

Robot Sharing Human Emotion for Improving Relationship based on Facial Expression Recognition

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Abstract The robot is closer to the human and becomes important to our future world of pervasive computing, where the robot currently facilitates our life such a service in a house, chatting robot, therapy. Therefore the robot has to live with a human in complete harmony. Since the robot has to make a trust to human. Trust is an important component of any healthy relationship. If robot relationship lacks trust, it's hard to get close to the other person and to rely on him or her for support. Thus the robot is crucial to deal with the great relationship to human. In a trusting relationship, you should be able to share information or feeling with the robot without worrying. Firstly, the robot should make a good relationship by not expressing the feeling which is opposite or conflict to human feeling. Therefore the robot should understand the feeling or have an empathy skill then decide to express corresponding emotion to human. If the robot can have an intimate relationship, the human feeling can affect to the robot feeling. For instance, the feeling does not affect from each other. When the user feels sadness but the robot feels pleasure from inside, if robot expresses its feeling that might make the user angry, the robot should express the feelings tactfully such as neutral. Since the robot is affected by the human feeling because of an intimate relationship and mutual feeling.

To make a robot have a trust relationship, we develop the robot system with the cognitive based on the consciousness system which depends on the perception. The consciousness is formed by the motivation level which the consciousness aspect is based on the ontogeny and phylogenesis analyzed by the level of animal biology. The recognition of the robot has two major sources composed of animal object recognition that is to stimulate the motivation and human facial expression recognition that is to share the mutual feeling from a user. The method is to improve the intimate relationship between robot and human. The emotion of robot is driven by the motivation and animal perception which is the simple object detection such color, shape, and position. The emotional robot expression is decided by the inside robot emotion and human expression. For the decision of the robot expression, we apply the brain-inspired learning method which is Topology-learning Adaptive Resonance Theory (TopoART) designed based on the consciousness aspect with the resonance state respect to that all conscious states are resonant states. Since we would like to initiate the system that combines the psychological aspect represented by mutual feeling and brain represented by TopoART which is the one of an artificial neural network that relates to the human being. From the system that based on the human being that should make a closer relationship between robot and human. Because human not only map the contact from the perception to behavior like Artificial Intelligence method (AI) but a human also behave from the mental state such as motivation, emotion, social interaction.

For the decision of the robot expression, the robot would not express directly its emotions however it will regulate its feelings by sharing feelings from user and express the mutual feeling. Where we separate the positive emotion and negative emotion by the level. The surprise is the most positive level of positive emotion and anger is the most negative level of emotion. Then the robot would basically determine the average level of emotion. Then we firstly use this information to train the robot expression model which is TopoART. However, the not only train from these samples it is also trained by the particular case depending on the object recognition that will make the system non-linear for emotion expression.

For the purpose, since we would like the make a robot that has a relationship in complete harmony for a human to make the trust relationship. We also present the experiment the system by performing the robot expression with the user facial expression. We use the arm robot to perform the robot behavior and use robot eyes expression. This poster focuses on three points in the development of our proposed framework: (1) the organization of the behavior including inside-state emotion regarding the phylogenetic consciousness-based based on basic emotions; (2) a method whereby the robot can have empathy toward its emotion and human's expressions of emotion to create the human-robot mutual feeling and expression; and (3) a brain-inspired method that enables the robot to select the eye expression in response to the human. In light of the successful demonstration of our proposed system, we conclude that the robot with mutual feeling was able to 'share' emotional expression with the human user. This level of emotional intimacy could be used to enhance robots' capacity for initiating the interaction with humans, which is desired such as personal robots rather than the robot playing with an object and create the emotion induced by the object for the inside state. However, the robot can express the emotion not only depend on its inside state also depending on human expression. The robot's learning system was also improved by the use of the TopoART, with which the robot was able to engage in autonomous learning for new patterns of emotion and behavior. With this system, the robot might have more realistic behavior and trust relationship. Further work to affirm that the robot will not harm to human that research recently investigates how to trust the robot when both robot and human are in an insecure situation. Thus we would like to initiate ability of sacrifice to the robot. For instance as we know from history, there are dogs that sacrifice its life for owners in a dangerous situation.

Keywords-component; Emotional Intimacy; Human-Robot Interaction; Facial Expression Recognition; Consciousness Based Architecture