Intelligent Humanoid Emotion Response based on Human Emotion Recognition for Virtual Intercommunication Simulator

Andrew Lim Wei Chin
Faculty of Computing
Universiti Malaysia Pahang Al-Sultan Abdullah,
Pekan, Malaysia
limandrew31@gmail.com

Lim Gim Wen
Faculty of Computing
Universiti Malaysia Pahang Al-Sultan Abdullah,
Pekan, Malaysia
imginwen6211@hotmail.com

Syafiq Fauzi Kamarulzaman*
Faculty of Computing
Universiti Malaysia Pahang Al-Sultan Abdullah,
Pekan, Malaysia
syafiq29@ump.edu.my

2023 IEEE 8th International Conference On Software Engineering and Computer Systems (ICSECS) | 979-8-3503-1093-1/23/$31.00 ©2023 IEEE | DOI: 10.1109/ICSECS58457.2023.10256398

***Abstract*—This paper aims to introduce a computational emotion model, named Fuzzy Artificial Intelligence Human Emotion Response (FATHER) after reviewing recent research on human emotion responses in human-machine interactions. Emotions play a pivotal role in human communication, influencing our moods and responses. The research delves into fundamental human emotions, computational emotion models, face detection algorithms, and fuzzy logic inference systems. FATHER is proposed and integrated into a 3D humanoid character named Umar. Umar's responses are presented using a virtual 3D human face model, allowing emotion expression through facial animations. This integration of 3D modeling and animation not only reduces costs linked with physical robotics but also propels advancements in affective computing research.**

Keywords—Artificial Intelligence, Machine Learning, Facial Expression Recognition

I. Introduction

Emotion holds a pivotal role in human communication, yet its subjective nature can lead to diverse interpretations. The industry's pursuit of understanding emotions has relied on data labeling and extraction methods to grasp their components [6]. Verbal communication was conventionally regarded as the main interaction mode; however, research by Barrett [3] emphasizes the significance of non-verbal interactions, including facial expressions and body gestures. Human emotion recognition hinges on key factors like facial expressions, body language, and speech tones. Facial expressions are particularly central to face-to-face communication, conveying vital non-verbal cues for interpersonal relationships [3]. This paper seeks to develop an intelligent humanoid capable of responsive behavior based on human facial expressions. Leveraging existing emotion recognition methods for facial expressions and tone, we aim to identify human emotions and offer appropriate feedback. By categorizing emotions via facial expression classification, labels like anger, happiness, fear, sadness, disgust, and neutrality emerge. These classifications feed into the fuzzy logic inference engine, guiding intelligent emotional responses in our 3D humanoid character. Once a suitable emotion is detected, the 3D character will mirror the corresponding facial expression in response.

In this paper, we propose a novel computational emotion model by integrating facial expression recognition and tone analyzer using Fuzzy Logic. We develop a 3D humanoid head model capable of providing emotional responses based on the newly proposed emotion model. We validate the effectiveness of the implemented emotion model through a real time interaction between a user and the 3D model. The paper will focus on a survey of the fundamental aspects of human emotions and the factors that influence emotions in order to construct a new computational emotion model. It will entail designing and developing a 3D humanoid head model capable of expressing emotions to the user.

II. Literature review

A. Emotions Model of Psychologists

a) Theory of Ortony Clore Collins: The Theory of Ortony Clore Collins (OCC) asserts that emotions manifest as balanced reactions to particular agents, events, or objects [1]. These elements, collectively termed environmental factors, shape human emotions. Emotional responses are evaluated in accordance with an individual's objectives, standards, and attitudes. For instance, one's emotional state can be influenced by an event's outcomes, the acceptance or rejection of an agent's actions, or the inclination towards or aversion to specific object attributes.

b) Theory of Lauzarus: The Theory of Lazarus, also known as the Appraisal Theory, primarily emphasizes two aspects critical for an individual's harmonious engagement with their surroundings [12]. These aspects encompass cognitive evaluation (appraisal) and adaptation (coping). Cognitive evaluation, described by the author, functions as an adaptive mechanism to preserve equilibrium between the individual and the world. This evaluation entails primary and secondary assessment. Primary evaluation gauges the pertinence and alignment of events, while secondary evaluation determines the most suitable reaction to the circumstance. For instance, when faced with stress-inducing situations, coping strategies are invoked. Adaptations for coping come in two forms: