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The Use of Edge Coloring Concept for Solving The Time Schedule Problem at Senior High School (Case Study at SMAN 9 Bandarlampung)

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Abstract— **Nowadays, the computer's technology is growing so fast and affects the human's life. With computer, people can do something easier, faster, more efficient, and so on. At SMAN Bandarlampung, the time schedule for teaching process is still done manually. One person is in charge of doing and making the time schedule so that all the lessons, time, classrooms, and days are supposed to be fixed and suitable for every teacher. However, this is not easy to be done, because there are some factors also that must be considered, for example: teacher who also put in structural position such as headmaster or vice headmasters. Besides, under Indonesian's regulations, the teacher whose certificate to educate must teach at least a certain hour per week. Therefore, in order to handle this condition, we design and develop a system so that the problem can be solved easily. We use the concept of edge coloring to match the schedule. The data are divided into three sets: the set of active time, the set of classes and classroom, and the set of teachers' obligation (which include : the data of teachers and their subjects/lessons, and how many time/hours needed to teach for every teacher. The system developed is running well and we will be discussed in the paper.**
Keywords :edge coloring, time scheduling, computer technology.

I. INTRODUCTION

The rapid development in technology influences people to use the technology in daily life. It is not avoidable that recently people are so depended on technology, including computer's technology. With
the use of computer, people can do something easier, faster, more efficient, and so on. At SMAN Bandarlampung, the time schedule for teaching process is still done manually. One person is in charge of doing and making the time schedule so that all the lessons, time, classrooms, and days are supposed to be fixed and suitable for every teacher. However, this is not easy to be done, because there are some factors also that must be considered, for example: teacher who also put in structural position such as headmaster or vice headmasters.

Besides, under Indonesian's regulations, the teacher whose certificate to educate must teach at least 24 hours per week. Therefore, in order to handle this condition, we design and develop a system so that the problem can be solved easily and efficiently. We use the concept of edge coloring to match the schedule. Our paper is organized as follow: in Section 1 we introduce and describe the problem faced, in Section 2 we give some basic idea and concept used in developing the system, in Section 3 we discuss how we design the system, in Section 4 we give the implementation and in Section 5 we derives conclusion.

II. GRAPHS AND COMPUTER'S DEVELOPMENT

At SMAN 9 Bandarlampung, the process of making a timetable for the whole teachers in that school is only under responsibility of the vice headmaster who in charge in the school's curriculum. However, this task is considered asnot an easy task because for the whole semester of a certain academic year, all academic activities in that school depend on that time table. Usually that vice headmaster done just using the brute and force method when he just input one data, if it fix and not coincide with other, then it is set fix, and so on. However, due the Indonesian' regulation that every teacher who has certificate to educate must teach at least 24 hours per week, then the process is becoming more complex. Not only he must make every teacher fix with the lesson, time and classroom, but also the minimal requirements needed for every teacher. Using brute and force method is quite time consuming because when a same schedule occurs then he must fix again. Therefore, in order to solve the problem we develop the system.

a. Factors to be considered.

There are some other factors that need to be considered besides the number of teachers (and their subjects/specialty). Those factors are: how many teachers are also have structural positions, how many teachers already have certificate to educate, how many teachers are already get fix positions as government employee and how many are not.

b. Information Technology

Information technology is one type of technologies that can be used for human to take note, save, analyze, send and get a data or information so that the data can be used as information so that it will be more useful and understandable (Satzinger et al,

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2007). Based on the function of the system, the information technology can be classified as:

1. *Embedded Information Technology*
2. *Dedicated Information Technology*
3. *General Purpose Information Technology*

The classification of information technology based on the size of the computer are :

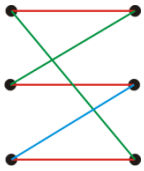
1. Super computer
2. *Mainframe*
3. Minicomputer
4. *Workstation*
5. Micro computer
6. Micro controler

c. *Some Concepts form Graph Theory*

*Graph*G =(V,E) is a structure that consists of two sets, V and E, where V is a set of n vertices V = {1,2,3,…n, ($V \neq \varnothing$) and set of edges E = $\{e_{ij} | i,j \in V\}$.(Bacak, 2004)

Bipartite graph is a graph where the set of vertices V can be decomposed into two set V_1 and V_2 so that V = $V_1 \cup V_2$, V = $V_1 \cap V_2$, and $\forall e_{ij} \in E$, $i \in V_1$, $j \in V_2$. (Deo, 1989)

Edge coloring is a map from the set of edges to set C whose elements are called as color. Edge coloring is proper if the adjacency edges are colored in such a way so that the two adjacency edges are colored with different colors.



d. Lazarus

Lazarus is an IDE (*Integrated Development Environment)*, an integrated software so that the software development can be done rapidly and faster. Lazarus is an open source and the basic language used is similar with Pascal. (Smith, 2010)

e. *PHPMyAdmin*

PhpMyAdminis a free software that written in PHP language and usually use to administrate MYSQL in*World Wide Web*. PhpMyAdminsupports some operations MySQL, for example to administrated data bases, tables, fields, relations, indexes, users, and permissions so that can help it users.

