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Journal of Behavioral Informatics
Digital Humanities & Development Research
Vol 9, No 2, 2023 Series

A Secured Online Clearance System for Graduating Students of the Federal Polytechnic Bida

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ABSTRACT

Students in tertiary institutions are faced with one academic challenges or the other, such as number of courses credits/units carrying capacity, computation of GPA/CGPA, carry- over/adding and dropping of courses, post-semester of courses, and spill-over of courses. These challenges may be simple or complex, but if not adequately addressed, then the students are likely to be wrongly advised and not properly guided. The students of the Department of Computer Science, Federal Polytechnic Bida are in the categories of students facing such problems. Advising and guiding these students for proper decision making involves many approaches, which are not effective, because of manual processes that involve large population of students meeting the examination officers and course advisers. With this ineffectiveness, this research therefore developed an expert system that will be more effective and accurate in advising and guiding these students for proper decision making. The system would be used independently at anytime, anywhere, and on any devices because of its web-based nature. The development of the system was achieved with the use of Forward-Chaining Algorithm of Rule- Based Expert System, the system was developed with XAMPP as the local server, with web development tools such as PhP scripting language used for the backend, CSS for the frontend, MySQL as the functional database. The implementation of the system is expected to give better data analysis and ease the decision-making process for an effective academic guidance of the students.

Keywords: Academic, Advisers, Decision-Making, Expert Systems, Guidance, Web-Based.

Journal Reference Format:
Alao, K.A., Onuoha, E.C. & Achodo, N.E. (2023): A Secured Online Clearance System For Graduating Students Of The Federal Polytechnic Bida. Journal of Behavioural Informatics, Digital Humanities and Development Research. Vol. 9. No. 2, Pp 27-44.
Available online at https://www.isteams.net/behavioralinformaticsjournal.

1. INTRODUCTION

Decision making on challenging issues is a very complex process that needs to be properly addressed. Such decision making in academic challenges is common today in our tertiary institutions. These challenges may be simple or complex, but if not adequately addressed, thestudents can wrongly be advised, then not properly guided. Students in tertiary institutions arefaced with one academic challenge or the other, such as credit/unit carrying capacity, computation of GPA/CGPA, carry-

over/adding and dropping of courses, post-semester, spill- over of courses, and possible grade accumulation for increased CGPA. The students of the Department of Computer Science, Federal Polytechnic Bida are in the categories of students facing such problems. Advising and guiding these students for proper decision making involvesmany approaches, which are currently not effective, because of manual processes of meeting the examination officers and course advisers. A decision support and expert systems are some of the approaches that can be used to address these problems. An electronic approach (ExpertSystem) can help and save time in providing fast expert advice based on the knowledge from its domain knowledge base component (Saraswathi, Hemanth, Udaya, Suraj & Khaja, 2014). An Expert System is an interactive computer-based decision tool that uses both facts and heuristics in solving difficult decision making problems, based on knowledge acquired from an expert (Alhassan, 2013 as cited in Abisoye, Alabi, Ganiyu, Abisoye & Omokore, 2015).

Many systems have been developed to address these issues, but the systems are found to be ineffective because they are not student-driven. With this ineffectiveness, a decision support expert system is developed to guide students more effectively and accurately for proper decision making. The system is used independently online at anytime, anywhere, and on any device (desktop, laptop, mobile phones, smart phones) because of its web-based nature. The deployment of this student-driven web-based decision support system for students of Computer Science Department for academic guidance, counselling and decision making in their academicchallenges gives a better data analysis, ease the decision-making process by effectively and accurately guides these students.

1.1 Statement Of Problem

The manual process of meeting the examination officer and the course advisers for academic guidance in the department of Computer Science of the Federal Polytechnic Bida is ineffectiveand inaccurate as a result of too much workload on the hands of the examination officers whichmade it not possible to have enough time to advise and guide students in their academic challenges. Also, the large population of students to be attended to by the course advisers makes it impossible to attend to them as adequate as possible. In addition, some students have the fear of having close contact interactions with examination officers and the course advisers.

1.3 Research Aim and Objectives

The aim of the research is to develop a web-enabled decision support system for students' academic guidance and counselling, in the Department of Computer Science, The Federal Polytechnic Bida Niger State, and the objectives are;

4. To get relevant data for academic guidance and counselling.
5. To create database for relevant data and information used for the purpose ofstudents' academic guidance and counselling.
6. To provide a platform and implement a user-friendly interface for students to independently have online academic guidance and counselling at anytime, anywhere, and on any device (desktop, laptop, mobile phones, smart phones).

2. LITERATURE REVIEW

2.1 Academic Guidance and Counseling

Guidance according to (Abisoye *et al*, 2015) is described as advising or helping an individual with any kind of educational, vocational or personal problem. The term guidance, is defined in a variety of ways as follows: Welty, Tural, and Weitzel (2009) define guidance as "a systematically organized phase of the educational process that helps a youth grow in his abilityto give point and direction to his own life, in order for him to gain richer personal experiences in making his unique contribution to our democratic society."

