© 2016 IJSRSET | Volume 2 | Issue 4 | Print ISSN : 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

An Intelligent Content Classification Algorithm for Effective E-Learning

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ABSTRACT

In this paper, we propose a new content recommendation system called Intelligent Content Recommendation System for E-Learning for selecting and retrievingthe exact e-content for teaching the subject "Software Engineering" based on group discussions through the social media. In this process, we analyze the various contents pertaining to the subject Software Engineeringand select the suitable e-content for recommending to the students and industrial people such as software developers. For this purpose, we use an intelligent preprocessing technique and also propose a new classification algorithm called Intelligent Ranked Document Classification algorithm for classifying and ranking the e-contents. In addition, we use the existing New Weighted Fuzzy C-Means clustering algorithm to help the decision making system to recommend suitable contents using fuzzy rules. The main advantage of the proposed system is that it provides different types of contents which are suitable to different types of learners accurately.

Keywords: Feature Selection, Enhanced MSVM, Weighted Fuzzy C-Means, Ranking, Clustering, Classification, Semantic Analysis.

I. INTRODUCTION

Learning computer science needs theoretical knowledge and programming skills. Theoretical knowledge can be gained through reading books and by undergoing mathematics courses. On the other hand, the learning for working professionals and academicians is different from the learning methodologies used for students. Most of the people who work on software industries know the art of programming. Similarly, academicians and students of computer science are familiar with programming languages. Such people can develop real world application programs using the programming languages and database systems known to them. However, software development is a skill which can be enhanced only by practicing the software development life cycle models and good software engineering principles. Hence, it is necessary to learn the principles of software engineering at various levels. For a new programmer or an undergraduate student, a first course on software engineering is necessary. Such a course can be taught effectively by introducing the principles of software engineering using a book or material written in simple English with real life examples.

Experts in the field of software engineering and researchers in this area also need e-learning materials. They must be prepared from reputed journals, reputed conference proceedings, research discussions, white papers on new findings and design manuals. They should be specialized in nature. For example, a separate e-learning content must be provided in the form of a book for software

process models. Similarly, special materials must be provided for topics such as requirements engineering, risk management, quality management, configuration management, cohesion and coupling, implementation methodologies, object oriented analysis and design, software metrics, software project management, software architecture and other aspects of the software engineering. Here, mathematical proofs must be provided and suitable theories like automata, statistics and other mathematical concepts must be discussed with rigor. Hence, e-learning of the subject software engineering needs the provision of different types of e-learning contents which are prepared using experts, validated using practitioners and verified using researchers. It needs the application of techniques from Artificial intelligence, Natural language processing, Theory of computation with special automata theory, soft computing techniques and knowledge base systems. In addition, the data mining principles such as classification, clustering and association rule mining are also important for analyzing the e-learning contents before they are delivered to the users.

In this paper, we propose a new e-learning recommendation system which recommends relevant materials for e-learning by the application of a classification algorithm based on Enhanced Multiclass SVM with ranking and a clustering algorithm called New Weighted Fuzzy C-Means Clustering algorithm for extracting and recommending the effective contents. In this work, we have taken Anna University undergraduate students who know C and C++ programming languages, Master of Computer Applications students who know Python, C, C++ and Oracle. In addition, we have considered the passed out students of Anna University, Chennai, the post graduate students who are doing project and research scholars who are working in the areas of software engineering methodologies. This work was tested with different number of documents which are prepared for providing e-learning materials on software engineering. In addition to this, the proposed methodologies have been tested using bench mark datasets on e-learning from the UCI Repository. From the experiments conducted with 300 undergraduate students of computer science and Information Technology, 180 students of Master of Computer Applications and 120 students of post graduate studies in computer science and engineering, software engineering and information technology, it is observed that the proposed system was able to provide more relevant materials to all groups of students.

The reminder of this paper is organized as follows: Section 2 provides the survey of related works. Section 3 depicts the architecture of the recommendation system proposed in this paper. Section 4 explains the methodology and the newly proposed algorithms in detail. Section 5 details the results obtained from this work and provides suitable discussions. Section 6 gives conclusion on this work and suggests suitable future enhancements.

II. METHODS AND MATERIAL

1. Literature Survey

Many research works have been done by various researchers in the area of e-learningduring the recent years. Among them, Mohamed et al [2] proposed a vision for future Knowledge Management (KM) approaches which aim to fulfill the needs of the new knowledge landscape by introducing the Learning as a Network (LaaN) theory.This learning theory is characterized by the convergence of KM and TEL within a learner-centric knowledge environment.

