A Self-Monitoring System for Online Education

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Abstract: *Over the past decade the rapid growth of technology has resulted in online learning gaining a lot of traction as the preferred method of studying amongst students. Accelerated further by the COVID-19 global pandemic, online education has overtaken traditional classroom education as students' preferred choice in learning. Traditional Classroom teaching has always been bi-directional, involving interactions between students and their teachers. Online Education in comparison has become more uni-directional and this lack of interaction between the student and teacher can severely impede a student's concentration. In addition, the presence of countless other distractions in a virtual environment has contributed towards students being more demotivated and uninterested in their education. This has brought the true effectiveness of online education into question. It is with the intention of countering these problems that a Self-Monitoring System for online education has been developed. The System will be developed to follow the guidelines of the Buddhist Philosophy of "Iddhipada" and will monitor students in a variety of ways including tracking emotion and monitoring activity which would help to improve concentration, motivation and produce better results. It is hoped that this system will help make online education as productive and focused as it can be.*

Keywords: *Self Monitoring System, Emotion Recognition, Artificial Intelligence*

1. Intorduction

The COVID-19 global pandemic has resulted in traditional classroom learning being shifted to online learning at all levels. Much more than just a new twist on distance learning, online schooling is changing the face of traditional classrooms and making education more accessible than ever before. By 2026, the global e-learning industry is projected to reach $336.98 billion. Digital Learning is also the quickest growing market in the education industry, with a whopping 900% growth in the past 20 years. 10 of the largest educational institutions in the world enroll as much as 20% of all online students. [1]

As evidenced by the statistics, online education has helped widen the horizons and the reach of education; however, it has not been without a host of challenges and obstacles when compared to traditional learning. Despite its powerful growth online education lowered a student's final grade by about 0.2 standard deviations. This may be indicative of certain issues present in the sphere of e-learning.

Traditional Classroom teaching has always been bi-directional, involving interactions between students and their teachers. This form of teaching was the mainstream avenue of education that existed for centuries prior to the Covid-19 pandemic. A traditional classroom is one where a teacher moderates and regulates the flow of information and knowledge. Students are expected to continue developing their knowledge of a subject outside of school through homework exercises. Here, students' main resource is their instructor who only teaches them face-to-face.

Online Education in comparison has become more uni-directional. Very often, online learning simply involves teachers lecturing through an online platform such as Zoom or Microsoft Teams to students that they, in most instances, cannot even see or hear. Most students in online classrooms have their microphones muted and video cameras switched off. There is no interaction between the student and teacher.

Students may be uninterested and de-motivated in their education. They may abandon listening to the lecture, they may not take notes and they may not interact with the teacher via questions or discussion sessions. . Coupled with the free use of laptops and mobile phones during classes, distractions have become countless, often coming at the cost of focusing during class. In fact, the student may even have logged into the lecture and simply abandoned their device to engaged in other tasks.

Teachers themselves often complain of a lack of tools to make the classes engaging, leading to a loss of interest from both parties. With the lack of any accountability in the online teaching method, education quality often becomes compromised. The physical presence inside a classroom with a teacher and fellow peers often leads to an atmosphere that can't be replicated through virtual means.

To sum up the above, the lack of personalized interaction between students and teachers in an online learning environment causes students to struggle with concentration and motivation in their studies. This impedes their ability to learn and develop at an adequate pace. Teachers themselves cannot monitor if a student is actively listening to the lesson and absorbing information.

It is with the intention of countering these problems that a Self-Monitoring System for online education has been developed. The System will be developed to follow the guidelines of the Buddhist Philosophy of "Iddhipada" and will monitor students and provide helpful suggestions for them to have increased levels of interest and dedication towards their studies and maintain high levels of concentration and motivation.

This article does a deep dive into the developed Self-Monitoring System for online education . It has been divided into several sections that will touch in order, the problem addressed by the system, the proposed solution, the existing systems related to online education along with their pros and cons, the design of the Self-Monitoring System, technology used and details on the system in action. The article will wrap up with its conclusions and references.

2. Review of Existing Systems

There are many existing systems, tools and technology that are used for Online Education. The developed Self-Monitoring System makes use of technology such as emotion recognition and chatbots combined with a learning interface that houses all the material to be used by students. Therefore, this subsection will mainly touch on existing learning management platforms, existing virtual meeting platforms and existing AI tools such as emotion recognition and chatbots.