According to Egbo (2010), a counseling program should assist students in achieving two seemingly opposing goals: societal adjustment and freedom to operate as distinct individuals. According to Alutu (2007) and Gesinde (2008), guidance is a comprehensive system of servicesand programs in schools designed to affect students' personal development and psychological competencies. Aremu (2002) and Omoni (2009) describe guidance as an all-encompassing concept that promotes a deeper understanding of an individual or group of individuals with the purpose of offering expert support to a person. From the collection of definitions, it appears that guidance is a professionally structured program intended to assist individuals in making individual adjustments in school, at home, in the workplace, and in society in order to achieveoptimal human performance. It's a cognitive educational service (within or outside of the school system) that helps people understand themselves if the client gives correct, dependable,and valid information about himself and his surroundings.

The following are the three main components of guidance and counseling in a school setting: -
(i) Educational Guidance (ii) Vocational Guidance (iii) Personal–social guidance

2.2 Expert Systems

An expert system is a computer system that holds a huge quantity of data and can make decisions in the same way that a human can. An expert system is a knowledge base withdomain knowledge and inference rules based on human expertise (Kumar, Gurram & Srinath 2018). Expert systems are designed to solve a wide range of complex problemsthat would be impossible for a human to solve. It is mostly represented by if-then rules and solves large difficult issues by reasoning via knowledge. These are the first successfulmachines created using artificial intelligence (AI) methods.

The knowledge of a human expert is represented in heuristic form by an expert system. The primary idea behind an expert system is to store a human expert's knowledge in a machine and use it whenever it is needed. The knowledge base and the inference engine are the two pieces of this expert system. The first element of the knowledge base is made up of facts and rules. Theinference engine, which is the second element, uses these facts to improve new facts based on existing facts. Forward chaining and backward chaining are the two modes ofthe inference engine. The expert system's overall operation is depicted in the diagram below.

2.4 Review of Related Works

In Gomal University, Pakistan, an expert system was developed to assist new students in choosing a faculty. CLIPS Language was used to create the rule-based Decision Support System. Based on the outcomes of the module examinations, the Decision Support Expert System assesses the student's strengths and proposes the optimal faculty. The fact that it is a stand-alone and customized Decision Support Expert System is a drawback (Muhammad & Nasimullah 2011). Naini, Sadasivam and Tanik (2008) use the Java framework to create a web-based interactive student advising system for course plan selection and registration. Pokraja and Rasamny (2006) describe in VEStA, an expert system that advises students on which courses they should take next. The recommender system also creates a semester timetable based on the semester's courses and students' curricula.

Bansal, Cline, Rangel and Zunke (2003) describe KRAK, a web-based advising system aimedat assisting students in customizing their college study paths, with advisers serving as mentors.It allows students to plan their whole degree, schedule semesters, and access information aboutcourses, professors, and universities. O'Mahony and Smyth (2007) present a collaborative course recommender system that assists students in selecting elective modules based on the core modules they have selected. In circumstances where no spaces are available or scheduling disputes occur, a "More Like This" recommender suggests students take comparable modules to their first choice of electives.

Marques, Ding and Hsu (2001) describe a system that provides advisees with up-to-date onlineadvising and related information, including a recommended list of courses for the following semester in order to fulfill degree requirements. The system contains a web-based main page where system users like students, instructors, and administrative personnel can visit their individual sites. The American University of Beirut (AUB) developed a web-based decision support tool for academic advising (Feghali *et al*, 2011). The survey between the Student Information System and the Online Adviser was conducted using a questionnaire. The online adviser is more effective and efficient than the student information system at the American University of Beirut. The preceding study has a flaw in that it is not student-driven.

3. RESEARCH METHODOLOGY

3.1 Data Collection

Data was collected from primary and secondary sources and analyzed to investigate the working of the current system. The review and study of the existing related web-based academic guidance systems. A face-to-face interview was conducted with the Examination officers and the course advisers to obtain relevant data and materials for the academic guidance. The new system was created using the rule-based expert system operating principle, which entails the employment of computer intelligent systems and electronic devices to advice weakstudent without having to meet with their course advisers/examination officers via client/server (web-based) computer hardware and software. The following major componentsmake up an Expert System: knowledge base, working memory/database, inference engine, and user interface.

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The standard Expert System Architecture is depicted in Figure 1.
Knowledge Base: The domain knowledge which is use to issue solution is stored in the knowledge base. The knowledge of a rule-based expert system is represented as a setof rules. The rules in the knowledge base are often organized as an IF—THEN construct, also known as a "production rule," with the following format: IF <antecedent> THEN <consequential>.

The antecedent is the requirement that must be met. The rule is triggered/fired when the antecedent is met. The action that is taken whenever the rule firesis known as the consequence.

Working Memory/Database: The database contains a set of facts that are matchedagainst the knowledge base's IF (condition) parts of rules.

Inference Engine: This is the expert system's main processing component, and it'sin charge of gathering data from the user. It looks for relationships in the knowledge base by interpreting, analyzing, and evaluating the rules in order to deliver answers, forecasts, and suggestions based on the knowledge base rules. When the inference engine examines rules, actions are taken if the information provided by the user meets the conditions in therules.

User Interface: The user interface is the way by which a user seeking a solution toa problem communicates with an expert system. The user interface facilitates communication between the user and the system.

