

Detection of Human Fear using Physical Parameters- An Analytical Approach

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Abstract

Fear is a response against anxious feeling, caused by our anticipation of some imagined event or experience. There are six basic emotions. They are happy, sad, fear, anger, surprise and neutral. Fear is a very dominant emotion among all other emotions. In this work fear coefficient is tried to be identified based on fourteen physical parameters which are heavily affected by the emotion, fear. The fear coefficient can be identified based on the generalized threat for the event with respect to incoming information about the real threat. The coefficients can measure the degree of fear for that particular event. The fear coefficient can be minimized by an external input which can work as anti fear agent.

Keywords: Emotion, Fear Coefficient, Fear Agent, Physical Parameters

1. INTRODUCTION

Human fear analysis is an emerging field in the field of emotion detection. In today's scenario major health problem is occurring due to mental imbalance and fear of unknown situation. According to the psychologists, fear is an anxious feeling, caused by our anticipation of some imagined event or experience. There are five basic type of fear. They are extinction, which can cause due to the fear of existence. Secondly, fear can be generated due to mutilation, which one is due to the fear of losing body parts. Fear of loss of autonomy is the third type which can be caused by the fear of immobility, entrapping etc. Fourth type of fear can be caused by lack of connection.

Finally, the most general fear is the fear of death. These are the general cause of fear, other than these lots of external or internal resources are in existence which can cause fear or fear like instinct inside the mind. The fear coefficient can identify the degree of fear and it can be minimized by some external agent based on the acuteness.

In this paper fourteen physical parameters are considered to identify the basic emotions. The physical parameters and their ranges are mentioned in Table 1.

Table 1 Range of Fourteen Physical Parameters

Serial No.	Parameters	Ranges
1.	Electroencephalogram	1.Alpha(13-15 Hz) 2. Beta(7.5-13 Hz) 3.Theta(2.5-8 Hz) 4.Delta(<4 Hz)
2.	Heart Rate	1.Low(20-70 BPM) 2.Normal(45-100 BPM) 3.High(84-120 BPM)
3.	Heart Rate Variability	1.High(0.15-0.4 Hz) 2.Low(0.04-0.15 Hz) 3.Very Low(0.003-0.4 Hz)
4.	Pre Ejection Period	1.Low(0-800 ms) 2.Normal(0-1000 ms) 3. High(500-1100ms)
5.	Stroke Volume	1.Low(10-144 ml) 2.Normal(100-250 ml) 3.High(240-400 ml)
6.	Systolic Pressure	1.Low(100-121 Hg) 2.Normal(110-134 Hg) 3.High(120-147 Hg)
7.	Diastolic Pressure	1.Low(77-88 Hg) 2.Normal(81-91 Hg) 3.High(85-91 Hg)
8.	Skin Conductance Response	1.Low(0-0.2ms) 2.Normal(0.1-1 ms) 3.High(0.85-1.5ms)
9.	Tidal Volume	1.Rapid(100-150ml) 2.Quiet(200-750 ml) 3.Normal(600-1200ml)
10.	Oscillatory Response	1.Low(0-0.49 breadths/minute) 2.Normal(0.4-0.88)

		breaths/minute) 3.High(0.5-1 breaths/minute)
11.	Respiration Rate	1.Low(5-10 breaths/minute) 2.Normal(7-23 breaths/minute) 3.High(15-24 breaths/minute)
12.	Non specific Skin Conductance Response	1.Low(0-2 /minute) 2.Normal(1-3/minute) 3.High(2-5/minute)
13.	Skin Conductance Level	1.Low(0-2 ms) 2.Normal(2-25 ms) 3.High(20-25 ms)
14.	Finger Temperature	1.Low(65F-75F) 2.Normal(75F-85F) 3.High(80F-90F)

These physical parameters can affect directly the fear coefficient. Fear coefficient is depending on generalized threat for a particular event with respect to the amount of fear for the particular incoming event in the same domain.

The flow of the paper is

- Section I Materials and Methods
- Section II Proposed model
- Section III Results & Discussion

2. MATERIALS AND METHODS

Fear model can be generalized with the help of equations and some assumptions. Let us assume that Q is the generalized information about the possible threat stored in the memory of an individual. I_Σ is the cumulative incoming information about the anticipated threat. The fear coefficient is denoted by f.

From the derivation of Prisnyakov and Prisnyakova we get that

$$f=A/ (Q- I_{\Sigma}) \tag{1}$$

A is the real constant characterizing the process of fear.

$$dI/dt \propto (-I) \tag{2}$$

dI/dt is the rate of change of fear information with respect to time. Negative sign is used with I because the rate of fear information will decrease with time. Therefore with proportionality constant k the equation 2 can be written as

$$\frac{dI}{dt} = -kI \quad (3)$$

Therefore the total amount of fear information with respect to time can be denoted as

$$I = I_0 e^{-kt} \quad (4)$$

I_0 is the initial information.

The total amount of information for time t can be written as

$$I_{\Sigma}(t) = I_0/k [1 - e^{-kt}] \quad (5)$$

The average information G can be written as

$$G = I_0/kT [1 - e^{-kt}] \quad (6)$$

The fear coefficient can be written by

$$f(t) = A / (Q - I_0/kT [1 - e^{-kt}]) \quad (7)$$

Since the derivative of $f(t)$ is greater than zero, it can be interpreted that rate of change of fear will increase with respect to time. To bring the fear down, E , an external agent can be used to minimize the fear.

Therefore the fear coefficient can be written as

$$f(t) = A / (Q - I_0/kT [1 - e^{-kt}] + E_0 e^{P(t-T_1)}) \quad (8)$$

P is the positive proportionality constant. T_1 is the time period. It is seen from the graph that the fear coefficient was increasing when only Q and I_0 were there. When E_0 , the external agent came, the fear coefficient started to decrease. In figure 1, it is clear that without any interference of output agent the fear coefficient increase. When E_0 is introduced, the fear coefficient started to decrease after a certain amount of time.

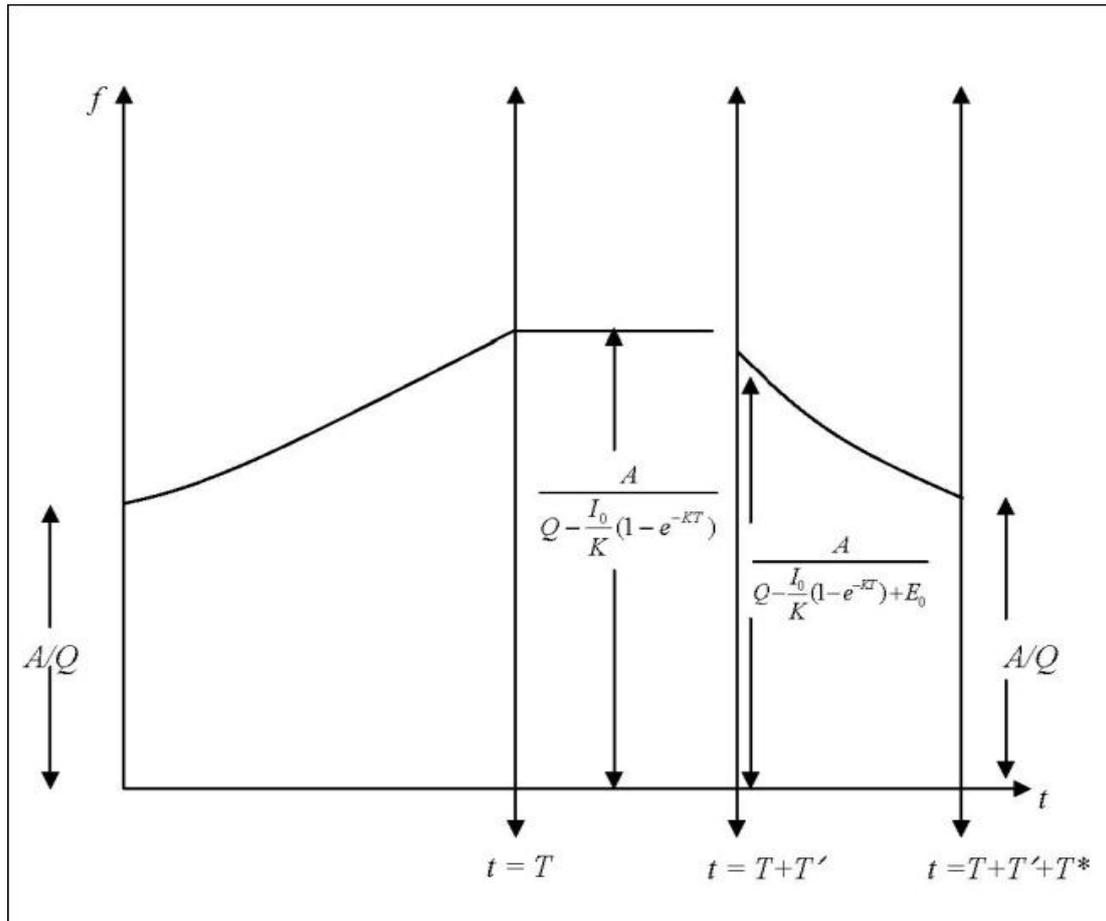


Figure 1: Changes of fear coefficient with respect to time

From figure 1 it is very clear that fear coefficient increases with respect to time, after a certain time it became constant and again started to decrease when E_0 is introduced.

