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FESCCO: Fuzzy Expert System for Career Counselling

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Abstract: Artificial intelligence involves two basic ideas. First, it involves studying the thought processes of human beings. Second, it deals with representing those processes via machines (like computers, robots, etc.). Artificial intelligence (AI) technologies and techniques have useful purposes in every domain of mental health care including clinical decision-making, treatments, assessment, self-care, mental health care management and more. This application involves an AI based fuzzy expert system which helps the students to give a basic idea or insight of possible career opportunities, to enable them to move forward towards the path most suitable for them in all respects. This project will give a personal aid to the students taking into consideration, the student's interest and aptitude test result. The fuzzy expert in our project will choose accurate careers for the user accordingly.

Keywords: *Fuzzy System, career, expert system, aptitude, interest*

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I. INTRODUCTION

In today's growing world of opportunities, it is important to have acute knowledge of the various careers available across the globe, to be able to select careers that are either high in demand or suit a person's personality.

A staggering 9 out of 10 people aged between 21 and 65 say they regret rushing their career choices, with many picking a university course at random because they simply don't know what they want to do and feel pushed to decide because they are 'running out of time'. Over half of the 3,000 students that responded to a GTI Media survey said their parents tried to exert influence over their choice of career or course. It, therefore, comes as no surprise that 20% of students currently enrolled at university say they would have chosen a different course if given the chance, with 18% saying they regret their choice of degree. The same study found that 18% of the 1,805 respondents cite a lack of initial research as the main cause of their disappointment. As a result of wrong career choices, China and India reported their unemployment rates in July and September this year at 4.7% and 4.3% respectively, as work-satisfaction is not achieved by them in a field that they didn't happily choose for themselves. These rates are approximately equal to 5.8 million, each, of Indians and Chinese (citizens). Beyond the financial impact there is to make a poor career choice, many scientific studies show that the wrong career can make you seriously ill - the total number of cases of work-related stress and depression in 2015/2016 was 488,000 with a prevalence rate of 1,500 for every 100,000 workers.

Career guidance for students, particularly in rural areas is a challenging issue in India. In the present era of digitalization, there is a need of an automated system that can analyze a student for his/her capabilities, suggest a career and provide related information.

For selecting the right career, we must bring down our list of appropriate careers to a selected few, which can be done by a juxtaposition of one's abilities and areas of interest. To overcome this, Artificial intelligence (AI) can be highly useful. Artificial Intelligence is the field within computer science that seeks to explain and to emulate, through mechanical or computational processes, some or all aspects of human intelligence. Included among these aspects of intelligence are the ability to interact with the environment through sensory means and the ability to make decisions in unforeseen circumstances without human intervention.

Expert systems are a well-known area of Artificial Intelligence which use human knowledge to solve problems that normally would require human intelligence. Education system will be revolutionized with the introduction of expert systems in this field because of the following:

(1) Educational planning and decision-making ability, manage student records, student counseling, and special education programs.

(2) Teacher training and education, specifically, identifying training needs and using computer assisted instruction to teach information and skills.

(3) Intelligent tutoring systems that guide students through instruction according to their individual strengths and weaknesses.

Artificial intelligence has a form called fuzzy expert system that uses a collection of membership functions (fuzzy logic) and rules (instead of Boolean logic) to reason about data. A fuzzy expert system is an expert system that utilizes fuzzy logic as the paradigm to express rules and thus uses a fuzzy inference engine to reason about this type of rules. Fuzzy logic uses a scale for degrees of truth that range between 0

and 1rather than the typical Boolean logic which uses either the 0 or 1 value to describe false and truth.

II. STUDY OF EXISTING SYSTEM.

This paper suggests a fuzzy based approach towards this issue. It has two parts; in the first part a student will be analysed for his/her capabilities and in the second part the available courses, job aspects related to their capabilities will be suggested. To analyse a student, marks in various subject in 10+2 standards and vocational interest in different fields have been considered and fuzzy sets have been formed. On example basis, fuzzy inference rules have been framed for analysing the abilities in engineering, medical and hospitality fields only. In second part, concept of composition of relations has been used to suggest the related courses and jobs. [1]
The above paper is limited, and analyses abilities based on aptitude only in the fields of engineering, medical and hospitality. It also does not consider the interest of the individual towards a subject/field while suggesting courses.

