Empathetic Conversational Artificial Intelligence Systems: Recent Advances and New Frontiers

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1 Title

Empathetic Conversational Artificial Intelligence Systems: Recent Advances and New Frontiers

2 A two-sentence tutorial description

Recently, empathetic conversational artificial intelligence (ECAI) systems exhibiting emotional and social intelligence have attracted increasing attention from the natural language processing (NLP) community. Recognizing users' affective states (emotions, sentiment, etc.) and behavior and responding accordingly is key to successful communication. While it is straightforward for humans, instilling such human-like capabilities into conversational systems is a challenging task. Since ECAI systems encompass a wide spectrum of human attributes, it becomes difficult for beginners to get started. Therefore, this tutorial aims to present a comprehensive review of empathetic conversational AI systems. The scope of the tutorial includes the background, evolution, datasets, techniques including the state-of-the-art approaches, evaluation methods, and recent trends in ECAI systems. Finally, it points out a few limitations and shortcomings of the existing techniques to facilitate future research.

3 A two-paragraph tutorial description

The primary objective of developing conversational artificial intelligence (CAI) systems is to satisfy users' concerns and requests by imitating human communication. Recent years have witnessed the modeling of empathy in conversational systems to encourage pro-social conduct and strengthen the sense of social bonding. This tutorial intends to review empathetic conversational AI (ECAI) systems, whose goal is not inherently to respond to diverse requests from users but also to boost the perception and expression of emotional states and personal preferences. In this tutorial, we first introduce conceptual models of empathy [Davis and others, 1980; Goleman, 1995] and briefly present the relevance of empathy in CAI systems [McTear et al., 2016].

Afterward, we discuss notable research works on ECAI systems. Specifically, we focus on the affective and social dimensions of the empathetic conversational systems. Emotion identification facilitates the selection of relevant empathetic responses [Rashkin et al., 2019]. A few studies have identified sentiments in user messages to respond empathetically [Chen and Nakamura, 2021; Lahoz-Beltra and López, 2021]. Following emotion-based generation, we quickly summarize the works that adhere to recognizing users' emotions/sentiments as a de-facto step towards empathetic response generation in CAI systems [Zhou et al., 2018; Firdaus et al., 2021a; Zheng et al., 2021; Firdaus et al., 2021b; Madasu et al., 2022; Majumder et al., 2022]. However, incorporating emotions and/or sentiments in the generated responses could only partially serve as the solution to empathetic response generation.

A more comprehensive ECAI system should have access to other information as well, such as emotion cause, user's intent, persona, social conduct (politeness), and external knowledge to enhance the sense of empathy in the generated responses. We intensively highlight several popular works that focus on these aspects to build better ECAI systems [Li et al., 2021; Gao et al., 2021; Xie and Pu, 2021; Zheng et al., 2021; Zhong et al., 2020; Firdaus et al., 2020d; Saha and Ananiadou, 2022; Firdaus et al., 2022d; Golchha et al., 2019; Firdaus et al., 2020c; Mishra et al., 2022b; Firdaus et al., 2022b; Mishra et al., 2022a; Firdaus et al., 2022a; Mishra et al., 2023; Yoo and Jeong, 2021; Sabour et al., 2022; Liu et al., 2022; Li et al., 2022]. In particular, we discuss the datasets, techniques and/or state-of-the-art (SOTA) approaches, and evaluation methods presented in these works.

Lately, multimodal information (a combination of features from different modalities - text, images, audios, and videos) has shown to be beneficial for emotion analysis in CAI systems [Poria et al., 2018; Firdaus et al., 2020b]. Hence, we also discuss the studies that have incorporated multimodal information in the empathetic response generation framework and have obtained significantly better performance compared to models with unimodal information [Tavabi et al., 2019; Firdaus et al., 2020a; Firdaus et al., 2022c]. Further, a new line of research on ECAI systems has shown that empathetic CAI systems are capable of social influence (affect the users' emotional and cognitive responses, contributing to changes in their beliefs, attitudes, and behaviors through empathetic conversations). The key social influence tasks include persuasion and psychotherapy [Wang et al., 2019; Althoff et al., 2016]. We briefly present the noteworthy study on this emerging trend in ECAI systems [Samad et al., 2022; Mishra et al., 2022c; Sharma et al., 2020; Sharma et al.,

2021].