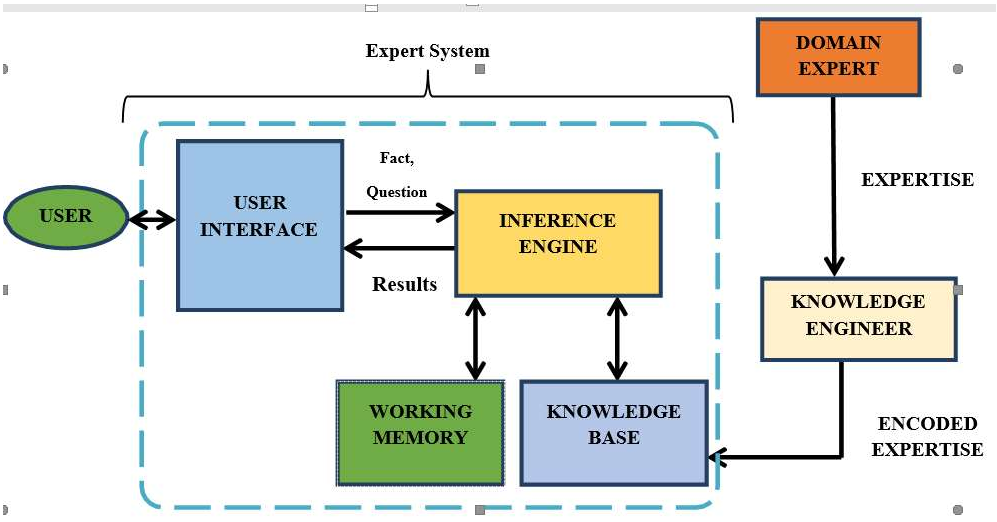

Figure 1: A Typical Expert System (Abhishek and Akansha 2013)

The expert system above operates with the data-driven principle of forward chaining algorithm.

Forward Chaining Algorithm

Forward chaining algorithm is a pattern matching algorithm that provides a generalized logicaldescription of an implementation of functionality (inference engine) responsible for matchingdata or facts against productions (rules) in a production rule system. It is primarily used to determine which of the system's rules should fire based on its data store. This involves assigning values to attributes, evaluating conditions, and checking to see if all the conditions in a rule are satisfied.

General Format/Pseudocode of Forward Chaining Algorithm

According to Griffin (1987) the general format of forward chaining algorithm is:

While values for attributes

remain to be inputread

values and assign to

attributes evaluate

conditions

fire rules whose

conditions are satisfied

execute actions

Step 1	=>	Attributes:	$X_1, X_2, \ldots, X_n$
Step 2	=>	Conditions:	$C_1, C_2, \ldots, C_n$

THE SYSTEM DESIGN

The System Architecture

The architecture of the system is as shown in figure 2 below. The architecture shows clearly the various tasks to be performed by the student that is seeking academic guidance.

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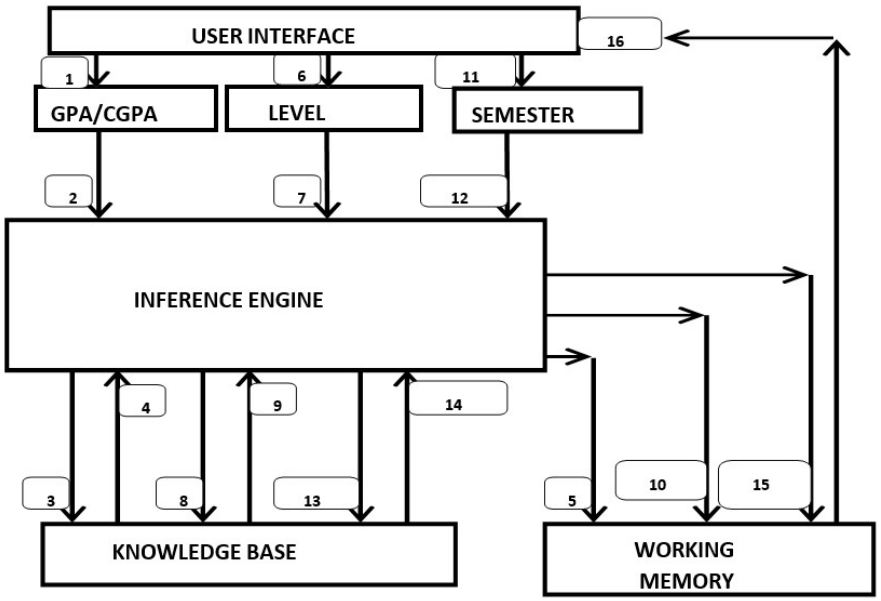

Figure 2: The System Arcitecture

KEY: The tasks involved are listed below.

(17) User which is the student supplies his/her GPA and CGPA through the userinterface.

(18) The inference engine captures, evaluates and examines the supplied GPA andCGPA.

(19) The inference engine matches the captured, evaluated and examined GPA andCGPA with the appropriate rule in the knowledge base.

(20) The inference engine fires/triggers/executes the matched rule in the knowledgebase.

(21) The fired/triggered rule determine if the student is to drop courses based on the ruleand saved the rule in the working memory.

(22) User also supplies the current level through the user interface.

(23) The inference engine captures, evaluates and examines the supplied student level.

(24) The inference engine matches the captured, evaluated and examined student levelwith the appropriate rule in the knowledge base.

(25) The inference engine fires/triggers/executes the matched rule in the knowledgebase.

(26) The fired/triggered rule selects the relevant courses from the stored relevant coursesin (5) above and also stores the selected relevant courses in the working memory.