In [2], an Intelligent Algorithm is implemented to design an expert application on smart phone. In this research, the expert system that will aid the student in his registration decision is designed as a fuzzy expert system and implemented as a mobile application that runs under the Android operating system.

Here the proposed system uses six inputs and produces a single output; these inputs represent fuzzy linguistic variables that can be set to certain fuzzy values. Table 1 lists the inputs and output and their corresponding values. Input variables and values were chosen based on an actual survey conducted on college students. The system uses Mamdani-style inference to reason from several fuzzy rules that represent the knowledge base.

Table 1:Variables and values [2]

	Variables	Symbol	Values
1	Perceived teaching efficiency of lecturer	A	inefficient, average, efficient
2	Past performance	B	bad, good, very good
3	Perceived difficulty of course	C	hard, average, easy
4	Appeal of course topic	D	unlike, average, like
5	Friend in course	E	none, some, all
6	Cost of course	F	high, moderate, low
7	Recommendation of registering the course	R	high, average, low

The above system suggests various courses based the ratings given to it by the students. It does not take into consideration the individual while suggesting the courses. The implementation of the fuzzy system was understood from this paper.

In [3], Career Advisor Expert System Based on Myers Briggs Personality Assessment is discussed. It advises the user based on his/her personality. This is achieved through the method of creating facts from the Myers-Briggs Type Indicator (MBTI) thereby mapping them to common Careers using a rule-based system based on the sixteen Personality Types (according to Myers-Briggs). It uses prolog for implementation.

Table 2: Key domains of Myer Briggs Personality indicator [3]

I. HOW WE PREFER TO DIRECT OUR ATTENTION AND ENERGY?	
1. Extraversion (E)	2. Introversion (I)
II. HOW WE PREFER TO OBSERVE THE WORLD?	
3. Sensing (S)	4. Intuition (N)
III. HOW WE PREFER TO MAKE DECISIONS?	
5. Thinking (T)	6. Feeling (F)
IV. HOW WE PREFER TO ORIENT OURSELVES ON LIFE?	
7. Judging (J)	8. Perceiving (P)

The table 2 shows four key domains of Myer Briggs Personality indicator. Careers are suggested according to the 8 personality types shown above. It only focuses on the personality types and not the abilities of an individual.

The paper [4], presents the design of a multi-expert system for educational and career guidance based on a multi-agent paradigm and the semantic web. It uses ontology for the decision making of careers. The use of ontology allows to identify the different guidance concepts and semantic links between them, to establish a better representation of the existing while staying within the context of sharing and reusing of knowledge. The proposed system uses the following experts: The psychologist, sociologist, pedagogue, economist, Coach, supervisor. It is a multi-expert system supervised and organized around a multi-agent system, which is based on the n-tier model of the web application. The presence of many agents makes the system very complex. And since it was a web application it was not easily accessible like a mobile app.

This section talks about Dr. John Holland's theory that has been extensively tested in the United States and many other countries, summarized the process of career choice in the following statements:

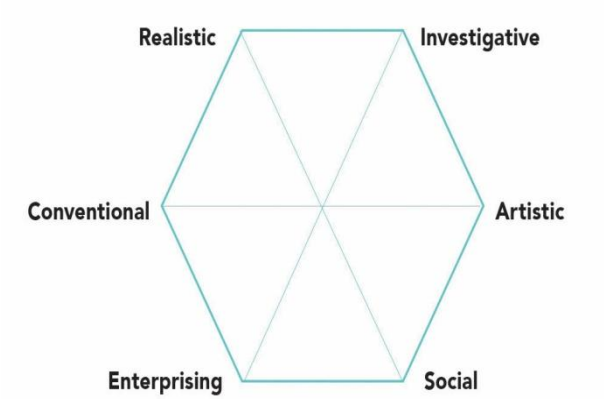

Figure 1: Holland Codes [6]

People can be described as a combination of two or more of six personality types, which he titled Realistic, Investigative, Artistic, Social, Enterprising, and Conventional. One's personality type can be measured by taking a reliable, valid assessment whose items are based on this theory.

Occupations, work environments, and school courses can similarly be described as a combination of two or more of the same six "personality" types.

Individuals of a given type seek environments of the same or highly similar type.

To the extent that individuals can enter educational or work environments of the same type as their own, it is likely that they will be satisfied and persist in them. [5]

Career guidance appeared alongside advances made in the social sciences in the early 1900s.Frank Parsons, author of the 1909 work "Choosing a vocation" and who was also part of the development of "vocational bureau" in Boston, USA, was one of the founders. Parsons states that occupational decision making occurs when people have achieved:

- An accurate understanding of their individual traits (aptitudes, interests, personal abilities)
- A knowledge of jobs and the labour market
- Rational and objective judgement about the relationship between their individual traits, and the labour market. [6]

III. FESSCO

To build a fuzzy expert system whose role should be to recommend various successful career possibilities to an individual based on various aspects of the individual given as input. The system should use aptitude and achievement assessments, to help clients evaluate their interests, skills, and abilities. The system should be capable of deducing realistic career possibilities based on aptitude and interest analysis. The application must enable the user to explore various existing career options and their scope. It should also enable the user to take tests and give a detailed report about the suitable careers in order of preferences. The system should display the list of renowned institutes for the suggested careers.

3.2 System analysis

System analysis report for FESCCO contains input given by user and output given by system. It consists of following subsystems:

Expert System:

An expert system is a computer system that emulates the decision-making ability of a human expert. Knowledge base and Inference engine are two integral parts of an expert system.

- **Fuzzy Logic Controller:**
  Fuzzy logic is an approach to computing based on "degrees of truth" rather than the usual "true or false" (1 or 0) Boolean logic on which the modern computer is based. Fuzzy Logic Controller mathematical system that analyses crisp input values in terms of logical variables that take on continuous values between 0 and 1.
- **Inference Engine:**

  Inference engine is a component of the expert system that applies logical rules to the knowledge base to deduce new information.

- **Knowledge base:**

  A knowledge base is a technology used to store complex structured and unstructured information used by the expert system

3.3 FESCCO Overview

The FESCCO system will be fuzzy expert system. The system will have properties of a fuzzy logic as well expert system. A fuzzy expert system is an expert system that utilizes fuzzy logic as the paradigm to express rules and thus uses a fuzzy inference engine to reason about this type of rules. Fuzzy logic uses a scale for degrees of truth that range between 0 and 1 rather than the typical Boolean logic which uses either the 0 or 1 value to describe false and truth.

The first step for the user will be to register. The user will have to enter detailed information about himself. This will include Name, email ID, password and details about education required for further analysis. Once registration is done user can login using his email ID and password. This will take the user to his home page. The home page will contain the profile of the user along with various options. The user can explore various career options available. He can also take tests after which a personalized report for the user will be generated.

The tests will be into sub parts:

1) **Interest Analysis**: This will have questions which will analyses the fields of interest of the user based on the answers. These questions will have options based on levels of whether he agrees/disagrees to the given statement or has a strong to weak interest

in a field. The answers will be analysed by the fuzzy system.

2) **Aptitude Analysis**: This will contain questions based on aptitude. It may further be divided in several sections like analytical, verbal, logical, etc. The results of these sections will show abilities of the user.

The results of both the tests will be combined and possible successful careers for the user will be displayed. There will be more than one careers displayed in order of preferences. The institutions for the given careers will also be displayed.

