International Journal of Engineering & Scientific Research (IJMRA Publications)
Vol. 6 Issue 6, June 2018,
ISSN: 2347-6532 Impact Factor: 6.660
Journal Homepage: http://www.esrjournal.com Email: esrjeditor@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gage as well as in Cabell's Directories of Publishing Opportunities, U.S.A

Detection of Human Emotion Based On Region of Interest and Fuzzy Logic

A. Joel Dickson
C. LinoBency
R. J. Alice Nineta

Article Received: 7th May, 2018
Article Revised: 14th May, 2018
Article Accepted: 25th May, 2018

Keywords:

Emotion, Region Of Interest, Calibration, Bio marker.

Abstract

Emotion recognition is the process of identifying human emotion, most typically from facial expressions. This is both something that humans do automatically but computational methodologies have also been developed. Emotion play an important role in human being. A non-invasive methodology is to detect human emotion. Fuzzy logic is used to analyse the parameter. To differentiate the subject and background we use image processing techniques. Detect the region of interest by using the bio marker. Top down hierarchial classifier is used to detect emotion. Calibration is based on the fuzzy logic model. Human show universal consistency indetect emotions but also show a great deal of variability between individuals in their abilities.The human face plays an important role for detecting emotions in the field of identification of human emotion.

Author correspondence:

A.JoelDickson, Assistant Professor
Department of Electronics And Communication Engineering
Bethlahem Institute Of Engineering
Corresponding Author Email Id: jusma@rediffmail.com

1. Introduction

Emotion is any conscious experience characterized by intense mental activity and a certain degree of pleasure and diapleasure. The emotion recognition is attaining mostly the area of exploration on smart system and interaction between human. Based on facial attributes the facial expression recognition can be classified on six emotions: sadness, disgust, happiness, fear, anger and surprise.emotions from facial expression would be widely applicable. Most application of emotion recognition examinestastic images of facial expression.Detecting human emotions in different scences, angles, and lightining conditions in real time. A facial expression is a gesture executed with the facial muscles, which convey the emotion state of the subject to observers. The study of emotions and their relation to facial expression expanded the list of classical emotions. Three dimensional fface recognition techniques uses 3D sensors to capture information about the shape of a face. This information is then used to identify distinctive features on the surface of a face. One advantage of 3d face recognition is that it is not affected by lighting like other techniques.

Non-invasive systems to monitor and diagnose health problems have been booming. It is a technology that allows measuring the radiation of energy that a body emits in a non-invasive way and without the limitations arising from the use of invasive sensors. Therefore, it has been increased as a solution

to analyse different problems in different field's human of human knowledge .specifically, humans are an important case of study where many investigations have emerged because the temperature is one of the most health indicators. In the context, emotions play an important role in the life of living beings considering that the main function of any emotion is to mobilize the body to quickly deal with interpersonal encounters. According to Ekman, emotions can be classified into six main categories: happiness, sadness, surprise, disgust, anger and fear [2]. Some emotions have been studied through region of interest, because when an emotion occurs a change in facial temperature appears due to the blood vessels in the subcutaneous area, this can be qualified and quantified through grey value. Research focused on the emotion of joy, in other words when a subject is smiling, it has been found that the temperature of the nose and forehead decreased during this event.The emotion of fear in patients with both posttraumatic stress disorder with mild symptoms and those who do not develop symptoms. It was found that the facial temperature in patients with PTSD is lower compared to those who are controlled [4]. A face recognition system is a computer application capable of identifying or verifying a person from a digital image or a video frame from a video source.

2. Proposed Method

The system methodology is shown in Figure 1. The image is captured by camera the input of the system were subject. We use two paths, first path taken from base linr and then ROI are analysed. The second path is taken a induced emotion and ROI are anlysed and passed to the calibration .the classifier can detect the emotion.

2.1 Subject

A group of 44 subjects are conducted. Standard medical procedures are followed as requirements. During image shots do not wear glasses, avoid the use of creams, cosmetics etc, do not drink alcohol before 24 hours, avoid smoke before 2 hoursnot to obstruct face area with hair.

