A Framework to Design a Web based Neuro Fuzzy System for Course Advisor

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Abstract— ***Course advisor should understand the student's requirements, interests, and other associated factors. Interactions with the course advisor help the student to choose the best course for the students. In this paper, an approach to design a web based neuro fuzzy advisory system based on Sugeno type ANFIS model is presented, which helps the students to take decisions in an efficient manner. Since, it is web based, students can have an easy access to this system. This course advisory system is designed according to the courses available in Christ University, Bangalore.***

Keywords— course advisor, ANFIS, web based, neuro fuzzy system, sugeno

I. INTRODUCTION

Technology used in the field of "course advising" will not replace a human advisor. This will only assist the course advisor to help the students to take decisions effectively and efficiently. Existing advisory systems have certain limitations in their design, be it database advisory systems, or artificial neural based stand alone systems, or fuzzy based stand alone systems, or web based systems. The advantages of the various existing systems are combined to develop a new web based neuro fuzzy course advisory system. Neuro fuzzy systems can solve the complex real world problems in an efficient way and its usage in this domain is highly recommended.

Fuzzy system provides human reasoning capabilities. Fuzzification process converts crisp input values to a fuzzy set using membership functions. Fuzzy systems use fuzzy IF – THEN rules. A fuzzy IF – THEN rule is of the form "IF X1=A1 and X2=A2 … Xn=An THEN Y=B" where xi and y are linguistic terms. The "IF" part is the antecedent part and "THEN" part is the consequence. In a fuzzy system, the collection of IF – THEN rules are stored in a fuzzy rule base called as inference engine. Fuzzified input is given to fuzzy inference engine to generate output fuzzy set. De-fuzzification process converts the fuzzy output to crisp output.

Artificial neural network is similar to the behavior and functionality of human brain and it can be trained according to the specific domain. Neural networks are good at recognizing patterns. But they are not good at explaining how they reach their decisions. On the other hand, fuzzy systems are good at explaining their decisions but they cannot automatically acquire rules. Thus the goodness of neural system and fuzzy system is achieved in a neuro fuzzy system. Many higher education institutions use stand alone course advisory systems to help the students to select the courses. The prevalent course advisory systems are predominantly stand alone systems, which have the problem of easy accessibility by the student and also do not provide the best possible advice in course selection. This is primarily very crucial for a student, looking to join an undergraduate course and can lead to his/her choosing a wrong career or a career which does not utilize the complete skill set or talent.

Rule based systems are used where features or characteristics of the students are known in advance. Therefore the nature of advising will be static in nature. But in the real world, course advising varies from student to student. Because of this dynamic nature, traditional systems like database systems cannot be used. Thus the usage of neuro fuzzy system is the best suited design in this domain of course advising.

II. LITERATURE REVIEW

The usage of technology in the course advising domain helps the advisor to select the best course. Technology-based advisory systems are no longer used for data storage but it facilitates the course selection process through knowledge base and reasoning ability. The existing technology based advisory systems are designed as standalone decision support systems, or web based decision support systems. These advisory systems were implemented as traditional data base systems or object oriented systems [1]. Such systems have their own limitations. Expert System for student selection to various courses [2] shows how neural networks can be trained for taking decisions. Web based decision support tool is designed to help the students in the process of academic advising [3]. Web based course advisor for higher education [4] can be accessed by students and advisors. Rule based reasoning and case based reasoning system model [5] shows expert system design with a hybrid reasoning skill. Web based fuzzy expert system [6] shows the web implementation of expert system with fuzzy logic. Decision support systems can be designed with artificial neural network [7]. It also deals with architectural design of artificial neural networks. Design of neuro fuzzy system [8] shows its application in the real world problems. Neuro fuzzy method is introduced to improve the accuracy of the results.

Neuro Fuzzy Model for the student domain is discussed in [12]. The model is connectionist feed forward architecture with five layers of neurons and four connections. MATLAB implementation of neuro fuzzy system is discussed in [13]. Neural network construction for precollege students is discussed in [14]. Decision making using fuzzy based system is studied in [15]. Design and development of web based academic advising system is studied in [16].