The Design of The System

This system is developed with desktop application structure where the data needed for timetabling is saved at localhost database. The information about the results on the implementation will be displayed for end user on MS Excel format. In general this system has 9 pages of interfaces which are :

1) *Interface* of the Main Menu

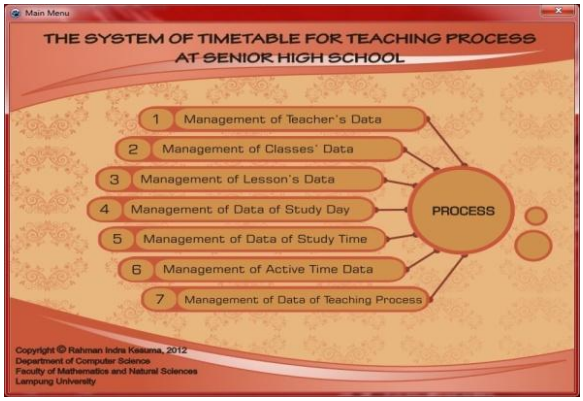


Fig1. *Interface* of the Main Menu

2) *Interface*of Data Bases of the Teachers.

Fig 2.*Interface* of Data Bases of the Teachers.

3) *Interface*of Data Bases of the Classes

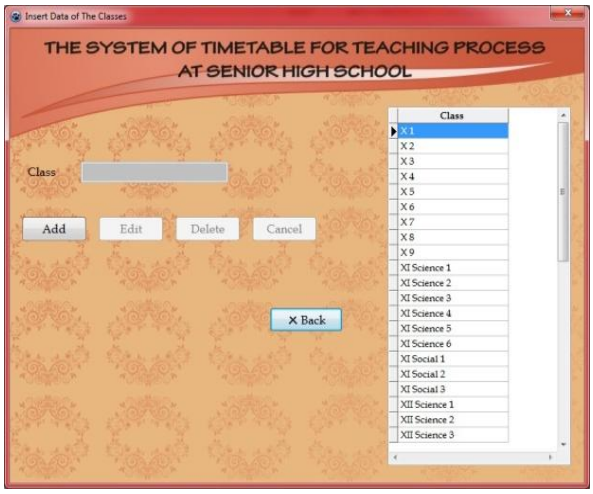


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Fig 3.*Interface* of Data Bases of the Classes

4) *Interface*of Data Bases of The Lessons.

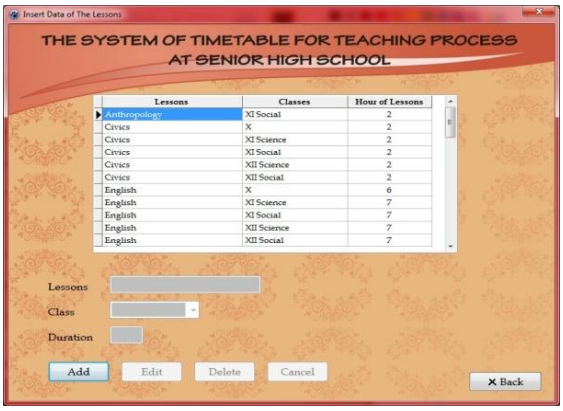

Fig 4.*Interface* of Data Bases of The Lessons.

5) *Interface*of data Bases of Study Day.

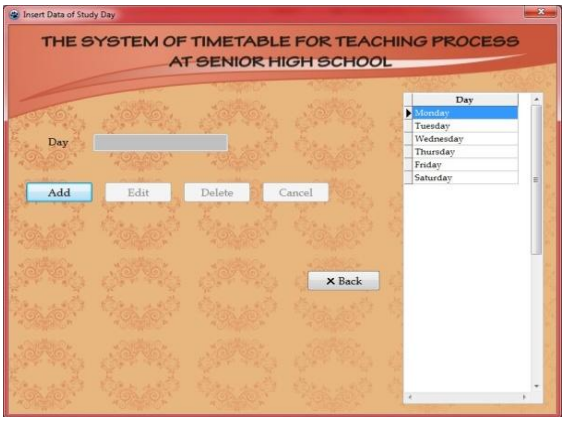

Fig 5.*Interface* of data Bases of Study Day.

6) *Interface*of Data Bases of Time Available for Teaching Process.

