Auto-Generate Scheduling System Based on Expert System

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Abstract— **This paper proposed a technique for smart auto-generate scheduling system specifically for the educational sector. In constructing a precise and high efficient timetable there are constraints that needs to be conceded i.e. availability of class rooms, students, lecturers, courses, time slots etc. These are the tedious elements that contribute to the challenges in producing the same. Considering Faculty of Electrical Engineering (FKE) Universiti Teknologi MARA (UiTM), Pasir Gudang campus as a piloted project, the proposed Auto-Generated Scheduling System (AGSS) is expected to overwhelm these problems. AGSS will provide the accessibility to the timetable committee to arrange the detail by simply loaded the information i.e. numbers of lecturer, list of class room, courses and loading detail (ATS) into the developed algorithm Artificial Intelligence (AI) expert system. Xampp and Visual basic is used in developing the timetable database and Graphical User Interface (GUI) for timetable system respectively. Based on the loaded information, the system will generate the class timetable automatically with individual user customizable setting. AGSS is adept to envisage the cost effective with fast and precise solution on the timetable management thus providing alternative solutions for timetable management while maintaining quality, reliability, and functionality**.

Keywords—expert system; auto-generate; visual basic; timetable system; smart scheduling;

I. INTRODUCTION

Initially, prior to the enrolment of a new semester, the timetable committee of UiTM Pasir Gudang have to arrange manually the specific requirement input data (i.e. lecturer details, courses, classes and time slot) into their existing scheduling system. UiTM for instance is applying Smart Scheduling System (SSS) to generate manually the class timetable. This hoary method entails inefficiency and time consuming due to the cases happened whereby the timetable need to rearrange several times due to unexpected changes on the parameters details. It is essential to ensure the precision of generated timetable to evade any discrepancy and failure on the scheduling system.

Though various approaches automated system are available to solve the timetable management problem, however, most of the organizations/universities still endure to solve the problem manually. This is happened due to most of the available systems are yet to provide additional features for customaries to furnish users special needs [1, 2]. In dealing with the timetables management, different optimization methods (i.e. particle swarm optimization (PSO), genetic algorithm (GA), tabu search (TS), ant colony system (ACS), fuzzy logic, Simulated Annealing (SA) etc.) have been used to obtain fast-computing abilities at its difference algorithm types such as metaheuristic, harmonic and memetic algorithms [3]. Several studies have been done in comparing the efficiency and high quality of each afore said mentioned methods but acquiescing the hard and soft limitations at different cases occurred are challenging [4]. PSO for instance is a population-based algorithm but possess poor local optima which affecting its global search abilities [5]. Evaluation performed in [6] conceded that GA is the most suitable approach in the arrangement of scheduling system compared with TS, PSO and ACS. Further research retrieves that after comparing different methods with each other, it was found that the evaluation results for hybrid methods (i.e. hybrid of PSO and TS, ACS-TS and ACS-SA) are more efficient than non-hybrid methods [3,5,7]. However, the accuracy and efficiency of the scheduling system are very much depending on the information populated from the input facts which is timetable committee.

Expert system is used in this research considering its abilities to imitate, extract and integrate between knowledge and human expert with data. The inference engine and knowledge base known as the subsystem designed to ensemble all the requirements to execute as human-like intellectual capacities [7]. Expert system is adopted by integrating with the object oriented database for the development of the proposed system in order to meet the user's unique requirement [8]. The valuable features of AGSS grant precise and fast solution to convey the information and notifications among the users. The stated piloted project involves 500 students, 50 lecturers, 30 courses, 21 laboratories and 7 numbers of classrooms that are allocated specifically for FKE. These elements will be defined as a proposed algorithm in expert system and any constraint occurred either hard or soft must or should be satisfied accordingly.

It is essential to note that each course may have one or more lecturers and classes depending on the total number of students registered at the particular semester. In promoting AGSS, it is imperative to emphasize the critical role that the proposed system performance in helping to equip benefits to the society, such as institution/university, school, academic staff,

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management and student. Therefore, AGSS is aiming to develop an auto-generate class time table using AI-based expert system with user customization option hence developing an interactive and user friendly of user Interface (UI) in one (1) system. Expertise in web technologies and programming are crucial in developing the AGSS. These technologies are keep developing and the information are widely accessible since the availability of a good platform and open source community in sharing the valuable recent information, solution and guides.