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(27) The user supplies their current semester through the user interface.
(28) The inference engine captures, evaluates and examines the semester in (11).
(29) The inference engine matches the captured, evaluated and examined the courses tobe offered in that semester using the appropriate rule in the knowledge base.
(30) The inference engine fires/triggers/executes the matched rule in the knowledge base.
(31) The fired/triggered rule selects the relevant courses from the stored relevant semester in (10) above and also stores the selected relevant courses in the workingmemory.
(32) The selected and stored relevant courses in (15) above are displayed to the user throughthe user's interface.

The System Flowchart

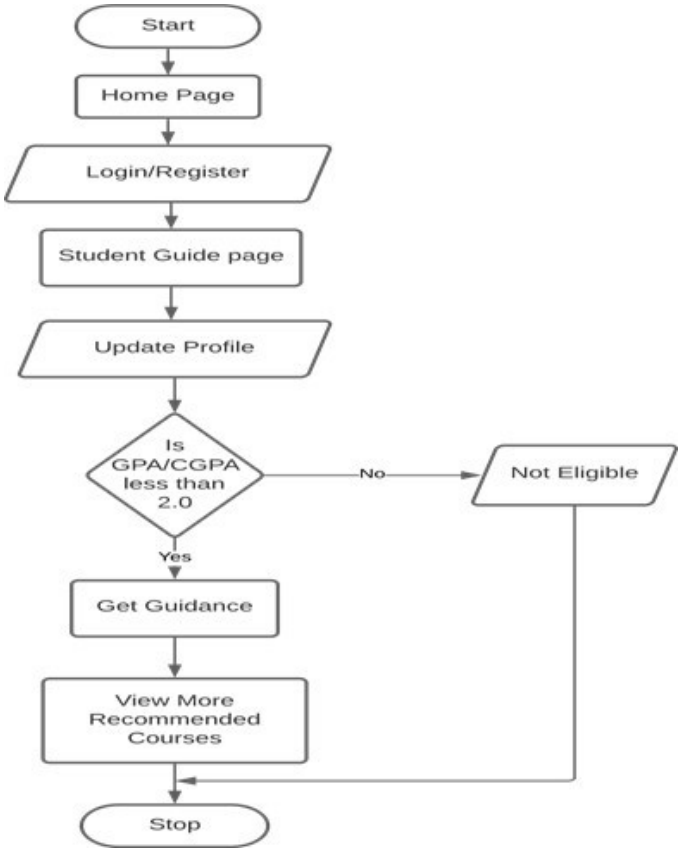

Figure 3: Flowchart Diagram of the New System.

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The above figure 3 shows how the students will interact with the new system. The students willinteract with the system by viewing the Homepage, where the student be prompt to Login or Register (if they do not have an account). The Registration process requires the student to entera valid matriculation number (2018/124119CS) and a password. After the registration is successful the student will Login into the system using their unique matriculation number andpassword which will link them to the student guide page, where all the necessary details to guide student are displayed. On the clicking the 'next' button students are prompt to update their profile by inputting their current Grade Point Average (GPA), Cumulative Grade Point Average (CGPA), Level and Semester. After the above steps has been completed, the system test if the student GPA and CGPA is less than 2.0, if more than 2.0 the system will display 'noteligible' to use the system, otherwise it recommends the possible courses to be offered by the student in the current semester. If the recommended courses are not suitable for the student, thestudent can click on 'View more recommendations' button.

The Use-Case Diagram

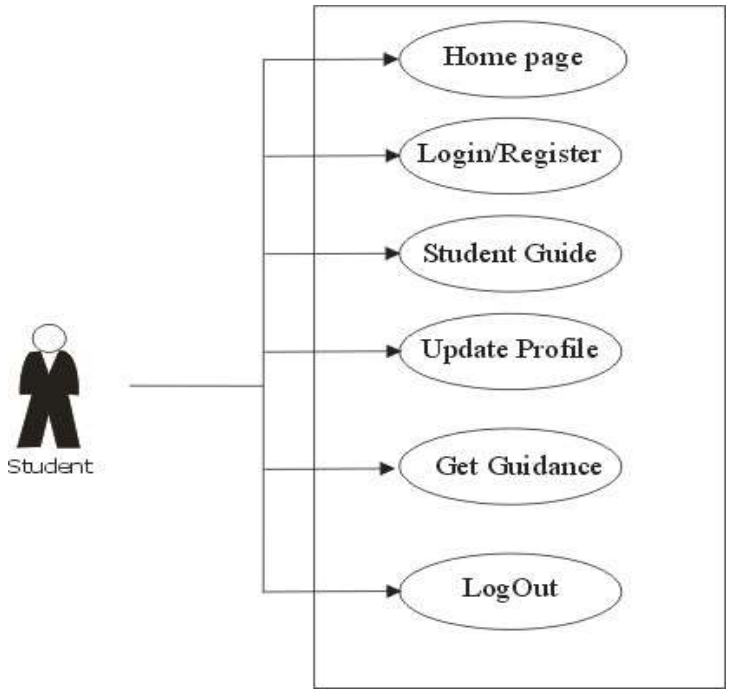

Figure 4_Use Case Diagram of the New System.

