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AN EFFICIENT EMOTION RECOGNITION SYSTEM FOR MOBILE APPLICATION

Vaishali Nawpute

Department of Computer Science and Engineering, CSMSS,Chh. Shahu College of Engineering, Aurangabad, India

Abstract- Many applications are available on mobile phone, for providing services to the user.so for providing the emotional care to the user, it is required to develop real time application which recognize the emotion of user on mobile phone. So the emotion recognition algorithms implemented for recognizing the emotion of user, should take smaller processing power, and less time requirement. In the proposed system, the image of the user is captured using the camera of android phone. The phone has inbuilt capacity of face detection. On the detected face area bandlet transform is applied. After applying bandlet transform the face area is divided into non overlapping blocks. Then Local Binary Pattern histograms are calculated for each block and concatenated and it will give feature set for image. Kruskal-Wallis feature selection is applied to select the subset of a features from feature set. Then Convolutional Neural Network based classifier is used to classify the emotion.

Keywords – *Emotion Recognition, Feature extraction, Local binary pattern, Convolutional neural network*

I INTRODUCTION

Emotions plays important role in human life. Emotions are means of conveying a person feeling. The ability of recognizing the emotion of humans by machine helps for better human to machine interaction.

Now there is an era of mobile phones, peoples are using mobile phones for doing many task, which were previously done manually and also mobile phones have inbuilt sensors in them. If we provide the emotion recognition on mobile phones, it will help a mobile user for providing emotional care. Emotion Recognition technology is beneficial in many areas such as health care, psychology ,in e-learning platform, in smart homes for providing care to old peoples.

American Psychologist's Ekman and Friesen defined six types of emotion categories Happy, Sad, Angry, Fear, Surprise, Disgust and it's the most popular categorization of emotions. The advances researches shows that they are only culture specific. Researchers of phycology says that the above emotion categories are not universal.

Emotions can be expressed using speech, facial expressions, and gestures categorized as unimodal social behavior. Or emotions of human being can be expressed using multimodal parameters such as audio, video and physiological signal.

Emotion detection using the facial expression is most useful and popular.

II PROBLEM STATEMENT

Many applications are available for recognizing emotions, but they are computationally expensive, and available for desktop platform. So there is a need for development of an efficient emotion recognition system for mobile platforms, using the algorithms which are computationally less expensive and will recognize emotion correctly in minimum computation time.

III RELATED WORK

Previously many methods are available for emotion recognitions using different modalities for emotions such as, speech, facial expressions.

On smart phone, real time facial expression recognition is available, which uses facial landmarks and Binary Robust Independent Elementary Features (BRIEF) as feature descriptor .Support Vector Machine is used for classification. System is tested using CK+ and JAFFE dataset [1]. The use of Binary Robust Independent features (BRIEF) is used for feature extractions. the advantage of BRIEF is that it is computationally less expensive for implementation on mobile phones and K-nearest algorithm is used for classification, system is tested on CK dataset [2].Emotion aware cloud computing is proposed, which uses big data and cloud computing, cloud computing is used for doing tasks which takes more time on mobile device [3]Emotion recognition using deep convolutional neural network is done, here convolutional neural network is used for feature extraction and softmax classifier is used for classification [4].Different types of multimodal sensor data also can be used for emotion recognition system. The advantage of sensors is that they can give extra information and overcomes the issues such as illumination variations, head pose. Use of the multimodal sensor data will help to improve the robustness of the system [5]. Emotion recognition application is proposed for healthcare in smart cities, Facial expression recognition is beneficial to healthcare system, because the facial expression of patient changes according to his health conditions [6].Emotion recognition using facial recognition in virtual learning is proposed, this is used in distance learning system, and it will help teachers for managing their training methods, according to the emotion of the students here students emotions data is obtained using captured video, by extracting frames from video[7].Emotion recognition can also be done using speech of user , The system uses the extracted feature from speech, which are Mel-frequency ceptrum coefficients (MFCC) and Modulation spectral (MS),then the classifier is trained using

extracted feature. Recurrent Neural Network is used as classifier [8]. Deep learning is also used for emotion recognition, the deep learning methods are more reliable and has scope in future, in this methods dataset such as, Kaggles and Karolinska Directed Emotional Faces (KDEF) are used. Model is trained using tensor flow [9].Different AI based multimodal methods are studied here, such as emotion detection from text, speech, image, video and physiological signals [10].

Emotion recognition available on desktop platforms are not limited by storage, processing power and time, but mobile devices has the limitation of less storage, minimum processing power. So emotion recognition system on mobile phone should be implemented using the algorithms, which will take lower time for processing on mobile phone.