2.2 DetectionAnd Analysis of ROI

For each image ROI are obtained, step by step procedure and methods are used.

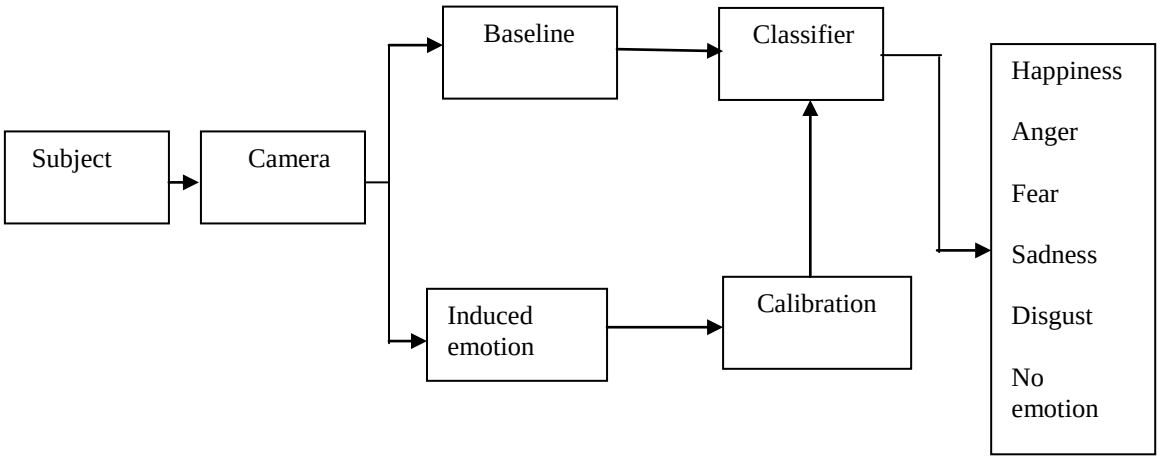


Figure 1: Block Diagram

2.3 Region Of Interest(ROI)

ROI are sampled with a data set identified for a particular purpose. ROI are commonly used in many application. In image or a volume define the boundary. ROI can be taken from polygonal selection from 2D map.

2.4Detection of ROI's

For detection of the ROI's the methodology presented in the above figure 2

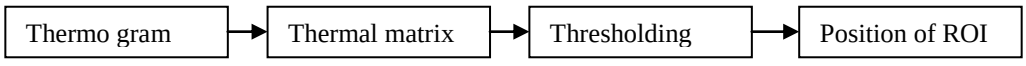


Figure 2: Methodology to detection of ROI'S

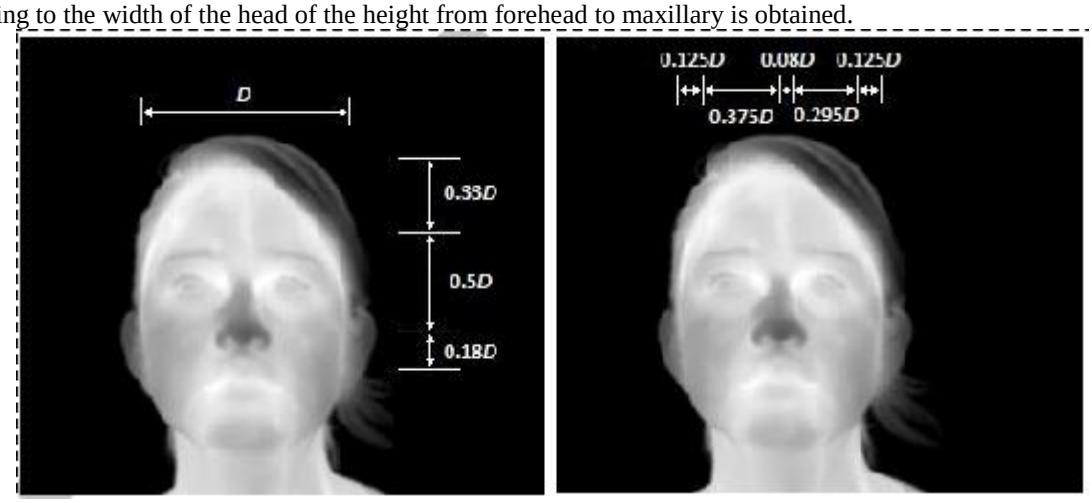
After the acquisition of the thermogram, the thermal matrix was obtained through the equation proposed by [7]

