An Expert System for choosing Branch in Medical Education using Artificial Neural Network

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Abstract: Higher education is an essential element in the organization and the modern society. It teaches us to become an independent. It prepares us for the workplace and allows us to learn from our mistakes before we are out in the real world. It is the very important stage for them career because whole future is depend on it. In choosing bachelor field there are lots of fields available. For the choosing field they have to think about some criteria like their interest for the specific field, mathematical concept, understanding, intelligence, and interest for the specific subject and his/her past records. In Gujarat for medical education the Admission committee for Professional medical of courses (ACPMC) does whole process. Due to lake of awareness and experience, students cannot do choice of proper stream and proper institute. For career choice artificial neural network will give the best solution. Decision support system will help to choosing specific field by asking some questions related to them interest capabilities and intelligence level. Paper includes different types of models used in online admission process. This research involves a multiple attribute decision making method, GRA is an optimization procedure in which multi-response problem is converted into single-response problem.[1] Grey Relation Analysis (GRA) is used for problem solving. GRA method is used In this case of the problem 28 alternative attributes and 5 performance attributes were considered. Grey relational analysis is a kind of method which enables determination of the relational degree of every factor in the system. [2]
Keywords: Artificial Neural Network, Admission System, Decision Support System, Grey Relation Analysis, Medical Education

I. INTRODUCTION

Higher education is an essential element in the organization and the modern society. It determines your academic future and career. In medical education there are different streams are available. The streams are MBBS, BDS, BPT, BAMS, BHMS, B.Sc. Nursing, B.P.O., B.O., B.O.T., B. NAT., and B.A.S.L.P. To take admission in these streams of government and self-financed colleges the Gujarat Professional Medical Education Colleges or Institutions made the rules on behalf of the Government Gujarat. Currently Admission committee for Professional medical of courses does this process manually. They prepared merit list based on GUJCET exam and 12th exams main subjects' theory marks.[3] Decision Support System (DSS) for the higher education should be gathering of all the information of academic process and give feedback for the improvement. DSS used quantity factors, need knowledge for analysis, model limitation and assumption, design failure, wrong modeling of design, wrong objective may create problem in existing Decision support system. To overcome this problems of Decision Support System (DSS) field, not only depending on computer's decision we are integrating decision with the encapsulating artificial intelligence techniques and methods. Some of the its methods are knowledge bases, knowledge bases, fuzzy logic, multi-agent systems, natural language, genetic algorithms, neural networks and so on. [4] Neural network is generally consists of following component. A set of Processing unit, the state of activation of a processing unit, the computational function of output of processing unit, the pattern of associative among processing unit, activation rule, activation function, rule of learning [5]. Artificial Neural Networks are made up of interconnecting artificial neurons. It can used in two ways either used in understanding of biological neural network or solving artificial intelligence problem without developing real life model. [6] The main advantage of neural network is network learning. In that case, we can find solution of any problem without building algorithms and problems. Another advantage is it is more like real nervous system. Parallel organization permits solutions to problems where multiple constraints must be satisfied simultaneously. Rules are implicit rather than explicit [7]. Grey Relational Analysis is a tool which is used to solve operations which have multiple performance characteristics. GRA is applied to wide variety of optimization decision-making and classification problem.[8] system students are facing problems to choose the appropriate branch and college. Our main objective is to creating an expert system which helps them to choose appropriate branch according to their interest, parent's education, parent's financial situation, personality etc. In Gujarat medical admission system is handled by "ADMISSION COMMITTEE FOR PROFESSIONAL MEDICAL EDUCATIONAL COURSES (ACPMC)". In admission students have to pass through different steps. They have had to fill up the suitable department and university preference online in numerous mock rounds. Sometimes they are failing to fill suitable preference of branches and faculties within allocated time length.

II. PREVIOUS RESEARCH

The advantage of the Grey system theory is that it is designed to study uncertainty. It is shown that Grey theory is superior to other methods in theoretical analysis of systems with uncertain information and incomplete data samples [9].

Deng proposed Grey system theory in 1982 as a simple and accurate method for multiple attributes decision problems. Grey system as proposed by included GRA for effective selection of relevant attributes.[10] Since then, the application of Grey system theory has extended to industry, agriculture, economy, energy, transportation, military, legal, financial and other fields, and has successfully resolved a large number of practical problems in production, life, and scientific research [11,12]. To define and constitute Grey Process replacing the stochatic process and to find the real time techniques instead of statistical model to deal with the grey process, in order to obtain an approach to modelling with few data, avoiding searching for data in quantities. Grey Forecasting The subjects of grey forecasting include: series forecasting calamities forecasting season calamities forecasting topological forecasting systematic forecasting As all of these are based on GM(l,l), we call'them grey forecasting, whose objective is to unify the field and to bridge the gap between grey process theory and practice. Our intention is to make forecasting useful for decision and policy makers who need future predictions. [13,14] Grey series prediction is a comlnon technique available for forecasting which is referred to essential prediction-and direct use of GM(1,1) will enable us to know where and how the events to be forecasted would appear. In paper grey relational degree of decision-making information was defined to solve the decision-makers clustered situation. A decision method based on grey relational analysis and D-S evidence theory was proposed to reduce the uncertainty of decision significantly [15]. Gevin,Holger and Graeme has deployed a system for forecasting real-time data. In their approach they have used combined approach Self-Organizing Map (SOM), partition of data-set and nonparametric kernel density estimator to calculate local density estimates local density estimates. This approach is used to forecast flow in Kentucky River, USA, using multilayer perceptron (MLP) model of ANN. And it has one limitation, when required high-frequency forecast required and little time available than between subsequent forecast than more efficient method is needed [16]. Kindermans, schutt has produces a model in which they have used Pattern Net and Pattern Attributes methods for their ANN model. They found that this method for NN should work best with simplicity. This methods work well for liner models and its theory gives improved explanation. They found that DeConvNet, Guided BackProp, and LRP models are used in multi-layer network but these models theoretically explanations are not correct. [17]

