Design and Implementation of Examination Scheduling Software for Tertiary Institutions in Nigeria

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Abstract – This paper deals with design and implementation of examination scheduling software for tertiary institutions in Nigeria. Borland Visual dBASE Management System (DBMS) was used to create database designs. The User Interface and other event-driven modules within the application were written using Visual dBASE Integrated Development Environment (IDE). The system implementation was supported by databases that collected information pertaining to the examination schedules such as invigilators, attendants, courses, and examination halls. The heart of the system is the scheduling engine, which allocates resources dynamically based on its intelligence using greedy algorithm. Iterative and user-centered design methodologies were adopted. The result shows that examination scheduling can be enhanced greatly by software applications. Invigilators and attendants can obtain a summary of their individual duties and view the schedule. The system also provides feedback and any other relevant information to the examination scheduling committee. In view of this, it is advisable for the tertiary institutions to adopt this automated option since it facilitates the preparation of examination schedules.

Keyword: Examination, invigilators, scheduling database, visual dBASE, greedy algorithm, scheduling engine.

1.0 Introduction

Examination is a critical requirement of an educational system at any level. Organizing an examination, such as assigning each subject to a room, assigning a set of invigilators to each examination room, and assigning a seating layout for each examination room requires a lot of tasks (Mohamad, 2018). The data for the tasks are usually obtained from many sources. Examination scheduling is the process of assigning examinations to time slots in a predetermined period of time and, simultaneously assigning rooms and invigilators to each examination, satisfying a set of different conditions (Danlami et al., 2014). This includes avoiding double bookings for rooms, lecturers and students, hall capacity and type conditions, examination sequence and spreading conditions, pre-assignment and availability of resources. The examination scheduling problem is similar to the institutions' course scheduling problem and it is difficult to make a clear distinction between these two problems (Vasupongayya, et al., 2013). An examination takes place in a given time slot, using a set of rooms and a set of invigilators. Each invigilator is assigned for a given room, although, several invigilators can supervise the same room. Each exam is schedule into one slot variable. For each exam, one or several exam rooms are allocated and for each room, a set of invigilators is defined. Examination scheduling is a largely studied class of timetabling problem concerning the scheduling for testing student's performance after several weeks of receiving lectures within a specified period of time (Mohamad, 2018) A good examination timetable ensures that students, lecturers and the school management are satisfied with the examination arrangement, making sure that all examination are scheduled within the stipulated time frame and both hard and soft constraints are well satisfied (Barry et al., 2008).

2.0 Motivation for the Study

The issue of examinations scheduling in institutions of higher learning is such that should be of interest to all. Most tertiary institutions in Nigeria today use manual system. This paper-based system is not only limited in its capacity, but also introduces both redundancy and inefficiency. The use of manual system for examinations scheduling has the problems of time wastage, inability to recognize double allocation of resources (lecturers, halls, courses), omission of resources (lecturers, courses, halls), re-allocation due to errors, highly tedious, and high implementation cost (Akhan and Güray , 2013). This leads to an idea of developing an application to create a suitable examination schedule.

3.0 Aim and objectives

The purpose of this study is to design Examination Scheduling Software for Tertiary Institutions in Nigeria.
Objectives of the study include:
(a)   To develop flexible and interactive Examination Scheduling Software that enables automatic   generation of examinations schedules for tertiary institution in Nigeria.
(b)   To develop a simple easy-to-use software which an individual with little or no idea of software   application can interact with a great deal of comprehension.

4.0 Literature Review

4.1 Exam Timetables
The resolution of the examination timetable problems can be claimed by different areas, such as the School Administration, Artificial Intelligence, Mathematics or Operational Research (Burke, et al., 2016). Probably, we must appeal on the techniques of simulation imported from fields as diverse as physics or biology, to solve the problem (Zhu and Tha, 2012). An examination takes place in a given time slot, using a set of rooms and a set of invigilators (José, 20016). Each invigilator is assigned for a given room, although, several invigilators can supervise the same room. Each exam is schedule into one slot variable. For each exam, one or several exam rooms are allocated and for each room, a set of invigilators is defined. This suggests a three phased approach, and as a result we have different types of variables: Time Slot Variable, Room Variable, and Invigilator Variables.

Timetabling problem in educational institutions is categorized in three groups: institution examination, institution course, and school timetabling. Institution examination timetabling defines the exact day, time slot, and room that each exam is held such that either no conflicts or a minimum number of conflicts occur. The main objective in the examination timetabling problem is no student takes more than one examination at any time period. This conflict can be regarded as a hard constraint and must be eliminated.

