Research Article

REAL-TIME ONLINE EDUCATION STUDENT LECTURE EMOTION DETECTION

MARWAN HOSAM ALSOKARI[1], ALİ OKATAN[1,*]

[1] *Department of Software Engineering, Istanbul Aydin University, Istanbul, Turkey, marwanhousam@stu.aydin.edu.tr,* aliokatan@aydin.edu.tr.,

ORCID: 0000-0002-8893-9711

ABSTRACT

During the Covid-19 pandemic, everything has been shifted to using the internet to get whatever the job is done. In particular, the educational system used the internet for online classes and meetings. This virtual connection faced some issues such as no facial expression between the students and the teachers. This is a big issue when it comes to learning. Neither the teacher nor the student has got to understand everything in the online classroom. This study comes to a solution. So, in order to make those virtual classrooms as normal as the face-to-face classroom, it creates a system of capturing the Emotion expressions into understandable language. This language is data that transforms into words. So, the teacher could get a statement about the student's emotions. Emotion recognition (ER) is the process of identifying human emotion, and it's the most complex field of pattern recognition. It has become an even more important topic since it has become the main component in many Artificial Intelligence applications. The goal of emotion recognition is to identify human feelings. Feelings can be captured either from the face or from verbal communication. Emotion recognition is a valuable tool for a variety of industries and applications. It can improve security measures, aid in healthcare, and assist in the care of children with autism. Additionally, it is utilized in the development of video games and human-computer interactions. One example of its use is in a study that uses students' computers to capture facial expressions through a camera, helping to identify common emotions.

Keywords: *Emotion recognition (ER).*

1. INTRODUCTION

This study connects the instructor with the student's emotional responses, so it could help them understand the best teaching methods based on what's affecting their classes at that time. Emotions are a normal part of human lives, they help us to engage socially with the world. Emotions are involuntary responses to our thoughts, so it all affects our thoughts and actions. People express emotions through facial expressions and by using their body language to communicate with others. One way to understand the emotions of others is to detect emotional expressions in facial images or body language. Emotional recognition is an active research area in computer vision, and many networks

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have been trained to identify different emotions from facial images. Computer vision techniques are used to analyze real-time lecture videos in order to extract the emotions of students, as emotions are crucial for effective learning. A pre-trained Convolutional Neural Network (CNN) is utilized to identify seven basic emotions: anger, disgust, fear, happiness, sadness, surprise, and contempt. These emotions are then used to determine levels of engagement among students in a virtual classroom, including highly engaged, and disengaged students. To achieve this goal, it is intended to investigate the possible use of two different classifiers; the classifiers used in this study include Convolutional Neural Network (CNN) and a genetically Optimized CNN model, The Convolutional neural networks (CNN) are trained to recognize emotions from facial images by taking advantage of deep learning techniques. A CNN contains several layers of neural networks that process and classify an image based on its features, and the second classifier is the Genetic Algorithm (GA) is a technique for solving optimization problems, both those with constraints and those without, using principles inspired by natural selection, the mechanism that drives biological evolution.

2. LITERATURE REVIEW

In this paper, Preeti develops a computer algorithm for the Classification of leukemia as an aspect of research in hematological image processing [1]. ADNAN and others present an automated dermatological diagnostic system that uses color image processing techniques to identify diseased skin [2]. Taiping and colleagues employ image processing to adjust face images to consistent lighting conditions [3]. Additionally, Zhangcan and associates describe an image processing based method for identifying crack patterns in cement [4].

Convolutional Neural Networks (CNNs) are powerful tools for image recognition and processing. These networks are a type of Artificial Neural Network (ANN) that are specifically designed to handle image data. CNNs consist of multiple layers, including convolutional layers, pooling layers, and fully connected layers, that work together to identify objects within an image. CNNs have made significant advancements in the field of computer vision and have been proven to be highly effective at object recognition tasks. The convolutional layer is responsible for creating feature maps by applying a set of filters to the input image, the pooling layer is responsible for reducing the spatial dimensions of the feature maps and the fully connected layers are responsible for making the final decision on the object in the image by combining the features extracted by the convolutional and pooling layers. The combination of these layers enables CNNs to effectively recognize patterns and features within images, making them an important tool for a wide range of computer vision applications.

I studied the paper by Yakup et al to explore the utilization of CNN in recognition tasks, the paper presents a modified CNN architecture that includes the addition of two normalization operations to two layers [6].

