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NOVEL LEARNING MANAGEMENT SYSTEM (LMS) WITH DEEPFACE EMOTION ANALYSIS

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Abstract

Objectives. To identify the best set of practices to develop a Novel Learning Management System to boost a learner's learning and productivity. The Education Arena has changed a lot given the conditions of the current world. As we navigate ourselves in the new normal, it is essential that systems that enable authentic and immersive learning applications be researched and developed. Learning the foundations of any skills is very essential in creating a modern workforce that is well equipped. When the foundations are found to be strong, anything built atop is found to be very effective and contributing to the society. This requires a long list of pre-requisites ranging from effective professors to complex education infrastructure. This Project aims at developing a novel learning management system that enables our vision to make quality education accessible to everyone in the society.

Methods. To attain the state as described in the objective above, it is essential to have a system that mimics the nurturing of a teacher to a student in his/her primary education. As the famous proverbs goes that The Face is the Index of the Mind, it is proven that facial emotion recognition opens a large opportunity to assess one's comfort with a subject / area of academic focus. To enhance learner observation and provide key insights that might have not been identified by their own-selves, it is proposed that Computer Vision using DeepFace powered by Python can be utilized to perform the emotion recognition. This analysis is then processed by statistical models that knit a bigger picture to identify the interests of a learner.

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Findings. It is found that a strong Learning Platform in the hands of a deserving learner that can be a game changer in the education sector. Emotion analysis processed by appropriate models show that education experience of a student can be improved several folds. Dependency on physical infrastructure and logistics that limit the seats available for a vast demand can be drastically reduced. The authenticity issue that is faced in the virtual learning model is also impacted positively to a great extent.

Novelty. In this modern world, several LMSs are available at different scales. This project is focused on the notion that enabling facial recognition will aid in understanding the needs of a student. This ensures the learner an immersive experience with drastically reduced authenticity issues. This model enables proctoring of the learners in a friendly manner during the time of learning with the aid of video, presentations or text material. This helps us arrive at an understanding of the learner's potential, areas of interest and several other pointers of significant importance.

1. Introduction

In the light of recent events and demands, Digital learning or e-learning is now becoming the trend across the world, right from Kindergarten to Doctoral studies, LMS is every teacher's go-to-solution. A learning management system [4] (LMS) is a software that is used to design, implement and evaluate a certain learning process. Learning management system permits an instructor to create and provide content, observe and evaluate a student's performance. The results later can be used by the instructor to improvise the standards of the curriculum and the learning experience of the learners in the future. In recent years, learning through online has significantly reached new highs. By the end of 2025, the MOOC market is expected to reach about USD 25.7 billion. With the use of LMS, learners can pursue subjects of their interest at their own pace and comfort [17]. This maximizes their productivity and reduces the travel expenditure and time spent greatly but on the other hand, learners tend to get distracted easily while studying through the web. Results show that notifications and pop-ups from gadgets added with attempts of multitasking while learning are understood to be major reasons for poor performances in assessments. In this new approach of hybrid learning, face to face interactions between the instructor and learner is very minimal in comparison to the usual physical lectures which leads to lack of interest and decline in performance and progress.

To sort out the need of the hour, we need to precisely monitor each and

every learner to rule out the causes of distraction. It will be of great demand if we could provide them great insights of their progress and areas of interests which the learner himself/herself tend to oversee. As an appropriate measure, utilization of AI technologies will open several doors to better assessments and learning experiences. In the approach used to develop this project, we have preferred the use of the Deep Face Library alongside OpenCV [9] to closely observe learners and their behavioral learning pattern. The Insights generated by the LMS can be put to use for the betterment of the learner as well as the course itself. It greatly minimizes the efforts required by the instructor, ensuring greater details of attention and personalized care on the same hand. This in-turn enables the learner in understanding himself/herself better and scale their careers to greater heights.

2. Review of Literature

1. Observed the existing and leading learning management systems and relevant research to understand the pros and cons of the technologies used.

2. Analyzed and identified the characteristics of each Model in Deep Face Library [1].

3. Identified the positives and downsides of facial emotion analysis and attempted to improvise the downsides.

3. Technology and Implementation Methodologies

This Learning Management System is primarily a web application and makes use of several technologies that are key to its performance. The following are the list of deployed technologies along with a brief introduction and their role:

a. **FLASK.** Flask is a Python [3] Micro-Framework [19] for web that has a small core and works based on easily addable extensions/plugins. It has got a wide community support along with third-party extensions as well. The LMS makes use of a Python Flask Web App [Figure 1] as a Server to perform the emotion analysis. Thus, Flask enables us to operate a very crucial part of the LMS.