3. PROPOSED MODEL

In proposed model the equations are tried to justify by the status of physical parameters. Fear is a chain of reaction in the brain that starts with a stressful stimulus and ends with the release of chemicals that cause increase in heart rate, fast breathing and energized muscle. The fourteen physical parameters that are directly affected by human emotions are shown in table 1. In table 2 we will show that how that fourteen parameters are affected by fear.[1][2]

Table 2: Physical Parameters change with respect to Fear

Serial No.	Parameters	Ranges of Parameters for Fear
1.	Electroencephalogram(A1)	Alpha(13-15 Hz) Beta(7.5-13 Hz)
2.	Heart Rate(A2)	High(84-120 BPM)
3.	Heart Rate Variability (A3)	High(0.15-0.4 Hz)
4.	Pre Ejection Period(A4)	Low(0-800 ms)
5.	Stroke Volume(A5)	High(240-400 ml)
6.	Systolic Pressure(A6)	High(120-147 Hg)
7.	Diastolic Pressure(A7)	Low(77-88 Hg)
8.	Skin Conductance Response(A8)	High(0.85-1.5ms)
9.	Tidal Volume(A9)	Rapid(100-150ml)
10.	Oscillatory Response(A10)	High(0.5-1 breaths/minute)
11.	Respiration Rate(A11)	High(15-24 breaths/minute)
12.	Non specific Skin Conductance Response(A12)	Low(0-2 /minute)
13.	Skin Conductance Level(A13)	Low(0-2 ms)
14.	Finger Temperature(A14)	Low(65F-75F)

Now let us take one example that, a person is alone in home. It is a kind of natural fear and the parameters are heavily affected by this fear is breathing speeds up, heart races, muscles tighten.

$$f(t)=A/(Q- I_0/kT [1-e^{-kt}]) \quad (9)$$

Let us assume that there is no initial fear. Therefore I_0 is equal to zero. [3]

Therefore the above equation can be written as

$$f(t)=A/Q \quad (10)$$

Q is the total amount of generalized fear which can vary with respect to incidents. In our example due to dark room, breathing speed must be high and heart rate is high. [4]

Therefore the equation (10) can be written as

$$\begin{aligned} f(t) &= (A_1 + A_2) / Q \\ &= (100 + 130) / Q = 230 / Q \quad [\text{Assumption Heart Rate} = 100 \text{ BPM \& Systolic Pressure} = 130 \text{ Hg}] \end{aligned}$$

If the number of parameters increases, the numerator will increase and Q will be constant for a specific case.

In proposed model we have taken five cases and estimated their fear coefficient and also estimated the changes of fear coefficient with respect to anti fear agent.

4. RESULTS AND DISCUSSION

The emotion fear can be analyzed analytically by fear model. In this paper five different cases are discussed.

CASE I FEAR OF EXISTANCE

It is a kind of fear where people will fear for death. As age increases the fear of existence will increase. In research, it is seen that after 80's it decreases automatically. If it arises at the age of 40's or 50's, it can be reduced by encouraging them to live. Therefore,

$$f(t) = (A_1 + A_2 + \dots + A_{14}) / Q \text{ [All 14 physical parameters]}$$

If we can encourage the people to live, then the E will be added at the denominator of the above equation and it becomes

$$f(t) = (A_1 + A_2 + \dots + A_{14}) / (Q + E) \text{ [All 14 physical parameters]}$$

It is seen that since E is added at the denominator, therefore fear coefficient will decrease with the anti fear agent.

CASE II FEAR OF MUTILATION

This is a kind of fear to lose the body parts. It is a kind of insecurity or over possessiveness about his/her own body parts. It can decrease with respect to time. All fourteen physical parameters will not be activated for all the cases. Some parameters will be dominant for some particular case.

CASE III FEAR FOR LOSS OF AUTONOMY

Fear of being immobilized, paralyzed, restricted, enveloped, overwhelmed, entrapped, imprisoned or otherwise controlled by any circumstances beyond our control. It can be overcome by self confidence.

$$f(t) = (A_1 + A_2 + \dots + A_{14}) / Q \text{ [All 14 physical parameters]}$$

If we can encourage the people to live, then the E will be added at the denominator of the above equation and it becomes

$$f(t) = (A_1 + A_2 + \dots + A_{14}) / (Q + E) \text{ [All 14 physical parameters]}$$

CASE IV FEAR OF SEPARATION

Fear of separation can arise from the fear of abandonment, rejection and loss of connectionless.

CASE V FEAR OF EGO

It is the fear of humiliation, shame or any other mechanism of profound self-disapproval that threatens the loss of integrity of the self.

5. CONCLUSION

In this paper fear coefficients tried to find out based on fourteen physical parameters. It is seen that fear coefficients will vary from situation to situation. The generalized information for a particular situation is constant, but the variables will change according to the situations.

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