MaBook : Personalized Book Visualization Creator
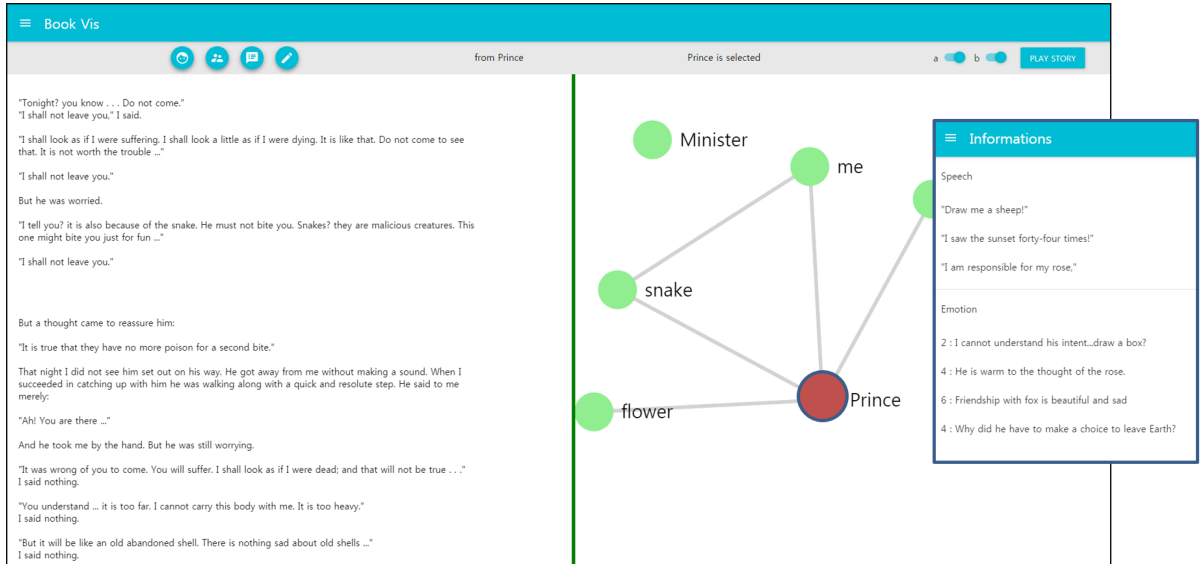
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Fig. 1. Our book visualization system

Abstract— People read books for leisure, reading discussions and storytelling purposes. They simply read books, leave notes, or even record their own visualizations. When reading a book again, when telling a story to someone else, and during a reading discussion, we must recall the contents of the book we read and the feelings at that time. Conventional book visualization provided only objective and quantitative information through text mining techniques. However, this visualization gives everyone the same information and does not provide subjective information. When reading a book, it is important to leave this subjective information, since the reader has their own feelings and interpretations. So we developed a web-based system that allows users to create their own visualizations while reading books, leaving feelings and opinions. And through the user study, we looked at how our tools can help a rich book reading experience.

Index Terms—Book visualization, Network visualization, Story telling

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1 INTRODUCTION

1.1 Motivation

Reading is an activity that anyone can enjoy in their spare time. Nowadays, because of the development of technology, electronic books are actively used and can be read more easily. Novel is a popular genre of books both young and old. A novel is a processed story of a prose form consisting of three elements: subject, composition, and style. The composition has three elements: character, background, and event. Readers interpret the character's characteristic and the relationship between the characters in their own various perspectives. Even if you read the same book, readers may have different opinions and feelings about the protagonists or about the event. And according to the chapter, the views about the characters may be different, and the relationship between the characters may become closer or even distant. When people read the book, they will draw the relationship map of the character in their head. There are many examples of visualizing a book

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or scenario. Network visualization refers to the main character in the story as one node and the relationship between the main characters as a line connecting the nodes([38, 28]). In figure 2, it can be seen at a glance at the relationship of all characters. But there are so many nodes and lines that it is difficult to focus on each character. And the visualization at the end of the story does not reveal how the relationship has changed in the middle. It visualizes the network of humanities as an adjacency matrix. You can see at a glance the relationships among all the characters, but this also shows only the final relationship, not how the relationship has changed [5]. Also, since the story in the book has a time flow, it is often expressed as a timeline visualization with the x axis as time. The timeline visualization shows a graph of the rate of appearance of the main characters according to the time of the story, or analyzes the feelings of the characters [1]. As shown in figure 3, sentimental visualization over time has been automatically drawn through text analysis and sentimental opensource libraries. However, there are many positive words in coming and going conversations, so it can not be asserted that the relationship is positive. And while two people are using negative words to talk, the reader may think that the conversation makes the relationship more intimate. As such, conventional book visualization was not the focus of the reader but of the summary. Therefore, we want to develop a reader-oriented and interactive book visualization tool. Readers will be able to read e-books and draw relationships between characters at the same time, which will help to
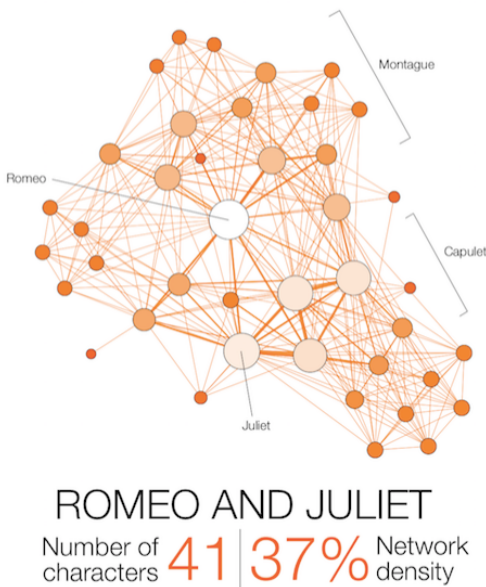
Fig. 2. The relationship network between characters in Romeo and Juliet

better understand the book. Each reader will have different visualizations and annotations, so they can share them and have a reading discussion. They could also use our system as a storytelling tool to tell the story of the book to others.

