**CHAPTER ONE**

**INTRODUCTION**

1. **Background of the study**

A timetable is a manuscript that serves as a complete guideline for time-wise allocation of resources to subjects, so as to minimize or eradicate the occurrence of conflict (Ozcan, 2003) and satisfy a set of desirable objectives (Kumar, et al, 2013). A timetable specifies which object meets at which resource and at what time. In an educational setting, the objects are students, lectures and courses with infrastructures and time as the resources.

Timetables play an important role in every educational setting (Gonzalez-rubio, 2006). However, apart from its significance towards ensuring that conflicts of schedules do not occur, the complexity attached to understanding scheduled timetables is fast becoming a major problem. Furthermore, students and lecturers have reported several cases of scheduled timetable misinterpretation, miscopying and forgetfulness (students arriving at a lecture or an exam after the scheduled time) (Carter and Laporte, 2004; Qu, et al., 2009). In addition, timetable administrators have reported high costs of scheduling and rescheduling, slow time to reach and cost of damage(Burke & Newall, 2004). This has necessitated the need for individual-centric timetables,and consequently the need for process (timetabling) and product (timetable) re-engineering, hence automation of timetable processes (Werra., n.d.).

Several platforms including web and cloud technology have been adopted for automating timetabling and digitizing timetables. The web timetabling approach simply involves integrating web development technologies for the implementation of web applications that permit timetable scheduling (Chan, & Zhao, 2014). This web application provides interfaces for timetabling through web browsers only (Chan, et al., 2014).

The academic environment has gone so complex that it may require an automated system to automate certain aspects of the academic system. One such area of difficulty is timetable scheduling; we always face those saddled with the responsibility of time table creation with challenges of creating an effective system that will deliver its purpose. However, there is a growing concern over the single usage of this technology for timetabling rather than hybrid (Attewell, 2005; Aakjeer, 2015). To harness this, using the most common academic institution timetable (for lectures, examinations and invigilation), this paper designs and implements web applications for scheduling, customizing and enforcing timetable schedules. A web application is implemented for scheduling timetables; customizing and enforcing schedules (setting reminders) based on user category and preferences:- hence hybrid approach. The timetable schedules of the Faculty of Computer Sciences, Heritage Polytechnic, AkwaIbom-Nigeria is used as a study test case.

I have seen automation as a way of enhancing Manual activities. For instance, we characterize Manual operations with some setbacks such as erroneous computation. With automation, those setbacks are either eliminated or reduced to barest minimal. To this effect applications are hiding the manual operations and project automation.

The general task of solving timetable scheduling problems is iterative and time-consuming. In real world application, the participants to the timetable scheduling have conflicting preferences which makes the search for an optimal solution a problem. To solve the problem, it is necessary to find a compromise between all the parties involved in the requirement, usually conflicting (e.g. day, time). I relate the constraints to the availability, timetabling and preference of each of the instructors, to room availability, number of students and curricula. In order to solve this problem for the particular case of the university system, timetable scheduling has to adopt the computer-base approach. Computer-base approach enables the institution to automate certain manual tasks and work efficiently. Also, in the particular case of timetable scheduling, the automated system could find an optimal or a sub-optimal solution using mainly inter-agent communication.

1. **Problem Definition**

The scheduling and management problem can be defined as a problem of finding the optimal sequence for evaluating a finite set of operations (task or job) under a certain set of constraints that must be satisfied.

A typical example of scheduling problems is timetable scheduling. The problems to be solved by timetable scheduling are mapped out below.

1. Maximize individuals in timetable scheduling or other resources.
2. time required to complete the entire process for timetable scheduling.
3. Production of timetable and of conflict interest, place, etc.
4. Notifying all parties in cases of modification.

All these problems and more are to be solved so that the proposal solution for timetable scheduling will be an enchantment over the manual.

**1.3 Aims and Objective**

In solving problems of timetable management, there is a need for effective and efficient techniques or methods.

One of the methods proven to be effective and efficient is the web-based approach. The approach that automates all the manual concepts of timetable scheduling thereby eliminates most of the problems associated with the manual technique.

To this end, this project work is designed to introduce a web-based approach to the conventional method of timetable management.

**1.4 Scope of the Study**

This study will only cover the management and allocation of spaces and time for lectures in the Department of Computer Science, Heritage Polytechnic. Also, the work will be made to run on the internet backbone this will make the application distributed and network based.

