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DESIGN OF A FUZZY RANKING SYSTEM FOR ADMISSION PROCESSES IN HIGHER SCHOOL OF LEARNING

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ABSTRACT

An expert system is a computer program that contains some of the subject-specific knowledge, as well as the knowledge and analytical skills of one or more human experts and reasons with uncertainty and imprecise information. Currently, in Nigeria, there are very few institutions that use computerized admission systems. Most institutions are still using manual process of admission system. However, the major task is to determine whether a candidate is qualified or not based on the ordinary level (O' level) results requirements, the qualifying examination result cut off mark for their course of choice and other determinant factors. In this paper we introduced fuzzy harming distance function into candidates ranking and implemented it with Java Netbean IDE 6.0. The system was used to evaluate candidates' credentials and every other determinant factor for admitting students. The results showed each candidate's chances of admission, while the system minimized the level of subjectivity in decision making.

Keywords: Fuzzy logic, artificial intelligence, decision making, fuzzy inference system

INTRODUCTION

Expert systems are computer programs that emulate the reasoning process of a human expert or perform in an expert manner in a related domain for which no human expert is readily available. An expert system can be used in several areas to solve one problem or the other. For instance it can be used for: decision making, interpretation, diagnosis, design, monitoring and control of processes. It could explain the reasoning process and handle levels of confidence and uncertainty, which conventional algorithms do not handle (Novruz *et al.,* 2007).

Recently, admission procedure has become more cumbersome than it was before the introduction of post-JAMB (Joint admission and Matriculation board) examination as the additional factor for admitting students into universities in Nigeria, especially the private universities. Also, Oral examination has been incorporated to know more about the applicants. The qualified applicant is determined after all the processes. However, the functionality of the admission procedure in some higher institutions of learning does not include the ranking of qualified applicants O' level results in order to determine their relative suitability for the courses applied for. This implies that the usual rigor associated with the process of candidate selection and the inherent subjectivity in manual process still exists. The issue of subjectivity can have a negative effect on the quality of a selection process if it is not properly controlled. This is particularly true in instances where the personal sentiments of the decision-maker come into play. Some of real life instances that can ordinarily warrant subjective judgments in admission process include:

(1) When there are more qualified applicants than the spaces available.
(2) When the assessment parameters being used are inexact and qualitative (e.g. excellent, very good, good, fair, bad).
(3) When two or more candidates have the same or almost similar qualifications.
(4) When the core requirements needed for a particular course is not available in the database and there is the need to choose subjectively from candidates with closely related qualifications.

Fuzzy reasoning is a model of human intelligence that can be introduced into computer systems using fuzzy logic concept (Ajith, 2005). It empowers a system to be able to handle instances of approximate reasoning and fuzziness just like humans will do. To do this, the Fuzzy Ranking Admission System (FRAS) uses a set of objective parameters relative to specific course requirements to evaluate the relative suitability of the applicants for the specific course of choice.

Expert system with the aid of fuzzy logic has been used as a tool in several areas for decision making, interpretation, diagnosis, design, monitoring, control and for selection or ranking as a solution to real life problems. For instance to determine a coronary heart disease risk a fuzzy expert

system was designed and reported by Liadis *et al.* (2003). Sonja (2001) reported a fuzzy expert system for ranking companies and investments using the Greekwood industry as a case study. In the work, a two-level personnel selection fuzzy model for short-listing and hiring decision was used (Edwards and Bader, 1988). Mingers (1997) discussed the use of an expert system in undergraduate admissions, and in Finlay and King (1989) the use of rule-induction approach to predict degree results was discussed. An expert system was applied for selecting applicants for public school system, the selection was supported by DECMAK, an expert system shell for multi-attribute decision making, which evaluates, classifies and ranks applications (Schneider *et al.,* 1996). Similarly Zadeh (1988), reported that an expert system to assist in admitting students onto a part-time postgraduate course was developed through three phases, using an expert systems shell. The first phase was an unstructured approach, which demonstrated the feasibility of the system but led to difficulties in development. The second phase followed a simplified systems analysis and resulted in a more comprehensive and structured system. However, its operation was cumbersome and unfriendly. The third phase involved developing a mathematical model of the decision-makers' judgment and led to a simpler, more effective and easier to use system.