III. DATA COLLECTION AND ANALYSIS

To collect information questionnaire is used. It is filled up by first year medical student of the Government Medical College, Surat. Total 100 students out of 120 have been filled up the questionnaire. Questionnaire is divided into three parts. First part contains personal information, second part contains personal interest and third part contains college infrastructure. In this section different types of factors included which will decide their interest of particular field.

A. *Personal Interest Factor*

Factors	Mean	S.D.	Variance
Are you interested in your father profession?	2.18	2.345	5.498
Are you interested in medicines, formulations, diseases, diagnosis, wearing a white coat and medical research?	3.62	1.576	2.489
Are you interested in diagnosis and treats the daily and miscellaneous illnesses of the human body?	3.48	1.502	2.255
Are you interested in working with teeth and jawbones?	1.54	1.313	1.723
Do you have knowledge of curative properties of herbs?	3.94	1.058	1.119
Do you have good communication skill?	4.22	1.36	1.849
Do you have ability to trace patient's history of illness through questions & record details simultaneously?	2.12	1.409	1.985
Does your personality Warm and a calm?	3.64	1.29	1.664
Do you interested in giving bedside care to convalescing patients, attending to newborns?	3.76	1.061	1.125
Do you have Coordination with other professionals like teachers, psychologists, doctors and parents?	1.98	1.392	1.938
Do you have planning, coordination and technical skills?	3.7	1.344	1.806

Table 1 Personal Interest Factor

B. *College Infrastructure Factor*

In this part college infrastructure and college facilities are included. For all the facilities and services mean, S.D. and variance is calculated to find out which factor has major importance.

Factors	Mean	S.D.	Variance
Type of College	4.3	0.823	0.678
Hotel, mess and canteen facility	4	0.816	0.667
Institute Infrastructure	4	0.816	0.667
Ranking of College	3.9	0.738	0.544
Facilities Provided	4.1	0.567	0.322
Scholarship	1.2	1.476	2.178
Reservation	2.3	1.829	3.344
Anti Ragging	3.9	0.738	0.544
Transportation Service Provided	1.2	0.789	0.622
Experienced Staff	4.3	0.823	0.678
Placement	4	0.816	0.667
Location	3.9	1.287	1.656
Market Value	4	1.054	1.111
Fee Structure	4.4	0.843	0.711
Distance From Home	2	1.414	2

Table 2 College Infrastructure Factors
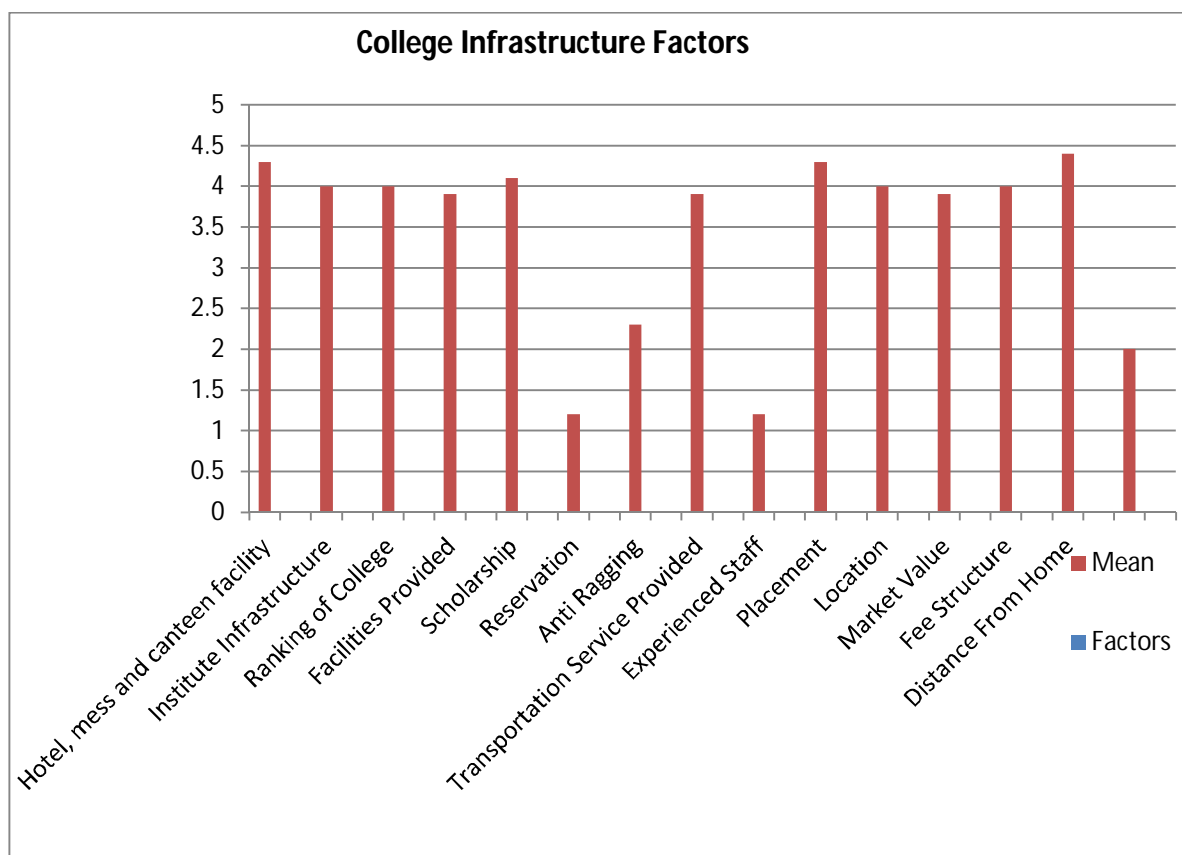
Fig.1 Chart of college infrastructure factors

IV. IMPLEMENTATION OF PROPOSED SYSTEM

An Expert system will work as advisory system for the students who willing to take admission in medical stream. In proposed model candidate data is integrated with the intelligence and give the best output. The method which is applied in proposed model is the best in this type of domain.
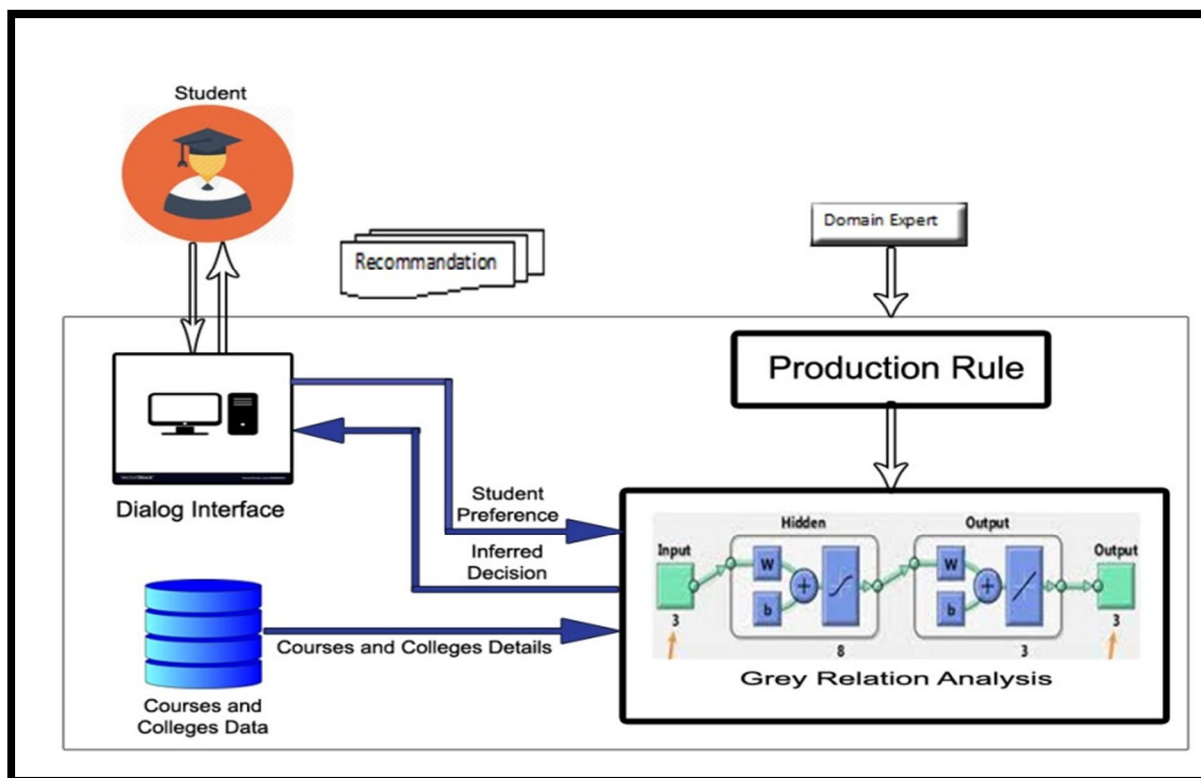
A. Schematic View Of An Expert System

Fig. 2 Schematic view of expert system

Proposed Model consists of five components
1) Student(User)
2) Dialog Interface
3) Course and College Data
4) Production rule
5) Grey Relation Analysis

B. Processing Steps of Model

1) Step-1: Student will communicate with the system through dialog interface. In this dialog interface number of choices are available from that student will choose interested factors. The system dialog interface displays list of questions which is based on literature survey and experienced students. These factors were successfully studied and arranged into proper form so that computer coding can be done easily.

2) Step-2: After the getting input, the data is evaluated for a predicting medical stream and college with respect to given answers we are using neural network technology already contain expert's knowledge, since they were subjected to the learning process on the basis of the production rules. After the input vector from step1 is given to the neural networks they generate the output vector. At the same instance the input vector constitutes a stimulation signal for the data base from which the information connected with the solution proposed by the system is drawn. Flow of training neural network and evaluating user choices with trained network is given in Figure 3 and 4 respectively:
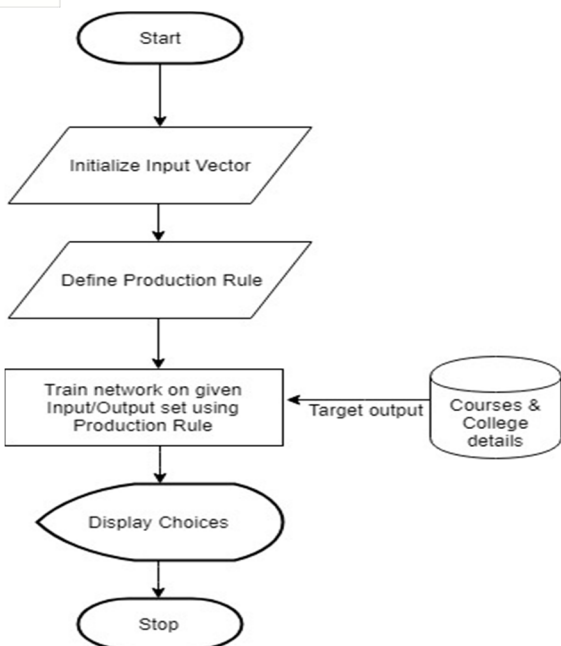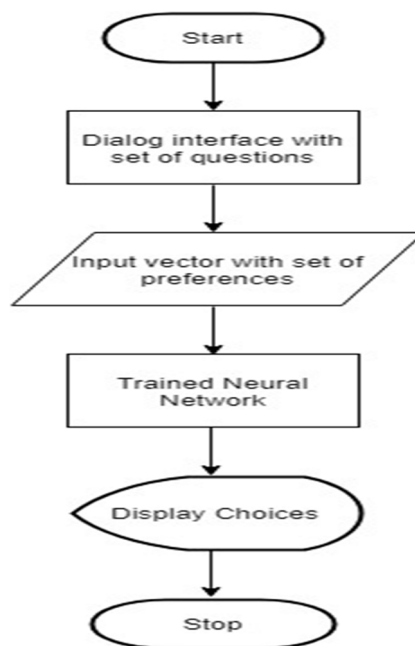
Fig. 3 Flow of trained neural network   Fig. 4 Flow of recommendation based on choice

3) *Step-3:* Pattern is produced of best branches will be given as recommendation to stakeholders of the system so that they give highest priority to this branch.

Therefore whole process work as follows

a) The weight age is given to academic performance is 0.4, family background is 0.2 and personal interest is 0.4.

b) If in first group selected 12th board – 1, 12th score is 90 or above -1, the family income – 1 and the from the third group selects in diagnosis and treats the daily and miscellaneous illnesses of the human body – then model will give output 1 as MBBS.

c) If in first group selected 12th boardm-1 ,score is 90 or above -1, the family income – 1 and the from the third group selects Are you interested in working with teeth and jawbones? -2 then output 2 as Dental.

d) If in first group selected 12th boardm-1 ,score is 90 or above -1, the family income – 1 and the from the third group selects Do you have good eye and hand coordination? – 3 then output will physiotherapy.

e) If in first group selected 12th boardm-1 ,score is 90 or above -1, the family income – 1 and the from the third group selects Do you have knowledge of curative properties of herbs?-4 then output will Aryuvedic.

f) If in first group selected 12th boardm-1 ,score is 90 or above -1, the family income – 1 and the from the third group selects Do you have ability to trace patient's history of illness through questions & record details simultaneously? – 5 then output will Homeopathy.

C. System Implementation

An expert system is developed in the MATLAB R2016a. The system takes an input from the user and it is passed to the model and model will predict the output based on choices.

1) Artificial Neural Network

A neural network is a generalised model used for analysis. Neural network has some advantages like they learn it. Artificial neural networks are the computational fashions stimulated by the human mind. Many new developments are developed under Artificial Intelligence like voice recognition, Image recognition, Robotics. All these enhancements are developed using Artificial Neural Network. These biological methods are considered as new improvements in the computer trade. Today these models are widely used in business problems like sale forecasting, Research on the customer, Validation of the data and management in Risk. Neural networks are consists of layers which are used to do computation and these units are called neurons. All the neurons are connected with different layers. These data are classified by different methods until the output will generate.

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To create neural network number of steps are involved. The steps are as follows:
a) Dataset preparation
b) Selection of NN topology
c) Deciding number of layers
d) Deciding the training function for the Neural Network
e) Making User Interface and communicate with Neural Network
     Here dataset is divided by Grey Relation Analysis method.

2) *Grey Relation Analysis:* Grey Relation Analysis is a part of Grey theory in which relational degree of every factor of the system can be analyzed. [18] The information in which some of them either incomplete or undetermined is called grey. The traditional system requires large number of data which is complex task. In opposite Grey System theory is designed to work when information is insufficient to fully characterize the system. [19] GRA has some advantages like it can work with incomplete information and solve unclear problems concisely.

