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Support System for Understanding Intention in Communication Using Diagrams

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Abstract: Readers understand the messages from the diagrams by grasping their features. However, some fail to notice the features and do not correctly grasp the messages. For the first step of reading the messages, this paper focuses on intentions included in diagrams as "emphasize," "classify," and "continuous change" and proposes a method for comprehending intentions from diagrams. To comprehend intentions, the differences in the attributes of figures must first be noticed, and then the intentions indicated by these differences must be considered. Our system encourages users to grasp intentions by following these steps. It also develops a system for experiencing the method.

Keywords: Intention of diagrams, reading diagrams, discovering attributes of figures

1. Introduction

Diagrams are often used to convey messages, because many people find them intuitive and easy to understand (Bondy & Frost, 1993). The creators of diagrams represent the contents and the intentions of messages as the features of figures. The contents of messages are often represented by the shapes of figures that can represent the meaning of the contents. For example, a triangle with a circle on its top often represents a human being. Intentions are represented by the distribution of attribute values. When the creators want to emphasize something, they put a different color on the target figure or increase its size.

On the other hand, readers understand the messages from the features of diagrams. However, some fail to notice the features and fail to correctly grasp the message. Helping such readers learn how to read messages is effective for smooth communication. This research aims to provide a method that readers can use for understanding messages from diagrams. For the first step of attaining to this research goal, this study focuses on intentions, such as "emphasize," "classify," and "continuous change," and proposes a method for reading intentions from diagrams.

As for human-computer interaction, several studies have developed systems that can read diagrams (Swinkels, Claesen, Xiao & Shen, 2018). In these studies, systems obtained the ability to understand the diagrams, but they do not support readers' ability to comprehend the diagrams.

This study proposes a method for comprehending intentions from a diagram and provides an environment for experiencing our method.

2. Method of Comprehending Intention from Diagrams

Readers grasp the intentions of creators by the values of the attributes of figures and their distributions. When the same value is assigned to all figures, there is no significant intention, but when different values are assigned, they suggest intention. The meaning of intentions differs by the distribution of the figures for each value. If the number of values are two and when the number of figures that belong to one value is small and the other is large, the creator may "emphasize" the figures in the smaller group. If the number of values exceeds two, the creator may "classify" the objects by values. When the number of values exceeds two and the attribute is a continuous value, such as size, the creator may indicate the "continuous change" of the features of objects.

An example of inferring intentions is shown with Figure 1. If readers focus on the shapes of the objects, they will divide them into three groups: ovals, rectangles, and arrows. Since the number of group exceeds two and the shapes are not continuous values, the intention is to "classify" the objects by their shapes. If readers only focus on the arrows, they might divide them into two groups by color: blue and red. Since only one object belongs to red, the intention, represented by the color of the arrow, probably "emphasizes" the red object.

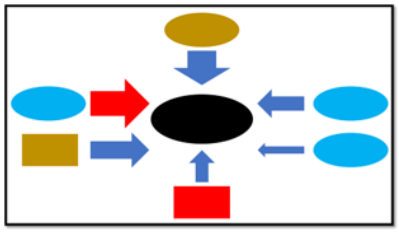

Figure 1. Example of Diagram.

Common and different values of attributes are differentiated by the target sets of figures. For example, in Figure 1 when focusing on all the figures, since no attribute values are common to all the figures, such attributes as color or size suggest intention. On the other hand, when the ovals are focused on, shape and size may be common to all the figures, but their color is different. Perhaps color represents intention. Therefore, to find attributes that may indicate intention, the focus group of figures need to be changed according to their common attributes.

This study defines the following method of comprehending intentions from a diagram:

Step 1: determine a group of focus figures, which is called a target group.
Step 2: select one attribute as a focus attribute.
Step 3: divide the figures in the target group into new groups based on the values of the focus attribute.
Step 4: consider the intention based on the number of figures for each new group.
Step 5: set the states of the target group as verified and return to step 1 until the states of all the groups are verified.

The current target intentions of this research are "emphasize," "classify," and "continuous change."

3. System for Obtaining Method of Reading Intention in Diagrams

This research proposes a system in which users can experience the reading intentions of diagrams with a defined method. Figure 2 shows its system configuration. The diagram database contains diagrams to provide to users and attribute values that represent intentions as correct answers.

The system has four interfaces. The group selection interface corresponds to Step 1 of the method (Figure 3). It gives a user a diagram in a diagram display area from the diagram database. In the interface, the user selects a target group comprised of figures. If users are able to find an attribute in the target group that represents intentions and push Next button, the attribute selection interface corresponding to Step 2 is shown for inputting the target attribute. If they are not able to find the attribute, the attribute discovery support functions presents in the hint area provides hints.

