iPoster: A Collaborative Browsing Platform for Presentation Slides Based on Semantic Structure

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Abstract. Coursera and SlideShare are crucial platforms for improving education; students are able to obtain various educational presentation materials through the Web. Recently, Prezi introduced a zoomable canvas as a substitute to the traditional presentations that allows users to zoom in and out of the presentation media. Teachers then attempt to provide presentations in a nonlinear fashion for enhancing the user interaction through these presentations. However, creation of non-linear presentations would be time-consuming, besides posing design challenges. In this paper, in order to support collaborative browsing, we build a novel collaborative browsing platform that generates meaningfully structured presentations, called "iPoster;" this enables users to automatically navigate through the slide-based educational materials. The system places elements such as text and graphics of presentation slides in a structural layout by semantically analyzing the slide structure. The structural layout can reveal the hierarchy of elements by moving from the overview to a detail using automatic transitions, such as zooms and pans. Through this, the collaborative browsing platform can support multiple students to interactively browse an iPoster in cyberspace on their tablets. The navigation information maps each student's specific needs by considering the student's operations, and detects other students who have similar learning purposes to help them share their interests with each other.

1 Introduction

Slide-based visual presentation support, such as Microsoft PowerPoint or Apple Keynote, is now one of the most frequently used tools for educational purposes currently. However, this format has been criticized repeatedly because of the limitations it imposes on authors and presenters [16]. Enormous amounts of slide-based educational materials that are often based on the collaborative learning teaching materials (i.e., textbooks), are freely shared on Web sites such as Coursera[1] and SlideShare[2]. Thus, students can browse the presentations anywhere, such as on a public display connected to a computer in a classroom or on their own tablets. However, the current slideshow mode of presentations merely permits fluid navigation of linear structures, even while it is being presented to a

[1] https://www.coursera.org/
[2] http://www.slideshare.net/

A. Nadamoto et al. (Eds.): SocInfo 2013 Workshops, LNCS 8359, pp. 29–42, 2014.

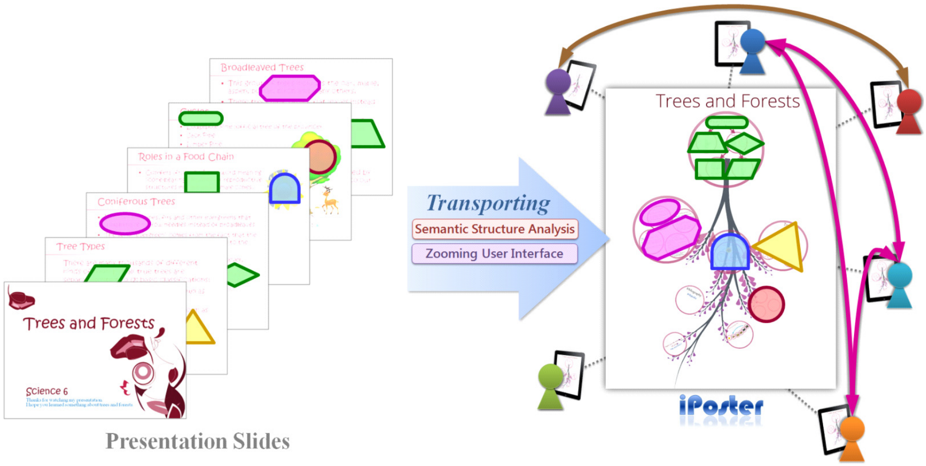

Fig. 1. Conceptual diagram of a collaborative browsing platform based on iPoster

diverse audience. Moreover, in CSCW tools, group awareness plays an important role in enhancing the effectiveness of the application [2]. In a case of a linear text document, it is challenging to map collaborators to one another, based on mutual interests. Canvas presentations are attempts to mitigate the problems posed by slideware. For instance, Prezi[3] provides an infinite canvas with a zoomable user interface (ZUI) [1] as an alternative to the traditional slides. This interface permits the canvas format to support the creation of expressive layouts. These layouts can be zoomed out, allowing the slide arrangement to be presented in its entirety to the audience [8]. The canvas model was also adopted by pptPlex[4]. In order to effectively support collaborative learning, authors and presenters will be required to create and deliver presentations in a nonlinear fashion. However, this will be time-consuming and pose challenges in designing.

