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Original Article

The Six Emotional Dimension (6DE) Model: A Multidimensional Approach to Analyzing Human Emotions and Unlocking the Potential of Emotionally Intelligent Artificial Intelligence (AI) via Large Language Models (LLM)

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Abstract - The rapid advancements in artificial intelligence (AI) research, particularly in training large language models (LLMs) such as OpenAI's ChatGPT 3.5 and 4, hold significant potential for future applications in education, healthcare, and assisted living. Emotionally intelligent AI systems can provide personalized and adaptive educational experiences, enhancing engagement and educational outcomes. In healthcare, they can offer empathetic mental health support, augmenting existing resources. In assisted living, AI companions can provide emotional support, cognitive stimulation, and monitoring services, promoting independence and safety. However, ethical considerations and privacy safeguards are crucial to ensure responsible deployment. Integrating emotionally intelligent AI in these domains has the potential to improve human experiences and well-being greatly, but continued research and responsible development are needed to leverage its benefits while addressing challenges and ensuring ethical implementation.

Keywords - Brain science-inspired AI, Complex adaptive systems, Psychology-based social robotics, Conversational AI

1. Introduction

The past year has witnessed exponential developments in the field of generative artificial intelligence (AI) and large language models (LLMs), unleashing new possibilities and raising intriguing questions about the future of AI [1]. These powerful models, such as OpenAI's ChatGPT 3.5 and 4, have demonstrated remarkable capabilities in generating human-like text and engaging in sophisticated conversational interactions [2]. As the field progresses, researchers and practitioners are exploring the potential applications of these models across various domains, including education, healthcare, and assisted living [3-6].

In this context, understanding and replicating human emotions within AI systems have emerged as compelling research areas [7]. While machine intelligence and human emotions differ fundamentally, the training capabilities of LLMs have shown promise in simulating and adopting different "personalities", and next will be to explore artificial emotional dimensions [1]. This opens up avenues for developing emotionally intelligent AI systems that can comprehend and generate appropriate emotional responses, fostering enhanced user experiences and more meaningful interactions [8].

The proposed model, the Six Emotional Dimension (6DE) model, offers a multidimensional approach to analyzing human emotions within the realm of AI and LLMs. By considering the dimensions of arousal, valence, dominance, agency, fidelity, and novelty, this model seeks to capture the intricate subtleties of emotional experiences. Each dimension represents a specific aspect of an emotion, enabling a more comprehensive and nuanced understanding of emotional states.

This article explores the potential future use of emotionally intelligent AI systems in education, healthcare, and assisted living, leveraging the insights provided by the 6DE model. By incorporating emotional dimensions into these domains, AI systems can personalize and adapt educational experiences, offer empathetic mental health support, and provide companionship and assistance in assisted living settings [9]. The 6DE model serves as a framework to guide the development of emotionally intelligent AI, facilitating a deeper comprehension of emotions and enabling more contextually appropriate responses.

The following sections will delve into the advantages of the 6DE model for AI systems, examine the implications and future directions of this approach, and discuss the ethical considerations involved. By harnessing the potential of emotionally intelligent AI systems, new opportunities can be unlocked for transformative advancements in education, healthcare, and assisted living, ultimately enhancing human well-being and quality of life.

2. Literature Review

Research on emotionally intelligent AI has highlighted the importance of emotions in intelligent behavior and decision-making and has been the topic of increasing interest [10-12]. It has emphasized the value of incorporating emotions into artificial cognitive processing and the need for artificial emotional intelligence in facilitating social interactions [13]. Studies have explored various aspects, including the programming of machines to exhibit empathy, the development of AI-enabled emotional communication systems, and the challenges and implications of artificial emotions in fields such as healthcare and online marketing [14-16]. The research has paved the way for integrating emotions into AI systems, enabling more nuanced and contextually appropriate interactions with humans [8].

Research on emotionally intelligent AI has encompassed various dimensions and interests, highlighting the significance of emotions in intelligent behavior and decision-making and the potential applications and challenges associated with incorporating emotions into AI systems. Studies on the role of emotions in intelligent behavior and decision-making [17] and the value of emotions in advancing artificial cognitive processing [18] emphasize the importance of emotions in shaping human cognition and advocate for broader recognition of their significance in engineering and computer science communities.