$$T_r = T_{min} + \left(\frac{Tgrey}{Tmgv}(T_{max} - T_{min})\right)$$

Where T_r is the thermal value of the thermogram, $T_{max}$and T_{min}represented the maxim and the minim value of the temperature in the thermogram in degree C, $T_{grey}$is the intensity of the pixel at same ponnt in the grey scale thermogram and T_{mgv} is the highest intensity value in the grey scale thermogram.

The temperature range in the thermogram from 22 degree c to 36 degree c this represents the lowest and the highest temperature in each thermogram. From these temperature and with the thermal matrix of the original thermogram a threshold to remove the background in each thermogram is proposed.

Based on thresholding, it is possible to obtain the width of the face, which is represented by D. According to the width of the head of the height from forehead to maxillary is obtained.



(a) (b)

Figure 3: Estimation of centers of the ROI's (a) vertical (b) horizontal

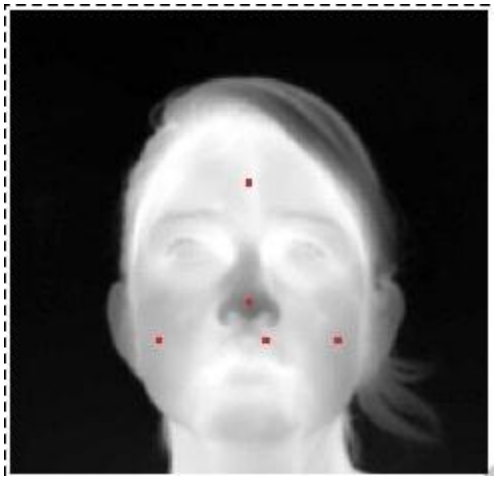


Figure 4:Centers of the ROI's detected

After the detection of the centers of the ROI's the area of the biomarker was obtained, for better visualization, these are presented in a color thermogram as shown in Figure 5.

