP content authoring tool uses the xml file to generate visual contents. VIP space displays this visual content for user interaction. In Fig. 6, the displayed contents in the VIP space were created by the VIP content authoring tool using the xml file generated by the VIP-Storyboard.

VIP-Storyboard was compared to other state-of-the-art systems to evaluate their effectiveness in terms of their strengths and weaknesses. For this purpose, we hired ten students from different labs in vicinity near to our lab and were asked the questions about the functionality mentioned in Table II. The students showed positive response toward VIP-Storyboard. We averaged the responses from the students in Table II that verify the superiority of VIP-Storyboard over the existing storyboard systems.

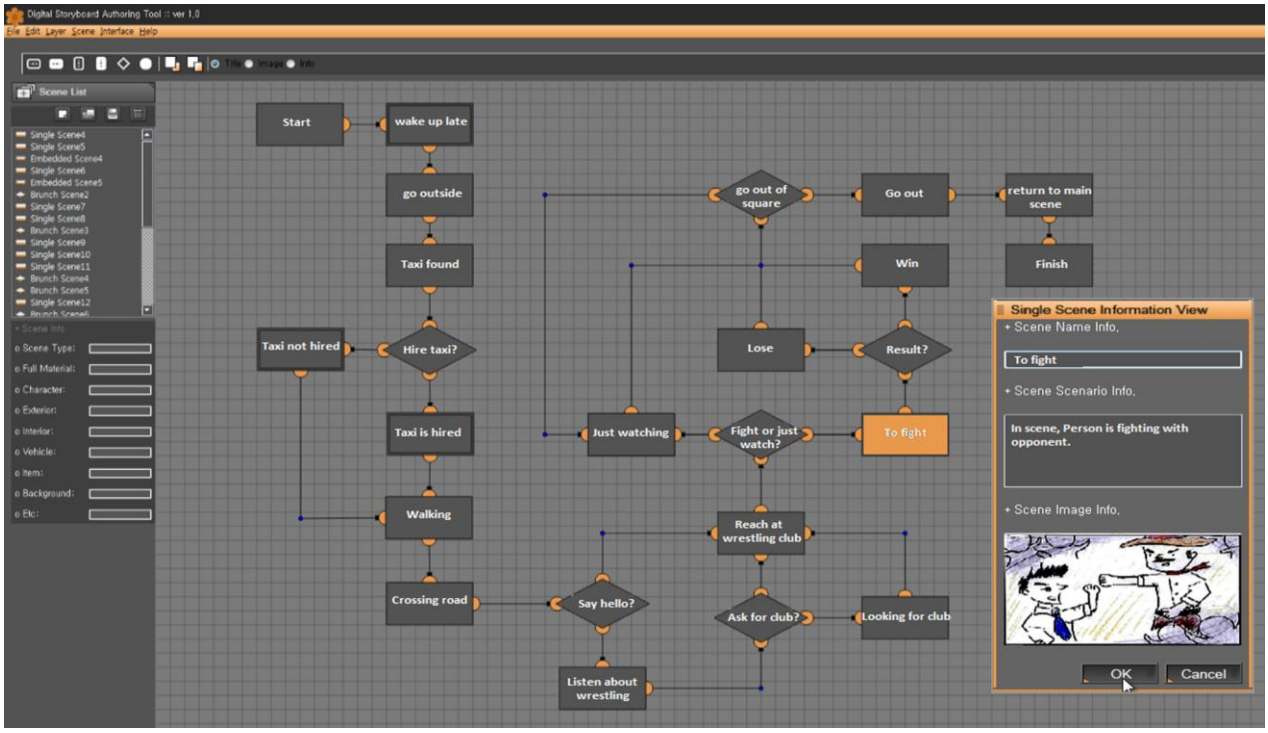

Figure 3. Description-mode of the VIP-storyboard

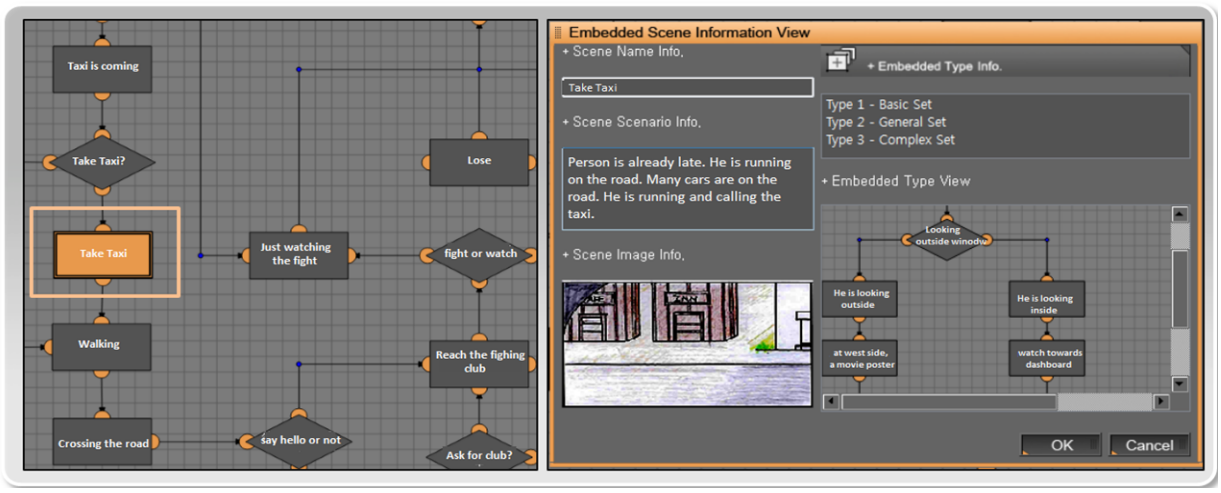

Figure 4. Elaborating complex scene using nested-scene (scenes inside scene) feature of VIP-Storyboard

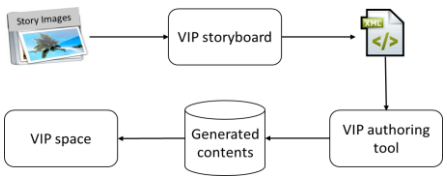

Figure 5. VIP space uses the visual content generated by the content authoring tool according to the xml-file produced by VIP-Storyboard

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Figure 6. VIP space system

TABLE I. SCENES INFORMATION USED IN STORY

ID	Type	Title	Image file	Nested file	Description	Relation
1	Scene	Wake up late	late.png	Nil	Person wake up late and watching time.	2
2	Scene	Run towards outdoor	outdoor.png	Nil	Person run towards outdoor as he is already late	3
3	Scene	Running	running.png	Nil	Person is running and also looking for taxi	4
4	Decision state	Should hire taxi?	Nil	Nil	He is thinking should he hire the taxi or not?	5, 6
5	Nested scene	Take taxi	takeTaxi.png	Taxi.png	He has hired the taxi and now looking outside	4
