

Various Approaches to Recognise Human Emotions

Anitha Modi^[1], Priyanka Sharma^[2], Dvijesh Bhatt^[3]

^{[1][3]}Assistant Professor, Nirma University

^[2]Professor, Nirma University

anitha.modi@nirmauni.ac.in, priyanka.sharma@nirmauni.ac.in, dvijesh.bhatt@nirmauni.ac.in

Abstract: Emotion recognition is a classification problem and one of the area of pattern recognition which is widely studied for more than three decades. Human beings have the ability to identify specific people among the group by their face, voice or written material. To add more the person under observation is associated with an expression of being happy, sad etc. The question that arises here is how human being are able to identify people and further classify their emotions. Research is carried out to provide a machine with the ability to identify a person through various recognition systems and the next step is to feed this information for recognising the emotions.

Keywords: Emotion recognition, FACS, Ekman emotions, AU.

1. INTRODUCTION

The primary concern is defining emotions and enlisting all the emotions. Emotions are themselves complex and involve various factors such as age, sex, geographical location, culture etc. Ekman^[1] classified the emotions and identified six basic emotions viz. Anger, Disgust, Fear, Happiness, Sadness and Surprise through nine factors that assisted in this process. Other emotions he classified as non- basic emotions. Ekman quoted that certain non-basic emotions can be recognised using facial features. Another concept of emotions was proposed by Robert Plutchik^[2]. He identified that emotions are bipolar in nature happiness and sadness etc. By varying the intensity of each emotion several other emotions were identified. Fig 1 shows the emotions identified by varying the intensities of bipolar emotions.

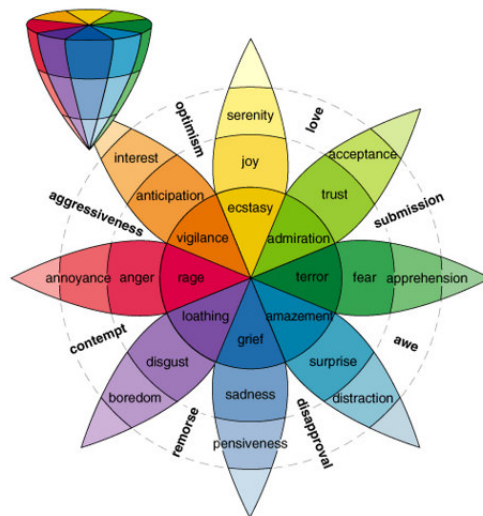


Fig 1: Robert Plutchik emotion wheel

More detailed analysis of emotions and their classification was proposed by Parrot^[3] who identified 136 emotions and gave a tree structure starting with six basic emotions.

Primary emotion	Secondary emotion	Tertiary emotions
Love	Affection	Adoration, affection, love, fondness, liking, attraction, caring, tenderness, compassion, sentimentality
	Lust	Arousal, desire, lust, passion, infatuation
	Longing	Longing
Joy	Cheerfulness	Amusement, bliss, cheerfulness, gaiety, glee, jolliness, joviality, joy, delight, enjoyment, gladness, happiness, jubilation, elation, satisfaction, ecstasy, euphoria
	Zest	Enthusiasm, zeal, zest, excitement, thrill, exhilaration
	Contentment	Contentment, pleasure
	Pride	Pride, triumph
	Optimism	Eagerness, hope, optimism
	Enthrallment	Enthrallment, rapture
Surprise	Relief	Relief
	Surprise	Amazement, surprise, astonishment
Anger	Irritation	Aggravation, irritation, agitation, annoyance, grouchiness, grumpiness
	Exasperation	Exasperation, frustration
	Rage	Anger, rage, outrage, fury, wrath, hostility, ferocity, bitterness, hate, loathing, scorn, spite, vengefulness, dislike, resentment
	Disgust	Disgust, revulsion, contempt
	Envy	Envy, jealousy
	Torment	Torment
Sadness	Suffering	Agony, suffering, hurt, anguish
	Sadness	Depression, despair, hopelessness, gloom, glumness, sadness, unhappiness, grief, sorrow, woe, misery, melancholy
	Disappointment	Dismay, disappointment, displeasure
	Shame	Guilt, shame, regret, remorse
	Neglect	Alienation, isolation, neglect, loneliness, rejection, homesickness, defeat, dejection, insecurity, embarrassment, humiliation, insult
	Sympathy	Pity, sympathy
Fear	Horror	Alarm, shock, fear, fright, horror, terror, panic, hysteria, mortification
	Nervousness	Anxiety, nervousness, tenseness, uneasiness, apprehension, worry, distress, dread