Proposed frameworks for socially emotional AI [19] and the programming of machines to exhibit empathy and emotional intelligence [20] highlight the necessity of artificial emotional intelligence in facilitating social and emotional interactions, paving the way for emotionally intelligent AI systems. Furthermore, explorations of AI-enabled emotional communication systems [21] and advancements in synthetic emotional intelligence [22]

showcase the potential applications and advancements in affective computing, including emotionally intelligent chatbots and real-life applications.

Considerations of the challenges and implications of artificial emotions [23] and the development of bio-inspired social and emotional cognitive systems [24] shed light on the ethical and practical considerations in implementing emotionally intelligent AI. Discussions on the transition from emotion AI to cognitive AI [21] and the importance of robust emotion models [25] highlight the core elements and the necessity of developing emotion models for real-world affective computing applications.

Proposals for merging emotion recognition tools in healthcare settings [26] and discussions on the autonomous decision-making rights of emotional AI systems [27] reflect the potential impact of emotionally intelligent AI in healthcare and the ethical considerations related to AI decision-making. Finally, addressing legal and ethical challenges [28] emphasizes the need to consider fundamental rights, such as freedom of thought, in the context of emotionally intelligent AI.

The brief overview of scholarship reveals a diverse range of studies and interests within the field of emotionally intelligent AI. Researchers have explored the role of emotions in intelligent behavior and decision-making, recognized the value of emotions in advancing artificial cognitive processing, and proposed frameworks for socially emotional AI. Additionally, investigations have been conducted on AI-enabled emotional communication systems, synthetic emotional intelligence, and the challenges and implications of artificial emotions. Ethical and legal considerations and the potential applications of emotionally intelligent AI in healthcare and other domains have also been addressed.

The proposed 6DE model offers a valuable contribution to this ongoing conversation by providing a multidimensional approach to analyzing human emotions. With its six emotional dimensions - arousal, valence, dominance, agency, fidelity, and novelty - the 6DE model offers a comprehensive framework for understanding and quantifying emotional states. By incorporating sub-dimensions within each dimension, the model allows for a more fine-grained analysis of emotions within text-based communication. This approach can potentially enhance the comprehension and generation of appropriate emotional responses by AI systems, leading to improved user experiences and more effective human-AI interactions.

The 6DE model aligns with the growing interest in emotionally intelligent AI and addresses the complexity of human emotions. It provides a common language for discussing emotional experiences and offers the potential for personalization and innovation. By integrating the 6DE model into AI systems, researchers and developers can strive towards more accurate and nuanced emotional analysis and response. As the field continues to advance, the 6DE model can serve as a valuable tool in developing emotionally intelligent AI systems for various applications, such as education, healthcare, and assisted living.

3. 6DE Model

The 6DE model, or the Six Emotional Dimension model, is a multidimensional framework designed to analyse and quantify human emotions [29]. It consists of six emotional dimensions that capture different aspects of emotional experiences. These dimensions provide a comprehensive and nuanced understanding of emotions, allowing for more accurate analysis and replication of emotional states. The six emotional dimensions in the 6DE model are arousal, valence, dominance, agency, fidelity, and novelty [30] (Table 1).

Table 1. 6DE model, or six emotional dimension model

Dimension	Description
Arousal	Represents the level of activation or energy associated with an emotion. Ranges from low arousal (calmness and relaxation) to high arousal (excitement and anticipation). It focuses on the intensity and physiological responses accompanying emotions, such as increased heart rate or breathing rate.
Valence	Refers to the positive or negative nature of an emotion. Ranges from negative valence (sadness and frustration) to positive valence (joy and contentment). Captures the emotional polarity or affective quality of an experience.
Dominance	Reflects the degree of control or power associated with an emotion. Ranges from low dominance (submission or passivity) to high dominance (dominance or assertiveness). Characterizes the level of influence and control an individual feels over their emotions.
Agency	Represents the level of control an entity has over an emotion. Spans from no agency (reflexive and involuntary emotions) to the full agency (emotions subject to conscious choice and volition). Captures the degree of personal control and autonomy individuals perceive over their emotional experiences.
Fidelity	Reflects how well an emotion represents the event or situation that caused it. Ranges from low fidelity (mismatch or incongruence between the emotion and its trigger) to high fidelity (strong alignment or congruence). Measures the accuracy and appropriateness of emotional responses to specific events or stimuli.
Novelty	Represents the degree of novelty or newness associated with an emotion. Spans from no novelty (habitual or familiar emotions) to high novelty (emotions arising from surprising or unexpected experiences). Captures the level of novelty or surprise that accompanies emotional responses.

