Learning Style Classification in E-Learning Systems using PN Rule Classification

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Abstract – This paper discusses an adaptive e-learning portal which analyses the learning style of a student and provides materials for education based on their learning style. The students' learning style applied here (Verbal/ visual) is based on the Felder Silverman Learning style model. The classification of these styles is done by PN rule classification, a rule based classifier model.

Keywords – Learning style, PN rule, classification, adaptive e-learning.

I. INTRODUCTION

The World Wide Web has become a more powerful and interactive medium for sharing information. The advancements in web technologies have catalysed the development of new learning experiences for students. One of the first types of web application is e-learning. E-learning is the use of electronic educational technology in learning and teaching. Since then e-learning has been a trending area of development. The important benefit of e-learning is classroom independence.

This paper discusses the creation of an adaptive e-learning system based on student's learning styles that is developed using Java Technology. The popular Felder Silverman learning style [1] will be explored and used for implementing the adaptation mechanism. The evaluation of online tests is done by using PN rule classification technique. Post development analysis has been done for calculating the accuracy of the system and the results are shown.

II. EXISTING SYSTEM AND PROPOSED WORK

There are various e-learning systems available on the Web, but they provide only the same plain HTML pages to all students regardless of individual ability. However, e-learning courses are used by a much wider variety of users than other campus-based courses. These learners may have very different learning capabilities. An e- learning course designed for a specific group of users, may not fit other users. Therefore the course material needs to be adaptive so that different students may get different types of materials that depends upon their own characteristics.

Adaptive e-learning system (AES) tries to solve these problems by providing material to suit every individual student[2]. It combines thoughts from hypermedia systems and intelligent tutoring systems to adapt the e-learning portal to every user. They incorporate a learning style classification model to collect information about his or her preferences, learning style and implement them.

III. ADAPTIVE E – LEARNING

Adaptive e-learning system is a recent area of research which integrates various technologies including Computer Assisted Instruction and hypermedia systems. These techniques are typically used by more heterogeneous users than others. Most of the web-based learning systems that is designed for a particular group of users may not suitable for other users. In general the user of AES can work without any assistance from the faculties, instead of teaching in the traditional way.

Some of the basic components of AES include domain model, student model, group model, learner model and adaptation model [3] . The domain model defines the resource of the AES. The student based model includes collection of characteristics for which the values are recorded for every individual user. The adaptation model is a definition of what parts of the e-learning can be adapted.

The important thing to provide adaptivity in AES is the student based model which represents the relevant aspects of the student such as preferences, knowledge and interests. The student model maintains information in a dynamic manner for individual user based on the students' knowledge and preferences. This system classifies the learning style of the student by presenting series of questionnaires and evaluating them. Advanced adaptation can be provided based on the accuracy level of the model.

The systems having trivial adaptations are called adaptable and they are not adaptive [4]. Mainly, Adaptable systems are not based on intelligent algorithms. They only changes the interface manually based on the user needs. The static adaptable characteristics are classified as adaptability.

On comparing adaptability and adaptivity, adaptivity represents the advanced one that forwarded towards the artificial intelligence. The adaptive system will automatically adopt according to the individual user model.

IV. PN RULE CLASSIFICATION

PN rule is a general-to- specific framework, a rule-based model. It is based on the presence and absence of the expected values. The presence of the expected value indicates the P-rule and the absence of the expected value indicates N-rule. The PN rule classifier is trained to identify the positive cases, and eliminate the negatives automatically. Hence it can be applied used in areas where the decision has to be made with just two options. Even other classification rules are applicable for decisions with more options. So, this PN rule classification is also called as the Binary Classification.

At first, highly accurate rules are opted, but later accuracy is compromised in favour of support. This compromise of accuracy causes some negative examples or false positives to be considered as true positives. Now, we combine all the true positives and false positives collectively as the P-rules, and from that, learn the N-rules on this reduced data-set to eliminate the false positives.

Using the statistics of P- and N-rules on training data, we develop a method to find the decision of each binary classifier [5]. The classifier weighs the effect of each N-rule on each P-rule which allows the PN rule to avoid overfitting and gives it a flexibility to model the test questions. PN rule is also naturally suited to take into account the different costs of wrongly classifying the various classes. We use the scores generated by the PN rule classifiers and the misclassification cost matrix, to arrive at predictions and make decisions.

PN classification can be applied on the case where the given set is separated into two sets, positive and negative. For example, in email filtering, we have set of emails in which some of the emails may be spam others may be legitimate. The process of classifying each such mail is represented schematically in the figure 3.1 found below. In every classification problem , the numerical representation is considered to be a feature for class prediction. Features that includes frequencies (presence of given word in dictionary), Boolean values (either true or false) and numerical values (temperature and blood pressure values).