IV PROPOSED EFFICIENT EMOTION RECOGNITION SYSTEM

Following figure shows the architecture of the proposed system

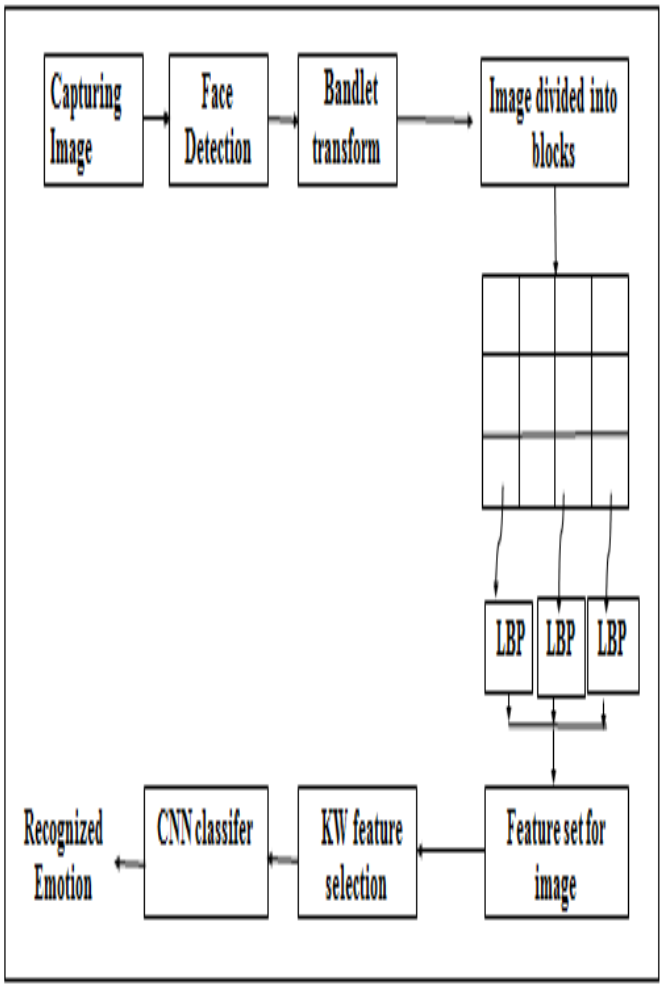


Figure 1: Proposed Efficient Emotion Recognition System.

The components of the system are:

1. Capturing Image

Image of the user is captured using camera of android smartphone.

2. Face Detection

The smart phone have inbuilt capacity of face detection, so they can detect face form captured Image.

3. Bandlet transform

Bandlet transformation is applied on detected face. The face image is composed of many geometric structures, but the problem with geometric structure is that they have high computational complexity. So bandlet transform help to solve this problem by representing geometric structure. Here image is divided into regions each containing contour. If block does not contain contour, geometric flow in that block is not defined.

4. Feature Extraction using Local Binary Pattern

In this step, local binary pattern histogram is applied on subband image given by bandlet transform, this is done by dividing subband image into a non overlapping blocks. Then for each block of a subband image local binary pattern histogram is calculated. After calculating LBP histograms for all blocks, they are concatenated. These concatenated histograms gives the feature set for the image.

5. Feature Selection using Kruskal-Wallis

Here KW feature selection is used for selection of subset of features from extracted set of feature extracted using LBP.

Feature set contains feature, but all of them are not necessary for emotion detection, by removing unnecessary features from feature set can reduce time required for detection of emotion. The advantage of KW feature selection is that it is simple and its computational complexity is low.

6. Classification

Selected features are given as input to CNN, during training, models of different emotions are created from feature set, during testing log likelihood scores are obtained for each emotion form feature set and the model of emotion, the emotion corresponding to the maximum score is the output of the system.

Advantages of CNN:

The advantage of using deep learning algorithm CNN for mobile applications, is that it will help to provide high quality intelligent services on mobile phones.

Limitations of CNN for mobile Application:

As, Smart phones have limited computational power, memory. Training of CNN needs to be done on powerful machines or with clouds, then this model can be used for mobile applications.

V EXPERIMENTAL RESULTS AND PERFORMANCE ANALYSIS

Experimentation

For the validation of the proposed system, the publicly available, dataset JAFFE is used.