2 RELATED WORK

2.1 Reading

Read studied how students can read longer books better [29]. He asked the students to write down what they wanted to learn through reading, and what they got after reading the book. Having students set their own learning success criteria and predicting success will help them learn better. Hayles explains close, hyper, and machine reading [11]. She explained how each reading has different characteristics as the book reading pattern changes from paper to online. Bal studied how fiction novels affect empathy [2]. He found that emotional transportation affects empathy, which is more significant in the case of fiction than in non-fiction. Walny studied how people reading network visualizations in active reading [36]. In his first experiment he observed how people read visualizations drawn on paper. Based on the results of the experiment, he implemented a freehand annotation layer on the tablet to evaluate its performance.

2.2 E-book

O'hara studied how reading differs from reading on paper and online [27]. He found out the advantages of paper reading compared to online reading, and presented the design direction for online reading. Hornbaek studied how reading patterns are different between various visualization techniques when reading electronic documents [13]. He experimented with overview+detail, a fisheye, and linear interface to find different usability trends and preferences. Li has created a tool to help user draw a cognitive map while reading book [22]. He implemented a visual cue to create a system to help navigation between pages, which helped to reduce the time for navigational tasks. Hinckley developed 'GatherReader', an e-reader prototype to help gather and organize information when active reading [12]. 'GatherReader' supports pen and multi-touch input, and helps user do tasks without interrupting reading through the concept of pocket. Massimi conducted a user study where several people read the e-book together [24]. From the experimental results, she discovered how people read e-books together and

what design improvements are needed to help them. Tashman developed a computer-based active reading system called 'LiquidTex' [33]. 'LiquidTex' is a multitouch input system that supports flexible accessibility from existing paper-based design and interaction. Wu studied how e-book can help Chinese language education [40]. His system helps users to do mind mapping on the tablet. The gruning study used a diary study to see why people tend to re-read e-books less than paper books [10]. This was related to the books on the shelf still visible but not the e-book.

2.3 Storytelling, Narrative Visualization

Kosara called storytelling the next step in visualization [20]. He described the history of storytelling and typical scenarios and introduces concrete examples. He gave research directions in aspect of approach, affordances, evaluation and various aspects. Cruz said that data fabulas become narrative medium when they pass the generative storytelling engine by narrator [7]. A generative storytelling engine consists of an event model that creates a timeline and an action model that creates a character's behavior. Tong investigated the literature on visual storytelling and categorized it into linear, user-directed/interactive, parallel and overview [34]. He then categorized each storytelling type into subcategories of authoring-tool, user engagement, transition, memorability, and interpretation. Lee created 'SketchStory,' a tool that helps you effectively present your data with your own storytelling [21]. 'Sketchstory' makes it easy to interact with a digital whiteboard with a pen or hand and make charts. Figueiras experimented with focused groups to find narrative elements that could be found in visualization and storytelling [9]. He quantitatively analyzed the subjects' comprehension, likability, and navigation scores for each story. Segal defined narrative visualization as a storytelling with data [31]. He said this would be used in promising areas such as journalistic storytelling and educational media, unlike traditional forms of traditional storytelling. He classifies existing narrative visualizations according to genre, visual narrative, and narrative structure and presents strategies accordingly. McKenna defined the seven characteristics of the stories as "flowfactors" [25]. She conducted a user study with 80 stories about how different story narrative flows impact the reading experience. Hullman studied narrative visualization in relation to bias [14]. He experimented with various techniques for framing effects in visualization. And he discussed how to apply framing effects to narrative visualization. Kim visualized nonlinear narratives using story curves [17]. Sequences of events are arranged in order, allowing the y axis (time) to move past and into the future. He visualized the famous movies that went back and forth without constant flow of time. Liu developed a storyline visualization 'Storyflow' that followed the evolution of movies and books [23]. 'Storyflow' is based on the layout pipeline and can be used for various interactions. He introduced an algorithm that draws an interactable pipeline. Hullman created a system that automatically sets the sequencing choices in narrative visualization such as slideshow-style presentation [15]. Wongsuphasawat developed 'LifeFlow', a tool to help analyze event sequences [39]. 'LifeFlow' introduces a new technique to summarize multiple events at once. Tapaswi has developed 'StoryGraph' which has a visualization technique that automatically summarizes the storyline in the TV episode [32]. 'StoryGraph' draws a figure chart through scene detection method.

2.4 Literature Visualization

Oelke created a tool for visually analyzing literature [26]. The names, gender, and relationships of characters extracted automatically from text are visualized as network, fingerprint, and plot. Wilhelm created a Web-based visualization tool that quantitatively analyzes Shakespeare's play [37]. He focused on analyzing when, how and what each person said. Storyspace is a hypertext writing tool that was first developed in 1987 and is still used ([16], [3], [4]). The tool draws a story map of nodes and links with structured data. Koch created the 'VarifocalReader', an interactive visualization tool for exploring and analyzing textual documents [19]. 'VarifocalReader 'is based on the focus+context technique instead of the overview+detail technique. Regan has studied how to visually analyze the Text of Philip Pullman's
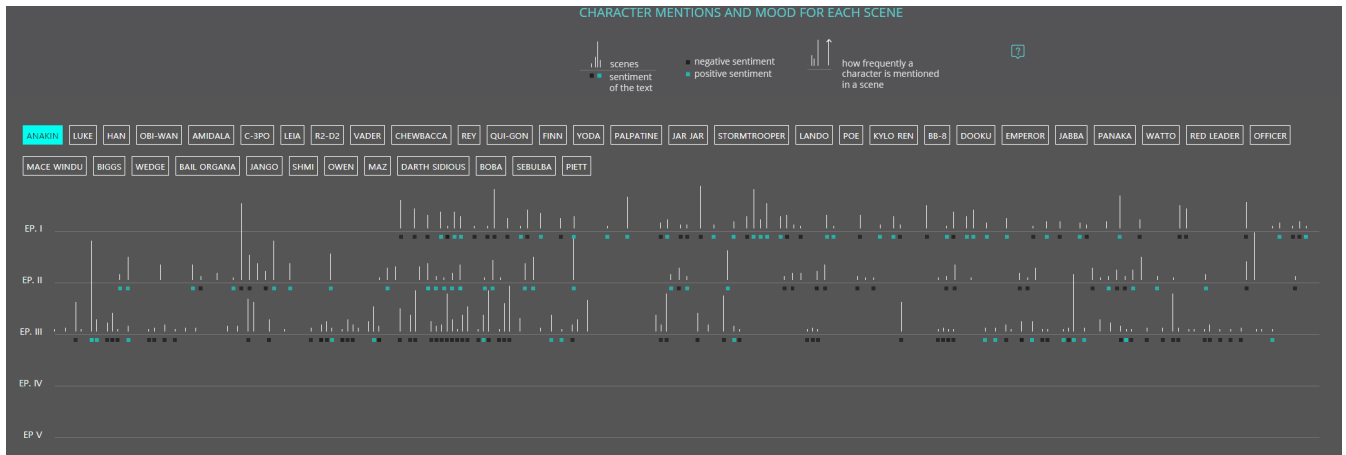
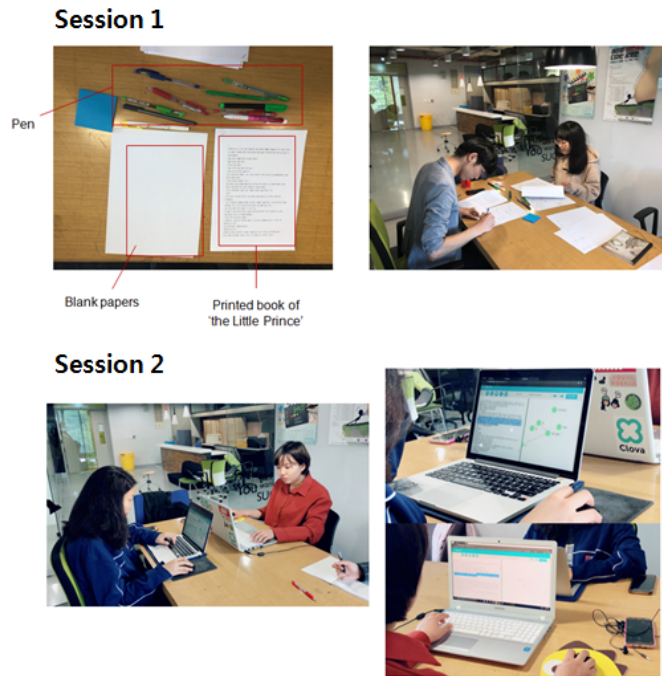Fig. 3. Sentimental timeline visualization of Starwars characters

Fig. 4. Experiment Method

Trilogy "His Dark Materials" from a sequence of words perspective [30]. Vuillemot has developed a tool called 'POSvis' that analyzes name entities in text collections in many ways [35]. 'POSvis' helps analyze entities with word clouds, self-organizing graphs, filters, and networks. Elrt implemented 'ViTA', a tool that visualizes narrative text information in a variety of ways [8]. 'ViTA' is a web-based tool that automatically extracts entities and relationships and presents them with word cloud, fingerprint, network visualization, and more.

3 USER STUDY

We conducted a user study as a combined method to verify efficacy of in-depth reading and to observe user experience while and after participants use the tools. The book is chosen as a novel, 'The Little Prince in Korean. Main reasons for choosing the book are familiarity and various characteristics with different relationships. For user study, we provided selected part related to relationship of some characters and main character, 'Little Prince'.

3.1 Method

We recruited four participants from college students of UNIST with word-of-mouth. Participants had explanations of contents, time that will take, and place before the user study. Explanations of our project and goal of the user study were also given to participants.

Whole user study consists of two sessions called S1 and S2 shown in 4. We divided participants into two groups of two participants, for observing reading with paper(S1) and observing reading with our system (S2). Participants were asked to draw a relationship network of the book while reading the book. Interviews after reading were conducted with mixed form of focus group and semi-structured interview. We conducted group interview which take advantage of communication and interaction between research participants to create data [18].

3.2 S1 : Observing reading with paper

3.2.1 Reading a book with a pen and papers

First group were asked to draw a relationship network manually. The printed book, pen with various kind and blank papers were given to participants. Before starting the session, participants received explanations of drawing a relationship network while reading a book.

3.2.2 Focus group interview

Interview questions focused on discussions of the book and drawings and writings on the printed book and given papers. Participants were asked to use their drawings and writings to discuss about contents and feelings of the book for the whole session.

3.3 S2 : Observing reading with our system

3.3.1 Reading a book with our system

Second group were asked to draw a relationship with a tool. Before starting the session, participants received explanations of functions of our tool including drawing network, add speeches and add annotations.

3.3.2 Focus group interview

For Session 2, interview questions focused on not only about the book and drew networks, but also about experiences of using a tool while reading the book. Participants were asked to discuss about book using their network relationship and speeches and annotations they saved for the whole session.

4 DESIGN

Our system should support reading books and creating visualizations at the same time. Therefore, the system is largely divided into e-book, workspace and detail view. The e-book will occupy the left side of the screen and the width size can be adjusted as desired. The user then creates a visualization on the right side of the system screen. In

this section, we will introduce each view. We did web development using JavaScrip (node.js). Interactive visualization system was developed using react and d3 library [6]. The beta version that has been developed so far can be seen in the figures.