3.4 Proposed Design/Architecture

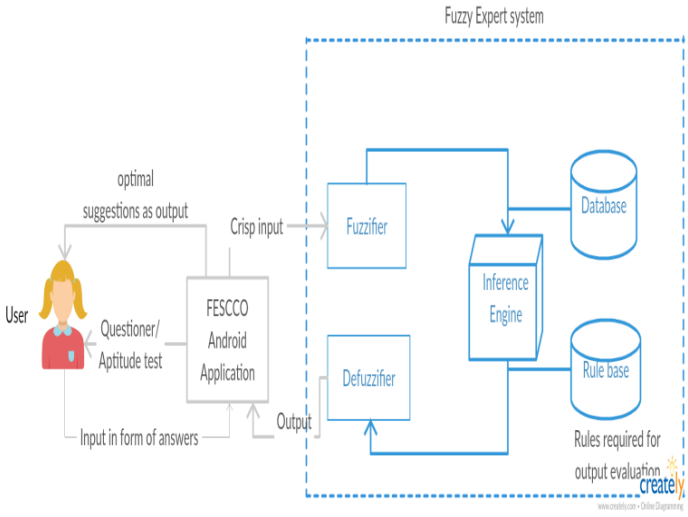

Figure 2: Proposed System Architecture

The system will consist of following components:

1) User: The user for the can be anyone who wants to seek advice on his/her career. The user must register after which he can login and start using the app. User can explore various options and take test to generate appropriate career options.
2) FESCCO Android App: It will act as an interface for the user. It will allow user to take tests and display results.
3) Fuzzy Inference System:
    a) Fuzzifier: Converts the crisp input to a linguistic variable using the membership functions stored in the fuzzy knowledge base.
    b) Inference Engine: Using If-Then type fuzzy rules converts the fuzzy input to the fuzzy output.
    c) Defuzzifier: Converts the fuzzy output of the inference engine to crisp using membership functions analogous to the ones used by the fuzzifier.
4) Databases:
    a) Rule base: It contains rules for the decision-making process of analysing interests and career choices.
    b) User Database: Contains user details and test status of the users.
    c) Test Database: Contains test questions and test details.

IV. APPLICATIONS

Assessing to deduce an **optimal** career option: There are uncountable career choices in the world. But, there are a finite number of career options that are suitable for everyone based on his own personality, IQ, grades, interests, preferences, etc. The processing of all answers given by the user in these aspects is done in the most precise form to deduce an optimal career path that is suitable or rather best for the user, based on his skills and capabilities that are assessed at the moment.

Available and accessible by students at any time, any day and at their convenience: Students have doubts or questions about which career to choose, what passion to pursue, and how beneficial can any career choice be for them and for the surrounding environment. These doubts can arise as random times of the day like 8pm, 2am, or at any day including a public holiday when relatives come over to meet them, and question them about their future goals. Meeting a user's requirement anytime anywhere is the best service that can be offered by an application, and FESCCO aims at achieving it.

This information system can serve as a complementary tool for real life counsellors: Not all counsellors have knowledge of each existing field in the country, let alone in the world. The application of FESCCO's Database is to reach out as an assistant to real-life counsellors while they assess a student based on their desired set of tests, and suggest him a career that he has the potential to excel in.

Provides guidance tips to all kinds of students: Not only is this app useful for students who are confused whether to choose Science, Commerce or Arts, and not only for the students who are confused in which specialization to take further in the above branches, but also for the people who have taken a year drop, or who wish to switch their field of studies, or who just simply wish to understand their own selves better in terms of their IQ, interests, potential, scope in a certain field, etc.

Explore all available career options: For curious and confused people alike, enlightening them with all career options available is a good way to explain which fields require what education, and thereby enable a user to view a career option not only suitable for him but also other options he could opt for. Also, exploring all career options is a major advantage to the real- life counsellors, as it gives them a platform to view all careers systematically, without feeding in details of each student

V. CONCLUSION

Our FESCCO system will establish an automated process like a one-to-one meeting with a career counsellor and will aid to 'plan' a career true to the student's grade, IQ, hobbies, interests, and other predominant specifications entered by the user at the time of registration. We aim at achieving optimum results in the time we have, as we believe that this app will be a boon to all those people out there who are at their major crossroads in life, striving to know in which stream and domain their strengths lie, and what all career options are awaiting them.

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