As depicted in Fig. 1, we present a collaborative browsing platform that generates a meaningfully structured presentation by transporting the presentation slides. It promotes user interaction and communication and is called the "iPoster," or an interactive poster. Users can access an iPoster on their tablets using a zooming metaphor in cyberspace. They can interactively browse the iPoster through user operations, and connect with each other's tablets. A collaborative browsing platform based on iPoster, which can share and navigate information, matches each user's specific requirements by analyzing the operations of the users. Further, it detects other users who have similar requirements by mapping the similarity in their operations and conveys their interests to each other. iPoster can be implemented by 1) analyzing the semantic structure of textual and graphic elements in slides and the semantic relationships between them; and 2) employing the zooming user interface for organizing elements in

[3] http://prezi.com/
[4] http://www.microsoft.com/en-us/download/details.aspx?id=28558

structural layouts, using zooming and panning transitions based on a basic idea of Prezi. In semantic structure analysis, we first extract elements by examining the presentation context of the particular element in the slides. The semantic relationships between these elements are determined using implicit hyperlinks in slides, based on a slide structure. Specifically, we derive the slide structure by focusing on the itemized sentences of bullet points present in the slide text. There are various types of structural layouts for constructing an iPoster, such as tree structure, stacked Venn, and pyramid structure. In this paper, in order to provide an overview of the content, we utilize a tree structure, combined with a stacked Venn for an iPoster. Finally, our iPoster is generated based on semantic relationships, using a ZUI for collaborative browsing, which can raise the collaborative awareness, and interaction, besides enabling users to understand the educational presentations easily and efficiently.

This paper is organized as follows. Section 2 reviews related work. Section 3 describes our semantic structure analysis model to extract elements from slides and to determine the semantic relationships between elements based on the slide structure. Section 4 explains the detailed procedure of an iPoster generation, based on the derived semantic relationships by employing zooming and panning transitions. Section 5 presents our collaborative browsing platform based on iPoster. Finally, Section 6 concludes this paper with suggestions for further work.

2 Related Work

A variety of applications address the identified weaknesses of the current slideware tools in the presentation and authoring domains. Our approach in iPoster builds on the strength of collaborative browsing.

Many recent applications address the need to capture complex relationships among content items, and assist in crafting compelling narratives. These applications employ both, new or unusual hardware configurations, as well as novel interfaces. Lanir et al. [5] proposed the MultiPresenter application that leverages spatial reasoning capabilities to relate content through dual-screen projection. Although iPoster does not adopt the dual-audience-display paradigm, it addresses the need to navigate through elements dynamically during the presentation. NextSlidePlease [15] is a novel application for authoring and delivering slideware presentations. This tool addresses issues of content integration, presentation structuring, time-management, and flexible presentation delivery. iPoster is similar to this work, as we utilize a structured layout, rather than one or more slide lists, to allow interactive and collaborative browsing by users for each other.

Good and Bederson [3] proposed replacing the card stack or film strip metaphor with a ZUI in their CounterPoint application, borrowing insights from the domain of mind-maps or concept maps [12] and visual storytelling [11]. Our iPoster uses a ZUI to navigate to the elements from slides. The Fly application addresses graph-based presentation authoring [9]. It provides a set of tools for authoring presentations from scratch in a two-dimensional canvas with defined paths. Our iPoster aims to utilize the strengths of ZUIs for providing an enhanced collaborative browsing tool.

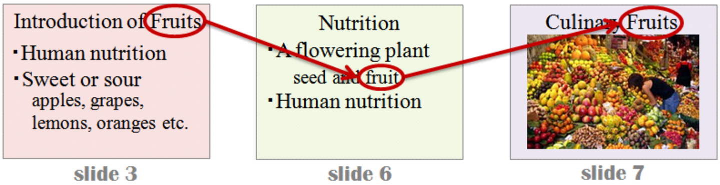

Fig. 2. An example of "fruit" appears at different levels in slides

Maekawa et al. [10] proposed a content partitioning method for collaborative browsing. It converts a tree-structured content into a complete graph and adapts a graph partitioning problem to the graph. On the other hand, Laufer et al. [6] argue about the use of avatars in ZUIs are providing a uniquely efficient environment for collaboration in productivity applications. Multiple users can develop a presentation together; create a mindmap, and a storyline or do brainstorming. Katayama et al. [4] proposed a collaborative document revision system as a web application. The collaborative document revision has a reviser-viewer, a reviser-reviser and a viewer-viewer collaboration. Our collaborative browsing that focuses on users' operations on their tablets using a zooming metaphor.

3 Semantic Structure Analysis of Presentation Slides

In this section, we describe a semantic structure analysis model for extracting elements and determining the semantic relationships between them. Preliminary ideas regarding this model are given in an algebraic query model [13] as well.

3.1 Element Extraction

The two most salient and dominant elements in a presentation slide are the set of textual elements and the set of graphic elements. These are based on the itemized sentences of bullet points in the slide text. We define the slide title as the 1st level, the first item of text within the slide body as the 2nd level, and the depth of the sub-items increases with the indentation levels (3rd level, 4th level, and so on). Non-text objects such as figures or tables are considered to be at the same indention level as the surrounding text.

