

A Spoken Dialogue System using Extended Hybrid Code Network in the Context of Hospital Receptionist Robot

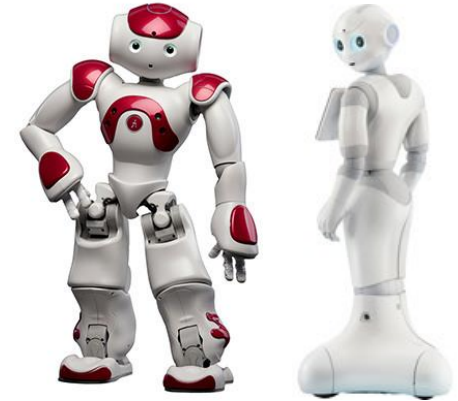
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- Expected to bring positive impact
 - Reduce working time and effort
 - i.e. receptionist robot
- In existing works [F. Faber et al., 2009; T. Fong et al., 2006; D. Spiliotopoulos et al., 2011]
 - Finite state machine (FSM)
 - Frame-based method (= slot-based method)
- Drawbacks in the existing works
 - Unclear how to define the dialogue state [J. D. Williams et al., 2017]
 - Not only expensive and time-consuming to deploy but also make it hard to expand to a new domain [M. Etric et al., 2017]



[F. Faber et al., 2009] F. Faber et al., "The Humanoid Museum Tour Guide Robotinho," in Robot and Human Interactive Communication, 2009. RO-MAN 2009. The 18th IEEE International Symposium on, 2009, pp. 891–896 .

[T. Fong et al., 2006] T. Fong, C. Kunz, L. M. Hiatt, and M. Bugajska, "The human-robot interaction operating system," in Human Robot Interacion, 2006, p. 41.

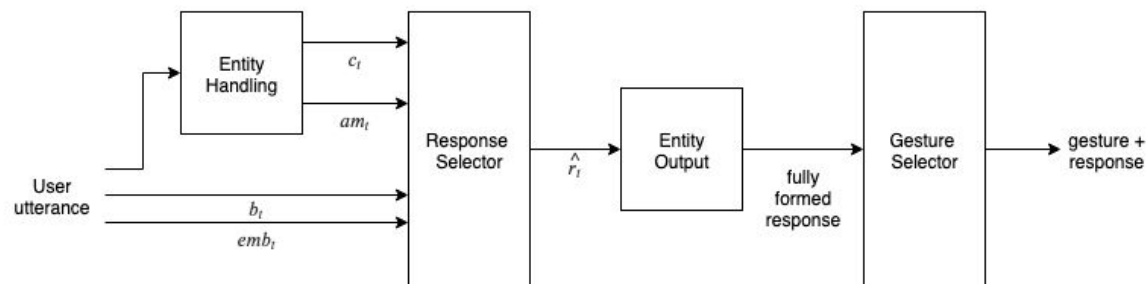
[D. Spiliotopoulos et al., 2001] D. Spiliotopoulos and C. D. Spyropoulos, "Human-Robot Interaction Based On Spoken Natural Language Dialogue," in Proceedings of the European workshop on service and humanoid robots, 2001, pp. 25–27.

[J. D. Williams et al., 2017] J. D. Williams, K. Asadi, and G. Zweig, "Hybrid Code Networks: practical and efficient end-to-end dialog control with supervised and reinforcement learning," in Proceedings of the 55th Annual Meeting of the Association for Computational Linguistics, 2017, pp. 665–677.

[M. Etric et al., 2017] M. Eric and C. D. Manning, "A Copy-Augmented Sequence-to-Sequence Architecture Gives Good Performance on Task-Oriented Dialogue," in the Association for Computational Linguistics, 2017, vol. 2, pp. 468–473.

RNN based End-to-End Dialogue System

- Utilized and extended Hybrid Code Network (HCN) [J. D. Williams et al., 2017]
 - RNN based end-to-end dialogue system
 - Extended trainable part to select gesture
- Consist of four different parts
 - Entity handling: identifies and maintains entities in user's utterance
 - Response selector: computing latent dialogue state and selecting system response
 - Entity output: generating fully-formed response based on templated system action from the response selected
 - Gesture selector: select gesture based on the selected response



- Our proposed system has been applied to NAO robot platform
- Conducted user study to evaluate our proposed system
 - Extended HCN (proposed) vs. Rule based system (baseline)
- Recruited 20 participants
- Interaction with the given scenario
- Evaluate each performance under PARADISE framework [M. A. Walker et al., 1997]

	Measure	Baseline	Proposed method
Dialogue efficiency	Number of tasks	M=3.9, SD=0.32	M=3.8, SD=0.42
	Number of user turns	M=13.4, SD=1.57	M=12.0, SD=1.49
	Number of robot turns	M=15, SD=2.31	M=13.2, SD=1.61
	Elapsed time(sec)	M=243.1, SD=29.17	M=204.7, SD=24.22
Dialogue quality	Number of time out	M=0.7, SD=0.67	M=0.2, SD=0.42
	Number of re-prompts	M=0.8, SD=0.91	M=1.3, SD=1.42
	Speech recognition	M=93.53, SD=2.24	M=93.39, SD=3.20
User acceptability	User satisfaction	M=3.72, SD=0.55	M=3.88, SD=0.43
	perception	M=3.79, SD=0.55	M=3.73, SD=0.32