Dataset

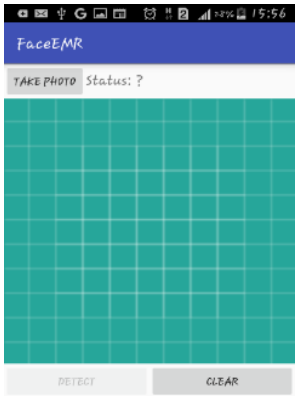
JAFFE (Japanese female facial expression) is the publicly available dataset, these database are used to validate the system.JAFFE dataset is used to train and test the proposed system.

JAFFE database is Japanese female facial expression dataset, it total consists of a 213 emotion images of 10 female Japanese actress in gray format and with resolution 256 × 256. Anger, happiness, sadness, disgust, afraid and surprise are emotion classes in it, along with neutral.

Fear Surprise Neutral

Seven expressions from JAFFE dataset.

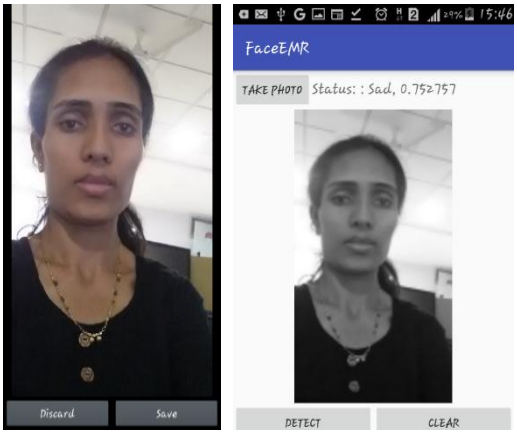
First Screen of the system



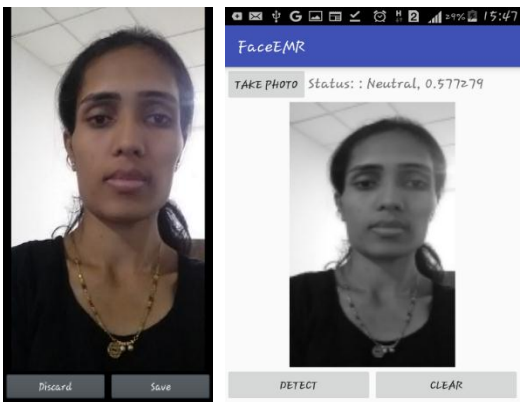
Examples of Emotion Recognition

Following images shows the captured image and recognized emotion.

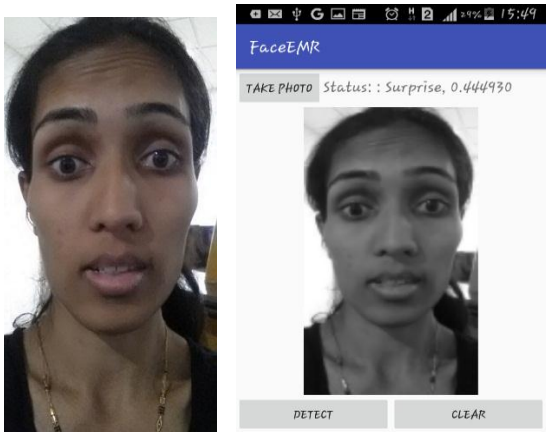
1.Example of sad



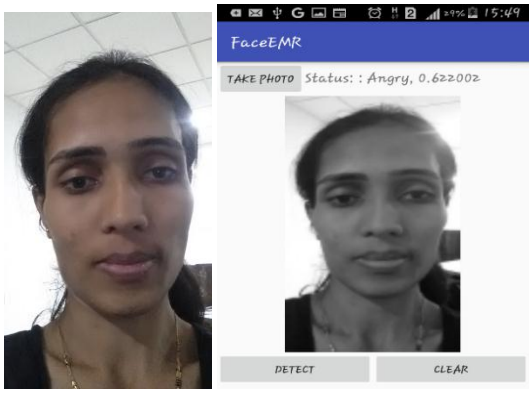
2.Example of Neutral



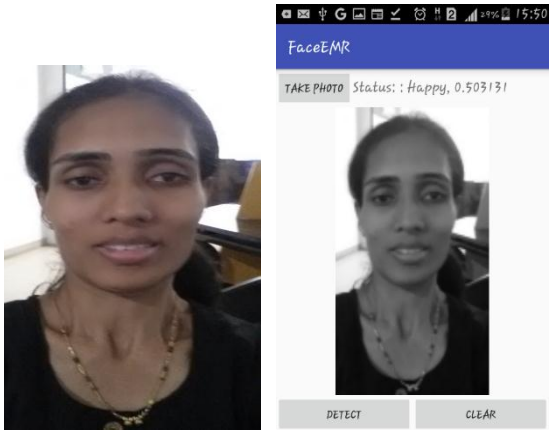
3.Example of Surprise



4.Example of Angry



5.Example of Happy



VI PERFORMANCE ANALYSIS

The performance of system is analyzed, by using the different block size in bandlet transform and by using the various invariants of LBP.