II. Design And Methodology

A. Problem Formulation and Definitions

The timetabling problem can be formularized as follows. There are two (2) main input facts that require to adhere in series namely as semester and student groups. The processing algorithm for semester must be fulfilled the constraints occurred prior on the student's group, lecturer and classroom which defined a finite set of semester S={s1,s2,..,sn}, a finite set of groups G={g1,g2,…,gn}, a finite set of lectures L={l1,l2,…,ln} and a finite set of classrooms C={c1,c2,…,cn}. Subsequent input fact is student groups algorithm which must comply the constraint occurred prior on the timeslots and gap for student groups, lecturers and availability of classroom. It is defined by a finite set of student's group G={g1,g2,..,gn}, a finite set of group and lecturer timeslots TG={tg1,tg2,…,tgn} & TL={tl1,tl2,…,tln}, a finite set of group and lecture's gap GG={gg1,gg2,…,ggn} & GL={gl1,gl2,…,gln} and a finite set of classroom R={r1,r2,…,rn}[9].

The proposed algorithm should find a timetable which fulfills a set of constraints. Each constraint may be hard or soft. The hard constraint is articulated as a must be complied cases while soft constraint prescribe that the case should be complied if possible. The set of hard and soft constraint can be describe as following:

Hard Constraints:

- Lecturer and student are not allowed to be assigned more than one (1) class at the same room or time.
- Two (2) different classes are not allowed to be held at the same room and time.
- Lab session should be allotted prior to classes.
- Classes are not allowed to be held after 6 pm.
- Lecturer and student should not have consecutively classes maximum four (4) hours.
- The capacity of the room selected should be appropriate with the number of students registered.
- Specific timeslot must be reserved for faculty meeting and special request events for lecturers.

Soft Constraints:

- Lecturer inclines to choose their preferable timeslots and rooms.
- At certain circumstances, student is allowed to cross program while registered for a particular subject.
- Lecturer requested to be assigned to teach within their expertise area.

Numbers of solution techniques has been introduced by the researcher for their own specific timetable scheduling problems. The above stated constraints are obtained from the expert of the piloted project and to be incorporated into the proposed artificial intelligence expert system.

B. Designing the Algorithm

While developing algorithm for AGSS, several aspects, constraints and impacts have been considered from various sources to ensure the successful of the project [10, 11]. All data acquired for the timetable generated in this paper must be arranged and managed accordingly to satisfy the proposed algorithm. Fig.1 illustrate the block diagram of the proposed system. The process flow of expert system is based on the forward chaining rule whereby the input facts i.e. list of lecturer, courses, classrooms/labs and loading are initially being asserted and loaded into the expert system to produce the output facts that emulates the human expert decision i.e. timetable for lecture, student, course and classroom/lab.

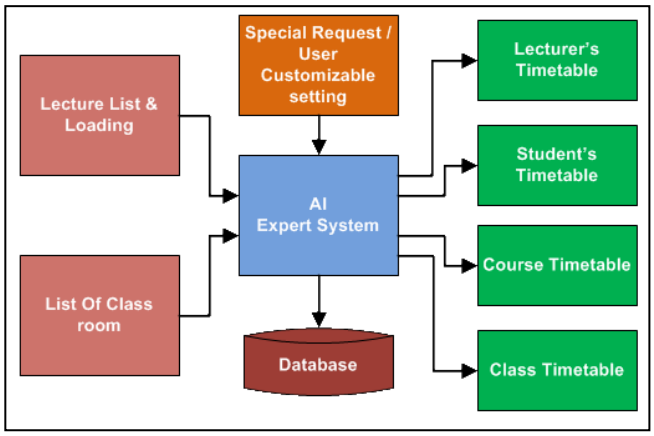

Fig. 1. Auto-Generate Timetable Block Diagram

Based on human expert knowledge which subsequently transfer into expert system algorithm, the rules must be executed in sequence according to the priority of the rule.

- Student's group timetable should be considered first prior to the lecturer timetable.
- Student's group priority are arranged according to the number of student for each semester.
- Largest number of students has highest priority.
- Lab session should be considered first before lecture and tutorial session.
- Student maximum consecutive class should be considered before lecturer consecutive class.

- Lecture and tutorial should not be on the same day.
- Lecturer timetable should cover every single day if possible.
- Faculty courses should be considered first before servicing courses.
- Courses with embedded lab should consider class in lab instead of classroom.
- Classes with embedded lab must use assign lab.

Fig.2 and Fig.3 illustrates the flowchart of AGSS main processing system and auto arranging timeslots availability separately.

