Computer Aided Learning for List Implementation in Data Structure

Ng Melissa Angga Informatics Engineering, University of Surabaya Kalirungkut Street, Surabaya, Indonesia (+62) 31 2981393

melissa@ubaya.ac.id

ABSTRACT

Data Structure is one of the core subjects in most Information Technology Faculty which considered as a hard subject that many students failed to understand the content of this subject. Through some analysis, found out that this problem caused by the lack of student motivation towards this subject, the lack of ability in picturing the process behind this subject, and the failure to comprehend the topic about list which heavily related to many other topics. List topic apparently is a crucial elementary topic in data structure, in which the failure of understanding in this topic would make it impossible to understand the other subsequent topics. In this paper, we offer an alternative way to presenting the topic about list in data structure using multimedia technology.

Keywords

List, Data Structure, Computer Aided Learning

1. INTRODUCTION

Data Structure is one of the subjects which most Information Technology Faculty adapted in their core curriculum. In data structure, students learn on how to organize data, save and manipulate them. Data structure would be the basic knowledge and prerequisite for many other advance subjects in Information Technology.

As much as the important role of Data Structure as a core competency needed for any Information Technology scholar, this subject is apparently not easy to be delivered. The number of failed students of this subject in one university is nearly one third of all members of the class. These issues should be taken seriously since the lack of competencies in Data Structure subject would resulting in the lack of competencies in any other subjects related.

Among many topics covered in Data Structure, topic about List stood up as the fundamental topic which applied and elaborated in many other topics. Having said that, some investigation also shows that student who failed on the topic of List would also failed on other topics.

Based on those facts, this research is conducted to offer a better way to deliver the topic about List in Data Structure subject. From some study, the authors found that multimedia technology is a very powerful tool that can be used to create a clearer and more concise presentation. Thus, multimedia technology would be adapted in this research. However the scope of this research would only limited to the implementation phase only, since the result of this research was not yet applied to the students of Data Structure subject. Susana Limanto Informatics Engineering, University of Surabaya Kalirungkut Street, Surabaya, Indonesia (+62) 31 2981395

susana@ubaya.ac.id

2. LIST

Nyhoff and Leestma (1992) identify list as a limited serelements in data structure. List actually has been used in our day life, for example people use shopping list to write down needed to be bought, in the dentist waiting room, the nurse list of the names in which she should call in sequence, a sechas a list of activities should be done by her boss in sectoday, etc. Each list has some fundamental operations relevan it, they are listed as follows:

- 1. Create an empty list
- 2. Check if a list is empty
- 3. Traverse the elements of some parts of the list
- 4. Insert new element to the list
- 5. Delete elements from a list
- 6. Check whether a list is full

Since list is described as a sequence of elements, therefore the an order of elements being placed on the list. There would a first element, second element, and so on up to the last one ordering should be reflected on the implementation of the list

The easiest way to create a list with an implicit ordering rule using an array which by default has its own ordering method.

Order	1	2	3	4	5	6	7
Data	a	a	b	A	z		

Figure 1. Implicit order of a list.

However easiness in creation is not a guarantee for the easimaintenance. To insert and delete an element to a list with ordering rule required shifting of many other elements assoce For instance, if one need to delete the second element of the list example, then the third element should shifted to the place, the fourth to the third place, and the fifth to the fourth then the result would be something like this.

Order	1	2	3	4	5	6	7
Data	a	b	a	Z			

Figure 2. List after deleting the second element

With the same manner, inserting a new element to the second required shifting of the fourth element to the fifth place, the the fourth place, and the second to the third place, before the new element injected to the second place. Maintaining a list in this way would be inefficient both in time and resource allocation.

To address the problem arise with implicitly ordering list, there is another alternative way to explicitly show the order of a list. This kind of method known as linked list. Each part of a linked list consists of the data and the address of the next element. Thus, if one has located the address of the first element, he would be able to determine every other element consecutively through the end. A representation of a linked list is shown on the next figure.



Figure 3. Linked list representation

Linked list data structure can be implemented using array or pointer. In both case, a class should be prepared to save data and the next address.

3. COMPUTER AIDED LEARNING

As been predicted by Baldwin and Down in Education Technology for Engineering (1981), the cost of technology in education process now has been too little to be ever put into consideration. Thus, the issue right now is not whether an educational technology is affordable, but it is how to exploit it in an appropriate manner.

The term Computer Aided Learning, or CAL in short, by itself covers both the educational parts in which the teacher set up and organize some teaching materials, and the technological parts in which a software and a computer used to aid the whole learning process. CAL typically aimed for some ambitions such as to cut down costs (by efficiently decrease the investments for other eaching materials and teacher working hours), to enhance the earning experience by closing gaps between theory and practice, and to serve the broaden coverage area.