Fig 2 : Parrots' Classification of Emotions (2001)

The key issue is there is no definite point of conclusion as final set of emotions. Psychologist have inclined their studies towards neuroscience in finding an answer of how brain identifies emotions, the physiological changes that is experienced and finally the number of emotions the brain experiences. Due to complex structure most of the research has been concentrated on identifying the 6 basic emotions proposed by Ekman and few research have been concentrating on methods to identify non-basic emotions.

2. GENERAL ARCHITECTURE

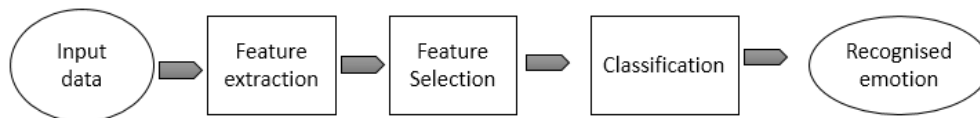


Fig 3: General Architecture of emotion recognition

Emotion recognition is generally classification problem and in specific a pattern recognition system. With reference to the general architecture shown in the fig. 1 we have the input data as voice, video, text or image. From the input noise is filtered such as adjectives from text, background elimination from images etc. After this features are extracted and certain features that contribute to emotions are selected and fed to the classifier. Based on the classification the emotions are recognised and reported. In rest of the paper several ways to recognise emotions from different type of inputs are discussed.

2.1 Characteristics of an efficient emotion recognition system

- Fully automatic system
- Capable of identifying emotions from any kind of input (voice, video, images or text)
- Real time support must be provided as they can be used in critical systems such as airport surveillance
- Capable of recognising basic and non-basic emotions.

- Robust system capable of adjusting to various situations
- System should be unobtrusive
- No pre-processing of data
- A generic system applicable to various kinds and category of individuals
- In case of images and videos but be immune to facial colour, glasses, makeup etc.
- It must be able to work with videos and images of different resolutions

3. DIFFERENT WAYS TO RECOGNISE EMOTIONS

3.1 Written material:

Written material such texts, emoticons can be used to recognise the emotions of a person under observation. Categorized words or phrases can be classified to recognise emotions. It's a classification problem. However words can be edited and manipulated to project incorrect emotion. According to research conducted in this area emotions can identified at coarse or fine grained level^[4]. Positive or negative emotions can be perceived from text which is coarse in nature. However when more precise analysis can be conducted on sentences with various methods such as keyword based , learning or a combination of both which is hybrid method.

Semantic and syntactic analysis is performed on the sentences. In keyword analysis, words are classified in WordNet – Affect^[5] based on which class of emotions they belong. These words are recognised in sentences and based on that emotions are identified. However there is ambiguity in usage of words and further there is always insufficiency in language information. In learning method, a semantic analysis is done on the training dataset to recognise emotions^[6]. An analysis was conducted on newspaper headlines.^[7] However desired accuracy was not achieved as human emotions are situation and event dependent. The dynamics of events, situations and their influence widely affect the emotions which is context sensitive. In hybrid approach a combination of both the approach was taken into consideration. Machine learning model was introduced in the analysis of texts and SVM, Max Entropy and Naïve Bayesian methods were used to classify emotions.^[8]

Much of the research work conducted in this area concentrate on basic emotion recognition. There is still a lot research scope to identify non-basic emotions which is quite complex.

3.2 Voice

Another mode of identifying emotions thorough voice sampling. Voice samples can be collected and certain features can determine the emotion of the speaker. Voice or speech is a varying structure. The signals are inconsistent with pauses, long silence and jitters. The entire speech can be divided into frames and each frame are analysed w.r.t to temper, pitch and other factors. There is a significant debate on whether to consider the global feature or local feature^[10]. Global features assist to identify basic emotions more prominently but these features are insufficient to train the classifier from the training set. Hence local features are taken into consideration for training the classifier. Further adding to the research continuous voice features such as energy, volume, and pitch project more accurate emotions. Hence this feature also have been largely studied for voice based emotion recognition system.

