Student's Emotion Recognition through Facial Expressions during E-Learning using Fuzzy Logic and CNN classification

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ABSTRACT

COVID19 brought up with lots of changes in education system. In E-learning, classes and trainings were done on platforms like Zoom, Google meet etc. Identification of state of the mind of students those were attending sessions becomes difficult. Emotion recognition is one of the hot topics these days in fields like medical, business, education, academic research and many more. Many applications like cognitive computing, affective computing, computer vision, entertainment is widely used with emotion recognition and are at high demand. Technique like facial expressions recognition with identification of emotions like Anger, Disgust, Sad, Happy, Surprise, fear and Neutral can be judged to better understand. The proposed solution calculates concentration index of student and also give feedback about delivery of the class to teachers by student's attention during the class. Implementation takes off traditional feedback method and comes up with original results on recognizing attention from student's expressions. This is implemented with deep learning model like Convolutional Neural Network using Keras (python language) where built model will be checked through live data and FER2013 datasets for the emotion recognition. Also, by using concepts of Fuzzy Logic, Fuzzy rule sets are prepared and membership functions implemented by Mamdani MATLAB Software. Finally, accuracy of the model will be calculated and results will be compared. Such applications are useful for any online learning student's/trainees/mentees that shows involvement, interest and attention of participants. Teaching learning process is improved with the help of such applications.

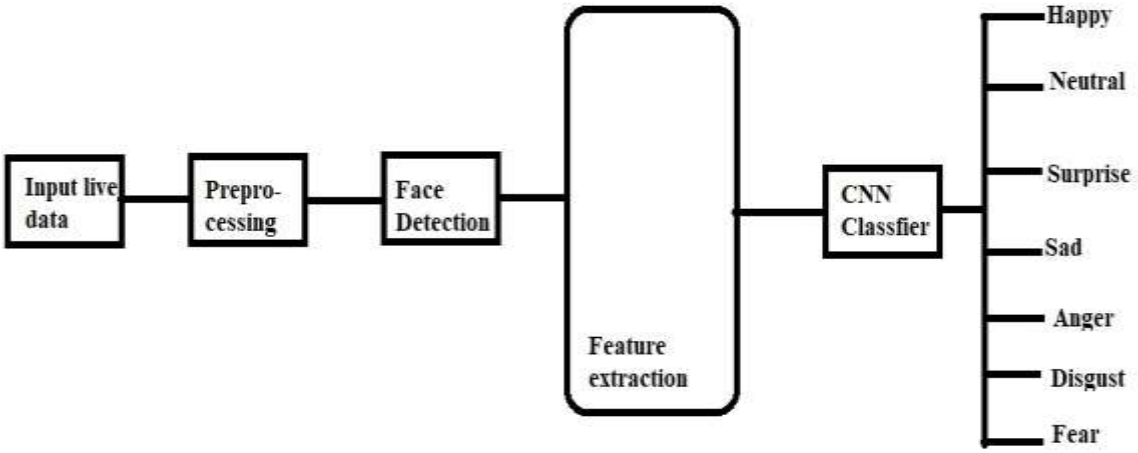
Keywords: *Convolutional; emotions; facial expression; fuzzy logic; e-learning;*

1. INTRODUCTION

Productivity is one of the evergreen factors that deal with every one of us. In terms of any training, classes, learning's productivity means a lot. During COVID19 most of the learning switched to online platforms; either selling or buying of products though e-commerce, work from home, online classes etc., so it becomes compulsory to find the attentiveness of attendees. While online class, teachers can visualize students only through their video in this case student's behavior can be detected only by processing their images. It is fact that non verbal communication means a lot not by words but by their emotions, as it is fact that words of human can tell lie but emotions are natural. Software's now built by developers for such systems and proved to give better results in terms of emotion detection. A system in artificial Intelligence can be built by training model by different inputs and apply knowledge to make a new system. Emotion detection has wide application range like for video games, driver of car, student learning online, market research, medical and health systems etc.

Online or e-learning is one of the important application in which research is required, because it is compulsory to know the student's gauge attending the online class. Many applications like Zoom, Cisco Webex, Google Meet, Skype, and Microsoft Meet are widely used but this application only connects the various participants but this is not able to recognize mindset and interest of present participants. Students those are attentive while attending the class can be considered as students with positive emotions like happy, neutral and surprise, while non-attentive students can be considered with negative emotions like sad, disgust, anger, boredomness etc. In this terms efficiency of teacher teaching in the class and concentration or attentiveness index of learners attending in the class can be calculated to improve Online Education System [8]. It will also make realize both students and faculty member's real situation of the online class for further mentoring in the upcoming sessions.