Figure: 5 Biomarker based on ROI's for thermal analysis

2.5 Calibration

The calibration system based on fuzzy logic model

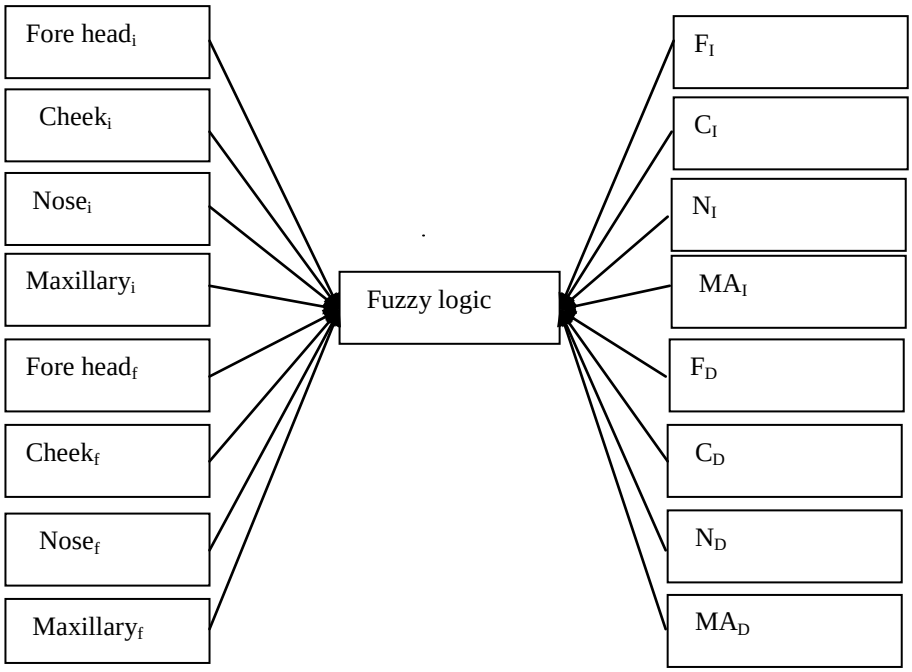


Figure6. Fuzzy Logic system to self-calibration

2.5.1 Inputs

Eight inputs are used, for the baseline subject use four (forehead$_i$, checks$_i$, nose$_i$, maxillary$_i$) and the emotion is induced the other four can use (forehead$_f$,checks$_f$, nose$_f$, maxillary$_f$) the four variables refers to each ROI at baseline and final state respectively. They are divided into three groups, "low", "high" and "normal". The first four represent how the grey value can change: "low" the grey value can be decreased; "high" the grey value increased; "normal" it needs no change. The last four comparision between baseline

and induced emotion, "high" the grey value increased, "low" the grey value decreased,"normal" there is no change.

2.5.2 Outputs

Eight outputs are used forehead increase, forehead decrease, check increase, check decrease, nose increase, nose decrease, maxillary increase, maxillary decrease these are represents ROI should increase or decrease by its grey value.

2.5.3 Rules

The interference machine is composed of a collection of forty rules in IF-THEN form. The following rule could be applied, the nose temperature is "low" and maxillary temperature is "high" THEN calibrate region is "decreased maxillary". Another example, IF nose temperature is "low", maxillary temperature is "low" and cheeks temperature is "low" THEN calibrate region is ":increased cheeks". So, all rules in the interference machine were done in this way. MATLAB fuzzy logic toolbox was used for the implementation of fuzzy logic system. Fuzzy logic system implemented shows the ROI where there should been a difference in temperature. With this or these temperature obtained.