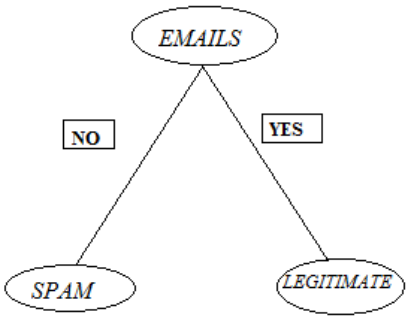

Fig 3.1: An example of PN rule classification

V. IMPLEMENTATION AND RESULTS

The E-learning system has been developed using JSP. Here the E-learning system is developed for the subject “C programming language”. The new users have to register first [6]. The details of the user will be collected and stored in the database during registration. After filling out the details, the user is directed towards the general test. The general test consists of a reading comprehension and an aptitude test by answering the questions of a visual [7]. The learning style of the user will be predicted by the general test whether his/her learning style is verbal or visual. This is done by using PN rule classification. It is stored in the database for respective user. After the registration process, the user can login to the system to start learning.

Two types of materials will be provided to the user for C language. They are in verbal and visual form. The initial material consists of all chapters in C. The user can learn the material in their respective learning style. After completing the learning process, they may proceed to the chapter wise test.

The PN rule classification is applied in the evaluation of the individual user’s test. The test consists of ten questions for each chapter. Each question carries different weights based on the difficulty of the question. There will be four options for each question. For each question the right and wrong answers will be evaluated using PN rule classification as positive and negative value. The right answer is considered to be positive value and the wrong answer is considered to be negative value. For every right answer the marks will be added as per the PN rule.

After the test has been evaluated, the score is displayed on the screen and is considered to be a factor to evaluate the user performance. If the user's score is below average then the material is provided according to his/her learning style for particular chapter for the user to improve in that area. Thus the user can benefit by making use of this material to improve themselves which is in their learning style.

There is an overall test at the end. This is to evaluate the performance of the user on the whole subject. Here, the weak areas of the user for each chapter will be detected and the materials based on their learning style will be provided in particular. The user has to rate the learning style of theirs after the test has been finished. The result of this project is given below:

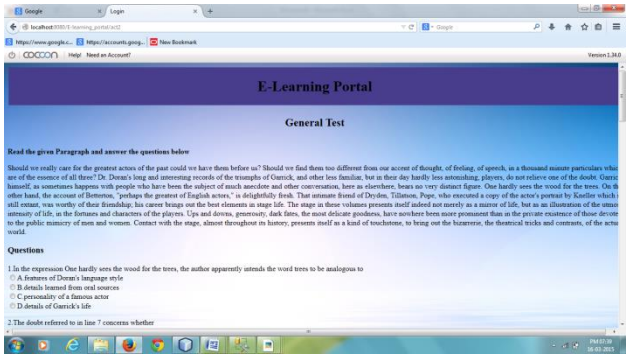

Fig 4.1 General Test (Verbal test)

Fig 4.2 General Test (Visual test)

