



Adaptive E Learning Model based on Artificial Intelligence (AI) for Boosting Moroccan Students' Performance

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Abstract. Nowadays, we are witnessing a strong evolution of learning environments; the move to online education today has become a necessity, not a choice. The use of information and communication technology (ICT), digital tools and online learning platforms have made significant strides in improving the learning process. Nevertheless, these platforms not fully meet the learners' needs and preferences, due to static pedagogical design. These advancements involve the deployment of techniques such as text analysis, sentiment analysis, voice recognition, and recommendation systems. Consequently, this work aims to propose an adaptive learning system that considering students' behavior during learning session, focusing on their feedbacks by using real-time sentiment analysis with the main goal of providing personalized learning environments adapted to the learner specificities.

Keywords: Online Learning, Real-Time Sentiment Analysis, Adaptive Learning, Artificial Intelligence, Higher Education.

1 Introduction

In the age of “everything is digital” and with the quickly emergence of data, the integration of Information and Communication technology (ICT) in the service of

education and training has become vital to improve teaching process This importance has been clearly observed in the last years especially with the emergence of the pandemic. Recently various Learning Management (LMS) platforms are used to ensure distance learning worldwide and for all teaching levels, from primary to tertiary education. In Moroccan higher education, according to Soumaya Elmendili et al. paper, teachers call on a wide range of resources for online teaching such as: Google Classroom and social media (Messenger, Facebook, WhatsApp and Youtube) especially in the time of crisis [1].

In this Context, the need for continuous improvement of pedagogical process as well as the growing demands for students' education make a necessity to apply more effective educational technologies and practices by aligning students' profile and their learning styles [2]. Certainly, the existing platforms have several advantages, but they do not take into account students' preferences, needs, feedbacks and mood. The aim of this work is to propose an adaptive learning system considering students' behavior during the learning session, focusing on their feedback using real-time sentiment analysis, with the main goal of providing personalized learning environments tailored to the learner's specificities.

Surely many papers discusses the issue; but differently, In [3], the author introduced the classification of sentiment analysis of Twiter users by building adaptive sentiment lexicons. In other context, sentiment analysis is used to identify students at risk for progression issues by automatically scoring preceptor comments [4].

The benefit of this article is to increase the success rate of online teaching in Morocco and enhance pedagogical process by improving students' performance. The benefit of this research will be achieved once the purpose of this research is fulfilled, such as knowing students emotional state in real-time for effective virtual teaching activities.

We will first recall the Moroccan strategies proposed to ensure online teaching and the major directions of the Ministry of Higher Education, Scientific Research and Innovation in this regards, secondly we will present the related works, than the proposed model and finally the conclusion.

2 Background

2.1 Major directions of the Ministry of Higher Education, Scientific Research and Innovation in Moroccan Higher Education

The University is undergoing major changes as part of its autonomy in administrative and pedagogical management. This autonomy will make today's university a driving force for cultural, economic and social development. The reform of the university is a permanent renewal of academic and scientific work, and this

reform must not be limited to form, but is rather a reform of the quality of the content of teaching and research through the introduction of new technologies.

M. Talbi in his paper [5], points out that good governance consists in designing, building and implementing a modern and entrepreneurial management system, that cultivates efficiency and dedicates performance, equipping the university with new technological tools: such as the digitization of all academic processes, new management methods, coupled with a system of upgrading and ongoing training of human resources (in languages, and in the use of information technologies in particular).

In the era of globalization, characterized by the spectacular development of information and communication technologies, Morocco and many other developing countries are obliged to put in place strategies and mechanisms capable of reducing the digital divide with developed countries on the one hand, and integrating into the knowledge society on the other. Education, training and scientific research are the engine of development of any country. Moreover, only a well-educated, highly trained and scientifically advanced population is able to lead the change that will ensure the reduction of the digital divide between developing and developed countries [6]. In this perspective, Morocco launches the e-Maroc project in 2010.