Reddi in Educational Multimedia, A Handbook for Teacher-Developers (2003), describe multimedia in our world today as a compilation of text, graphic art, sound, animation and video dements. Whereas an interactive multimedia is a multimedia project which allow the alteration of presentation by the end user, a other words, the end user are able to change 'what' to be presented, 'when' is the time to presented, and 'how' is the presentation.

The popularity of games development nowadays can be used as an indication on how multimedia presentation would be accepted in education world. Multimedia technology offer richer and clearer resentation, moreover the presentation looks better and could gain more interest from the students.

during said that, multimedia technology offer a better way to simulate process which hard to be presented in traditional way via peech and text only. This simulation would give a better explanation and let it stay longer in the memory.

- ANALYSIS OF THE PROBLEM

Complished the low percentage of the number of students who fully Complished the data structure subjects, a study has been made to and out the root problems behind those results. The examination has been conducted through a survey to some previous students. Some conclusion regarding the root cause of the problems has been drawn after the completion of the survey, those conclusions were:

- Students don't have enough motivation towards the subject. This problem arises because this subject has been gained its reputation as one of the killer subject. Previous alumni used to address this subject as hard and difficult. This kind of addressing would inevitably lower the motivation of the student even before they ever have a touch of the subject itself. And this assumption is aggravated once they step in to the class and learn some early topics of this subject (one of them was the topic about List).
- Student's background knowledge makes him/her incapable to picture the process behind some topics. Thus they hardly understand the explanation about the process.
- Some topics are considered prerequisite for other topics. Therefore the failure to handle one topic can devastate the chance to understand another topic. One topic related to this matter is List.

5. DESIGN AND IMPLEMENTATION

Based on investigation on the recent learning activities as stated above, a design for new presentation of "List" has been proposed. In addressing the lack of motivation problems, this presentation should be interesting enough and promote the clear concise explanation regarding the topic. Considering the difficulty of the student to picture the background process of the topic, this presentation should provide a step by step simulation of the process.

The presentation of the List topic is started by the general explanation of list. After a brief introduction with the list, then the student would be conducted through two different paths one at 'a time. The first part is the presentation of the sequential storage for the implicit presentation of list order. The next part is created as an explanation for the linked list as an alternative way to construct a list. The linked list part is separated again into two sections, which are the usage of array for linked list and the usage of pointer for linked list.





Figure 4. Introduction of List

On the introduction of list, the explanation is supported by some animation and example to describe it more clearly. The implementation of list definition and example is shown in Figure 4 above (the explanation is conducted in Bahasa Indonesia).

The implementation of sequential storage then follows the introduction of lists. The presentation can be started with illustration of the list implementation by implicit usage of ordering method. The example of the data put inside the storage is picture by some coins which would be delivered to the sequential storage, as shown in figure 5.



Figure 5. Illustration of sequential storage

The implementation of the sequential storage is covering the operations that should be provided for the list. Each oper would be explained by the means of process simulation and setep debugging of the algorithm at the same time. Thus stude see the effect of every command line of the algorithm. The command line is recognized by the used of red color for the (figure 6).



Figure 6. Insert process in sequential storage

The next section of the presentation is the linked list section part is divided into two parts. The first one is to explain the based implementation of linked list. As the section previous part is also equipped with step by step execution of eac command and the simulation of the process behind it (figure



Figure 7. Traverse process in array based linked 🔚

Implementation of pointer based linked list would be enusing a locomotive and wagons illustration and animation this illustration student should be able to grab the understandow every element connected to each other and can be starting from the locomotive as the head (figure 8).



Figure 8. Illustration of pointer based linked list

Like the other implementation of list operations, this part would also provide a simulation as an addition to step into mommand line method, as shown in figure 9 below.



Figure 9. Delete element in pointer based linked list

6. CONCLUSION

Creating a computer aided learning for topic about list in data structure is a challenging project. The previous study has shown some obstacles which made the learning process of this subject harder. However, this barrier apparently can be overcome by the means of multimedia technology. Multimedia technology has proven itself to be adequate to bring the learning experience to the higher level in which the student has the chance to gain a better understanding through a better simulation and representation of the instruction material. And it offer a more interesting way of learning as well.

7. REFERENCES

- Nyhoff, L. and Leestma, S. 1992. Data Structures and Program Design in Pascal. Macmillan Publishing Company.
- [2] Reddi, U.V. and Mishra, S. Ed. 2003. Educational Multimedia, A Handbook for Teacher-Developers. Commonwealth Educational Media Centre of Asia.
- [3] Baldwin, L.V. and Down, K.S. 1981. Educational Technology in Engineering. National Academy Press.



INFORMATICS DEPARTMENT PETRA CHRISTIAN UNIVERSITY

CERTIFICATE

This certificate is presented to

NG MELISSA ANGGA

In recognition of participation in the

2nd International Conference on Soft Computing, Intelligent System and Information Technology (ICSIIT) 2010

Hardrock Hotel, Bali, Indonesia, 1-2 July 2010

Program Committee Coordinator