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Prototype of Interest Measurement Expert System and Career Field Based on Holland Theory in Indonesia

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ABSTRACT

This research intends to develop an application based on an expert system that aids in assisting a person in identifying the type of employment that best fits their personality and set of traits. When a task that was previously performed manually and will be transferred to a computer system based on an expert system, measurements are made of each person's interests and talents. The Visual Basic programming language was used to construct this application. Realistic, Investigative, Artistic, Social, Enterprising, Conventional (RIASEC), developed based on Holland's thesis, is one of the six fundamental personalities that must be considered to suit individual psychological conditions in professional growth. The six parameters will be provided in various question formats, including graphic images, to help with measurement accuracy. Measurements are improved in accuracy and efficiency thanks to this application. It is anticipated that the system will be able to replace the psychologist in gauging interest according to Holland's theory if adequate measurement and analysis findings are available.

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1. Introduction

Many believe technological advancements have occasionally advanced quickly, particularly in computer technology. As a result, people's requirements become increasingly complex. Computers were once only employed in the academic and military sectors. Still, because of the incredibly quick advancements in technology, they are used in practically every part of daily life, including business, education, games, healthcare, psychology, design, industry, etc. This motivates computer scientists to create machines that can assist or replace human labour in certain tasks.

In computer science, known as artificial intelligence, researchers combine software and hardware to create intelligent systems that can approximate human capabilities [1]. One area of study in artificial intelligence is the development of expert systems, which are computer programs that store the knowledge of experts in a given field to make decisions or offer solutions in the same way as experts. Psychology is one of the scientific areas allowing expert systems to be applied. Self-measurements are used in psychology to study aspects of a person's personal qualities, and expert system programs can employ these measurements. Practically speaking, most measurements continue to be conducted via traditional techniques, including responding to questions or surveys to respondents as objects to be studied [2].

The questionnaire method could be more effective since it requires a lot of processing time and is prone to saturation among respondents, which affects the conclusions drawn from the data. To preserve consistency and accuracy, one way to get around this is to use technology to help or even replace human labour place; the authors developed a computer application that uses an expert system to assess interests and talents based on Holland's hypothesis. It is intended that this computer application system would help a person decide which

professional field is most suited to that individual's interests and talents based on expert knowledge in psychology, especially Holland Theory. The constraints or problems that arise in the traditional measurement of interest and aptitude include: it takes a long time to implement so that it could be more efficient; there is a feeling of boredom due to the large number of questions asked, which impacts the conclusions produced.

To overcome these obstacles, technology must be used, specifically by deploying an expert system as a tool for gauging interests and talents. The innovation was to put an image in each question answered to make it more entertaining and interactive. Holland's Career Theory is used to guide the extent of measuring or assessing interest in this study. According to Holland's theory, six primary personalities must be considered for an individual's psychological state during job development: realistic, investigative, artistic, social, enterprising, and conventional [3]. The measuring process is carried out by asking the user a series of questions, and at the end of the test, a conclusion is obtained in the form of which job sector is suitable for the user. The procedure is based on the expert system concept and written in the Visual Basic computer language.

2. Method

This system was built to be able to measure a person's interests and talents using an intelligent computer, which is normally done manually using paper and writing instruments. Using an expert system improves the measurement process's efficiency and effectiveness. Holland's psychology theory about interests and skills is the foundation of knowledge in developing this intelligent system. According to this theory, there are two fundamental characteristics in gauging a person's interests and abilities: activity and competence [4]. Some of the research methodologies used include:

a. Literature study entails researching numerous theories through books, journals, conference papers, and other sources to serve as a theoretical foundation and support for studying Holland's theory or developing expert system applications based on Holland's theory.
b. Expert interviews, or interviews with expert informants; in this case, the author interviewed one of the teaching lecturers majoring in psychology.
c. Observation Method, making observations for college student difficulties.

After completing the system requirements analysis, the knowledge employed in the system must be designed. Following the explanation of the system requirements, it is clear that the domain of expert knowledge is a branch of knowledge in psychology. As a knowledge base, this system employs Holland Theory. This information was gleaned from books, journals, and literature on Holland's Theory, as well as expert interviews with one of the Doctors of Psychology who truly understands Holland's Theory and its evolution[5].

