



AN INTELLIGENT RECOMMENDER SYSTEM FOR CAREER PATH SELECTION AMONG SECONDARY SCHOOL SCIENCE STUDENTS IN NIGERIA



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Abstract: Over the years, secondary students are tempted to choose a career which their parents, peers and people in general think to be a good career which often leads to difficulties. However, choosing a career is one of the biggest issues facing students in secondary school most especially in Nigeria. As the success of the career path choice depend on some factors such as relevant subject grades made in WAEC exam, scores obtained in UTME and availability of the course in the preferred institution. Also, with the limited number of counselors available compared with the number of students. This justifies the need for this study. Thus, this research work explored the possibility of building an Intelligent Expert System for Career Path Selection (IESFCPS). The waterfall model was used for the design. Rule based approach was used for the development of the inference engine and PHP was used to develop the software while SQL was used to develop the database. The knowledge base was formed from UTME brochure. The results revealed that IESFCPS recommend based on career interest, subject requirement and scores obtained in UTME. The study concluded that IESFCPS developed was able to provide guidance to students on career path selection. The system is recommended for students in secondary school especially in science class and school management. Artificial intelligence can be used in the future for the development of the inference engine.

Keywords: career, expert system, waterfall model, PHP programming language, SQL

Introduction

Career is the course of events that constitute a life, the sequence of occupations and other life roles which combine and express one's commitment to work in his or her total pattern of self-development (Super, 1976). Parents' educational and occupational background may affect student's choice of career because some students may contemplate on whether to continue with their parent's occupation or not (Blang, 2007). What the students see in the television also may affect their career choice; some careers demand that you have the personality to match the qualities of the occupation. For these reasons the necessity of a guidance counselor on schools cannot be over emphasized. Johnson and Mortimer (2002) defines career as one's profession which includes a number of occupations, vocations or jobs one person engage in during his or her working life. A career is an occupation, work or job undertaken for a significant period of a person's life. It involves both an opportunity as well as progression. Work involves the task or activities to be undertaken to achieve a purpose or result.

Career counseling is a process that enables us to obtain knowledge and information in order to understand ourselves and the world of work (Herr and Cramer, 1996). Basavage (2007) pointed out that career choice is one of many important choice's students will make in determining future plans and that this decision will impact them throughout their lives because; the essence of who the student is revolves around what the student wants to do with their life-long work. Super (1990) maintains that initial career decision-making is a cultural developmental task that students are expected to have accomplished by the end of their high school year. At secondary school level, a student is expected to have knowledge of what he or she intends to do in the future, this in turn guides the choice of subjects the West African Certificate (WACE). This decision – making is very important and students must be

allowed to choose their careers because it will create awareness in the students mind for the challenges ahead (Kniveton, 2004). It is good to say that the younger generation is the future of any society because they will determine the development of that society. Therefore, their career choices should help them develop the knowledge, skills and attitude needed to successfully examine their lives, while exploring and evaluating a wide range of career options to attain goals in the future. Clearly, career choice is purposeful or necessary and must be carefully done to avoid regrets. Students forced into any career find it difficult to embrace and adjust to the challenges that come, thereby leaving the student at a choice of being stagnant or retreating as the case may be. This also discourages the student and puts him or her in a position of not wanting to try anything new or different in a case where the student cannot excel to maximum expectation (Brown et al., 1996). Indeed, career choice is for development and the choice of a career must satisfy the expectations of the student(s) to attain higher heights as he or she strives to succeed.

Hence, in order to support students in overcoming difficulties in choosing the right career in accordance with what is desired, in addition to assist parents and career teachers in schools through the use of ICT-based application; therefore, the need of an Expert System is required. Expert systems are part of artificial intelligence designed based on developer analysis, design and expert knowledge (Giarratano and Riley, 2010) To support easy access to career path choice selection, a web-based information system application is needed that will provide guidance information for students in obtaining information about career professions then with an expert system approach integrated with system information, students are expected to be able to conduct independent career guidance (Nambiar and Dutta, 2010). Thus, in line with the benefits attached to expert system in solving real life problem in which guiding students in the right career

choice with the aid of intelligent system is not exempted, the study seeks to develop a career recommendation expert system that provides direction and guidance to students in choosing their careers in the field of science.

