Real-time Identification of the Emotional State in the Classroom to Improve the Teaching-learning Process

Edward Flores [1], José Livia [2], Alfredo García [3] and María Dávila [4]

[1,2,3,4] *Universidad Nacional Federico Villarreal, Lima, Perú.*

Abstract

In recent years, the teaching-learning process has been changing from face-to-face to virtual mode, this process was significantly accelerated by the pandemic caused by COVID-19, where the classroom was virtualized at all educational levels to world level. The present objective was to identify the emotional state that students have in the virtual classroom to allow the teacher to improve their teaching-learning strategies in real time, as a methodology an application in artificial intelligence with neural networks was proposed that allows capturing the state of the students in the classroom by webcam. The results obtained allow to determine the states of the group so that the teacher can perceive the sensation inside the classroom at the time of the class and thus improve their strategies, concluding that it is an efficient form of continuous improvement for the processes of active learning within the classroom

Keywords

Neural Networks, teaching-learning, virtual teaching, active learning.

1. Introduction

During the last years, Artificial Intelligence (AI) has been constantly growing in terms of its field of application, it has been used in many areas such as medicine [1], justice [2] and education [3] among other contexts , indicating its impact for the future of work [4] in the same way, little by little beginning to have influence not only in technological areas or rigid processes, but also in other areas of the social sciences, such as psychology [5,6] and psychiatry [7], where the need arises to interpret human patterns and behaviors from the behavioral point of view, translating these data in the computer context and applying mathematical models to be able to interpret and understand certain actions or patterns of human behavior that allow a classification in order to understand their behavior.

From the applications of mobile phones that locate our place of residence and where we work based on the daily journey, we make daily, the various devices used to recognize voice, music, even cars that circulate on the streets without a driver Some, Artificial Intelligence has taken a turn in our lives [8]. The technological context is rapidly updated with artificial intelligence, allowing it to be a main component in the work and the processes that it entails, in making the right decisions in various ways. However, within the context of education, AI must seek new ways of working within the complexity of this area and go beyond the knowledge of disciplines such as computing or engineering [9].

Artificial intelligence is based on a set of defined algorithms that make it possible for machines to make decisions instead of human beings. This new technology allows to see an improvement in the decision-making of end users in various areas [10]. In order to analyze the information that is constantly growing exponentially, so-called deep learning techniques are regularly used that allow, in this way, to achieve valid results. The success of deep learning for the development of IoT is possible thanks to the

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EMAIL: eflores@unfv.edu.pe (A. 1); jlivia@unfv.edu.pe (A. 2); agarcia@unfv.edu.pe (A. 3); mdavilad@unfv.edu.pe (A. 4)
ORCID: 0000-0001-8972-5494 (A. 1); 0000-0003-2226-3349 (A. 2); 0000-0001-8373-3127 (A. 3); 0000-0002-2555-8276


constant growth of information that today is known as Big data, and also to the current processing power [11]. Currently the use of recognizing images has been used in various fields of study, such as medicine, pharmacology, treatment of diseases by images. This technique has been the subject of extensive study [12].

This is why the need arises today to understand the human factor within the teaching-learning processes, mainly due to the situation in which we find ourselves as a result of the pandemic caused by COVID-19, where , the students stopped attending their educational institutions in person and found themselves in the need to listen to classes in virtual mode, thus virtualizing the entire service of the teaching-learning process to be able to give continuity to the educational processes.

One of the main problems encountered is communication between the student and the teacher, it is the interaction and interpretation of the feelings of the students in front of the class, in a face-to-face context, the teacher can appreciate at all times the emotions of the students and of Accordingly, determine strategies to motivate or reconnect the student with the knowledge of the course, in order to develop activities and capacities within the learning session. [13] have described the relationship between emotional intelligence and academic performance, increasing the scores in this last variable as the scores in emotional intelligence increase, as well as relationships between fear and academic performance and Fear and emotional intelligence, these being inversely proportional.

Within the context in which the human being develops, emotions allow to be an essential form of communication that originates in the gregarious nature. In general, all living forms, regardless of culture or species, require the use of emotions so that they can express or transmit the way of informing other people about the feelings they have [14]. An important challenge to take into account when integrating educational technology is to get students involved with various affective forms. On this, in addition, there is still no way how technology can shape the attitude and in the same way the behavior at the time of learning. What was found in educational psychology and also what was found in the learning sciences, result in the lack of interest in the research [15]. Within cyberspace, the essential means that allow us to communicate feelings are social networks, this has been due to the rapid growth of internet access. Various people through social networks use audio and video content, images or text to make their feelings or achievements known [16]. Likewise, over time it has been possible to process video and audio on the same platform, allowing to reduce the scope of the solution with considerable energy savings, if the time factor were a critical factor, it could currently work in real time, achieving in this way, keep under control the time of use of the system and the different connected devices [17].

Another context that focuses on the student is active learning, where the student resorts to discussion, in the same way in the play of various roles, about collaborative solution in problem solving, in order to involve little by little. little to the student, however, this process has been relatively diminished due to the current situation, today, these process activities that were previously focused on the classroom are carried out virtually [18]. Active learning is currently part of a strategic approach to be part of an educational principle. When students commit themselves, they generate a greater concern, many studies have been carried out on how to support this approach, but there is a problem on how to evaluate progress and performance effectively [19]. Large study groups generally face new challenges in order to improve active learning, classroom feedback and repetition in some way, as they are essential to promote student learning [20].

The biometric technique often used for face identification is facial recognition. It is a technique that is responsible for facial recognition through multimedia photographs. With the growth of the society and its advanced, it is now an important requirement to have it. This technique has been gradually increasing worldwide [21]. Convolutional neural networks are the support for identifying images as vectors. Similarity needs are identified in a pair of images, and it is sought that they are as similar as different. This type of similarity can be calculated by various forms or metrics, such as Euclidean distance, cosine similarity, or through the L2 form. Usually, the configuration that is used in the main is cosine similarity [22].

The present objective is to identify the emotional state that students have in the virtual classroom to allow the teacher to improve their teaching-learning strategies in real time, in this way, always keep students motivated and in constant attention within the context of the course, This may be based on the strategies used by the teacher, either through motivation, participatory, collaborative activities, among others, this will allow to improve active learning in real time within the classroom.

2. Methodology

In the present investigation, the constructivist paradigm was used, since in constructivism relativism affirms that there are no unique and determined realities, but constructions that respond to the individual perception of each individual, which builds diverse needs and interpretations of what surrounds them. individuals [23], the research approach is quantitative by collecting information from the individuals observed and in the same way, by determining the probability of their occurrence. For data analysis, the data-based approach was used, an approach widely used within artificial intelligence and machine learning. Within the developed method, the non-experimental design has been used, of a descriptive transectional type that aims to investigate the incidence and the values in which it manifests one or more times, for which, a software solution in artificial intelligence with networks was developed. Convolutional neurons in Python programming language that allows to identify through the webcam, using biometric analysis, collect people's emotions such as angry, fear, neutral, sad, displeased, happy and surprised, using the application libraries with high precision facial recognition models Deepface and DeepID based on experiments, Dlib obtained 99.38%; DeepID scored 97.05; ArcFace got 99.41%; FaceNet / w 128d got 99.2%; FaceNet, VGG-Cara, ArcFace and dlib above Openface, VGG-Face obtained 98.78%; As support, FaceNet / w 512d scored 99.65%; OpenFace had 93.80% accuracy in the LFW dataset, compared to people who only have 97.53% [22].

