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Review Article

EMOTION DETECTION USING FCM FOR CONTROLLING DEVICES

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ABSTRACT

The human face is the most important and significant bodily part that contributes greatly to both human-to-human and human-to-machine communication. We always recognize a person by their face, from which we can infer their gender, extrapolate their age, and also deduce certain cultural traits. The technology we use most frequently today is face detection, and a number of programs need to be able to recognize emotions. The prevalent models do not use feelings to regulate device operation; instead, they rely on facial function identification from a whole image, which has a low accuracy level. The suggested module gathers photos from a camera or a database, recognizes faces, and then extracts features to build a powerful emotion detection tool for practical applications. Fuzzy clustering is used to identify different human emotions including happiness, sadness, and fear while managing the technology. These robust devices are made to be employed in successful human–computer interaction and human decision-making.

Keywords: Neural networks, Machine learning, Fuzzy C-means, Weber's local descriptor, Convolutional neural networks.

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INTRODUCTION

Facial expression is the most and natural means of non-verbal communication for communicating among personalities. During this analysis, we tightly hinge on the prevailing models by applying tech called fuzzy agglomeration to not solely defect the actual face expression but also to regulate devices. Recognition has a great effect which admits the flexibility of PCs to seek attention of human-human communication. Human-to-machine interactions would use the associate degrees to sense the person's behavior, so that it will be reacting consequently. Our challenge is to construct sturdy and real-time automatic system to trace the facial expressions. The flexibility to spot an associate degree verifies one's emotions, it will function as authorization for the sector like AI and provides rise to smarter machines. In recent times, various computer vision technologies have been developed for recognition purposes.

Therefore, human–machine communication is highly beneficial in fields as diverse as computing technology, medicine, and [6,7] security applications such as research on pain and depression, health supporting appliances which monitor stress, fatigue, and so on. Due to this level of practical importance, facial recognition has become a need. Facial expression recognized by smart machines has attracted the interest of many cognitive researchers from the fields such as artificial intelligence and many.

This sturdy proposes a stable and reliable algorithm for a systematic clustering called Fuzzy C-means clustering. The usage of this algorithm is due to the reduced computational time. This algorithm depends on concept called Fuzzy C-partition. First, in this algorithm, the final output converges to actual cluster center. Hence, choosing a good set of initial clusters is very important for Fuzzy C means clustering (FCM) algorithm. We proposed a reliable method for efficient clustering which improves the standard and performance. Experimental results state that the proposed system attains better performance than skin probability map method. This method is capable of teaching and guiding people with Autism on how to react consequently as they always use non-verbal communication.

SYSTEM DESIGN

Existing system

Automatic systems used to detect the human facial expression have always been a challenge while using on many real-time applications. Most of the existing automated systems attempt to recognize few classic emotional expressions such as happiness, fear, angry, sad, and so on [1]. In this existing system, some papers proposed a convolutional neural networks (CNNs) based deep learning architecture for emotion from images, but this method needs lots of training data [2]. Numerous steps feature selection and extraction, classification using two-layer perceptron. However, this method has low level of recognition rate [3]. The network build is based on CNN which has reduced parameters. Custom dataset is built in their laboratory However; this method cannot recognize full range of behaviors.

Proposed system

In this proposed system, we are intended to add extra features to make emotion detection user friendly and accurate by introducing sequence of phases. Our work consists of five phases. First phase is that skin tone detection – Skin detector generally transforms a given element into associate acceptable color house and so uses a skin classifier to label the element whether or not it's a skin or a non-skin element.

Second phase is feature extraction – The neural network which is initially learnt nothing, and it is trained using the image dataset. This image is pre-processed followed by the extraction of the features from the images. Third phase is feature selection – Information gains describes the differences between the entropy of the labels in the dataset (e.g., "happy") and entropy of the labels when the behavior of one of the features is known (e.g., "happy" it gives the distance between the mouth corner and nose is known). Fourth phase is Fuzzy C means – It uses the reciprocal distance to compute fuzzy weights.

A more efficient algorithm is new FCM. Fifth phase is final feature set – The number of features is determined empirically, optimizing for accuracy. The final feature set includes that the top 85 features for each emotion class.

ARCHITECTURE DIAGRAM

In this system, the user image is captured by the image acquisition device. Then the acquired image is passed on to the Fuzzy C means algorithm, certain features are extracted. The extracted features are identified using trained dataset. Finally, stable features are determined and the facial expression is recognized.

PROJECT MODULES

There are four modules:
- Installing dependencies
- Training the dataset
- Detecting real time emotion
- Output verification.

Installing dependencies
For using this machine learning concept, you need to install a lot of dependencies into your system using the command prompt.

Training the dataset
For training purposes, we use the predefined untrained dataset CSV file as my main input for my input for training the machine.

Detecting real-time emotion
For detecting the emotion, first, you need to run the train.py program to train the data. First, the facial recognition is done using image acquisition device. Then, the emotion from the acquired image is detected fuzzy C means algorithm.

Output verification
Now, you can run the videoTester.py program. Your camera automatically turns on and detects the emotion of your face.

ALGORITHM AND TECHNIQUES

RGB color space
Skin tone color detection is a technique used to isolate some features like faces, arms, and so on. After isolation is done, skin-colored pixels present in the image are identified then converted into RGB color space.
- Normalizing the colors present in the image
- Marking pixels on the image using skin color model
- Non-skin regions are removed
- Confirm the face acquisition from the image.

