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Evaluation of Activity Monitoring Algorithm based on Smart Approaches

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Abstract: Activity monitoring in online group meetings has become a needed application in the COVID-19 situation. During the lockdown period, most of the teaching classes were conducted through online web applications. The number of attendees in such classes are very higher and it is not to be manageable by a single tutor of the class. The applications are also designed to show only several number of person's faces in a particular window. To improve the quality of such online classes, it is mandatory to verify the listener's activity. The paper evaluates certain artificial intelligence based deep learning techniques for finding a suitable approach for monitoring the listener's activity in real time.

Keywords: Facial emotion detection, deep learning classification, class monitoring algorithm, group meeting emotion detection.

Introduction

Facial emotion detection is a broad and recent topic in research to analyze the mentality of a person. These kind of detection algorithms were also used on several applications to monitor the physical activities. Now, the researches are extended to monitor the physical activity of an online listener. This improves the outcome of the online teaching process. At present the online classes are evaluated from the feedbacks collected from the listener. This analyze help to evaluate only the tutor side performance. To verify the class observation, certain questioner methods are followed by the online class conductors to validate the listener's performance. Figure 1 indicates the architecture of an online teaching class.

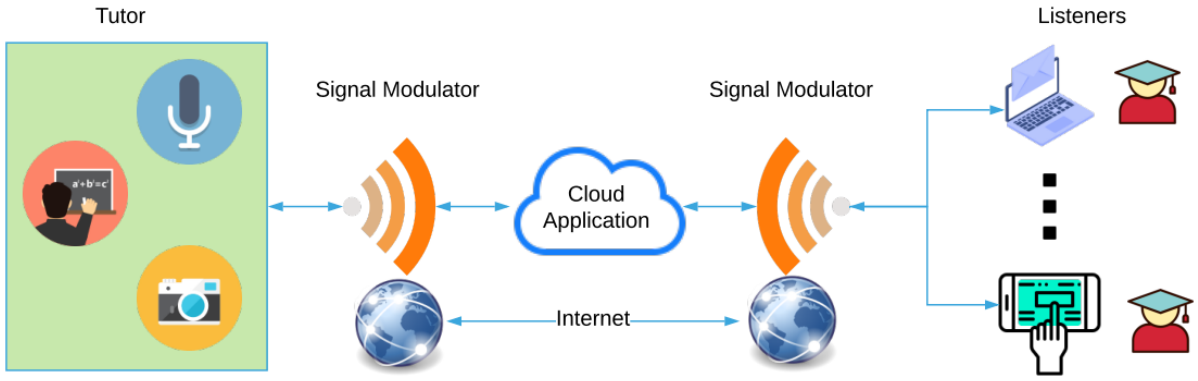

Figure 1. Architecture of online teaching class.

The architecture can be broadly splitted in to tutor section and listener section. Both of these two sections are connected with internet connection. The data transmitted from those sections are consolidated in the cloud area for saving purpose. The data from the cloud storage can also be accessible by both section people. There are certain applications developed in recent years to make the cloud storage to be more convenient to the users. Such applications

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transmits the speech and video signals to the cloud space through signal modulators for encoding the data. So that the data can be securely placed in the cloud for longer time.

The proposed work is developed as a listener side add-on algorithm for the cloud application. The algorithm segregates the activity of the listener by taking several screenshots at the time of streaming the class with certain interval of time. In order to enable such artificial intelligence to the algorithm for segregating the screenshot images, an appropriate algorithm is need to be defined. The task is achieved by training several deep learning algorithms with the dataset images for selecting an optimum technique.

Related work

The section shows several existing methods of deep learning algorithms taken for facial emotional studies with their limitations and achievements. A facial emotion detection technique [1] based on modified eyemap and mouthmap algorithm was proposed to find the landmarks on face. Then the neural network was used to classify the images from the identified landmarks. The algorithm was verified with tensor flow version for analyzing the emotion detection. A biometric recognition technique based on capsule networks [2] was designed to perform with retinal images. The technique utilizes capsule network because of its improved learning nature with lesser sample data. The technique was verified with face 95 dataset along with CASIA iris database to measure the accuracy of the system. An extended deep convolution neural network was developed to classify six facial emotions [3]. The model was analyzed with CK+ and JAFFE dataset for training and testing the developed model. The images were preprocessed with intensity normalization before training the images. The model shows better accuracy over certain existing models.