4.1 E-Book

Our research is far from an e-book interface design or usability improvement. So we do not follow existing e-book interface. It shows the text file of the book and can be scrolled to read the entire contents. We provide text dragging, which allows the word or sentences to be easily captured. You can do two things by dragging text. The first is to drag the name of the character to make the node straight. The second is to drag and save the words the characters say. Above e-book, there are four buttons. They are 'Create Character Node', 'Create Relationship Link', 'Create Character Speech' and 'Leave subjective information' which are (a),(b),(c) and (d) in Fig. 6. Click on one of the nodes and press the button in the upper left corner (e) to see the details of the character. Each button function requires dragged text or selected nodes. If the button is clicked while these requirements are not met, a notification message pops up shown in Fig. 5.

4.2 Workspace

The user will work in the workspace to visualize. User can add nodes and links to draw network visualizations. Nodes and links can be freely created, modified and deleted at any time. We will concentrate on the relationship between the character in the book, each node is the character and the link represents the relationship between characters.

4.2.1 Network Visualization

The number of nodes does not have to be equal to the number of all characters in the book. User can create a node if he thinks it is important in the story. When you create a character node, you can drag the text of the E-book and click the button (a). Then one node will appear on workspace (Fig. 6). After user creates a node, he can annotate basic information about the character. Not only information about the person, such as gender, age or occupation, but also subjective opinion such as person's importance, favorability about the person can be written using annotation. There is no need to have a link between all nodes. And no matter what relationship two characters in a book have, they do not necessarily have to be connected by lines between the two characters. When you create a relationship link between characters, you must first select two nodes in the right workspace (Fig. 7). Click on the source node and target node that you want to create a relationship and click the Create Relationship Link button (b) to draw the link. The graph on workspace can be zoomed in and out using the mouse wheel. The network is based on a forced-directed graph, and the link length is freely adjustable.

4.3 Detail View

If you want to save a particular dialogue of the character, drag the dialog and press the Create character speech button (c). Then you will see a drop-down that allows you to click on a character (Fig. 8). Speech information can be seen by selecting the character node and pressing the detail button (e). You can enter subjective information about character (Fig. 9). Click on the character node and press the button (d). In the pop-up window, you can leave your emotion and annotation on the character. Emotions has seven scale from negative to positive, and annotations can be freely written. These subjective information can also be confirmed by pressing the button (e).

5 RESULTS

In this section, we will analyze the results of the experiment and show you the interviews. We asked participants to talk about active reading behavior, understanding the book, and related feedback.

5.1 S1 : Analysis of Experiment Result

Participants made writings and drawings on the paper and on the book while they read the book. P1 and P2 usually took notes on the blank paper. Moreover, Writings are accounted for majority of the notes
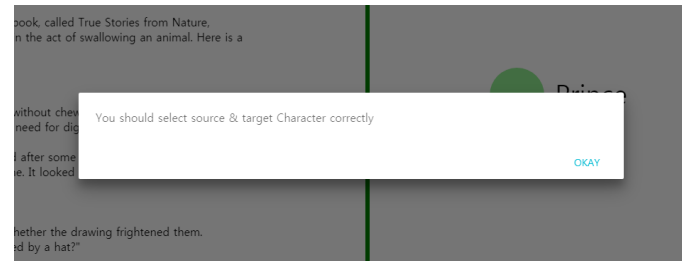

Fig. 5. Notice message

on the empty paper, even though both participants are asked to draw relationship network through whole user study.

5.1.1 Notes on the empty paper (writing)

Both P1 and P2 used keywords to take notes on the paper. P1 used keywords to identify characters and their properties and P2 used keywords to identify places and characters that 'the Little Prince' met. Quotes and summary also take big portion of the whole notes. P2 tried to quote whole sentences of speeches that P2 feels important part of the story. While P2 did not leave any note of feelings ans emotions of oneself, P1 leave own thoughts on the paper by short comments.

5.1.2 Notes on the empty paper (drawing)

Icons for drawing relationship and identify characters. P1 made relationship of 'I' and 'the Little Prince' with 'the sheep' through making icons of each elements. P1 also drew icons to identify characters and wrote short description beside them. Illustrations are used to describe scenes of the book. P2 made drawings similar to illustration to describe specific scenes like the first moment of 'the Rose' came to 'the Little Prince'. Symbols are also used like arrows to inform the lapse of time and subcategories and brackets used to emphasize keywords. P1 drew arrows for indicating a lapse of time of the story. P2 drew arrows for indicating subcategories of writings. Brackets are used by P1 to emphasize keywords of the paper.

5.1.3 Notes on the printed book

Participants also made notes and highlights on the book, with lines and color pen. Circle are used to sign keywords of the book. Brackets are used to mark long sentences. Highlights and underlines are used to mark sentences that P1 and P2 wanted to remember. While P2 did not leave any comments on the book, P1 leaved opinions of oneself, beside or under the sentences.