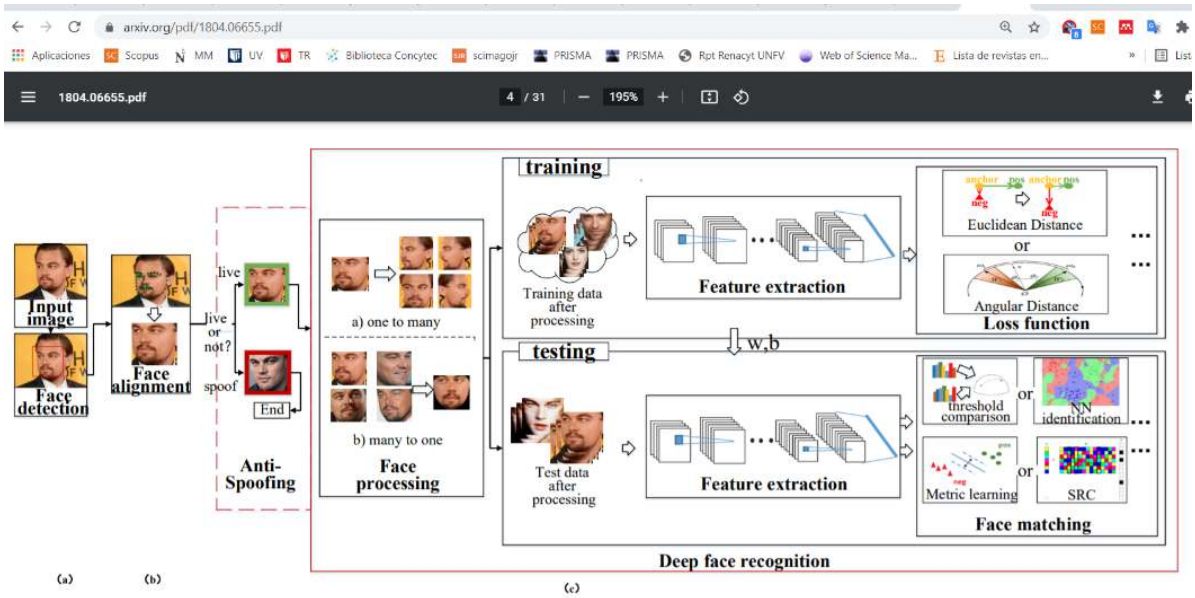

Figure 1: DeepFace facial recognition model [24].

The described model, As mentioned [24], for facial recognition three steps are required, as can be seen in figure 1. First an image is identified that may even be in a video. Second, the image is aligned with the normalized canonical coordinates Third, the veracity of the image is identified to rule out any falsification, in this way, any type of attack is avoided, after this, facial recognition can be performed [24]. In the same way, in the third part of figure 1 the image processing model can be determined, where a set of image processing and another to perform the tests against the processed images are determined, all of them supported by convolutional neural networks.

With the purpose of evaluating the situational status of all students in the classroom in real time, processing the information, and in this way, sending the information to the teacher so that through their computer they can identify the total status of the classroom in Based on the seven states indicated, a test was carried out, for which, the software solution to be developed requires that the participants have their cameras turned on during class, in such a way that the system collects the emotions of each student in real time and send them to the teacher at all times.

3. Results

In the prototype process carried out, in figure 2, the collection of information from a student is appreciated, according to the emotions that they can register at different times in a class.

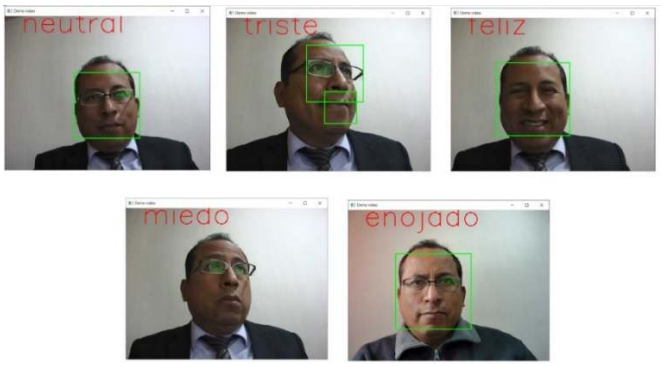

Figure 2: Emotional states of facial recognition.

The proposed system will evaluate the different images in real time through artificial intelligence algorithms of regular convolutional neural networks and will determine probabilistically the results corresponding to the images collected from the person, in such a way that it can be collected at any time during the class. the probability of the seven states described and estimate the highest acceptable value as a result of their expression.

The following code is the result of the information obtained within the prototype made, which shows us a set of parameters established to indicate a person in a normal (neutral) state.

```
program (Output)
{'emotion': {'angry': 0.019127620907966048,
  'disgust': 0.0019221228285459802,
  'fear': 23.840796947479248,
  'happy': 18.211452662944794,
  'sad': 21.598833799362183,
  'surprise': 0.0010724763342295773,
  'neutral': 36.326801776885986},
 'dominant_emotion': 'neutral'}
```

As can be seen, a set of relevant information about the emotional states of the student is verified, where we can find the seven states indicated for the present study, which are detailed in Table 1.

Table 1.
Emotional states of a student in a moment of class.

Emotional State	Probability obtained	Probability
Angry	0.019127620907966048	0.02%
Disgust	0.0019221228285459802	0%
Fear	23.840796947479248	23.84%
Happy	18.211452662944794	18.21%
Sad	21.598833799362183	21.60%
Surprise	0.0010724763342295773	0.00%
Neutral	36.326801776885986	36.33%

As can be seen in table 1, the emotional state with the highest probability is the Neutral state, which means that at that moment the student is in a normal condition within the class.

Additionally, for the present study, the developed application also shows the average states of age, gender, and race, where it also determines a probabilistic study on the possible races of the student between Indian, black, white, Middle Eastern and Latino. Hispanic, from which the probability of the dominant race is also obtained.

Once the information of all the students has been collected, the real statistics will be determined in the application by the number of students from the different states found in the classroom, visually determining the results that can be viewed on the teacher's monitor in real time while the class is developing, this data will be permanently updated throughout the session.