Finally, as a conclusion, we draw attention to the limitations and shortcomings of contemporary approaches so that it will be simpler for beginners to advance research on ECAI systems.

4 Proposed length of the tutorial

1/2 day (consisting of one slot or two 1:45h slots)

5 Outline of the Tutorial

This tutorial is organized as follows:

- **Conceptual models of empathy (15 minutes)**
  We will introduce the fundamental conceptual models of empathy, including the different types of empathy and the individual differences in the perception of empathy [Davis and others, 1980; Goleman, 1995].

- **Need for empathy in conversational AI systems (15 minutes)**
  Empathy is regarded as a necessary trait, and studies have been undertaken to enhance empathy in humans in a variety of contexts [Spinrad and Gal, 2018]. Computational modeling of empathy helps in better comprehending human relations [Yalcin and DiPaola, 2018]. Thus, we will precisely talk about the works which suggest that the incorporation of empathy in CAI systems could enhance the user experience and contribute to bridging the human-machine gap [McTear et al., 2016].

- **Empathy-related concepts in ECAI systems (135 minutes)**
  An ideal ECAI system is expected to exhibit emotional and social competence. In this part of the tutorial, we will first introduce the various concepts related to empathy and then points out the works that we will cover in detail.

  - *Emotion/Sentiment*: Emotion/sentiment helps in understanding users' feelings/attitudes towards an entity. Ever since the introduction of the EMPATHETICDIALOGUES dataset [Rashkin et al., 2019], the interest in building ECAI systems has spiked. There have been works that attempt to identify the emotion and use the predicted emotion label to generate emotionally consistent responses [Zhou et al., 2018; Madasu et al., 2022]. The multiple emotions and corresponding emotional intensity-based empathetic response generation is presented in [Firdaus et al., 2021a]. The key factors of empathy expression (communication mechanism, dialog act, and emotion) are modeled in a hierarchical way in [Zheng et al., 2021] for empathetic response generation. The correlation between sentiment and emotion has been exploited in [Firdaus et al., 2021b] for generating empathetic responses. The distinct elements of human communication, *viz.* emotional presence, interpretation, exploration, and sentiment are used to guide the response generation towards empathy in [Majumder et al., 2022].

  - *Emotion cause*: Emotion cause facilitates understanding the underlying cause of a particular emotion for generating more relevant empathetic responses. Emotion cause identification in ECAI systems studies has been an active area of research in recent times due to significant performance improvements [Li et al., 2021; Gao et al., 2021].

  - *Intent*: Recognizing the users' intent in conversational systems is essential for delivering the requisite information to the users. A few studies on ECAI systems have attempted to identify users' intent during the conversation. In particular, the works in [Xie and Pu, 2021] identify 8 new intents and combine these intents with 32 emotion categories from the EMPATHETICDIALOGUES dataset [Rashkin et al., 2019] to form a hybrid emotion-intent category. This emotion-intent category data is utilized in another ECAI study to emphasize its usefulness [Zheng et al., 2021].

  - *Persona*: Persona-based research in CAI systems necessitates that the agent exhibits a specific personality while interacting with users. Persona is highly correlated with personality, which in turn influences empathy. A Persona-based Empathetic Conversation (PEC) dataset has been created in [Zhong et al., 2020]. Several other studies have utilized persona-aware techniques for enhancing the performance of empathetic response generation [Firdaus et al., 2020d; Saha and Ananiadou, 2022; Firdaus et al., 2022d]. The results of these ECAI studies indicate that persona influences empathetic conversations more than non-empathetic ones.