The above figure 4 shows how the students will interact with the new system. The Students will use the system to login, make enquires such as, knowing the minimum and maximum unitsthat can be offered in a semester. The students update profile by entering their GPA, CGPA, Level and current semester. Based on the profile uploaded the student will be guided on what decision to make, which involves dropping of course and possible choices of course(s) they can offer for the semester.

Input Design

The input to the system from the user (Students) is majorly the user's actions and responses onthe web pages of the system website. The actions and responses involve the user's selecting the relevant activities. The steps and replies include the student entering his/her current GPA/CGPA, level and semester appropriately.

Table 1: Student Table

S/NO	NAME	TYPE
1	USERNAME	Varchar(15)
2	STUDENT_PASSWORD	Varchar(15)
3	STUDENT_NAME	Varchar(100)
4	LEVEL	Varchar(5)
5	CURRENT_GPA	Varchar(5)
6	CURRENT_CGPA	Varchar(5)
7	SEMESTER	Int(1)

Output Design

The output is what the user will see on the screen, it contains the outcome of the processed data/input. The output design is projected inform of interfaces which is interactive with the users, the interface is projected using the Hypertext Transfer Protocol (HTTP).

Table 2: Course Table

S/NO	NAME	TYPE
1	ID	Int(11)
2	COURSE_CODE	Varchar(10)
3	COURSE_NAME	Varchar(50)
4	SEMESTER	Int(3)
5	COURSE_UNIT	Int(3)
6	LEVEL	Varchar(8)

Storage Design

The system have a fully dynamic and functional database. The database was created using XAMPP and queried using MySQL. As shown in figure 5a and 5b, the web-based academic guidance System consists of databases with the tables shown below:

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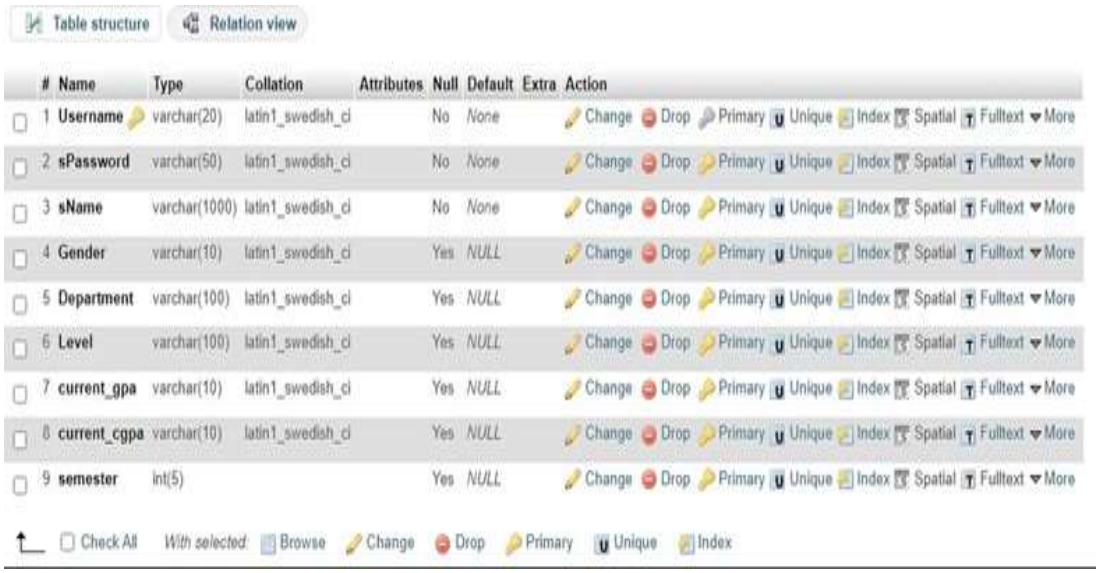

Figure 5a: Database Showing Different Tables

Figure 5b: Database Showing Different Tables

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4. SYSTEM IMPLEMENTATION

The implementation was carried out on a system running Microsoft Windows 7 Ultimate platform/Microsoft Windows 8 platform. Being a responsive web application, the client- side/user/web interface pages were encoded and implemented using "Bootstrap 3" front-end framework for (cross-platform/responsive-web).
The "Bootstrap 3" contains HTML5 (HyperText Markup Language), CSS3 (Cascade Style Sheet), and JavaScript. For the back-end, XAMPP was used as web server with support for PHP as a scripting language and MySQL forworking memory functional database.

System Modules

The system is designed in various modules with each having its own set of buttons and links tonavigate through the entire system. The major operational modules of the system are explainedbelow.

The Home Page: The home page, essentially consists of 'Login/Register' button for students, and it offers brief information about the system.

