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Synergizing Aptitude, Interest, and Intelligence: A Systematic Approach to Career Selection Decision-making in Higher Education

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***Abstract*— The process of making informed career decisions during higher education holds great significance, both for individuals and society at large. Careful evaluation of factors such as aptitude, interests, and intelligence is essential when selecting a suitable career path. The impact of this choice is far-reaching, influencing professional paths and contributing to personal contentment and societal advancement. This study delves into the pivotal roles played by aptitude, interest, and intellect in shaping students' career choices, particularly within the realm of higher education.**

The primary objective of this paper is to examine existing research on the process of career decision-making within the context of higher education. By establishing connections among aptitude, interest, and intelligence, the study aims to offer insights into an effective framework for supporting career decision-making approaches, thereby guiding students toward careers that align with their aspirations and yielding successful outcomes.

To achieve this goal, a fuzzy-based technique is used to aid students in making well-informed career selections subsequent to completing their higher education. The system incorporates interest, intellect, and aptitude as input variables, encompassing a comprehensive array of eleven inputs, including nine specific aptitude dimensions. The ultimate output variable encompasses the chosen career option. The synthesis of scores from diverse aptitude, interest, and intelligence assessments serves as the basis for determining the most suitable career path. Employing the Mamdani technique within a fuzzy logic framework facilitates a thorough analysis of these inputs, offering pragmatic career alternatives congruent with individual skill sets.

In order to gauge the system's efficacy, a comparative analysis is conducted between the proposed fuzzy-based approach and the traditional manual methodology employed by career counselors. The system's effectiveness is tested by comparing its results with those of the counselor. A high degree of positive correlation (0.988) is observed between the two results, indicating the system's good efficiency. The results of this correlation reveal that the fuzzy-based approach demonstrates a high degree of similarity to the outcomes generated by human counselors, thus validating its effectiveness as a valuable tool for aiding students in their career decision-making process.

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I. INTRODUCTION

For students the importance of choosing the proper career path after their higher education cannot be strained because it influences how individual animate their professional life and promotes both individual fulfillment and society advancement. This paper explores how intelligence, interest, and aptitude acts as key roles in choosing a career option and useful in a thorough understanding these factors influence students' decision while selecting their career field after their higher education.

To develop a thorough approach for career decision-making, researchers have focused the necessity to incorporate criteria, such as aptitude, interest, and intellect etc. According to study (Gottfredson's 2002) limitation and compromise theory, individuals narrow down their employment alternatives based on their skills, interests, and intellect through a process of elimination and selection. Higher education institutions can provide individualized career advice that enhances students' potential and raises the possibility of successful career outcomes by combining these variables.

A key component of a successful career is aptitude, which is often known as a natural talent or potential. Without the right direction and assessment, it can be difficult to recognize and utilize these inherent abilities. Similar to how an individual's hobbies influence their career path, true passion and enthusiasm serve as strong motivators for commitment and strength in dealing with of obstacles. In order to understand how intelligence, which encompasses a wide range of cognitive abilities, connects to career preferences and performance, more research is required.

Aptitude tests can help individuals narrow down feasible career possibilities by identifying their basic abilities and possible areas of expertise. These tests, which consist of a time based multiple-choice questions, to assess students' logical reasoning and capabilities.

The student's chosen field of study will be looked at in the interest assessment method for choosing a career. It will examine the student's field of interest while choosing a career path.

In intelligence tests, which shed light on an individual's cognitive ability and problem-solving techniques. Matching students to careers that correspond with their intellectual talents can be made easier by understanding the relationship between intelligence and career choice.

This study will look at approaches, such as standard tests for determining aptitude, interest, and intelligence score. Also, it will look at how these three factors are useful individuals to select their career option. Fuzzy based system approach is used to guide students through the process of selecting suitable career after their higher education studies using scores of aptitude, interest, intelligence level of the students.

- ***Motivation of the Study:***

When presented with number of career alternatives, each requiring a distinct set of abilities and qualities, many students are confused and anxious. We seek to provide an extensive perspective that not only helps students match their choices with their inherent talents but also fosters a sense of purpose and passion in their chosen professional pathways by looking at the aptitude, interest, and intelligence.

II. LITERATURE REVIEW

The literature on career decision-making, aptitude, interest, and intelligence testing, to higher education, is reviewed in this part. It will look at fuzzy based model and empirical research that has looked into the link between these elements and career decisions. This section will also go over how career counseling and other interventions can help individuals make better career decisions.