The task of admitting student into a higher institution of learning is different from one institution to the other. For the purpose of this research a particular institution in Nigeria is taking as a case study. In the institution, the students' O'level results, post-JAMB examination results, age and oral examination performance essentially determine whether the applicants will be admitted or not. After an applicant has purchased the university form and submit it to the admissions office, they will be invited for the post-JAMB examination and the oral interview by the admissions officer. For the post-JAMB, the pass mark is 60 out of 120 marks. For the oral interview there are a number of questions to be asked and each applicant will be graded a value based on the mark allocated for each question. The recommended applicant must have above average.

The recommended age for admission ranges between 14 to 20 years. Any age outside the range is not recommended. All the results are to be forwarded with remarks to the admissions office. The admissions office recommendation is referred to as the final decision. The admission list is then released and admission letters issued to only the qualified applicants. A simplified diagram of the admission system is shown in figure I.

It is glaring and obvious that the whole university system places the bulk of admission processes on the admission registrar and the officers. It was thought that an expert system might be useful to reduce some of this load and additionally standardize the decision-making. As it was pointed out in Sonja (2001) expert systems have been advocated for their potential of improving consistency and relieving experts, by transferring work to clerical staff. The system might also reduce some of the paperwork involved in the admission process.

Therefore, as a solution to the problem of fuzziness in the admission selection process, this study on the design of Fuzzy Ranking Admission System (FRAS) that is capable of initiating intelligent decision making in the ranking and evaluation of the applicant's O'Level result, post-JAMB examination result and oral interview result was undertaken. This was achieved by:

1. defining fuzzy membership expressions for the input parameters (O'level Examination result, post-JAMB examination result, Age, Sponsorship, Physical Appearance and Communication Skill);
2. fuzzifying each applicant's record;
3. generating qualified admission list by evaluating the closeness of each applicant's fuzzified data to the ideal requirements for a specific course using the fuzzy hamming distance function; and
4. using fuzzy distance metric to sort the qualified candidates in order of eligibility for the admission.

MATERIALS AND METHODS

Description of fuzzy ranking admission system architecture: The architecture of the Fuzzy Ranking Admission System (FRAS) consists of applicants' database which includes the applicants' results in the post-UME, oral interview and personal data related to admission process requirements. Another input into the system is the requirements database. This database contains the specific course requirements and general university requirements which each applicant must satisfy.

The Fuzzy Inference System consists of:

1. Fuzzifier component: This handles the conversion of input values from candidates' records into fuzzy values within requirement parameter fuzzy set.

2. Fuzzy rule base: The Fuzzy If-Then rules store the knowledge of the Fuzzy Inference System. It represents the knowledge base of the expert system. Each of the rules has an antecedent (If) and a conclusion (Then) part that prescribes what should be done when certain conditions are true. The specific criteria for selection for each specific course are represented as If-Then rules which determine the eligibility of applicants.
3. Fuzzy inference engine: This implements the fuzzy reasoning by combining the fuzzified inputs with the rule base.
4. Applicant ranking components: Evaluate the closeness of each applicant's fuzzified credentials, JAMB result, post-JAMB result, oral interview results and other admission parameters to the ideal requirements for a specific course using the fuzzy hamming distance function. This fuzzy distance metric is used to sort candidates in order of eligibility for the admission. The fuzzy hamming distance is given as:

$$\delta(O,R) = \sum_{i=1}^{n} |\mu_O(x_i) - \mu_R(x_i)| \quad \text{(John and Bennett, 1997)}$$

Where: $\mu_O(x_i) = 1$ if x is totally in O;

$0 < \mu_R(x) < 1$ if x is partly in R for each parameter included in a specific job requirement.

5. Decision and result interface: This plays the role of decision making by ensuring that only applicants whose ranking fall on or above the cut-off point are recommended. It also has a human-computer interface that displays the result. The conceptual view of the architecture is shown in figure I.