By examining emotions across these six dimensions, the 6DE model provides a comprehensive framework for understanding emotional experiences. It enables a more detailed analysis of emotional states within text-based communication without relying on sensory input. This fine-grained approach made possible by considering the subdimensions enhances the ability of AI systems to comprehend and generate appropriate emotional responses, contributing to enhanced user experiences and more effective human-AI interactions.

To utilize the 6DE model with ChatGPT, individuals can actively engage in conversations or interactions with the AI system to harness the power of emotional analysis and generation. Whether the aim is to gain insights into the emotional dimensions of a given situation or to generate specific emotional responses, the 6DE model provides a framework for a more nuanced understanding of emotions. Here are a few examples of instructions and prompts that can be used to guide the interactions:

To train ChatGPT with the 6DE model and enhance its understanding and generation of emotional responses, users can follow a set of instructions and prompts designed to guide the training process. By incorporating the 6DE model into the training data, ChatGPT can acquire a more comprehensive understanding of emotional dimensions and generate more appropriate and nuanced emotional responses. Here are instructions and prompts that can be utilized:

Table 2. Prompts to train LLMS on emotional responses

Instruction	Prompt
Please analyze the emotional dimensions of the given situation using the 6DE model.	Describe a recent event or experience and ask the model to provide an analysis of the arousal, valence, dominance, agency, fidelity, and novelty dimensions associated with it.
Generate an emotional response with specific dimensions based on the given scenario using the 6DE model.	Set up a hypothetical scenario and ask the model to generate an emotional response with desired levels of arousal, valence, dominance, agency, fidelity, and novelty.
Provide an explanation of how the emotional dimensions of a character in a story can be described using the 6DE model.	Describe a character from a book or movie and ask the model to analyze the character's emotional experiences in terms of arousal, valence, dominance, agency, fidelity, and novelty.
Discuss the potential implications of personalizing emotional responses using the 6DE model in AI systems.	Ask the model to provide insights on how AI systems can use the information from the emotional dimensions to tailor emotional responses to individual users and discuss the potential benefits and challenges of such personalization.
Imagine an AI assistant with different personalities based on variations in the emotional dimensions. Describe how this could enhance user interactions.	Encourage the model to explore how AI systems with varying levels of arousal, valence, dominance, agency, fidelity, and novelty in their personalities can lead to more effective and meaningful interactions with users in different contexts, such as education, healthcare, or assisted living.

Table 3. Training LLM on 6DE model

Instruction	Prompt
Incorporate the 6DE model into the training data for ChatGPT to enhance its understanding and generation of emotional responses.	Provide a dataset that includes conversations or text examples where emotional dimensions are explicitly discussed or expressed. This can include annotated emotional data, user interactions, or simulated dialogues involving the arousal, valence, dominance, agency, fidelity, and novelty dimensions.
Fine-tune ChatGPT using the 6DE model as a guiding framework to generate emotionally intelligent responses.	Train ChatGPT with a modified objective function incorporating the 6DE model's emotional dimensions. Use reinforcement learning or other techniques to guide the model towards generating responses that align with desired arousal levels, valence, dominance, agency, fidelity, and novelty.
Integrate the 6DE model as a post-processing step to analyze and refine the emotional content generated by ChatGPT.	After ChatGPT generates a response, use the 6DE model to analyze the emotional dimensions present in the generated text. Provide feedback or adjustments to the response based on the desired emotional qualities to enhance the emotional intelligence of the model.
Train ChatGPT using a combination of the 6DE model and existing emotional datasets to improve its emotional understanding and generation capabilities.	Merge the 6DE model with existing emotional datasets, such as the AffectNet or EmotionX datasets, during the training process of ChatGPT. Fine-tune the model to capture the nuances and subtleties of emotions represented by the dimensions in the 6DE model.
Create a dialogue dataset where users interact with ChatGPT, explicitly providing feedback on the emotional qualities of the responses.	Collect user feedback on the emotional dimensions of ChatGPT's responses in a dialogue setting. Prompt users to rate the arousal, valence, dominance, agency, fidelity, and novelty of the generated responses. Use this annotated dataset to train ChatGPT to understand better and generate emotionally intelligent responses.