Related Works

Wulansari et al. (2022) carried out a study on developing an expert system to determine intelligence using Howard Gardners' multiple intelligence concepts. The study employed the use of Software Development Life Cycles (SDLC) and Unified Modeling Language (UML). Ledisi and Agba (2019) carried out a study on building an academic career path recommendation web expert system tools for students. The study employed the use of waterfall methodology; C# programming language was used, Microsoft access for data base and rule-based inference engine. Ezenkwu et al. (2017) carried out a study on developing an Automated Career Guidance Expert System (AC-GES) using case-based reasoning (CBR) technique. The study employed the use of data collection, data pre-processing, data splitting, implementation of CBR algorithm and implementation of AC-GES. Usman et al. (2018) carried a study on developing a computerized academic advising system by building a rule-based expert system for academic advising via WEB tool. The study employed the use of second generation of expert systems model, rule-based systems methodology and proto-typing model. Asnani and Agarwa, (2018) carried out a study on designing an expert system that aims to counsel a senior secondary student to decide his career path on the basis of his academics and extra-curricular interests. The study employed the use of rule based expert system and clips (C language incorporated production system). Desnelitaa et al. (2013) carried out a study on the development of an expert system for a career path recommendation model based on the profile of graduates in universities. The study employed the use of Procedural algorithm, architecture of expert system-based software, rule-based inference engine. Iwayemi et al. (2016) carried out a study on the development of a career-advisor expert system based on Myer-Briggs Personality Assessment. The study employed the use Myers-Briggs Type Indicator (MBTI), Rule based production system and Prolog (programming in logic is used for implementation). Gunwant et al. (2023) developed a rule-based expert system for career selection. The study employed the use of rule-based production system Inference engine, knowledge base is developed using JSON rule editor and syntax and user interface using angularJS, node.js and Mysql. Saif et al. (2022) carried out a study on developing a proposed system using fuzzy logic approach to get a solution for the career selecting challenge. The study employs the use of Fuzzy logic technology/expert system and MATHLAB to create fuzzy structure and database of decision rules. Al-Abri and Sidhu (2023) carried a study on designing a hybrid neural expert system that can be helpful in counseling. The study employs the use of neural network expert system, C# programming language for implementation and generic algorithm.

Materials and Method

The study employed waterfall model for the development of an intelligent recommender system for career path selection (IRSCPS). (Royce, 1970)). It is the breakdown of developmental activities which are passed down from one phase to another, which includes system requirement, system design, system development, system testing as shown in Fig. 1:

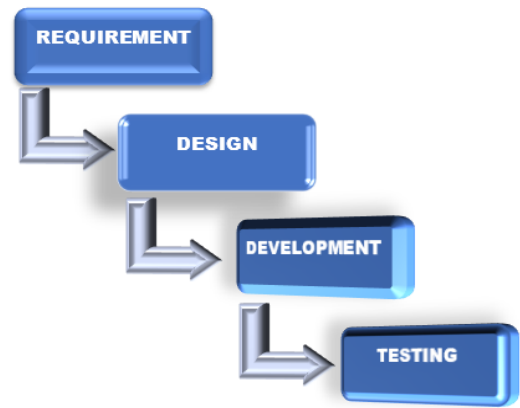


Fig. 1: Block diagram of waterfall application of IRSCPS
Source: Researchers Model

The waterfall model was used to build the core of the software which gives room for additional features to be added to it. The waterfall methodology, php programming language in an IDE environment (visual studio code) and a local host server (wamp server) was used to develop the software while SQL was also used to develop the database containing expert knowledge which was derived from existing resources (JAMB BROCHURE). Fig. 2 shows the architecture of Expert System developed. The IRSCPS gives recommendation using student career interest, subject requirement and scores. After inputting the required information, the student will receive qualification approval on the chosen career interest or an alternative based on the subject and score provided if not qualified.

