

Sikarju: Expert System of Major Recommendation to Increase the Chances of Being Accepted by University

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Abstract - Major is one of the important factors in the world of lectures. Along with the increasing need for knowledge and skills required in the world of work, increasing the number of majors offered by tertiary institutions. The number of considerations from prospective students regarding the selection of majors causes students to be confused in determining the best major they will choose to continue their education. The research aims to design an expert system-based website that will be used to provide major recommendations. The method to be used is the forward chaining method, where this method works by matching data based on predetermined facts, then obtaining results based on matching the data. Based on the black box testing that has been done, the results show that the designed expert system is by the expected functionality. Therefore this expert system can be said to be feasible to use.

Keywords: expert system, major, university

I. INTRODUCTION

According to Indonesia's statistical report, in 2021 there are 3,115 universities spread throughout the archipelago. As many as 2,990 units or 93.98% of universities recorded are private universities. While the rest, namely as many as 125 units, are state universities. Based on data obtained from the Ministry of Research, Technology and Higher Education, there are 26,886 study programs in all state and private universities in Indonesia.

Universities in Indonesia can take the form of Universities, Institutes, Colleges, Polytechnics and Academies. Each type of college has a variety of majors offered. Different majors will learn different things. The many considerations for choosing a major such as the field mastered, interests and talents, academic abilities and demands from parents cause prospective students to be confused in determining the best major which will later be the right choice for them in continuing their education.

After making observations at SMAN 3 Padang, data on students who graduated from state universities was obtained from as much as 23.6% through the SNBP, 29.8% through the SNBT and as much as 45% through the Mandiri. Then a survey has also been carried out on students from 6 study programs at Universitas PGRI Sumatra Barat, namely the Informatics Education study program, English Language Education, Indonesian Language and Literature Education, Geography Education, Sociology Education, and Economic Education, obtained data as much as 59.3% of students felt that they had chosen the wrong major. This is motivated by different factors ranging from difficulty understanding the material or feeling that the major taken is not by the interests they have.

Based on this view, an expert system is needed which will later be used as material for consideration for prospective students in choosing majors. An expert system is a system that tries to match human knowledge with computers, where this system is designed to model problem-solving abilities like an expert [1]-[3]. Expert systems can be used to facilitate the selection of majors in tertiary institutions and can provide solutions to users [2], [4]-[5]. Expert systems can be used to assist students in determining the majors to be taken without having to meet experts directly. So it can be concluded that the expert system is a system that can be used to help provide recommendations for majors.

The method that will be used in the design of this expert system is the forward chaining method which is considered capable of finding solutions to problems by collecting and uniting information properly [6]. This method is very suitable for use because it gives results based on fact matching first [7]-[8].

Here are some previous studies on expert systems using the forward chaining method, namely research conducted by Syihab in 2021, namely the expert system for selecting interest in study programs, obtaining results that the expert system can be used to facilitate the selection of majors in universities based on previous

interests and education [4], Then research conducted by Mulyani et al in 2018, namely an expert system to determine lecture majors based on the interests and talents of high school students, obtained the result that the expert system can be used to determine majors based on interests and talents [2], and research conducted by Yayang et al in 2022, namely an expert system to recommend college majors, found that the expert system can be used to provide department recommendations based on the type of interests and talents possessed [9].

From some of these studies, it can be concluded that the expert system can be used to provide major recommendations to prospective students without the need to meet with experts in person. The disadvantage of these studies is that the recommendations given are only in the form of majors. Based on this view, the author wants to design an expert system with a wider scope, namely designing an expert system that not only provides recommendations in the form of majors, but can provide recommendations in the form of majors along with the choice of universities in the city of Padang, West Sumatra province that provides these majors.

II. METHOD

A. Time and Place of Research

The research entitled "Sikarju: Expert System of Major Recommendation to Increase the Chances of Being Accepted by University" was carried out in January 2023 and was located at SMAN 3 Padang, which is located at Jl. Gajah Mada Dalam No.11, Mt. Pangilun, North Padang District, Padang City, West Sumatra.

This research starts from the data collection stage. Data collection is carried out by conducting interviews with parties appointed as experts. The data obtained is in the form of criteria needed to provide recommendations to prospective students to enter the university. Furthermore, the data obtained is analyzed and then converted into rules that will be used in the expert system to be designed.