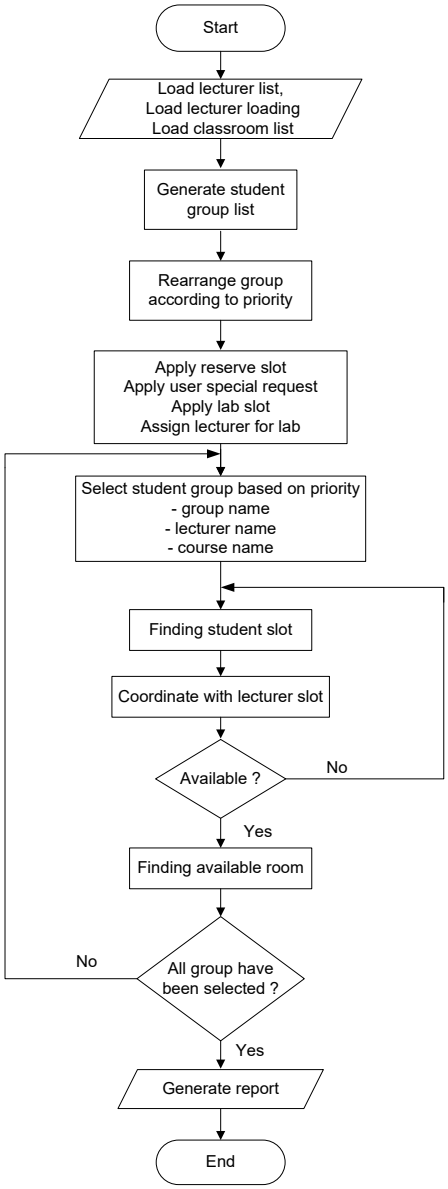

Fig.2: Flowchart of AGSS Main Processing System

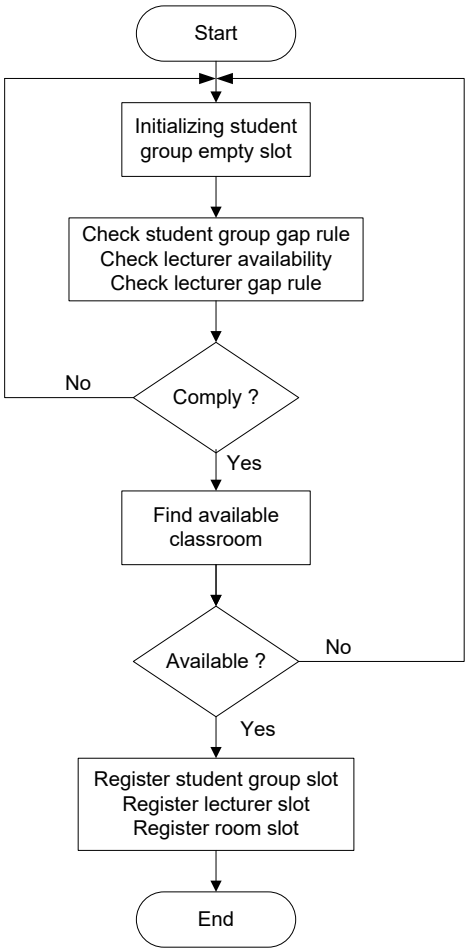

Fig.3: Flowchart of Auto Arranging Timeslots Availability

III. SIMULATION RESULT

Visual Basic is used as a main coding language in developing the AGSS and GUI. This system has been tested several times by using the real input facts. The ability of the system to generate the precise schedule according to the rules stated is proven with it shorten generating time (less than 15 second). The result demonstrated that the hard and soft constraint for lecturers is satisfying by simply embedded the command into the expert system as illustrate in Fig. 4.

AGSS will also benefits the students in providing a proper approach in generating their timetable as shown in Fig. 5. Fig. 6 show the attractive feature of AGSS that assist management of the timetable committee while arranging subjects in the classrooms. All input facts loaded are successfully displayed at one UI that are accessible by the administration staff, lecturer and student.