III. METHODOLOGY

Course advising is a multiphase process. It includes student interface, department interface and course advisor. The Figure 1 shows the block diagram of the course advisory system. The student is a client in the system. Student can be connected to the internet by using any one of the internet service providers. Neuro fuzzy system and the associated databases is stored in the server. Neuro fuzzy system is developed as a sugeno type ANFIS system using Matlab. Php server side script is used to connect to the databases. The detailed structural diagram is given in Fig 2.

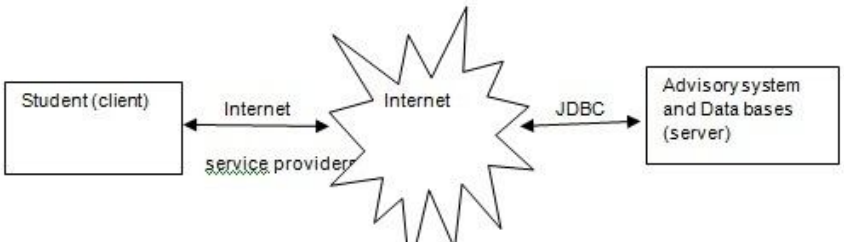

Fig. 1 Block Diagram

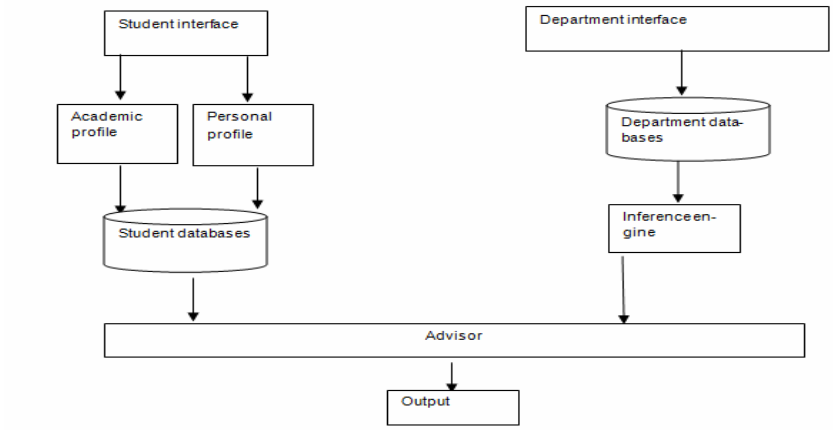

Fig. 2 Structural Diagram

A. *Student Interface*

Students log into the university portal and select the course advisor system link. Since it is a web based system, the student can access the student interface. It is a graphical user interface designed to collect inputs from the student. Questionnaire kind of a form will be displayed and thus the interaction between the student and system begins. Responses will be stored in the appropriate databases. Initially personal details like name, date of birth, father's name, mother's name, father's designation, mother's designation, father's monthly income, mother's monthly income, sibling details, address, phone number, gender, nationality, regarding break in studies and degree holders in the family are collected and stored in the database. Secondly academic details of the student like tenth standard and twelfth details which include marks in various subjects, name and address of the school studied, extracurricular activities details, and interests which specify the course to be studied in future will be collected.

B. *Department Interface*

Using this interface course details will be recorded. Courses are categorized based on the different departments of Christ University, Bangalore. Course details can be updated as and when needed. New courses can be added or any of the existing courses can be deleted. Course details like course name, prerequisites, market demand, fee details are stored in the database. Rules for each course will be stored as fuzzy rules in the database.

C. *Advisor*

Advisor is the core of the course advising system. Student strength will be calculated based on the core subject knowledge and consistency in the academic performance. Student interest is used to identify the courses offered by the department. Prerequisites for the courses will be specified as fuzzy rules in the fuzzy inference engine. Based on the above inputs, advisor advises courses to the students.

Artificial neural network based system functions and behaves similar to a human brain, where knowledge is stored in the interconnected processing elements called neurons. Each neuron is linked to other neurons by connection of different strengths known as weights. The weights are adjusted, so that neural network learns and produces appropriate results. Real time problems can be solved using Multi layer perceptron neural networks. A multilayer network consists of an input layer, an output layer and one or more hidden layers between the input and output layers. It has to be trained in order to learn and gain knowledge required to do a certain task.