Figure 1. Conventional method for emotion detection using Convolutional Neural Network



The core work flow for FER i.e. Facial Emotion Recognition mainly deals with three major steps: Face detection, feature extraction and feature classification. Convolutional Neural Network consists of many layers like convolution, pooling and fully connected along with activation function and Softmax. This help in model to extract best features for high accuracy. In order to implement the model computer vision with OpenCV can be used. Computer Vision is technique in which some kind of information can be extracted from the image. The image that is fed results better when it is of good quality in terms of brightness and contrast. Haar cascade function in Open CV is implemented in Python for training model for different negative and positive images. This results in detection of face by making rectangle around the face and can process any kind of images or videos that will be converted into images with the help of key frame extraction [9]. Then features will be extracted and CNN classifier is applied for detection of emotions.

The paper further organized as follows: Section 2 describes the literature survey i.e. work done by other authors in the related field. Next, Section 3 describes about Mathematical formula that is created for calculation emotions mathematically. Section 4 describes about proposed methodology of the proposed problem and at last Section 5 notifies screenshots and discussions about the built model and last, section 6 presents conclusion and future scope of present work.

2. LITERATURE SURVEY

Machine learning means train any model by training sets and deep learning means repeating same task in order to train better and increase the accuracy of the result. Deep learning fields and applications are increasing these days as it extracts best features from the data and also overcome many limitations in terms of technicality. Emotion recognition is one of the trending areas where researchers are working these days. It is good way to connect between human and machines. Many researches already done in the field of recognition of human facial expressions but still there is

chance to improve existing systems. Neural network is used in deep learning for emotion detection and CNN classifier proved to be best fit for emotion recognition. It takes lot of time to load datasets in previous systems but deep CNN with transfer learning technique reduces this time and results better to gain fully connected layer. Some of the related studies which grown through during the work:

G. Hemalatha et. Al (2014) [1], proposed steps and techniques for facial expression using holistic and feature based recognition that is analyzed with various methods of facial detection, facial feature extraction and classification. Methods for face detection that are useful are Distribution features, ASM, Knowledge based, skin based, Facial invariant, Texture based, Template matching, multiple features and Appearance based. Feature extraction techniques like DCT, Gabor filter, Principle Component Analysis, Independent Component Analysis, Linear Discriminant Analysis etc..Feature classification techniques like Neural network, HMM ,SVM, AdaBoost etc. were surveyed and compared.

Nahla Nour et. Al (2020) [2], proposed the Facial Expression Recognition with the use of CNN model with SVM classifier. Three models like Alexnet Model, VGG-16, ResNet models used. CK+ datasets were used to check and predict results. In this study, CNN layers and its uses are described including convolution layer, pooling layer, fully connected layer, softmax classifier, sigmoid function etc. By training and testing with data recognition are classified and performed. AlexNet model with higher accuracy judged in the paper.

In-kyu Choi et. Al (2018) [3], proposed here facial expression recognition method using CNN (Convolutional Neural Network). Different expressions are seen and hence collected and arranged to make a database. Pre-processing and data augmentation steps are also added at initial to improve efficiency and performance. The concept is given as that more numbers of feature map can be adjusted with convolution layer and can be seen in fully connected layer that results in better with less execution time. Multiple use of convolutional layer results better technique for feature extraction. Around 10 different databases used for checking and testing result. FER 2013 database used widely as it contains 37000 different images as expressions.

Weiqing Wang et. Al (2020) [4], proposed the emotion recognition of students by capturing face images of students from camera collected from online class or meeting, like Tencent meeting. These facial expressions are further analyzed and classified. Input images can be in two ways static or dynamic. These images are preprocessed, for facial detection; images were aligned, rotated and resized. Histogram is plotted for expression and complete process of FER is explained with parameters to CNN model like kernel number, kernel size, steps and input size. Input layer here followed in 2 blocks: 2 convolutional layer and 1 max pooling layer 2 fully connected layer and use of dropout to avoid overfitting. Softmax of 60 is opted as activation function for classification of expression. CK+, JAFFE and FER 2013 like datasets used here. The overall result can improve teaching methodologies and online teaching strategies.

Chulapong Panichkriangkrai et. Al (2021) [5], proposed a method to recognize emotions of students in online conference meeting during their e learning. This can be said as internal assessment system that is used to calculate tiredsomeness of students attending class. Boosting face recognition method is suggested here, where continuous evaluation of students will be done during online environment. Hence face on the screen will be captured and after regular span of time emotion will be detected. A technique like UCCF that is current member presented in the class and normal based face detection (NBFD) is used. A conceptual system is that can detect changes through color that change in the students most of the times. Moreover, the proposed system has accuracy 88% around of facial emotion recognition.

Shanmuk Srinivas Amiripalli et. Al (2020) [6], summarized the detection of emotion by capturing image of student by a camera and compute images and consider same as data sets, the fed to the deep learning classifier and then resultant output inputted to the machine learning algorithm in order to check the performance. Datasets divided into training, testing and for validation purposes. These inputs are fed into the deep learning classification algorithms to

assess the behavior of the student and then those outputs are fed into the machine learning algorithms to assess his performance. Algorithms are shown in the form of block diagram. By this, an innovative tool for analysis is developed to recognize and show the best education given by any education system specially engineering.