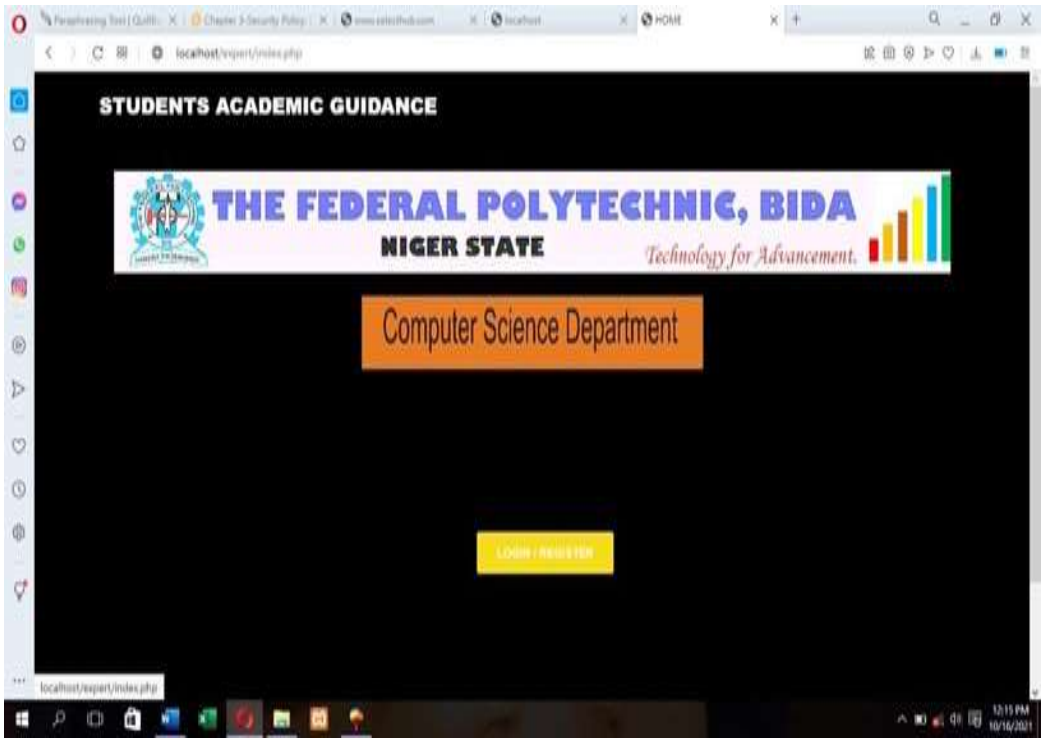

Figure 6: Home Page

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Registration Page: Authentication and authorization are required for access to the web-based decision support expert system for student academic guidance and counselling. A user registers by filling out an html form, which is shown below.

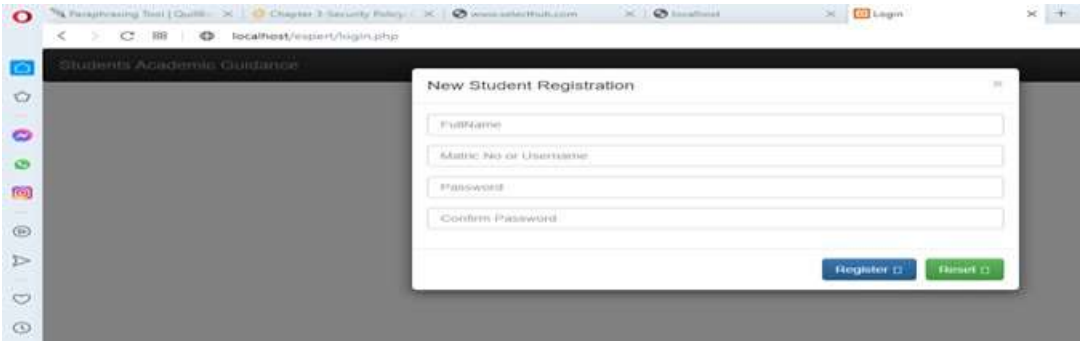

Figure 7: Students' Registration page

Login Page: Login is available to any existing or registered user (Students). Students can log in by filling up an html form with their matric number and password and submitting it, as seen in the image below. If the authentication is successful, the user will be logged in.

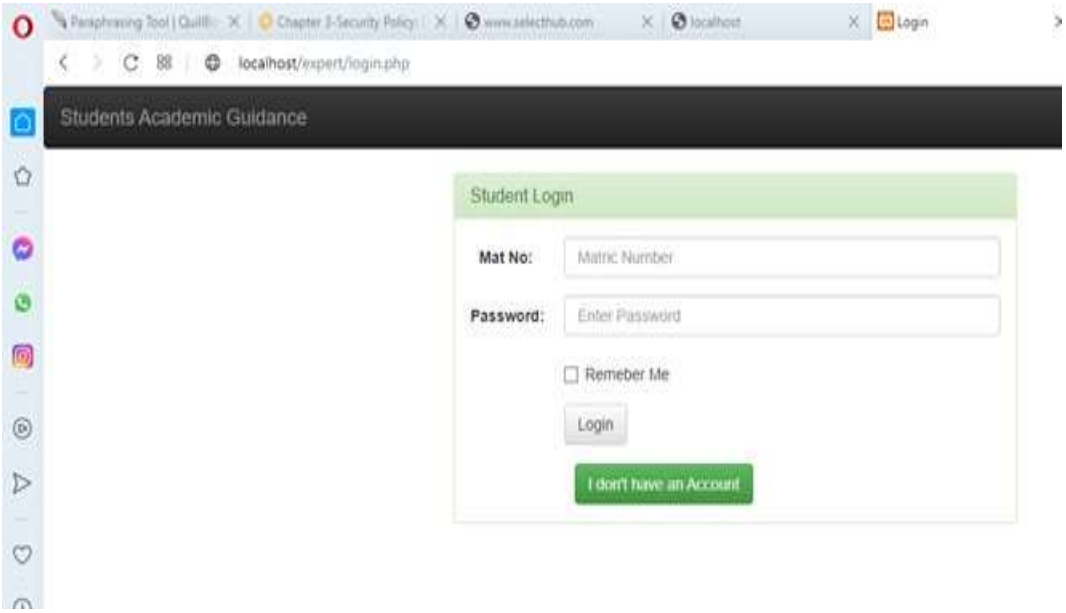

Figure 8: Students' Login Page

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Student Guide Page: This page contains all of the pertinent regulations that must be adhered to in order to guide the student. Students can inquire about course carrying capacity for each semester, when to add or drop course(s), the amount of course units that can be writtenin post-semester, course code, course title, and course unit.

