An Evolutionary Distribution System for Web-Based Teaching Materials

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Abstract

The paper describes an evolutionary distribution system for web-based teaching materials that can sophisticate teaching materials stored in the system spontaneously. The system consists of web server, assisting tools and repository of teaching materials represented as HTML/XML data. The layered structure of the information model of teaching materials enables to treat content of teaching materials as scenarios, subjects and elements independently. For this purpose XML language is used to represent teaching materials. The proposed system is being built at Nippon Institute of Technology to evaluate its usefulness to open for the Internet within the year 2001.

1. Introduction

Web-based teaching (WBT) is spreading to wide range of schools through increasing of personal computers connected to the Internet in the schools (ex. [1]). The state of art in WBT is using web pages as teaching materials created with HTML by teacher’s self. The excellent feature of WBT is its interactive property to bring up active learning of students.

The paper will describe a distribution system for WBT materials, of which evolution mechanism can sophisticate spontaneously WBT materials stored in the system.

2. Evolutionary distribution system

The objective of the research is to promote WBT especially for teachers with less training of computer-based teaching. To attain this objective, we have set up two goals:

(1) to distribute WBT materials freely via the Internet
(2) to provide assisting tools for modifying WBT materials by less trained teachers.

In this research, the system not only distributes WBT materials but also sophisticates the materials spontaneously by itself. A key element of the system is XML representation that encodes features of teaching materials like genes of lives.

3. Evolution mechanism

The idea of the evolutionary distribution system is rooted in evolution mechanism of biological system. Darwin’s theory of natural selection assert that “genes that fit to the environment would survive”, where genes means a suite of DNA representing features of lives. Genes are mixed by reproduction of lives conveying the genes (so called “crossover”), or are changed by mutation. The digital feature of genes enables these mixing and changing of genes in biological evolution process (Fig. 2).
4. Information model of WBT materials

Preliminary observation for existing WBT materials on the Internet reveals that three types of information exist:
(1) scenario information describing lesson plans, teaching strategy, steps of presentation, and so on,
(2) subject information describing content of lessons, fundamental knowledge, and so on,
(3) element information specifying types of data such as texts, images, scripts, and so on.

The need to reuse WBT materials on the Internet requests the three types of information can be treated independently. This requirement leads to the layered structure of information model of WBT materials.

5. XML representation

XML (the eXtensible Markup Language) has emerged as a standard for data representation and exchange on the Internet [3]. The basic elements of XML are tags and relationship:
(1) tags on data element identify the meaning of the data,
(2) relationship between data elements is provided via simple nesting and references.

The following XML data shows an example teaching material for a mathematics lesson with layered structure.

```xml
<?xml version="1.0" encoding="UTF-16"?>
<SCENARIO item="Lesson plan">
  <GOAL> To understand that fundamental figures are sets of points </GOAL>
  <STRATEGY> Solve an every problem by applying the procedure of drawing figures </STRATEGY>
</SCENARIO>
<SCENARIO item="Problem 1">
  <SUBJECT item="equi-distance points from two points">
    <ELEMENT text="There are …"> ...
    <ELEMENT image="image1.gif">
</ELEMENT>
  </SUBJECT>
  ...
</SCENARIO>
```

6. Discussion

The outstanding features of the proposed system are summarized as follows:

(1) allowing less trained teachers to use WBT materials by tailoring to fit for their own lesson plans
(2) spontaneous sophistication of WBT materials in the repository by reusing materials as the evolution mechanism.

7. Related work

Using XML to create and use WBT materials is getting familiar in recent few years (ex. [4]). But most of those activities are merely language change from HTML to XML to apply the extensibility of XML to WBT materials. On the contrary, the proposed system in this paper enables not only to create and use WBT materials but also to sophisticate in spontaneous way.

The search tool for WBT materials is proposed in several papers in Japan (ex. [5]). These systems use information filtering mechanism with user profiles and evaluation by users. The filtering mechanism is fundamental in search tools for WBT materials, so the proposed system in this paper use more sophisticated filtering mechanism such as collaborative filtering [6] than the previous systems.

8. Conclusion

The paper has described the design and implementation of an evolutionary distribution system for WBT materials. The system allows less trained teachers to use WBT materials that match for their own lesson plans. Furthermore the system enables to sophisticate WBT materials in the repository by the evolution mechanism of the system. The system is implementing with XML and agent technology to open for teachers in Japan within the year 2001.

References