Interactive Storytelling System for Enhancing Children's Creativity

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Abstract. We developed an interactive storytelling system that generates stories from hypothetical questions, called 'What-If' function. Specifically, the stories are expressed in a rule-based form 'If-Then'. The system allows users to create a story that has a synopsis different from the original story by changing the 'If' part. For example, if the user changes the appearance and personality of a character, the outline of the story also changes. We believe this process can help improve the creativity of users of the system. This system was also developed to help users visualize written stories as images and allow them to experience stories interactively. An evaluation experiment, conducted on 21 fifth graders in elementary school, showed an improvement in the children's creative ability.

Keywords: Story generation · Expanding storylines · 'What-If' function

1 Introduction

A story is like a rule-based system in which a storyline is expanded and one event triggers a latter event. A Japanese old proverb says, 'When the wind blows, pail-makers are profitable'. This metaphor means that the occurrence of an event may affect places and things that have no relation at first glance. Why? When the wind blows, pail-makers are profitable because the following phenomenon is developed. (1) A strong wind blows dust. (2) The dust enters people's eyes; the number of blind people increases. (3) Blind people buy a shamisen, a musical instrument made from cat skin (an occupation for the blind at that time). (4) Cats are killed to make the shamisen. (5) As the cat population decreases, the mice increase. (6) Mice bite pails. (7) The demand for pails increases, and pail-makers are profitable [1]. The story developed from common-sense knowledge of the living environment of the people in those days. Accordingly, we believe that a story will be developed by using common-sense knowledge when one event is triggered. As the development of each event changes, based on the hypothesis of what it would be like, a variety of stories will be developed.

In this study, we developed an interactive storytelling system that generates stories from hypothetical questions. An interactive storytelling system is defined as a system capable of developing stories in a non-linear order, and users can actively experience the stories [2]. In this system, a story is represented by expressing it in a knowledge base of an 'If-Then' format, according to common-sense knowledge. Users can create a story different from the original story simply by changing the 'If' part, called the 'What-If'

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function. For example, if the user changes the appearances and personalities of a character, the outline of the story will change. It is therefore possible to generate different stories from the original story.

Scheherazade searches for answers to questions on the Internet and incorporates the answers into stories [3, 4]. In our proposed research, we do not use information on the Internet, but instead, we use common-sense knowledge as a prototype. With this 'What-If' function, users can try out the influence of various assumptions in their minds on things. We believe this will enhance the creativity of the user because the system can show that something will happen except what he/she was thinking.

We also believe this system can help users visually recognize the story by adding animations of the characters, 3D objects and scenes, as well as text information of the generated story. According to the research of Mayer [5], when the linguistic and image content are related, the image improves understanding; therefore, it is considered that the animation of this system helps understand the content. We adopted the method of previous studies [6–8] such as assigning animations from the text in-formation. Therefore, the subject of the text is linked to the character, the verb is linked to the action of the character, and the scene is linked to the visualized place.

In this research, we developed an interactive storytelling system with animations that generate stories from hypothetical questions based on the 'What-If' function that can change the If part of an If-Then formatted rule-based system and examine it as a system to improve children's creativity.

2 Interactive Storytelling System with "What-if" Function

In this system, a story is created by defining the state of characters and objects and applying rules linking personalities and appearances with behaviors of the characters on the rule-based system. Currently, the number of rules is 26. The rule-based system is defined by CLIPS, which is a rule-based engine, text, and animation. The 3D objects are displayed using Unity 5.0 of the game development environment. The 'defrule' in CLIPS defines rules of characters such as personalities or appearances. Using 'assert', the definition of characters can be changed.

We developed a system based on an existing story (Fig. 1). 'Snow White' is selected because it is a famous fairy tale from the first edition of the Grimm's Fairy Tales collection. Therefore, it is simple for users to imagine the story. Based on Snow White's original story, the system creates various stories by using the 'What-If' function. In this system, Snow White's final ending is represented in 17 styles. During the story generation session, a user has a chance to change the storyline. For example, when the user is confronted with the branch 'The queen visited the house of Snow White', and Snow White's definition was set to 'doubtful personality', the behavior will be the action of a doubtful personality based on the rules of common-sense knowledge such as 'If' part is 'doubtful personality' and 'Then' part is 'do not receive things from unknown people'. In the original story, if Snow White's definition is set to 'pure personality', then actions such as 'receives things from an unknown person', and finally 'gets into a coma' occur.