  - *Politeness*: Politeness is an important virtue of humans and to make the CAI agents behave more like a human, it is necessary to induce politeness in such agents. Politeness is vital for developing a cordial and empathetic connection with the users [Mishra et al., 2022b]. Lately, certain studies attempt to build CAI systems that incorporate polite behavior in customer care agent's responses [Golchha et al., 2019; Firdaus et al., 2020c; Mishra et al., 2022a; Firdaus et al., 2022a; Mishra et al., 2023]. The work in [Firdaus et al., 2022b] generates polite responses based on the age and gender of the users to offer a more personalized experience to them. The findings of these studies indicate that politeness improves the empathetic nature of the agent.

  - *External knowledge*: The CAI agents sometimes need to have access to external knowledge for generating more informative and relevant responses. The use of such knowledge sources in ECAI systems research facilitates a more in-depth comprehension of the user's circumstances/feelings by deducing the implicit information inherent in the user's responses. For instance, from the user's response *"I have cough issue for the last 10 days."*, the agent can infer the correct emotional state of the user by accessing the knowledge bases like Con-

ceptNet [Speer *et al.*, 2017] as the word *'cough'* is related to *'illness'* in ConceptNet. Some works have been presented that incorporate information from external knowledge bases for improving the ECAI systems performance [Sabour *et al.*, 2022; Liu *et al.*, 2022; Li *et al.*, 2022].

- *Multimodal information*: In recent times, employing multimodal information has gained immense popularity in affective computing. It plays a vital role in fully understanding the users' emotional state by using both textual and non-textual features. A few works have been pinpointed in the literature that utilized multimodal information for better response generation in ECAI systems [Tavabi *et al.*, 2019; Firdaus *et al.*, 2020a; Firdaus *et al.*, 2022c].

Specifically, during this session, we will discuss the most prominent works that have implemented the above-mentioned empathy-related concepts for empathetic response generation, which includes [Firdaus *et al.*, 2021a; Firdaus *et al.*, 2021b; Kim *et al.*, 2021; Xie and Pu, 2021; Firdaus *et al.*, 2020d; Firdaus *et al.*, 2022d; Golchha *et al.*, 2019; Firdaus *et al.*, 2020c; Mishra *et al.*, 2022a; Firdaus *et al.*, 2022a; Mishra *et al.*, 2023; Firdaus *et al.*, 2022b; Li *et al.*, 2022; Firdaus *et al.*, 2020a; Firdaus *et al.*, 2022c]. We will outline the datasets used in these ECAI systems studies followed by the machine learning/deep learning techniques proposed to imbibe empathetic behavior in such systems, state-of-the-art approaches, and evaluation methods.

- **ECAI systems for persuasion and psychotherapy (30 minutes)**

Persuasion and psychotherapy are intricate processes that often involve an empathetic connection between two individuals. Research has shown that empathy leads to positive outcomes in persuasive and therapeutic conversations. Following this, we will discuss studies that attempt to build ECAI systems for such social good applications [Samad *et al.*, 2022; Mishra *et al.*, 2022c; Sharma *et al.*, 2020; Sharma *et al.*, 2021].

- **Conclusion and Future Directions (15 minutes)**

This tutorial discusses the most recent and representative works followed by the current trends in ECAI systems. Despite the remarkable advancements in ECAI systems, many research challenges remain in the context of empathetic systems, which gives future directions in this research area:

- Combining target-dependent emotion with user modeling would be the next step in this line of research, as emotion is a particular dimension affixed to the speaker and other conversational participants. Emotion and personality should be correlated dimensions of the user, and should therefore be modeled jointly.
- Utilizing the existing knowledge base containing sentimental or emotional knowledge, e.g., Sentic-Net, can aid in detecting the emotional states of the user and understanding background information

beyond the context, which eventually leads to generating emotionally-coherent responses.

6 Target audience for the tutorial

We believe that the potential target audience could be the students at all levels (Doctorals, Masters, Bachelors), and anyone who is associated with e-commerce, customer care, & related application areas, and researchers.

We would assume an acquaintance with basic concepts about chatbots and neural networks, such as those included in most introductory Machine Learning (ML), Deep Learning (DL) and Natural Language Processing (NLP) courses.

