Integration of Sensory Modalities for Advice in Human-Robot Scenarios

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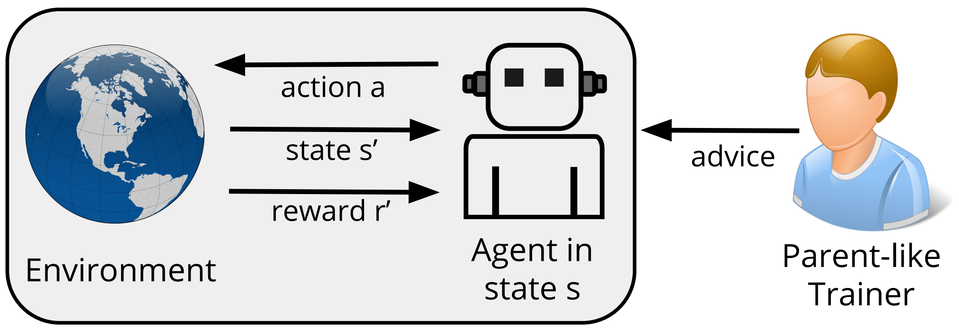
INDEPENDENCIA · PLURALISMO · COMPROMISO

1. Motivation

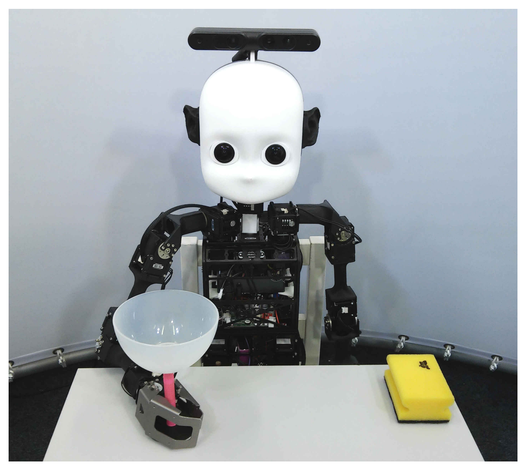
- Robots are able to autonomously learn new tasks.
- *Problem:* the time needed for a robot to acquire new skills.
- A parent-like trainer may speed up the learning process by using Interactive Reinforcement Learning (IRL):



2. Robotic Scenario

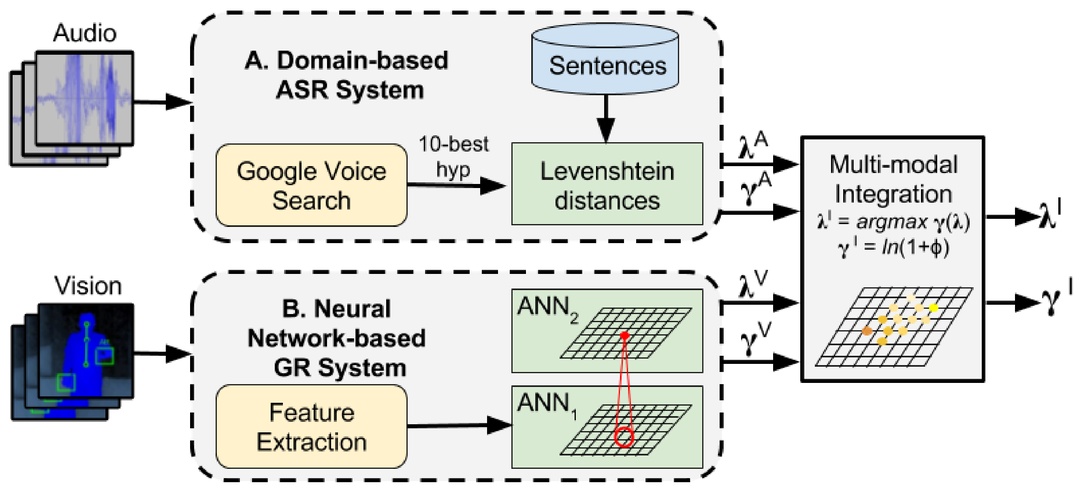
- In a reinforcement learning scenario, a robot learns how to clean a table. We define *objects*, *locations*, and *actions* as follows:

Objects	Locations
sponge	left
goblet	right
	home
Actions	
go <location>	
get	drop
clean	abort