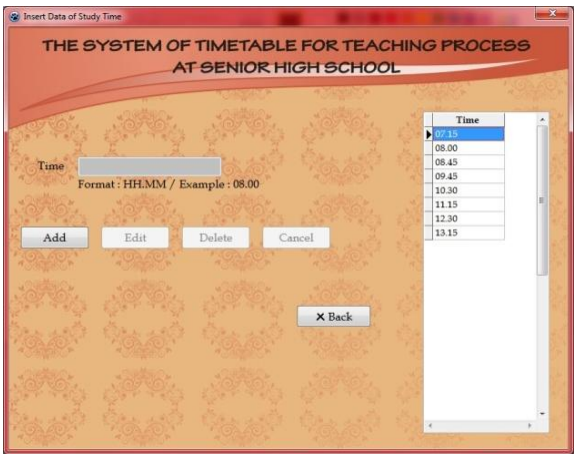

Fig 6.*Interface* of Data Bases of Time Available for Teaching Process

7) *Interface*of Data Bases of Active Time for Study.

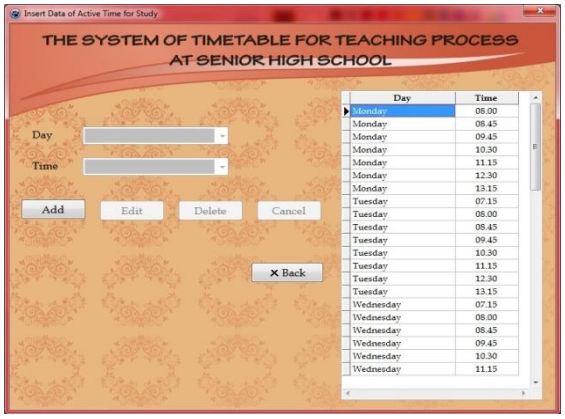

Fig 7.*Interface* of Data Bases of Active Time for Study.

8) *Interface*of Menu of Teaching Process.

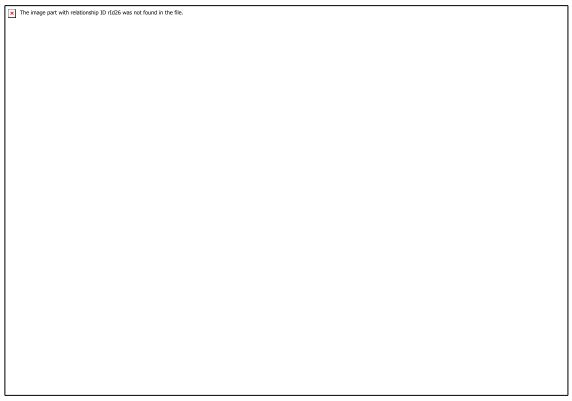

Fig 8.*Interface* of Menu of Teaching Process.

9) *Interface* Menu of Timetable Processing

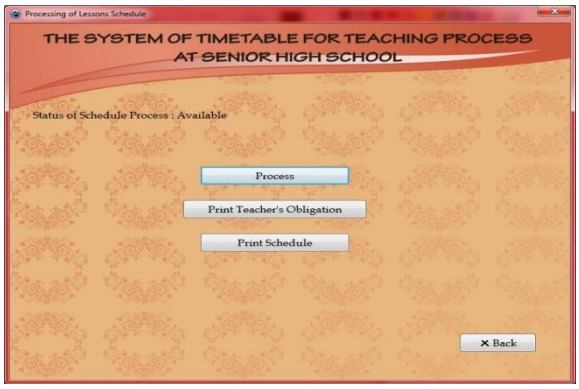

Fig 8. *Interface* Menu of Timetable Processing

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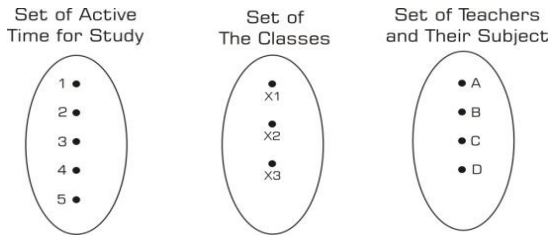
III. RESULTS AND IMPLEMENTATION

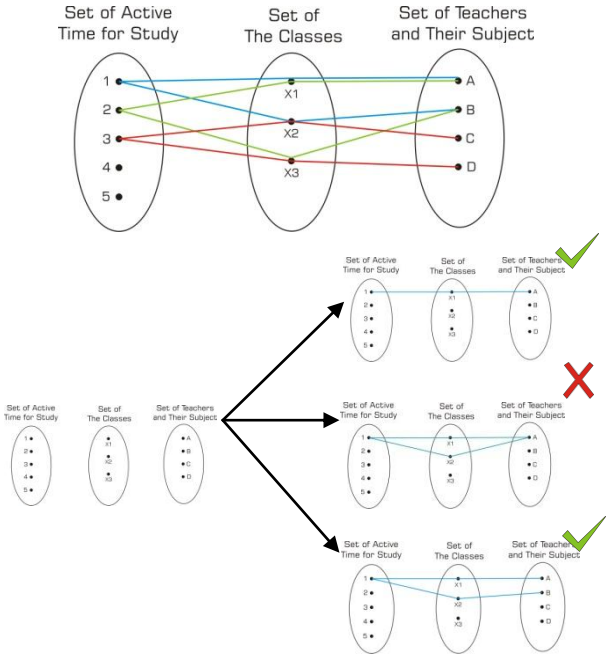
a. The Use of Edge Coloring.