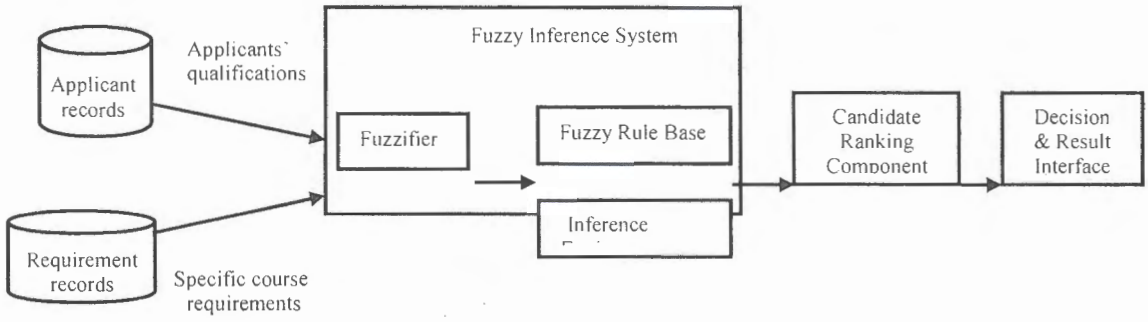

Fig. I: Conceptual View of Fuzzy Ranking Admission System

System implementation: This system is a rule base expert system such that the knowledge base for requirement is stored in form of If – Then rule. The applicant's qualification and department will determine which rules to be fired. The number of rules is determined by the number of departments involved and their requirements.

Fuzzy Ranking Admission System (FRAS) was implemented using JAVA Netbeans IDE 6.0. The system consists of two databases; applicant database and requirement database. The first database consists of Applicant record table, fuzzified applicant record table (formed from applicant record, based on the applicant qualification membership function) and qualified applicant table according to their ranking (formed from applicant record, base on the departmental requirement). The databases were created using Microsoft Access, because of its flexibility.

The applicants' information was captured at the data entry screen of FRAS, which is showed in figure V. The requirement for admission differs from one department to another within the colleges/faculties in the institution, so the FRAS interface allows the users to pick the program of choice from a drop down programs. Different requirement table will be fired based on the department of choice. In conclusion, the closeness of each applicant fuzzified result to the ideal qualification determines each applicant's ranking.

Fuzzification of requirement parameters: According to the knowledge obtained from the expert, the main determinant factors for admitting students into the university are O'level results and Post-UME examination results. Other factors are age and oral interview performance grading which include personal appearance, communication skill, and evidence of sponsorship. These factors are the input parameters for the expert system.

For each input parameter we define a membership expression. For instance, post-UME examination result value (say x), fuzzy membership expression will be as:

$$\mu_{pjh}(x) = \begin{cases} 0 & x \le 59 \\ \dfrac{x-59}{61} & 59 < x < 120 \\ 1 & x = 120 \end{cases} \quad (1)$$

for O'level results, linguistic values are based on the examination grading and the membership values as :

O'level result *{ 0/D or E or F, 0.4/C, 0.8/B , 1.0/A}* (2)

for Age value (say x) fuzzy membership expression will be as :

$$\mu_{age}(x) = \begin{cases} 0 & x < 14 \\ \dfrac{x-13}{4} & 14 \le x \le 17 \\ \dfrac{21-x}{4} & 17 \le x \le 20 \\ 0 & x > 20 \end{cases} \quad (3)$$

for oral Interview parameters (physical appearance, communication skill, and sponsor) physical appearance (PA) {1/excellent, 0.8/ good, 0.5/average, 0.2/fair, 0/poor} (4)

communication skill (CA) {1/excellent, 0.8/ good, 0.5/average, 0.2/fair, 0/poor} (5)

sponsor { 1/parent, 0.5 uncle or brother or sister, 0/self} (6)