3) *Deciding the training function and validation for the Neural Network:* Trainlm (levenburg marquardt) method is used to train the network. It changes value of weight and bias using levenburg marquardt optimization. In this method Epoch value is set to 1000 therefore it will terminated at 1000 step. As Network performance function mse function is used. MSE means Mean Square Error. It's formula is:

$$MSE = \frac{\sum_{j=0}^{P} \sum_{i=0}^{N} (d_{ij} - Y_{ij})^2}{N P}$$

Where,
P – processing elements output in number
N – number of total elements in dataset
d_{ij} – desired output for samples i at processing element j
Y_{ij} - network output for samples i at processing element j

D. *Screen Description*
1) *Home Page*
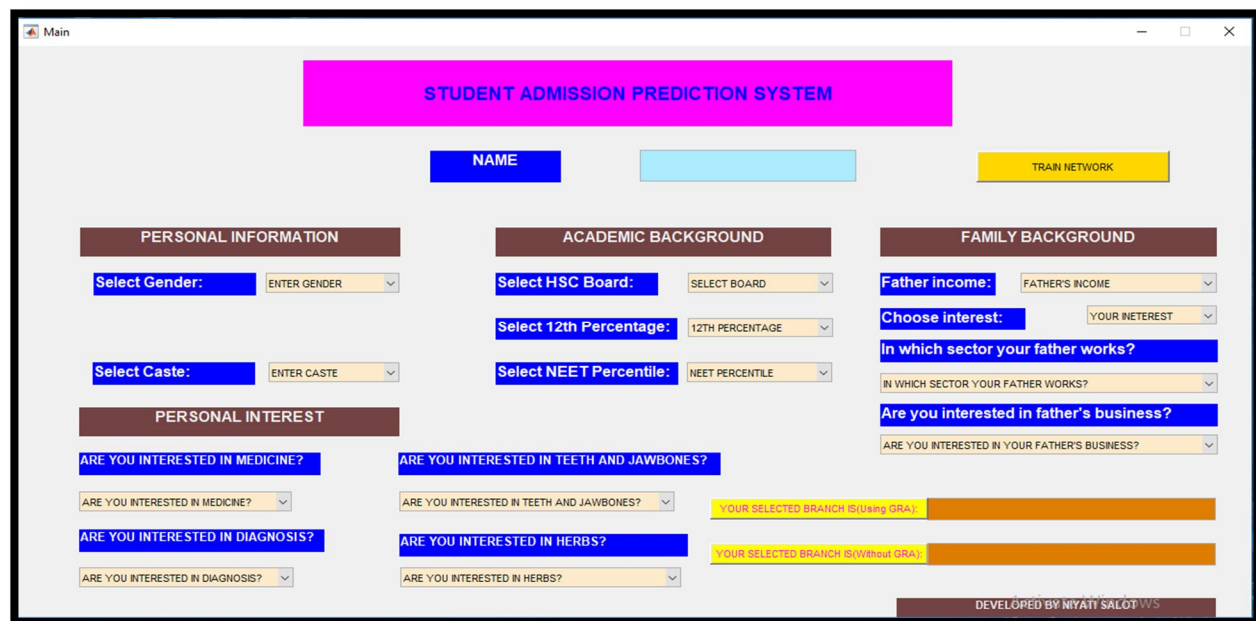a) *Description:* It is used to get personal details of the student.
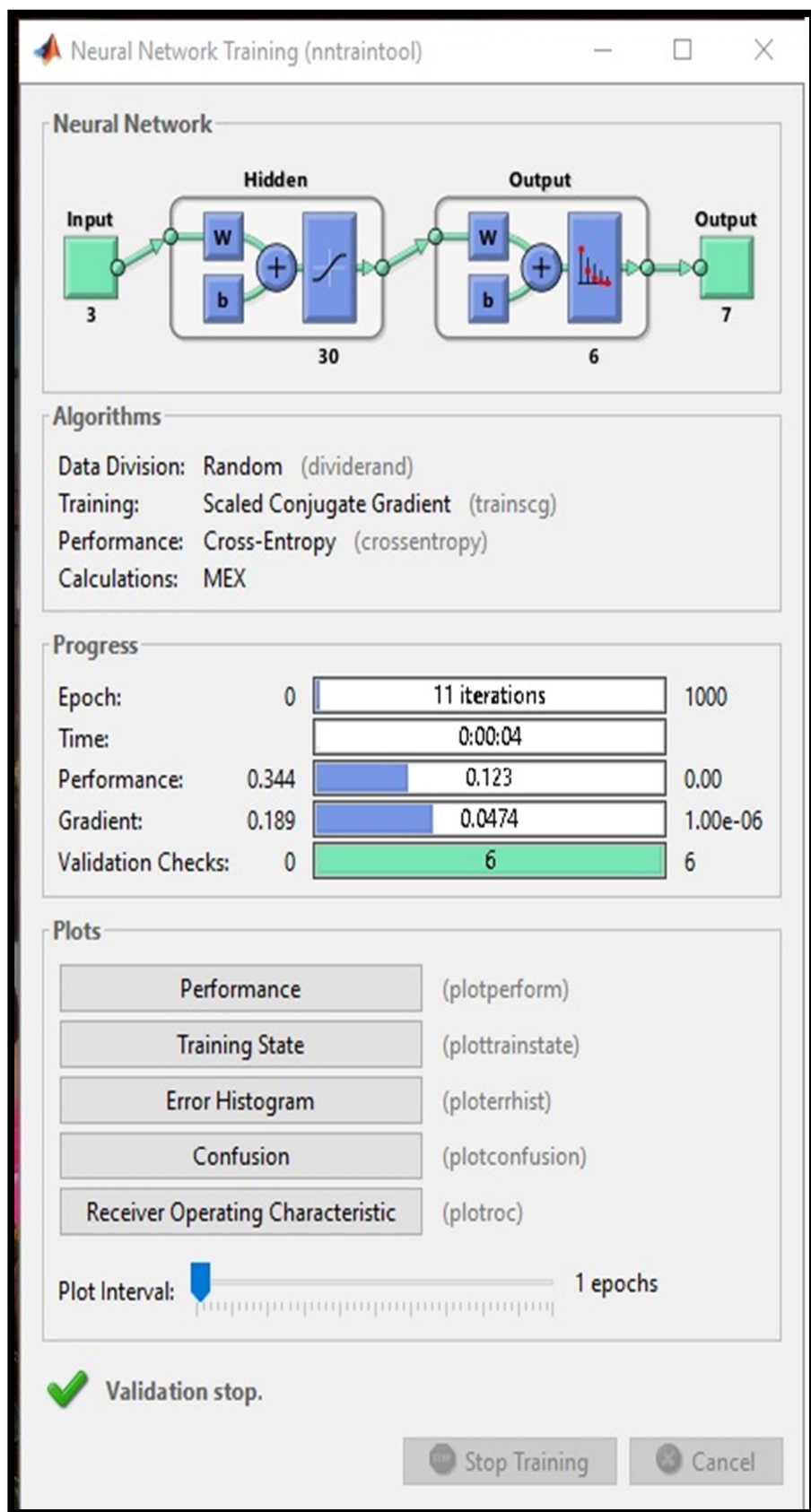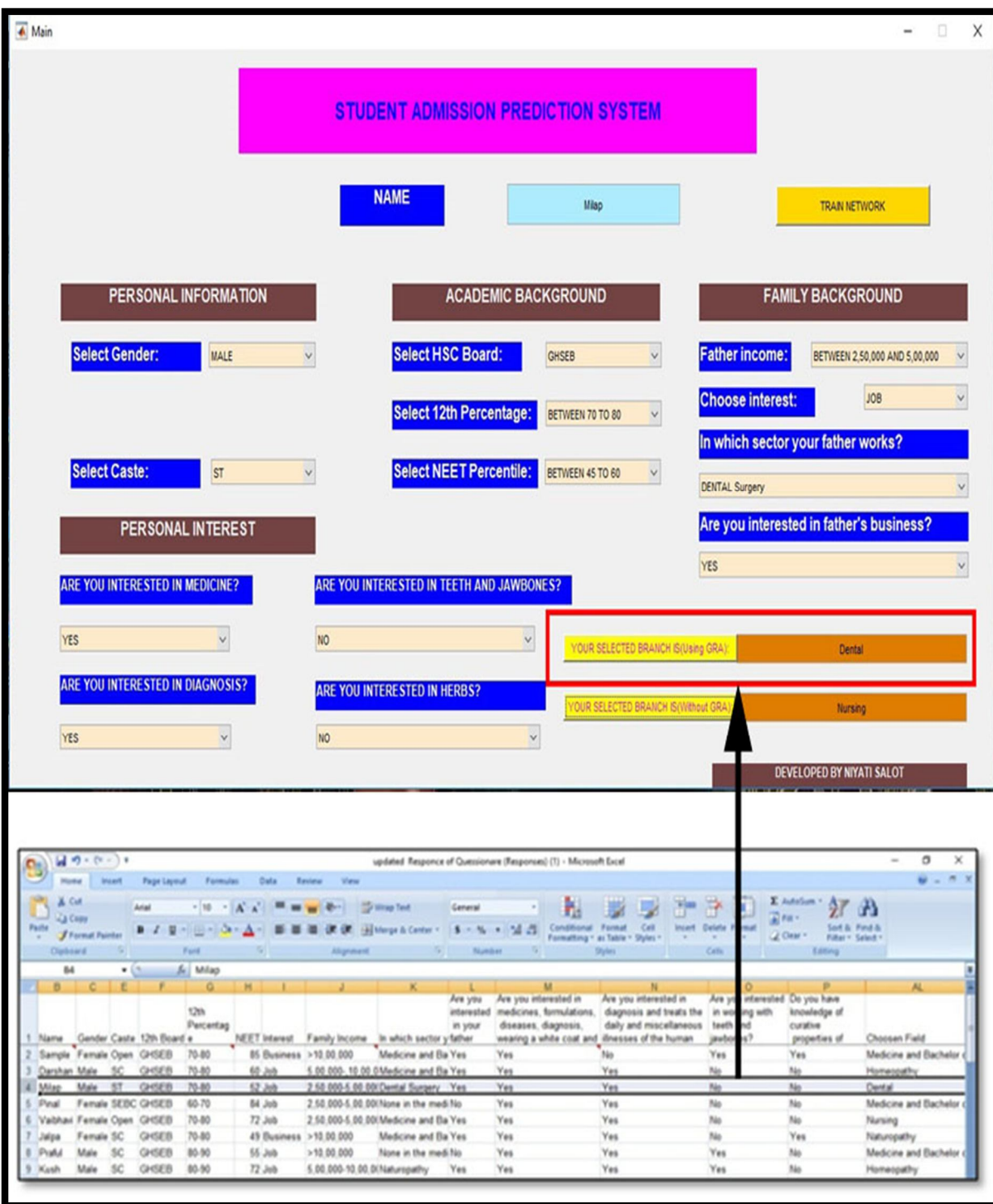