Textual Elements. We define textual elements as topics that focus on the nouns in slides. Based on the presentation context, a topic can be described as a learning point with multiple nouns that frequently appears at the higher levels (such as in the slide title) in neighboring slides. Initially, we extract noun phrases using a language analysis toolkit MSR Splat[5] based on the XML files of slides.

The topics that appear in the title of a slide and the body of other slides can be considered to indicate its context in a presentation (see Fig. 2). Then, we

[5] http://research.microsoft.com/en-us/projects/msrsplat/

extract topics by locating the same noun phrases in different slides, at varied levels. If a noun phrase k appears at different levels in slides s_i and s_j, then k is a candidate for being one of the topics T in the presentation. The steps to determine T using k is explained here, which is presented both, in s_i and s_j.

$$T = \{(k, s_i, s_j) | l_{max}(k, s_i) \neq l_{max}(k, s_j)\} \quad (1)$$

where, T is a bag of noun phrases that can be considered as candidates for topics. $l_{max}(k, s_i)$ is a function that returns the highest level of k in the slide s_i. For instance, when the highest level is the title, i.e., the first indentation level, of s_i, then $l_{max}(k, s_i)$ returns 1; and when the highest level is the third indentation level of s_j, then $l_{max}(k, s_j)$ returns 3. When k appears at different levels, k is determined as a candidate for topics provided $l_{max}(k, s_i)$ is not equal to $l_{max}(k, s_j)$. Then, the weight of k in T is defined using the levels of k, and the distance between slides s_i and s_j, as follows:

$$I(k) = \frac{1}{l_{max}(k, s_i)} + \sum_{k, s_i, s_j \in T} \left(\frac{1}{l_{max}(k, s_j)} \cdot \frac{1}{dist(s_i, s_j)} \right) \quad (2)$$

where $l_{max}(k, s_i)$ indicates the weight of k in s_i, i.e., it returns the highest level of k in slide s_i by Eq. (1). $dist(s_i, s_j)$ corresponds to the strength of the association between s_i and s_j, and it denotes the distance between s_i and s_j. Thus, if k appears at a high level in s_i and s_j, and the distance between s_i and s_j is short, the weight $I(k)$ of k is high. Here, k, s_i, and s_j belong to T in Eq. (1).

Graphic Elements. When compared to pure textual elements, images are more attractive, appealing and informative from a psychological standpoint. Based on the study of search results presentation [7], it can be noted that summaries with images assist in quicker understanding of the results, thereby helping in arriving at relevant judgments faster. Therefore, we define graphic elements as images corresponding to the topic candidates in slides, given that the noun phrases in the surrounding text of the images are similar to the topic candidates. We considered that the images used to describe the content in slides, and a slide title can be a subject of the content. This is calculated using the Simpson similarity coefficient [14]. The surrounding text can be selected from any portion of the slide, from its title to its body (i.e., from the high level to the low level). When the similarity exceeds a predefined threshold, the noun phrases in the surrounding text and the topic candidates are considered similar. Then, the images are recognized as the corresponding images of the topic candidates.

3.2 Determination of Semantic Relationships between Elements

Semantic relationships between elements are determined from a document tree of a presentation to enable users obtain relevant information between the key elements at a glance, for a quick understanding of the content.