The attribute discovery support function provides two function for supporting users who cannot identify which attributes to focus on: the attribute unification function and the group concentration function. One reason that users cannot discover particular attributes is that they are overly focused on the differences in the values of already discovered attributes. If there are no differences in the values of such attributes, they will not concentrate on them and will look for other attributes. Therefore, attribute unification function changes the values of the already found attributes of the figures to one unified value. Another reason that users cannot discover certain attributes is that the diagram has too many figures. If it only shows figures whose attributes need to be discovered, users may more easily find the attributes. Group concentration function eliminates the figures other than those whose attributes should be discovered.

After selecting the attribute in the attribute selection interface, the group generation interface corresponding to Step 3 is invoked (Figure 4). In this interface, users can divide the figures in the target group by the values of the focus attributes and generate new groups for each value of the focus

attributes. By pushing Next button, the intention and meaning input interface corresponds to Step 4 appears and allows users to identify the types of intentions and assign meanings to target groups. When the assignment is completed, the group selection interface is activated again. By comparing the user's input and the correct answer, the interface judges whether all the intentions of the correct answer were derived; if not, the system starts the method from the beginning.

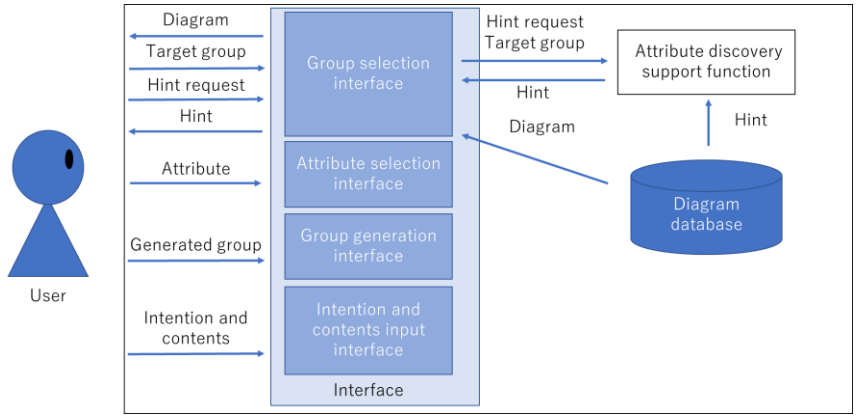

Figure 2. System Configuration.

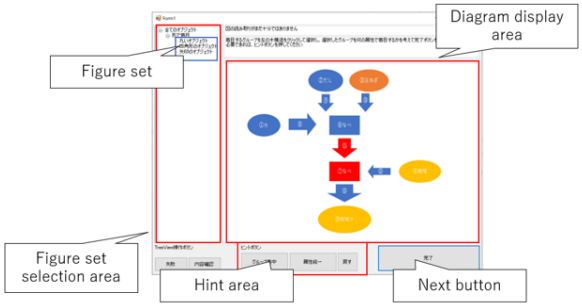

Figure 3. Group Selection Interface.

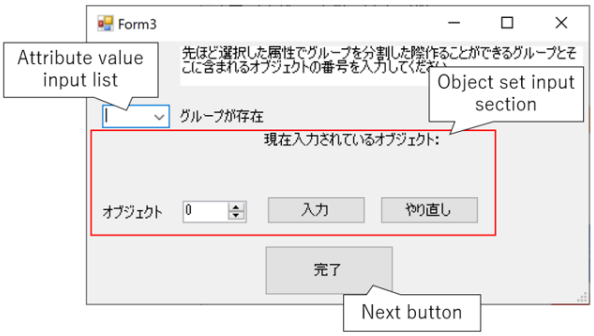

Figure 4. Group Generation Interface.

4. Conclusion

This paper proposed a method for understanding the intentions drawn in diagrams. It consists of noticing the attributes of figures, grasping the intentions based on the distributions of the figures for each attribute value, and considering the meaning implied by the attributes. We developed a system for experiencing reading intentions by following our proposed method. This system also provides support functions for recognizing attributes.

Currently our research only focuses on comprehending the "intention" included in diagrams and does not support the understanding of their "contents." The shapes or attributes of figures themselves often represent intuitive imagining of the contents. For instance, arrows may represent flow and balloons often indicate a character's voice. To understand the diagram's meaning, we must understand its contents. Our future work will develop a system that allows users to grasp the contents of diagrams based on the characteristics of the shapes of figures.

References

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