5.2 S1 : Observation of Reading Behavior

Q1 : Leaving the annotation, some left on the book and some on the extra paper. What is the difference between the two?
P1 : He mostly handwritten on extra paper. We asked why he did. *'The purpose of the handwriting is to organize my thoughts while reading rather than to look again later. So I handwritten with a single color pen on the extra paper.'*
P2 : She used both books and extra paper. On the extra paper, she summarized the contents and highlighted line on the book. We asked her writing style. *'Black is a common word, blue is a meaningful word, and fluorescent light is a word thought to be important. It is a good sentence to look at in the whole context, I thought that it is meaningless to write the sentence separately.'*
Q2 : Why did you leave other symbols or drawings besides writing?
P1 : He used some mathematical symbols and we asked the reason why. *'It is just my writing habit. The words 'therefore' and 'because' are easier to write symbols instead of writing. And at first, I wanted to draw a picture to represent the character, but gave up because it was difficult.'*
P2 : She draw network with figures and arrows. *'I liked to look at the picture rather than just reading it, so I drew it. At first I tried to draw a*
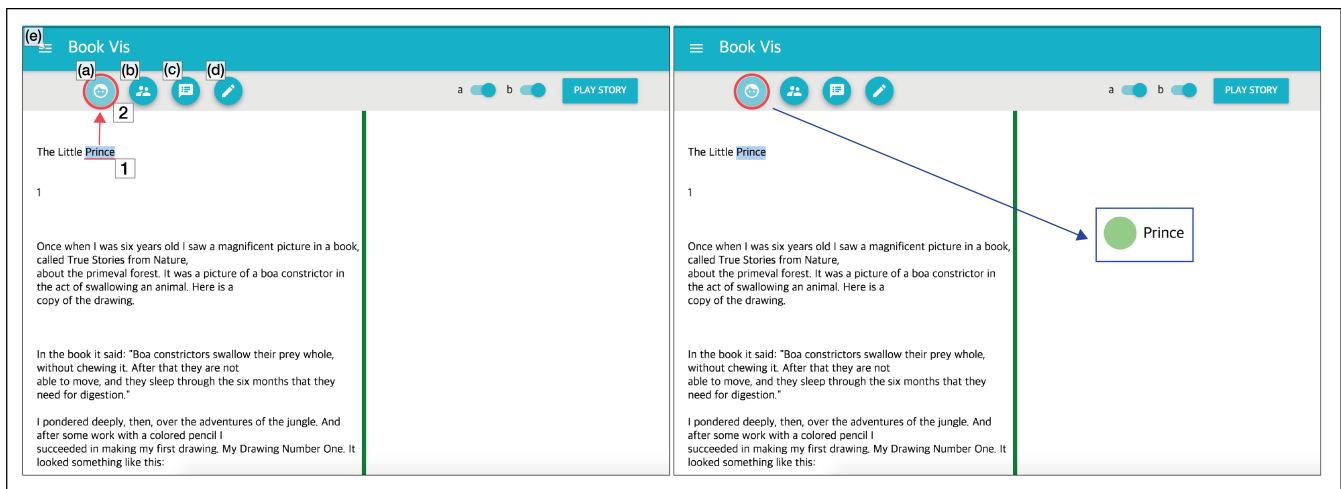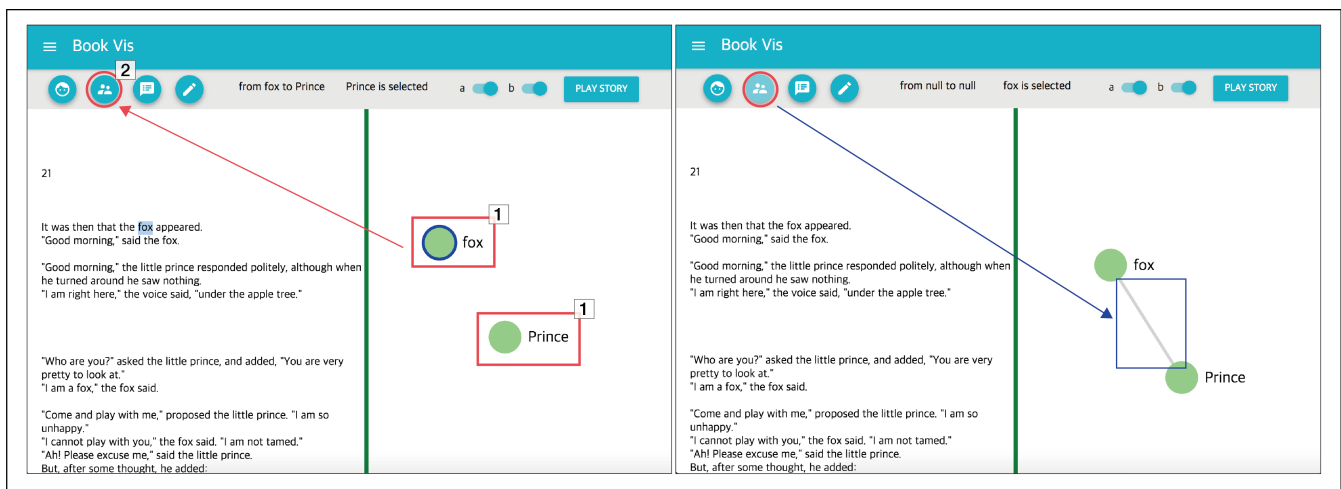
Fig. 6. Creating character node