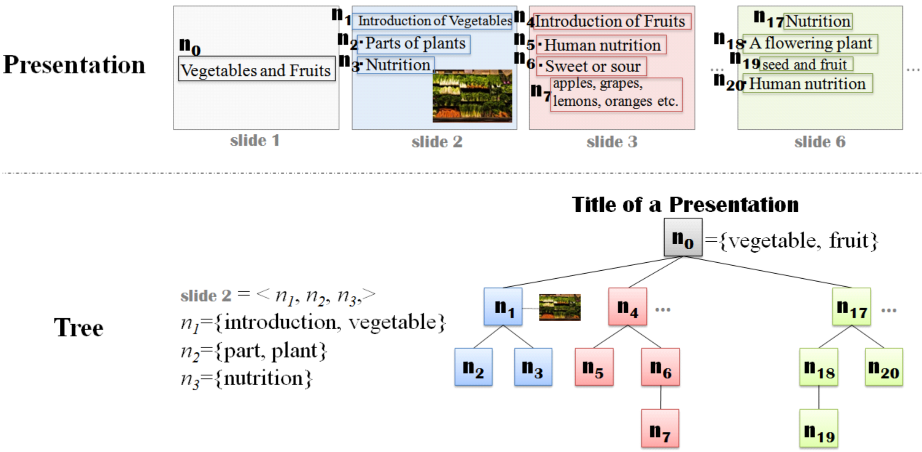

Fig. 3. An example of a presentation and its tree representation

Basic Definitions and Algebra. The presentation shown in Fig. 3 is represented as a rooted ordered tree $D = (N, E)$ with a set of nodes N and a set of edges $E \subseteq N \times N$. There exists a distinguished root node from which the rest of the nodes can be reached by traversing the edges in E. Each node, except the root, has a unique parent node. Each node n of the document tree is associated with a logical component, such as $< title >$ or $< sections >$, based on the bullet points of slides using an XML file in the given presentation. There is a function $words(n)$ that returns the representative noun phrases of the corresponding component in n. A partial tree of the document tree D with a given noun phrase as its root is defined as a fragment f. It can be denoted as $f \subseteq D$. A slide is a fragment by the slide title. In Fig. 3, $< n_1, n_2, n_3 >$ is the set of nodes in slide 2 and a fragment of the sample document tree.

To formally define the semantic relationships between the noun phrases from the extracted elements, we first define operations on fragments, and sets of fragments using a pairwise fragment join [13]. Let F_x and F_y be two sets of fragments in a document tree D of a given presentation, then, the pairwise fragment join of F_x and F_y, denoted as $F_x \bowtie F_y$, is defined to extract a set of fragments. This set is yielded by computing the fragment join of every combination of an element in F_x and an element in F_y, in pairs, as follows:

$$F_x \bowtie F_y = \{f_x \bowtie f_y \mid f_x \in F_x, f_y \in F_y\} \tag{3}$$

Fig. 4 illustrates an example of operation for pairwise fragment join. It refers the sample document tree in Fig. 3. For the given two noun phrase $x = nutrition$ and $y = fruit$, where $F_x = \{< n_3 >, < n_5 >, < n_{17}, n_{18}, n_{19}, n_{20} >, < n_{20} >\}$, $F_y = \{< n_4, n_5, n_6, n_7 >, < n_{19} >\}$, $F_x \bowtie F_y$ produces a set of fragments $\{< n_3 > \bowtie < n_4, n_5, n_6, n_7 >, < n_5 > \bowtie < n_4, n_5, n_6, n_7 >, < n_{17}, n_{18}, n_{19}, n_{20} > \bowtie <$

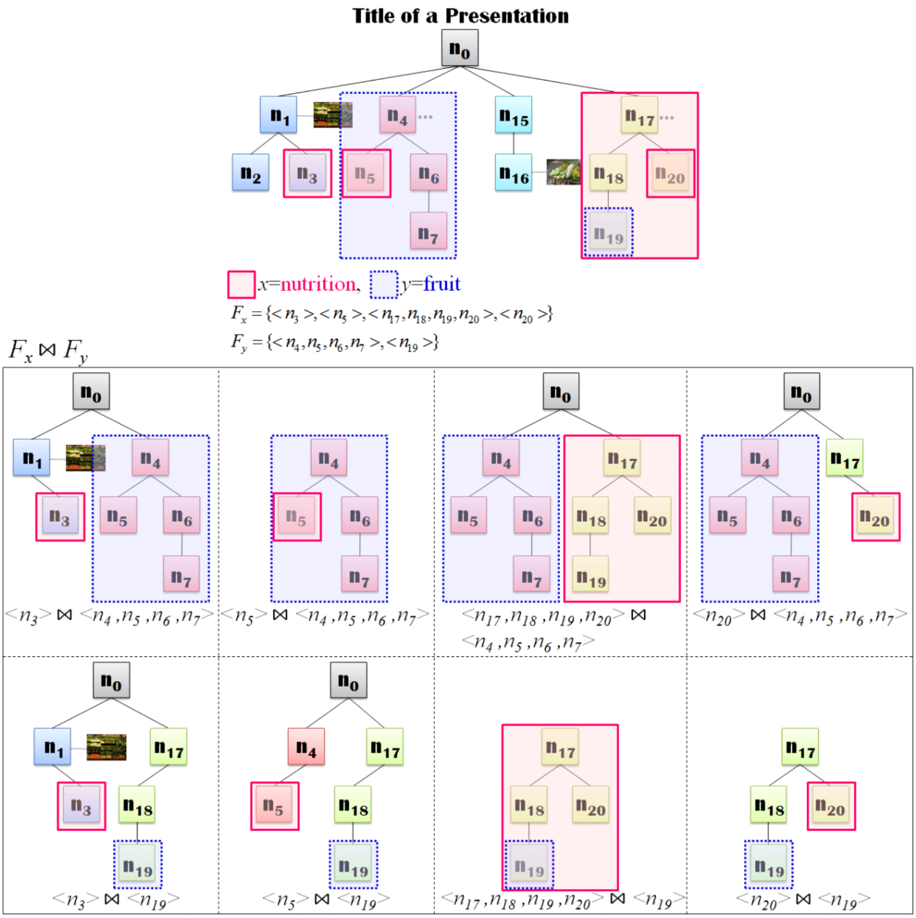

Fig. 4. An example of pairwise fragment join

$n_4, n_5, n_6, n_7 >$, $< n_{20} >\bowtie< n_4, n_5, n_6, n_7 >$, $< n_3 >\bowtie< n_{19} >$, $< n_5 >\bowtie< n_{19} >$, $< n_{17}, n_{18}, n_{19}, n_{20} >\bowtie< n_{19} >$, $< n_{20} >\bowtie< n_{19} >\}$ on applying Eq. (3).

Semantic Filters. We determine semantic relationships between the given noun phrases, x and y, from the extracted elements using the set of fragments produced by taking pairwise fragment join as semantic filters. For this, we define four types of semantic filters by considering the horizontal and vertical relevance, as well as the structural semantics from the document tree of the given presentation.

Horizontal Distance. Logically interrelated slides of a presentation are typically close to each other. Therefore, is such presentations, the horizontal distance between nodes in different slides of a document tree is a reasonable measure of the inter-relationship between nodes. Specifically, when the horizontal distance between the nodes in slides containing x and y exceeds a certain threshold, x is irrelevant to y. Supposing, $hdist(t_i, t_j)$ denotes the distance between the nodes of the slide titles t_i and t_j in slides containing x and y, we set the threshold value α at $|N|/2$, i.e., half the total number of nodes N in the document tree, for normalizing various presentations. If $hdist(t_i, t_j)$ does not exceed α, then the distance between two slides containing x and y is short (i.e., relevant); contrarily, if $hdist(t_i, t_j)$ exceeds α, the distance between two slides containing x and y is long (i.e., irrelevant).

Vertical Distance. Logically, indentations of slides are typically close to each other. Therefore, when the distance between the slides containing x and y is long, and x and y are at the low levels in slides, they can be less relevant in the document tree. When vertical distance between the nodes in slides containing x and y exceeds a certain threshold, and x and y are at the low level in the slides, x is irrelevant to y. Supposing, $vdist(r, q)$ denotes the distance between the root node r and the node containing each given noun phrase q (e.g., x or y), we set the threshold value β at $ave(depth)$, which is an average of the depth of levels in the document tree, for normalizing various presentations. If $vdist(r, q)$ does not exceed β, then the level of the node containing x or y is high (i.e., relevant); contrarily, if $vdist(r, q)$ exceeds β, the level of the node containing x or y is low (i.e., irrelevant).

Hierarchy. For judging the semantics of x and y, we compare the levels of x and y in the fragments based on the theory of hierarchical semantics. When $l(x) < l(y)$, it denotes that the level of x is higher than the level of y; x is a superordinate concept of y (y is a subordinate concept of x). Contrarily, $l(x) > l(y)$ denotes that the level of x is lower than the level of y; x is a subordinate concept of y (y is a superordinate concept of x). When $l(x) = l(y)$, this denotes that the level of x is same as the level of y; they have coordinate concept with each other.

Inclusion. We can consider the inclusion relationships between the fragments of x and y. When $f_x \subseteq f_y$, it denotes that the fragment of x is included in the fragment of y, i.e., f_x is a partial tree of f_y. Contrarily, when $f_x \supseteq f_y$, it denotes that the fragment of x includes the fragment of y, i.e., f_y is a partial tree of f_x.

Semantic Relationship Types. We determine five types of semantic relationships between the given noun phrases, x and y, by combining the semantic filters of Table 1. For measuring the relevance between x and y, we focus on the *horizontal distance* and the *vertical distance*. Here, when the *horizontal distance* between them is long, the *vertical distance* should be short. We determine hierarchical relationships, x *shows* y, x *describes* y, and x *likewise* y, by focusing on *hierarchy*. In x *shows* y, $l(x) < l(y)$ means x is a superordinate concept of y (y is a subordinate concept of x). In x *describes* y, $l(x) > l(y)$ means x is a subordinate concept of y (y is a superordinate concept of x). Then, *show* and *describe* are functionally interchangeable, when x *describes* y

