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Personalized E-Learning System Based on User's Performance and Knowledge: An Adaptive Technique

Patchava. RamyaSree, Tammisetty. Bhuvaneswari, Vulchi. Vamsi Swapnika Reddy, Jonnalagadda. Surya Kiran

Abstract: ***The Learning style of every individual is unique. We require some adaptive and personalization techniques to extract required learning content from enormous content available. Here we build up an adaptive learning approach so that the personalization is conceivable. An adaptive learning system is developed by considering learner's knowledge. We develop this by considering a specific domain. It takes the individual's performance into consideration and modifies constantly by responding with student specific learning content. We categorize learners based on the initial assessment conducted. Based on the results obtained and on his/her choice of content displayed. Learner's performance is observed and modelled, adaption is done accordingly through continuous appraisals conducted after each module and tweaked during interactions. The essential goal of this paper is to incorporate the revelation of ideal settings, where the students can improve their learning capacities.***

Keywords :Personalization, Adaptive Learning, domain, assessment, interaction.

I. INTRODUCTION

E-Learning is "Utilization of Internet Innovations and advancements to present a greater range of approaches that upgrade abilities and performance". Over a decade there have been many developments in E-learning. Unlike Traditional learning which provides same and limited learning content for any individual. Moreover, the learner can learn during his comfortable time and place.E-Learning provides plenty of resources. Learners can pick their learning content in e-learning system. E-learning is a continuous process. Day by day the learning content and the resourceavailability is becoming huge. It consumes plenty of time while searching for the required content. There have to be effective strategies to provide necessary learning content. Not everyone has the same knowledge regarding a particular subject.Hence the learning material to be provided to the learner also to be different.

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* Correspondence Author
Patchava Ramya Sree*, Department of Computer Science and Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, AP, India.
Tammisetty Bhuvaneswari, Department of Computer Science and Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, AP, India.
Vulchi Swapnika Reddy, Department of Computer Science and Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, AP, India.
Jonnalagadda Surya Kiran,Department of Computer Science and Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, AP, India.

Providing the related content makes the system adaptive and personalized.While developing an E-learning systems personalization is an important aspect to be taken into consideration. It is critical to provide a customized framework which can consequently adapt to learner's learning styles and keenly prescribed content with personalization. Since the issue isn't about making electronic learning resources but about finding how to provide the accessible data in customized way. This paper establishes personalized E-learning system which does student profiling first followed by a knowledge test which assess the learner's level of knowledge and displays the information accordingly and during the course of time learner progress is tracked and assessed by conducting an assessment after learning a chapter the system adapts accordingly.

II. LITERATURE SURVEY

i)Title: Intelligent Recommendations for E-Learning Personalization based on Learner's Learning Activities and Performances

Authors: DamindaHerath, LashmanJayarathne

This paper introduces the practical type of learning for E-Learning personalization which uses Education Data mining frameworks. It distinguishes the student's conduct like:

a. Learner's activities
b. Monitoring
c. Predicting performance

This proposed work mainly made of 3 models:

i. Learner Model: Uses to identify Learner's learning actionsand choices.
ii. Area Model: This model contains all the information about a particular content.
iii. Proposal Model: This model pre-processes the data and helps to build a list using intelligent recommender module and thereby predicts the performance using prediction module.They used mainly two sorts of methodologies for this model:

One using content and other using available information and preferences of user.
These methodologies can be upgraded by using the techniques like:

a. Classification
b. Clustering
c. Prediction
d. Association rules

Here, Utility matrix is used for anticipating the results of unaware entries depending on the results of known entries. After the analysis of the system developed, the results demonstrated that the conduct was improved. Yet, here the teaching strategies were not taken into consideration and there is no interaction between the Learner and the system[1]

ii)Title: Analysis of Personalized E-Learning system on the basis of Behavioural Data Mining.