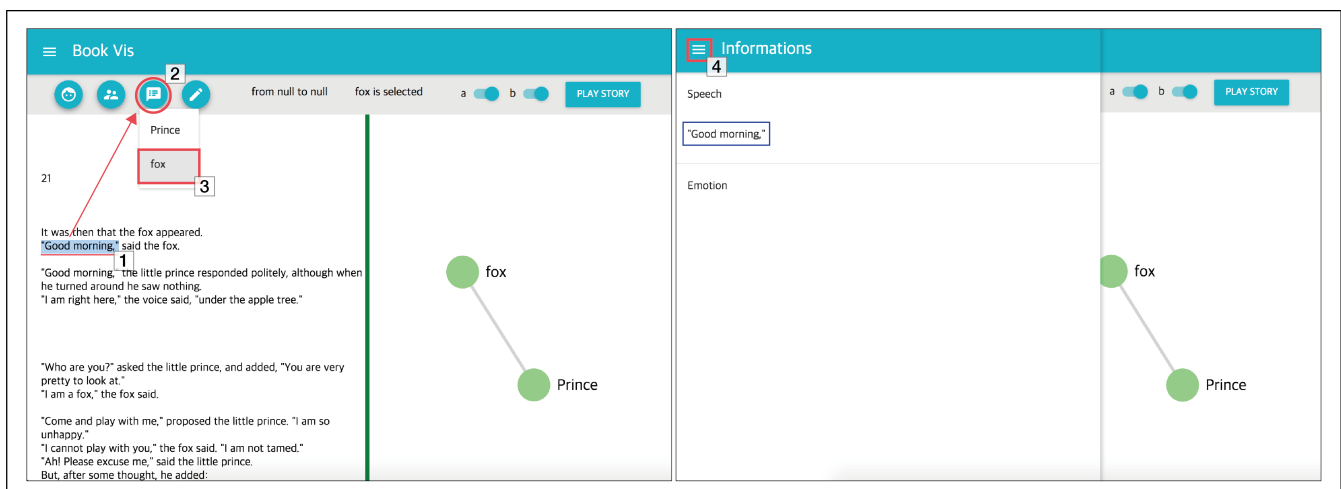Fig. 7. Creating relationship link
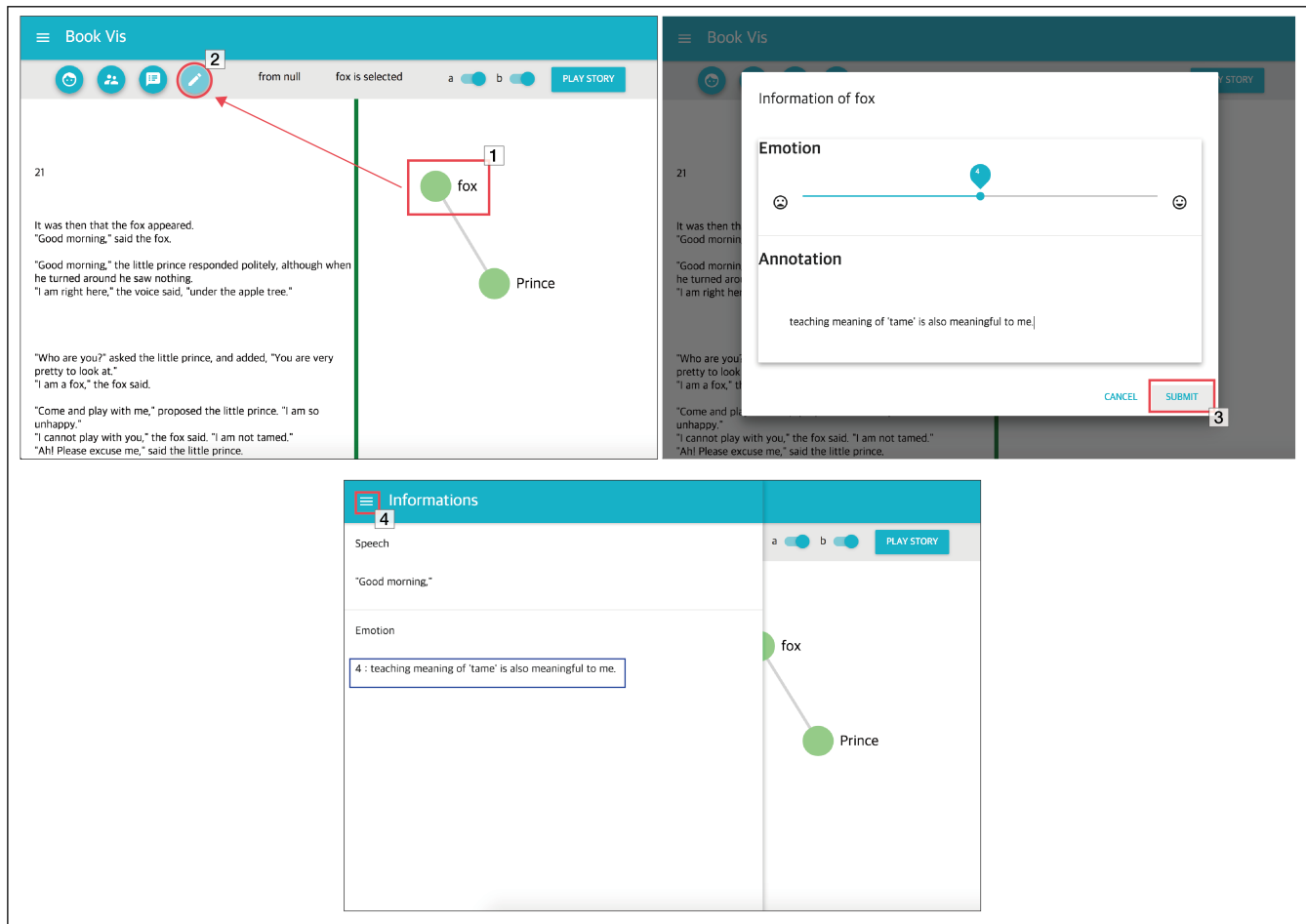

Fig. 8. Add character's speech

Fig. 9. Add emotion and annotation

relationship between characters, but many people just met and passed the little prince. So instead of relationships, I drew arrows to represent the time flow.'

Q3 : Why do you go back to the previous page while you are reading a book?

Both of them read through the pages during the experiment. And after reading it, they did not stop the experiment and went back to the previous page and read the book again.

P1 : He said that he did not understand back part, so he went back to the front page and read about related part. *'After reading the book, I read the front part again. The reason is that when I read the book and look at the front again, there are new interpretations.'*

P2 : *'When I read a book, I thought that one character seemed to be in contrast to the character who appeared in front of him. It is a fox and an old men. I reread the front part of the book to look again at the dialogue of the two characters.'*

5.3 S1 : Understanding of Story

Q1 : What was the most impressive part?

P1 : He showed what he had written, he wrote down the words of the characters. *'I was so impressed by the expression that the fox was 'tame'. At first, the little prince did not know the meaning of roses, but after seeing the fox, he thought of the tame roses.'*

P2 : She opened the book and showed a sentence marked with a highlighter.

'The fox said, 'The word is a source of misunderstanding', which gave me a great understanding.' Then she turned over the page and unfolded the part where the rose appeared. *'I think roses are different from words and behaviors, and it seems to have caused misunder-*

standing.'

Q2 : Were there any major changes in your feelings while reading the book? So, did you write it down separately?

P1 : He said there was a part that felt different when he was young and when he read it. *'The fox tells the little prince, 'If you come at four, I'll be happy from three.' I just realized this meaning now.'* But he did not record this idea because the idea of the moment could change later. He said, *'If I read it later, I may think it differently, so I do not write it down.'*

P2 : She said, showing the handwritten notes that *'The thing that adults lost'*. *'I was very sad when I saw this passage, because it reminded me the character of 'Bing Bong' in the movie 'Inside Out'. The reason I did not write the emotion separately was because it seemed that the emotion would come to mind when I was writing.'*

5.4 S1 : Feedback and Suggestion

Q1 : Can you use your annotations to storytelling to others?

P1 : He said he could explain the story only with his annotations. He said, *'If you understand the contents properly, memories will be recalled from your notes. But if I have to show this handwriting to others, I think I'll write it again a little more neatly.'*

P2 : She said if she had a storytelling, she would like to write down the annotation again. *'I think I have to correctly indicate who said which dialog. However, if there are a lot of lines, there will be too many lines to read, so I think I will write simply to know where the lines are located.'*

Q2 : If there is a tablet tool that supports active reading of novels, what function would you need?

P1 : He was skeptical about the ability to pull out the text of a book
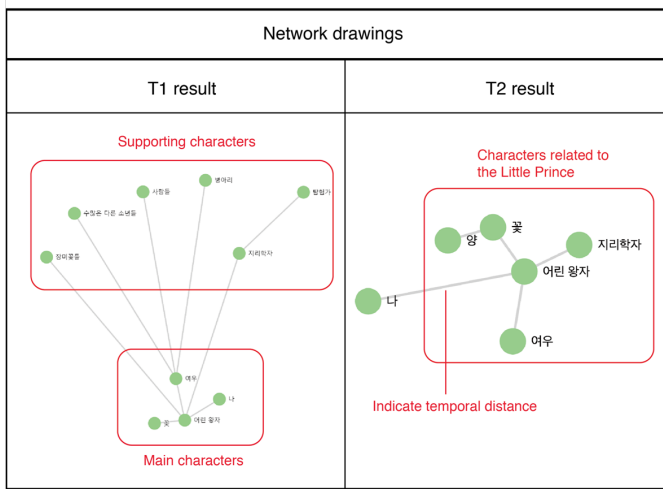
Fig. 10. The result of P1 and P2 in session 1

Fig. 11. The category of result in session 1

Fig. 12. The result in session 2 - Network Visualization

through copy and paste. *'I tend to think slowly with writing, while copying and pasting is very fast. Then I do not have time to sort out my thoughts. I also do not like the fact that it is not really my handwriting.'* He said if he do this with a tablet, it would be useful if it has export function that annotation can use in other applications.

P2 : She said she would like to have the ability to show what part of the book is associated with the rest. *'I wish it had the ability to navigate to the book's content by clicking on the handwriting.'* She also said she wanted to take advantage of icons. *'For example, if I want to put a fox icon, it shows all the fox pictures from the internet. Then I choose one of them to create a network of people ..'*

5.5 S2 : Analysis of Experiment Result

5.5.1 Relationship network drawings

T1 drew whole relationship that can be observed in the book while T2 focused relationship which considered as more significant than others. T2 said she tired to put all characters at first, but she deleted nodes which seems less significant than others and decided not to put all characters. T1 said that she put not only appearing characters but also mentioned characters from speeches. T1 put 'Human' and 'Chick' as character nodes which mentioned from conversations of 'the fox' and 'the Little Prince'. T1 also put other name of the Little Prince,'Explorer', which called by 'Geographer'. Both participants also emphasize some relationships by grouping and adjusting distance. T2 put 'I' and 'the Little Prince' distant to describe temporal distance, rather than psychological distance. T2 put characters around 'the Little Prince' to inform relationship belong to 'the Little Prince'. T1 put character nodes on the top which considered as supporting characters to differentiate from main characters which exists on the bottom of the drawing.

5.5.2 Leaved speeches

Both T1 and T2 leaved speeches of the book that considered as important and desired to leave to remember. Speeches are focused on relationship of 'I', the Little Prince' and 'the rose', which is main part of the printed book. Meanwhile, T2 put not only speeches but also sentences describing emotions that she thinks impressive. T2 put speeches to describe specific property of character. T2 marked continuing questions of 'the Little Prince' at speeches menu, to describe his childlike characteristics.

5.5.3 Leaved emotions and annotation

T1 said she tried to leave emotions at first, but later did not scale any emotion because she thought it is useless. Instead, T1 leaved her own evaluations and feelings about characters at the annotation menu. T1 evaluated 'the Little Prince' as one sentence, "the Little Prince love the rose , but do not know how to love." T2 scaled emotion as a character

might feel in the book, excluding her own emotions. T2 said she did not leaved any annotation or emotion to character nodes which give her feeling of existing as a kind of literary device.