The prototyping methodology has been used to develop information systems in various research, including simulation and forecasting information systems [5], medical information systems for clinic diagnosis centres [6], and decision support systems in employee rankings in a corporation [7]. According to past research relevant to this study, the Prototyping model has a high success rate under numerous conditions and criteria that need a short design time and user requirements that can be incorporated during system development. This prototype model is used to create the system as a physical model in that users can interact with the functionality of each generated function [8]. The picture below depicts system development utilizing the prototype model utilised in this study.

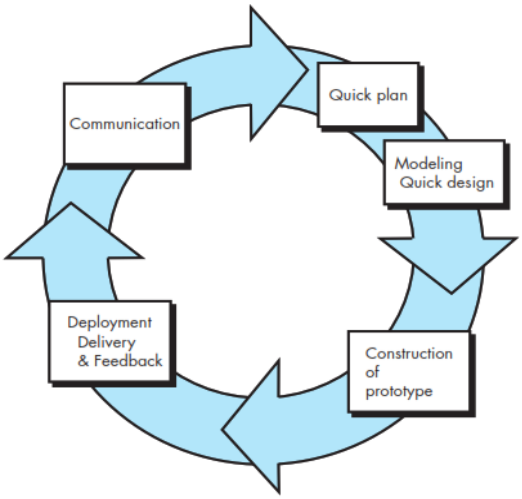

Figure 1. Prototyping Model

The Communication Stage is the first of five system development steps utilizing the Prototype Model, followed by the Quick Plan Stage, Modelling Quick Design Stage, Construction of Prototype Stage, and Deployment Delivery Stage:

a) Communication: At this stage, communication is established with the College's owner. This communication phase also includes observation and analysis. Based on our plans, we conduct surveys to identify problems and provide solutions. In this phase, we prepare the data to support the created solution and the system development functions.
b) Quick Plan: The system development process necessitates quick planning and preparation at this stage. Planning entails selecting a programming language, coding tools, a framework, and a relational database management system (RDBMS).
c) Modeling fast Design: Following the fast design, the next phase would be a design process that uses Unified Modeling Language (UML) diagrams to explain the major functionality of the system based on user requirements.
d) System Development: The next phase is the system development stage, which includes the construction of a system prototype. This stage is used to create a user interface design. All features produced and current functional requirements are based on the rapid plan and design modeling results [21].
e) Deployment Delivery & Feedback: At this step, the results will be continued with testing utilising the User Acceptance Testing (UAT) approach to measure the system's functioning [4]. The system has been constructed, and the user has approved its fit for the user's demands. System users run tests and provide feedback on the intended system [6].

Figure 1 depicts the stages of the prototyping model-based system development model. The initial step was to collect business process flow from College users, who were interviewed as part of the user stories phase. A needs analysis is performed after user stories have been utilized to gather system requirements. Table 1 Necessity investigation:

Table 1. Requirement Analysis

No.	Problem Analysis	Needs
1	Information Needs The expected outcome of this application is to become an alternative for experts for teens, particularly high school students, in knowing from a young age the interests that exist within themselves, as well as knowledge and employment suggestions that match those interests.	Based on Holland's idea, create a prototype of an interest-measuring expert system and career field.
2	Parameter data processing (personality qualities to assess interest) comprises inserting, updating, and deleting all data. The results obtained with this feature will be more dynamic.	Functional requirements will be more dynamically mapped.
3	Holland's theory was used to calculate the personality probability value to determine the interest taken using the RIASEC model.	The results of the calculations will be entered into the Visual Basic Program coding procedure.
4	The expert checks the value.	The results are displayed in a View report that the expert can view.

This study enters the spike stage after acquiring the requirements analysis, which is the stage for estimating or estimating the application model or potential outcomes in the design process. Estimates can be of two types: uncertain estimates and confident estimates. Forecasts of the scheduling application design completion time and application functionality based on user demands are still skewed, with an undefined scope for uncertain projections. Forecasts must then be concentrated and specific to move to the Planning stage.

Following receipt of the Requirements Analysis and Estimation from the Spike stage, the Planning stage is initiated. During the planning stage, a web-based application is constructed. The work plan is shown in Table 2:

Table 2. Work Plan by Fungsional Needs

No.	Problem Analysis	Needs	
		User	Admin
1	User Data		
	- Input data		☑
	- Edit data	☑	

	- Delete Data		☑
	- View Data	☑	☑
2	Psikotes		
	- Do Test	☑	
	- Input Test		☑
	- Edit Test		☑
	- Delete Test		☑
	- View Test		☑
3	Result		
	- View Report Result Test	☑	☑

Knowledge representation is to organize knowledge in a specific shape and manner so that computers can understand it [6]. The appropriate knowledge representation must be adopted to develop an effective expert system. The expert system can access the knowledge base for decision-making or conclusions by selecting the appropriate knowledge representation. Knowledge representation models include using semantic networks, frames, production rules, and predicate logic [7]. Figure 2 depicts a knowledge representation model with a semantic network.