Author: Duoduo Liu, Lihua Zhang

This paper analyses the behavioral data mirroring the intrigue highlights by using Data Mining Techniques. After the analysis of behavioral data it models a Personalized Recommendation System. This system helps the Learner in an effective manner. It takes Learner requirements into notice and then it suggests the Learner depending on Behavioral Data Mining.Educational Data Mining can help to recommend which Learning Activities, Resources, Tasks as well as experience. Educational Data Mining incorporates five techniques:

1) Statistical Analysis
2) Visualization
3) Cluster Analysis
4) Prediction
5) Relationship Mining, Text Mining

Data Mining also included SQL Server, SSAS, UCIMET and EXCEL.

In any case, the selection to Learning resource matches with Learner's interest on specific content. In this paper Data Mining Techniques is used for the behavioral data and personalized E-Learning system helps to recommend content based on Learner's interest. However, it does not take the Learner's knowledge into consideration.[2]

iii) Title: A Systematic Approach to improving E-Learning implementations in High Schools

Author: Bens Pardamean and Teddy Suparyanto

For the most part inspects the existent pattern of actualizing E-Learning in High School. The strategy used is said to be Learning Management System (LMS). E-Learning for the most part partitioned into three segments: The Educating Process, The Process of Learning and The level of Knowledge. The interaction between the learner and system is also depicted. Here, a study was conducted to determine the connection between students' computer abilities and their academic accomplishments within Information Technology courses. Pearson's Correlation Analysis is utilized to discover the level of relationship. It reflected the degree of linear relationship between learner's computer skills and the Curriculum accomplishments. This paper says that student's achievements are not based on the scores. They are based on the psychomotor and affective scores. These two factors can be further explained.[3]

iv) Title: A Personalized E-Learning based on Recommender system

Author: OutmaneBourkoukou, Essaid El Bachari and Mohamed El Adnani

In this paper, their main work is to propose a Personalized E-Learning Recommender system (PERS) by using Collaborative Filtering Methods. The Learning content will be offered to the learner in a personalized way. The Learning style of a learner is recognized by using the Questionnaire with the goal that Cold Start problem is resolved. This Personalization recommender system consists of 3 segments:

1) Domain Model: Courses are exhibited by a set of concepts and concepts are introduced by a set of learning objects.
2) Learner Model: Just learning style of a Learner is considered.
3) Recommender Model: In this model soon after registering, an Index Learning Style Questionnaire (ILSQ) is conducted to evaluate the Learning style. Then the content is displayed based on the result of Questionnaire.

The Learner profile is built using the Data Mining Techniques. Learning content scenario is classified into following:

a. Cleaning & Pre-Processing
b. Normalization
c. Similarity Computation
d. Recommendation

The work was completed by taking the Dataset from AdaptErrEx.[4]

v) Title: An Approach to Personalized E-Learning

Author: Matteo Gaeta, Sergio Miranda1, Francesco Orciuoli1, Stefano Paolozz, Antonella Poce

The use of Semantic web is also an innovative way for Personalization in E-Learning. In this paper Intelligent Web Teacher (IWT) is proposed where E-Learning activities are performed. The Learning Model in IWT uses 2 separate models:

1) Knowledge Model: Interaction between concept and Learning object.
2) Learner Model: List of subjects correlated with grade. Grade shows how much the Learner knows about the subject.

For IWT informatics Ontology there are 5 steps:

a. Vocabulary filling
b. Hierarchization
c. Decomposition
d. Categorization
e. Refinement

Analyses are done on six unique courses. Use of this platform made percentage increase massively. Categorization of users in not done.[5]

vi) Title: A Personalized E-Learning Framework

Author: Mohammed M. Alhawiti, Yasser Abdelhamid

This paper discusses about the E-Learning domain. Parser tool is used to structure a personalized plan based on Learner's goals. Another technique examined in this paper is Web Mining. It is used to deliver the learning content to Learner according to his/her preference.

It was also mentioned that not only Learner's preferences but also Learning courses and Teachers preferences affect the Personalization system. Learning content is included in the learning object, learning object metadata includes data like type of Learning object, Format and Teaching or Interaction style.