**1.5 Significance of the study**

1. Web-based Timetable system is basically designed to save users information, facilitate the manipulation of data at a faster rate, provide concurrent access (access to many users at the same time) to authorize users, and also ensure the integrity and accuracy of the information system stored by the authorized users.
2. This project work will help to ease the queuing system in the university as the online Timetable system will help students to achieve whatever they want to achieve without coming to the various offices for Timetable.
3. The web-based Timetable system will enable the users to check and get notified of any changes in their class timetable.

There are several other advantages of web-based Timetable system and they are listed below:

1. It saves a lot of time.
2. It is very convenient to use it right from the comfort of your bedroom, office or anywhere at all in the world.
3. It is inexpensive to both the student and the school management.
4. It also helps the school in reducing cost such as labour and stationery.

**1.6 Limitations**

The proposed development is a time consuming process, to this end the project will be streamline to ND1 ND2 program due to time limitation.

**CHAPTER TWO**

**LITERATURE REVIEW**

Traditionally, the system of managing a college timetable was done manually by doing paper work. All the schedules of students,faculties and allocating subjects, classes, time had to be managed on paper. So if there were any changes to be made in the timetable it has to be replaced everywhere manually in the whole timetable making it messy and more difficult. There was lot of manpower needed in this process and consumed more time and resources. Thus the manual work was more and system was complex.

Then desktops or laptops were used to generate timetables which were produced by making tables consisting of particular subjects, classes, time and faculties required. This reduced the use of paper but the manual work was yet to be improved. At every place where there was any change in the schedule of faculty/student or adding any new faculty/subject it has to be changed manually everywhere thus consuming a lot of time.

Even though most college administration work has been computerized, timetable scheduling and updates is still done manually due to the difficulties involved. The manual timetable scheduling requires considerable time and effort. Timetabling is the allocation of given resources to objects that are placed in space time, in such a way that they satisfy a desirable set of objectives.   
Thus in our project the work load of manually adding the subjects, classes, faculties, time, making changes, and getting every party to be notified has been reduced due to the use of web technology which will be produced by giving subjects, faculties and time as inputs and generating a timetable as output. And whenever there will be any change in the schedule or there are any proxies the use of instant messaging provided in our project will help to solve the problems/clashes generated between students/classes thus saving time and manpower.

The school’s lecture-timetabling problem asks us to find some slots and classrooms which satisfy the constraints imposed on offered courses, lecturers, classrooms and so on. The problem is a combinatorial optimization problem belonging to the NP-hard class where the computational time grows exponentially as the number of variables increases. Various approaches have been made in the past decade to solve the problem of constructing timetables for schools and colleges. In our paper this problem is formulated as a constraint satisfaction problem and we discuss the various approaches that are capable of handling both hard and soft constraints. Hard constraints cannot be violated under any circumstances. For example, two classes cannot be allocated to a single teacher at the same time period, two classes cannot be attended by a student at the same time, more than one class cannot be held at a room at the same time et cetera. Soft constraints are necessary but not absolutely critical. For example, a timetable must be made in such a way that a group of students don’t have to come to college to attend only one class.

According to Kong, S. C. & Kwok, L. F. (1999), timetabling system involves a heuristic function to increase the scheduling performance, as well as producing a best outcome. Currently, the well-known solutions for the timetabling system are Genetic Algorithms and Memetic Algorithms (Mohd. Dain, A. A., Shaari, N. S. Gom, Y. S. & Bacheck, Z. A., 2001). However, Causmaecker, P. D. and his friends introduced the Semantic Web as a solution in the domain of timetabling. Berger, J. & Barkaouia, M. (2002) also introduced a Parallel Hybrid Genetic Algorithm for the vehicle routing problem, which they argue to be faster, more cost-effective and highly competitive than the best-known heuristic routing procedures and solutions. Obviously, researchers are still looking forward to heuristics that are suitable for their particular problems (Causmaecker, P. D., Demeester, P. & Vanden B. G., 2002). On the other hand, there are many solutions for the timetabling system, while each of them has their strengths and weaknesses.