The convolutional neural network is highly effective in recognizing human facial expressions. Steve and his team presented a rapid, automated system for face recognition,

which combines a local image sample representation, a Self-Organizing Map (SOM) network, and a convolutional network for face recognition [7]. Furthermore, Earnest and his team proposed two methods for facial recognition under varying lighting conditions, utilizing deep convolutional neural networks, which allows the system to distinguish between individuals by analyzing the unique patterns in their facial information [8].

Facial expression recognition has become a core concept in Artificial Intelligence (AI) research. It has a crucial role in many applications of computer vision, and human-computer interaction, it is also essential for communication and emotional processing.

In this paper, Khadija and others provide a comparative study on facial emotion recognition problems and offer a more up-to-date introduction to the area [9]. Ananthu and his colleagues proposed a real-time facial emotion recognition system that aims to create an advanced system that can accurately identify a user's facial expression in real-time, and generate the corresponding emotion. The system could have wide range of applications from user engagement in virtual reality to psychological research and mental health monitoring [10].

The process of extracting features from data is crucial for many machine learning and computer vision tasks, including face recognition. One notable example of a feature extraction algorithm is the Feature Extraction based Face Recognition, Gender, and Age Classification (FEBFRGAC) algorithm proposed by Ramesha and his team. This algorithm involves three main steps: pre-processing, feature extraction, and classification.

Another approach to feature extraction that has been proposed for face recognition is the margin-based between-class scatter and regularization process developed by Youn Jung and his colleagues. This method aims to improve the accuracy and reliability of face recognition systems by addressing the issue of accurate feature extraction. This approach uses a margin-based criterion to separate features and regularization process to improve the robustness of the model. This method can be used to improve the performance of face recognition systems by providing more accurate and reliable feature sets.

Face recognition utilizes ML and AI algorithms to recognize human faces. AI is a research field that utilizes technology to simulate human intelligence processes. To evaluate information patterns using AI algorithms and correlate the information to produce results, AI needs a set of unstructured data. By learning from and discovering through data, AI may automate frequent, high-volume operations. Second, it gives products in the area of automation, conversational platforms, intelligent machines, and bots more intelligence. Thirdly, it can learn by itself via algorithms by identifying patterns and regularities.

Machine Learning (ML) is a branch of Artificial Intelligence (AI) that primarily focuses on using data and algorithms to simulate human learning. It employs statistical tech-

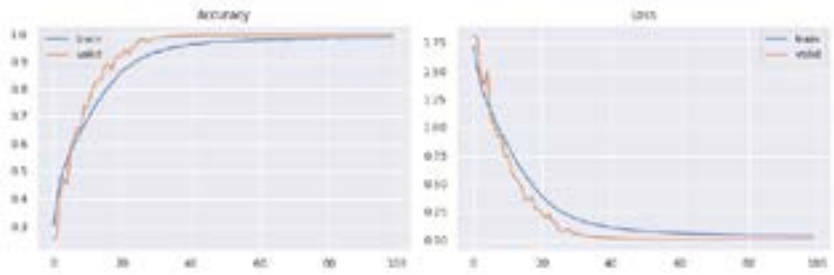
niques to train algorithms to classify, predict, and uncover insights from data mining projects. In the field of computer vision, ML is utilized to extract valuable information from images, videos, and other visual inputs. It can be used to identify patterns, objects and even emotions in the visual data, which can have wide-ranging applications in various industries such as healthcare, security, and entertainment.

Computer vision is a branch of Artificial Intelligence (AI) that is focused on giving computers the ability to understand and interpret the visual information in images or videos. One of the key ways that this is accomplished is through the use of deep learning techniques, which are known for their ability to achieve superior results in challenging computer vision tasks such as image classification, object detection, and facial recognition. These methods are able to learn complex patterns and features from the data, allowing for more accurate and robust results.