- ***Aptitude and Career Decision-making:***

An individual's aptitude is their innate capacity for learning a certain skill or body of knowledge. Aptitude is a key factor in the decision-making process when choosing a career, according to research by (Lent, Brown, and Hackett 1994). Since it results in higher job satisfaction and performance, people prefer to migrate toward career options that complement their inherent talents. Numerous career assessments have been used to evaluate students' aptitudes and match them with appropriate career alternatives, including the Strong Interest Inventory and the Myers-Briggs Type Indicator (Hossen, 2017). Institutions can direct students toward careers where they are likely to succeed by integrating aptitude evaluations into career advising.

The term aptitude describes a person's intrinsic capacity to develop particular talents or achieve success in particular fields. Making appropriate career choices may

need a clear awareness of one's aptitudes. According to authors (Gottfredson's 2002), people are drawn to professions that match their skills and personality. High aptitude individuals may perform better in related jobs and experience more job satisfaction. Therefore, assessments of aptitudes should be a part of career advising interventions to assist students in matching their talents with appropriate career alternatives.

The term aptitude describes a person's innate capacity to carry out particular tasks or learn particular abilities. According to research, determining one's aptitude might be quite important when choosing a career (Lounsbury et al., 2020). Students who are more talented in a specific field are more likely to succeed and like their work in that field. According to studies, career interventions based on aptitude tests can considerably improve students' ability to make professional decisions. Higher motivation, job happiness, and overall career success can result from identifying one's aptitude and matching it with appropriate career possibilities.

The ability to learn specific abilities and do activities effectively is referred to as aptitude. Numerous studies have stressed the importance of taking aptitude into account while choosing a career. According to a longitudinal study by (Dacre and colleagues 2021), students who matched their profession choices to their aptitudes reported improved job satisfaction and performance. Similar to this, authors (Chen et al. 2022) investigated the link between aptitude and professional success and discovered that an individual's job choice and inherent ability significantly impacted career advancement and personal fulfillment.

- ***Interest and Career Selection:***

Interests are a reflection of a person's interests, passions, and inner tendencies toward particular pursuits or professions. People are more likely to pick career that match their interests and personality types, according to Holland's theory of vocational personalities (Holland, 1997). Students who select occupations that align with their interests are more motivated and engaged, which increases work satisfaction and commitment, according to studies of authors (Tracey and Robbins 2006). In the context of making professional decisions, career exploration programs and interest questionnaires, such the Self-Directed Search, have been found to be beneficial in assisting students in identifying and pursuing their passions (Su, Rounds, & Armstrong, 2009).

The predictive validity of professional interests in career decision-making has received extensive scientific support (Larson & Borgen, 2019). Career counselors can evaluate students' interests using interest inventories, such as the Strong Interest Inventory, and offer advice on possible career options that fit with their passions.

Student profession choice is significantly influenced by their areas of interest. People are more likely to be involved in and devoted to their work when they are passionate about their career choice (Li et al., 2022). According to recent study, interest is a key factor in determining long-term employment objectives and aspirations (Heinonen et al., 2023).

By providing career advice, exposing students to a range of employment choices, and developing an environment that supports individual interests, higher education institutions can encourage students' career decisions.

Decisions about a career are strongly influenced by interests. Individuals frequently succeed and find fulfillment in occupations that complement their passions and hobbies. According to a study by (Johnson and Smith 2023), determining a student's interests is crucial when offering career advice because it fosters greater involvement and dedication to the chosen professional path. Additionally, Lee et al.'s meta-analysis showed a considerable correlation between job happiness and career interest congruence, highlighting the importance of taking interests into account while making career decisions (Lee, H., Anderson, J. R., & Williams, A. 2023).

- ***Intelligence and Career Selection:***

Intelligence, as measured by various cognitive talents, is a key factor influencing career choice. Cognitive abilities including verbal thinking, spatial reasoning, and numerical competency can have an impact on a person's aptitude for various careers. For instance, research by (Sternberg and Hedlund 2002) highlights the significance of analytical ability in scientific and technical subjects. By incorporating intelligence tests into career counseling, which can give students relevant information about their career fit, students can make well-informed selections that are in keeping with their cognitive ability.