B. Data and Tools

The data needed in this expert system is in the form of a list of majors and university and a list of rules for providing recommendation results. The data required on this expert system is as in Table I.

The tools used in this expert system is Sublime Text which functions as a text editor, XAMPP which functions as a local server to accommodate data and MySQL which functions to manage the database. The tools required on this expert system is as in Table II.

TABLE I
DATA OF MAJOR AND UNIVERSITY SOURCES USED IN RESEARCH

Data	Format	Source
University	Tabular	Website UPGRISBA, Website UNP, Website UNAND, Website Imam Bonjol, Website Politeknik Negeri Padang.
Major	Tabular	BK teacher at SMAN 3 Padang and Website UPGRISBA, Website UNP, Website UNAND, Website Imam Bonjol, Website Politeknik Negeri Padang.

TABLE II
TOOLS USED IN SYSTEM DVELOPMENT

Tools	Function
Sublime text	Edit text and code
Xampp	Local Server
MySQL	Database

C. Processing

Data in the form of rules obtained from these experts are analyzed to determine the department and the university that has the major. After determining the major and college, the data is grouped to be made into a decision tree.

D. System Development Life Cycle (SDLC)

SDLC used in this research presented in Fig. 1. This expert system as in Fig. 1 is designed using this forward chaining method using the Software Development Life Cycle (SDLC) method with an iterative model as the research method. The iterative model itself has 6 stages, including: planning stage, analysis stage, design stage, implementation and integration stage, testing and maintenance stage [10].

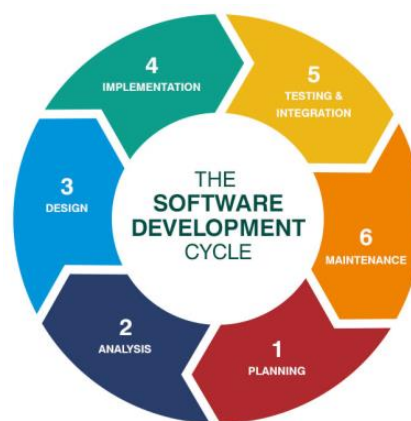


Fig. 1 System development life cycle

1) *Planning Stage*: At this stage, observations are made on the needs of the system such as identifying and evaluating problems, opportunities and obstacles as well as the need for the system that is expected as a proposed improvement. Then identify the required system, namely related to the selection of majors and feasibility studies of the system developed.

2) *Analysis Stage*: At this stage, 6 aspects will be analyzed, namely: system analysis, user analysis, process analysis, procedure analysis, the system needs analysis, proposed system analysis.

3) *Design Stage*: This stage discuss about system design, database design and interface design.

4) *Implementation and Integration Stage*: This stage is the stage where the system design is formed into a code (program) that is ready to be operated.

5) *Testing Stage*: This testing stage is carried out to find out whether the designed system can run properly or not. Several things must be observed, such as ease of use to the achievement of the objectives of the system that has been compiled since the system design was carried out. If a related problem is found in the designed system, it must be corrected immediately.

6) *Maintenance Stage*: This stage covers the whole process which necessary to guarantee continuity, smoothness, and refinement of the system that has been put into operation.

III. RESULT AND DISCUSSION

A. System Design

1) *Rules*: Rules are obtained by transferring expert knowledge into a computer. Researchers conduct interviews with expert that is a BK teacher at SMAN 3 Padang, regarding what criteria will be used in providing major recommendations. The data obtained is in the form of rules that contain a list of questions and solutions in the form of major recommendations (Table III).

Table III is a table that contains a list of questions that will be asked to system users, each question has a code to facilitate data matching in determining the results obtained. There are 174 questions list that obtained from the results of writer's interviewed with an expert (Table IV).

Table IV is a table that contains a list of majors and university that will be used as recommendations. There are 120 solution list that obtained from the expert and several university websites in Padang City (Table V).