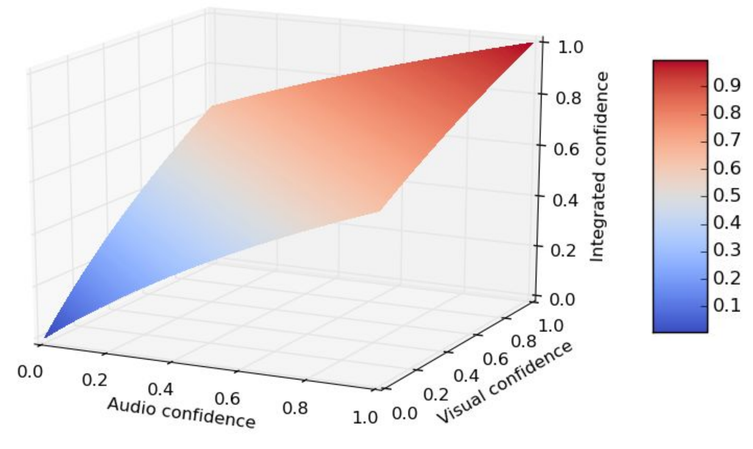
3. Approach

- Human parent-like trainer advising learner-agents.
- Audiovisual advice using recordings.
- Instructions may be unclear or misunderstood.
- Levels of interaction and consistency of feedback.

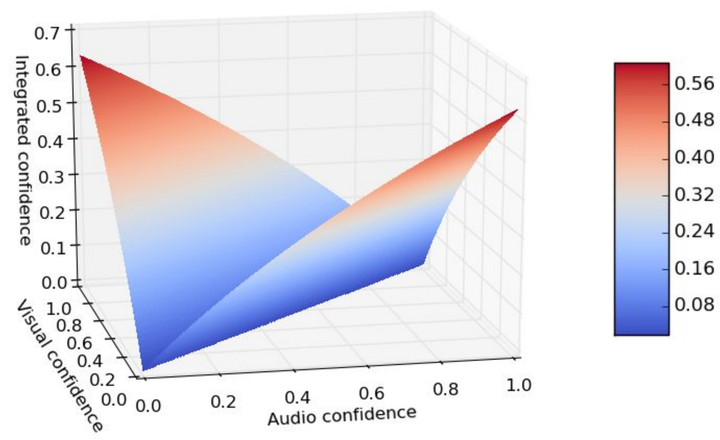


4. Experimental Results

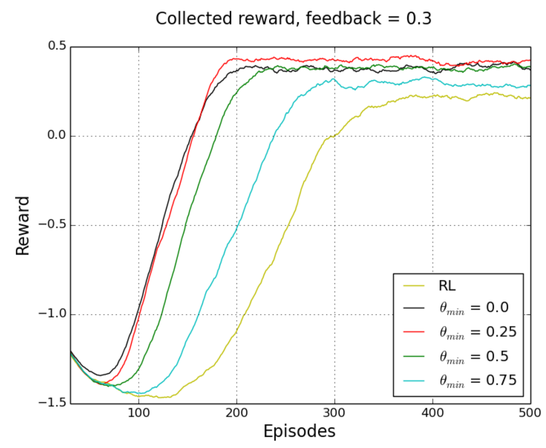
- Experiments in a robotic IRL scenario.
- Different confidence levels to verify whether small confidence values benefit the learning scenario.
- We considered $\lambda_I > \theta_{min}$ with θ_{min} being the minimum confidence threshold to be considered as a valid advice.



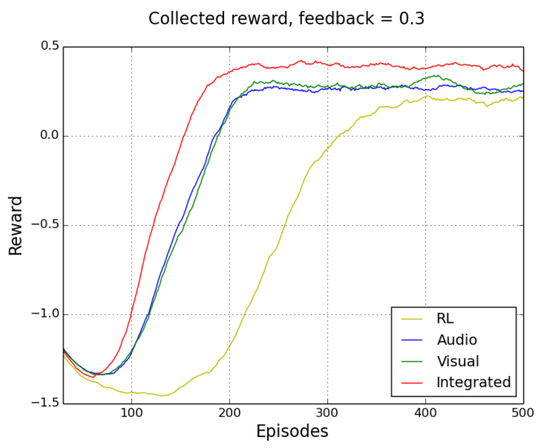
(a) Integrated confidence with equal uni-modal predicted labels



(b) Integrated confidence with different uni-modal predicted labels



Integrated reward.



Uni- and multi-modal reward.

5. Conclusions

- Interactive feedback provides advantages over RL, but parent-like trainers need to give good feedback.
- Integrated advice leads to better performance in terms of accumulated reward and required learning episodes.

References

- Cruz, F., Parisi, G. I., Twiefel, J., and Wermter, S. Multi-modal integration of dynamic audiovisual patterns for an interactive reinforcement learning scenario. *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 759-766, Daejeon, Korea, 2016.
- Cruz, F., Parisi, G. I., and Wermter, S. "Multi-modal Feedback for Affordance-driven Interactive Reinforcement Learning". In Proceedings of the IEEE International Joint Conference on Neural Networks (IJCNN), pp. 5515-5122, Rio de Janeiro, Brazil, 2018.