An adaptive E-Learning domain is built by combining the efficiency of content management, Ontology, Semantic Web and Learning objects. This framework is of 4 stages: i) Authoring ii) Characterization iii) Delivery and iv) Feedback.
This framework has 4 main modules:

i. ***Learning Content Authority module:*** It has facilities like Creating, Modifying and Managing Learning Objects. The Learning objects are of two types i) Content of the Learning Object ii) Learning Object Metadata

ii. **Tagging Module**: It adds special annotations to each module.

iii. **Intelligent Personalization Module**: It uses tags to determine which content suits best for the Learner.

iv. **Learning Content Delivery Module**: It is the front end of the system that deals with the learner directly.

Here, there is a Lack of Personalization and there is no interaction between the system and the Learner.[6]

vii)Title: Use of Unsupervised Clustering to Characterize Graduate Students Profiles based on Educational Outcomes

Authors: LotfiNajdi , Dr. BrahimEr-Raha
This paper mainly discusses about the unsupervised learning methodologies to extract the clusters and also the profile of graduate students. Clustering is an important technique that is used in Education Data Mining. This helps to group the students based on the similarities. Different techniques like EM, Hierarchical Clustering and X-Means can also be used in EDM. Learner profile is built using Agglomerative Hierarchical Clustering. Classification techniques are used for student's assessments. Latent class analysis is used to for Digital Library Usage. Cluster analysis is implemented by using R. The approaches to perform cluster analysis are as follows:

1) Data Cleaning & Pre-Processing: Here, missing values are replaced by mean values and outliers are detected and replaced with non-suspect data. The data is scaled to restrict the variation range of attribute values. Only numeric values are considered.
2) Deciding the suitable criteria for the Clustering technique: As we don't know how many clusters is formed ELBOW method is used to determine the no. of groups. K-Means is calculated for different values of K.
3) Performing Student Clustering using K-Means: The results obtained in the ELBOW method are used as k to the K-Means clustering algorithm. Here, K clusters are formed.
4) Interpreting Mined Patterns: Clusters are formed by summing the results and by calculating the mean of each variable. A visual data analysis is formed.

This Cluster analysis helps the Universities get a clear view of the student's Learning Behavior and achievements. Finally, An Interactive Web Based Design can be produced to cluster the student's data.[7]

viii)Title: Adaptive Education based on Learning Styles: Are Learning Style Instruments Precise enough?

Authors: Alzain Meftah Alzain, Steve Clark, Ali Jwaid, GrenIreson
This paper mainly focuses on the previous papers and discloses to us that the current Learning styles are only based on textual form i.e. VARK instrument. This textual structured data is more suitable for students having good verbal abilities. In this paper the newly developed ALSI instrument tries to implement different learning styles like Visual and Active. Likewise, Figures, Charts and Equations are also taken into consideration for ALSI instrument. Here a paired t-test is conducted using both the instruments (ALSI and VARK) To validate these Learning styles Hypothesis (H0, H1) are taken into consideration.H0 hypothesis shows that the impact of newly developed instruments won't affect the learning styles. H1 hypothesis shows that the impact of newly developed instruments will affect the Learning styles. The results confirmed that ALSI will significantly affect the Learning Style.
A research was conducted on about fifty students and it proved that ALSI works best when compared to VARK instrument.
In any case, it lacks Adaptability and Specialization.[8]

III. METHODOLOGY

(DYNAMIC PERFORMANCE TRACKER – ANADAPTIVE ALGORITHM)

This Application involves 4 modules

1. Authentication: New user must be registered into the system, once he/she completes the registration, and then they can directly login into the system.

2. Knowledge Test: In this module a test is conducted which analyses the knowledge level of an individual. And the result obtained is considered while clustering the learner. The learner selects his/her preferred programming language. By doing this the system gets an idea of what content to be displayed to the learner in the beginning.

3. Clustering and Content Display: Based on the results obtained in the above module learners will be clustered. A learner based on his ability will be under any of the 3 clusters labelled Beginner, Intermediate, and Advanced. He will be provided with the required and necessary content. The learners of advanced category can also access the beginner level contents and tests. The learners of beginner level can also access the advanced level contents and tests provided they complete all the tests in his/her level by meeting the threshold value for each and every test.

4. Performance Monitoring and Analysis: After completion of a chapter the learner will be assessed by conducting a test which contains questions based upon the preceding chapter learnt and will be graded accordingly.