Within the framework of the strategy “Maroc Digital 2022”, the development of competence and training is among its pillars as shown in the figure [7] (see Fig. 1):

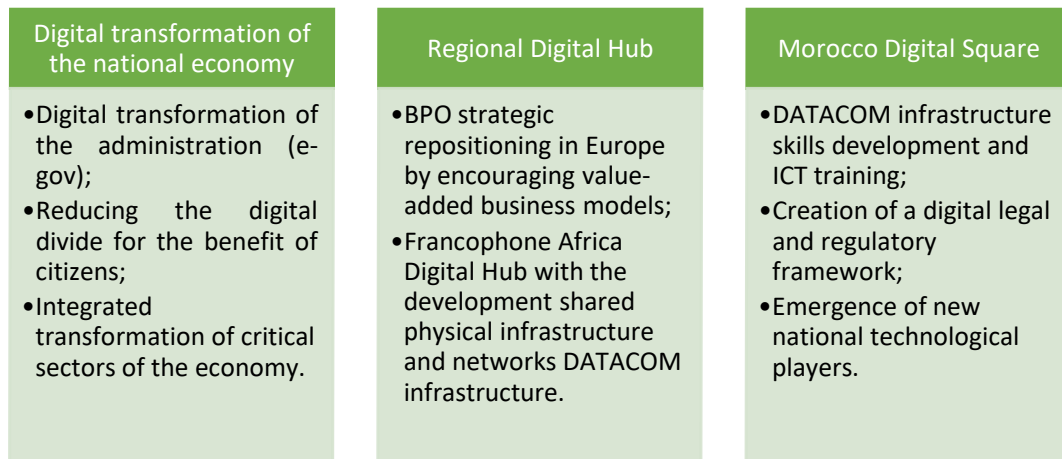


Fig. 1. The Pillars and Initiatives of the "Maroc Digital 2020" Strategy.

In the same context, the General Guidelines for the development of digital by 2025 reinforces the integration of digital in the educational field [8].

The strategic plan for the higher education and scientific research sector 2017/2030 improves this vision where the second axis entitled Enhance quality to improve the outcomes of all higher education and align them with development and labor market requirements, touched the following ideas [9]:

- ✓ Develop continuing education and ensure lifelong learning;

- ✓ Diversify the educational offer;
- ✓ Strengthen and develop the national system to ensure the quality of higher education.

2.2 Concepts of Sentiments Analysis

Sentiment analysis is a subset of artificial intelligence that concern peoples' feeling, sentiment, attitudes and toward topics like events, subjects, facilities and organizations [10]. For Nasukawa and Yi declare in their article that the component of sentiment are [11]:

- ✓ Sentiment holder: Person or organization who express an opinion about specific subject;
- ✓ Sentiment object that can be an object, product or person who sentiment holders have voiced an opinion;
- ✓ Sentiment is a persons' viewpoint, perspective or feeling.

The sentiment expressed toward the object can be positive, negative or neutral, which can be classified using classification techniques. The figure bellow shows the process of sentiment analysis [12] (see Fig.2):

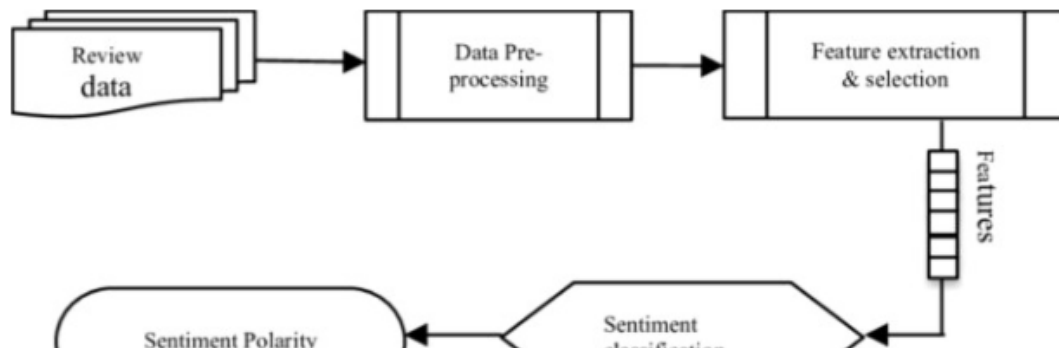


Fig. 2. Process of Sentiment Analysis.

