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A Robust Facial Expression Recognition System for Android Devices

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ABSTRACT

This research work presents an idea for detecting an unknown human face in an input imagery and recognizing the facial expression. The objective of this research is to develop a highly intelligent android application for facial expression recognition. A Facial Expression Recognition system needs to solve the following problems: detection and location of faces in a clustered scene, facial feature extraction, and facial expression classification. In this research work three basic expressions were considered, which are: Happy, Sad, and Angry. Georgia Tech face detection dataset and some locally captured face of Federal University of Technology, Akure students were also used. Local Binary Pattern (LBP) and Random Forest (RF) were used for Feature Extraction and classification respectively for the three emotions. The experiments show that the proposed facial expression recognition framework yields 80% accuracy for angry gesture, 60% for sad gesture and 73.33% for happy gesture.

Keywords: facial expression, detection, recognition, gesture classification and feature extraction. .

1. INTRODUCTION

Facial expression plays an important role in recognition of human emotions (Fasel, 2003 & Yeasin, 2006), it is one of the most powerful, natural, and immediate means for human beings to communicate their emotions and intentions. The expression on a face carries important information about the emotions, mental and even physical states of the conversation. Recognizing an expression on a face in an input image needs two parameters: detecting a face in the image and recognizing its expression. We believe recognition of human facial expression by computer is a key to develop such technology. In this work, Local Binary Pattern (LBP) algorithm was used due to the fact that it is a non-parametric descriptor whose aim is to efficiently summarize the local structures of images.

LBP summarises the local structures of images efficiently by comparing each pixel with its neighbouring pixels. The most important properties of LBP are its tolerance regarding monotonic illumination changes and its computational simplicity. LBP was originally proposed for texture analysis, and has proved a simple yet powerful approach to describe local structures.

The objective of this research is to develop an intelligent mobile application that can recognize the three different emotions of Anger, Happiness, and Sadness.

Dataset (Georgia Tech face detection).

The system classifies images of people expressing one of the basic six emotions: disgust, anger, fear, happiness, sadness or surprise. The dataset used for training and testing the system was chosen out of the free and publicly available datasets on the web, namely Georgia Tech face detection.

It contains image of 50 people taken in two or three session between 06/01/99 and 11/15/99 at the Centre for Signal and Image Processing at Georgia Institute of Technology.

All people in the database are represented by 15 colour JPEG images with cluttered background taken at resolution 640x480 pixels. The average size of the faces in these images is 150x150 pixels. The pictures shows frontal and/or tilted faces with different facial expressions, lighting conditions and scale. Each image is manually labelled to determine the position of the face in the image. Image Database Face Detection Feature Extraction Emotion Classification Graphical User Interface.

Figure 1, Some Images from the Georgia Tech face detection dataset

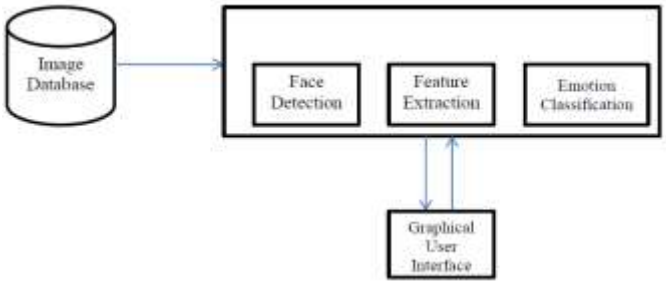

Figure 2, Architecture of the proposed system

2. SYSTEM REQUIREMENT

The hardware required for the development of a facial expression recognition system mobile application can work on any compatible personal computer with the following properties;

RAM: 1GB minimum

Screen Resolution 800x600 with 256 colours minimum (recommended 1024x768 in 16-bit high colours) and Camera of 5MP minimum

Home Screen of the Application

At launching of the application, the home screen is the first feature of the application. This page contains a button which has two different options which are **about** and **help**. Clicking on the about button gives you brief information about the application while the help button give a brief information about how the application can be used, it also gives user support about how to work their way through the application. Another button on the home screen is the start button, clicking on this button directs you to the main page where the image upload and emotion classification is carried out.