2.6 Top-down hierarchial classifier

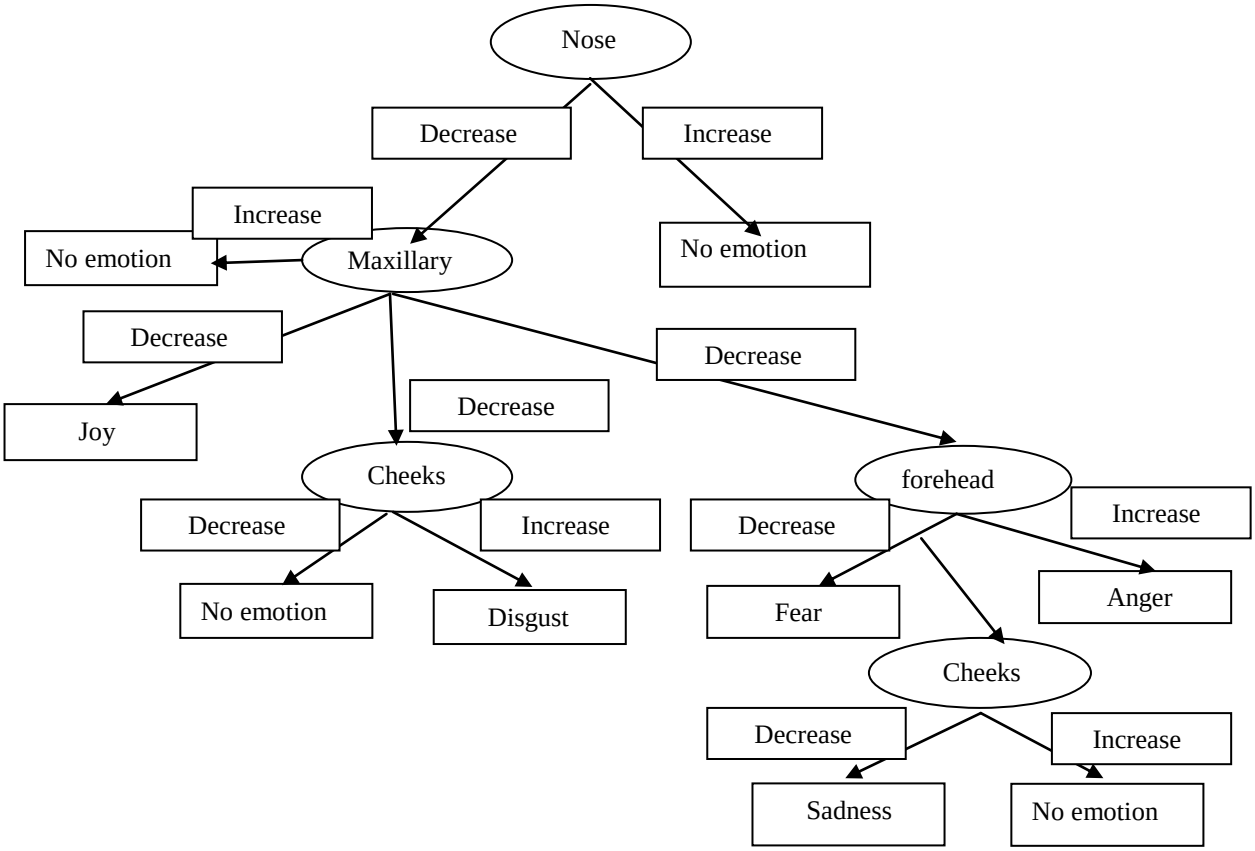


Figure 7:Top-down hierarchial classifier to classify emotions

The small image changes of 0.1 to 0.2 are considered insignificant, for this reason, the ROI,s whose change is below this value in the majority of the subjects were despised, and the ROI's with a change above the same grey value were chosen. Correlating the behaviour pattern and the grey value is obtained. Having the trend of these emotions is possible to implement a top-down hierarchical classifier as a classifier in order to achieve the goal of detection which emotion is present. In the top-down hierarchical classifier, the ROI,s chosen are decision nodes, the split function is the grey value change, if it increases or decreases, and finally the result is the emotion studied in this work or no motion.

2.7 Validation

An important step is the validation. The facial expression of emotion due to expressions are an important indicator of emotion and they are expressed and recognized similarly worldwide this group was present during all the study in order to support the study.

3. Experimental result

When an emotion is induced a gradual change according to the baseline occurs, previously is due to blood flow that radiates through the blood vessels when an emotion take place. Fig 6 shows some examples of the thermograms obtained. Table 1 shows the average temperature of the 44 subjects under study in each ROI and for each emotion. However, any small change in temperature represents that an emotion has happened, sometimes small fluctuation of ± 0.1 to $\pm$ 0.2 are considered insignificsnt and consequently may not affect the value of the final status.