Table 1: Fuzzy ranking admission system pseudo code

```
Input :        Applicant database; AD, requirement database; RD, membership expressions; MF
Intermediate:  Qualified list (QD)
Output:        Rank list of the Qualified applicant (RQD), Admitted applicant after considering the
               cut-off point
Method:

    FD = fuzzification(RD MF);          /* the applicant database is fuzzified base on the
                                           membership expressions */

    for (i = 1, i <= n, i++)            // for each record i∈ FD; scan fuzzified database
        {
        if (μ_PJR(i) = 0 ) && (μ_age(i) = 0 ) return cout << "not qualified"
        else {
                for ( x= 1;x <=5 ;x++)
                {
                    if μ_grade(i) = 0 return cout << "not qualified"
                }
            }
    Store (QD ) = fuzzy distance (FD )      /*Qualified applicant fuzzy harming distance
                                              is determined*/
        }
    RQD = ranking ( QD )                    /* Qualified list is ranked based on their
                                               fuzzy harming distance*/
    Printout (RQD )                     // the ranking list is printed out
```

RESULTS AND DISCUSSION

Experiment test and system evaluation: The system was tested by capturing few applicants' records from the system entry form as shown in figure V. An instance of the submitted applicant record, Candidate's fuzzified information form and Successful candidate list with their harming distance value are shown in figure II, figure III and figure IV respectively. Most existing systems are conventional problem-solving programs with well-structured algorithms, data structures and crisp reasoning strategies to find solution. In that case as the knowledge changes the program has to be rebuilt. But, in this case only the knowledge base will be updated.