Ahmed et al [4] introduced the use of Adaptive Neuro-Fuzzy Inference System (ANFIS) as a reasoning engine to deliver learning content for mobile learning applications. This study was conducted by the authors to illustrate the potential effectiveness of ANFIS with hybrid learning, for the adaptation of learning content format for mobile learning users. The performance of ANFIS was evaluated using standard error measurements which revealed the optimal setting necessary for better predictability.Since the numbers of

fuzzy rules obtained from thehuman experts were in-sufficient, their workadopted a hybrid approach that combined the Fuzzy Inference System with the Neural Network for determining a complete fuzzy rule system. The ANFIS approach has successfully solved the problem of incompleteness in thefuzzy rule base made by the human expert. By training the Neural Network to apply the human expert's fuzzy rule base to different training data, the Neural Network was able to recognize other decisions that were previously not detected.Ganapathy et al [6] proposed a new temporal fuzzy min-max neural classifier for effective classification.

Ekaterina Gilman et al [5] identified needs of four user roles in ubiquitous learning systems, i.e., learner, instructor, developer, and researcher. They analyzed the state of the art techniques in ubiquitous learning and found that roles other than learners have not received much attention in the literature. Finally, they proposedmethods for supporting different needs identified on four user roles by adding meta-level functionality to ubiquitous learning systems. Their proposal adds self-introspective capabilities to such systems to serve their users better.Sannasi et al [3] proposed new intelligent agent based preprocessing and classification algorithms for effective decision making on any dataset.

Rodrigues et al [11] discussed the potential of online social networks in the development of students learning process, describing the most relevant available applications. Their new structure gives users spaces to contact each other's and share information between them. They can have numerous websites with several available services that will allow, for instance, contact with groups of people with common interests or websites where one can make or edit existing content, such as wikis. Their paper also presented modules that incorporate these features and demonstrated their integration in an e-learning platform.

In spite of the presence of all these works in the literature, the existing systems are not providing contents to the learners based on the abilities flexibly. Moreover, most of the existing systems are working based on syntax analysis alone. Hence, in this paper a new content recommendation system which considers user levels for providing most relevant contents is proposed. The proposed system uses preprocessing, classification, ranking and clustering techniques to identify the most relevant content.

2. Proposed Work

This proposed model consists of three major subsystems namely the preprocessing module, content recommendation module and the decision manager. The recommendation system developed in this work consists of three major modules namely preprocessing module, ranking and classification module, and the clustering module.

2.1 Preprocessing

An Intelligent Agent based Attribute Selection algorithm (IAASA) [3] is used for effective content preprocessing. This algorithm is useful for effective classification and also helpful for better content recommendation.

2.2 Classification

Now, the classification module uses the Intelligent Agent based Enhanced Multiclass Support Vector Machine (IAEMSVM) [3] to classify the subject contents into software engineering contents, software project management content, software process models content, software analysis and design contents, software testing contents, software maintenance contents and contents not related to software engineering. The steps of this algorithm are as follows:

Intelligent Ranked Document Classification Algorithm

Input : Parsed documents
Output : Classified documents

Step 1: Read the sentences in the document one by one.
Step 2: Perform semantic analysis and find the nature of sentences.
Step 3: Apply IAEMSVM [3] to put a label to each sentence.
Step 4: Collect all labels and contact the decision manager to put a final label.
Step 5: If the label is software engineering then accept this content
Step 6: Send this content for checking the relevancy.

Step 7: Apply the existing ranking algorithm [9] to put rank for the relevant content.

2.3 Clustering

In this work, the classified contents are grouped using the existing clustering algorithm called New Weighted Fuzzy C-Means clustering algorithm [10]. This clustering algorithm is useful for grouping the classified or recommended content.

III. RESULTS AND DISCUSSION

In this work, we used the benchmark data set which is collected from UCI Repository [8]for carrying out the experiments. The data set contains 500 e-content documents. In our experiments, we used all the e-content documents for training and also used our own dataset which is prepared by own from Anna University, Chennai student forums for testing. The training datasetare either labeled as Beginners, Normal learners and Expert learners. Similarly, the test data are also labeled as Beginners, Normal learners and Expert learners.

In this work, all the experiments have been carried out with the WEKA tool as the software. Moreover, the proposed method have been simulated in JAVA (in Intel core i3 with 3GB RAM)for the feature selection, accuracy calculation and the attack detection in the intrusion detection system.

The five experiments have been conducted for evaluating the preprocessing algorithm over the documents which are grammatically corrected. Figure 1 shows the performance analysis of the proposedrecommendation system with preprocessing algorithm on the grammatically corrected documents. We have considered the various numbers of sentences such as 500, 550, 470, 650 and 720.