5.6 S2 : Observation of Reading Behavior

Q1 : Did not the tool interfere with the book reading?
T1 : She read a lot of text and then used the tools' functions. *'I was not able to read the book at the same time as using the tool's various functions. There was a feeling that there was an interruption because there was a story.'* She also said she had to concentrate more on scrolling so she did not miss what she was reading.
T2 : She had a habit of reading PDF and marking it with a highlighter. But our tool has a lot of other features, so she said it feels like reading is interrupted.
Q2 : How do you think about dragging text to create a node or leave a note? The two users expressed opposing views on this question.
T1 : She said she was comfortable with having to type the name of the node directly when drawing a network of person relations. She said that thinking about how to name it could be a hindrance to reading.
T2 : When she added the node, she said she wanted to name the node. She said, *'All the characters do not have names alone, do they? I wanted to add a nickname or an additional description.'* And she said that the amount of text to drag and store is too much because she considers the entire paragraph more important than one sentence.
Q3 : Did the function to leave emotions help to record emotional changes?
The basic emotional recording function that we provided was not very helpful to both users.
T1 : She said that it was difficult to choose on a linear scale because of the variety of emotions. She said *'I'd rather write my feelings freely without guidelines.'* In her emotional annotations, she used various words such as 'anger', 'curiosity', 'regret', 'vanity'.
T2 : In our system, user could leave emotions only about characters. So,she said she wanted to leave feelings about sentences, paragraphs, and so on. *'I do not know exactly what I feel about it, so I do not know where to add it.'* So she rarely used the annotation to leave feelings.

5.7 S2 : Understanding of Book

Q1 : What was the most impressive part?
T1 : She had the most impressive part, but she did not leave any memos. So she searched the word 'wheat field' through the word search. She said, *'I was most impressed when the fox looked at the wheat field and remembers the little prince.'* She did not leave much to subjective feelings because she thought that she should leave it with objective information. The annotations she left were mainly those of each character.
T2 : She showed us the sentence she had saved as an annotation of 'Me'. *'It was most impressive when 'I' said he was moved by walking with the little prince.'* She left the impressed dialog mainly as an annotation.
Q2 : What do you think of the relationship between the rose and the little prince?
T1 : She grasped the characteristics of each of the roses and the little prince and objectively assessed the relationship between the two. She noted that the little prince is angry about the flower and regrets leaving it. And she left a note saying that the flowers were vanity and pride, but in fact she was sad. She said, *'It seems to me that the process of realizing that the rose is not a 'transient being' is important to little prince.'*
T2 : She felt impressed by the first meeting of the little prince and the flower so left it as a memo. The seeds that were different from the baobab tree that came from somewhere seemed to be a very special expression. She also said that the expression "lovely flower" was pretty and left as a memo. She said, *'The process of the rose and the little prince realizing each other's preciousness seemed like love story.'*

Leaved emotions / annotations		Leaved speeches	
T1 result	T2 result	T1 result	T2 result

Fig. 13. The result in session 2 - Leaved annotation

5.8 S2 : Feedback and Suggestion

Q1 : Was it inconvenient to scroll the pages of books?
T1 : Our system did not have a page number at the bottom for scrolling. She said, *'If there was a page number, I can see where I am currently reading and what the remaining pages are. But scrolling was impossible to do it, and I felt like I had a lot to read psychologically.'*
T2 : Unlike P1, she said she was comfortable with the scrolling and did not feel the need for page numbers.

Q2 : What are the advantages of this system over writing on paper?
They said they were not good at writing when she they reading a book.
T1 : She said, *'I think the tool has encouraged me to take notes. And the handwriting seems to have helped me recall the memory later.'* But she added that it was uncomfortable that she could not write on the text just as it was in the book.
T2 : The main function of our system is to help to draw network visualizations. She said she was able to think more deeply about the relationships between the characters as she was drawing the network.

Q3 : What else do you need if new features are added to this tool?
T1 : She used various drawing tools because her major is design. If it is similar to the existing interface of the existing tools, it seems to be able to use it intuitively without hesitation. She said additionally, *'It would be better if I could leave a variety of notes in various places without focusing on people and relationships.'*
T2 : She liked the network visualization very much and suggested additional features. *'I think we can show more information in terms of size and color of the node. And since the relationship is bi-directional, I think it might be better to point in an arrow.'* And she said she has a habit of sticking post-it when reading real books. So it would be useful if the system has a similar bookmarking feature.

6 DISCUSSION

Through experiments, we have learned the following points. The writing style differs according to the usual reading habit. Because all four of the experimenter were writing in different ways, we were able to get a variety of results. We are planning to conduct a user study on a lot of subjects to observe more writing method. All of the participants wanted to know where the content of annotations they left is located. It shows that a hyperlink function is needed for our tool to create a different advantage from paper books. Participants in Session 1 painted their own characters or used their own markers. This is the part our system does not currently support. Therefore, we will add to the tool the ability to add icons or create owns symbols. Participants in the Session 2 said that is was unfamiliar to active read the novels on PC. In this regard, it is our limit that usability was not good. For the future study, we should develop tool that can do active reading on tablets similar to the e-book environment. Participants in the Session 2 moved the nodes to create a group when they create the network. So, we will add features such as creating groups, changing the color and size of nodes and link. If there is a network relationship, there is a tendency to storytelling while explaining the relationship. There are participants who prefer automatic system and those who do not. We considered a lot of constrain when designing the system, which hindered the user's freedom. It means that our tool should automatically supports users with a high degree of freedom. Also participants did not like to leave emotion on linear scale bar. We designed it on a scale that would give them the burden of choosing if they had too many choices, which hindered freedom of expression. We will develop tool that can leave a variety of feelings without guidelines.

7 CONCLUSION

We have developed a system to leave our own subjective emotion and interpretation of the book. And we observe what different behaviors are when reading paper books and reading books with our system. We could not generalize because there were a small number of experimenters, but we could see that participants had different reading behaviors. Through observation experiments, we were able to discover characteristics of reading that we could not think of, and we got an idea of how to improve the system in the future. Through feedback from the participants, we will redesign to create a user-centered system. We will be able to develop novel systems that will help us to read novels through constant design modification and prototyping.

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