Table 1. Semantic relationships with semantic filters

Relationship types	Horizontal distance	Vertical distance	Hierarchy	Inclusion
x shows y	$< \alpha$	*either*	$l(x) < l(y)$	*either*
x shows y	$\geq \alpha$	$< \beta$	$l(x) < l(y)$	*either*
x describes y	$< \alpha$	*either*	$l(x) > l(y)$	*either*
x describes y	$\geq \alpha$	$< \beta$	$l(x) > l(y)$	*either*
x likewise y	$< \alpha$	*either*	$l(x) = l(y)$	*either*
x likewise y	$\geq \alpha$	$< \beta$	$l(x) = l(y)$	*either*
x part-of y	$< \alpha$	*either*	*either*	$f_x \subseteq f_y$
x part-of y	$\geq \alpha$	$< \beta$	*either*	$f_x \subseteq f_y$
x has-a y	$< \alpha$	*either*	*either*	$f_x \supseteq f_y$
x has-a y	$\geq \alpha$	$< \beta$	*either*	$f_x \supseteq f_y$

is from the viewpoint of *y shows x*. In *x likewise y*, $l(x) = l(y)$ means x and y have coordinate concept with each other. We determine inclusion relationships, which are *x part-of y* and *x has-a y*, by focusing on *inclusion*. In *x part-of y*, $f_x \subseteq f_y$ means that the concept of x is included in the concept of y. In *x has-a y*, $f_x \supseteq f_y$ means that the concept of x includes the concept of y. Then, *part-of* and *has-a* are functionally interchangeable, when *x has-a y* is from the viewpoint of *y part-of x*. When x and y fail to match these determinations of semantic relationships, x and y are independent. Therefore, a numbers of semantic relationships between x and y are formed from a set of fragments produced by taking the pairwise fragment join; a semantic relationship is determined by majority.

In this work, the semantic relationships follow a transitivity law, e.g., iff *x shows y*, *y shows z*, then it is assumed that *x shows z*.

4 iPoster: Interactive Poster Generation

We generate an iPoster possessing the following two features: (1) Providing an overview of elements from the slides, retaining this feature of traditional posters; and (2) Utilizing a zooming user interface, reflecting the semantics of the elements and promoting user interaction.

4.1 Determination of Element Layouts

For providing an overview of elements from slides, we attempt to determine the element layouts by utilizing a tree structure combined with a stacked Venn, based on the semantic relationships between the elements. When hierarchical relationships exist between two elements, i.e., either *show*, *describe*, or *likewise* exists between the elements, they reveal a hierarchy between those elements, as applied to a tree structure. *Show* or *describe* maps a parent-child relationship in the tree structure; for instance, if *x shows y* (*y describes x*), then we mark x in a parent area and y in a child area, suggesting that the layer of x is higher than the layer of y. Additionally, *likewise* maps a sibling relationship in the tree structure; for instance, if x *likewise* y, then we locate x and y in the same layer. Inclusion relationships between two elements, i.e., *part-of* and *has-a*, reveals a logical relationship of inclusion and exclusion applied, as to a stacked Venn. For instance, x *part-of* y (y *has-a* x), we conceive an area of x that is included in an area of y, and that the area of y is larger than the area of x.

4.2 Determination of Transitions between Elements

To utilize a zooming user interface for navigating through presentations, the transitions discussed here explain the kinds of visual effects that are applied to the semantic relationship types, to reflect the meaning of the elements from the slides. We animate the zooming and panning transitions for navigating through elements in the structural layout based on the semantic relationship types; this can help users to visually understand the overview and details of the contents within a presentation.

Transitions for *show* (*describe*). When the hierarchical relationship, *show* (*describe*), between two elements is not included in an inclusion relationship, i.e., *part-of* (*has-a*), then, firstly the view must be zoomed-out from the focused element to an overview of the tree structure, following which, it must be zoomed-in to the target element. In addition, when *show* (*descibe*) between two elements is included in the inclusion relationship, the transitions between two elements includes zooming-out from the focused element to the whole element area in the stacked Venn, and zooming-in to the target element. Therefore, the transitions include passing through the overview or the whole element area, which helps users to easily grasp the super-sub relation existing between them.

Transitions for *likewise*. When the hierarchical relationship, *likewise*, exists between two elements, the transitions between the two elements include zooming-out from the focused element to an area enclosing both the elements and their parent element, and then zooming-in to the target element. Therefore, the transitions indicate the presence of the parent element; thereby elucidating to the user the existence of a subservient relationship.

Transitions for *part-of* (*has-a*). When the inclusion relationship, *part-of* (*has-a*), exists between two elements, the transition between the two elements pans from the focused element to the target element. Therefore, this simple and direct transition between the two elements helps users to easily understand that they are dependent on each other, and that there exists an inclusion relationship between them.

In addition to the above, the transitions between two independent elements include zooming-out from the focused element to all elements, and then zooming-in to the target element. Therefore, these transitions help the users to easily know that they are irrelevant with respect to each other in an iPoster.

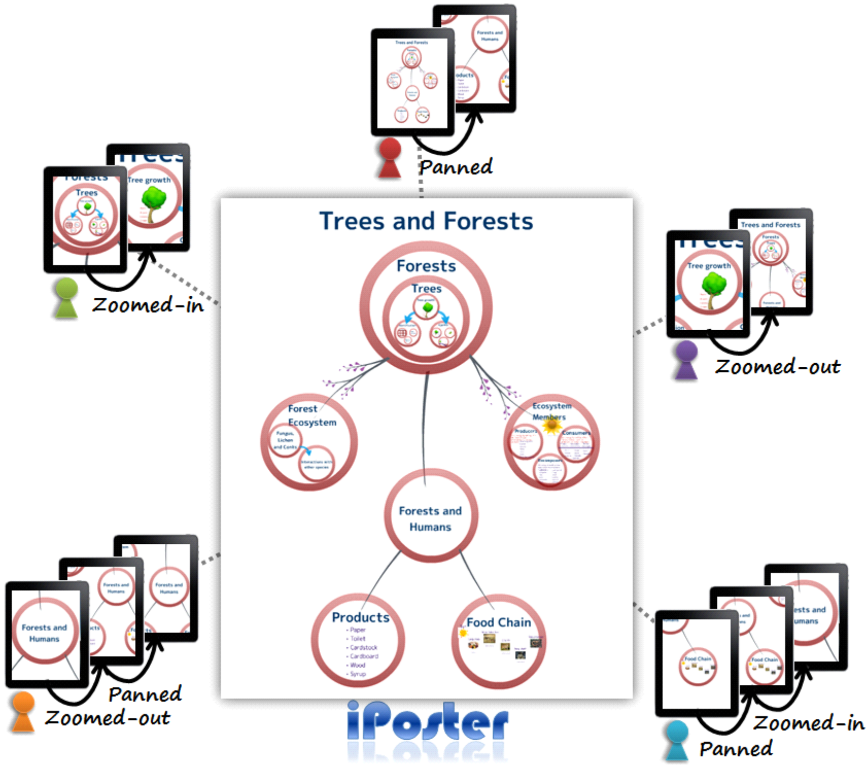

Fig. 5. An example of a collaborative browsing platform based on iPoster

5 Collaborative Browsing Platform Based on iPoster

Based on the method described above, we build a novel collaborative browsing platform that aids users to interactively gain a broad understanding of the presentation slides, based on the usersf operations and our semantic structure analysis. We generated an interactive poster using an online lecture material called "Trees and Forests."[6] As depicted in Fig. 5, our iPoster provides an overview of "Trees and Forests," containing key points such as "Forests," "Forest Ecosystem," "Forests and Humans," "Ecosystem Members," "Products," and "Food Chain." Users A, B, C, D, and E are interactively browsing our iPoster that is shared in the cyberspace, operating on their tablets from anywhere.

In this case of collaborative browsing with iPoster, 1) iPoster can share the most important topics with each other and represent information that meets each user's specific requirements on certain topics, 2) Users can detect other users who have the similar requirements on certain topics and share their interests

[6] http://teacherweb.com/AB/GilbertPatersonMiddleSchool/MsDavid/Tree-Types-2b-Posting-version.ppt

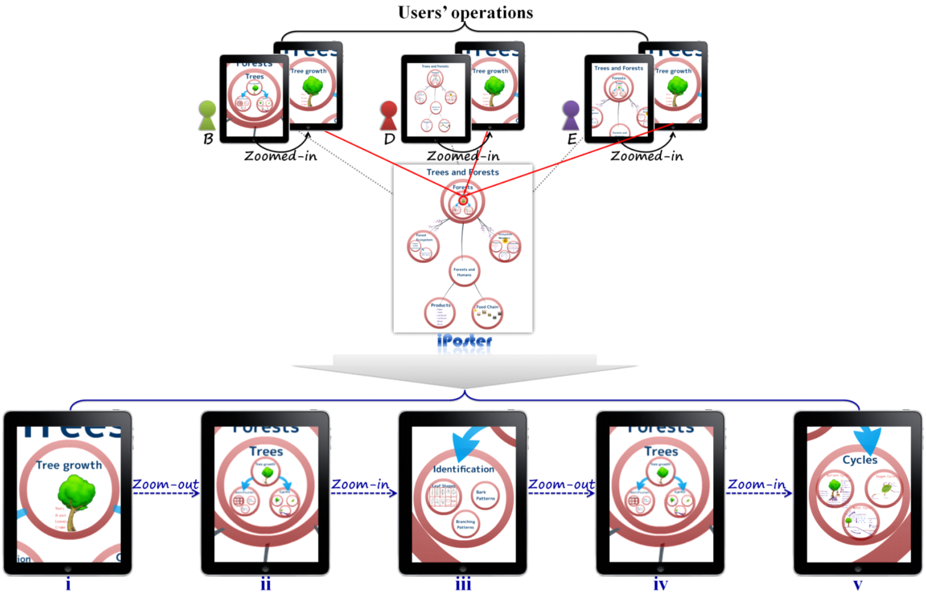

Fig. 6. An example of showing details of 'Tree growth' based on zooming transitions