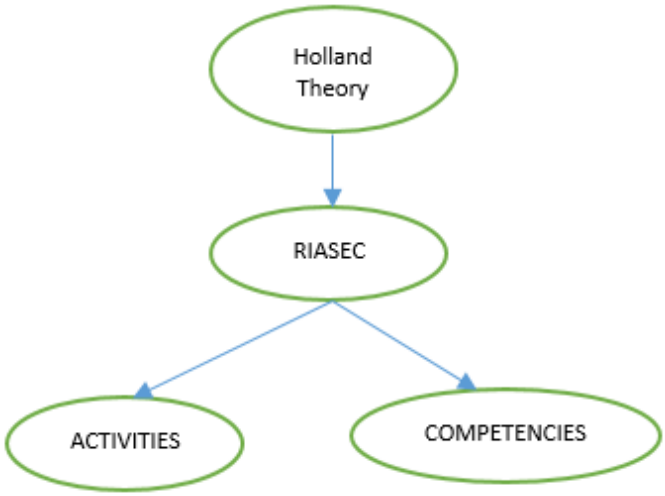

Figure 2. Knowledge Representation Model with Semantic Networks

There are two main parameters in measuring this system's interests and talents: activities and competencies for each category (Realistic, Investigative, Artistic, Social, Enterprising, and Conventional). Students completed cognitive and interest tests and created a report in the form of the results of a psychologist's examination, a mix of the cognitive and interest test results. The multiple-choice model is used for cognitive testing, while the forced-choice model is used for interest tests [9].

Based on this model, you can use the first equation formula to get the score for each sub-aspect (verbal/ numerical/ figural) as follows:

$$N_{SA}=Q-S \quad \text{..... (1)}$$

Information:
N_{SA}: The number of sub-aspect values
Q: Number of questions
S: The number of questions answered incorrectly

After obtaining all of the sub-aspect scores, the value of each aspect may be calculated using the 2nd equation formula, which is as follows:

$$N_A = N_{SA1} + N_{SA2} + N_{SA3} \quad \text{.....(2)}$$

Information:
NA: Total Score for Each Aspect
N_{SA1}: Total Score of First Sub Aspect (Verbal)
N_{SA2}: Sum of Second Sub Aspect Score (Numerical)
N_{SA3}: Total Score of the Third Sub Aspect (Figural)

The value category derived from the overall score of each aspect is divided into five categories, namely:

1. Low: Score 1 to 3
2. Lower Average: Score 4 to 7
3. Moderate: Score 8 to 11
4. Top Average: Score 12 to 15
5. Height: Score 16 to 18

After determining the value of each aspect, compute the entire cognitive test score using the third equation formula, namely:

$$N = N_{A1} + N_{A2} + N_{A3} \quad \text{.....(3)}$$

Information:
N: Total Score
N_{A1}: Total Score of First Aspect (Analytical)
N_{A2}: Total Score of Second Aspect (Creative)
N_{A3}: Total Score of the Third Aspect (Practical)

The paired comparison method is used in this interest test, together with a directed choice model (forced choice). The paired comparison method is a scaling approach that compares two psychological stimuli or objects. The subject or judgment is asked to select one of the two stimulations in this manner [10].

3. Results and Discussion

At this step of data requirements analysis, it describes the data required to create a career decision expert system based on this personality as follows:

1. Information about the students
   Students and counselors use the personality-based career determination expert system. Reports are made using student data.
2. Personality
   According to Holland, personality types emerge through combining intrinsic and environmental elements. This interaction results in preferences for various activities, which steer individuals to certain types of behavior.
3. Information about your career
   Personality type influences career choices. Pupils' Career choices also depend on their personalities in the Counseling Guidance section.