4.2 The greedy algorithm
The greedy algorithm with a simple priority function, dictates that all subjects are sorted according to the number of students in the subject from large class size to small class size. The algorithm will assign rooms for each day by separating morning section and afternoon section. At each section of each day, all subjects of that time are sorted according to their class size from large to small size. The available rooms of that time are also sorted according to their capacity from large room to small room. The algorithm then maps the large subjects to the large room. However, the whole subject might not fit in one room because some seats must be assigned to other subjects. The algorithm will search and assign the next subject to the room until the room is filled. Then, the algorithm moves to the next room and performs the same steps. The algorithm stops when there is no subject left to be assigned or there is no seat available. Either case, the algorithm will report to the user. Once, the room assignment is done the seating layout of each room must be produced or printed. All results are stored in the database so that they can be viewed, printed, edited or retrieved later as the case may be by the authorized users (Prabnarong and Vasupongayya, 2011).

5.0 Methodology

The study has been derived from the implementation of relational database management system (Frank and Simon, 2008), Iterative System Design was adopted. This is a purposeful design process which tries to overcome the inherent problems of incomplete requirements specification by cycling through several designs, incrementally improving upon the final product with each pass (Joseph, 2012). The design, coding, and testing were done in an iterative manner (Roger, 2006)

5.1 Data Collection Technique
A significant percentage of data and background information needed to successfully design the system were collected from tertiary institutions in Nigeria through various methods which include the followings:
(a)   Interview: In order to obtain relevant information which regards to the policies, procedures, and situations that might not be apparent from document, the interview method was used.
(b)   Direct Observation: The activities of the departmental staff (Examination scheduling committee) carrying out their various tasks were directly observed.
(c)   Document Analysis: the relevant materials and literatures were read to get valuable information. Some of the materials include the institution instruction booklets, examination instruction guides, and institution's past schedules'

6.0 Results and Discussion

The major components of this design are Input Design, Database Design, Table and File Design, Data Design, Output Design, process Design and Program Design. For this research work, Borland Visual dBASE Integrated Development Environment was used to create programs and databases (Longe et al., 2009). The heart of the system is the scheduling engine, which allocates resources dynamically based on its intelligence. The system allows manual intervention both before and after the automated scheduling process. The user interface and other programming modules within the application were written using Visual dBASE IDE.

6.1 The Model of the System
The Use Case Diagram and System flowchart of the system are shown in figures 1 and 2 respectively:
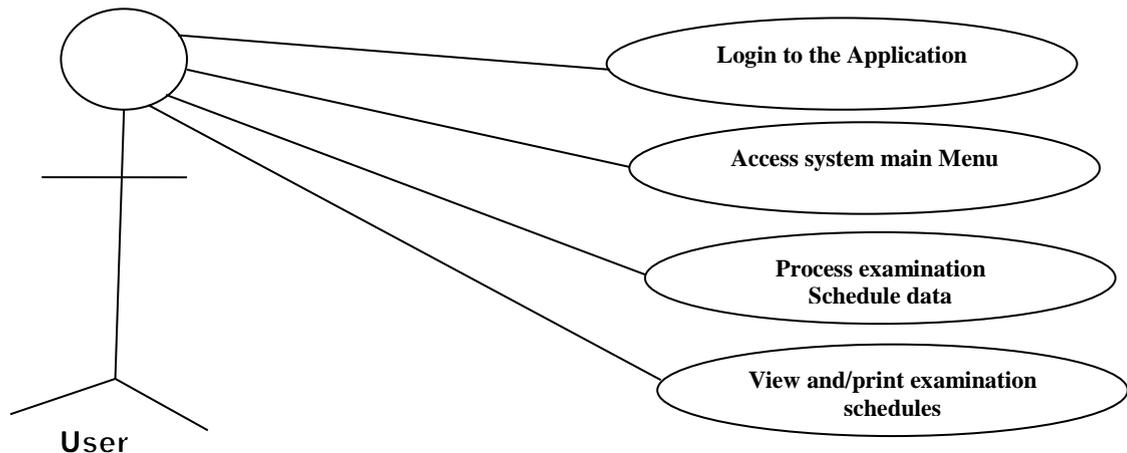