A. Learning Management System (LMS)

A Learning Management System (LMS) is a robust platform that holds course content, materials and administration in one user-friendly online system. The phrase itself can be broken down based on its three words. Learning is the core of delivering any educational or training program by an individual. Management is the stem of the learning program which manages all the schedules for each and every individual. The system is nothing but an e-platform to deliver the learning programs. LMS is designed to help an individual to develop, manage and provide online courses and programs to learn. It provides a platform for the students and instructors to learn and highlight their skills wherever and whenever they want as per their convenience.

There are a multitude of LMS platform currently available in the market. The table below explores the features and limitations of existing LMS systems.

Table I. Summary of LMS Platfroms Reviewed

Learning management platform	**Features**	**Limitations**
Mindflash	Facilitate creating training courses within minutes Robust learning experience for users Easy-to-use interface Scalable	No ready-made templated Limited Styles for Quizzes Adding voice-over can be difficult
SkyPrep	Standardized courses Customizable reports Strong security features	Limited user role customization No downloads for mobile users No gamification Built in authoring tools are too simple
iSpring Learn	Online Tests Self-Assessments Portable	Knowledge articles cannot be filtered out Overwhelming for new features
Talent LMS	Fully Customizable Easy to Use Streamlined Mobility and flexibility in courses	Lack of system notifications Unavailability to integrate a grade book to the system.
Docebo	Secure Uses AI powered technology Content curation and aggregation	Live training and recording features are limited No way to indicate completed course
Moodle	Open Source Easily Customizable Widely Available Familiar	Not fully developed to cope with big projects The more students that access the platform, the slower the system becomes
SAP Litmos	Collaboration facilities Tracking	Website can also shut down on occasion Customization cannot be done without coding knowledge
Canvas	Dynamic Effective Course Design Zoom Integration	Low speed of grading Issues in integration features

B. *Exsiting Virtual Meeting Platforms*

Virtual meeting platforms are video applications and software that bring people together over the internet. Usually, this software includes a form of video conferencing, as well as tools like chat, reactions and screen sharing. Virtual meeting platforms are being used as the primary platform to conduct online education and lectures at both school and university level.

Table 2. Summary of Virtual Meeting Platforms

Virtual Meeting Platform	**Features**	**Limitations**
Livestorm	Easy-to-use interface Automated Recordings In-room features such as emoji reactions, video sharing, team whiteboards, live polls and questions upvotes	Many features available only for group meetings, not 1:1
Google Meet	Noise cancellation, Up to 250 attendees Meeting videos saved to goggle drive Strong security features	Difficulty in integrating with third party applications Limitations in some features such as the whiteboard.
Microsoft Teams	Easy to schedule meetings through the Outlook calendar Record meetings Virtual backgrounds Shared whiteboards, Breakout Rooms	Not user friendly for some users Primarily a messaging platform
Zoom	Polls, Whiteboards Breakout room Virtual backgrounds, Snapchat-style filters Reports	Limited Storage Capacity Have to download to use
WebEx	Screen sharing Breakout rooms Virtual backgrounds Live polling Real gesture emoji features	Additionally have to download Cisco Webex Productivity Tools Some features are limited in-browser

While these platforms come with inherent features that may contribute to improving the learning experience, it still does not ensure that the student is being monitored and learning at the required pace. As mentioned, before it would be quite easy for the student to simply log onto the meeting from their device, mute their microphone, switch off their cameras and simply have their focus be elsewhere. That said, virtual meeting platform are still one of the major components in online education. Some of the most popular and their respective advantage and disadvantages have been covered in more detail below.

C. *Exsiting Emotion Recognition Techniques and Tools*

Emotion Recognition involves the analysis of various facial features to match them to their common corresponding facial expressions. For example, an emotional state of anger is characterized by burrowed eyebrows, intense gaze and raised chin. An emotional state of joy would however be shown by characteristics such as raised corners of mouth into a smile

Most emotion recognition systems tend to follow a sequential flow in carrying out the process of emotion recognition. First, the relevant input such as the facial image will be fed into the system. Then different types of techniques and tools will be used to analyze and extract the important features of these inputs. Afterwards, these features will be matched to the most appropriate emotion corresponding to them. “Fig 1” depicts the flow diagram that applies to general process of emotion recognition systems.