Weber's local descriptor (WLD)
WLD is used as textual descriptor. This descriptor represents the image as histogram. This descriptor has several interesting properties such as robustness and illumination changes.
- Reduces the computational complexity
- Dimensions of feature space is reduced

The computational of WLD consists of three steps:
- Finding differential excitation
- Finding gradient orientation
- Building histograms

$$\frac{\Delta I}{I} = k$$

Where ΔI represents the increment threshold.
I represent the initial stimulus intensity
K signifies the proportion on left side of the equation.

FCM algorithm
Clustering is the process of grouping the given set of unlabeled patterns into a number of clusters such that patterns based on the similarity are assigned to one cluster. To remove some redundant and noisy features, it selects the subset containing best-performing features in terms of accuracy. It performs dimensionality reduction using FCM. This algorithm is composed of following steps:

1. Initialize $U = [u_{ij}]$ matrix, $U^{(0)}$
2. At k-step: calculate the centers vectors $C^{(k)} = [c_j]$ with $U^{(k)}$

$$c_j = \frac{\sum_{i=1}^{N} u_{ij}^{m} \cdot x_i}{\sum_{i=1}^{N} u_{ij}^{m}}$$

3. Update $U^{(k)}$, $U^{(k+1)}$

$$u_{ij} = \frac{1}{\sum_{k=1}^{c} \left(\frac{\| x_i - c_j \|}{\| x_i - c_k \|} \right)^{\frac{2}{m-1}}}$$

4. If $||U^{(k+1)}-U^{(k)}||<$ then STOP; otherwise return to step 2.

Sobel operator
Edge detection is a necessary area in the field of image processing. Edges refer to the boundaries between regions present in an image, which helps with segmentation. Sobel operator is used in the field of image processing specifically in edge detection algorithm. Detecting the edges in an image significantly reduces the amount of data to be processed and also filters out unnecessary information while maintaining the important properties of an image. Edges can be detected by:
- Smoothing out the noise presents in the image.
- Calculating the gradient of the image frequently to generate a "gradient" image. (Remove lighting effects and threshold value should be set between 50 and 100).

Implementation

```
cv2.ocl.setUseOpenCL (False)

# dictionary which assigns each label an emotion (alphabetical order)

emotion_dict = {0: "Angry," 1: "Disgusted," 2: "Fearful," 3: "Happy," 4: "Neutral," 5:

"Sad," 6: "Surprised"}

#start the webcam feed cap = cv2.VideoCapture(0)

while True:

# Find haar cascade to draw bounding box around faceret, frame = cap.read()

if not ret: break

facecasc =cv2.CascadeClassifier('haarcascade_frontalface_default.xml')
gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)

faces facecasc.detectMultiScale(gray,scaleFactor=1.3,minNeighbors=5)
for (x, y, w, h) in faces:

cv2.rectangle(frame, (x, y-50), (x+w, y+h+10), (255, 0, 0), 2)roi_gray = gray[y: y + h, x: x + w]
```

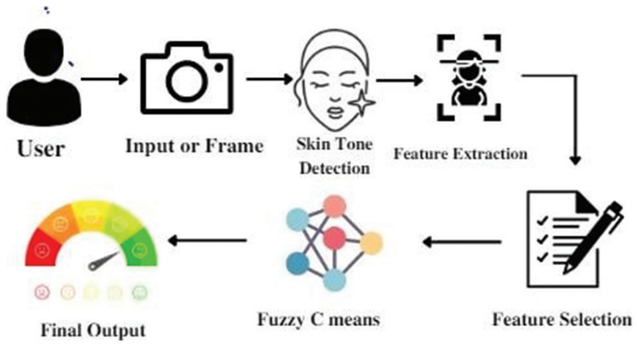

Fig. 1: Architecture diagram

Fig. 2: Sample output

cropped_img =np.expand_dims(np.expand_dims(cv2.resize(roi_gray, (48, 48)), - prediction = model.predict(cropped_img)

1), 0)

maxindex = int(np.argmax(prediction))

cv2.putText(frame,emotion_dict[maxindex],(x+20,y-60), cv2.FONT_HERSHEY_SIMPLEX, 1,

(255, 255, 255), 2, cv2.LINE_AA)

cv2.imshow('Video',cv2.resize(frame,(1600,960),interpolation=cv2.INTER_CUBIC)) if cv2.waitKey(1) and 0xFF == ord('q'):break

cap.release() cv2.destroyAllWindows()

SAMPLE SCREEN SHOTS

None

CONCLUSION

In this study, we have proposed a hierarchical framework based on The fuzzy C-means algorithm for emotion detection to control the device. Nowadays, people are aware about security-based applications, so that emotion recognition plays a major role in these secure applications. The FCM-based clustering algorithm performs well on recognizing and classifying emotional data. The concepts of fuzzy sets promote more strong and reliable representations of real-world objects. Experimental results showed that the system has satisfied the status of a user-friendly input device. The fuzzy C-means algorithm enhances speed and reliability to perform the desired task. In the future work, we plan to establish the rigid head movements, (i.e.,) head pose, into the model to handle multiple views of the faces, we also plan to introduce the advanced technology to identify and recognize the faces with masks on. The advanced clustering technique is used here to achieve more efficient result and to reduce the time taken for computation.

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