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Story Composition support by IGA and CBR

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Abstract

Elementary school pupils frequently have difficult acquiring creative writing skills, i.e. how to develop the idea to be expressed, how to compose the materials of the outcome or contents.

In this paper, we focus on the problems of how to support creative writing work to arrange materials in order to formulate ideas as the stories develop. The basic ideas behind the method are that (1) a basic story is automatically generated by GA-based operations and shown to a user as sequences of pictures, (2) IGA(Interactive Genetic Algorithm) is used to evaluate and select a preferred story, (3) the results are compared with previously stored stories using case-based techniques. Based on these ideas, we have developed a computer supported environment for this purpose and conducted related experiments.

1. Introduction

Research has been presented in the areas of IGA applications in the fields of graphic arts [17] and apparel design planning [10], engineering [15],[16] and marketing [14] , this research is a new attempt at applying education applications to the area of IGA.

Until the present, IGA approaches have sought the optimum results related to the process of interaction between humans and computers. This research seeks to support the acquisition by the user of useful data through the interaction between the user and the computer and proposes a new application method of IGA.

We have selected the support of story composition by children as the area of focus. There have been various studies on Intelligent Tutoring Systems[9], but these have focus on clearly defined problems based on value systems based on a single dimension. In contrast, story composition requires imagination and emphasis on a multidimensional set of values and it is difficult to determine what the "correct" answers are. At present there are no ITS reports which relate to the support of story composition .

We consider it possible through the application of our approach to create an enjoyable and stimulating creative writing environment using computers.

We have created a pilot version story composition system (IMAGINE-1), in which on the user first selects on his/her own accord 4 pictures from a multiple number of pre-installed pictures. Based on experimental data results taken from elementary classroom experiments, an investigation was conducted on the effectiveness of proposed IGA applied story composition arrangements.

Chapter 2 below provides an explanation of IGA, case-based reasoning and story composition. Chapter 3 describes an algorithm pilot version system and user interface, while Chapter 4 provides an explanation of tests conducted followed by related discussion.

2. IGA and Story composition

In this chapter we first describe the special characteristics of IGA and its effectiveness with regard to user support in the creative writing process. This is followed by an explanation of Case-Based reasoning and story composition .

2.1 IGA

IGA [1],[3] as used in this research is applied as a creative writing support that emphasizes multiple value systems. The motive here is not only to evolve the individual as the subject of the user's attention, but to advance the evolution of the user himself/herself.

The reason why standard genetic algorithms that automatically make selections cannot be used is that human emotions are involved, which do not permit clear evaluation function with regard to the matter at hand, since the optimization problem cannot be defined.

2.2 CBR

Case-based Reasoning (CBR) [4] is attracting attention as either a substitute for Rule-based Reasoning (RBR) or a supporting reasoning method. CBR accumulates a case database of previous actual cases and when a new problem is entered, its features are analyzed and serve as index tags. Since there are normally multiple cases, appropriate selections are made according to evaluation standards. Since solutions offered by selected cases frequently cannot be applied in their existing form to new problems, some form of adjustment can sometimes be made to successfully add to the case database. On occasion such attempts are sometimes met with failure.

In this research, CBR is applied to search for the works of other pupils. Upon completion of a work the user is able to see the works of others who have chosen similar picture sequences. This provides the user with additional interpretations and concepts relating to the images.

2.3 Story composition

This paper proposes a support system for creative writing that takes a multi-dimensional value system into account.

Writing is a very difficult subject for most children. In normal conversation, the purpose is provided or required by the conversation partner; however, for writing no such assistance is provided and the writer must set up the situation. This is very difficult for children [12]. In order to write a composition, the normal strategy is to determine the topic, devise the overall structure, and elaborate on the details, but the work does not necessarily develop according to plan. In some cases the direction is changed in the midst of jotting down a given series of thoughts [8]. Children are thought to develop images in their minds as the creative writing process continues.

Accordingly, for the child writer, if there is a counterpart and an interactive environment, this could be conducive to the image development and writing process.