**2.1 REVIEW OF RELEVANT THEORIES AND TECHNOLOGIES**

Solutions to timetabling problems have been proposed since the 1980s. Research in this area is still active as there are several recent related papers in operational research and artificial intelligence journals. This indicates that there are many problems in timetabling that need to be solved in view of the availability of more powerful computing facilities and advancement of information technology (S.B. Deris et.al, 1997).

The problem was first studied by Gotlieb (1962), who formulated a class-teacher timetabling problem by considering that each lecture contained one group of students, one teacher, and any number of times which could be chosen freely. Since then the problem is being continuously studied using different methods under different conditions. Initially it was mostly applied to schools (de Gans, 1981; Tripathy, 1984). Since the problem in schools is relatively simple because of their simple class structures, classical methods, such as linear or integer programming approaches (Lawrie, 1969; Tripathy, 1984), could be used easily.

However, the gradual consideration of the cases of higher secondary schools and universities, which contain different types of complicated class-structures, is increasing the complexity of the problem. As a result, classical methods have been found inadequate to handle the problem, particularly the huge number of integer and/or real variables, discrete search space and multiple objective functions.

This inadequacy of classical methods has drawn the attention of the researchers towards the heuristic-based non-classical techniques. Worth mentioning non-classical techniques that are being applied to the problem are Genetic Algorithms (Alberto Colorni et al., 1992), Neural Network (Looi C., 1992), and Tabu Search Algorithm (Costa D., 1994). However, compared to other non-classical methods, the widely used are the genetic/evolutionary algorithms (GAs/EAs). The reason might be their successful implementation in a wider range of applications. Once the objectives and constraints are defined, EAs appear to offer the ultimate free lunch scenario of good solutions by evolving without a problem solving strategy (Al-Attar A., 1994).

A few worth mentioning EAs, used for the school timetabling problem, are those of Abramson et al. (1992), Piola R.(1994), and Bufe et al. (2001). Similarly, EAs, used for the university class timetabling problem, are those of Carrasco et al. (2001), Srinivasan et al. (2002) and Datta et al…

Since 1995, a large amount of timetabling research has been presented in the series of international conferences on Practice and Theory of Automated Timetabling (PATAT). Papers on this research have been published in conference proceedings, see e.g., (Burke & Carter, 1997) and (Burke & Erben, 2000), and three volumes of selected papers in the Lecture Notes in Computer Science series, see (Burke & Ross, 1996), (Burke & Carter, 1998), and (Burke & Erben, 2001).Additionally, there is a EURO working group on automated timetabling (EURO-WATT) which meets once a year regularly sends out a digest via e-mail, and maintains a website with relevant information on timetabling problems, e.g., a bibliography and several benchmarks.

There are two main problems in timetabling. The first one is related to the combinatorial nature of the problems, where it is difficult to find an optimal solution because it is impossible to enumerate all nodes in such a large search space. The second one is related to the dynamic nature of the problems where variables and constraints are changing in accordance with the development of an organization (S.B. Deris et al., 1997). Therefore, a timetabling system must be flexible, adaptable and portable, otherwise the users will not use the system optimally or even as decision aids such as for storing, retrieving, and printing timetables, when the timetable planning decisions are made manually. In addition, most of the universities adopting a semester system give freedom to students to choose subjects provided that all pre-requisites are satisfied. This situation further complicates the construction of a timetable.

Various techniques have been proposed to solve timetabling problems. These techniques are neural networks (Gianoglio P, 1990), heuristics (Wright M, 1996), graph coloring, integer programming, Genetic Algorithms (Burke E. et al., 1994; Paechter B. et al., 1994), knowledge-based, and constraint logic programming (Lajos, 1995). The models formulated by some of these techniques cannot be easily reformulated or customized to support changes, hence the selection of the genetic algorithm for the implementation of this project.

**2.1.1 A Brief History of Generic Algorithm**

Generic Algorithm (GA) was introduced by John Holland (Aziz M. A., 2002). It utilizes several iterations to choose the best solution from a set of solutions for a problem (Yingsong, Z. & Kiyooka, S., 1999). Tzafestas, S. G. (1999) listed four fundamental different ways of GA compared to normal optimization and search procedures, thus:

1. GAs work with a coding of parameter set; not the parameters themselves,
2. search from a population of points; not a single point,
3. GAs use a payoff (objective function) information; not derivatives or other auxiliary knowledge, and
4. GAs use probabilistic transition rules.