- **Review Data:** it refers to data collection (sentences level classification) where each sentence hold a single opinion;
- **Data Preprocessing:** includes tokenization (is a task of breaking a sequence of words into individual words called tokens), stop word removal(that don't hold any opinion) , stemming (a task consisting in converting the variant forms of a word into its basic form), lemmatization, etc.
- **Features Extraction and Selection:** In this technique, text must be converted into a feature vector using a data-driven approach.(example; Term Presence versus Term Frequency):

- **Sentiment Classification:** it refers to the classification of then different approaches or methods of sentiment classification can be used like: Lexicon-based, Machine learning;
- **Sentiment Polarity:** it define the orientation of the expressed sentiment, it determines if the text expresses the positive, negative or neutral opinion.

According to Liu [13] there are three levels of sentiment analysis:

- ✓ **Sentences Level Sentiment Analysis:** It analyses the sentences to determine if it is positive, negative or neutral opinion. It is based on category of subjectivity which is either objective sentences or subjective ones ;
- ✓ **Document Level Sentiment Analysis:** That aims to detect if a document as a whole, conveys a positive or negative message;
- ✓ **Aspect Level Sentiment Analysis:** It studies the opinion itself rather than linguistic forms, which means that instead of looking for a feeling word, the target studies aspects and the accompanying feeling.

For sentiment analysis, there are three different types of sentiment classification techniques: Machine learning which employs algorithms as well as language features, lexicon-based that represents is a collection of pre-recognized and pre-compiled sentimental phrases, it can be divided into two approaches: dictionary-based and corpus-based.

And finally hybrid that integrates the both approaches [14], the figure bellow illustrate the most popular approaches of sentiment analysis (see Fig.3):

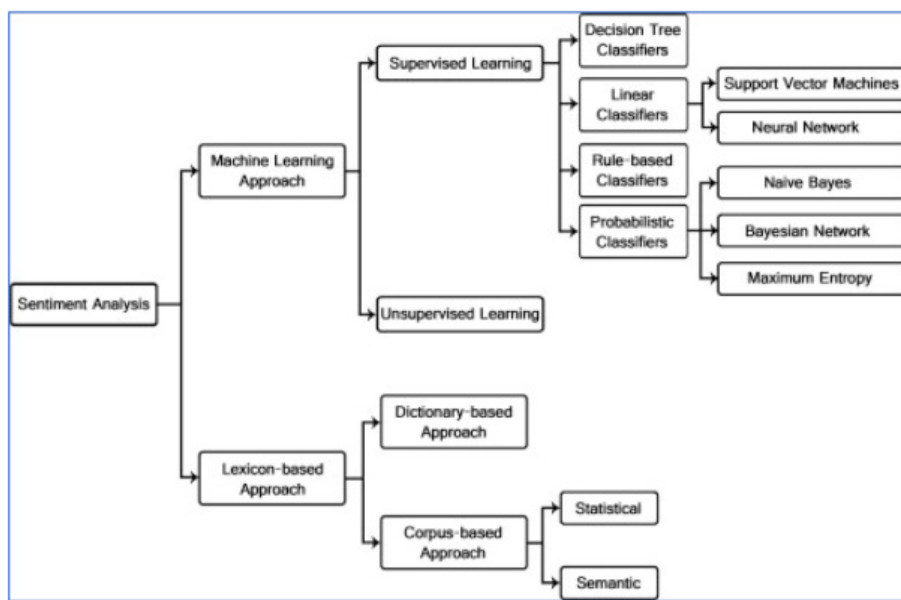


Fig. 3. Sentiment Analysis Approaches.