A key element in determining academic and professional success is intelligence. Higher cognitive ability levels are typically associated with better performance in a person's chosen profession. When choosing a career, author (Gottfredson 1997) stressed the significance of intelligence, contending that individuals are more

inclined to choose careers that match their cognitive capabilities. The authors (Salgado and colleagues' 2017) research has demonstrated that intelligence accurately predicts work performance across a range of occupations. Higher education institutions can therefore help students by giving them access to intelligence tests and counseling services that take their cognitive strengths and shortcomings into account when choosing a career.

Success in the workplace is correlated with intelligence, as determined by a variety of cognitive talents. Higher cognitive ability can result in greater job performance and career development, according to recent research that have examined the relationship between intelligence and job performance (Harms et al., 2022). Though they can have varying effects on occupational success, several types of intelligence, including as emotional intelligence, social intelligence, and practical intelligence, must be taken into account (Gardner, 2021). In order to help students make the most of their cognitive capabilities in their chosen careers, higher education institutions might incorporate intelligence testing and training into their career development programs.

Another important element that may influence job decisions is intelligence. Assessments of intelligence can provide information about a person's cognitive skills and possible career appropriateness. According to a recent study by (Williams and Brown 2023), student with higher intelligence scores had a higher chance of succeeding in difficult, cognitively demanding careers. It is important to remember, though, that choosing a vocation shouldn't just be based on intelligence. To promote a well-rounded career selection process, a thorough awareness of a person's interests and aptitudes should also be taken into account (Foster et al., 2022).

- ***Integrating Aptitude, Interest, and Intelligence:***

A comprehensive approach that incorporates aptitude, interest, and intelligence assessments is needed to improve career decision-making. Career counselors can give students more thorough and individualized advice by integrating these factors. When numerous assessments are combined, students are better able to grasp their own skill sets, motivations, and potentials, which makes it easier to find career possibilities that suit those (Brown & Brooks, 2014).

The process of choosing a career may be improved by the integration of aptitude, interest, and intelligence assessments. Higher education institutions can help students make informed choices that align with their particular talents and inclinations by combining these elements to provide thorough and individualized career advising.

Several researchers have supported for a comprehensive approach that integrates aptitude, interest, and intelligence assessments to improve career decision-making. A study by (Anderson et al. 2022) proposed a framework that combined psychometric testing with career counseling to help students explore various career options and identify the best-fit choices. This approach yielded positive outcomes in terms of career satisfaction and reduced instances of career change.

Even while aptitude, interest, and intellect are important characteristics on their own, they frequently interact and cross paths when making professional decisions. According to recent studies, ability and interest work best together to increase one's sense of vocational identity and career certainty (Duffy et al., 2022). Additionally, those who have stronger cognitive abilities are typically better at locating and pursuing job options that fit with their skills and interests (Karwowski et al., 2021). Career advisors and educators can better customize interventions to support students in making better career decisions by having an understanding of how these elements interact.

Students' ability, age, aptitude, place of residence, attitude, community, counselors/advisors, course curriculum, environment, family business financial support/family income, friends' influence, gender, hobbies, interest, industry alignment with subjects, IQ, job guarantee, learning experience, location, life style, opportunity, outcome expectations, parents' influence, past academic performance, of individual are some of the factors influencing career choice. Students can use all of these characteristics to assist them choose a stream or program at a certain institution after completing their secondary, higher secondary education (Waghmode Manisha L., 2015).

Technology developments have made significant effects on career guidance methods. Multi-dimensional analysis has become more accessible and cost-effective due to career evaluation tools and virtual counseling platforms. The efficacy of digital career interventions is shown in studies of the authors (Di Fabio and Kenny 2020), emphasizing the potential of technology to improve career decision-making in higher education.

III. METHODOLOGY

Making a decision about a career selection after higher education may be a difficult and complicated process. There are many systems and approaches that might employ while making this choice.

Here is commonly adopted step-by-step procedure used to guide students to choose a career option as below.

- Evaluation of the student's ability, IQ, field of interest, etc.
- Use of any computer assisted recommendation system, or taking career counselor advice.
- Find and match the top careers for students that fit their assessments and skill sets.
- Gather information about the alternative that was above chosen from friends, professionals, family, etc.
- Make a final choice.

➢ ***Methodology used in the study is as below:***

A fuzzy-based system is designed to guide students in choosing suitable careers, with inputs from nine aptitude dimensions, intelligence scores, and field of interest. The Mamdani technique in a fuzzy logic framework facilitates a thorough analysis of these inputs, offering pragmatic career alternatives congruent with individual skill sets. Comparative analysis with traditional manual methods validates the effectiveness of the fuzzy-based approach.