3. Pilot system

In the proposed authoring support system, the repeats options until a satisfactory sequence is attained, with the final result being a complete story. The candidate sequences are generated based on one-point crossover GA and intentional mutations. The user repeats selections of candidate sequences displayed on the screen. It is possible for the user to request candidate sequences until the user arrives at a satisfactory sequence. After achieving a satisfactory sequence, the user then adds a written story line. There is also a function for the user to view the works of other users. While composing his/her story, the user has the option of viewing similar works of other users that resemble that of the user.

3.1 Algorithms

The five system steps can be summarized as follows.

1) Generation of Parent Sequences

Two sequences are created using "m" as the total number of pictures prepared and "n" as the number of pictures in each sequence. Each sequence of "n" pictures is designated as a genotype. At this stage, the user generates two parent genotypes.

2) Generation of Candidate Phenotypes

One-point crossover and mutations are used to generate k-2 offspring genotypes in addition to the two parent genotypes described in 1) above. A total of "k" phenotypes are displayed on the screen, comprised of the two parent genotypes and k-2 offspring genotypes.

3) Interactive Evaluation and Selection

The user continues to make repeated selections based on IGA, selecting any two preferred phenotypes from the above total of "k" phenotypes (picture sequences) displayed on the computer screen. These two phenotypes become the parents during the subsequent story generation.

Steps 2) and 3) are repeated until the user is finally satisfied.

4) Comparison of stories with existing ones

The system retrieves and displays similar works based on the story sequences selected by the user. By viewing the works of other users, the user is able to gain insight about approaches and thoughts from different vantage points.

The user adds text in the space provided next to the selected picture sequences. The completed story is added to the cased database.

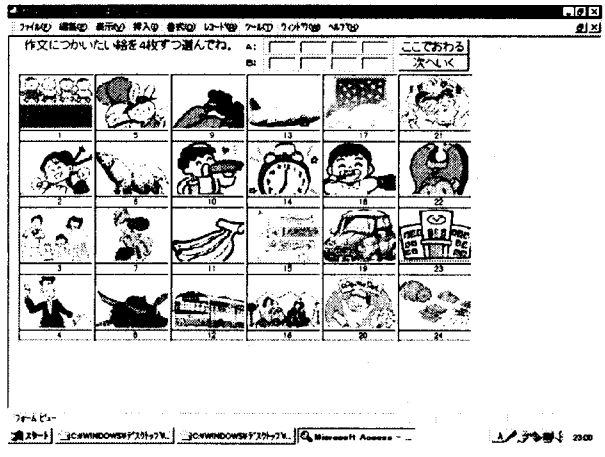

Fig. 1 Pictures screen

3.2 User Interface

IMAGINE-1 is comprised of the following three screens.

1) Pictures Screen

At the outset the user first generates two picture sequences. The pictures screen displays twenty-four pictures. The user composes a single sequence by choosing four pictures from the twenty-four pictures displayed and putting them in his/her preferred order. This procedure is repeated once to create another sequence.

2) Creative Screen

The creative screen displays six picture sequences, the first two of which the user creates using the pictures screen. The system creates the remaining four using the GA algorithm.

The user can carry out the following two operations using the creative screen. The first operation is to select any two sequences from the six that the system displays on the creative screen, to generate a new sequence by making these two the new parents. The creative screen will then generate this new sequence. The second operation is to make a final selection of only one sequence, on which the story line will be based. This operation generates the composition screen, which is described in the following section.