Sentiment Analysis Approaches can be roughly divided into machine learning (ML) approaches and lexicon based approaches. The ML Approaches uses the ML algorithms and linguistic features. However, the Lexicon-based Approach relies on sentiment lexicon, that is a collection of well-known, pre-compiled sentimental terms.

3 Proposed Real-Time Sentiment Analysis Model Architecture

Sentiment Analysis (SA) [15] is defined as a technique based on AI tools to analyze textual data in natural language, it can be useful for characterizing interaction between students and teachers for improving learning through timely, personalized feedback. Unfortunately, SA techniques have paid little attention to potential differences such as cultural differences, language barriers, age, and gender (Yadegaridehkordi et al., 2019). [16] In this context and before starting the modeling of our adaptive learning system, it is important to define the students' needs and preferences that should be taken into consideration (see Fig. 4):

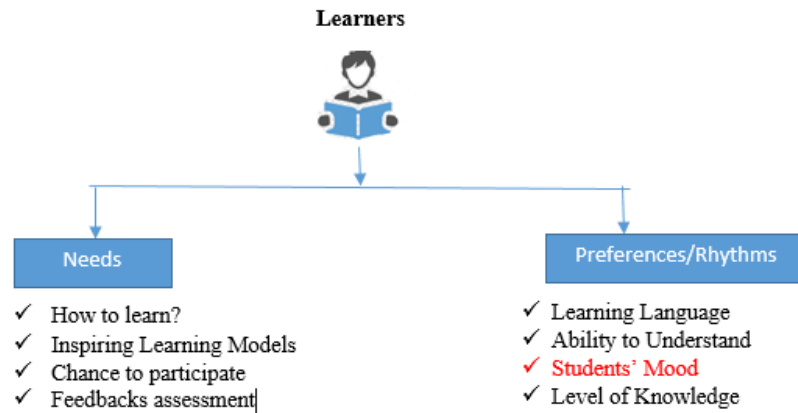


Fig. 4. Students' Needs and Performances.

As shown in the figure the students mood can affect the learning process, although all the virtual learning environments don't shed light on students specificities to improve online teaching, and that's why it is crucial to develop a system which is capable to overcome this limit. In this context, we can introduce the architecture of our proposal model (see Fig. 5):

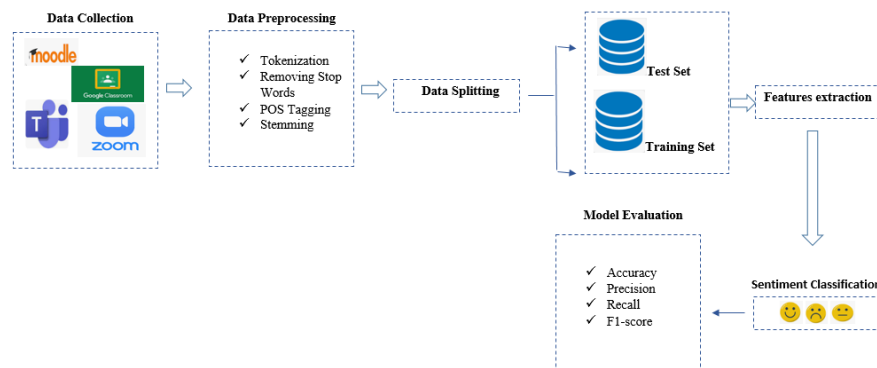


Fig. 5. Proposed Model Architecture.

Data Collection: For this step, the system based on the data shared by students using the virtual learning environments, shared on discussions and comments during the virtual classroom.

Data Preprocessing:

- **Tokenization:** this step concern the breaking down of a sentence into individual elements (symbol, keywords, .etc.). [17]

- **Removing Stop Words:** It refers to sentences' objects that is not required in any segment of text mining.
- **POS Tagging:** It is the process of assigning the part of speech to the given word.
- **Stemming:** It is the process of allowing the modified forms of a word into a common interpretation.

Data Splitting: In this step, the data divided into two part split train and test.