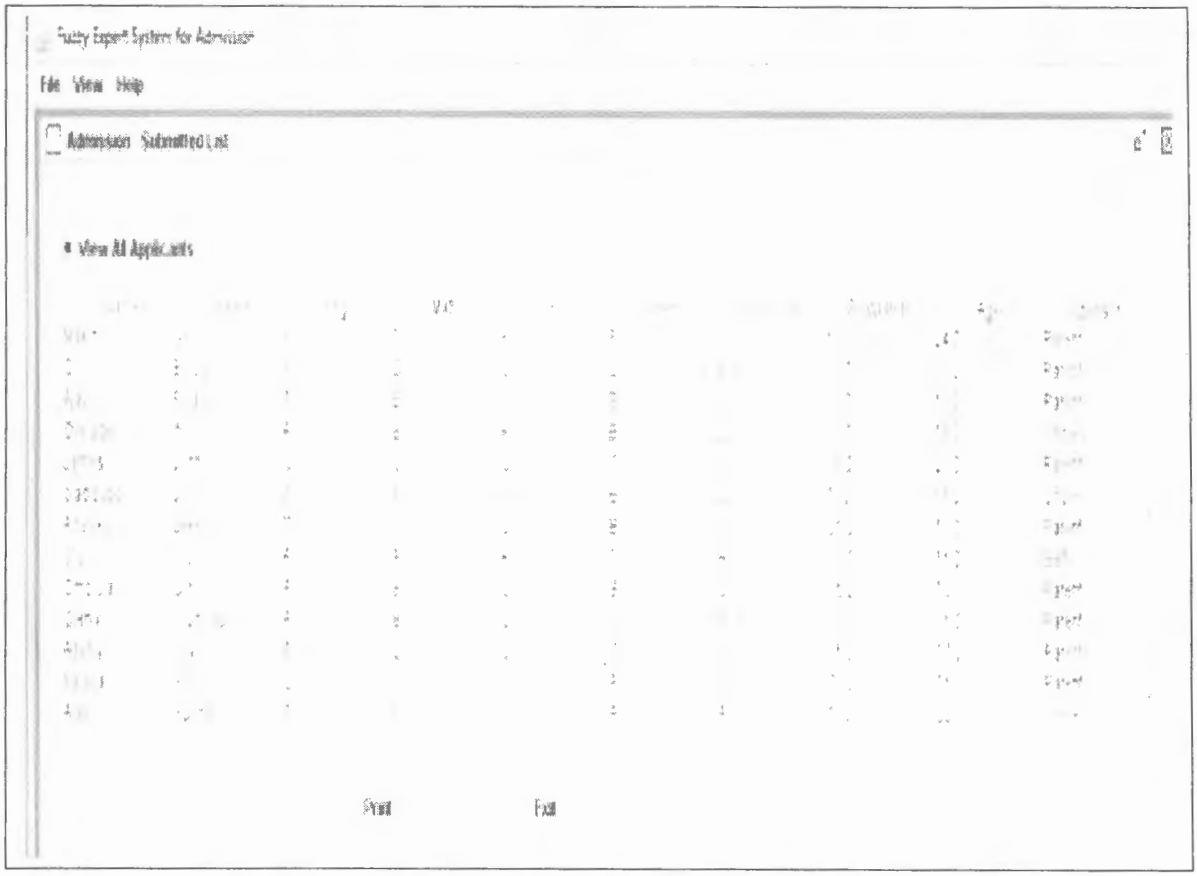

Fig. II: An Instance of Student Qualifications Database.