7 Why this tutorial?

The popularity of CAI systems has exploded since ChatGPT was released. Empathy is a vital component for humanizing the CAI systems. Consequently, the empathetic conversational AI systems have witnessed a great surge of interest in recent times owing to its promising potential and alluring commercial and social importance. Such systems that are capable of comprehending users' affective and behavioral states help humans in achieving their desired goals whilst acting as a companion to them.

The current advances in ECAI systems spans a numerous humanly aspects catering to a large pool of research. These aspects include emotion, sentiment, emotion cause, intent, persona, politeness, external knowledge accessibilty, multimodality and persuasion. It illustrates the wide applicability of ECAI systems but also make it more challenging for beginners to get started. The beginners should have the knowledge of these aspects in addition to being conversant with the latest developments in neural NLP techniques. An in-depth tutorial could be beneficial for them. With this goal, we present this tutorial that serves as a detailed guide to research and development on ECAI systems and suggests future directions in this domain.

8 Ethical Concerns

ECAI systems are ubiquitous in everyday life. Research on how we use empathy in our lives spans a number of applications, including customer care, persuasion, and psychotherapy, to name a new. While we think about these applications, it is also crucial to keep several ethical considerations in mind, including:

- **Privacy and Confidentiality:** Conversational AI systems can collect sensitive information from users during conversations, including personal details, health information, or other sensitive data. Ethical considerations for conversational AI research should ensure that users' privacy and confidentiality are respected, and that any data collected is used appropriately. To guarantee the privacy and confidentiality of users, the data utilized in the research presented in this tutorial has been anonymized, and any personal details have been kept undisclosed.
- **Fairness and Bias:** Conversational AI systems should be developed with an understanding of potential biases

and avoid reproducing or amplifying social inequalities. Research presented ensures that conversational AI is fair to all users, regardless of their race, gender, age, or other characteristics.

- **Transparency and Explainability:** Conversational AI systems should be transparent about their capabilities and limitations, as well as how they make decisions. Users should understand how their interactions with conversational AI are being analyzed and used. In this regard, we provide detailed evaluations both automatic and human to make the findings in this tutorial completely transparent to the readers.

- **Empathy and Emotional Intelligence:** Conversational AI should be developed with empathy in mind and take into account the user's emotional state during a conversation. AI should not only respond correctly to users' statements but also identify their emotional state and respond in an appropriate manner. This ethical consideration is the key topic of the tutorial that has been actively considered in the research presented.

- **User Empowerment and Control:** Conversational AI should be designed with the user in mind, allowing them to control the conversation and make decisions about what information is shared. Conversational AI should be respectful of users' autonomy and provide a choice to end the conversation or request additional assistance. The datasets designed for different research topics discussed in this tutorial takes care of user's autonomy.

Overall, ethical considerations for empathetic conversational AI research should prioritize the needs of the users while maintaining privacy, fairness, and transparency. Developers should seek to promote user empowerment, emotional intelligence, and empathy while avoiding harmful biases or discriminatory practices.

9 Presenters

Priyanshu Priya, Mauajama Firdaus, Kshitij Mishra, and Asif Ekbal. The CVs of all the presenters are attached to this proposal.

10 Relevant publications from research group

1. Kshitij Mishra, Priyanshu Priya, and Asif Ekbal (2023). *Help Me Heal*: A Reinforced Polite and Empathetic Mental Health and Legal Counseling Dialogue System for Crime Victims. In 37th AAAI Conference on Artificial Intelligence, February 7-14, USA (accepted) (Core - A*; h5-index: 180)

2. Z. Ahmad, K. Mishra, and A. Ekbal (2023). RPTCS: A Reinforced Persona-aware Topic-guiding Conversational System. In 17th Conference of the European Chapter of the Association for Computational Linguistics (EACL), May 2-4, Croatia (accepted) (Core - A; h5-index: 62)

3. K. Mishra, M Firdaus, and A. Ekbal (2023). GenPADS: Reinforcing politeness in an end-to-end dialogue system PLosOne, https://doi.org/10.1371/journal.pone.0278323