The pictures below show the illustration of the searching for the solution of the timetable for teaching process using edge coloring method.

First, all factors are grouped into three sets as follow:

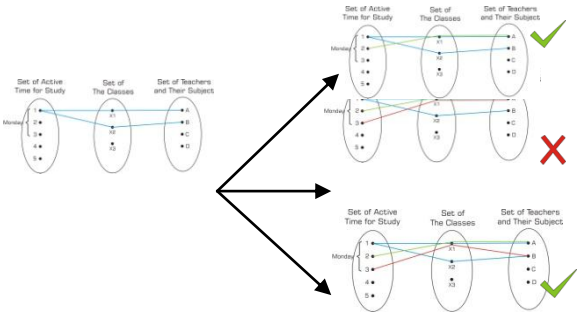


Next, connect the set of Active Time for Study to Set of Classes and Set of Teachers and Their Subjects.



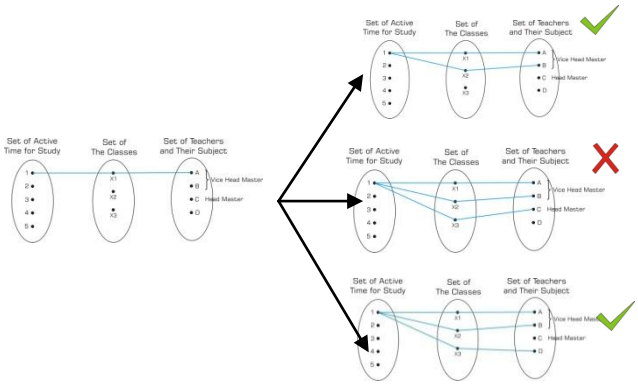
Timetabling process is done by first searching for the data of active time and data of classes and it is represented by and edge connecting the two sets. This edge is colored, and then we chose a vertex in the set of teacher and their subjects/attributes. Then do testing if the edge which connect with teachers and theirs attributes (such as what subjects they are teaching) have the same color. If there is a similarity then we chose another vertex in the set of teachers.

The next process is the testing to avoid the same lessons is taught in the same class more than two hours in the same day.



To do this process we consider three indexes of the vertices with the edges related to them. The edges not only bring the color identity but also the incident vertices. Therefore,when there exist edge which relate the same vertex of class or vertex of learning process (which include teacher, lesson and other attributes) then the process will be continued to test if the previous edges that relates the same classes and the same subject have already two hours in the same day. If that condition hold then we remove the edge and test with the other edge. This test is to avoid the same subject is taught more than two hours in the same day.

Next process is to test if we can find at least one structural position (such as headmaster and his vice) is free of teaching during one active study time



The testing is done by first we observe and analyze the value of input, output and specification. We use error guessing where we make a list of possible mistakes and proceed the testing whilst observe and analyze the list. We give the list for testing in a table below:

TABLE I.
TESTING TABLE

No	Testing	Detail
1	Aplication function	a. Data processing (saving, editing, deleting) b. The relationship

No	Testing	Detail
		between one menu with the other. c. The use of data relation. d. Management of time allocation. e. Print the result.
2	AplicationInterfaces	a. The bound on input characters. b. The bound on the use of input characters. c. The bound on the type of input characters. d. Respond to application. e. Process of button manipulating.

The result of testing is shown in the following table:

TABLE 2.
RESULT TESTING

Testing	Detail	Info
Aplication function	a. Data processing (saving, editing, deleting)	Good
	b. The relationship between one menu with the other.	Good
	c. The use of data relation.	Good
	d. Management of time allocation.	Good
	e. Print the result.	Good
Aplication Interfaces	a. The bound on input characters.	Good
	b. The bound on the use of input characters.	Good
	c. The bound on the type of input characters.	Good
	d. Respond to application.	Good
	e. Process of button manipulating.	Good

IV. CONCLUSION

The edge coloring concept can be used in solving the time table problem by first divided the factors into some sets. Based on the system that already developed, we found that this system might be able to be used as a tool to help people in charge to solve the problem faced every semester easier and faster. However, this system still need to be improved in order to get a better system which not only can run in windows but also in other operating systems.

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