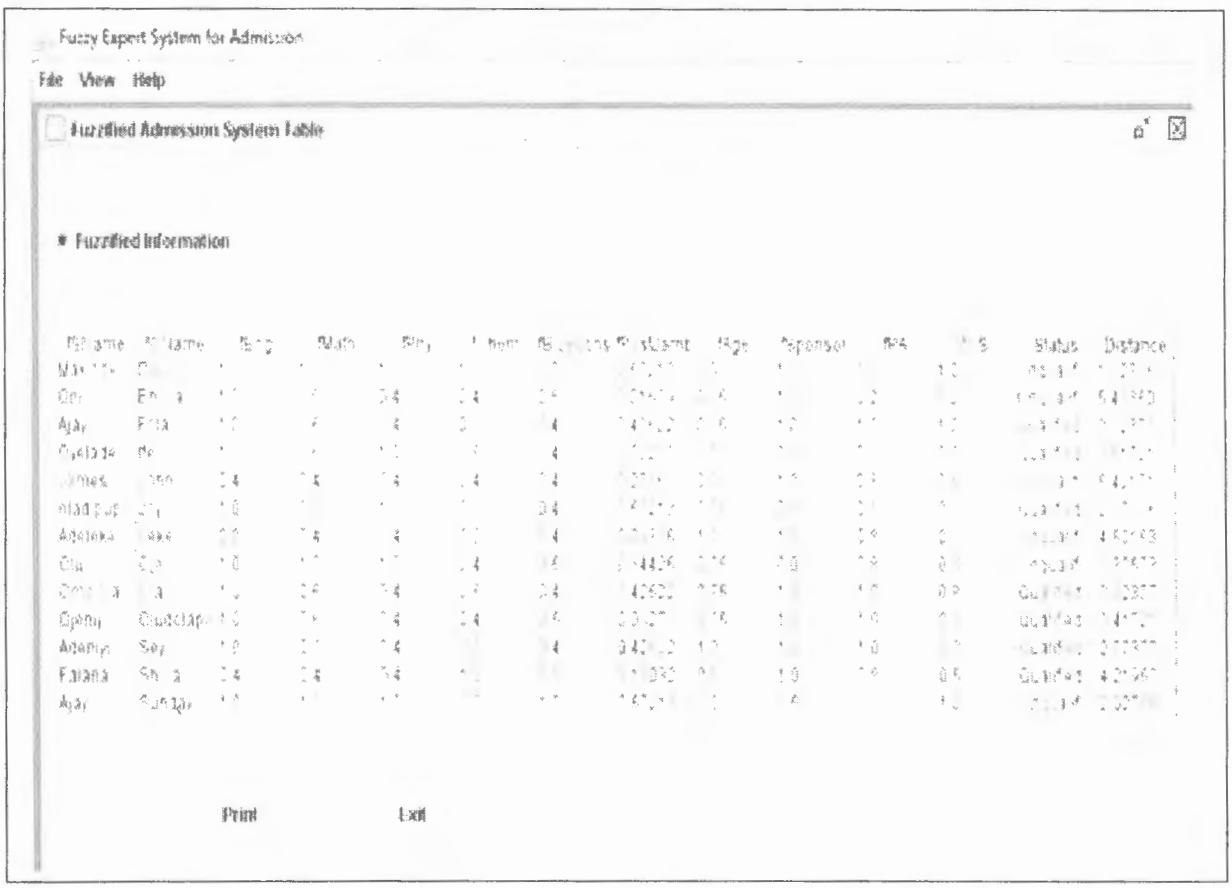

Figure III: Candidates fuzzified information form

Also, in admission decision making FRAS takes all the requirement parameter value into consideration by using fuzzy logic membership function approach. For instance the existing system says "you are admittable if you score a mark >= 60 in post-UME".

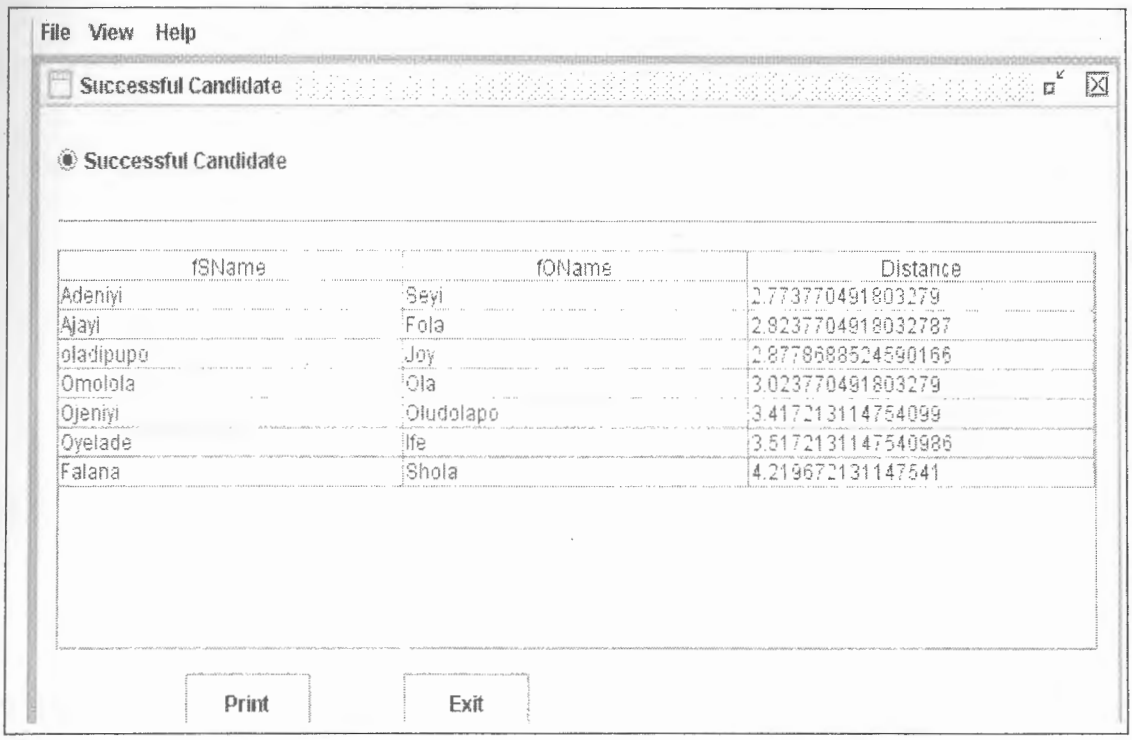

Fig. IV: Successful candidate list Form.