The major difference between the deep learning algorithms and traditional learning algorithms are their feature extraction process. The traditional learning algorithm utilizes the manual feature extraction process for learning features from the desired images, while in deep learning the algorithm learns the features on its own [4]. A facial emotion recognition method was framed using convolution neural network [5]. The method extracts facial features by removing the background presence in an image. The accuracy of the method varies with respect to different datasets. To the maximum it obtained 96 percentage of accuracy in NIST database. A smart security system was created to identify suspicious activity in a public place [6]. The system was employing a motion sensor for physical movement verification to enable the face identification algorithm. The system was verified with real time video recordings using python program. A convolution neural network based ResNet deep learning framework was structured [7] to classify six category of emotions from FER database. A self- attention block was added to the framework for providing visual ability to the network algorithm. A smart image processing algorithm was designed to recognize text features from an image for extracting information for vocalization [8]. Here the features are extracted from a preprocessed image for better learning process. The feature extracted images are also further post processed to classify the image features in a better way.

An emotion understanding algorithm from text [9] was proposed based on big data analytics with deep learning networks. The method was developed as a semi-automatic algorithm for training the text features to the classifiers and the method was developed to classify sad, happy and angry emotions from the given text. An artificial intelligence based education system along with student evaluation algorithm [10] was designed to automate the education process. For that the algorithm was modeled by training learner model program along with the pedagogy model programs. An emotion detection algorithm based on convolution neural network [11] was framed to classify facial emotions from real time images. The algorithm was tested with eight different datasets along with self-made dataset. The accuracy level of the algorithm varies with respect to the emotions and datasets. The learning complexity of artificial intelligence algorithms are rises due to high sear optimization of features from an image [12]. So it is always must to choose a better and specific feature extraction method and classifier for a particular task.

To enhance the performance of facial recognition system a multi-stage progressive transfer learning method [13] was structured. The method is a supervised one to train the images with AlexNet deep network. It is designed to extract features from normal and challenging images. The results indicates that the developed model performs well than the traditional transfer learning methods. Capsule network is a latest emerging algorithm network for designing the deep learning architectures with lesser training data [14]. The network structure performs better when the number of samples are increased to training. A classification algorithm based on capsule network was designed to extract

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noisy features from an image was developed with lesser data [15]. A recommendation system based on gaze has been proposed [16] by detecting emotions on human face. The design has a webcam for capturing the faces at real times and it analyses the facial references point to calculate the facial emotions.

Proposed Method

The proposed activity monitoring system architecture is shown in figure 2. The architecture consists of camera and cloud storage unit for saving the captured images at several interval. The images can be further retrieved to the local data storage unit through internet connection. The images in local data storages device can be used for training the classifier. After completing the training process the classifier will gets the ability to classify the images on their respective emotions. The classifier is designed with an unsupervised training algorithm. Instead of using the physical data storage.