Uğur Ayvaz et. Al (2017) [7], proposed facial emotion recognition system that give feedback to the educator for their teaching learning process of a class during video conferencing in an online platform. It is a hybrid system for learning that comprises of machine learning and computer vision concept for weighted emotional state to be calculated. kNN and SVM attempts to give best and expected accuracy with such models. An image in format .png or .jpg is taken and image processing process started for detection of emotions. GPU is also required to work on such models. Nowadays NVDIA kit is popular for this work and Open CV & dlib are used along with software packages like Scikitlearn, pandas and numpy.

3. MATHEMATICAL REPRESENTATION

Facial Action Coding system (FACS) is used to mention different face expressions and moments as a number. This is known as Action Units. This AU varies for different body parts such as eyes, head, lips, jaws, eyebrows, shoulders, cheek, nose and chin. Several muscles action movements represent different recognition of emotions. Around 100 action units' numbers are already defined on the muscular basis with identified FACS name [10]. Muscles as group also represents emotions like happiness, sadness, fear, surprise, disgust, neutral, anger etc.

Table 1: Stages of emotions with Membership Function.

Stages	Membership Function
Stage 1: Anger	$\mu_{Anger}(x) = \begin{cases} \frac{x}{0.5}; 0 \le x \le 0.5 \\ \frac{(1-x)}{(1-0.5)}; 0.5 \le x \le 1 \\ 0; x \ge 1 \end{cases}$
Stage 2: Disgust	$\mu_{Disgust}(x) = \begin{cases} 0; x \le 1 \\ \frac{(x-1)}{(1.5-1)}; 1 \le x \le 1.5 \\ \frac{(2-x)}{(2-1.5)}; 1.5 \le x \le 2 \\ 0; x \ge 2 \end{cases}$
Stage 3: Fear	$\mu_{Fear}(x) = \begin{cases} 0; x \le 2 \\ \frac{(x-2)}{(2.5-2)}; 2 \le x \le 2.5 \\ \frac{(3-x)}{(3-2.5)}; 2.5 \le x \le 3 \\ 0; x \ge 3 \end{cases}$
Stage 4: Happy	$\mu_{Happy}(x) = \begin{cases} 0; x \le 3 \\ \frac{(x-3)}{(3.5-3)}; 3 \le x \le 3.5 \\ \frac{(4-x)}{(4-3.5)}; 3.5 \le x \le 4 \\ 0; x \ge 4 \end{cases}$
Stage 5: Sad	$\mu_{Sad}(x) = \begin{cases} 0; x \le 4 \\ \frac{(x-4)}{(4.5-4)}; 4 \le x \le 4.5 \\ \frac{(5-x)}{(5-4.5)}; 4.5 \le x \le 5 \\ 0; x \ge 5 \end{cases}$
Stage 6: Surprise	$\mu_{Surprise}(x) = \begin{cases} 0; x \le 5 \\ \frac{(x-5)}{(5.5-5)}; 5 \le x \le 5.5 \\ \frac{(6-x)}{(6-5.5)}; 5.5 \le x \le 6 \\ 0; x \ge 6 \end{cases}$
Stage 7: Neutral	$\mu_{Neutral}(x) = \begin{cases} 0; x \le 6 \\ \frac{(x-6)}{(7-6)}; 6 \le x \le 7 \\ 1; x \ge 7 \end{cases}$

In the same context, mathematical formula is generated to calculate different emotions for facial expressions that is present by the combination of expressions like lips, mouth, eyes, eye brows etc.. The present work relates to a calculation through fuzzy logic system for emotion detection. It is known that, Fuzzy logic control is a system that controls based on 0 i.e. false and 1 i.e. false. It is an approach that makes human being think of controlling best for any system. Fuzzification is the technique that is further mentioned to evaluate membership function. Variables can be best controlled by fuzzification. Fuzzification is process that is root with applying basic rules and this is system to prepare any decision with inputted rules. Membership function is generally triangular or bell shaped that can presented by plotting graphs.

Below are some rules that is to be considered [11][14][15]:

• If (upper eyelids pulled up, lower eyelids pulled up, Lowered and knit together, staring intensely) and (margins of lips rolled in lips may be tightened) and (One side of the mouth raised) then (Stage 1 is Anger).

• If (upper eyelids pulled up, lower eyelids pulled up, Lowered and knit together) and (Eyebrows pulled down) and (margins of lips rolled in lips may be tightened) then (Stage 2 is Disgust).

• If (Eyebrows pulled down) and (lip stretcher) and (mouth stretched, Open mouth) then (Stage 3 is Fear).