Fig. 5 Homepage

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Fig. 6 Train Network

Fig. 7 Data matches with questionnaire data

E. Result and analysis

Expert system will forecast the medical stream according to student's interest. It will forecast MBBS, Physiotherapy, Ayurvedic, Homeopathy and Nursing. In order to evaluate the system different performance graphs are used. Performance graph, ROC graph and confusion matrix is used to determine the performance. Classifications models are evaluated for their performance by common performance measures. This function calculates the following performance measures: Accuracy, Sensitivity, Precision, and Recall. Therefore two plot diagrams are used such as Precision Recall curve plot diagram and Receiver Operating Curve plot.
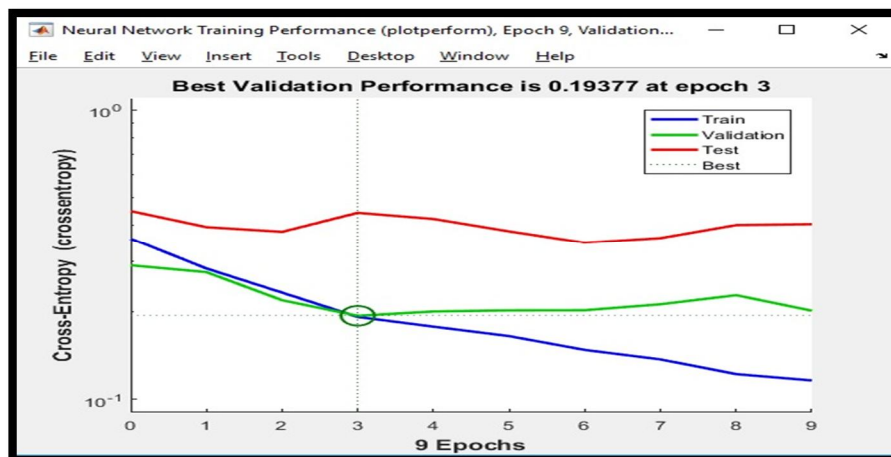
Fig. 8 Performance Plot

1) *Confusion Matrix:* The confusion matrix is used to shows that the target data is accurately predicted or not. Confusion matrix consists of different diagonals. It has number of rows and columns and intersected at the cell. Each of the cell has specific values. Plotconfusion(target,output) function is used to generate confusion matrix. The rows represent the forecasted class where as columns represented the true (output) class. The diagonal cells show how many percentage of the examples trained network accurately forecasted from the inspection class. Therefore it represents how many percentage of correct and forecasted classes' equivalent. The off diagonal cells represent the mistake of the classifiers that is between 1 and 0. The right column of the plot represents the accuracy of the each forecasted class that is respectively 87.5%, 100%, 70%, 83.3% and 86.7%. The bottom column represents the accuracy of the each true class that is 82.4%, 85.7%, 77.8%, 90.9% and 92.9% respectively. The bottom right unit represents overall accuracy that is 84.7% .

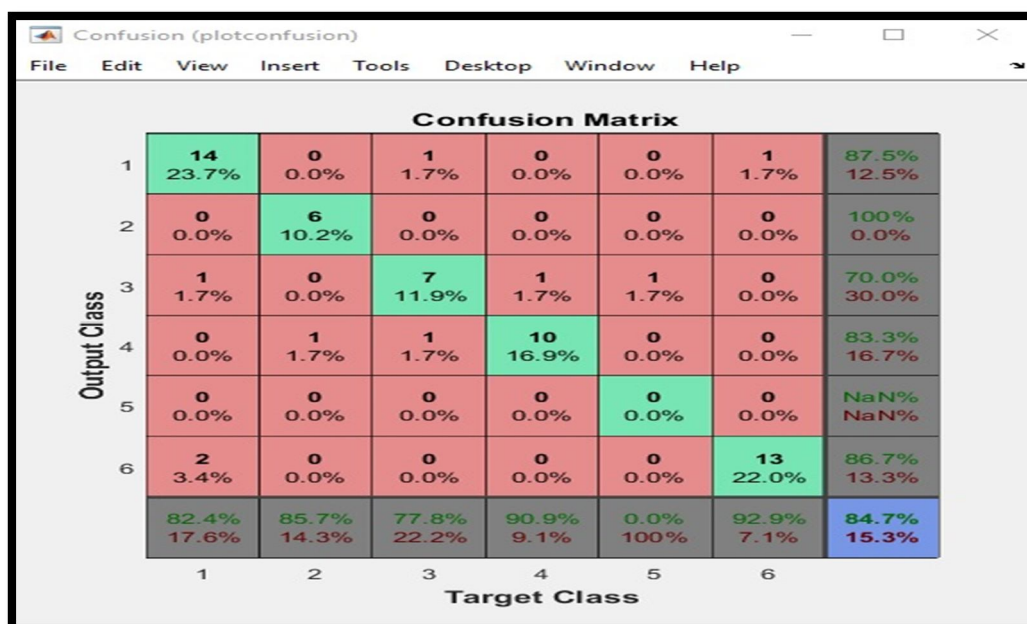| Output	Output1	Output2	Output3	Output4	Output5	Output6	Overall Accuracy
Target class	87.5%	100%	70%	83.3%	-	86.7%	84.7%
Output Class	82.4%	85.7%	77.8%	90.9%	100%	92.9%	

Table 3 Output of confusion matrix

Fig. 9 Confusion Matrix

2) *Receiver Operating Characteristics:* The ROC matrix is used to determine the quality of classifiers. [tpr,fpr,thresholds] = roc(targets,outputs) formula is used to plot the ROC curve. In this formula trp stands for True Positive Ratio, fpr stands for False Positive Ratio. Plotroc() function is used to visualize all these values. When the curve touches at the left and top edges of the plot then it shows that it gives the better classification. During the past 40 years ROC analysis becomes a popular method for evaluating accuracy for any prediction system.