TABLE III
QUESTION SAMPLE

No.	Code	Question
1.	P001	<i>Apa jurusan anda?</i>
2.	P002	<i>Apakah nilai matematika anda > 80?</i>
3.	P003	<i>Apakah nilai fisika anda > 80?</i>
4.	P003-1	<i>Apakah nilai fisika anda > 80?</i>
5.	P004	<i>Apakah nilai kimia anda > 80?</i>
6.	P004-1	<i>Apakah nilai kimia anda > 80?</i>
7.	P005	<i>Apakah nilai biologi anda > 80?</i>
8.	P005-1	<i>Apakah nilai biologi anda > 80?</i>
9.	P006	<i>Apakah nilai geografi anda > 80?</i>
10.	P006-1	<i>Apakah nilai geografi anda > 80?</i>
.....
174.	P116	<i>Apa bahasa yang ingin anda pelajari?</i>

TABLE IV
SOLUTION SAMPLE

No.	Code	Major	University
1.	S001	<i>Tadris Matematika</i>	<i>UIN Imam Bonjol</i>
2.	S038	<i>Pendidikan profesi dokter</i>	<i>UNAND</i>
3.	S040	<i>Psikologi</i>	<i>UNAND dan UNP</i>
4.	S048	<i>Pendidikan Bahasa Arab</i>	<i>UNAND, UNP dan Politeknik UNP</i>
5.	S075	<i>Administrasi Pendidikan</i>	<i>UNP dan UPGRISBA</i>
6.	S084	<i>Pendidikan Bahasa dan Sastra Indonesia</i>	<i>Politeknik</i>
7.	S116	<i>Teknologi Informasi</i>
...
...
120.	S120	<i>Studi Humanitas</i>	<i>UPGRISBA</i>

TABLE V
RULES SAMPLE

No.	Rules
1.	IF P001 AND P002 AND P003 AND P004 AND P005 AND P009 AND P010 AND P011 THEN S074
2.	IF P001 AND P002 AND P003 AND P004 AND P005 AND P009 AND P010 THEN S038
3.	IF P001 AND P002 AND P018-2 THEN S001
4.	IF P006 AND P007 AND P008 AND P039 AND P089 AND P090 AND P024-15 THEN S101
5.	IF P006 AND P007 AND P008 AND P039 AND P089 AND P090 THEN S065
.....
123.	IF P006 AND P007 AND P079-1 AND P024-28 THEN S100

Table V is a table that contains a list of rules. There are 123 rules used to describe the relationship that occurs between the questions (Table III) and the solutions (Table IV) provided by the system.

2) *Decision Tree*: Decision tree is a tree that imitates human thinking, where in each branch shows a decision or result [11]. The structure like a tree describes the complex decision-making process to be simpler so that decision tree will better interpret the solution of the problem (Fig. 2) [12]. This method is flexible so that it can improve the quality of the resulting decisions [13].

Fig. 2 illustrates the condition under which the system performs data matching based on the answer choices selected by the system user. The question will continue until the system finds the data matching the user's answer. Decision tree is the implementation of predetermined rules as in Table V.

3) *Unified Modeling Language (UML)*: Unified modeling language or commonly abbreviated as UML is a standard language for creating software blueprints. UML can be used to visualize, define, build and document artifacts in a software-intensive system, in

other words UML is used to identify system functionality [14]. The types of UML diagrams include use case diagrams, activity diagrams, sequence diagrams, and class diagrams [7], [14]-[15].

B. System Implementation

1) *Login User Menu Display*: This page is the user's Login page. Users are required to fill in their identity in the form of name and age first, to proceed to the next stage (Fig. 3).

2) *Question Page Display*: This page is a question page that contains a series of questions that will be asked by the system based on the rules set by the expert. Then the user will choose the answer according to the desired conditions to get the results of the major recommendation (Fig. 4).

3) *Solution Page Display*: This page contains solutions that will be provided by the system based on answers to questions posed by the system. This page contains the user's identity, conclusions on the answers to the questions asked, as well as the results of major and college recommendations (Fig. 6).