• If (Muscle around the eyes tightened, "crows feet" wrinkles around the eyes) and (lip corners raised diagonally) and (Raised corners) then (Stage 4 is Happy).

• If (Raised and arched eyes) and (lip corners raised diagonally) and (Raised corners) then (Stage 4 is Happy).

• If (Inner corners of eyebrows raised, eyelids loose, Lowered and knit together, looking away) and (lip corners pulled down) and (Corners that are drawn down) then (Stage 5 is Sad).
• If (Raised and arched eyes, eyelids pulled up) and (lips part) and (mouth hangs open, A dropped jaw) then (Stage 6 is surprise).

4. MEMBERSHIP FUNCTIONS FOR DIFFERENT FACE PARTS

4.1 Membership functions for Eyes

Table 2: Eyes Membership function

INPUT FIELD	RANGE	SET	Abbreviation
Eyes	<30	upper eyelids pulled up lower eyelids pulled up Lowered and knit together Staring intensely	E_U&LEPu
	20-50	Muscle around the eyes tightened, "crows feet" wrinkles around the eyes	E_M&Crows
	50-70	Raised and arched eyes eyelids pulled up pupils dilated	E_R&Pu
	>70	looking away	E_LA

Table 3: Eyes Membership function Formula

E_U&LEPu	E_M&Crows	E_R&Pu	E_LA
$\mu_{E\_U\&LEPu}(x)=\begin{cases}\frac{x}{15};0\le x\le 15\\ \frac{(30-x)}{(30-15)};15\le x\le 30\\ 0;x\ge 30\end{cases}$	$\mu_{E\_M\&Crows}(x)=\begin{cases}0;x\le 20\\ \frac{(x-20)}{(35-20)};\\ \frac{(50-x)}{(50-35)};\\ 0;x\ge 50\end{cases}$	$\mu_{E\_R\&Pu}(x)\begin{cases}0;x\le 50\\ \frac{(x-50)}{(60-50)};50\le x\le 60\\ \frac{(70-x)}{(70-60)};60\le x\le 70\\ 0;x\ge 70\end{cases}$	$\mu_{E\_LA}(x)=\begin{cases}0;x\le 70\\ \frac{(x-70)}{(80-70)};70\le x\le 80\\ 1;x\ge 80\end{cases}$

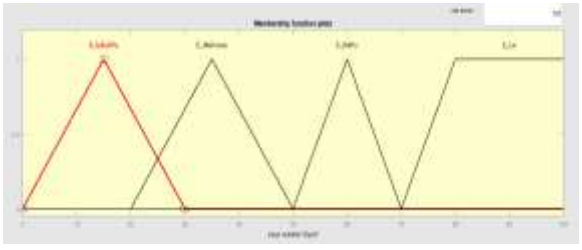


Figure 2. Resultant graph for Eyes

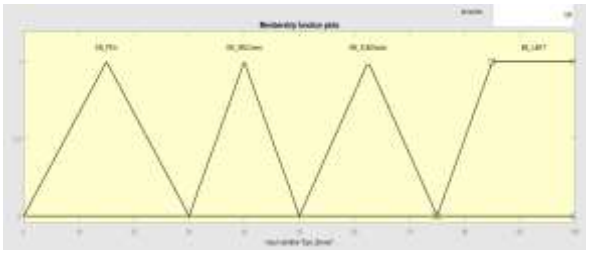


Figure 3. Resultant graph for Eye Brows

4.2 Membership functions for Eye Brows

Table 4: Membership Functions for Eye Brows

Input variable	**Linguistic variables and their ranges**		
INPUT FIELD	RANGE	SET	Abbreviation
Eye brows	<30	Eyebrows pulled down	EB_PDn
	30-50	Muscle around the eyes tightened, "crows feet" wrinkles around the eyes	EB_M&Crows
	50-75	Inner corners of eyebrows raised eyelids loose	EB_IC&Eloose
	>70	Lowered and knit together	EB_L&KT

4.3 Membership functions for Lips

Table 5: Membership Functions for Lips

Input variable	**Linguistic variables and their ranges**		
INPUT FIELD	RANGE	SET	Abbreviation
Lips	<20	margins of lips rolled, lips may be tightened.	L_M&LT
	20-30	lip stretcher	L_LS
	30-45	lip corners raised diagonally	L_CRDi
	45-70	lip corners pulled down	L_CDn
	>70	lips apart	L_Pr