Figure 3: Home Screen of the Application

Images upload and face detection page

This page is where the major work is done. This page has the Select photo button, the detect face button and the classify emotion button. Clicking on the select photo button brings out three more option prompting the user to select the means through which they intend to upload the picture. Clicking on this select photo brings out a menu called add photo with three option, Take photo, choose from gallery and cancel.

Figure 4: Image upload and classification page

Clicking on the take photo option connects with the device camera which allows the user to take the picture, it will then be followed by face detection and emotion classification. Clicking on choose from gallery connects with the device gallery in order for the user to pick existing images.

Figure 5: Add Photo menu

Figure 6: showing the uploaded image

Once the image has been successfully uploaded into the system, it can now perform face detection, Clicking on the **detect face** button detect the face on the uploaded image

Fig 7: Detecting the face

3. Emotion Classification Phase

Once the face detection is over, the system is ready to recognize gesture presented as its input. The **Classify emotion** button performs classification of the face, displaying the predicted label and its description in the Emotion Details" panel.

Figure 8: Outputted value detecting a happy gesture

Figure 9: Outputted image detecting a sad gesture

Figure 10: Outputted image detecting an angry gesture.

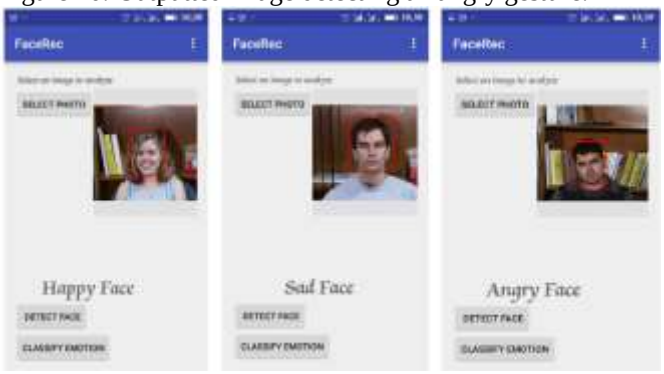

Figure 11: Outputted image from Georgia Tech Face detection dataset

4. STATISTICAL SUMMARY OF THE RESULT

Table 1 and 2 below shows the result that has been obtained during different rounds of testing the system, where the rows correspond to the true labels and the columns to the predicted one

Table 1. Shows the result of the testing using local faces captured

NO OF INPUT IMAGES	TYPE OF GESTURE	RECOGNIZED	RESULTS (%)
15	ANGRY	12	80%
15	SAD	9	60%
15	HAPPY	11	73.33%

The Table 2 shows the result of the testing using Georgia Tech Face detection

NO OF INPUT IMAGES	TYPE OF GESTURE	RECOGNIZED	RESULTS (%)
7	ANGRY	5	71.42%
6	SAD	4	66%
7	HAPPY	5	71.42%

CONCLUSION:

This research work provided a framework for recognizing facial expressions on human faces using Georgia tech dataset and locally captured faces of the students of Federal University of Technology, Akure. Local Binary Pattern (LBP) and Random Forest (RF) were used for feature extraction and classification respectively for the three emotions. The experiments show that the proposed facial expression recognition framework yields 80% accuracy for angry gesture, 60% for sad gesture and 73.33% for happy gesture.