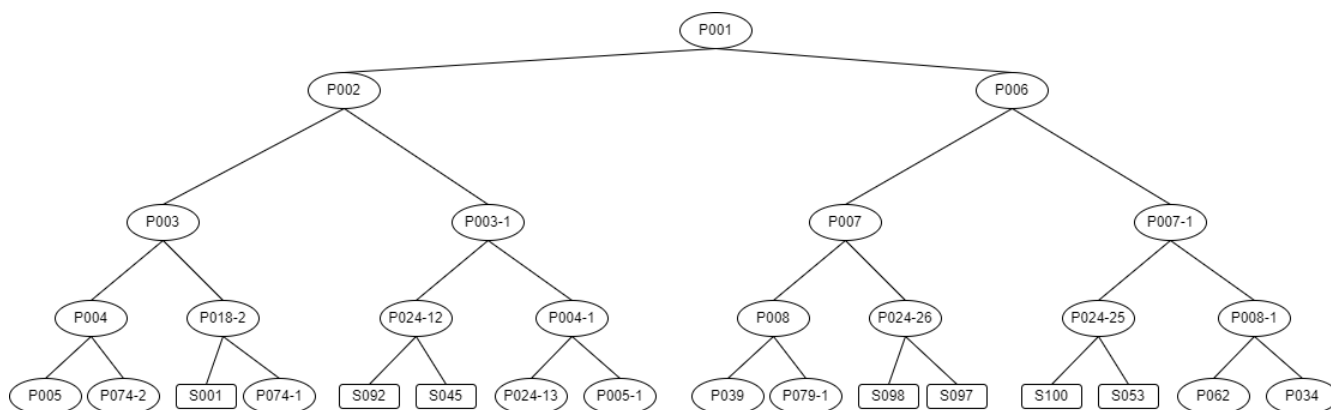


Fig. 2 Decision tree sample

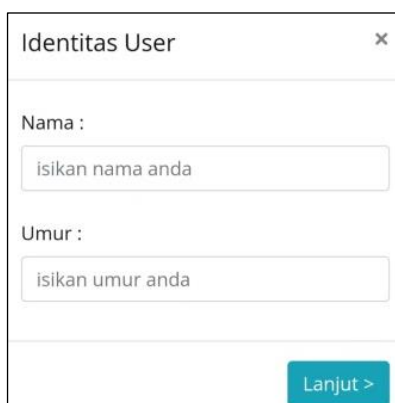


Fig. 3 Login user menu display

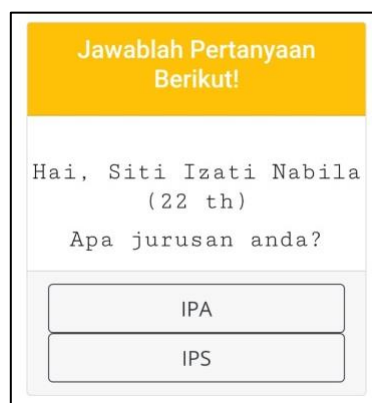


Fig. 4 Question page display



Fig. 5 Solution page display

4) *Login Admin Page Display:* This login page can only be accessed by admins by entering the username and password stored in the database.

5) *Dashboard Page Display:* This page is an expert dashboard page, where the page is used to add new facts to the system and can see the facts that are already stored in the system (Fig. 7).

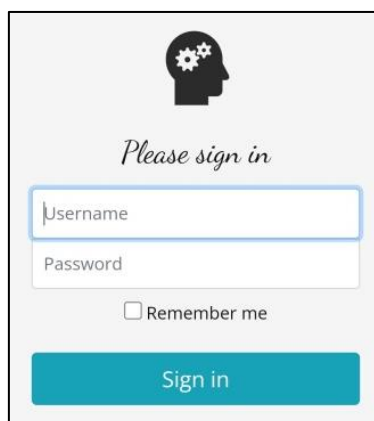


Fig. 6 Login admin page display

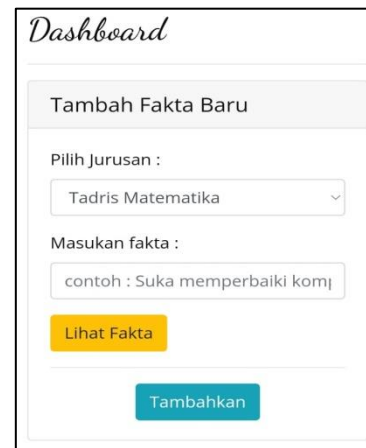


Fig. 7 Dashboard page display

C. System Testing

The system testing phase is divided into two types, namely alpha testing (which can be done using the blackbox testing method and whitebox testing) and beta testing (experts testing and users testing) (Table VI).