3.3 Physiological changes

MRI scans are studied to identify patterns of physiological changes a person undergoes while experiencing an emotion as increased blood pressure, heavy breathing, and intense rise in heartbeat rate when a person is experiencing fear etc. As stated earlier there is a huge integrated research going on in this field.

3.4 Facial feature.

Face undergoes certain changes when a person experiences emotion such mouth wide opened and raised eyebrows when astonished. We can study the patterns of changes in the facial features and categorise and classify them as enlisted set of emotions. Face parameters can be recoded and the system can be trained as done in FACS^[12] where action units are enlisted such as broadened lips and upper curving lips. Based on this action sequences emotions can be identified.






NEUTRAL	AU 1	AU 2	AU 4	AU 5
				
Eyes, brow, and cheek are relaxed.	Inner portion of the brows is raised.	Outer portion of the brows is raised.	Brows lowered and drawn together	Upper eyelids are raised.

Fig 4: Action units

Apart from action units animation parameters were added to precisely recognise emotions through facial feature. The system first recognised human faces then extracts the above feature and based on the classifier and the features the emotions are recognised. The major issues in facial emotions recognition system is non availability of spontaneous data. The training set consists of posed emotion rather than spontaneous emotions. This might lead to lesser emotions being recognised and there is lack of data to train the system for non-basic emotions.

4 APPLICATIONS

Emotions recognition systems is applicable in various fields. In security system at airport for surveillance, as cockpit voice recorder analyser in case of pilot training or air crash investigations. Human – computer interaction, robotics, human psychology, criminal investigation etc.

5 CONCLUSION

Although there are several ways to recognise emotions but most systems are designed to recognise basic emotions. Lack of spontaneous data for training the system is a major concern for developing these system.^[14]. Further the temporal dynamics such as onset, offset of emotions has to be taken into consideration to increase the number of emotions that are identified. Microexpressions which last for 1/25th of a second can conceal true emotions. There are several other parameters that have to be studied in detail to identify emotions.

References

- [1] Ekman, Paul. "An argument for basic emotions." *Cognition & emotion* 6.3-4 (1992): 169-200.
- [2] Plutchik, Robert (1980), *Emotion: Theory, research, and experience: Vol. 1. Theories of emotion 1*, New York: Academic
- [3] W.G Parrot. 2001. *Emotions in Social Psychology: Essential Readings*. Psychology Press.
- [4] Shaheen, Shadi, et al. "Emotion Recognition from Text Based on Automatically Generated Rules." *Data Mining Workshop (ICDMW), 2014 IEEE International Conference on*. IEEE, 2014.
- [5] Carlo Strapparava, and Alessandro Valitutti. "WordNet Affect: an Affective Extension of WordNet." *LREC*. Vol. 4. 2004.
- [6] Carlo Strapparava, and Rada Mihalcea. "Learning to identify emotions in text." *Proceedings of the 2008 ACM symposium on Applied computing*. ACM, 2008.
- [7] Radim Burget, Jan Karasek, and Zdeněk Smekal. "Recognition of emotions in Czech newspaper headlines." *Radioengineering* 20.1 (2011): 39-47.
- [8] Hui Yang, et al. "A hybrid model for automatic emotion recognition in suicide notes." *Biomedical informatics insights* 5.Suppl 1 (2012):17.
- [9] Utane, Akshay S., and S. L. Nalbalwar. "Emotion recognition through Speech." *International Journal of Applied Information Systems (IJ AIS)*(2013): 5-8.
- [10] El Ayadi, Moataz, Mohamed S. Kamel, and Fakhri Karray. "Survey on speech emotion recognition: Features, classification schemes, and databases." *Pattern Recognition* 44.3 (2011): 572-587.
- [11] C.Busso, S.Lee, S.Narayanan, Analysis of emotionally salient aspects of fundamental frequency for emotion detection, *IEEE Trans. Audio Speech Language Process.*17 (4) (2009) 582–596.
- [12] P. Ekman and W.V. Friesen, "Manual for the Facial Action Coding System," Consulting Psychologists Press, 1977.
- [13] I.S. Pandzic and R. Forchheimer (editors), "MPEG-4 Facial Animation: The Standard, Implementation and Applications," John Wiley and sons, 2002.
- [14] N. Sebe, M.S. Lew, Y. Sun, I. Cohen, T. Gevers, and T.S. Huang, "Authentic Facial Expression Analysis," *Image and Vision Computing*, vol. 25, pp. 1856-1863, 2007.