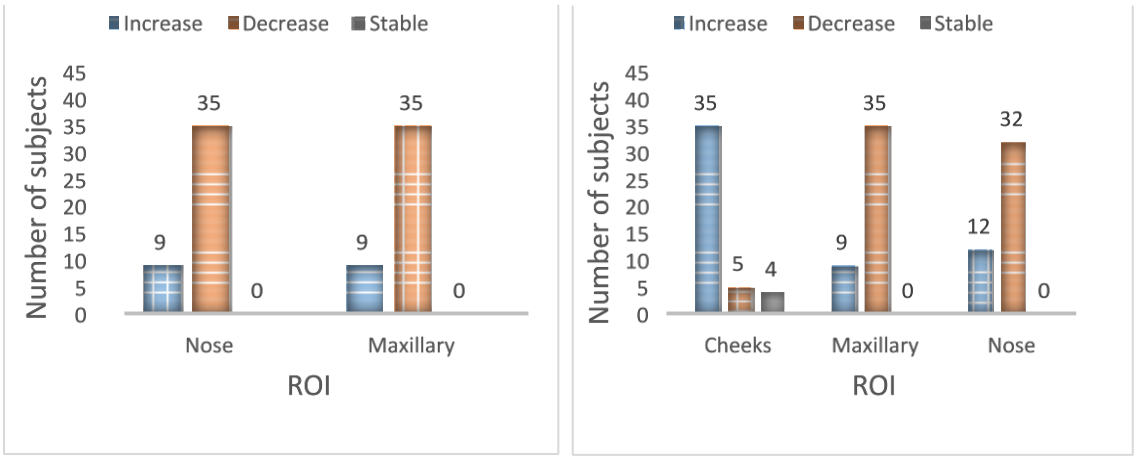
Emotion	ROI	Cheeks		Forehead		Nose		Maxillary	
		X	Σ	X	Σ	X	σ	X	σ
Anger	T_i	*	*	33.40	0.28	33.57	0.18	34.44	0.21
	T_f	*	*	33.52	0.27	32.02	0.24	33.43	0.29
	Δ_t	*	*	0.12	-0.01	-1.55	0.06	-1.01	0.08
Disgust	T_i	32.84	0.41	*	*	33.93	0.22	34.67	0.20
	T_f	33.2	0.49	*	*	33.62	0.21	34.42	0.20
	Δ_t	0.36	0.08	*	*	-0.31	-0.01	-0.25	0.00
Fear	T_i	*	*	34.85	0.21	34.14	0.16	34.72	0.19
	T_f	*	*	35.94	0.22	33.72	0.19	34.72	0.19
	Δ_t	*	*	0.09	0.01	-0.42	0.03	-0.37	0.04
Joy	T_i	*	*	*	*	33.72	0.18	34.59	0.18
	T_f	*	*	*	*	33.24	0.17	34.50	0.17
	Δ_t	*	*	*	*	-0.48	-0.01	-0.09	-0.01
Sadness	T_i	32.75	0.27	34.67	0.42	33.67	0.18	34.50	0.23
	T_f	33.01	0.25	34.58	0.38	32.63	0.23	33.99	0.24
	Δ_t	0.26	-0.02	-0.09	-0.04	-1.04	-0.05	-0.51	0.01

Table :1 Mean temperature of ROI's for each emotion

The average baseline temperature (T_i) can be seen, and the induced state (T_f) with respect to each ROI's emotion, similarly the temperature difference (Δ_t) on these states is shown, increase in temperaturebare marked in red and decrease are marked in blue.

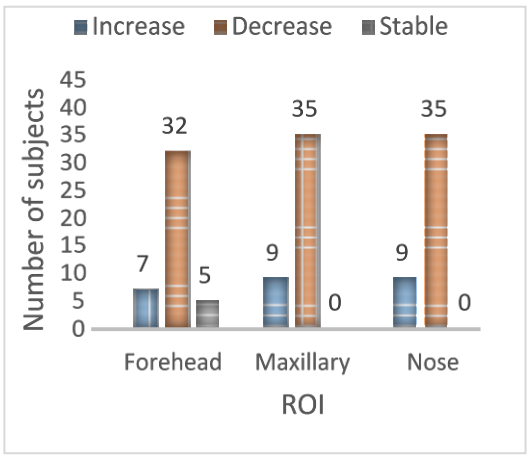
In Joy analysis, temperature decrease in the nose and marcillary compared to the intial state. Fig 8(a)

In disgust, the cheek area increasing trend and decreasing temperature on marcillary and nose area Fig 8 (b). In fear temperature on forehead, maricillary and nose decreases Fig 8 (c). In Anger forehead temperature tends to increase and maxcillary and nose temperature decreases Fig 8 (d). In sadness, region of cheeks area increasing and forehead area decreasy Fig 8 (e).

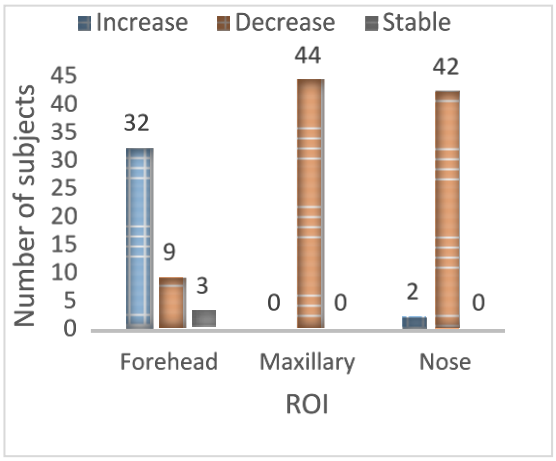


(a)