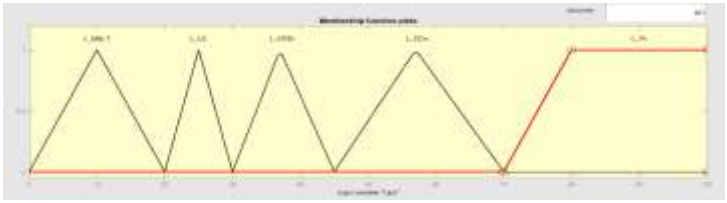


Figure 4. Resultant graph for Lips

Table 6: Eye Brows Membership function Formula

EB_PDn	EB_M&Crows	EB_IC&Eloose	EB_L&KT
$\mu_{EB\_PDn}(x)=\begin{cases}\frac{x}{15};0\le x\le 15\\ \frac{(30-x)}{(30-15)};15\le x\le 30\\ 0;x\ge 30\end{cases}$	$\mu_{EB\_M\&Crows}(x)=\begin{cases}0;x\le 30\\ \frac{(x-30)}{(40-30)};30\le x\le 40\\ \frac{(50-x)}{(50-30)};40\le x\le 50\\ 0;x\ge 50\end{cases}$	$\mu_{EB\_IC\&Eloose}(x)=\begin{cases}0;x\le 50\\ \frac{(x-50)}{(62.5-50)};50\le x\le 62.5\\ \frac{(75-x)}{(75-62.5)};62.5\le x\le 75\\ 0;x\ge 75\end{cases}$	$\mu_{EB\_L\&KT}(x)=\begin{cases}0;x\le 75\\ \frac{(x-75)}{(85-75)};75\le x\le 85\\ 1;x\ge 85\end{cases}$

Table 7: Lips Membership function Formula

L_M&LT	L_LS	L_CRDi	L_CDn	L_Pr

$\mu_{L\_M\&LT}(x)=\begin{cases}\frac{x}{10};0\le x\le 10\\ \frac{(20-x)}{(20-10)};10\le x\le 20\\ 0;x\ge 20\end{cases}$	$\mu_{L\_LS}(x)=\begin{cases}0;x\le 20\\ \frac{(x-20)}{(25-20)};20\le x\le 25\\ \frac{(30-x)}{(30-25)};25\le x\le 30\\ 0;x\ge 30\end{cases}$	$\mu_{L\_CRDi}(x)=\begin{cases}0;x\le 30\\ \frac{(x-30)}{(37-30)};30\le x\le 37\\ \frac{(45-x)}{(45-37)};37\le x\le 45\\ 0;x\ge 45\end{cases}$	$\mu_{L\_CDn}(x)=\begin{cases}0;x\le 45\\ \frac{(x-45)}{(57-45)};30\le x\le 57\\ \frac{(70-x)}{(70-57)};57\le x\le 70\\ 0;x\ge 70\end{cases}$	$\mu_{L\_fy}(x)=\begin{cases}0;x\le 70\\ \frac{(x-70)}{(80-70)};70\le x\le 80\\ 1;x\ge 80\end{cases}$

Table 8: Mouth Membership function Formula

M_1SMR	M_S&Op	M_RC	M_CDn	M_MHO&DJ
$\mu_{M\_1SMR}(x)=\begin{cases}\frac{x}{10};0\le x\le 10\\ \frac{(20-x)}{(20-10)};10\le x\le 20\\ 0;x\ge 20\end{cases}$	$\mu_{M\_S\&Op}(x)=\begin{cases}0;x\le 20\\ \frac{(x-20)}{(25-20)};20\le x\le 25\\ \frac{(30-x)}{(30-25)};25\le x\le 30\\ 0;x\ge 30\end{cases}$	$\mu_{M\_RC}(x)=\begin{cases}0;x\le 30\\ \frac{(x-30)}{(40-30)};30\le x\le 40\\ \frac{(50-x)}{(50-40)};40\le x\le 50\\ 0;x\ge 50\end{cases}$	$\mu_{M\_CDn}(x)=\begin{cases}0;x\le 50\\ \frac{(x-50)}{(65-50)};30\le x\le 65\\ \frac{(80-x)}{(80-65)};65\le x\le 80\\ 0;x\ge 80\end{cases}$	$\mu_{M\_MHO\&DJ}(x)=\begin{cases}0;x\le 80\\ \frac{(x-80)}{(85-80)};80\le x\le 85\\ 1;x\ge 85\end{cases}$

4.4 Membership functions for Lips

Table 9: Membership function for Mouth

Input variable	**Linguistic variables and their ranges**		
INPUT FIELD	RANGE	SET	Abbreviation
Mouth	<20	One side of the mouth raised	M_1SMR
	20-30	Mouth stretched, Open mouth	M_S&Op
	30-50	Raised corners	M_RC
	50-80	Corners that are drawn down	M_CDn
	>80	mouth hangs open, A dropped jaw	M_MHO&DJ

