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 programmes 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 in order 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.**

Key Terms: Neural Networks, Machine Learning, Fuzzy C-Means, WLD, Convolutional Neural Networks

I. INTRODUCTION

Facial expression is the most and natural means of non-verbal communication for communicating among personalities. During this analysis, we tightly hinge upon 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 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 Technology 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 like research on pain and depression, Health supporting appliances which monitors stress, fatigue and so on. Due to this level of practical importance facial recognition has become a need. Facial Expression

Recognized by Smart Machines have attracted the interest of many cognitive researchers fromthe fields like 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. Firstly, this algorithm, the final output converges to actual cluster center. So, choosing a good set of initial clusters is very important for FCM algorithm. We proposed a reliable method for efficient clustering which improves the standard and performance. Experimental results states that the proposed system attains better performance than Skin Probability Map (SPM) method. This method is capable of teaching and guiding people with Autism on how to react consequently as they always use non-verbal communication.

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II. SYSTEM DESIGN

EXISTING SYSTEM:

Automatic Systems used to detect the human facial expression has 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 (CNN) 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 Convolutional neural network 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 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 by using the image dataset. This image is pre-processed followed by the extraction of the features from the images. Third Phase 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 include that the top 85features for each emotion class

III. ARCHITECTURE DIAGRAM:

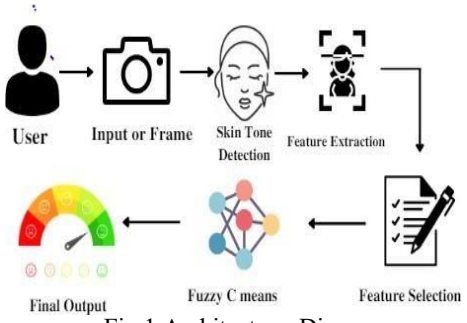

Fig.1.Architecture Diagram

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 by using trained dataset. Finally, stable features are determined and the facial expression is recognized.

IV. PROJECT MODULES:

There are Four modules:

- Installing Dependencies
- Training the dataset
- Detecting Real Time Emotion
- Output Verification

A. Installing Dependencies:

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

B. 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.

C. 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 emotionfrom the acquired image is detected Fuzzy C means algorithm.

D. Output Verification:

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

V. 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 areidentified 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):

Weber's local descriptor is used as textual descriptor. This descriptor represents the image as histogram. This descriptor has several interesting properties like Robustness and illumination changes.

- Reduces the computational complexity
- Dimensions of feature space is reduced The computational of WLD consist of three steps:
- Finding differential excitation
- Finding gradient orientation
- Building histograms

$$\Delta I/I=K$$

Where, ΔI represents the increment threshold.

I represent the initial stimulus intensity

K signifies the proportion on left side of the equation

Fuzzy C means Clustering (FCM) Algorithm**:**

Clustering is the process of grouping the given set of un labeled 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 Fuzzy C Means Clustering. This algorithm is composed of following steps:

1.Initialize $U = [u_{ij}]$ matrix, $U^{(0)}$

2.At k-step: calculate the centres vectors $C^{(k)} = [c_j]$ with $U^{(k)}$

$$Cj = \frac{U_{i-1} . X_{ij} \sum_i^m}{\sum_{1-I}^n . m_{ij}}$$

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

$$Uij = \frac{1}{\frac{Ci}{K-1}\left(\frac{||Xi-Cj||}{Xi-Ck}\right)^{2/m-1}}$$

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 present 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 to 100)

VI. 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)
facesfacecasc.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]
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,(1
600,960),interpolation=cv2.INTER_CU
BIC)) if cv2.waitKey(1) & 0xFF ==
ord('q'):break
cap.release()
cv2.destroyAllWindows()
```

VII.SAMPLE SCREEN SHOTS:

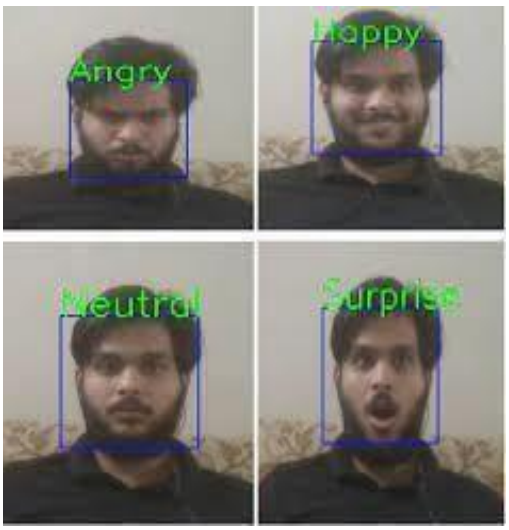

Fig.7.Sample Output

VIII. 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 hasSatisfied 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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