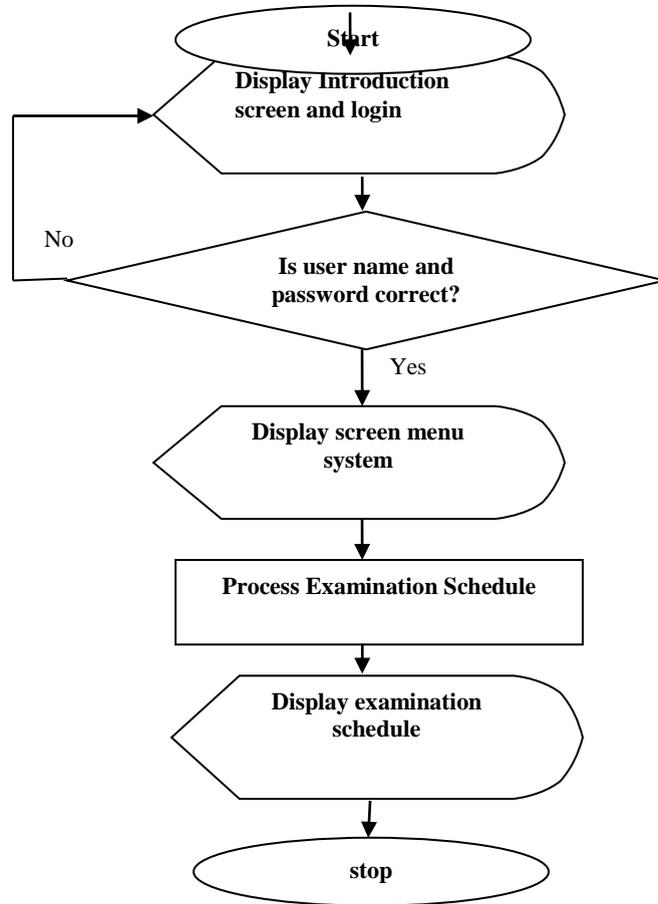**Fig 1: The Use Case Model of the System**

Fig 2: The System Flowchart

This system is made possible with the creation of databases that collect information pertaining to the examination such as invigilators, attendants, courses, and examination halls. This system benefits especially the Academic Administration Office of the Institutions of higher learning because it generates comprehensive examination schedules. The main menu is the gate way to the Examination Scheduling software. The menu bar lists the menus available for a particular screen. The main menus contain options for performing certain actions. The first screen, "welcome screen" is the introductory screen, followed by the other screens such as system main menus, Database Input screen, etc. Figures 3, 4, 5 and 6 show the screen shots from the software:

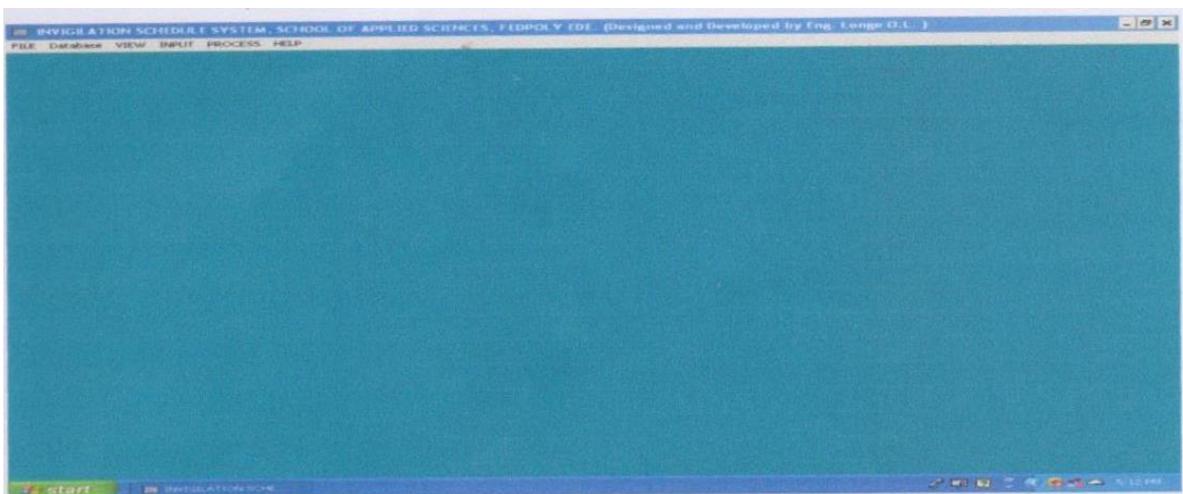Fig 3: Screen shot of the Introductory Screen
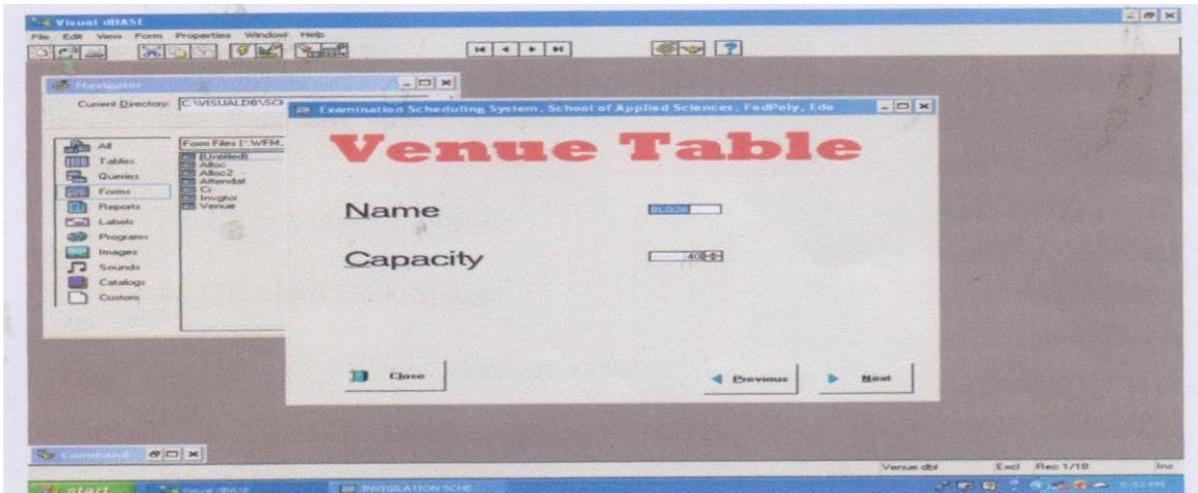