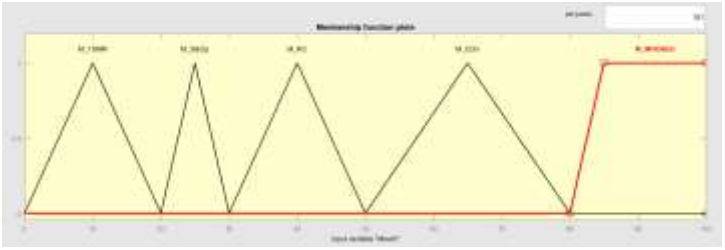


Figure 5. Resultant graph for Mouth

4.5 Output Variable

Table 10: Output Variable with Range and Sets

INPUT FIELD	RANGE	SETS
STAGE	<1	Stage 1: Anger
	1-2	Stage 2: Disgust
	2-3	Stage 3: Fear
	3-4	Stage 4: Happy

	4-5	Stage 5: Sad
	5-6	Stage 6: Surprise
	>6	Stage 7: Neutral

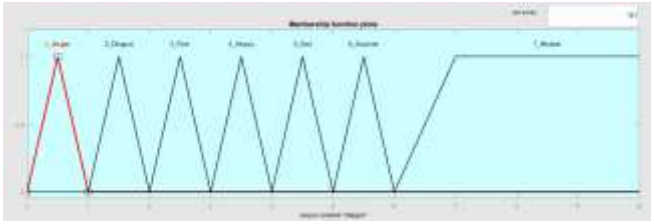


Figure 6. Membership function for Output Variable

5. METHODS AND FLOW DIAGRAM OF WORKING MODEL

Initially input given to the prepared model and at last different emotions for particular image will be generated. Here input can be given either from datasets like FER2013, CK+, JAFFE etc. or it will be taken from live recording and videos during online learning either from Zoom meeting, Cisco Webex, Google meet, Microsoft Team etc. Then input will be preprocessed and key frame structure will be applied; videos will be converted into gray images. These images will further taken as an input for feature extraction method where face is detected by using HAAR cascade method [12]. All images will be equally sized of 48x48 resolutions.

Open CV, Keras, TensorFlow, Numpy, pickle, sklearn, etc. python libraries are used during the implementation. The model after implementation is tested on online learning of students of different age groups like kindergarten (2-5 Years), primary (5-12 Years), juniors (12-18 Years), adult (18-24 Years) and company employees (25-60 Years) for different emotions prediction.

Now Convolution Neural Network classifier is applied for recognition of emotions. Convolution layers helps in working with large sets of images of datasets with best accuracy, along with this pooling layer with kernel function, flatten layer and fully connected i.e. dense layer is also added. Images are divided into two parts i.e. training sets (75%) and testing part (25%). Figure 7 represents how build model work like. First of all, new session can be recorded by giving name to the session as class1, class2, class3 etc. As soon as class prepared press start button to capture the images of students for emotion recognition those are present in the class. After some period of sufficient recording stop button can be pressed. Now recorded large number of images then clustered into groups by selecting class from session records. These results in clusters of different students/learners and later by pressing recognition button, emotion recognition will start and it will give message when recognition will complete. At last all clustered images will be seen with images captioned with different emotions like happy, neutral, sad, anger, surprise, disgust, fear etc.