Features Extraction: two techniques proposed to ensure this step:

- ❖ **Count Vectorizer technique:** It is about counting the occurrence of a term in a document and uses this value as its weight as integers to convert a collection of text documents to a vector of term/token counts and builds a vocabulary of terms
- ❖ **Term Frequency-inverse document frequency (TF/IDF):** consists of extracting features from the text, TF measuring the number of term t in document d , and IDF aims to provide the terms' importance:

$$TF(t, d) = \frac{\text{Number of times term } t \text{ appears in a document } d}{\text{Total number terms in a document } d} \quad (1)$$

$$IDF(t) = \log e \frac{\text{Total number of documents}}{\text{Total number of documents with term } d} \quad (2)$$

$$TF - IDF(t, d) = TF(t, d) * IDF(t) \quad (3)$$

TF-IDF as shown in the equation (3) calculates the weight for a term in a document by multiplying the equations (1) and (2).

Sentiment Classification: called also polarity categorization of recognizing and labeling a certain opinion based on orientation (positive, negative, neutral). An opinion mining is a technique of evaluating and analyzing the subjective information from the huge corpus (text).

Model Evaluation: comparing the models used through accuracy, rate, etc.

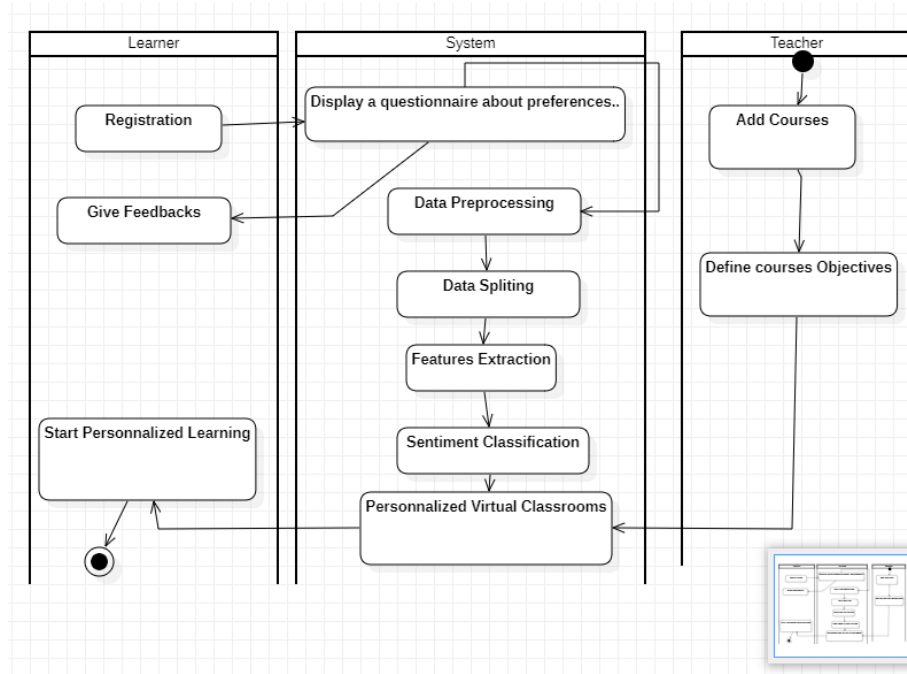


Fig. 6. Learning Process of Learners.

The diagram above (see Fig. 6) illustrated the proposed model of learning process that boost students- motivation and preferences by integrating students' opinion in learning process in order to adapt a personalized learning for each category of students' (Personalized Virtual Classrooms).

4 Conclusion and Future Works

Our study introduces an adaptive system for sentiment analysis based on students' conversations shared on virtual learning environments' discussions. In our work, we introduced the major directions of the Ministry of Higher Education, Scientific Research and Innovation in Moroccan Higher Education, and to what extent our contribution can answer certain points concerning this subject, we develop the basic principles of system working in the light of sentiment analysis and artificial intelligence tools. Certainly, this study has some limits that should be developed in the future works by applying the proposed system on data and choosing the suitable model by analyzing some measures like the rate, average and accuracy.

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