Fig. 4: Screen shot of the system Main Menu
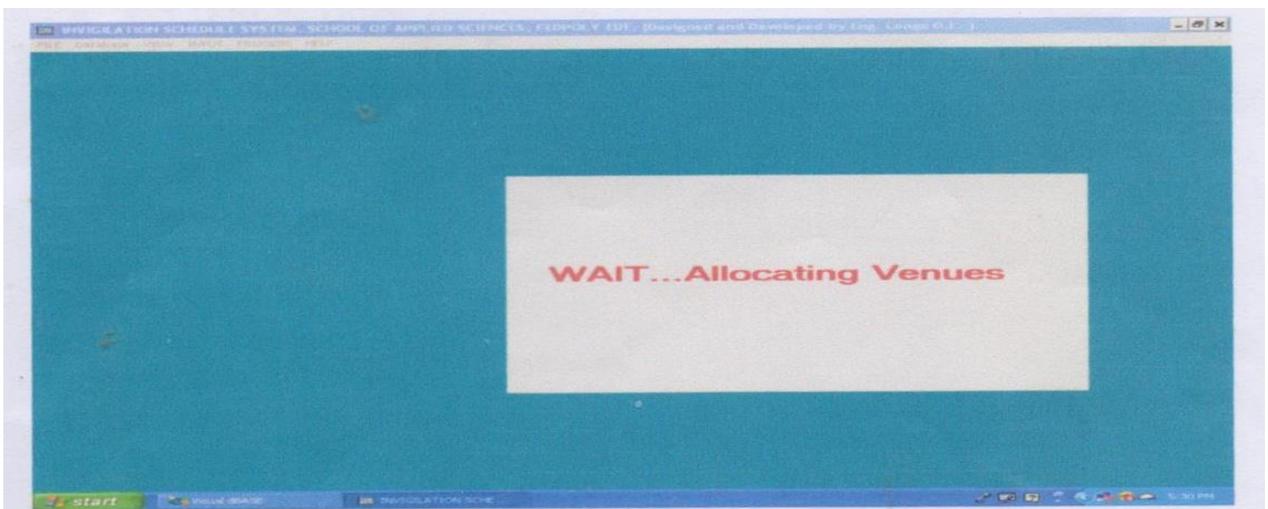
Fig.5: Screen shot of the Database Input Screen

Fig.6: Screen shot of the Processing Screen

7.0 Conclusion and Recommendations

The study has examined the design and implementation of Examination Scheduling Software for tertiary Institution in Nigeria. In a challenging economy, education is a vehicle for economic development and it requires a good method of learning and conduct of examinations to achieve its objectives.

To achieve highly reliable examination schedules, the following recommendations are made:
(a) The management of each institution should create Examination Management Unit (EMU) to manage and maintain the software
(b) The federal government should assist in funding and maintenance of the Nigeria tertiary institutions in order to enhance the application of ICT products at all levels.

(c) Funds and resources could be attracted from wealthy individuals, corporate organizations and international organizations for the purpose of improving the ICT compliance of tertiary institutions in Nigeria.

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