➢ ***Objectives:***

The study's objectives are as follows.

- To explore the process of deciding a career path.
- To design fuzzy based system for the career decision-making guidance.
- To implement the system's design into practice.
- To compare the outcomes of the fuzzy system with the system used by manual career counselors.

To provide suitable career selection decision, a career selection model was developed using MATLAB. As simply one factor is insufficient to determine a student's professional path after completing their higher education, aptitude, interests, and intelligence scores are the three primary traits utilized to help students choose their careers.

The Mamdani technique is utilized in this research to construct system inference. The Fuzzifier model, fuzzy inference engine, knowledge base, and defuzification module are the components of this system. In MATLAB, the fuzzy-based methodology is used. The technique of employing fuzzy logic to map from an input to an output is known as fuzzy inference. Eleven inputs and one output variable are used to create the fuzzy inference system. Triangular and sigmoidal membership functions are employed to build this system.

IV. PROCESS OF CAREER SELECTION

After completing their higher education, students can get assistance choosing a career from career counselors using a personalized and systematic method. While precise methods may differ, the procedure commonly followed by career counselors is summarized as follows:

- ***Personality Assessment:*** To better understand an individual's traits, choices, aptitude, abilities and constraints career counselors may use personality tests.
- ***Interest Assessment:*** They assist individuals in identifying their passions, interests, and hobbies so they can be directed toward appropriate job alternatives.
- ***Skill Assessment:*** Evaluation of abilities gained through higher education and other experiences in order to identify prospective job matches.
- ***Research study:*** Counselors assist the students in investigating various professions, businesses, and work functions. Researching work conditions, prerequisites, job descriptions, and career prospects are all part of this process.
- Encourage students to obtain information by using networking opportunities, informational interviews, job shadowing, and online resources.
- Helping students narrow down the alternatives based on the results and preferences of their assessments.
- ***Decision Analysis:*** Using methods and instruments for decision-making to assist students in assessing the final options for careers and making an informed choice.

❖ ***The study's step-by-step methodology is listed below:***

Collecting the student's scores in the different categories as indicated below.

- Nine aptitude scores are obtained from nine subtests of the aptitude that measure an individual's ability for calculation in the fields of

mathematics, reasoning, vocabulary, and other topics.

- Score of the student's intelligence tests.
- Score for the student's field of interest.
- Using the final scores of these examinations, students will be given recommendations for the best career fields which suits their abilities, aptitude and interest.