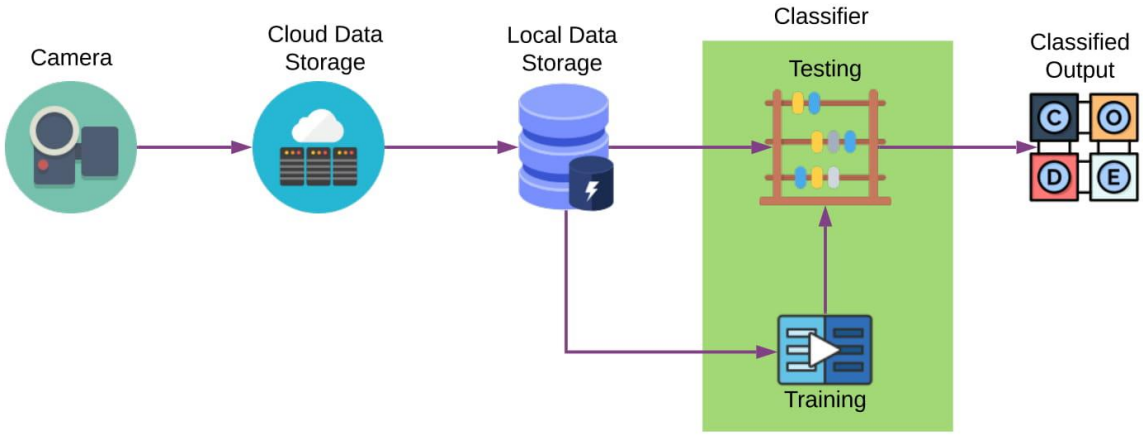

Figure 2. Architecture of the proposed activity monitoring system.

The algorithms are verified with a JAFFE dataset. The dataset consists of 213 images of seven facial emotions. The sixty percentage of each emotions are taken for training the algorithms and remaining are utilized for testing the algorithms. The evaluation process of the proposed model is verified with convolution neural network (CNN), decision tree (DT), K-nearest neighbor (KNN) and capsule networks (CapsN). The convolution neural networks are the basic algorithms in the deep neural networks widely used for classifying the images. The convolution neural network has the in-built ability to classify the images without supervision. Hence the convolution neural network was taken to evaluate in the proposed model. The mathematical representation of the convolution is expressed as below.

$$(x * y)(t) = \int_{-\infty}^{\infty} x(\tau)\, y(t-\tau) d\tau$$

The decision tree is another basic and familiar algorithm used to classify the images in a different way. The classification types are first learned by the network architectures by their major features in the decision tree. Then the hidden features are termed as like to the following major features as sub-features of an image. So that the classification output from the decision tree algorithms are always comparatively better than several network algorithms. Hence the decision tree algorithm is also taken here for comparing the classification accuracy. The entropy and information gain of the decision tree algorithm is calculated as by the following equations.

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$$E(d) = \sum_{i=1}^{n} -p1log2p1$$

$$G(x,y) = E(d) - \sum_{n} \frac{S_n}{S} E(S_n)$$

Where,

n stands for number of classes, which is 7 in the proposed work.

P indicates the number of instance happening in the network and

S_n notes the combination of instance attributes in y.

The KNN is a competitive algorithm in image classification, which predicts the classification by the comparing the observed values from the testing data. The observed values are taken to compare with the learned data from the training samples. The KNN algorithm always takes the identified pixel value from the testing images to the dataset for verifying. Hence the algorithm prediction will be always good on some specific classification process. The closeness of the data values are measured by the following equation.

$$K(x,y) = K(y,x) = \sqrt{\sum_{i=1}^{c} (xi - yi)^2}$$

Capsule network is the sub class of artificial neural network. It works contrast to the convolution neural networks by predicting the samples in to several class for closer combination. The process is stated as dynamic routing. It helps the sample to be classified in to a particular class by verifying its feature for multiple times. This improves the accuracy of the classification process with lesser dataset. Hence capsule network always gives better accuracy over several algorithms. The squashing function of the capsule network is represented as,

$$Cj = \frac{||Vj||^2}{1 + ||Vj||^2} \frac{Vj}{||Vj||}$$

Methodology

The JAFFE dataset is utilized in the proposed work for training and testing purpose. The total images are partitioned in to sixty forty ratio for training and testing. There are seven numbers of emotions are available in the dataset. So the images are partitioned with emotion wise from the dataset. The sample images of the dataset is shown the figure 3. The images are first preprocessed into specific form to learn the features in a better way before forwarding it to the classifier for learning and testing.