**2.1.1 Automated time table generator**

Time table scheduling has been in human requirements since all thought of managing time effectively. It is widely used in schools, and other fields of teaching and working like crash courses, coaching center, training programs etc. In early days, time table scheduling was done manually with one single person or some group involved in the task of scheduling it with their hands, which takes a lot of effort and time. While scheduling even the smallest constraints can take a lot of time and the cases are even worse when the number of constraints or the amount of data to deal with increases. In such cases, a perfectly designed time table is reused for the whole generation without any changes, proving to be dull in such situations. Other cases that cause problems are when the number of employers/workers are weak, resulting in the rescheduling of timetable or they need to fill in empty seats urgently. They need to schedule their course to meet the need of current duration and facilities that are available to them. However, their schedule should meet the requirements of the new course additions and newly enrolled students to fresh batches. This may result in rescheduling the entire time table once again for its entire batch and to be scheduled in the shortest possible time before the batch courses start. Another problem that occurs when scheduling timetables for exams. When multiple batches have their exam on the same day, they need to be scheduled effectively taking into account all problems related to the facilities that are available to conduct these exams simultaneously.

**2.1.2 Benefit of Automated time table generator**

Most colleges have a number of different courses and each course has a number of subjects. Now there are limited faculties, each faculty teaching more than one subject. So now the time table needed to schedule the faculty at provided time slots in such a way that their timings do not overlap and the time table schedule makes best use of all faculty subject demands. We use a customized algorithm for this purpose. In our Timetable Generation algorithm, we propose to utilize a timetable object. This object comprises Classroom objects and the timetable for everyone likewise a fitness score for the timetable. Fitness score relates to the quantity of crashes the timetable has regarding alternate calendars for different classes. Classroom objects comprises of week objects. Week objects comprise of Days, Days comprises of Timeslots. Timeslot has an address in which a subject, student gathering going to the address and educator showing the subject is related. Also further on discussing the imperatives, we have utilized composite configuration design, which make it well extendable to include or uproot as numerous obligations. In every obligation class the condition as determined in our inquiry is now checked between two timetable objects. On the off chance that condition is fulfilled i.e. there is a crash is available then the score is augmented by one

**Advantages**

* Faculty does not need to worry about time clashes.
* Authority now does not need to perform permutation and combination.
* Authorities can concentrate on other things rather than wasting their time on preparing Time-Table.
* Gives accurate information.
* Simplifies the manual work.
* It minimizes the documentation related work.
* Provides up to date information.
* Friendly Environment by providing warning messages.

**2.1.2.1 Definition**

Good management is difficult to define for practical, theoretical and abstract reasons. It may also mean different things at the individual, group, organizational and common levels of observation. Most managers have little difficulty in defining good management at the individual workers level. Whether they are in the private or public sectors, their eyes are fixed firmly on productivity.

**2.1.3 Good Automated faculty time table general**

If you are an educator, you can understand how manual preparation of timetables for each class and adjust them according to teacher availability is tedious and frustrating. The Timetable Management system helps students to register for courses and see how course-section fits into the timetable schedule.

Timetable software provides effortless scheduling of timetable apart from an array of benefits to schools, colleges or any other institution.

They include:

1. **Eliminate Paper-based Processes**

Manual timetable system involves arduous paperwork and manual data entry that results in scheduling errors. You don’t get the information you need at the right time. This affects the productivity of the education institution and precious resources and time are wasted.

1. **Intuitive & User-friendly**

Timetable Management Software is simple and easy to use. No technical knowledge is required to operate it. Very easy to implement in institutions of any type or size.

1. **Automatic Timetable Scheduling**

Automatically create and maintain academic schedules of students within minutes. Automated Timetable Management System allows you to easily create a unique timetable for each class and subject. Generate reports for different periods and automatically calculate absences.

1. **Generate Multiple Timetables**

Create multiple timetables at a time and manage different timetable databases for multiple departments with customizable notifications and alerts.

1. **Customization & Flexibility**

Timetable software can be fully customized to meet the unique class scheduling needs and suggestions of the institution. Seamlessly integrate timetables to reduce course conflicts of students and allotment of classes according to convenient timings.

1. **Optimal Resource Allocation**

Assign teachers and classrooms for periods and optimize allocation of resources in the best manner possible.

1. **Highly Secure**

This software is highly secure with role-based permissions and privileges to provide restricted access to users and ensure transparency. Strict privacy and confidentiality of information is protected.