Neuro fuzzy model in general makes use of five layers. The first layer is the input layer. The input is in crisp form. Layer 2 is the fuzzification layer where the crisp input is converted to a linguistic term using membership functions. Layer 3 specifies the antecedent part of the fuzzy rule. Layer 4 specifies the consequent part of the fuzzy rule. Layer 5 does the defuzzification process.

This design strategy can be implemented as a sugeno type Adaptive network based fuzzy inference system (ANFIS) using Matlab. Matlab allows users to create a neuro fuzzy inference system. Neuro fuzzy systems can be created by using editors which helps to define input variables, membership functions and rules. The Adaptive Network based Fuzzy Inference System (ANFIS) implements a Takagi Sugeno fuzzy inference system and it has five layers. The first layer is responsible for the mapping of the input variable to each membership functions. In the second layer the antecedents of the rules are calculated. The third layer normalizes the rules strengths. The fourth hidden layer determines the consequents of the rules. The output layer calculates the final output as the summation of all the signals that arrive to this layer. ANFIS uses back propagation learning to determine the input membership functions parameters and the least mean square method to determine the consequents parameters.

The crisp input marks are fuzzified with the linguistic terms like Excellent (E), Good (G), Average (A), Poor (P), and Very Poor (VP). Membership functions are defined as shown in Fig. 3. The number of membership function that suits the prescribed design strategy is five. The type of membership functions is selected as triangular membership function.

$$\mu_{mathmark}(x1) = \begin{cases} E & \text{if } x1>=76 \\ G & \text{if } 66<=x1<=75 \\ A & \text{if } 56<=x1<=65 \\ P & \text{if } 46<=x1<=55 \\ VP & \text{if } x1<=45 \end{cases}$$

Fig 3 membership function

IV. IMPLEMENTATION FRAMEWORK

Various modules involved in the work has been identified and defined in the implementation framework of Fig. 4.

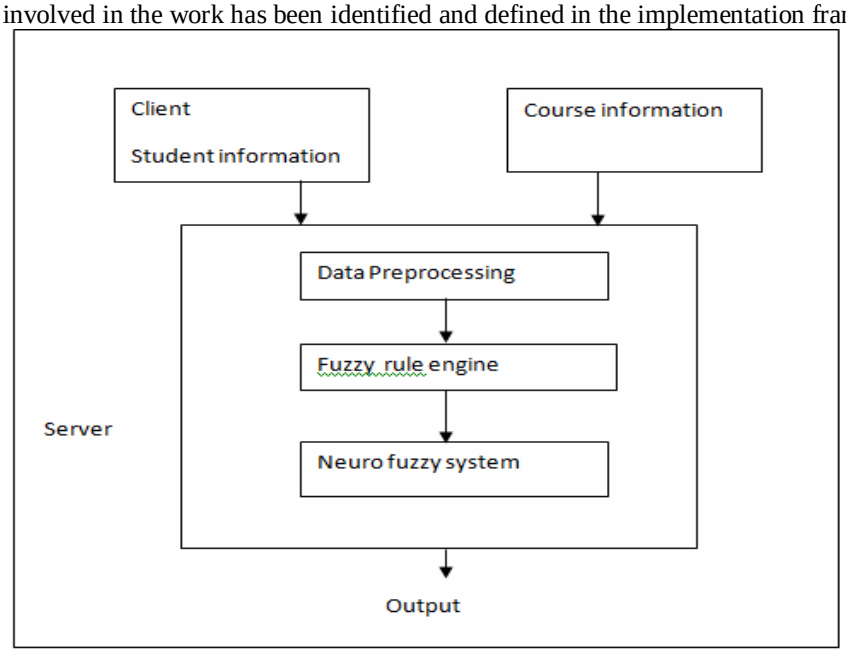

Fig 4 Implementation Framework Design

A. Student information

The student is a client and the information will be the collected through a form and can be stored in a database. It is found that students are from different Boards of Education, like State board, CBSE, ICSE and international students, with different evaluation patterns in terms of marks, grade. For students who are from different countries, language strength of the student is to be considered. For training the neuro fuzzy system, data is collected from the first year students of CMS, CME, PME, PCM, BCB, BCZ courses at Christ University, Bangalore. From the dataset, 80% of the data is used to train the network and 20% of the dataset is used as testing dataset.

