3. FACIAL EMOTIONS

3.1 INTRODUCTION

Charles Darwin proposed that emotions are universal and it is not different among various cultures. Emotions are intense feelings that are directed at something or someone [13], [41]. Facial expressions are used to convey our mood and feelings. Human beings possess and express emotions in everyday interactions with others. Emotions are often reflected on the face, in hand and body gestures, and in the voices, to express our feelings. Even though it is very difficult to give a precise definition to emotion, it is undeniable that emotions are an integral part of our existence. Everyday communication uses both facial expressions as well as vocal emotions. People do a great deal of inference from perceived facial expressions. The fact that we understand emotions and know how to react to other people's expressions greatly enriches the interaction.

Humans can express dozens of expressions simultaneously. It is very difficult to classify emotions. Recently it is reported that emotions can be classified into six basic categories [13]. They are joy, sadness, surprise, anger, fear and disgust. Any emotion can be considered as a point in a six dimensional space which is the emotional space. The emotional space need not be orthogonal. Origin of the emotional space is considered as a neutral expression. Any emotion will be a function of these six basic expressions. From the computational perspective, basic emotions are represented by an intensity value ranging from 0 to 1. Intensity value 1 means maximum emotion.

In addition to the six basic facial expressions, there are also coordinated stereotyped non-verbal displays that include stereotyped facial expression components. Stereotyped facial expressions include eyebrow flash, yawning, startle, embarrassment and shame displays.
3.2 BASIC EMOTIONS

This section describes the six basic emotions and the corresponding changes in the facial image [24]. Figure 3.1 shows facial image of neutral emotion.

Smiling is a stable indicator of happy emotion. The smiling is characterized by oblique raising of lip corners, wrinkling and bulging of eye cheeks, narrowing of eye lids, crow's-feet wrinkling at the corners of eyes, and raising of the outer and upper area of the cheeks. Even though the appropriate raising of lip corners may be present, the degree of narrowing of eyelids, and crow's-feet wrinkling of corners of eye may be absent in actual happy emotion.
Joy

Fig. 3.2

Happy expressions are universally and easily recognizable. The happy expressions are generally interpreted as conveying messages related to enjoyment, pleasure, friendliness. Examples of happy expressions can be obtained from photographs. People can easily produce happy expression on demand in the absence of emotion. Happy expression may be practiced behaviours and can be used to hide other emotions and deceive or manipulate other people.

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Sadness

Sad expression may be taken as negative of happiness. But this is not true at all. Sad expressions convey messages related to loss, bereavement, discomfort, pain, helplessness. It is difficult to produce sad emotion as compared to producing a fake happiness emotion. It is difficult to use sadness to hide other emotions. Only an experienced artist can show a sadness emotion on demand in the absence of any other emotion. According to psychologists sad emotion faces are low intensity forms of crying as observed early in newborns, but differences noted between these two expressions challenges this view, though both are related to distress. Weeping and tears are common signs of sadness. But tears are not indicative of any particular emotion as in tears of joy.

A crying baby face shows sadness expression characterized by narrowed eyes, raised cheeks, eye brows pulled together, lip corners are pulled down, chin boss pushed up, later a lip stretching and has no raising of eye brows in the centre of forehead. A suffering child which shows sadness emotion is characterized by narrowed eyes, raised cheeks, eyebrows pulled together, and raised in the centre of forehead and a slightly pushed up chin boss. Down turned lip corners and pushed up chin boss are consistent with a sad expression. The eyes may be narrowed, with any actions in the brow area obscured. Posture, gaze direction, and head orientation help convey the overall sad expression.
Surprise expression is difficult to record in real time. They almost occur in response to events that are occurring unexpected, novel or amazing. The surprise expression is usually followed by other expressions such as fear or happiness. For example, suppose we find a friend unexpected, the typical emotion will be surprise followed by happiness. Suppose we find a snake unexpectedly, the emotion will be surprise followed by fear. Surprise expression is different from startle and it acts as a switch which shifts our attention.

The surprise expression is characterized by extremely raised eyelids, mouth opened by too much of a jaw or too tense of a mouth opening, which is constricted. Horizontal forehead wrinkles from the straight upward brow raise is also typical of a natural looking surprise expression.
Anger expressions are seen increasingly in modern society, the reason behind is stress and frustrations are seem to increase, but the expectation of reprisals decrease with the higher sense of personal security. Anger expression is very difficult to produce on demand as compared to producing a fake happiness emotion. Anger expressions are normally spontaneous in nature. Anger expression is associated with hostility, opposition, and potential attack. The uncontrolled expression of rage exerts a toxic effect on the angry person, and chronic anger seems to be associated with unhealthy problems. Although anger expression is associated with violence and destruction it often underlies the efforts of individuals to shape societies into better, more just environments, and to resist the imposition of injustice and tyranny.

Anger expression is characterized by lowered eyebrows that are pulled to form wrinkles in the skin of forehead, tensed and straightened lower eyelids, and tension in lips. The closed mouth form of anger expression with lips closed together, aided by a pushing up of the chin boss and open mouth form of anger expressions are invariably found. Lips will be tense and thinned. The upper eyelid may be raised causing a glaring look.
Fear

Fig 3.6

Fear expressions are not often seen in societies where good personal security prevails. Primary reason behind fear is personal destruction from interpersonal violence or impersonal dangers. Fear expressions convey information about imminent danger, anger by threat, or likelihood bodily harm. Organization of behaviour and cognitive functions are adversely affected during fear, as escape becomes the peremptory goal. Anxiety is commonly related to fear and may involve some of the same bodily response.

The facial expression of fear is characterized by raised upper lids. The eye brows will be pulled up and together. The mouth will be stretched laterally, and the neck muscles pulled. Blends of fear and surprise expression are common. The elements of fear expression such as eyebrows raised straight up, upper eyelids raised up, jaw dropped and mouth open etc. combined with one or more surprise elements create an expression of sad and surprise.
Disgust emotion is due to body's response to objects that are nauseating, such as rotting flesh, faeces, insects in food, or other offensive material. Disgust expressions are often displayed as a commentary on many other events and people that generate adverse reactions, but have nothing to do with the primal origin of disgust as a rejection of possible food stuffs.

The disgust emotion is characterized by wrinkled nose with the eyebrows pulled down and the upper lip drawn up, the lower eyelid tense and eye opening narrowed. The pressing of the lips and raising of the upper eyelids are relevant to an anger expression, whereas the mouth would be open and the upper eyelids relaxed in the typical disgust expression.
3.3 ENCODING EMOTIONS

Emotion intensities are encoded by real numbers from 0 to 1, enclosed in brackets, in the order joy, sadness, surprise, anger, fear and disgust.

e.g. (0.5 0.0 0.3 0.0 0.0 0.0) is 0.5 joy with 0.3 surprise

Emotion intensities can be inserted anywhere in the Malayalam text file. An example is shown.

(0.5 0.0 0.1 0.0 0.0 0.2)

We recognise these numbers from the text file, by the token ‘(‘ and ‘)’ and store the values in an array of real numbers.

![Text Processor Diagram](image)

Fig 3.8

Text Processor
3.4 CONCLUSION

In this chapter, basic emotion types for facial animation are explained. The basic emotions considered are joy, sadness, surprise, anger, fear and disgust. The effect of basic emotions on facial images is discussed in detail. Encoding of emotion types using real numbers, along with the Malayalam text, is also described.