with each other through their tablets. An example is shown in Fig. 6, the area of "Tree growth" is highlighted on iPoster sharing on all tablets, because of the area of "Tree growth" is zoomed-in on the tablets of B, D, and E by their zoom-in operation. Because "Identification" and "Cycles" *describes* "Tree growth," and are included in "Trees," we assumed that the users want to get details of "Tree growth" with their zoom-in operation. Therefore, the iPoster represents the transitions between the area of "Tree growth" and the areas of its details (including "Identification" and "Cycles") on the tablets of B, D, and E. As shown in Fig. 6, on the tablets of B, D, and E, the iPoster firstly zooms-out from the area of "Tree growth" as shown in **i**, to the whole area of "Trees" as shown in **ii**; this conveys to B, D, and E about the whole concept "Trees," which contains "Tree growth," after that, the iPoster zooms-in to the area of "Identification" as shown in **iii**. This enables B, D, and E to understand that "Identification" is a detail of "Tree growth." Next, the iPoster zooms-out from the area of "Identification" as shown in **iii** to the whole area of "Trees" again as shown in **iv**, following which it zooms-in to the area of "Cycles" as shown in **v**. This enables B, D, and E to comprehend that "Cycles" is a detail of "Tree growth" as well. In general, "Tree growth" is a rather uncommon subject for content; however, in this work, we supposed that it was a topic which is worthy to know, considering that many users focused on it. In addition, we can represent the relevant information based on semantic structure analysis, by deriving the users' requirements from their operations.

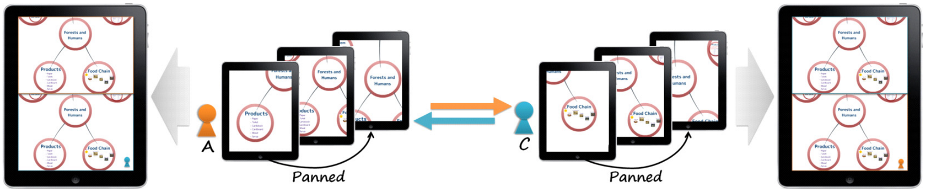

Fig. 7. An example of sharing screens of A and C with each other

On the other hand, when A pans from the area of "Products" to the area of "Forests and Humans," and C pans from the area of "Food Chain" to the area of "Forests and Humans," areas including "Forests and Humans," "Products," and "Food Chain" are represented on their tablets and they can share their screens with each other using their tablets (see Fig. 7). In this case, since "Products" *describes* "Forests and Humans," "Food Chain" *describes* "Forests and Humans," and "Products" *likewise* "Food Chain," based on our semantic structure analysis, we considered that A and C have similar needs concerning the topic "Forests and Humans" by panning from its coordinate subtopics, "Products" and "Food Chain." Then, we display the whole area of "Forests and Humans" and share their screens with each other in order to support them to compare their interests, and to promote their communication.

6 Conclusions and Future Work

In this paper, we built a collaborative browsing platform for presentation slides based on interactive poster generation, called the "iPoster," for presenting elements (i.e., textual and graphic elements) in a meaningfully structured layout with automatic transitions, such as zooms and pans, to promote user interaction. Especially, we introduced a semantic structure analysis model for extracting elements and determining the semantic relationships between the elements of the slides. In order to generate an iPoster in a zoomable canvas, we initially placed the elements in a tree structure combined with a stacked Venn. We then attached the zooming and panning transitions between the elements, based on the semantic relationship types. iPoster enables users to interactively and collaboratively browse, and understand educational presentations easily and efficiently using their tablets.

In the future, we plan to varied structural layouts for generating iPosters to help users intuitively understand traditional presentations. Additionally, we have to confirm that our collaborative browsing method enables users to browse and understand the presentations, meeting their needs effectively and easily. Further, we need to consider the semantic structure analysis on slides by comparing users' operations on an iPoster. We must combine the meanings of the content with the meanings of the users' operation. For instance, if the user zoomed-in from x on y on the iPoster, we can deduce that the user wanted the details of y. However, *x describes y* and *z describes y* shows that both x and z have the details of y in the slides. Then, we can suggest y zooms-in z to the user, which indicates that z has the details of y that can satisfy the user's requirement.

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