4. M. Firdaus, A. Ekbal and P. Bhattacharyya (2022). PoliSe: Reinforcing Politeness using User Sentiment for Customer Care Response Generation. In 29th International Conference on Computational Linguistics (COLING), October 12-17, Korea (accepted) (Core-A; h5-index: 58)

5. K. Mishra, A. Samad, P. Totala and A. Ekbal (2022). PEPDS: A Polite and Empathetic Persuasive Dialogue System for Charity Donation. In 29th International Conference on Computational Linguistics (COLING), October 12-17, Korea (accepted) (Core-A. h5 index-58)

6. D. Varshney, A. Prabhakar and A. Ekbal (2022). Commonsense and Named Entity Aware Knowledge Grounded Dialogue Generation. In Proceedings of NAACL-HLT 2022, 1322-1335, July 10-15, USA. (Core-A; h5-index: 105)

7. A. Samad, K. Mishra, M. Firdaus and A. Ekbal (2022). Empathetic Persuasion: Reinforcing Empathy and Persuasiveness in Dialogue Systems. In Proceedings of NAACL-HLT 2022 (Findings), 844-856, July 10-15, USA. (Core-A; h5-index: 105).

8. Zishan Ahmad, Asif Ekbal, Subhashish Sengupta , Pushpak Bhattachharyya (2022). Neural Response Generation for Task Completion using Conversational Knowledge Graph, PLosOne, https://doi.org/10.1371/journal.pone.0259238 (IF-3.752; h5 index: 180) (IF-3.752; h5 index: 180)

9. M. Firdaus, N. Thangavelu, A. Ekbal and P. Bhattacharyya (2022). I enjoy writing and playing, do you?: A Personalized and Emotion Grounded Dialogue Agent using Generative Adversarial Network. In IEEE Transaction on Affective Computing, doi: 10.1109/TAFFC.2022.3155105 (Impact factor- 10.305).

10. Kshitij Mishra, Mauajama Firdaus and Asif Ekbal (2022). Please be Polite: Towards building a Politeness Adaptive Dialogue System for Goal-oriented Conversations, Neurocomputing, 94, 242-254, Elsevier (IF-5.719; h5 index: 123).

11. K. Misra, M. Firdaus, A. Ekbal (2022). Predicting politeness variations in Goal-oriented Conversations. IEEE Transaction on Computational Social System, IEEE, doi: 10.1109/TCSS.2022.3156580 (IF-4.747; h5 index: 44).

12. Gopendra Vikram Singh, Mauajama Firdaus, Shambhavi, Shruti Mishra, Asif Ekbal (2022). Knowing What to Say: Towards knowledge grounded code-mixed response generation for open-domain conversations. Knowledge Based System, Elsevier, 249: 108900 (2022) (IF: 8.038; h5 index: 107).

13. Mauajama Firdaus, Nidhi Thakur, Asif Ekbal (2022). Sentiment Guided Aspect Conditioned Dialogue Generation in a Multimodal System. In Proc. of ECIR (1) 2022: 199-214. (Core-A)

14. Firdaus, H. Chauhan, A. Ekbal and P. Bhattacharyya (2021). More the Merrier: Towards Multi-Emotion and

Intensity Controllable Response Generation. In Proceedings of AAAI 2021, PP. 12821-12829 (Core-A*; h5 index: 180).

15. D. Vershney, A. Ekbal and P. Bhattacharyya (2021). Modeling Context Emotions using Multi-task Learning for Emotion-Controlled Dialogue Generation. In Proceedings of EACL 2021, PP. 2919-2931 (Core-A; h5-index: 62).

16. M. Firdaus, U. Jain, A. Ekbal and P. Bhattacharyya (2021). SEPRG: Sentiment aware Emotion controlled Personalized Response Generation. In Proc. of the 14th International Conference on Natural Language Generation (INLG), 353-363.