1. **Substitution Management**

Avoid the headache of creating the timetable from scratch when teachers are not available or absent. Easily manage substitution timetables with automatically assign

1. **Easy Integration**

Seamlessly integrate timetable with any calendar application. Automatically send email notifications, reminders and SMS alerts when you create or modify timetables.

1. **Localization Support**

Timetable Management software offers multilingual support to ensure fast and smooth timetable creation related to the geographical region and facilitate collaboration.

**2.2 Case study of the research**

This system will also help in faculty time table general application.

The purpose of developing a web-based faculty time table in general application is to computerize the traditional way of working Timetable.

The scope of the project is the system on which the software is installed, i.e. the project is developed as a web application, and will work for a particular operation. It is uses HTML, CSS, PHP & MySQL for designing & implementing the Proposed System.

**2.3 Compare Between existing systems**

There were a lot of web-based and automated faculty timetable general application and they had some differences between the characteristics of their works so here we compare some of them with our system.

**2.3.1 Automated time table generator**

Automated timetable generator operating system of time table preparation in schools is very monotonous and time-consuming which results in either the same teachers ending up with more than one class at a time or a number of classes conflicting at the same classroom. Due to a non-automatic perspective, absolute utilization of resources has proven ineffective. In order to deal with such problems, a mechanized system can be designed with a computer aided timetable generator. The system will take different inputs like number of subjects, teachers, maximum lectures a teacher can conduct, priority of subject and topics to be covered in a week or a lecture, considering which, it will create feasible time tables for working days of the week, making excellent application of all resources in a way which will be best suited for the constraints. A suitable timetable is then chosen from the optimal solutions generated.

**2.3.2 Automated school timetable generator**

Most of the timetable software uses complex design to generate timetables but as a result often lose simplicity. This application works on the most basic and simple design which can save hundreds of hours of teachers of small school/college or education institute.

Special thing about this utility is that it does not ask to fill up information required but on the contrary it collects the information on the fly as you type. Start building a time table instantly without entering any details such as number of teachers, their names, subjects etc.

**2.3.3 Online automated faculty time table general application**

Web-based automated faculty timetable general application is developed for lecturers and students to provide complete solutions. It will enable lecturers and students to get information correctly. It is uses HTML, CSS, PHP & MYSQL for designing & implementing the Proposed System for Web-based automated faculty time table general application

The features available in this new system are:

* Time saving
* Very secure
* Easy to use
* Reliable and accurate and more efficiency
* Power full

**CHAPTER THREE**

**SYSTEM ANALYSIS**

A system can be defined as a group of components consisting of sub system or procedures that works in a coordinated fashion to achieve said objective.

This chapter reviews how the existing system works as well as to produce a better alternative for its improvement.

The relationship amongst entities and information flows within the organization is very important; in a nutshell, system analysis is the study of an existing system with the view of improving on it or developing an entirely new system to replace the existing one. The process involves collecting and interpreting facts, identifying the problems, and decomposition of a system into its components. The idea and techniques applied is that which improves the system and ensures that all the components of the system work efficiently to accomplish their purpose.

The major task here is to design a new system with a front-end and back-end for students and lecturers.

**FUNCTIONS OF THE PERSONNEL**

1. **H.O.D**: He is the head of the department. He plans and assigns work schedule for each staff and students, and he oversees their duties. He possesses some administrative rights in the system.
2. **LECTURERS**: A lecturer lectures students professionally. A lecturer is assigned to a schedule in the timetable. Some administrative rights are reserved for the lecturers.
3. **STUDENT**: Students have access to timetables and can get notified in cases of modification. The system can be modified to allow students generate a personal timetable for themselves.

**CHAPTER THREE**

**MATERIALS AND METHODS**

Software Engineering system development principles were adopted for the implementation of the timetable customization system. Waterfall and Iterative models(Aggarwal& Yogesh, 2007) were used as the process models for the web and Android application respectively.

The web application was implemented on Programmers Microsoft Visual Studio Code Editor using markup, programming, scripting and query languages. Markup language (HTML) and styling sheet (CSS) were used to design and format the Graphical User Interfaces. Programming (PHP) and scripting languages (Javascript) were used to handle the logic and behaviors of the layouts. Query language (MySQLi) was used to query the database of the application.