5.1 Introduction

In this chapter, the integration of all the techniques described earlier into a single expert system tool is presented and explained. A Graphical User Interface (GUI) is designed. The developed tool, which stores the details of the children in the student database and retrieves their LD report as and when required, helps in classifying LD as well as imputes the missing values in the data set in an accurate way. The main stages of information processing adopted in the tool design are data preprocessing, mining of data, getting knowledge and prediction of LD.
5.2 System Flowchart

The system flowchart and a layout of the system component of the integrated knowledge based tool for LD prediction are given below at Figure 5.1 and Figure 5.2 respectively.

![Figure 5.1 System flowchart](image1)

![Figure 5.2 Knowledge based system layout](image2)
5.3 Architecture of the Tool

The architecture of the developed tool is as shown in Figure 5.3 given below. The main tool components are explained under section 5.4 below.

![Figure 5.3 Architecture of the tool](image-url)
5.4 Design of the Tool

Design and structure of the tool are given under. The main components of the tool are students database, LD GUI, students report, data set loader, data preprocessing, classification, training, knowledge base and inference engine.

5.4.1 Students database

In the tool design architecture, two types of data sets are used. The first type is the data set obtained by means of informal assessment using checklists containing the 16 attributes which are the symptoms of LD.

The second type of data set is prepared for the fuzzy concepts. Here, instead of one attribute, four questions, sub attributes, related to that attribute are used. Each questions having a particular ranking. The rank is between 0 and 100. By summing up the score (rank) of these four sub attributes, the total rank of each attribute is calculated. By using this method very accurate results can be collected and hence this type of data set is very effective and hence this leads to a good classification results. Each case values are calculated automatically by a special microprogramming excel sheet.

5.4.2 LD GUI

A GUI is designed in MatLab 7.10 software environment, for the proposed LD tool, is as shown in Figure 5.4. The purpose of this developed tool is to help the child, parents and teachers to assess the child’s LD status effectively. Here knowledge of the machine to perform the classification and prediction is used. The rules and facts built in the knowledge base can be viewed and modified, expanded or updated through this component. This interface plays the role of translator where the information displayed to the user is in English-like format. It acts as the user interface. It shows 100% accuracy.
The GUI collects the details about the child. When the FILE button in the GUI is enabled, the trained data set is loaded into the system. Then the data preprocessing and training are performed. Thereafter from the 16 attributes or signs and symptoms of LD, which is/are applicable in the case, is given and testing is performed. The GUI is very user friendly and the time consuming for the testing is much less. Any type of informal assessment checklist can be loaded in the GUI for testing. After the testing, apart from the degree of LD its percentage can also be assessed by the user from this GUI.

![Figure 5.4 Designed GUI of LD tool](image)

5.4.3 Students report

The system is designed such that, the different methods to be used can be selected from the scroll bar. The details about the children are saved in the student database of the designed tool. After the all processing, we can take the detailed report of the student. It contains details about the child and details about the LD.
5.4.4 Data set loader

The purpose of data loader given in the GUI is for loading the data for training. After training, the knowledge is stored in the system.

5.4.5 Data preprocessing

Learning disability databases are highly susceptible to noisy, missing and inconsistent data due to their childish nature. They may not respond to the question or the teacher couldn’t identify their problems. Sometimes the assessment may not correct. In addition to these problems the data sets should have same characteristics of usual database. The purpose of this data preprocessing is to improve the quality of the data and, consequently of the mining results. The collected data has to be preprocessed so as to improve the efficiently and ease of the mining process.

Here, the different methods are implementing for improving the quality of the data sets are closest fit algorithm and correlation based algorithm. Also, attribute reduction is done using PCA. These methods improve the quality of the datasets and it will help to classify the LD children effectively.

5.4.6 Classification

In this system, we are using different classification models such as decision tree, neural network, fuzzy and neuro fuzzy systems. The classifier results fully depend on the quality of the data. So we provides different methods for improving the quality of data and hence these classifiers shows a better results.

5.4.7 Training

Different training methods are performed here viz. training for neural network, decision tree and fuzzy. After performing the training, testing will be
performed. Based on our data set, in this tool, 50% data is used for testing and the knowledge gained from here is used for testing.

5.4.8 Knowledge base

The acquired knowledge of the components is organized in the form of facts and rules in this knowledge base component [149]. The knowledge base provides a means for information collected on LD and how it is organized, shared, searched and utilized. The machine knowledge bases stores knowledge in a computer readable form. They contain a set of data, often in the form of rules, decision tree, neural net, etc. that describe the knowledge in a logically consistent manner. Knowledge base of our tool contains 243 rules from ANFIS, 153 rules from fuzzy model, 26 rules from fuzzy with attribute reduction and 9 rules from decision tree.

5.4.9 Inference Engine

The inference engine is the mechanism by which the search for conclusions or reasoning is conducted using a search strategy of the knowledge built in the knowledge base [1]. An inference engine is a program that derives answers from the knowledge base. It is also called testing. It is the brain of the system that uses to reason about the information in the knowledge base for the ultimate purpose of formulating new decisions.

5.5 Tool Testing

Testing is carried out on the whole data. For the performance evaluation of the tool, in presence of the professionals, details of new candidates are entered and we obtained 100% accurate LD results. The developed tool, viz. Knowledge Based Learning Disability Prediction (KBLDP) tool is tested for its accuracy and found highly performed for the cases tested. Different types of test results
are obtained. These are LD – True and LD – False. Apart from this, the class of LD such as low, minor and major along with the percentage of LD in each class are also obtained in an accurate way while testing.

5.6 Screen Shots

A typical result obtained in the GUI of the tool designed using the neuro fuzzy method is shown in Figure 5.5. It can be seen from the figure that, the child is having LD, its class is low and percentage of LD is 60%. The low LD is a normal state but it shows some similarities with that of children having LD. So we have to observe the percentage of LD present in that particular child, whether it is increasing or decreasing. Most probably this may reduce or disappear after some years. On further observations, if it is found increasing, it means that the LD present in the child tends to a minor state, which is at a higher grade than that of low state. As such, the developed tool is very helpful for the teachers as well as the parents for giving more concentrations/remedial measures to the children.

![Figure 5.5 A typical case of GUI output with class low and LD 60%](image-url)
Another typical result for a child having LD class minor with LD 52% is shown in Figure 5.6. This minor LD of 52% is somehow higher than that of low LD of 60%. From the percentage of LD and its class, we can understand the depth of learning disability faced by the children. Hence, based on the class and percentage of LD, we can provide the appropriate remedial solution to the child.
The third typical case we have observed is that the class of LD major with LD 88% as shown in Figure 5.7. Even though, it is a very complicated case, if it is identified in an early stage we can provide a very good remedial solution and moral support to the children in early days. This will certainly improve the child’s confidence and get a good change in his future. The GUI output obtained in a typical case for a child having no LD is shown at Figure 5.8.

As such, the designed tool is a very good scaling for the learning disability measurement. In the study, we are using three input method - one for neural network and decision tree, second for fuzzy input and third for fuzzy with reduced attribute and neuro fuzzy methods. The study reveals that, both these functions applied in MatLab GUI for the prediction of learning disabilities
in children shows a high accuracy in LD prediction. Ultimately, the tool is found very effective in LD prediction and suggesting remedies for the help of children, parents and teachers.

5.7 Performance Evaluation of the Tool

The designed tool for predicting the learning disability in school age children and determining the class of LD viz. low, minor or major and its percentage measurement has been tested and evaluated in presence of professionals in the field. The tool shows 100% accuracy and the experts/professionals have agreed that the developed tool is very effective in the case of informal assessment and can be used for easy and speedy identification of LD. They opined that the tool can be used without their presence. As in the Indian scenario, parents/children may not be willing to undergo LD assessment and evaluation carries out in LD clinics. In such situations, the tool is found very effective, as it is user friendly and it can be used by teachers at the school level itself or even by the parents.

5.8 Summary and Conclusions

An integrated knowledge based tool designed with the help of a GUI for prediction of LD in school children is explained. The developed tool helps in classifying LD after performing different data pre-processing methods also. The developed tool performs in good manner. In future, the tool has to be enhanced to incorporate other assessment methods of LD, including formal assessment. Also, in future, other classifying methods including hybrid computing approaches and advanced features of fuzzy models have also to be studied for these assessment methods.
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5.9 Contributions

The developed tool is helpful in finding the LD at an early stage. Depending upon the degree of LD present, as determined by the school authorities/parents, they can recommend the child for further treatment with councilors/special educators/LD clinics, etc., for proper remedial solutions. With the right help and intervention at proper time, children with LD can succeed in school and go on to be successful later in life, where the designed tool is found much relevant as early detection of spotting out of signals of learning disability can be easier to correct.