B. Courses information

The information regarding the under graduate courses offered by Deanery of Science, Christ University, Bangalore is stored in a database.

C. Data Preprocessing:

Data Preprocessing is a two step process. It involves data cleaning and data transformation.

- **Data cleaning**
  - Data cleaning involves handling noise, inconsistency and missing values in the input data.
  - By designing student interface form with all validations, data cleaning process is accomplished.
- **Data transformation**
  - Data format conversion is performed for student marks.
  - X standard marks to be normalized in number format.
  - XII standard marks to be normalized in number format.
  - Students are from different countries. Marks are to be processed in a uniform format as number. Also, language strength of the student to be considered.
  - Minimum one subject of the triple major should be studied at X standard

D. Fuzzy rule engine

Fuzzy logic provides a mathematical strength to capture the uncertainty of human cognitive processes such as thinking and reasoning. Rules are defined according to the prerequisites of the department.

E. Neuro fuzzy system

Neuro fuzzy system is modelled as sugeno type ANFIS system. ANFIS model is constructed, trained and tested and is placed in the server. The role of the neuro fuzzy system is to compute the academic strength of the student. Given the academic information, neuro fuzzy system has to classify the student as very poor, poor ,average, good and excellent for each core (main) subject. For each core subject xi, if the student is classified as good or very good or excellent, then the courses offered by department is listed out. It is a two step process.

- Step 1: Academic strength at Xth standard level is to be computed.
- Step 2: Academic strength at XIIth standard level is to be computed.

F. Output

Course Advising will be based on Academic strength of the student. Courses that the student can select will be the output of the system.

Data collection

Data has been collected from first year students of Science Deanery of Christ University, Bangalore, by circulating Questionnaire among the students. Parameters are identified from the questionnaire, which helps the neuro fuzzy system to be modeled, trained and tested. Data is broadly classified into five categories like Personal details, Family details, Interests' details, Tenth class mark details , XII standard (PU) mark details. This information is used to build the student interface for the Neuro Fuzzy system. Deanery of Science, Christ University, offers different under graduate programmes which include BCB, BCZ, CBZ, CMS, CME, PCM, PME, EMS, BCA. There are nine science departments including Bio Chemistry, Botany, Chemistry, Computer Science, Electronics, Mathematics, Physics, Statistics, and Zoology. Bio technology department offers BCB and BCZ. Botany department offers BCB and CBZ. Chemistry department offers BCB, PCM, CBZ and BCZ. Computer Science department offers CMS, CME and BCA. Electronics department offers PME and CME. Maths department offers CMS, CME, PCM, PME and EMS. Physics department offers PCM and PME. Statistics department offers CME and EMS. Zoology department offers CBZ and BCZ. Each department has a prerequisite for the students to select a particular course.

The minimum 60% is needed in the core subject offered by the department. This information is used to build the department interface for the Neuro Fuzzy system. Fuzzy rules can be defined based on the subjects offered by the department. Inputs on academic details are used to calculate the academic strength by matching with the fuzzy rules. Considering the inputs like family details, interests details, personal details, the weights of the neuro fuzzy system can be adjusted. Data set is classified into Training data set and validating data set.

V. CONCLUSIONS

This proposal shows how a web based Neuro fuzzy course advisor can be constructed. The proposed system will help the students to take effective decisions. Neuro fuzzy hybridization results in a hybrid system that synergizes these two techniques. The proposed system is used to minimize the dropouts in higher education and to provide good academic strength for the students. Updating the system by adding more data and rules is a continuous process. The proposal concentrates widely on the courses available in the science stream. The system can be improved to satisfy other areas of the student needs like selecting an elective, selecting certificate courses, selecting arts, commerce, engineering and post graduate courses. Web based Neuro fuzzy system will facilitate the students to complete their interested courses in an efficient way.

ACKNOWLEDGMENT

This work is supported in part by the Christ University, Bangalore under Minor Research project.

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