17. Mauajama Firdaus, Hitesh Golchha, Asif Ekbal, Pushpak Bhattacharyya (2021). A Deep Multi-task Model for Dialogue Act Classification, Intent Detection and Slot Filling. Cognitive Computation 13(3): 626-645 (2021).(h5 index: 43; IF-5.418)

18. Mauajama Firdaus, Nidhi Thakur and Asif Ekbal (2021). Multi-Aspect Controlled Response Generation in a Multimodal Dialogue System using Hierarchical Transformer Network. In Proc of 2021 International Joint Conference on Neural Networks (IJCNN). (h5-index:63)

19. Mauajama Firdaus, Arunav Pratap Shandilya, Sthita Pragyan Pujari and Asif Ekbal (2021). Attribute Centered Multimodal Response Generation in a Dialogue System. In Proc of 2021 International Joint Conference on Neural Networks (IJCNN). (h5-index:63)

20. M Firdaus, N Thakur, A Ekbal (2021). Aspect-Aware Response Generation for Multimodal Dialogue System. In ACM Transactions on Intelligent Systems and Technology (TIST) 12 (2), 1-33. 1. (IF-3.971; h5-index: 38).

21. M. Firdaus, H. Chauhan, A. Ekbal and P. Bhattacharyya (2020). EmoSen: Generating Sentiment and Emotion Controlled Responses in a Multimodal Dialogue System (2020). IEEE Transactions on Affective Computing, 10.1109/TAFFC.2020.3015491. (Impact factor- 10.305)

22. Mauajama Firdaus, Nidhi Thakur, Asif Ekbal (2020). MultiDM-GCN: Aspect-Guided Response Generation in Multi-Domain Multi-Modal Dialogue System using Graph Convolution Network. In Proc. of EMNLP (Findings) 2020: 2318-2328. (Core-A; h5-index: 154).

23. M. Firdaus, A.P Shandilya and A. Ekbal (2020). More to Diverse: Generating Diversified Responses in a Task Oriented Multimodal Dialog System. PLosONE, https://doi.org/10.1371/journal.pone.0241271. (IF-3.752; h5 index: 180)

24. Mauajama Firdaus, Asif Ekbal, Pushpak Bhattacharyya (2020). Incorporating Politeness across Languages in Customer Care Responses: Towards building a Multilingual Empathetic Dialogue Agent. In Proceedings of The 12th Language Resources and Evaluation Conference (LREC), pp. 4171-4182. (h5 index: 49)

25. Hardik Chauhan, Mauzama Firdaus, Asif Ekbal and Pushpak Bhattacharyya (2019). Ordinal and Attribute Aware Response Generation in a Multimodal Dialogue System. In Proceedings of Association for Computational Linguistics (ACL), pp. 5437-5447.(Core-A*; h5 index-169)

26. M. Firdaus, H. Chauhan, A. Ekbal and P. Bhattacharyya (2020). MEISD: A Multimodal Multi-Label Emotion, Intensity and Sentiment Dialogue Dataset for Emotion Recognition and Sentiment Analysis in Conversations. Proceedings of COLING 2020, pp. 4441-4453. (Core-A. h5 index-58)

27. Zishan Ahmad, Asif Ekbal, Shubhashis Sengupta, Anutosh Mitra, Roshni R. Rammani, Pushpak Bhattacharyya (2020). Active Learning Based Relation Classification for Knowledge Graph Construction from Conversation Data. In Proceedings of ICONIP (4) 2020: 617-625. (Core-A in 2020)

28. M. Firdaus, N. Thangavelu, A. Ekbal and P. Bhattacharyya (2020). Persona aware Response Generation with Emotions. In the 2020 International Joint Conference on Neural Networks (IJCNN), Glasgow, UK, July 2020. (h5 index: 63).

29. M. Firdaus, A. Kumar, A. Ekbal and P. Bhattacharyya (2019). A Multi-task Hierarchical Approach for Intent Detection and Slot Filling. Knowledge based Systems, Elsevier, ttps://doi.org/10.1016/j.knosys.2019.07.017. (IF-8.038; h5 index: 107).

30. Hitesh Golchha, Mauajama Firdaus, Asif Ekbal, and Pushpak Bhattacharyya (2019). Courteously Yours: Inducing courteous behavior in Customer Care responses using Reinforced Pointer Generator Network. In Proceedings of the 2019 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies, pp. 851-860. 2019. (Core-A; h5 index: 105).

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