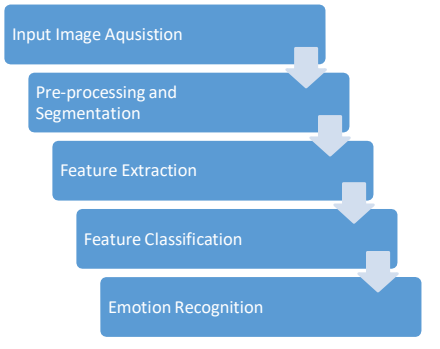

Fig 1. Flow Diagram of an Emption Recognition

Many systems have been developed over the years for the purpose of emotion recognition. This section highlights the main features of some of those systems.

Table 3. Summary of Techniques and Tools Reviewed

System Name	Techniques and Tools Used
Emotion Based Msuic Recommendation System	Image pyramid Histogram of Oriented Gradients Linear Classifier
An Intelligent System for Facial Emotion Reciognition	Facial Animation Parameters Dynamic Committee Machine (DCM) Feed-forward back propagation neural network Luminance and Edge based masks
A Combined Approach for Emotion Recognition using Bezier Curve and Facial Expression Analysis An Intelligent System for Facial Emotion Recognition	Bezier Curve WEKA machine learning calculations ANN
Facial Emotion Detection to Assess Learner's State of Mind in an Online Learning System	Convolutional Neural Networks
Deep Learning for Robust Feature Generation in Audiovisual Emotion Recognition	Forward Selection Information Gain Principle Component Analysis Gaussian Restricted Boltzmann Machines Deep Belief Networks (DBN)
Modeling of Recommendation System Based on Emotional Information and Collaborative Filtering.	Algebraic energy End-Point Detection Feature Parameter Extraction Gaussian mixture model Hidden Markov model Support vector machine Artificial neural network
Emotional Recognition from Facial Expression Analysis using Bezier Curve Fitting	Bezier Curve Spatial filtering
Fast Facial emotion recognition Using Convolutional Neural Networks and Gabor Filters	Gabor Filters Convolutional Neural Networks

As observed from the systems above, emotion recognition is one of the many facial recognition technologies that have developed and grown through the years. The systems developed thus far for emotional recognition have covered several different techniques and tools. However, they have also come with certain drawbacks and areas for improvement.

For instance, there are several different ways that a system for emotional recognition can be designed. Choosing what model or training data to use is not the end of it, as there are different inputs that can be used or given to the system to analyze. For example, video, speech, text, conversation are all possible inputs that can be used for emotion recognition. While most systems discussed above focus on Images as the input to the system, Kim Y et al [8] also takes in account audio cues and designs a system high in accuracy. Thus, the systems that focus on just a one specific input may benefit from also branching out to other audio or sensory inputs. This may however result in high costs and complex systems, a factor which must be taken into consideration.

D. Chatbots

A chatbot system uses conversational artificial intelligence (AI) technology to simulate a discussion (or a chat) with a user in natural language via messaging applications, websites, mobile apps or the telephone. It uses rule-based language applications to perform live chat functions in response to real-time user interactions.

Two preliminary applications for Chatbots within education have been identified through a study carried out by S Cunningham-Nelson et al [40]. The two applications are as an FAQ Chabot to answer commonly asked questions, and a short response quiz Chatbot. These applications are discussed below.

i. FAQ Chatbot

The aim of this type of FAQ chatbot would be to anticipate and reply to some of the common queries that are made by students. If a student writes a question to the Chatbot, the question can be matched with a question in the existing database that is most similar, and then the response that is most relevant is chosen and given to the student. An FAQ chatbot has the clear benefit of being available for students 24/7, able to answer their questions when needed in time. This style of FAQ Chatbot has the potential to help identify communication issues between educators and educators and students. If one of the questions is asked more frequently by students, educators may need to consider how that is currently communicated to students.

ii. Short Response Quiz Chatbot

Another application which we believe a chatbot could have a significant impact in, is in the context of online short response questions. For example, students may be asked to respond to a multiple-choice question, giving a justification about the answer they had selected. The chatbot would facilitate this interaction and then provide some personalized feedback. The benefits of this chatbot mirror the general benefits for Chatbots, including a more personalized approach for users and the 24/7 availability of the Chatbot. Implementing this style of textually enhanced concept inventory as a chatbot would allow for other benefits, specific to this application.