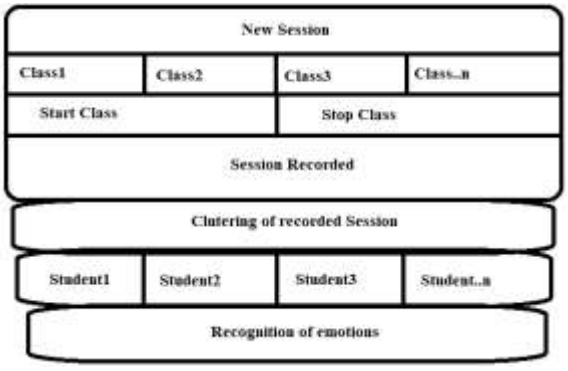


Figure 7. Find emotions in developed python model ConvEmo

6. MODEL RESULTS WITH SCREENSHOTS

6.1 Step 1: Run the main python file in which model is built.

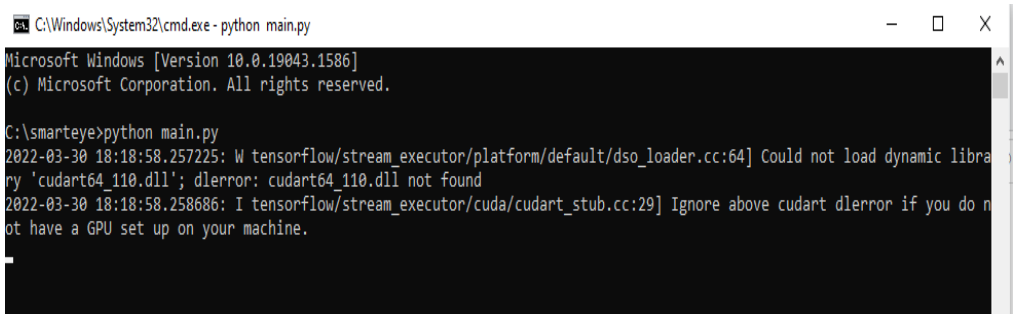


Figure 8. Screenshot of first step to run the main file of built model ConvEmo

6.2 Step 2: Option to start new session of class to check record student's faces from online class.

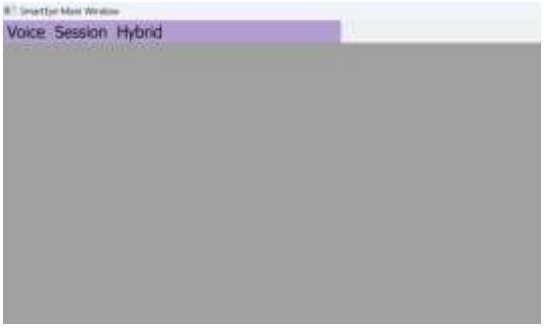


Figure 9. Screenshot of second step to go to session option

Figure 10. Screenshot of second step to either select recorded session or start new session

6.3 Step 3: When new session is selected, it is mandatory to give session title that contains start and stop button to record session. Here, it will be also showing the total recorded time by the user.

Figure 11. Screenshot of third step showing recording new session with title name

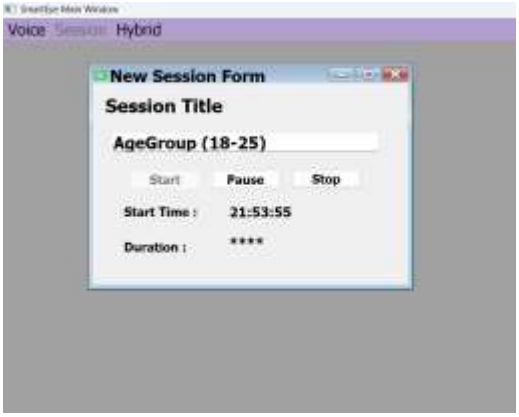


Figure 12. Screenshot of third step with session title name, start time and duration of recording

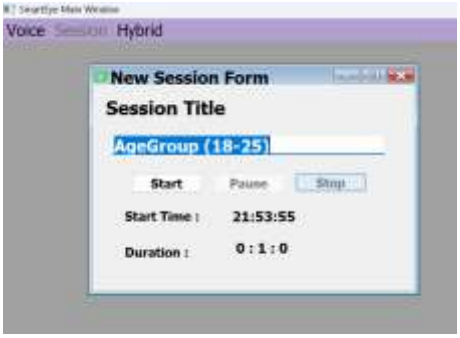


Figure 13. Screenshot of third step with session duration while pressing stop button

6.4 Step 4: One again select session record option by clicking session for selecting needed session title. Here all faces will be recorded as captured during the online meeting. Now click on cluster option, so that same images can be clubbed and form cluster that named as student1, student2...upto different numbers of identified images.

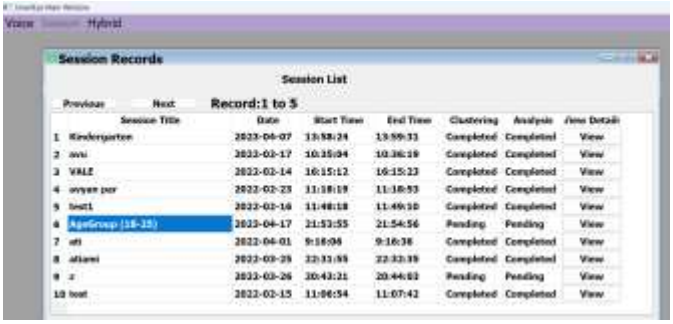


Figure 14. Screenshot of fourth step showing all the recorded sessions for testing the model (press view button for particular session)

6.5 Step 5: When working with the new session, cluster button already used in Step4 for clustering the similar images of single student. Once the clustering over's, recognition button will be enabled to identify different emotions on the face of students.

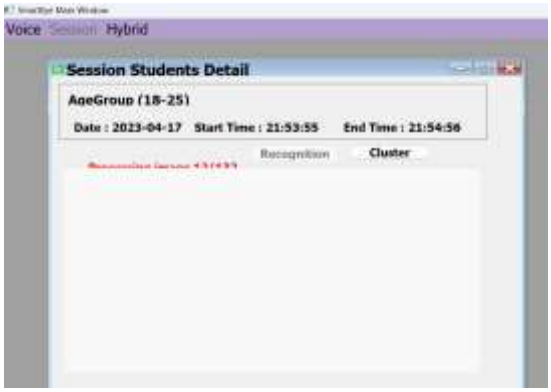


Figure 15. Screenshot of next step showing processing of images for clustering

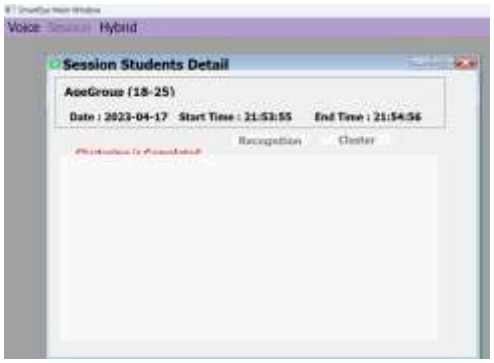


Figure 16. Screenshot of next step for recognition of emotions from clustered images