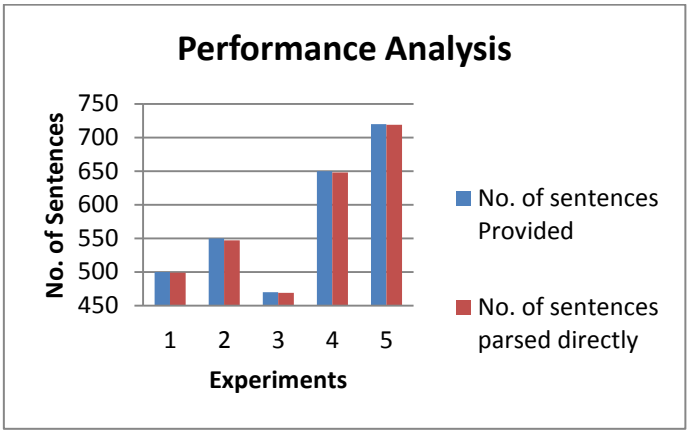

Figure 1. Performance Analysis of the preprocessing algorithm

From this figure, it can be observed that the performance of the proposed preprocessing algorithm accuracy is significantly changed according to the number of sentences considered for experiments.

Figure 2 shows the accuracy analysis between the proposed recommendation system with preprocessing and classification module and the existing HITS [8]. Here, we have considered the various documents such as 50, 100, 150, 200, 250 and 300 for experiments.

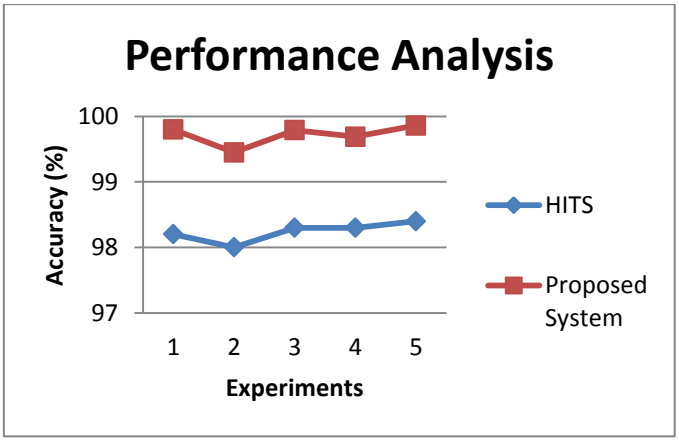

Figure 2. Performance Analysis between the proposed system and HITS

From this figure, it can be observed that the performance of the proposed system is better than the existing algorithm.

Figure 3 shows the accuracy analysis between the proposed recommendation system (Preprocessing + Classification + Clustering) and the existing model. Here, we have considered the various documents such as 50, 100, 150, 200, 250 and 300 for experiments.

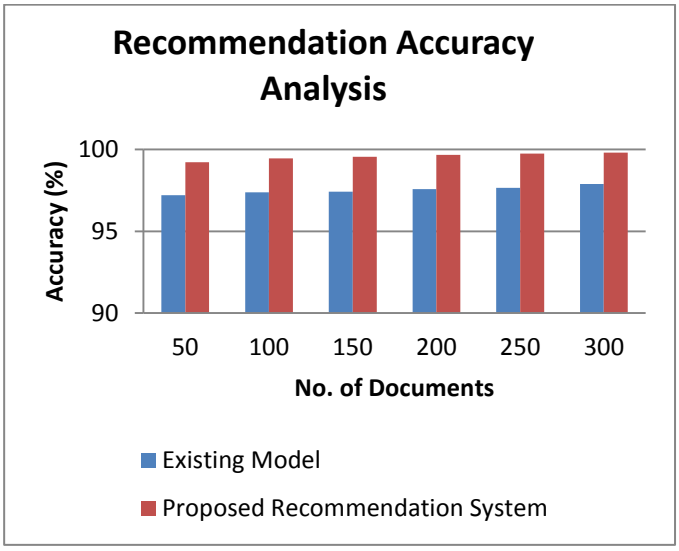

Figure 3. Accuracy Analysis between the proposed recommendation and existing model

From this figure, it can be observed that the accuracy analysis of the proposed recommendation system is better than the existing model. Thus is due to the uses of intelligent agents in preprocessing and classification and weighted fuzzy rules in clustering process.

IV. CONCLUSION AND FUTURE WORKS

In this paper, a new content recommendation system is proposed and implemented for E-Learning using social network analysis and intelligent techniques. For this purpose, a new ranked document classification algorithm is proposed and the New Weighted Fuzzy C-means clustering algorithm is used for effective decision making. Moreover, an effective agent based preprocessing algorithm also used for better performance. Experiments were conducted with students, developers and faculty members using different level of contents. Further works in this direction can be the creation of a bench mark datasetand effective preprocessing algorithm to further improve the performance of the system.

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