3) Composition Screen

Composition screen displays the final picture sequences selected by the user. The user types in the story line while looking at the pictures, and this information can be saved in the database. It is also possible to retrieve similar story lines from the database and display them. The user is able to edit the story line while looking at similar works done by other users in the past

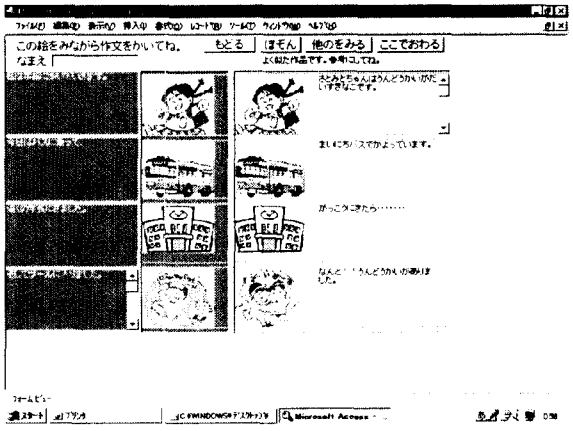

Fig. 2 Composition Screen

4. Experiments with Elementary School Pupils

An experiment was conducted using elementary school pupils to study changes in thought patterns during the creative writing process. For the first trial, the students produced stories using paper and pen without Imagine-1 in the normal classroom environment. With the Imagine-1 was introduced for the second trial.

4.1 Without Imagine-1

1)Objective

To observe how the creative process functions when pupils write stories with paper and pen in the normal classroom environment.

2)Method

Elementary school pupils were instructed to write stories in the classroom during their Japanese language lesson(s). Test participants were each one sheet of paper with twenty-four pictures and one sheet of standard composition paper. The pupils were instructed to cut out all twenty-four pictures and select four from the total. They were instructed to then line these up vertically in their order of choice, and finally to write a composition in the space at the right of each picture.

The creative process of test participants was observed at random and a survey was conducted upon completion of the composition work.

3) Results

Survey results indicated that two of the pupils altered the order of the four pictures and one student chose an replaced one of the four pictures with one previously rejected. The reasons given for these substitutions were that it was that the original order did not lend easily to the creation of a smooth flowing story.

Table 1 Composition Writing Process

Observed Behavior	Pupils
Change of picture order	2
Substitution with alternative picture	1
Completion without interruption	15

The remaining fifteen pupils created their stories using the order of four pictures originally selected. It is thought that they did so without departing significantly from their original story lines, the initial scenarios devised at the start of writing.

4.2 With Imagine-1

1) Objective

To observe the creative writing process following the introduction of the IGA system and to monitor any related changes.

2)Method

After school hours, the same created stories with the assistance of Imagine-1.

A video record was made and a survey was taken following the experiment.

3) Results

The results for all of the test subjects are given as follows.

Table 2 No. of Interactive Exchanges

No. of Interactive Exchanges	Pupils
1 times	8
2 times	9
3 times	1

Table 3 indicates the number of sequences generated by computer, as compared to the number of sequences generated by the test subjects themselves.

Table 3 Sequence Selection Generators

Sequence Selection Generator	pupils
Test Subject	5
System	13

As indicated above, two subjects in the paper based experiment changed the order of the pictures and one subject substituted a previously rejected picture. In comparison, thirteen pupils selected sequences generated by computer. It is thought that the interaction between the computer and pupil gave rise to new scenarios.

4.3 Discussion

In this experiment, the user imagines two stories while generating a series of pictures.

The pupil repeats the generation of new sequences beyond the first two sequences generated, eventually until a picture sequence is arrived at with which the student is satisfied. During this time, the pupil's thoughts are primarily in terms of images as compared to the written word. The user simulates the story writing process, with his/her thoughts repeatedly reinforced and refreshed by the computer through IGA operations.

The user is able to retrieve the stories of other pupils upon completion of his/her composition. It is likely that seeing the work of others can support the pupil through the introduction of new writing styles.

5. Conclusion

In this paper, we have proposed the concept of an Interactive story composition support environment. Features include an evolutionary computation process the user experiences as he /she develops his/her creative thought process. (1)the user subjectively interacts with the system according to his or her own value system, (2) the stories the user has composed can be evaluated objectively by comparing them with the existing ones, and (3)using IGA-based generate-and-test techniques. The efficacy of this system has been confirmed through experimental trial results of elementary school pupils.

Future work will include the conducting experiments in a computer network environment.

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