Some system modeling employs Unified Modeling Language (UML) diagrams at the Modeling Quick Design stage to explain the system's core functionalities to be produced and to determine each user's role. The diagram below depicts the major components of the information system as well as the roles of each user who will access the system:

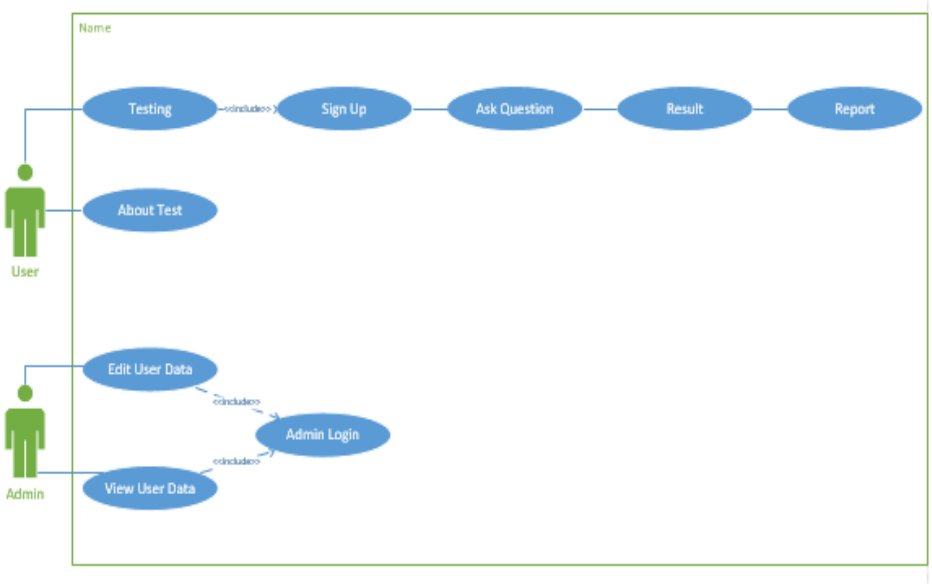

Figure 2. Use Case Diagram of Interest Measurement Application and Career Field

The use case diagram is illustrated in Figure 2. The inventory cashier system employs three actors: admin, cashier, and warehouse. This design system will separate The two actors into three levels based on their user type. The Class Diagram will be used after the Use Case Diagram to define the information system's entities, their attributes, and the relationships between entities. The system has two types of actors: test takers (users) and administrators. Before taking the test, participants must first register. Participants may begin the test after completing registration. After answering the questions, the participant will receive the test results as a report. Admin has the right (privilege) to view (view) and edit participant data. Log in as an admin is required to be able to view and edit.

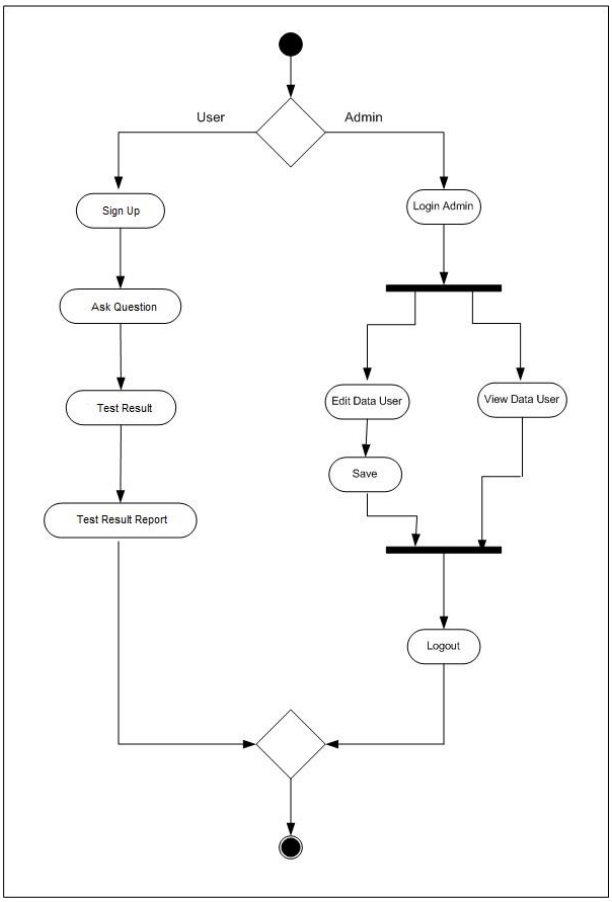

Figure 2. Activity Diagram Application for Measurement of Interests and Career Fields

Activity diagrams describe the system's procedural logic, business processes, and task pathways [11]. They are similar to flowcharts in some aspects, but the main difference is that they permit parallel behaviour [12].