3. Design of The Self Monitoring System for Online Education

As reviewed above there are many different systems, platforms and techniques available to aid in education. A few notable gaps in literature would be the absence of a proper philosophy setting the foundation for a learning

management system. In addition, simply the presence of study material does not indicate that the student would be listening or learning at the rate required. An emotion recognition plug in would greatly increase the learning rate of students an ensure they are actually paying attention.

Taking into account the above gaps in literature, the following system has been developed. A Java based desktop application to self-motivate students in their education, based on the Buddhist Philosophy of Iddhipada, through the use of techniques such as emotion recognition, multi-agent systems, chatbots and interactive GUIs.

The functional requirements of the system are as below:

- Create a Learning Environment for a student based on the Buddhist Philosophy of "Iddhipada"
- Provide learning Materials and Questions relating to the subject area.
- Monitor the student and track their emotional state, concentration and motivation levels.
- Provide support and suggestions to the student from the backend of the system, to improve their emotions, concentration and motivation levels
- Have a Chatbot with which the students can interact

i. *Philosophy behind the project*

The Self-Monitoring System is based on a Buddhist Philosophy by the name of "Iddhipada" which highlights four bases of spirituality that can be followed when undertaking a task. If all four of these bases are followed in equal and adequate amounts any undertaken educational task will be successful.

The 4 bases touched on are :

- 'Chanda' - Intention and Interest
- 'Citta' – Positive Mindset
- 'Viriya' - Effort and perseverance
- 'Vimansa' - Curiosity and an investigative nature

ii. *Methodology and Design Diagrams*

The methodology used for the design of this system was the scientific method which has its steps in the following order: Observation of the research problem, Preliminary Study, Problem Definition, Build up theoretical, Hypothesis, Experimental Design, Data Gathering, Data Analysis, Conclusion.

The top-level design of the developed Self-Monitoring System can be depicted as in "Fig: 2."

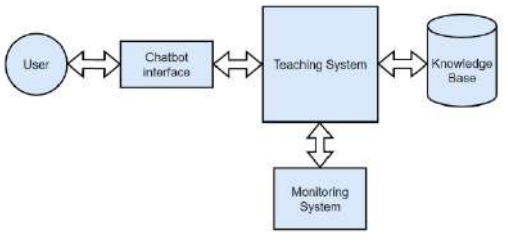

Fig 2. Top Level Design

It consists of the user interacting with the teaching system via a chatbot interface. The database connected to the teaching system houses all necessary material for the system. The monitoring system will interact with the teaching system as required. "Fig: 3" touches on the design of the monitoring system in more detail.

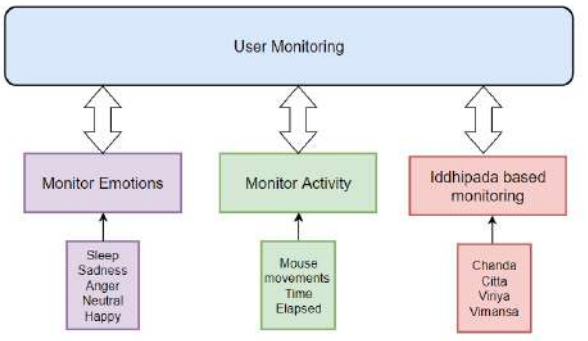

Fig 3. Monitoring System

There will be three types of monitoring carried out by the system. One of the monitoring aspects will monitor emotions and provide helpful suggestions on how a negative emotional state can be changed to a more positive state. Secondly activity of the student such as mouse movements and timing will also be monitored to ensure that they are focusing on learning. Thirdly, values for the four Iddhipada bases will also be maintained and monitored. Each of the questions in the system will be assigned specific Iddhipada weightage and according to the questions answered by the student, their overall value will change .

When focusing specifically on the tools and technology used for the system, it can be said that Java was used as the coding base. All interface design and most features of the system of the PHP + MySQL was used for the database. The emotion recognition portion is carried out by using TensorFlow and Keras. The chatbot was implemented through a compatible framework.