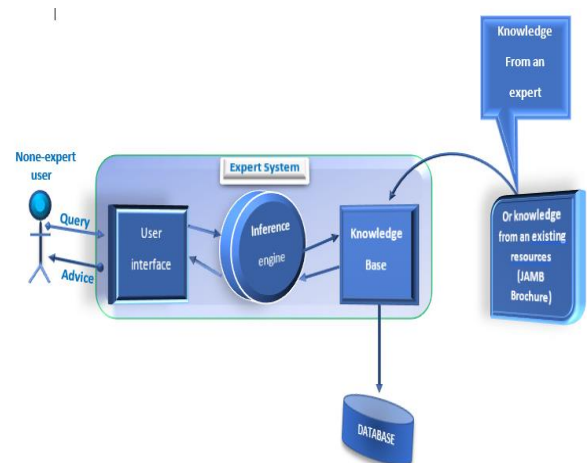


Fig. 2: Architecture of the Expert System

Source: Researchers Model

The Inference Engine

The inference engine is responsible for processing the knowledge and providing recommendations, which is developed based on the knowledge representation. The inference engine provides recommendations and uses the

knowledge base (where the acquired knowledge is stored). This stage, known as the knowledge base implementation, consists of entering the rules, facts, and concepts into the system. It evaluates the conditions of the rules against the available facts or input data, matching the patterns specified in the rules. When a rule's conditions are satisfied, the associated actions are executed. PHP was used as the programming language to design the inference engine and knowledge based in an IDE environment.

RULE 1

```
if ($result->num_rows > 0) {
    $row = $result->fetch_assoc();
    $qualified = (
        $mathematics >= $row['mathematics'] &&
        $english >= $row['english'] &&
        $biology >= $row['biology'] &&
        $chemistry >= $row['chemistry'] &&
        $physics >= $row['physics'] &&
        $agric >= $row['agric'] &&
        $geography >= $row['geography'] &&
        $jamb >= $row['jamb']
    );
};
```

RULE 2

```
if ($qualified) {
    $output .= "<p>Congratulations, $user_name! You qualify for $career.</p>";
} else {
    $output .= "<p>Sorry, $user_name. You do not qualify for $career. Here are some alternative careers:</p><ul>";
    $sql = "SELECT career FROM career_requirements WHERE mathematics <= $mathematics AND english <= $english AND biology <= $biology AND chemistry <= $chemistry AND physics <= $physics AND agric <= $agric AND geography <= $geography AND jamb <= $jamb";
    $result = $conn->query($sql);
```

RULE 3

```
if ($result->num_rows > 0) {
    while ($row = $result->fetch_assoc()) {
        $output .= "<li>" . $row['career'] . "</li>";
    }
} else {
    $output .= "<li>No alternative careers found</li>";
}
$output .= "</ul>";
} else {
    $output .= "<p>Career not found.</p>";
}
```

Results and Discussion

This IRSCPS uses a combination of HTML, CSS, JavaScript, PHP, and SQL to create a complete career recommender system. HTML and CSS handle the front-end, JavaScript adds interactivity, PHP manages server-side logic, and SQL sets up and interacts with the database. The students interact with IRSCPS to input their bio data as shown in Figure 3. The system will display a module for the students to choose their career interest as shown in Fig.

4. After the users authenticates, submit their career interest and results as shown in Fig. 5 This module display recommendation for the user as an output, which contain either a congratulation message and eligibility of user career interest or an alternate career of which the user can select based on requirement as shown in Fig. 6.