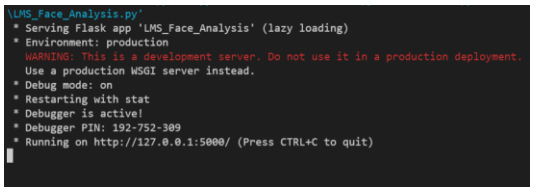

Figure 1. Demo of the Flask Server.

b. **REST API.** Representational State Transfer (REST) [20] is a structure or style of architecture [19] that enables web applications to offer services. It uses less bandwidth and requires very less processing capabilities on the client side. It makes use of the HTTP Request only. The Client Web App in the LMS makes use of REST APIs to exchange services and data between the Python Flask Server and the Apache Server. Figure 2 shows a simple demonstration where a sample image (Figure 3) is passed in exchange for JSON based emotion recognition data.

Figure 2. Sample Data from Python API.

Figure 3. Sample Image.

c. **LAMP Stack.** One of the most common and popular stacks for web applications. It is a generic stack with interchangeable components (Figure 4)

including Linux, Apache, MySQL, PHP/ Perl/ Python. It essentially powers the core of the LMS Application. A sample of the client interface can be observed below (Figure 5)

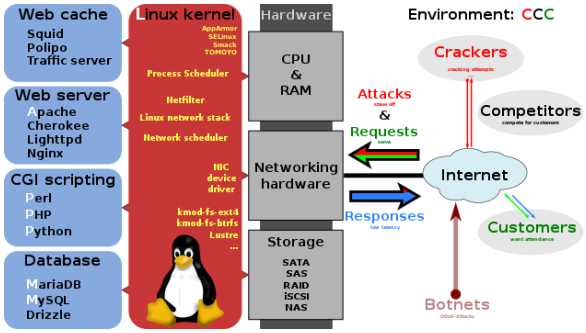

Figure 4. Components of the LAMP Stack [21].

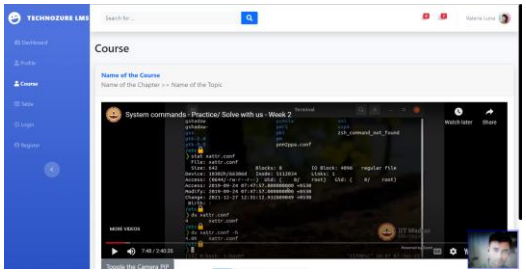

Figure 5. Course Page of the LMS with Proctoring.

4. Introduction to DeepFace

DeepFace is one of the several facial recognition systems [15] that is very light-weight in terms of computation requirements and a facial attribute analysis module for the Python Programming language [2] which is listed in the Python Package Index (PyPI). Since DeepFace is an open-source library licensed under the MIT License, it permits extensive use for research and development. Thus, developers around the planet prefer to use, modify and reuse in a commercial or research context. It is a vast pack of various leading facial recognition models powered by state of the art and cutting-edge Artificial Intelligence (AI) technologies. It greatly reduces the need for explicit programming by handling all analysis procedures implicitly with higher accuracy rates.

4.1 Features of the Deepface Library.

The Features as described in detail in the paper [1] are the below in brief:

- **Face Verification.** Compare one face with another.

Figure 6. Demonstration of Face Verification.

- **Face Recognition:** Finding/identifying a face.

Figure 7. Demonstration of Face Recognition.

- **Live Stream Face Analysis.** Live facial recognition and analysis.

Figure 8. Demonstration of Live Stream Face Analysis.

Facial Attribute Analysis: This process helps analyzing and describing the parts of the face to determine several attributes like age, race, gender and emotions that are based on the geometric structure of the human face (Fig. 4)

Figure 9. Process of Emotion Analysis.

5. Face Recognition Models

Several Facial Recognition Libraries operate on the basis of a single AI model whereas the DeepFace Library brings together several face recognition model together that yield results of great accuracy and speed [1]. The following is a comparison of algorithms/models that can be used with the DeepFace Library. Several of them are built based on Convolutional Neural Networks (CNN) and outcome can be observed below:

Performance of each Model with their corresponding detectors [1].

Model Name	VGG-Face	Google FaceNet	OpenFace	FB DeepFace	DeepID	Dlib	ArcFace	Dlib + MTCNN (Proposed)
LFW Dataset	97.78	99.63	93.8	97.35	99.15	99.38	99.4	**99.7**
Detector	OpenCV	OpenCV	OpenCV	OpenCV	OpenCV	OpenCV	OpenCV	**MTCNN**

Figure 10. Accuracy Comparison Chart across various Models.

6. Conclusion

It is very evident that a well-developed Learning Management System in the right hands can yield great results. The use of state-of-the-art web technologies as explained in detail along with facial recognition and emotion analysis can become the key to understand the inherent potential of a learner. The results that the Facial Recognition system arrived at, helps us in understanding and mapping the physical facial attributes to the learner's state of mind and comfort. Expression of emotions on a human face is key to several insights as it is indeed true that the face of a human is the index of his mind and heart. Tracking such behavioral pattern enables us to provide large scale access to in-demand courses, ensuring authenticity and quality at the same time. The current headwind for the new hybrid mode of learning is that the learner's identity and levels of observation are not tracked up to the mark. It is one of the core barriers that this project would like to address and break the stigma associated with the valuation of Hybrid/Online Education.

Acknowledgement

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