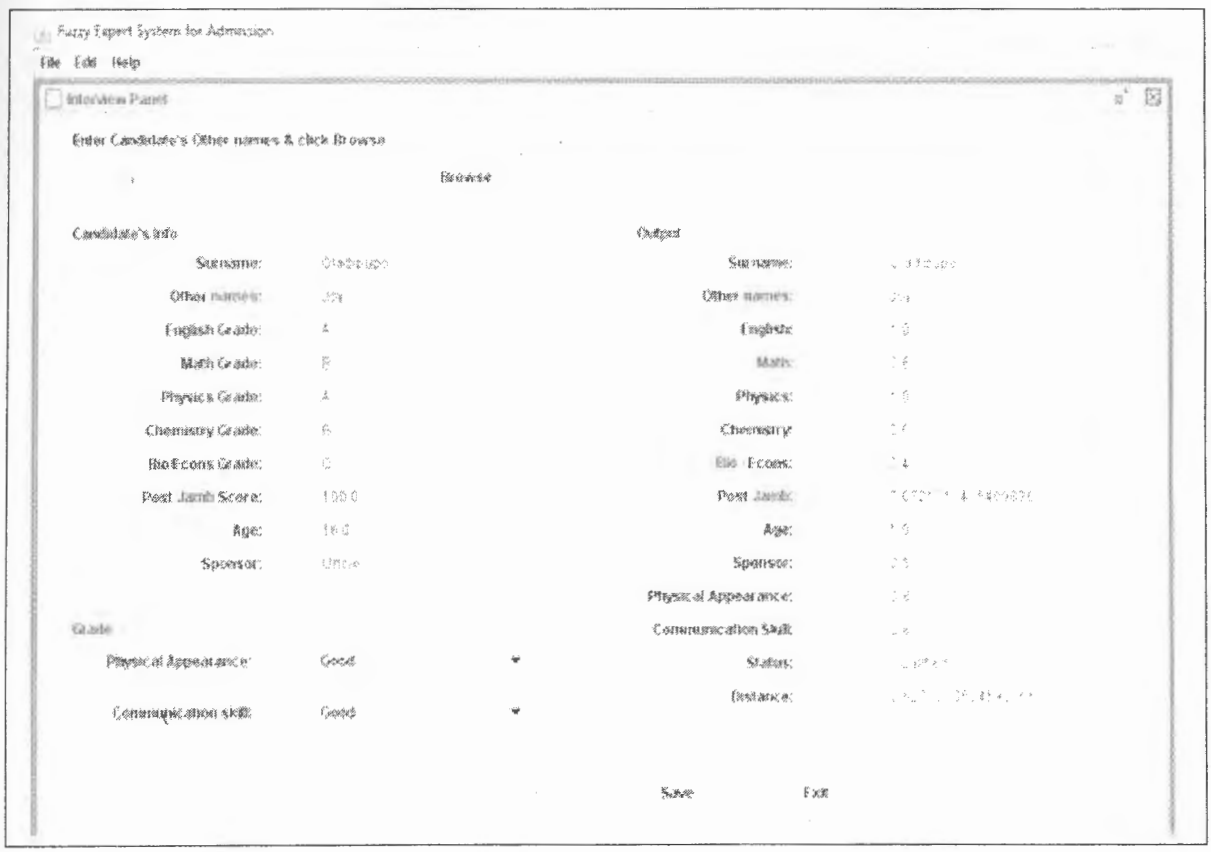

Fig. V: System entry screen form

That shows the equality of 60 marks and 120 marks. Also, it says "If your age ranges between 14 and 20 years and not self sponsored, you are admittable" That shows equality of age value and sponsorship. Form the test data, record 3 and 5, 2 and 9 would have been ties for admission opportunity, but with the Fuzzy ranking system record 3 would have a better chance to 5 and record 9 also has a better chance to 2.

CONCLUSION

In this paper, we present FRAS, an intelligent admission system for higher school of learning and the detailed explanation of its operational mechanism to demonstrate the feasibility of a fuzzy logic–based approach using a specific practical example. The admission process was modeled based on expert's knowledge and the existing literature. The characteristic of the system is the development of some simple fuzzy models to represent the expert's knowledge which was crucial to the success of the system. This improves the accuracy of the system. These models enabled the expert's knowledge to be represented efficiently in much smaller and more structural knowledge base. The medium case experimental result shows that FRAS did quite better than non-experts system, more effective and user friendly. It affirms the potential of a Fuzzy Expert System to greatly complement the existing admission systems. For further research a neural engine can be introduced to this system to predict qualified candidate for admission in subsequent years.

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