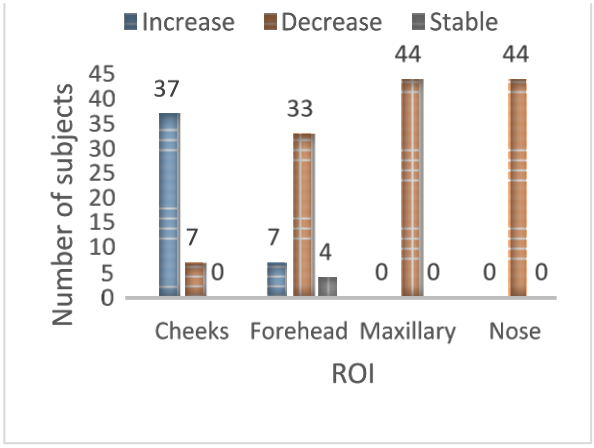
(b)



(c)



(d)



(e)

Figure 8: Thermal tendency of ROI's (a) joy (b)disgust (c) fear (d) anger (e) sadness

4. Conclusion

This paper presences true development, test and implementation of a smart thermal system which was successful in 90.4%. It was the capability of monitoring Biomedical thermal images, detect Rois (forehead, cheeks, nose, Maricillary) and diagnose emotion through a biomarker that automatically analyzer the temperature. This is a proven system for celebratory each subject to diagnose correctly the five emotions which are joy, fear, anger, disgust and sadness. This paper shows the quantification of temperature changes that occurred in the different Roi'scanbecataloges as a bio marker. Which provides accurate information to diagnose an emotion.

5. Reference

1. I. Fernandez – Cuevas, J.C. BouzasMarins, J. ArnaizLastras, P.M. Gornez Carmona, S. Pinonosa Cano, M.A Garcia – Concepcion, M. Sillero – Quintana, Classification of factors influencing the use of infaredtermography in humans: A review, infaredphys Technol. 71 (2015) 28-55. doi: 10.1016/j.infrared. 2015.02.007.

2. P. Ekman, (1999), Basic Emotions. In: Handbook of Cognition and Emotion, In Dalgleish, T. & Power, M. J. (Eds.), pp. 45-60, New York, NY: John Wiley & Sons Ltd.

3. S. Ionnou. V. Gallese, A. Merla, Thermal infared imaging in psychophysiology: Potentialities and limits., Psychophysiology. 51 (2014) 951 -963. doi:10.1111/psyp.12243.

4. S. Ioannou, S. Ebich, T. Aureli, D. Bafunno, H.A. Ionnides, D. Cardone, B. Manini, G.L. Romani, V. Gallese, A. Merla, The autonomic signature of guilt in children: A thermal infarerd imaging study, PLos One. 8 (2013). doi:10.1371/ Journal. pone. 0079440.

5. I. Maglogiannis, D. Vouyioukas, C. Aggelopoulos, Face detection and recognition of natural human emotion using Markov random fields, Pers. Ubiquitous Comput. 13 (2009) 95–101. doi:10.1007/s00779-007-0165-0.

6. U. Murad, M. Malkawi, Artificial neuro fuzzy logic system for detecting human emotions, IEEE CITS 2012 - 2012 Int. Conf. Comput. Inf. Telecommun. Syst.(2012) 1–13. doi:10.1109/CITS.2012.6220388.

7. M.S. Jadin, S. Taib, K.H. Ghazali, Feature extraction and classification for detecting the thermal faults in electrical installations, Measurement. 57 (2014) 15-24.

8. F. Shih, Automatic extraction of head and face boundaries and facial features, Inf. Sci. (NY). 158 (2004) 117-130. doi: 10.1016/j. ins. 2003.03.002.

9. A. Young. D. Perrett, A. Calder, R. Sprengelmeyer, P. Ekman, Facial Expressions of Emotions: Stimuli and Tests (FEEST)., Psychol. Man (2002).