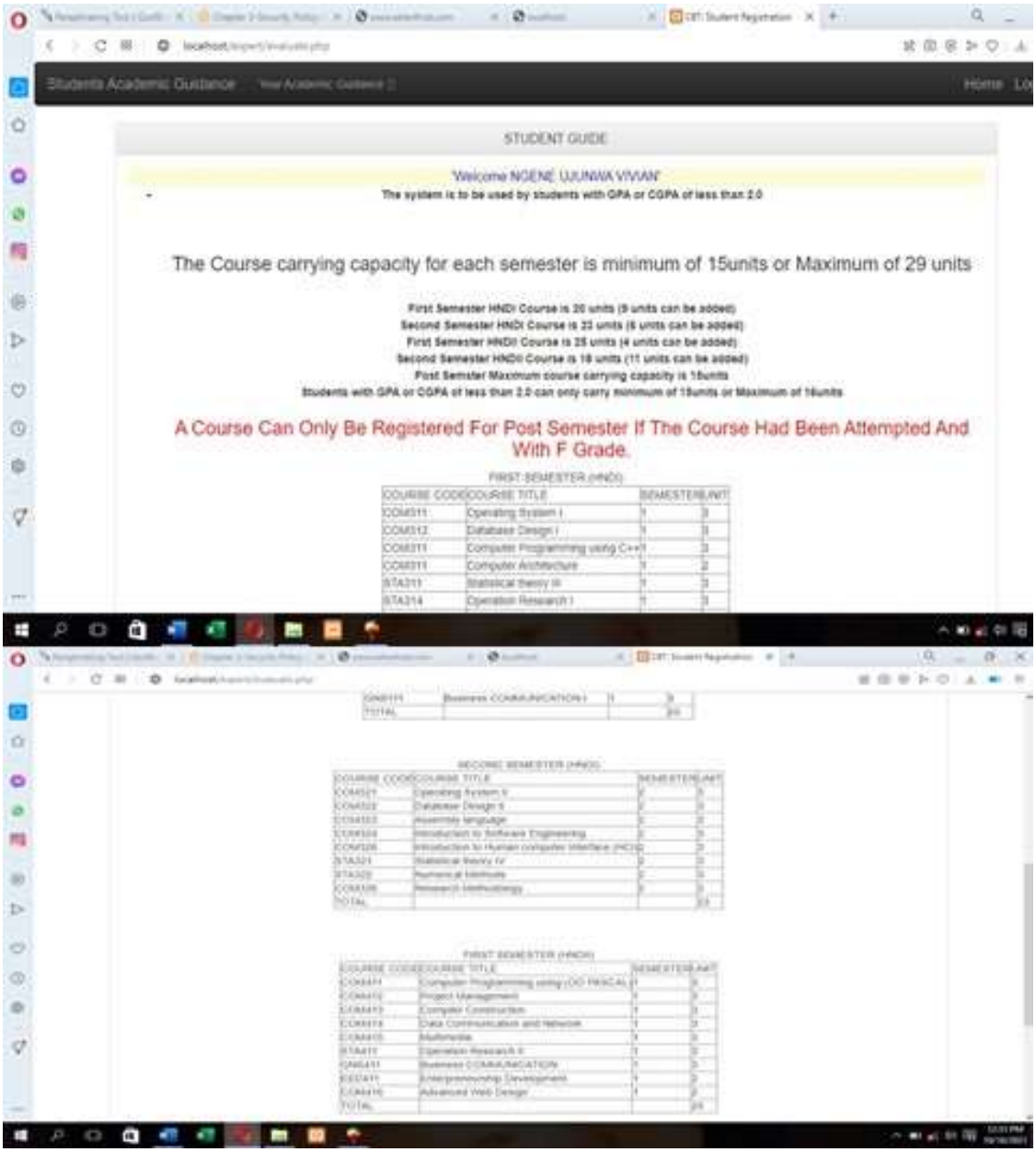

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Figure 9: Student Guide Page.

Students' Profile Update Page: The student(s) update their profile by entering their GPA, CGPA, Level, and current Semester then proceed by clicking the 'update profile' button.The profile update can be done every semester.