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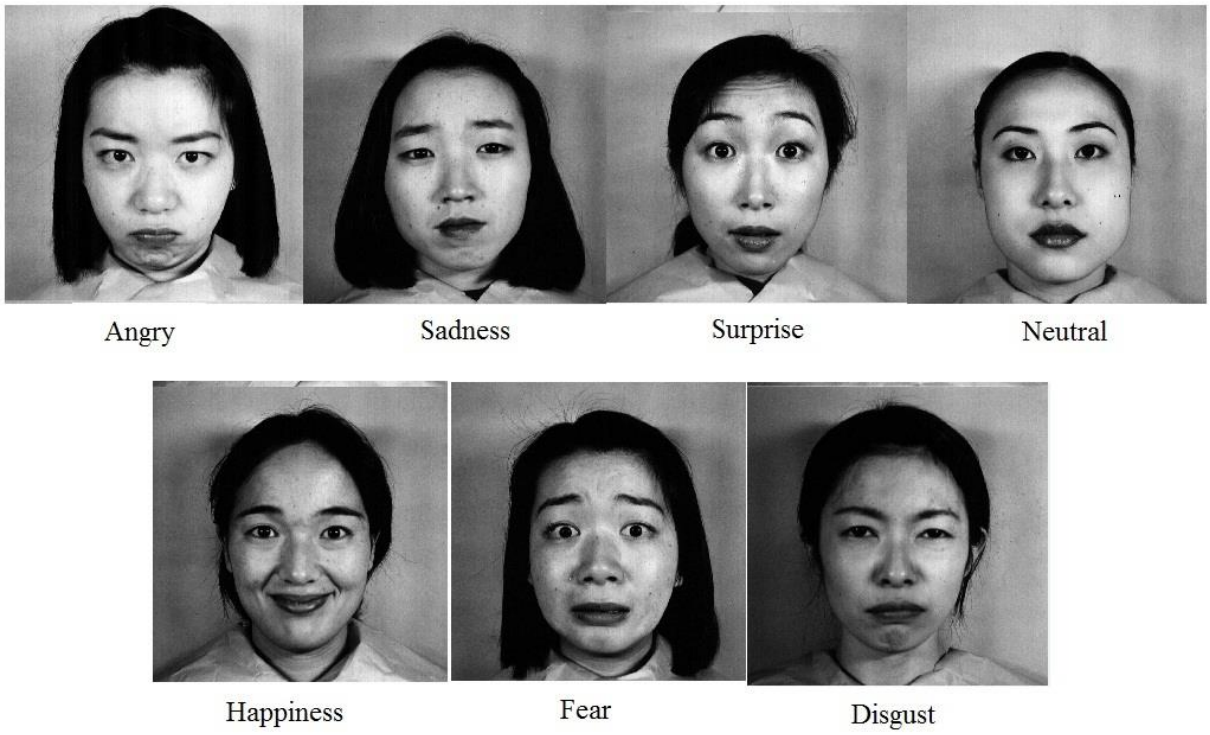

Figure 3. Sample dataset.

Experimental Results

The JAFFE dataset is analyzed with the mentioned algorithms for evaluating the betterment of algorithm nature. From the table 1 and figure 4, the accuracy and several analyzing parameters of classification algorithms are observed. In that the accuracy of the CapsN looks higher than all the other algorithms but in case of sensitivity and recall the CapsN goes average than the decision tree algorithm. Similarly the precision and specificity are higher in the convolution neural networks but the accuracy level of CNN is lesser than the CapsN. So that with respect to the accuracy and precision the CapsN can be used for emotional classification process.

Table 1. Result analysis of the classification algorithms.

	Accuracy	**Sensitivity**	**Specificity**	**Precision**	**Recall**
CNN	88.37209	91.139241	57.142857	96	36.36364
DT	84.88372	98.591549	20	85.36585	75
KNN	89.53488	96.153846	25	92.59259	40
CAPSN	94.18605	97.560976	25	96.38554	33.33333