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REFERENCES

1. Andreea Pascu, M. Suwa, N. Sugie, and K. Fujimora. (2015). Facial Expression Recognition System with universal emotionA preliminary note on pattern recognition of human emotional expression, 1978.
2. "C. Shan,S.Gong, P.W.McOwan (2009). Facial expression recognition based on local binary patterns: a comprehensive study, published in ELAEVIER Journal. 27: 803–816.
3. Chen and Huang, 2003, "A new clustering-based technique for facial expression analysis has been introduced"
4. Fasel, B, Luettin, J. 2003, "Automatic facial expression analysis:" A survey. Pattern Recognition, Vol. 36, and pp.259–275.
5. Iyengar, P.A., Samal, A., 1992. "Automatic Recognition and Analysis of Human Faces and Facial Expressions: A Survey", Pattern Recognition, Vol. 25, No. 1, pp. 65-77.
6. J. L. Wayman, A. K.. Jain, D. Maltoni, & D. Maio (2005). "Biometric systems: technology, design and performance evaluation". Springer.
7. L. Camras, L. Lambrecht, and G. Michel (1966). Infant surprise expressions as coordinative motor structures. *Journal of Nonverbal Behaviour*: 20:183–195.
8. L. Brown and Y.-L. Tian(2002). Comparative study of coarse head pose estimation. In IEEE Workshop on Motion and Video Computing, Orlando.
9. M. Valstar, B. Jiang, M. Mehu, M. Pantic, S. Klaus (2011). "The first facial expression recognition and analysis challenge," in Automatic Face and Gesture Recognition
10. Michel Beaudouin-Lafon, Wendy Mackay(2003). The human-computer interaction handbook. Chapter Prototyping Tools and Techniques, pages 1006-1031.

11. M. Black and Y. Yacoob (1995). Tracking and recognizing rigid and non-rigid facial motions using local parametric models of image motion. In Proc. of International conference on Computer Vision, pages 374–381.
12. M. Black and Y. Yacoob (1997). Recognizing facial expressions in image sequences using local parameterized models of image motion. International Journal of Computer Vision, 25(1): 23–48.
13. N. Ahmed, T. Natarajan, and K. R. Rao (1974). Discrete cosine transform. IEEE Transactions on Computers, 23:90–93
14. Ojala, T., Pietikäinen, M., Mäenpää, T (2002). Multiresolution gray-scale and rotation invariant texture classification with local binary patterns. IEEE Trans. Pattern Anal. Mach. Intell. 24(7): 971–987.
15. Ojala, T., Valkealahti, K., Oja, E., Pietikäinen, M (2001). Texture discrimination with multidimensional distributions of signed gray-level differences. Pattern Recognit. 34(3), 727–739.
16. Ojala, T., Pietikäinen, M., Harwood, D(1996). A comparative study of texture measures with classification based on feature distributions. Pattern Recognition. 29(1), 51–59.
17. Paul Viola and Michael J. Jones (2004). Robust real-time face detection. International Journal of Computer Vision, 57(2):137-154
18. P. Viola, M. Jones (2001). Rapid object detection using a boosted cascade of simple features. In Proc. IEEE Conference on Computer Vision and Pattern Recognition, pages 511–518.
19. P. Viola and M. Jones (2001). Robust real-time object detection. IEEE ICCV Workshop Statistical and Computational Theories of Vision.
20. T. Ahonen, A.Hadid, M.Pietikainen (2006), Face description with local binary patterns: application to face recognition IEEE Trans. Pattern Anal. Mach.Intell.28:2037– 2041.
21. Takeo Kanade Henry A. Rowley, Shumeet Baluja (1998). Neural network-based face detection.Pattern Analysis and Machine Intelligence, IEEE Transactions on, 20(1): 23-38.
22. Takeo Kanade Henry Schneiderman (2000). A statistical method for 3d object detection applied to faces and cars. 1:746{751 vol.1.
23. Kam Ho (1995). Random Decision Forests. In proceedings of the 3rd international conference on document analysis and recognition pages 278-282.
24. Varma. M, Zisserman. A (2009). A statistical approach to materials classification using image patch exemplars. IEEE Trans. Pattern Anal. Mach. Intell. 31:2032–2047.
25. Wang et al. (2006). used LDA classifier and rate level of 83.6% has been reached on the BU- 3DFE database.
26. Wang, L., He, D.C (1990). Texture classification using texture spectrum. Pattern Recognition. 23:905-910
27. Xiaohua Huang (2014). Methods for facial expression recognition with applications in challenging situations.
28. Y. Adini, Y. Moses, and S. Ullma (1997). Face recognition: the problem of compensating for changes in illumination direction. IEEE Transactions on Pattern Analysis and Machine INTELLIGENCE, 19:721–732.
29. Ying-Li Tian, Takeo Kanade, and Jeffrey F (2005). Cohn. Facial expression analysis. In Handbook of Face Recognition, Springer New York Journal pages 247-275.

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