4. Implementation Of The Self Monitoring System For Online Education

The implementation of the Self-Monitoring System for Online Education can be described in terms of its various modules and functions.

i. *Account Creation and Login*

The student may log into the system by first creating an account. The student's information including username and password will then be saved to the database. Students may

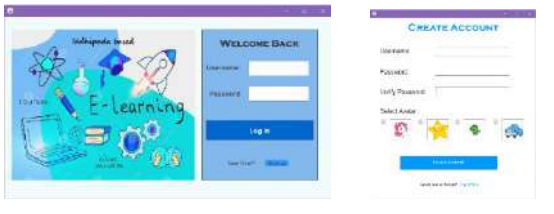

Fig 4. User Login and Create Account

use this username and password to login to the learning system.

ii. *Selection Of Subject And Chapter And Accessing Material*

After the student has logged in, they can select the necessary subject and then chapter and gain access to the material. The learning material will be available in the form of video and pdf lessons. In addition, there will quizzes available to test the knowledge of the student. “Fig: 5” shows the interface for selecting the subject as mentioned above.

Fig 5. Select Subject

iii. *Capture Of User Image And Recognition Of Emotion*

The image of the student will be captured periodically while they are engaged in studies. This image will be fed to the emotion recognition model which will identify the current emotional state of the user and provide solutions on how to improve this state if necessary.

iv. *Attempt Quizes*

The student may attempt quizzes in order to test their knowledge. There are three different types of quiz questions: short answer, MCQ and images. Each of these questions is geared towards understanding where a student stands and what areas they must improve on. Each answer given by the student will be checked against the database of answers, it will be marked as either correct and incorrect and feedback will be provided. “Fig: 6” shows the interface for quizzes.

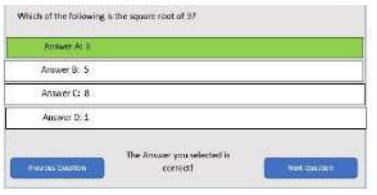

Fig 6. Quiz Interface

v. *Record other monitoring details of student*

The system will also monitor other aspects of the student such as time elapsed in answering questions and the mouse movements during studying. These stats can be used to know if the student is focusing as necessary on their work.

vi. *Interact with Chatbot*

The student will be able to interact with a basic level chatbot. This chatbot will respond to simple queries made by the student and provide basic guidance. It is hoped that the presence of a chatbot will further aid in improving the student’s level of concentration.

That concludes a description of the major features of the Self-Monitoring System for Online Education. The above developed system could go a long way towards furthering online learning and ensuring learning happens at the most productive rate possible.

5. Conclusion

The Covid-19 Pandemic has seen the shift in traditional forms of learning to online learning at all levels. However, Online Education is not without its own unique set of challenges. The lack of personalized interaction between students and teachers in an online learning environment causes students to struggle with concentration and motivation in their studies. This impedes their ability to learn and develop at an adequate pace. Teachers themselves cannot monitor if a student is actively listening to the lesson and absorbing information. The physical presence inside a classroom with a teacher and fellow peers often leads to an atmosphere that can’t be replicated through virtual means.

There are already several systems in existence to tackle these issues. These systems range from learning management systems, virtual meeting platforms, emotion recognition tools and chatbots. However, the existing systems all have their specific disadvantages and a clear gap in literature can be identified.

It is as a solution to this gap in literature that a Self-Monitoring System for Online Education was developed. The system is a Java based desktop application developed with the goal to self-motivate students in their education, through the use of techniques such as emotion recognition, multi-agent systems, chatbots and interactive GUIs. The design of the system as well as a demonstration of what the system would be like in action, was provided.

The system will be tested by means of a control experiment involving a classroom of students. They will be taught two similar sample lessons online, one whilst using the system and the other without. The students can be given a quiz to complete after both lessons. If there is a significant improvement in answers in the instance that the self-monitoring system is used, that proves the effectiveness of the system in online education.

In conclusion, it can be said as the popularity and demand for a fully digitalized world grows, it is necessary to start developing new systems to keep up with the upward moving trends. It is hoped that the developed Self-Monitoring System for Online Education will contribute towards bridging the gap between offline and online education and will create a excellent learning environment.

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