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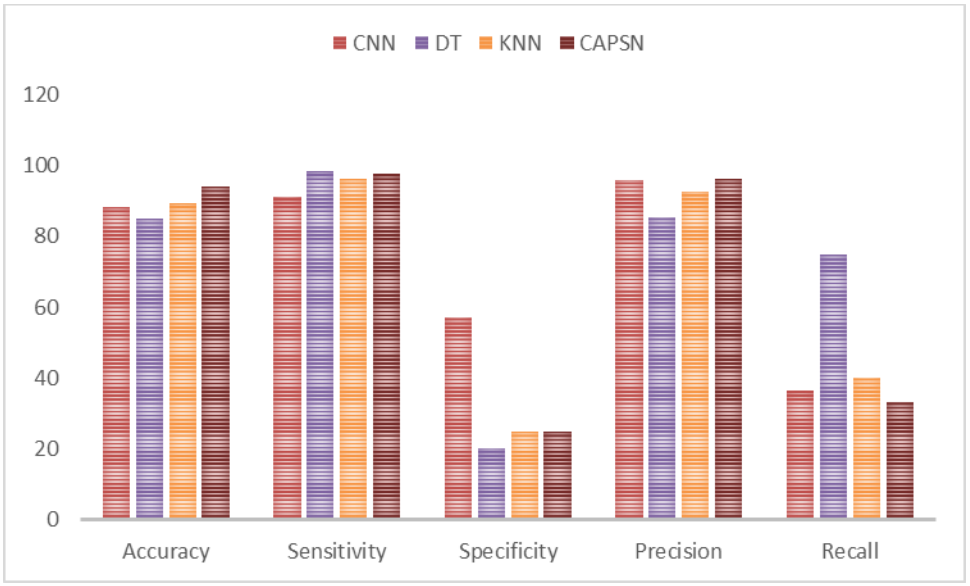

Figure 4. Result comparison chart of classifiers.

The class wise accuracy of the classifiers are also compared between the classifiers in the figure 5. Where as in accuracy, the CapsN is almost coincides with the KNN at three classes. In the remaining four classes the accuracy of CapsN is better in major classes. Also the precision of the KNN is comparatively lesser than the CapsN. Hence the work evaluation suggests the CapsN for face emotional classification. The computational time of the KNN is also comparatively vey higher than the CapsN. The KNN always compares its each layer of features with the dataset. So that it takes more time for the analysis. This is eliminated in CapsN, here the features are compared with the extracted features saved in the network itself. Hence the computational is also lesser in the CapsN when comparing with the KNN.

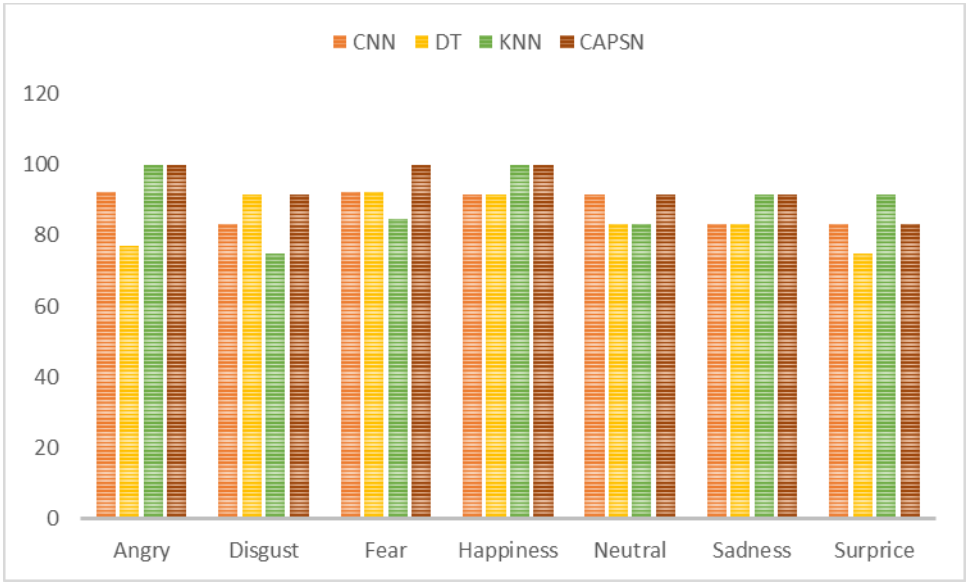

Figure 5. Class wise accuracy of the classifiers.