To train ChatGPT with the 6DE model, users can follow a set of instructions and prompts designed to analyze and generate emotional responses. By engaging in conversations or interactions using these instructions, users can explore the emotional dimensions of various situations and generate appropriate emotional responses based on desired levels of arousal, valence, dominance, agency, fidelity, and novelty.

For example, users can provide a given situation and instruct ChatGPT to analyze the emotional dimensions associated with it using the 6DE model. This allows users to gain insights into the intensity, positive or negative nature, degree of control, level of agency, fidelity to the triggering event, and level of novelty of the emotions related to the situation. The 6DE model provides a comprehensive framework to accurately capture and describe these emotional dimensions.

Users can also prompt ChatGPT by describing a recent event or experience and asking the model to provide an analysis of the emotional dimensions associated with it. By generating emotional responses based on specific scenarios, users can explore the intricate interplay of arousal, valence, dominance, agency, fidelity, and novelty within emotional experiences.

The 6DE model can be used to analyze the emotional experiences of characters in stories or movies. Users can describe a character and ask ChatGPT to analyze the character's emotional dimensions in terms of arousal, valence, dominance, agency, fidelity, and novelty. This allows for a deeper understanding of the emotional journeys of fictional characters and their impact on storytelling.

Moreover, the 6DE model opens up possibilities for personalizing emotional responses in AI systems. Users can discuss the potential implications of tailoring emotional responses based on individual users' emotional dimensions. By leveraging the information from the 6DE model, AI systems can adapt emotional responses to individual preferences, enhancing user experiences and fostering stronger connections between humans and AI. In summary, the 6DE model provides a powerful framework for training ChatGPT to understand and generate emotionally intelligent responses. Following the instructions and prompts aligned with the 6DE model allows users to delve into the intricate world of emotions, analyze emotional dimensions, and generate personalized emotional responses, leading to more meaningful and engaging interactions with AI systems.

4. Conclusion

The field of emotionally intelligent AI has witnessed significant developments, with scholars recognizing the importance of emotions in shaping intelligent behaviour and decision-making [10]. However, there is still a need for broader recognition and integration of emotions within the engineering and computer science communities [31]. As such, he proposed 6DE model offers a multidimensional approach to analysing human emotions for AI systems, providing a comprehensive framework to capture the nuances of emotional experiences. By considering dimensions such as arousal, valence, dominance, agency, fidelity, and novelty, the 6DE model enables AI systems to comprehend better and generate appropriate emotional responses. It offers a common language for discussing emotional experiences, enhancing the effectiveness and relatability of human-AI interactions.

The significance of the 6DE model lies in its ability to provide a more fine-grained understanding of emotions within text-based communication. By incorporating sub-dimensions within each emotional dimension, it enables detailed analysis and replication of emotions. This level of granularity contributes to enhanced user experiences and more accurate emotional replication and opens up possibilities for personalization and innovation in emotional AI research.

Moving forward, there are several avenues for future research in emotionally intelligent AI. Researchers can continue refining and improving the 6DE model, exploring additional sub-dimensions or considering different

contextual factors that influence emotional experiences. Further studies can investigate the effectiveness of the 6DE model in real-world applications, such as education, healthcare, and assisted living, to evaluate its impact on user engagement and well-being. Additionally, exploring the ethical implications and addressing challenges related to emotional AI, such as privacy, bias, and the rights of AI systems, will be vital for responsible development and deployment.

The preceding discussion of the model provides a valuable framework for advancing the understanding and replication of human emotions in AI systems. By embracing a multidimensional approach, AI systems can better analyse, generate, and personalize emotional responses, leading to more meaningful and effective interactions with users. With continued research and innovation, emotionally intelligent AI has the potential to revolutionize various domains and enhance the overall human-AI relationship.

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