

Recognizing and Expressing Affect

Presentation Summary

Part 1 Research status of emotion expression recognition

1.1 Facial expression recognition.

1.2 feature extraction

Part 2 Markov, D-S theory

2.1 Markov model

There is probability of changing emotion status in Markov model, so in this emotion model, there are 27 $P_{i,j}$ ($i, j \in [1, 2, 3 \dots, 27]$) and they construct 27 dimensional Probability matrix A_p .

$$A_p = \begin{bmatrix} P_{1,1} & \cdots & P_{1,27} \\ \vdots & \ddots & \vdots \\ P_{27,1} & \cdots & P_{27,27} \end{bmatrix}$$

$P_{i,j}$ ($i, j \in [1, 2, 3 \dots, 27]$) is the probability of i_{th} status to j_{th} status. Additionally, there is a relationship among them:

$$\sum_{i=1}^{27} p_{i,j} = 1, i \in [1, 2, 3 \dots, 27]$$

We can conclude that if there are m emotions and there will be m dimensional emotional space, and for every emotion there are n levels, which means that there will be n^m emotion status. Regard $l=n^m$, we can find that:

$$A_p = \begin{bmatrix} P_{1,1} & \cdots & P_{1,l} \\ \vdots & \ddots & \vdots \\ P_{l,1} & \cdots & P_{l,l} \end{bmatrix} \text{ and}$$

$$\sum_{i=1}^l p_{i,j} = 1, i \in [1, 2, 3 \dots, l]$$

2.2 Dempster-Shafer evidence theory

The D-S evidence theory is based on the theory of non-empty finite fields Θ . Θ is called frame of discernment or FOD, which represent a finite number of system states $\{\theta_1, \theta_2, \dots, \theta_n\}$, the system state assumes that H is a subset of Θ , an element of FOD's power set $P(\Theta)$.

D-S combination formula:

$$m(A) = \sum_{\substack{B \cap C = A \\ k = \sum_{B \cap C = \emptyset} m_1(B)m_2(C)}} m_1(B)m_2(C) / (1 - k)$$

For multiple basic probability assignment functions, there is a rule:

$$m(A) = m_1 \oplus m_2 \oplus \dots \oplus m_n$$

The combined probability value after combination is

$$m(A) = \frac{\sum_{\substack{A_i = A \\ 1 \leq i \leq n}} \cap m(A_i)}{1 - k}, A \neq \emptyset$$

$$k = \sum_{\substack{A_i = A \\ 1 \leq i \leq n}} \cap m(A_i)$$

Combine emotional space model with D-S evidence theory. This model will capture outer simulation by sensor, and then D-S theory will be applied into it for combining outside emotion information, which finally will promote the transfer of emotion status and reach a new state of emotion.

Part 3 Models (Application of Markov, D-S theory)

Discrete Affective Space Model

1. Construct a three-dimensional model based on fear, anger and happy, and any

emotional status will match a certain point on the 3-dimensional space.

2. Define happy as a , anger as b , fear as c , so, there are $a \in (0, 0.5, 1)$, $b \in (0, 0.5, 1)$, $c \in (0, 0.5, 1)$.

3. Set that every basic emotion only have three intensity.

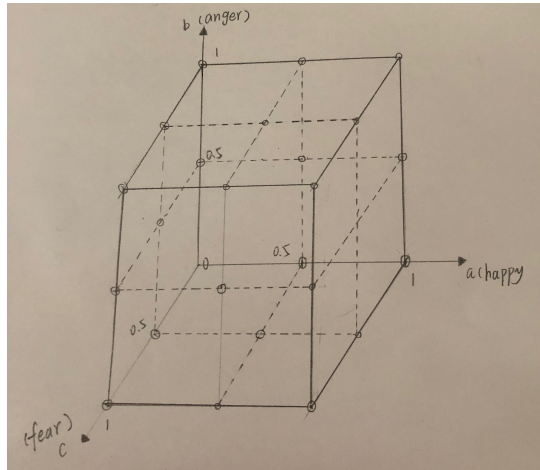


Fig. 1. emotional space model

4. Combine emotional space model with d-s evidence theory.

5. This model will capture outer simulation by sensor, and then D-S theory will be applied into it for combining outside emotion information, which finally will promote the transfer of emotion status and reach a new state of emotion.

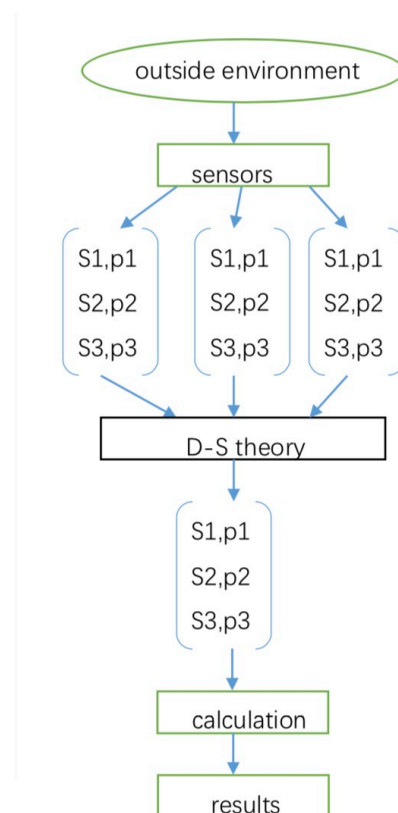


Fig. 2. Emotional Information Processing Flow