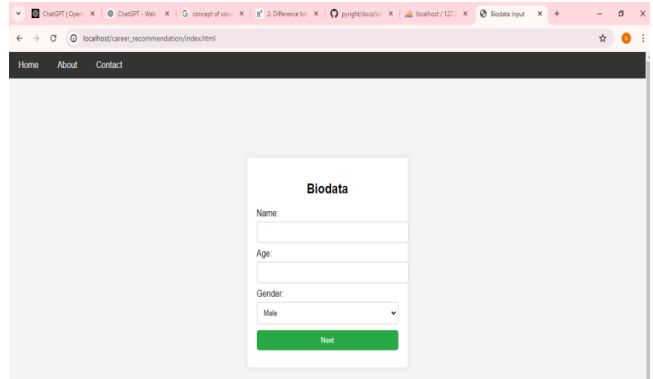


Fig. 3: Student Bio-data Module

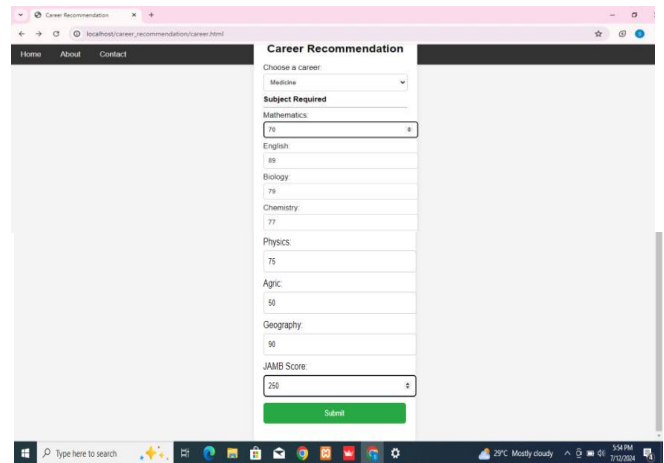


Fig. 4: Career Interest and Result Module

The IRSCPS developed in this study was able to provide counselling for students in science class in Nigeria secondary school based on the WAEC subjects passed, UTME score obtained and the availability of the course chosen in their preferred university. Together, these technologies provide a seamless user experience for determining suitable careers based on academic scores. Each module was tested before the final integration and testing of the whole system. The input bio-data and the career recommendation forms are designs generally based on the necessary data that needs to be entered into the system. The data are captured through the keyboard and stored in the SQL database. The result after the IRSCPS testing on accuracy and efficiency was satisfactory. The software is found to be reliable, valid and meeting up with the specific need of the students offering science subjects. The IRSCPS developed provide counselling to students based their request which is in line with study of (Al-Abril and Sidhu, 2023).

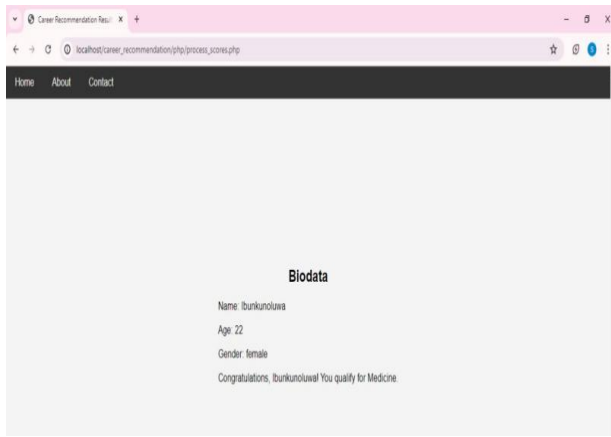


Fig. 5: Career Recommendation Module

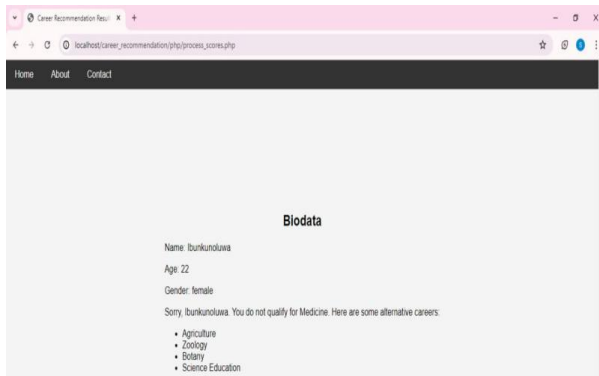


Fig. 6: Alternative Career Recommendation Module

Conclusions

Expert systems have been found to be very useful in our today’s world driven by technology. When expert knowledge is extracted and stored, such knowledge can be used to replace the human expert in case of demise. Career recommendation will have greater part of expert system advantages, knowing that only limited specialties exist in the academics counseling and guidance field. The knowledge of such specialist can be replicated and made use of in times of extreme necessity. Hence, the study concluded that the development of an expert system needs to be encouraged in secondary to assist in career path selection among secondary students.

Conflict of Interest: No conflict of interest

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