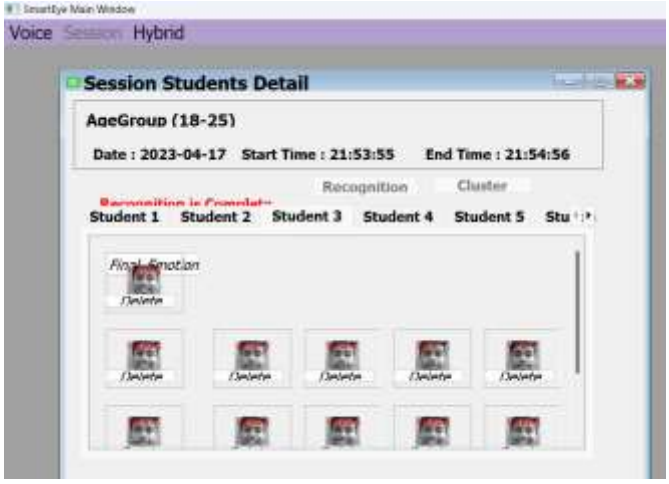


Figure 17. Screenshot of next step with images of students learning online with different identified images

6.6 ConvEmo Model with FER 2013 datasets

Now checking accuracy of the model with the help of FER 2013 datasets.

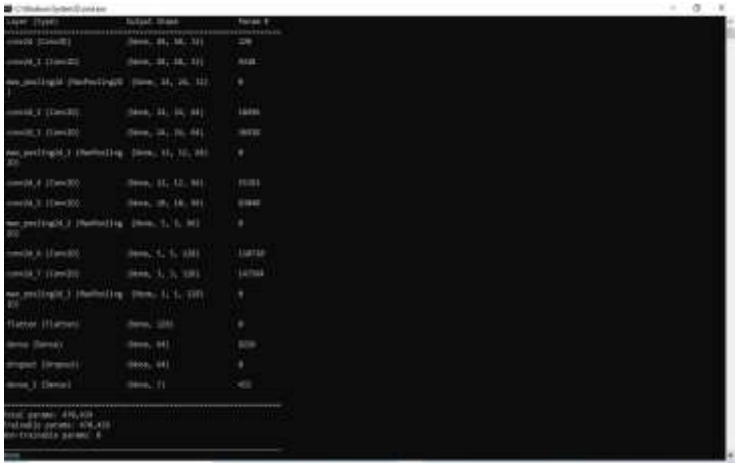


Figure 18. Screenshot of prepared model for best results showing layers of ConvEmo model

Figure 19. Screenshot of model showing accuracy for FER2013 datasets 98.49%

7. CONCLUSION AND FUTURE SCOPES

Different behaviors represented by learners while learning specially in online class. Due to difference of age groups, a reaction of learners varies. When the matter is about Kindergarten, concentration index of students found quite low as distraction from class found more in Kindergarten students. Primary students in comparison found less distractive with little high concentration index and juniors and adults are comparatively represented better concentration index with more positive emotions. Company
employees are more neutral while learning because they attend learning problems with all eyes. So, by applying deep learning techniques of machine learning with face recognition system better identifies the emotions of the students who are learning in the class. This is the best way to give real feedback both to students and faculties how attentive they are in class by attending and delivering the topics. It throws back the normal pen and paper feedback method in which students may write wrong feedback to impress faculty members. Mathematical formula generation put the best efforts in finding the emotions.

Sometimes it happens that facial expressions may not always up to the marks, so to make this system better one, emotion recognition through speech will also be added to this system. Because, it is known that speech is one in which various factors like jitter, frequency, pitch and energy can be identified. By making the hybrid system in future, results can be made better. This system will be helpful for teachers and trainers taking classes online to understand their attentiveness in the class. This paper gave us membership formulae through which emotions are detected and verified with different organs like lips, mouth, eyes and eyebrows.

CONFLICTS OF INTEREST

There is no conflict of interest between the authors. On behalf of all authors, the corresponding author states that there is no conflict of interest. No funding involved in this.

DATA AVAILABILITY STATEMENT

The datasets analyzed during the current study are available in the [KAGGLE] repository, https://www.kaggle.com/datasets/msambare/fer2013 and live data is taken during the zoom meeting with participants.

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