In the figure 3 shows us a prototype example of the application that the teacher will see, as you can see, it will not display percentages for each identified state of the students, nor the name or location of the students within the virtual classroom, with the purpose To avoid value judgments about any of the students during the class, you will only have to visualize the various states so that the teacher can validate and properly choose which is the most appropriate strategy within the teaching-learning process to develop their class. In the same way, taking into account that the teacher cannot be permanently looking at the situational state of his classroom, it has been determined to incorporate a representative image to the state of the class and related to the indicated color, in this way, distraction will be avoided or constant concern on the part of the teacher.

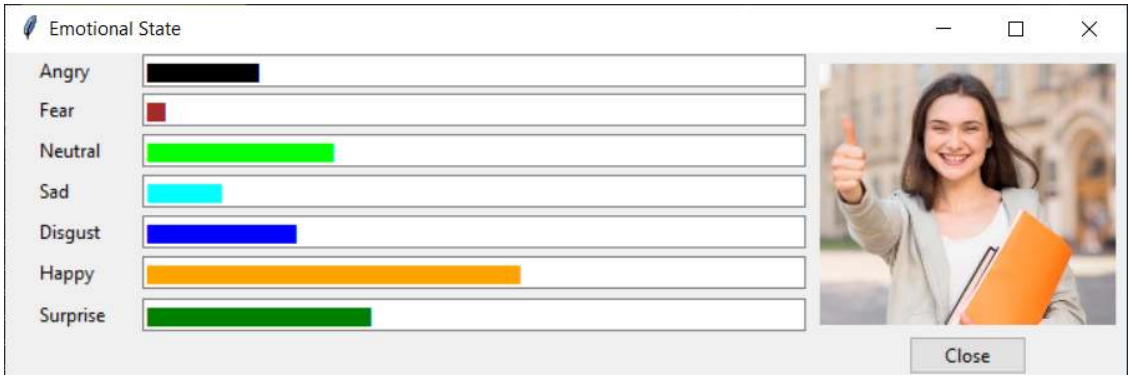

Figure 3: Situational monitor of the classroom in happy state.

4. Discussion

According to [24], it tells us that to manage student attendance at classes, this is a task that is presented repeatedly and requires a lot of time for school administrators and teachers, for which reason it was thought to automate this task. activity with the implementation of known advances within machine learning. In conducting his research, he develops a proposal for an assistance system characterized by the use of facial recognition. Inside the classroom he permanently photographs himself with a camera. Then an in-depth analysis is carried out on obtaining the captured images in order to identify and extract the facial features, thus allowing facial recognition of their identity, which allows us to identify relevant concordances with the proposal presented in the present article, by using artificial intelligence with neural networks to register facial images within the processes that are necessary to facilitate the development of classes. On the other hand, [25], they tell us that IoT uses various sensors and certain existing devices together with different algorithms that allow developing a learning experience that can be more efficient and intelligent for both teachers and students. Based on the bibliographic survey carried out in the research carried out, it suggests identifying moments in which students are distracted from class and warns the advisors or sends an alert through smart applications to the students. The system is in charge of asking students about the subject and if they make a mistake, the advisors are notified so that they can provide a better learning experience, which also shows us the concern of the use of artificial intelligence in a similar way to the present study, to improve teaching-learning processes. Finally, [20], describes about digital technologies that offer new possibilities to increase development through active learning, repetition and feedback in very large classes. They developed a form that allows evaluating the implementation of various digital tools on perception in active learning, repetition and feedback. All these important factors mentioned are important for the effectiveness of learning, which allows them to agree on the concern to improve the teaching-learning process more and more.

5. Conclusions

It was determined that there is an improvement in the teaching-learning process from the accompaniment of the teacher making use of artificial intelligence and convolutional neural networks, being able to verify that appropriate strategies can be developed from the knowledge of the emotional state of the students. This allows the future to improve the conditions of active learning in the classroom.

It is concluded that the prototype of the proposed solution can be applied at any educational level in virtual environments, being able to identify that a main factor is the emotional state of the student. This allows the teaching-learning processes to participate actively and thus establish in the future a process of continuous improvement between the students and the teacher.

The proposed model based on artificial intelligence is a low-cost solution since it does not transmit video in real time, but rather captures images at various time intervals, allowing not to saturate the internet service in which the teaching-learning process is developed and contributes to identifying the emotional state of students to improve the strategies of the teaching-learning process within the classroom.

Future work can be carried out from the present solution that allows to measure other aspects of the students, such as participation in class, collaborative learning, monitoring of evaluations, among others.

6. References

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