The results of the tests mentioned above are used as input by the system

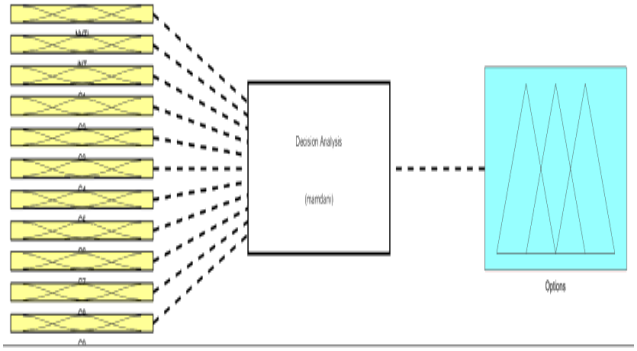

Fig. 1. Fuzzy Logic Design of the career decision system

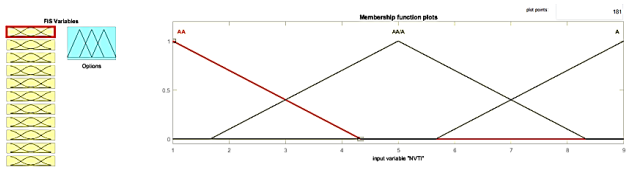

Fig. 2. Membership function editor of Intelligence Test

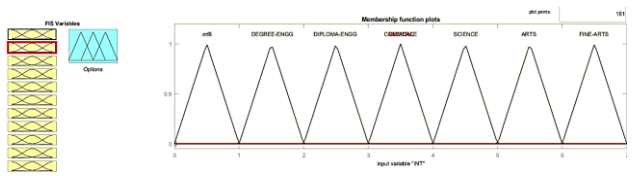

Fig. 3. Membership function editor of Interest Test

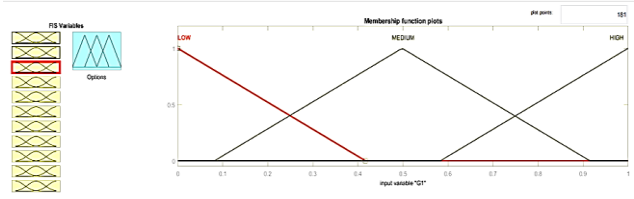

Fig. 4. Membership function editor of Aptitude Test

V. SYSTEM DESIGN

The design of the career selection system employing fuzzy logic is shown in figure 1. Total eleven distinct inputs such as aptitude, interest and intelligence are used to help students make career decisions. The Mamdani technique is used to analyze these inputs and provide feasible career options to students, which can help them make decisions that are appropriate for their skill sets.

This approach for choosing an appropriate career was developed using fuzzy logic and is used to assist students in making career selection decisions.

The membership function editor of the three primary factors taking into consideration while making a career decision is shown in figures 2, 3, and 4. The membership function of the intelligence test is shown in figure 2, while the membership functions of the interest and aptitude tests are shown in figures 3 and 4, respectively.

The method uses a rule base that was developed based on various inputs from the students' aptitude, interest, and IQ scores to recommend a career option.

The system's rule base is shown in table1.

Table 1: Rule Base

Input Variable											
G1	G2	G3	G4	G5	G6	G7	G8	G9	N	I	O
			H		M	H	H		AA	M	M
		H	H	M/H	M/H		H		AA	E	E
		M	M	M	M		M		A	E	DE
M/H	M/H		M/H		M/H		M/H		A	C	C
		M/H	H		M/H		M/H		A	E	S
			H			M/H	M/H	H	A	A	A
		H	H		M	M/H	M/H		A	FA	FA

The mentioned guidelines are applied to formulate the principles for selecting a career direction. The aptitude scores have been categorized as high, medium, or low based on their numerical values. Scores ranging from 1 to 3 are classified as low, scores from 4 to 6 as medium, and scores from 7 to 9 as high. Similarly, IQ scores have been categorized as above average, average, or below. Scores falling within the range of 1 to 3 are categorized as below average, while scores spanning from 4 to 6 are considered as average. Scores falling between 7 to 9 are designated as above average. Various letters, such M, E, C, A, and FA for medical, engineering, commerce, arts, and fine arts, respectively, are used to denote interest scores. Various letters, such as M, E, DE, C, S, A, FA, are used

to denote the final career selection. These letters stand for medical, engineering, diploma engineering, commerce, science, arts, and fine arts, respectively.

In the table 1, G1 through G9 represent the scores/results of nine aptitude tests, while the letter N is utilized to record students' intelligence quotient. The letter I is employed to capture the score reflecting a student's interest in a specific field of study. Furthermore, the letter O is labeled to denote the most appropriate career choice, tailored to the individual student's scores across the aforementioned tests.

Utilizing the guidelines outlined in Table 1, the rule base is formulated through a fuzzy methodology.

The presented system approach involves creating a set of predefined rules that help guide individuals toward suitable career options based on their scores in various tests such as aptitude, intelligence and interest.

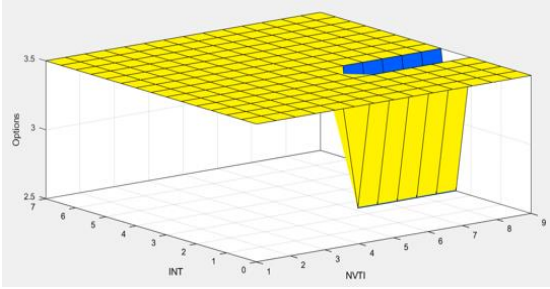

Fig. 5. Surface Viewer

Figure 5 depicts the inputs and outputs' surface viewer.

The rule viewer of the created system featuring eleven input variables and one output variable is illustrated in Figure 6.