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Conclusion

The paper evaluates several classification algorithms for activity monitoring purpose. Here the emotional activity of human faces are classified with several deep learning algorithms for identifying an optimum approach for future work in class monitoring applications. The evaluation was undertaken with JAFFE dataset on CNN, KNN, DT and CapsN for analysis purpose. As the JAFFE dataset has small number of images it performs well with the CapsN dataset. The decision may be changed when the classifiers are verified with different kind of datasets. The research work is further extend to analyze the classification process from the cloud data itself. So that it improves the feasibility of the class monitoring architecture. Also it will reduces the space requirement of the dataset storage and it will also improves the computational speed of the classifiers.

References

1. Joseph, Allen, and P. Geetha. "Facial emotion detection using modified eyemap–mouthmap algorithm on an enhanced image and classification with tensorflow." The Visual Computer 36, no. 3 (2020): 529-539.
2. Jacob, I. Jeena. "Capsule network based biometric recognition system." Journal of Artificial Intelligence 1, no. 02 (2019): 83-94.
3. Jain, Deepak Kumar, Pourya Shamsolmoali, and Paramjit Sehdev. "Extended deep neural network for facial emotion recognition." Pattern Recognition Letters 120 (2019): 69-74.
4. Bashar, Abul. "Survey on evolving deep learning neural network architectures." Journal of Artificial Intelligence 1, no. 02 (2019): 73-82.
5. Mehendale, Ninad. "Facial emotion recognition using convolutional neural networks (FERC)." SN Applied Sciences 2, no. 3 (2020): 1-8.
6. Chen, Joy Iong Zong. "Smart Security System for Suspicious Activity Detection in Volatile Areas." Journal of Information Technology 2, no. 01 (2020): 64-72.
7. Gupta, Arpita, Subrahmanyam Arunachalam, and Ramadoss Balakrishnan. "Deep self-attention network for facial emotion recognition." Procedia Computer Science 171 (2020): 1527-1534.
8. Manoharan, Samuel. "A Smart Image Processing Algorithm for Text Recognition Information Extraction and Vocalization for the Visually Challenged." Journal of Innovative Image Processing (JIIP) 1, no. 01 (2019): 31-38.
9. Chatterjee, Ankush, Umang Gupta, Manoj Kumar Chinnakotla, Radhakrishnan Srikanth, Michel Galley, and Puneet Agrawal. "Understanding emotions in text using deep learning and big data." Computers in Human Behavior 93 (2019): 309-317.
10. Kumar, NM Saravana. "Implementation of artificial intelligence in imparting education and evaluating student performance." Journal of Artificial Intelligence 1, no. 01 (2019): 1-9.
11. Jaiswal, Shruti, and G. C. Nandi. "Robust real-time emotion detection system using CNN architecture." Neural Computing and Applications (2019): 1-10.
12. Raj, Jennifer S. "A comprehensive survey on the computational intelligence techniques and its applications." Journal of ISMAC 1, no. 03 (2019): 147-159.
13. Aly, Sherin F., and A. Lynn Abbott. "Facial emotion recognition with varying poses and/or partial occlusion using multi-stage progressive transfer learning." In Scandinavian Conference on Image Analysis, pp. 101-112. Springer, Cham, 2019.
14. Smys, S., Joy Iong-Zong Chen, Shahed Mohammadi, and Álvaro Rocha. "Capsule networks and autonomous systems." International Journal of Intelligent Unmanned Systems (2019).
15. Koresh, H., James Deva, and Shanty Chacko. "Classification of noiseless corneal image using capsule networks." SOFT COMPUTING (2020).
16. Jaiswal, Saurabh, Shubham Virmani, Vishal Sethi, Kanjar De, and Partha Pratim Roy. "An intelligent recommendation system using gaze and emotion detection." Multimedia Tools and Applications 78, no. 11 (2019): 14231-14250.

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