3. PROPOSED METHOD

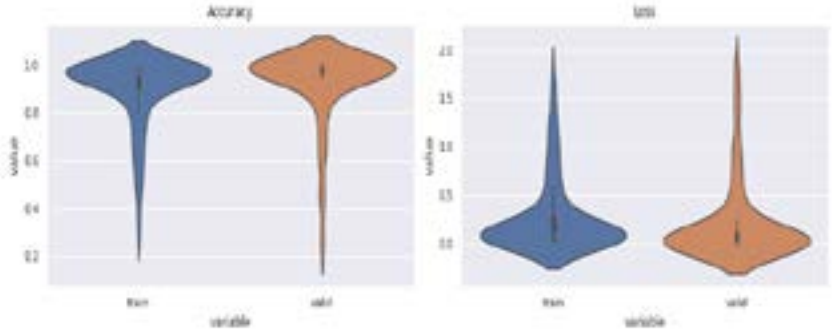
This section explains the proposed system, which includes data gathering and preprocessing. Following preprocessing, the data will be fed into both ML and DL models. In ML, the preprocessed data will be fed into ML classifiers and the outputs of all ML classifiers will be shown. It will also choose the best ML model with the maximum accuracy. The goal of this model is to effectively recognize facial expressions by utilizing a limited dataset through training. This approach is inspired by the research of Caroppo et al. and Heidari and Fouladi-Ghaleh [13]. In order to achieve this, I employed the transfer learning technique by building a convolutional neural network (CNN) using a pretrained model known as VGG16. This model is provided by the Keras library in Python. As discussed in the literature review, VGG16 is a powerful model that comprises of five convolutional blocks and three fully connected layers. I utilized this framework as a foundation for my CNN model, while also making several modifications and additions. Specifically, the input layer was adjusted to accept images of size 48 * 48 *1. In this approach, we are leveraging the already learned feature from the pre-trained model and fine-tuning it to our dataset, this will reduce the amount of data needed for training, and also will increase the performance of the model. For each convolutional block, there are convolutional layers, one 2D max-pooling layer, and one Batch Normalization layer for each convolutional layer. The five convolutional blocks contain 265, 500, 800, and 1024 convolutional kernels of size 3 * 3. Following the convolutional blocks are three fully connected layers of 512 neurons. A “Rectified Linear Unit (RELU)” activation function is applied after each layer to improve the model’s performance. Additionally, dropout layers with a rate of 25% are included. To counteract the potential issue of overfitting due to limited data, I incorporated dropout layers into the model. These layers act as a form of regularization by randomly deactivating certain neurons during the training process. This helps to prevent the model from becoming too specialized to the training data and increases the generalization of the model. As a result, it will be able to perform better on unseen data. This way we can improve the robustness and the accuracy of the model.

4. RESULTS



(a) (b)

Figure 1. The plot line between the accuracy and the number of epochs.



(a) (b)

Figure 2. Expresses the accuracy, and it represents the loss.

The following graph (Figure 1) expresses the plot line between the accuracy and the number of epochs, In the graph, the blue line indicates the accuracy of the training set, while the red line represents the accuracy of the validation set. It can be observed that the accuracy improves as the number of epochs increases. The validation set reaches its peak at around 83 epochs, while the training set reaches its optimal performance at 90 epochs, and for the other plot (Los function) it expresses the percentage change of the real value with the value of predict through the model, and this value we want to try to

approach zero starts The loss was at a value of 1.75 about the training and validation, and the loss kept improving, and when it reached the number of epochs 40, the loss in terms of validation had reached the maximum value, and the training set was at the number of epochs 80. Graph (Figure 2. a) expresses the accuracy, and graph (Figure 2. b) represents the loss. The white dot on the violin plots represents the median, the black bar in the center of the violin is the interquartile range and the black lines stretched from the bar represent the lower/upper adjacent values. It's concluded that when the number of epochs is 80, the accuracy increases to reach 1.0, and the loss decreases until it becomes almost zero and we reach the best accuracy result.

5. CONCLUSION

In conclusion, this research aimed to enhance communication and engagement between teachers and students during online lectures through the use of facial expression recognition technology. The program developed in this study provides teachers with valuable insights into students' emotional states in real time, which can be used to adjust teaching methods and materials to better meet the needs of the students. One of the unique contributions of this study is the analysis of less frequently examined facial expressions, which expands the scope of previous research in the field of facial expression recognition. The program developed in this study is based on the combination of two technologies: facial recognition and image processing. The program uses the OpenCV library for feature extraction, which is then fed into a Support Vector Machine (SVM) classifier that is trained with labeled data sets. The program is designed to recognize and distinguish between five primary facial expressions: happy, sad, surprised, angry, and disgusted. The implementation of this program can result in a more effective and engaging learning experience for students and can help teachers to adjust their teaching style to better meet the needs of their students. Additionally, this program can be used in other fields such as customer service, security, and marketing where understanding people's emotions is crucial.

NOTE: This article is taken from master's thesis (REAL-TIME ONLINE EDUCATION STUDENT LECTURE EMOTION DETECTION) under the supervision of Prof. Dr. Ali Okatan, at Istanbul Aydin University.

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