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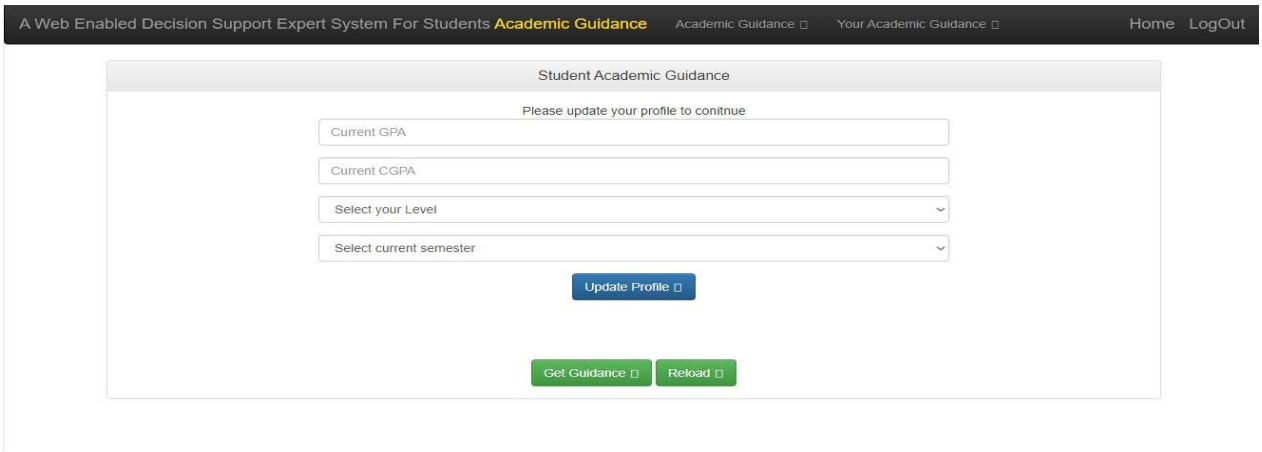

Figure 10: Student Profile Update Page.

Student Guidance Page: This page shows the student's GPA/CGPA, and recommendsome possible courses the affected student can offer based on the course carrying capacity of that student in warning (GPA < 2.0 or CGPA < 2.0) (which should not be more than 16 units and not less than 15 units) for the current semester.

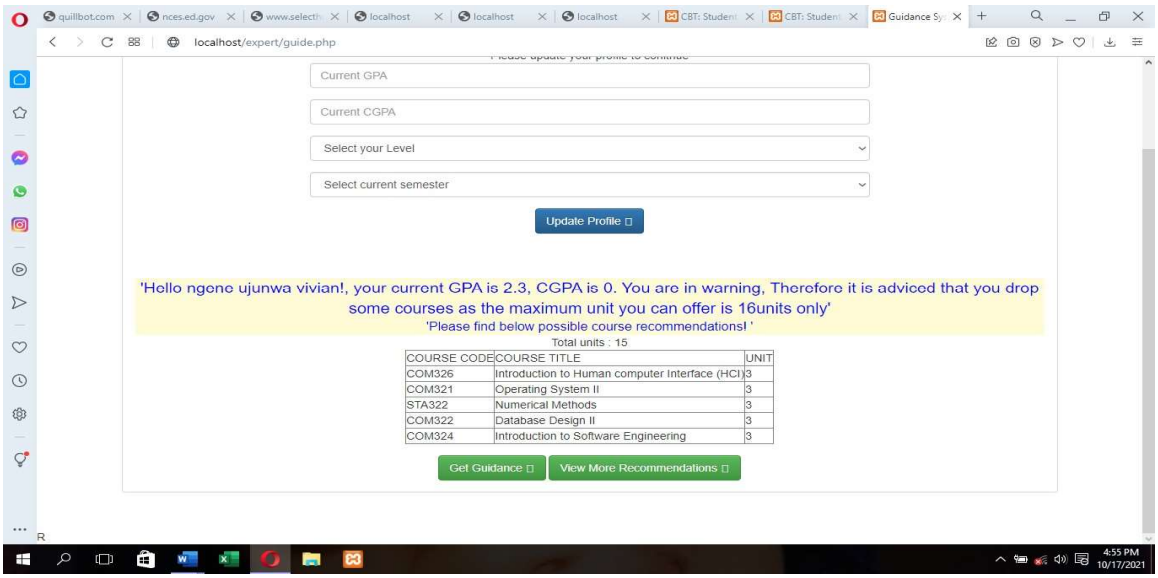

Figure 11: Student Guidance Page.

5. CONCLUSION AND RECOMMENDATIONS

Decision making on challenging issues is a very complex process that needs to be properly addressed. Such decision making in academic challenges is common today in our tertiary institutions. This research has explored the challenges faced with the manual method of guiding or counselling students of the Computer Science Department Federal Polytechnic Bida in their academics such as dropping or adding of courses when they are in warning GPA/CGPA.A web enabled decision support system for student academic guidance and counselling was developed to eliminate the manual process of guiding student. The web enabled decision support expert system uses a parameter such as a student GPA or CGPA to know if the studentis to drop courses and recommend some possible courses the affected student can offer basedon the course carrying capacity of that student (which should not be more than 16 units and not less than 15 units) for the current semester. The new system is student-driven, in which students are able to access it at any time and from any location using any internet-enabled device, this will go a long way in guiding large number students without physically meeting the examination officer, and by extension remove the student's fear of face-to-face engagementwith the examination officer or course adviser.

The optimal use of the system can be achieved by its integration on the school portal, also future enhancement of this research work could be carried out to accommodate more student-driven parameters that will guide students with GPA > 2.0 and CGPA > 2.0 on possible GradePoint Average (GPA) to obtain in other to achieve higher Cumulative Grade Point Average (CGPA) such as (lower credit, upper credit and distinction).

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