Modeling Changes in Affect with Scrabble Gamebot

RI Summer Scholar: Allison Funkhouser Advisors: Dr. Reid Simmons, Maxim Makatchev

Motivation

When humans interact with each other, there is an expectation that the emotions displayed by others will conform to our own understanding of the events they have encountered as well as our own perception of their personality. Since expressing emotion is an important part of social interaction, these expectations can carry over to human interaction with social robots. In order for human-robot interactions to follow human social conventions, robots should be capable of showing emotions that adhere to these expectations.

Goal

The goal of this project was to design criteria for determining the emotional state displayed by the scrabble gamebot. Each emotion displayed should be a logical extension of the positive and negative events from the game, such that the people who interact with the robot could easily identify rationalizations for the robot's current mood. Changes in the robot's mood must be determined based on the robot's previous emotional state, so that a single positive or negative event will not cause a drastic shift in mood. This aspect sets gamebot apart from the previous roboceptionist project. While the roboceptionist displayed distinct emotional levels based on its most recent interaction, those emotions could change instantly from intense anger to extreme happiness in a manner that does not accurately reflect human mood.

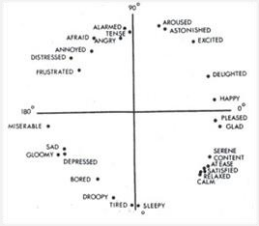
References

1. R. Kirby, J. Forlizzi, R. Simmons, "Affective social robots," *Robotics and Autonomous Systems*, vol. 58, no. 3, pp. 322-332, Mar. 2010

2. J. Russell, "A circumplex model of affect," *Journal of Personality and Social Psychology,* vol. 39, no. 6, pp. 1161–1178, Dec. 1980

Adapting Russell's Circumplex Model of Affect

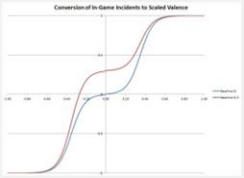
The design specifications were met by adapting Russell's circumplex model of affect, a model of human emotion in which potential emotional states are assigned coordinates on a two dimensional plot, shown below.



x-axis: valence – how positive or negative an emotion is

y-axis: arousal – how much energy is put into an emotional display

The graph was divided into four areas representing four basic emotions: neutral, angry, happy, and sad. The boundaries between these emotional areas were chosen to coincide with the robot's abrasive personality. Changes in valence and arousal for specific in-game events were also chosen so that gamebot would be more likely to become angry than sad, further reinforcing the robot's personality.



Incidents within the game were not linearly correlated to changes in valence or arousal. Instead, the same piecewise function used to determine the intensity of roboceptionist's expression was used to relate number of incidents to a scaled valence/ arousal. This scaled value was then used to determine current mood, which means the emotional state can settle near a specified baseline value for many in game incidents before a change in emotion will start to occur. This keeps the emotion from changing too quickly. In the future this baseline value will be controlled to change the robot's long term mood. Also, as time passes valence and arousal decay toward this baseline value.

Enhancing Emotional Expression

Another task I worked on this summer was enhancing the robot's expression of emotion within emotional categories. This included creating more subtle facial expressions, expanding the dialogue for responding to particular situations, and crafting more nuanced responses based on specific information from the current state of the game.

Condescending

Frustrated

Happy Surprise

Future Research

The groundwork laid this summer was designed to be easily expanded into a much more complex model of emotion. Though the current mechanism for changing between emotions only uses four basic emotional states, the same recipe format can be duplicated to allow for many more emotional categories. Eventually a z-axis will be added to account for changes in gamebot's current confidence in his scrabble playing abilities. The baseline values of valence and arousal are set so that they could be easily adjusted in order to simulate changes in long term mood. Also, though the boundaries between emotions and changes in valence and arousal were chosen with this specific robot's personality in mind, these attributes could be fine tuned to represent other personalities so that this model of emotion could be extended to other social robots.