It shows the following values:

a) TP (True Positive) of C1 is all C1 instances that are classified as C1.

b) TN (True Negative) of C1 is all non-C1 instances that are not classified as C1.

c) FP (False Positive) of C1 is all non C1 instances that are classified as C1.

d) FN (False Negative) of C1 is all C1 instances that are not classified as C1.

	True Positive	True Negative	FN(Columnwise)	FP(Row wise)
CLASS 1	14	40	03	02
CLASS 2	06	52	00	01
CLASS 3	07	47	03	02
CLASS 4	10	46	02	01
CLASS 5	00	58	00	01
CLASS 6	13	43	02	01
TOTAL	50	286	10	08

Table 4 ROC Parameters

Formulas:

$$PRECISION = \frac{TP}{TP + FP} \quad (1)$$

$$SENSITIVITY\ OR\ RECALL = \frac{TP}{TP + FN} \quad (2)$$
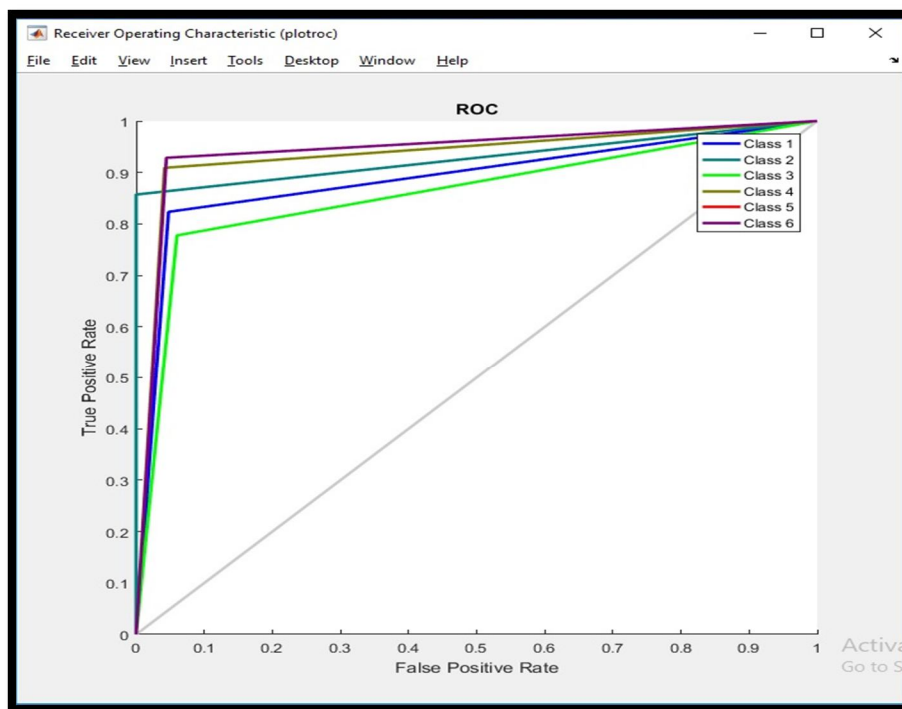
$$SPECIFICITY = \frac{TN}{FP + TN} \quad (3)$$

Fig. 10 ROC Plot

F. Limitation and future extensions

Current expert system is working only with 5 medical branches out of all over 8 branches. In addition to this colleges are not considered in this application. Therefore colleges will be added according to types government, grant-in-aid and self-finance. Therefore the information of the system is limited in span. Here our main aim is to find suitable methodology which can be applied with neural network to develop an intelligent system that can be applied to all the field of undergraduate admission process. It also can be useful to higher education study courses too.

Here statistics and regulations we've got used are contingent from professional knowledge. No longer right processing method is implemented. Right here more recognition is given on addressing the hassle and the answers whilst performance can be developed later. In future we are able to observe right information processing algorithm to assess and set precedence for every college and course.

Present system is desktop based system so in future it can be converted into the web based application.

V. CONCLUSIONS

Today, the importance of guidance and counselling with respect to career choices is often overlooked and undervalued. This is responsible for many dropouts in our school education. To make their school and future lives healthy, Comfortable and productive, students must be provided with rich guidance and counselling services, so that they can discover relevant courses where they stand better chance not just to graduate as at when due, but to come out with better performance. Substantial research has been done on the use of neural networks for pattern recognition or classification. Many research studies have been conducted on the application of artificial neural net-works in computer security, detection of computer intrusion and detection of computer viruses, image detection, and fingerprint recognition. There is very little if any research that has been done in the area of student selection for university admission. Student characteristics for university admission have been fluctuating making it very difficult to recognize required patterns. Neural networks could play a beneficial role in trying to resolve these challenges, especially given the several advantages they have. One such advantage is that universities are likely to have highly motivated students as these students will now be doing courses of their own choice. This may lead to improved chances of having a better graduate at the end of the training. This in itself will translate to improved quality of the manpower produced. It is also likely to reduce the costs and time spent on the processing the students placement. The time students normally spend out of learning could also be greatly reduced. The ANN application may reduce the cost spent on the application processing and the time the applicants have to wait for the outcome.

VI. ACKNOWLEDGMENT

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