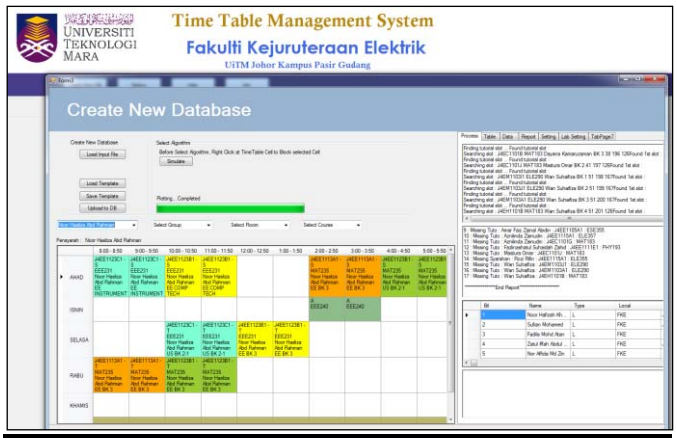

Fig.4: Timetable Generated for Lecturer

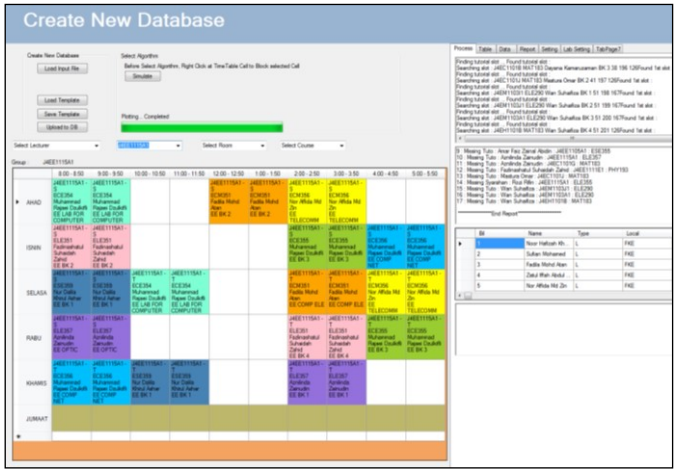

Fig.5: Timetable Generated for Student Group

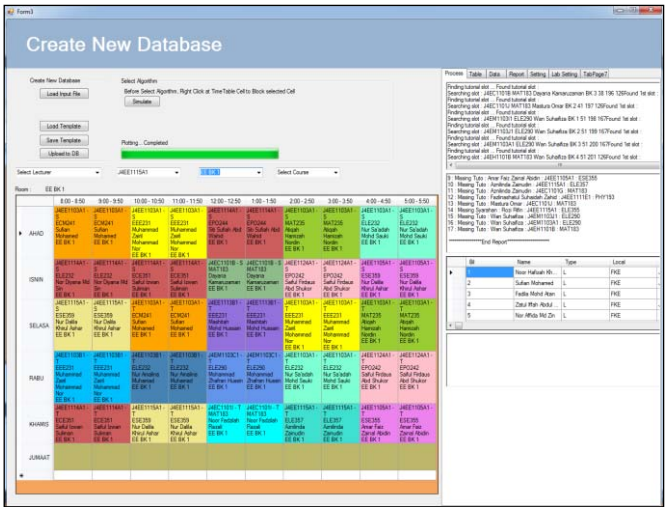

Fig.6: Timetable Generated for Classroom

At the final process of auto generation simulation, a report is produced to check the effectiveness of the system by running the auto checking student and lecturer's timetable. Happened if there is conflict between classes, missing lecturer and tutorial slot, a report on group, lecturer and classroom will be display for manual slotting.

IV. Conclusion

The development of an auto-generate class timetable using AI-based expert system with user customization option is successfully developed. Separate timetable for the student's groups, lecturer and classroom are generated automatically by this AGSS. The AGSS is developed in such a way that, no conflict will be occurred considering all input facts while providing features to customize the timetable as of requested. The capability of the developed system is well tested with the satisfaction of the algorithm to comply hard constraints and soft constraints respectively. AGSS is adept to envisage the cost effective with fast and precise solution on the timetable management thus providing alternative solutions for timetable management and maintaining quality, reliability, and functionality.

V. Future Works

Since FKE UiTM Pasir Gudang is currently the piloted project for the proposed system, hence it can be further enhanced by integrating the FKE's subject with other servicing subjects (i.e. mathematic, physics and chemical) that are relevant to the students. Consequently, the system can be farther improved by having automatic generation for the entire faculties available in UiTM Pasir Gudang thus providing alternative solutions for timetable management while maintaining quality, reliability, and functionality. Next, the system can be improved by having an online access into the automatic timetable generation whereby the information is able to retrieve by entering staff or student's id number. Significantly, it will give a great appreciation to all lecturer and student as the information on the timetable can easily being access everywhere and anytime.

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