6	Scene	Did not hire taxi	noTaxi.png	Nil	He did not hire the taxi and just running to reach the destination	4
1	Scene	Wake up late	late.png	Nil	Person wake up late and watching time.	2

TABLE II. COMPARATIVE ANALYSIS OF DIFFERENT STORYBOARD SYSTEMS IN TERMS OF STRENGTHS AND WEAKNESSES

Storyboards / functionality	Toon-Boon	Storyboard-That	Storyboard- Quick	AR-Storyboard	VIP-Storyboard
Entertainment	YES	YES	YES	NO	YES
Easy to use	YES	YES	YES	NO	YES
Relation between scenes	NO	NO	NO	NO	YES
Title description	NO	NO	NO	NO	YES
Textual description	NO	NO	NO	NO	YES
Pictorial description	YES	YES	YES	YES	YES
Interactive	NO	NO	NO	YES	YES

IV. CONCLUSION

In this paper, a novel storyboard system is presented which has the ability to create descriptive pictorial stories for various complex scenes and show them in a single view. The flowchart used in the VIP-Storyboard has unique features for describing the relation among various scenes of the story. VIP-Storyboard has three modes for the story description and has the ability to nest scene inside scene. This property of VIP-Storyboard solves the problem of complex scene to describe. It produces xml file as an output containing story information. VIP-authoring tool creates visual contents for VIP-space using the xml file. These visual content are displayed in VIP-space and user can interact. VIP-Storyboard consists of distinct features that enable the story-maker to easily formulate and translate his thoughts in the form of flowchart based storyboard. It easily visualizes the story and provides an opportunity for prompt feedback from the users. These features surpass the VIP-Storyboard over other state-of-the-art systems.

ACKNOWLEDGMENT

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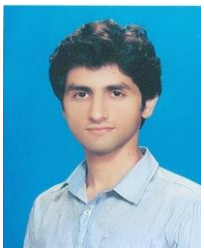

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