1) *Alpha testing:* This alpha test is done to see if all systems can run properly and are done by the system maker or those involved in the creation of the system [16].

- *Whitebox testing*

The test was carried out using the whitebox testing method, where the logic flow in the expert system was in accordance with the website structure and using flowcharts, cyclomatic complexity determination and system test cases [17], [18].

- *Blackbox testing*

Testing is carried out the blackbox testing method, where blackbox testing is a behavioral test that focuses on the functional requirements of software which means that this test allows creating multiple conditions fully entered will perform all functional needs for the program [18], [19]. Blackbox testing is a test that targets the aspect of functionality, namely how the software acts on user input to obtain the desired output [19], [20]. This blackbox test is carried out by the developers of the information system.

2) *Beta testing:* This beta testing is carried out to determine the suitability of the system to functional and non-functional needs with the main function of the system, namely knowing the extent to which the quality of the software being built, whether it is by expectations or not and the level of feasibility used based on certain criteria.

TABLE VI
SYSTEM TESTING

Types of Testing	Testing	Purpose	Respondents
Alpha Testing	Whitebox	To test whether a program component is running properly by looking at the internal code of the program	Developer
	Blackbox	To test the functional requirements of software which means that this test allows creating multiple input conditions that will fully perform all functional requirements for the program	Developer
Beta Testing	Experts Testing	To test the feasibility level of the system based on established criteria To test the conformity of the established rules with the expected results	3 Expert System Developers BK Teacher and Lecturers
	Users Testing	To test the conformity of the system to functional and non-functional needs with the main functions of the system To test the validation level of the recommendation results provided by the system	30 students of class XII 27 Students who have graduated in a major that suits their wishes and expertise

• *Expert testing*

The intended test subjects were 3 lecturers of Informatics Education, at Universitas PGRI Sumatera Barat. The results of the beta testing of system experts can be seen in the Table VII.

The intended test subjects were 1 teacher of BK SMAN 3 Padang. The results of the beta testing of experts can be seen in the Table VIII.

TABLE VII
EXPERT SYSTEM TESTING

Criteria	Percentage(%)	Status
Fungsionalitas	88,9	Very Good
Reliability	91,7	Very Good
Usability	90,0	Very Good
Efficiency	100	Very Good
Maintainability	94,5	Very Good
Portability	100	Very Good
Average	94,2	Very Good

TABLE VIII
EXPERT TESTING

Criteria	Percentage (%)	Status
Content	91,7	Very Good
Accuracy	100	Very Good
Format	90,0	Very Good
Ease of use	100	Very Good
Timeliness	100	Very Good
Average	96,3	Very Good

• *User testing*

User testing is done by students and college students. The intended test subjects were 30 students of class XII SMAN 3 Padang. The results of the beta testing of students can be seen in the Table IX.

The average beta test conducted on users on the major's recommendation expert system was 87.1% with very good results. So it can be concluded that in terms of the flow of functional and non-functional systems, the expert system of major recommendations is valid for use. So that this system can be used by prospective new students to get recommendations for majors and university that they will take to continue their education.

TABLE IX
STUDENT TESTING

Criteria	Percentage (%)	Status
Content	83,5	Very Good
Accuracy	83,8	Very Good
Format	85,7	Very Good
Ease of use	91,7	Very Good
Timeliness	84,6	Very Good
Average	85,9	Very Good

IV. CONCLUSION

Based on the results of research, design, and implementation of the system, it can be concluded that the tests carried out in this study are divided into 2, namely alpha testing (whitebox testing and blackbox testing) and beta testing (testing of experts and testing of users). From the results of beta testing on validation carried out by experts (system experts) obtained an average score of 94.2% with very good status, validation carried out by experts (experts) obtained a score with an average of 96.3% with very good status, user assessment questionnaires (students) obtained a score with an average of 85.9% with very good status and user ratings (college students) obtained a score with an average of 87.1% with very good status. Based on the results of the tests that have been carried out, it can be concluded that using expert system of major recommendation can increase the chances of being accepted by university.

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