Accuracy (%) Graphs

1.Accuracies of the system in different bandlet scales and block size

In the step of bandlet decomposition, different sizes of block and different scales of subband image are used, for finding the accuracy of system. Different block size of 2 ×2, 4× 4, 8× 8, 16 ×16 32 ×32 are used with scale 0,1 and 2.

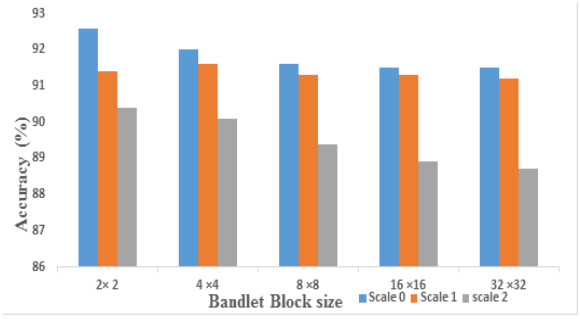


Figure 2: Accuracies of system in different bandlet scales and block size

The above figure shows that, Block size 2×2 and scale 0 produces the highest accuracy.

2.Accuracies of the system, using normalized bandlet coefficient

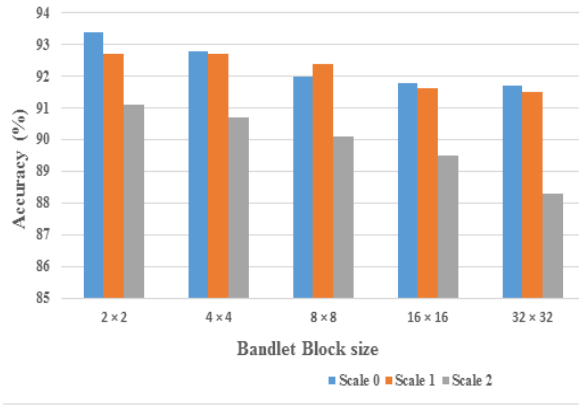


Figure 3: Accuracies in different Bandlet scales and block sizes using normalized Bandlet coefficient

The above figure shows that, after using the normalized bandlet coefficient, there is improvement in accuracy (%).

3.Accuracies of system after using different invariants of LBP

Following figure shows the accuracies using different LBP invariants in bandlet scale 0 and block size 2×2, horizontal axis shows LBP variants and vertical axis shows accuracy (%)

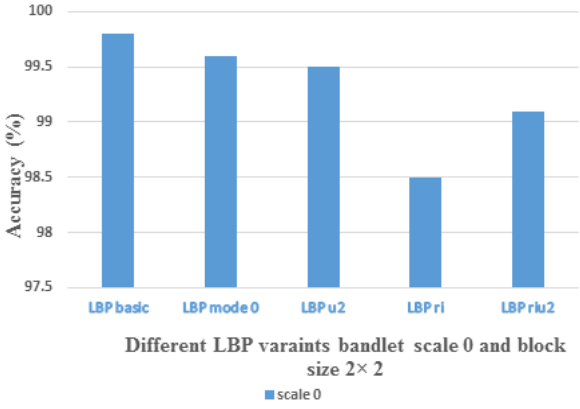


Figure 4: Accuracies using different LBP variants in Bandlet scale 0 and block Size 2×2

The above figure shows that, the basic LBP obtained highest accuracy.

VII CONCLUSION

An efficient emotion recognition system for mobile application has been proposed, inbuilt camera of the mobile phone is used for capturing the image of user. Bandlet transform and LBP is applied on detected

Face for feature extraction. Feature selection is done is using kruskal–Wallis feature selection, and finally Convolutional Neural network is used for classification of emotion.

The system validation is done using JAFFE dataset.

Average Accuracy of the proposed system using JAFFE dataset is 99.96%.time required for recognizing emotion is 2 sec.

VIII FUTURE WORK

In future we can integrate this system with mobile big data and cloud computing, to process more data by capturing video of user for real time applications such as patients monitoring system, distance learning system. Also we can integrate this system with different types of sensors for capturing more data of users, the use of sensors, will help to improve the reliability and accuracy of emotion recognition system.

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