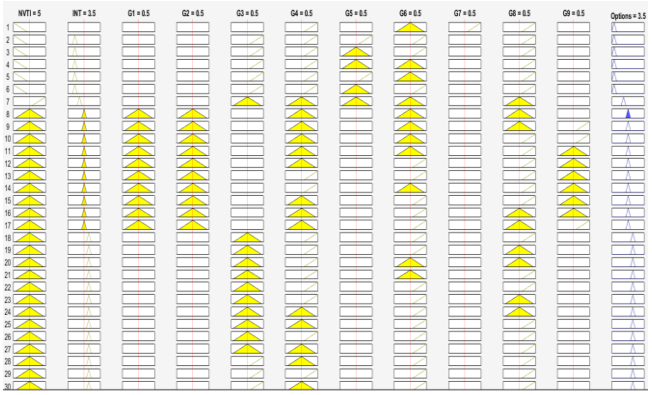

Fig. 6. Rule viewer of the system

VI. IMPLEMENTATION AND RESULTS OF THE SYSTEM

After the system has been designed and the rule base has been established, the next step involves testing the system by comparing its recommendations for career selection guidance with those provided by a career counselor using a manual guidance process. The outcomes of this testing are presented in Table 2, illustrating the results given by the automated system alongside the results derived from the career counselor's manual guidance approach.

This comparison allows for an evaluation of the effectiveness and accuracy of the automated career selection guidance system in relation to the insights provided by a human career counselor.

Table 2: Result of the System

CN	Input Variable											SO	EO
	G1	G2	G3	G4	G5	G6	G7	G8	G9	N	I		
1	4	7	5	7	5	8	7	7	5	7	1	1	1
2	3	4	7	7	5	6	5	7	5	8	2	1.5	2
3	3	3	5	5	5	6	5	6	5	7	2	2.5	3
4	7	5	6	6	4	7	6	6	4	5	3	3.5	4
5	4	4	6	7	4	6	4	6	4	5	4	4.5	5
6	4	3	7	7	5	6	5	7	5	7	2	1.5	2
7	5	5	5	7	5	6	6	6	7	5	6	6	6
8	4	5	7	8	5	6	5	8	5	8	2	2	2
9	4	4	6	8	4	5	4	5	4	5	4	4.5	5
10	5	4	5	7	5	6	6	5	7	5	5	5.5	6

In the Table 2, different letters have been assigned to store values for input and output variables. The label "CN" stands for case number, which uniquely identifies each case. The input variables G1 to G9 are allocated to record scores from various aptitude tests. The variable "N" is utilized to denote the score obtained in an intelligence test, while the letter "I" is employed to store the test score from an interest inventory assessment. The entry "SO" is designated to hold the system's recommended option, while the letter "EO" is used to represent the career counselor's guidance. This notation facilitates the organization and representation of data within the table, ensuring a clear distinction between different variables and their corresponding values.

The system's output is compared with the output from a career counselor to assess the accuracy of the system using spearman's rank correlation. The association between system option and counselor's option is displayed in Table 3.

Table 3: Results of Correlation

Spearman's rho		System Output	Expert Output
System Output	Correlation Coefficient	1.000	.988**
	Sig. (2-tailed)	.	.000
	N	10	10
Expert Output	Correlation Coefficient	.988**	1.000
	Sig. (2-tailed)	.000	.
	N	10	10
**. Correlation is significant at the 0.01 level (2-tailed).			

The table3 shows that there is a high degree of positive association between the options offered by the system and those suggested by the counselor, with a correlation coefficient of 0.988 between the two. As a result, we may conclude that the system approach is effective and producing results comparable to those offered by counselors.

VII. CONCLUSION

In conclusion, the systematic approach presented in this paper offers a valuable framework for enhancing career selection decision-making among higher education students. By synergizing aptitude, interest, and intelligence, individuals can make informed choices that align with their strengths and objectives. This approach encourages a comprehensive identification of individual capabilities and preferences, enabling students to select career paths that not only capitalize on their innate talents but also foster personal satisfaction and success. As higher education institutions continue to adapt to the evolving demands of the workforce, this approach serves as a guiding light, empowering students to navigate their academic journey with confidence and purpose. Ultimately, the integration of aptitude, interest, and intelligence cultivates a well-rounded and holistic approach to career development, ensuring a more fulfilling and prosperous future for students in today's dynamic world.

Thus choosing a career option in higher education is a difficult process influenced by a variety of variables, such as ability, interest, and intelligence. The importance of coordinating these aspects to improve students' professional decision-making processes has been highlighted by current study. The system's effectiveness is tested by comparing its results with those of the counselor. A high degree of positive correlation (0.988) is observed between the two results, indicating the system's good efficiency.

Hence fuzzy based system approach can be used to guide students through the process of selecting suitable career after their higher education. Higher education institutions can better assist students in choosing wise and fruitful career decisions by incorporating aptitude and interest tests and utilizing different kinds of intelligence.

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