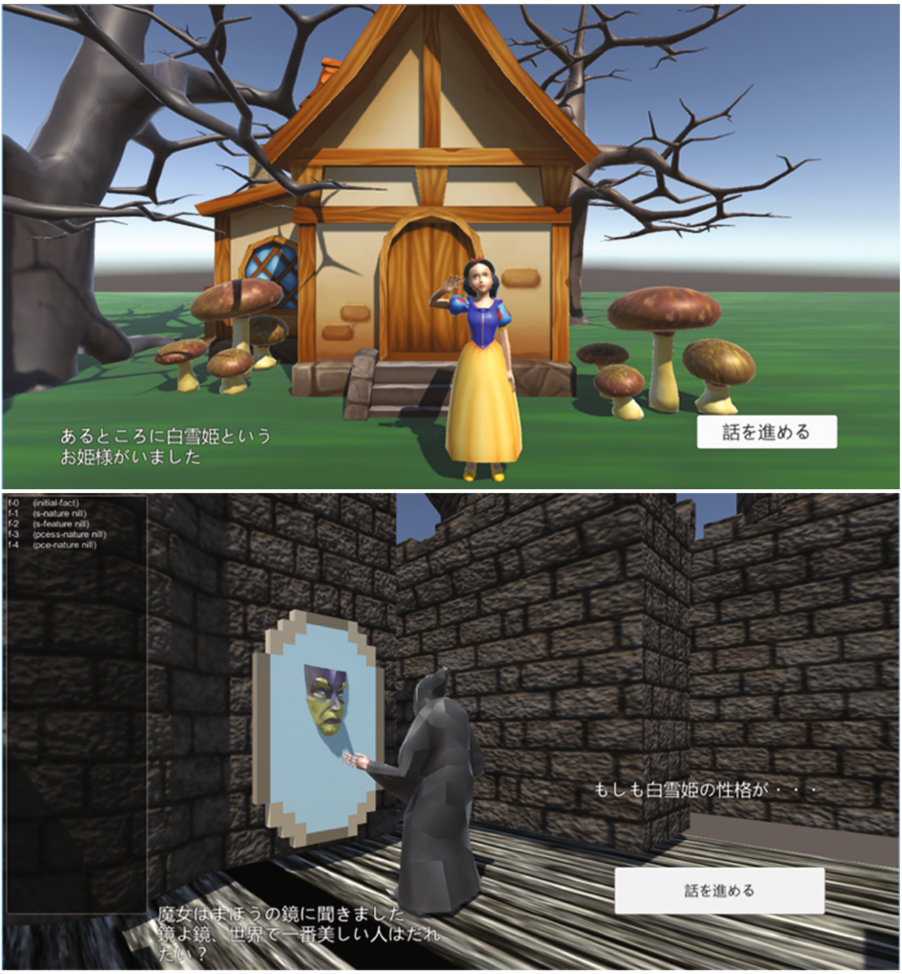

Fig. 1. System screenshot (Snow white).

By pressing the button on the screen, text information of the next storyline is read by a voice synthesizer and an animation appears. In addition, in the window on the left side of the screen, the user can operate it to confirm the definition of the characters currently selected by the user. The lower side of the screen shows the storyline. For example, when the user encounters the branch, 'The woman visits Snow White's house', the user sets the definition of Snow White with a 'doubtful character'. Then, based on the definition, it acts as 'do not receive apple from woman'. In addition, if Snow White's definition is 'pure personality', actions such as 'receive apple from woman' and consequently 'go into a coma' occur.

3 Conclusion

We conducted a workshop to evaluate the system for 21 fifth graders in elementary school and distributed a questionnaire to determine whether our system improves creativity and asked the users' impression of the system. We evaluated how creativity was enriched before and after the system was used via the creativity test [9]. The screen of the system was projected on a paper dome with a projector using a fisheye lens. The paper dome is shaped like half a sphere and is made of cardboard. The experiment took 45–50 min. In the creativity test, the experimenter showed the picture, asked children about continuation storyline of the picture, and then let them write it on the paper. The children were asked to write as many sentences as desired.

We compared the pre-test and post-test scores using an existing creativity test for children subjects in elementary school. Thus, since the children's post-test score significantly increased compared to the pre-test score, it could be concluded that the creativity of children improved. Observing the content written by the children on the post-test, there were many cases where they changed the personality of the characters. We observed cases where children created stories of how the story would look like if the characters were gentle, evil, and so on. It can be concluded that by using the 'What-If' function, children started imagining how the storyline would change if the personality of the character changed. According to the questionnaire, at least 90% of the children responded positively to questions such as: 'Is the story generated by the system more interesting than the existing story'? 'Is the system's operability good'? 'Is the system easy to understand'? They scored 4 or more in 5 grades. Thus, it could be concluded that the children are satisfied with the system. In the questionnaire, most comments noted that 'the system was fun because various stories could be created'. Therefore, we can conclude that it is interesting to generate various stories by using the 'What-If' function.

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