If the learner's performance is degrading, he might be asked to learn the content again or can be relegated to other category and vice versa.

The above grades will be used in clustering the learner again while displaying the next chapter's content and this adaptation continues until all the chapters are learnt.

During the course of time learner performance will be monitored, tracked, and analyzed.
Even the learner can monitor his/her performance which is available in progress where one can view all the test scores.

IV. DATA FLOW DIAGRAM

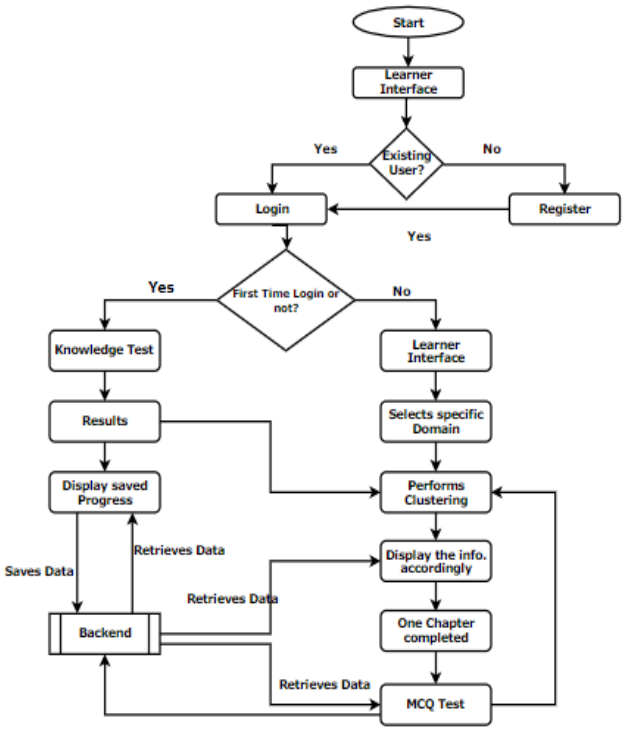

Fig.1. Proposed system Flow diagram.

Step 1: If the learner is a new user, he/she must get registered. If the learner is an existing user, he/she gets login into the system.

Step 2: If the learner logs in for the first time, he/she has to take the knowledge test. If it is not the first time, he/she will be directed to the home page.

Step 2a: Learner chooses the programming language

Step 2b: Based on the results obtained in the knowledge test and the programming language selected the learner will be clustered

Step 2c: Learner will be displayed with the suitable content

Step 3: Progress will be saved into database

Step 4: Saved progress stored in the database can be viewed by the learner

Step 5: Learner continues learning.

Step 6: After completion of one chapter, a test is conducted.

Step 7: Based on the results obtained the learner will be clustered again and is displayed with the suitable content.

Step 3 to Step 7 takes place recursively.

V. EXPERIMENTAL SET UP AND RESULTS

A. DATASETS

In our project Registration is done for 50 users and Knowledge test is taken for different users covering all the possible scenarios. Considering these results we explored all the possibilities and checked if all the validations were perfectly applied.

B. EXPERIMENT

Step 1: Registration is done, and Knowledge test is taken. According to the test results they were assigned any one of the 3 categories Basic, Intermediate or Advanced.

Step 2: Among the available languages C language is selected.

Step 3: Selected few of the registered users covering all the three categories.

Step 4: Tests were taken, and responses were stored, and results were noted. All these results along with number of attempts were tabulated. Best score among all the attempts was taken as the final score.

Step 5: Progress of the user was checked, where the user's whole progress along with all the results was displayed. Bar graph can also be used to know the progress of each test in each level.

Step 6: Admin's view is checked after signing out. All the users list was displayed and can delete or view progress of any user. Also, the number of users taking tests in each level can be known with the help of a Bar graph.