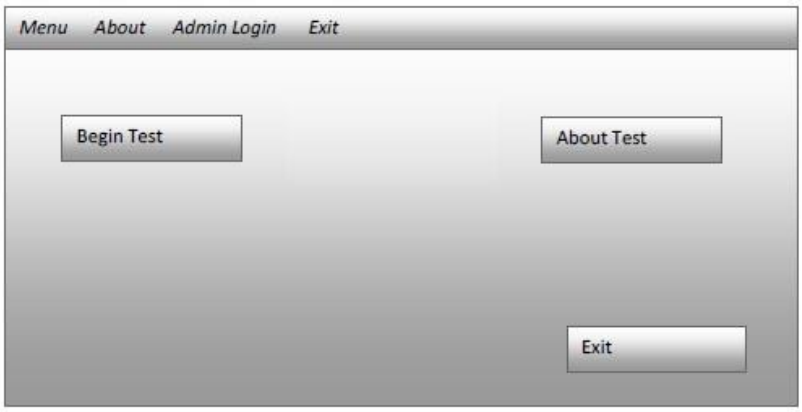

Figure 3. Main Menu Application for Measurement of Interests and Career Fields

Menus to start the test, about the test, a brief explanation of the admin login, and a program are displayed on the main menu. The primary menu is depicted in Figure 3.

Figure 4. Interest Measurement Application Sign-Up Form and Career Field

After you select the Begin test menu, the signup form (user list) will appear. Before taking the test, test takers must fill out this form with their personal information. Figure 4 shows the design of the sign-up form.

Figure 5. Interest Measurement Application Test Form and Career Field

The participant starts the test on the test form after filling out the contents list on the signup form. The test questions are presented in photos, and participants respond to them by selecting the images they prefer. Figure 5 depicts the test form design. The exam questions in the implementation process are in the form of visuals related to specific work activities, and the test taker is needed to answer each question by selecting (clicking on the image) or not selecting (simply being silent).

Figure 6. Interest Measurement Application Result Form and Career Field

After the user has completed all the test questions, the Result form displays the results. This form contains a list of career titles and study programs based on the participant's Holland code. Figure 6 depicts the test form design. On this page, participants can see how many grades/scores they received in each category and a list of employment and study programs that match the test results. The Holland code obtained is based on the category with the highest and second-highest scores.

After the Construction of the Prototype stage is completed, the Deployment Delivery & Feedback stage is carried out to test the system's suitability to user needs using the User Acceptance Test (UAT) method, as explained in the Prototyping model stages section. This test was carried out by three users who will use the system, namely the Admin as the owner of the College[13][14][15]. Table 2 summarises the results of system testing:

Table 3. User Acceptance of IS

No.	Process Description	Testing Case	Result	
		Expected results	Success	Failed
1	Add participant data	Data from participants was successfully added to the system database.	☑	
2	Changing participant data	Data for participants was successfully modified.	☑	
3	Delete participant data	Data from participants were successfully erased from the system database.	☑	
4	Displays participant data	Data from participants was successfully shown.	☑	
5	Test process.	All participants completed the test.	☑	
6	Added test questions	The new test questions were added to the database successfully.	☑	
7	Change test questions.	The test questions were successfully altered.	☑	
8	Delete test.	The test questions were erased successfully from the system database.	☑	
9	Displays data about the test.	The successful exam questions are listed.	☑	
10	Display Reports	Data from participants was successfully added to the system database.	☑	

4. Conclusion

After conducting research based on the Expert System application that was created, namely the RIASEC Expert System application, it can be concluded that the application of measuring interests and talents based on this expert system is easier and faster in the measurement process when compared to conventional (manual) methods. As a result, it offers benefits in terms of time efficiency, effort, and ease of assessment. This is demonstrated by statistical tests of the RIASEC Expert System application's performance in terms of Appearance, Ease of Use, Process Speed, Accuracy in Drawing Conclusions, and Clarity in providing user information regarding test results.

All parameters perform above the 4.0 scale in the hypothesis test of one normal independent population on two different samples, using a scale of 5 as the level of satisfaction. This demonstrates that the RIASEC Expert System application is appropriate for usage by both lay users and psychologists.

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