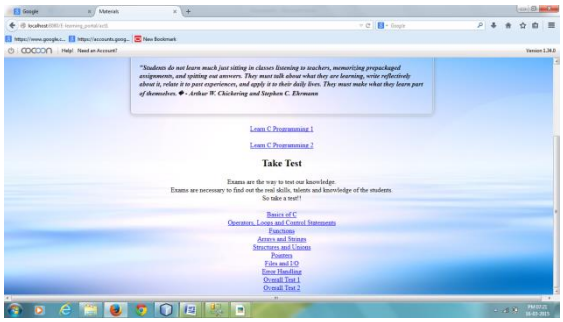

Fig 4.3 List of Materials and Tests

Fig 4.4 Chapter Test

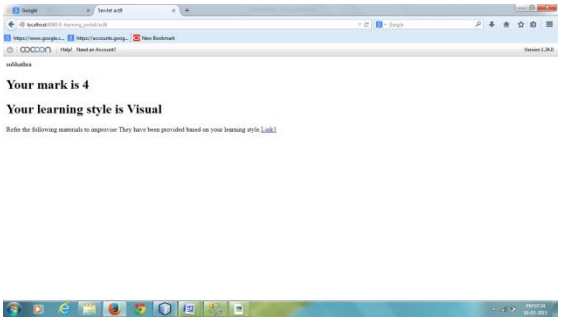

Fig 4.5 Material provided based on learning style

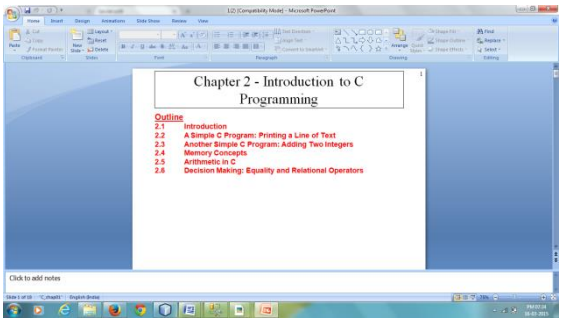

Fig 4.6 Visual Material

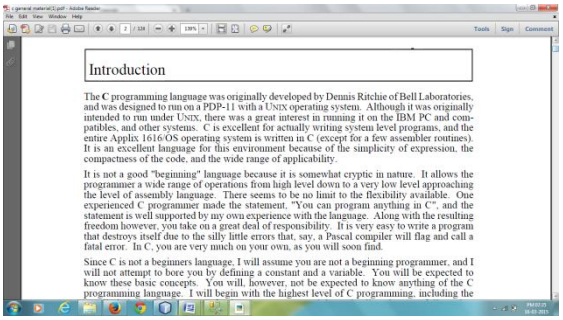

Fig 4.7 Verbal material

The adaptive e- learning portal was given to a set of 50 students for evaluation. The results of the evaluation proved that the application of Felder Silverman's learning style (Verbal/Visual) has proved to be correct. It is given in a pie chart below:

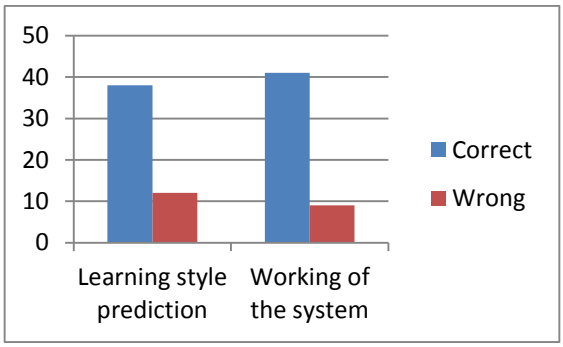

Fig 4.8 Results of the feedback

VI. CONCLUSION AND FUTURE WORK

The Adaptive E-learning system that is described in this paper presents learning materials that match students' learning styles (verbal/visual). The system identifies the student's learning styles and tendency through a set of questionnaire. The questionnaire scores are used by the system as basis to provide the student a presentation of learning materials differently. The system is implemented by using Java Server Pages Technology and Microsoft SQL Server 2005 is used as the database. The ongoing evaluation at the design and implementation stage is done to make sure that every feature of the system works well. The evaluation results show that all adaptation functionalities of the adaptive e-learning has performed correctly.

VII. REFERENCES

[1]. Sabine Graf, Silvia Rita Viola, Kinshuk, Tommaso Leo . Austrian Federal Ministry for Education, Science, and Culture, and the European Social Fund (ESF) under grant 31.963/46-VII/9/2002. *Representative Characteristics Of Felder-Silverman Learning Styles: An Empirical Model**

[2]. Lorna L. Gappi, Ph.D. "*Relationships between Learning Style Preferences and Academic Performance of Students"* 2013 Society of Education, India

[3] M. Cannataro, A. Cuzzocrea, C. Mastroianni, R. Ortale, and A. Pugliese, "*Modeling adaptive hypermedia with an object-oriented approach and XML,"* presented at the 2nd International Workshop on Web Dynamics (WebDyn 2002) in conjunction with the 11th International World Wide Web Conference (WWW 2002), Honolulu, Hawaii, 2002.

[4]. Herman Dwi Surjono "*The Evaluation of a Moodle Based Adaptive e-Learning System"* International Journal of Information and Education Technology, Vol. 4, No. 1, February 2014

[5]. Ramesh Agarwal and Mahesh V. Joshi "*PNrule: A NewFramework for Learning Classifier Models in Data Mining (A Case-Study in Network Intrusion Detection)".* Technical Report RC 21719, IBM Research Report, Computer Science/ Mathematics, April 2010.

[6]. Wei, X. & Yan, J. (2009). "*Learner profile design for personalized e-learning systems*". International Conference on Computational Intelligence and Software Engineering (CiSE 2009) (pp. 1-4). Wuhan China: IEEE.

[7] Herman Dwi Surjono "*The Design of Adaptive E-Learning System based on Student's Learning Styles*" (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 2 (5) , 2011, 2350-2353