C. RESULTS

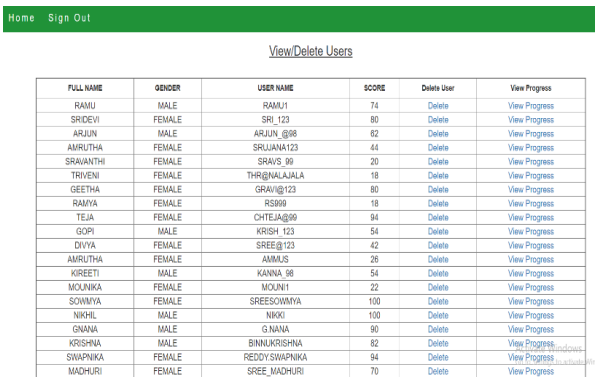

Fig. 2. Admin View

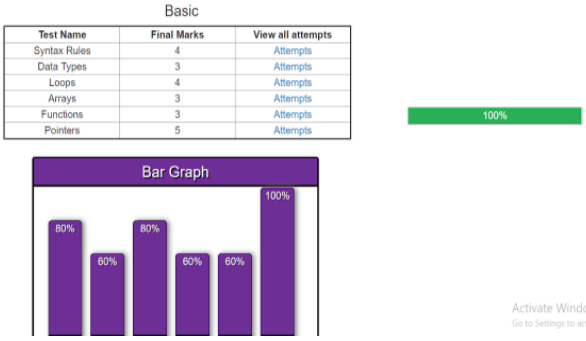

Fig. 3. Progress of User

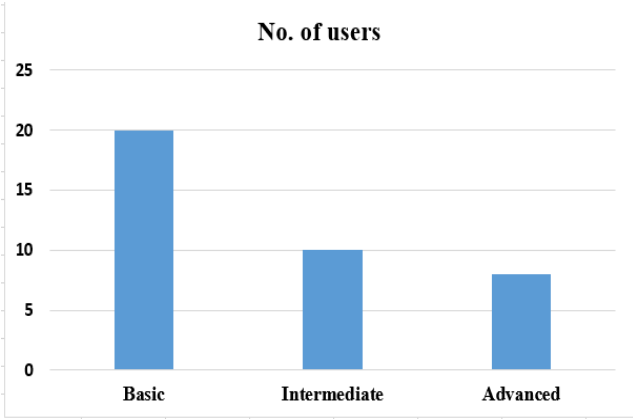

Fig. 4. No of users taken test under each category

VI. CONCLUSION

In this paper we have discussed the importance of personalization for enabling proficient e-Learning forms. It gives the learner the right content based on one's performance so that it fits well. As the data is increasing day by day and searching requires a lot of time, Initial knowledge test as well as student profiling enables the system to provide the right content from the very beginning. As the content in the learner's level is viewed one after the other it enables the learner to learn in an organized way, with perfection and the following topics can be understood clearly. Even if learner in higher levels are given access to lower levels. We are not limiting the user to the higher levels with a view that they may want to refer or learn previous topics in any circumstances.

The tests conducted after each chapter not only allows the learner to know his abilities and can keep track of his performance and the areas yet to be improved but also the system to keep track of user's performance and provide the necessary suitable content. Moreover, learner can easily access the right content without searching for longer time. The learner can view the complete progress along with the number of attempts and score obtained for each attempt, final score, Percentage of tests completed.

FUTURE SCOPE

More number of languages and topics can be added in the future. There also may be a possibility to develop the content based on user's qualification. Test assessment patterns may be more advanced.

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AUTHORS PROFILE

Patchava Ramya Sree, Currently Studying 4th Year B.Tech. (CSE) at K L (Deemed to be University). Her research interests are in the fields of data mining and machine learning. I would like to extract knowledge from the data available and find the underlying patterns.

Tammisetty Bhuvaneswari Currently Studying 4th Year B.Tech. (CSE) at K L (Deemed to be University). Her interests are in Data Analytics and Machine learning. I would like to model testing instances and data with the help of training data available.

Vulchi Swapnika Reddy, Currently Studying 4th Year B.Tech. (CSE) at K L (Deemed to be University). Her interests are Artificial Intelligence and Computation Science.

Jonnalagadda. Surya Kiran, Currently working as Assistant Professor in CSE Department at K L (Deemed to be University). He is having 4 Years of experience in Teaching and 1 Year of experience in Industry. His Interests are Artificial Intelligence, Data Science and Social Media mining.