Foreword

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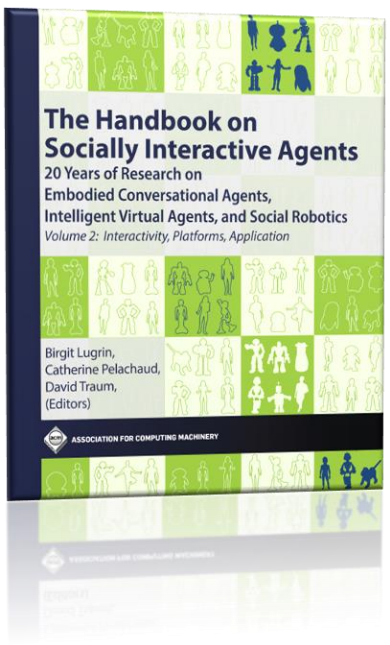

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Foreword

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This handbook is a timely publication for a field that has grown substantially in recent years. Its roots go back to work in embodied conversational characters from the late 1990s [Cassell et al., 1998]. This drew on the earlier Natural Language Processing field of dialogue management [see for example Larsson and Traum, 2000], as well as the explosively expanding area of Agent Technology in the 1990s [Wooldridge and Jennings, 1994].

As technology developed making it feasible to take computer technology out of special static locations, and into a variety of existing human social environments, the issue of social intelligence was necessarily raised. It had already been shown [Reeves & Nash, 1996] that people attributed social personhood to computer systems they interacted with. This was all the more so as this field created embodiments for such systems, whether as graphical characters (intelligent virtual agents) or as robots [Dauhtenhahn, 1998] that drew on the human instinct to anthropomorphise.

Moreover the addition of embodiment opened up new dimensions of interaction through non-verbal communication – covered in Chapter 16 on "The Fabric of Socially Interactive Agents: Multimodal Interaction Architectures" [Kopp and Hassan, 2022] - that were necessarily socially-located. This in turn raised questions, little considered in dialogue management or agent technology, of perceived personality, discussed in Chapter 18 on "Adaptive Artificial Personalities" [Janowski et al., 2022], as well as affective displays. Work in Cognitive Science and Artificial Intelligence (AI) was fused with work in animation and other graphical technologies, with game engines often used as a delivery mechanism as we see in Chapter 20 on "Platforms and Tools for SIA Research and Development" [Hartholt and Mozgai, 2022]. Alongside intelligent virtual agents, similar ideas were developed in robotics [Breazeal 1998], with the foundation of the field of human-robot interaction in which embodiment was fundamental.

Volume 2 of this handbook offers a comprehensive coverage of the last twenty years of R&D in the field and the current state-of-the-art. It focuses on some of the theory behind social interactivity in Part IV, and on the wide range of application areas that have been tackled in part V. The discussion of social interactivity theory in Chapter 14 on "Interaction in Social Space" [Vilhjálmsson, 2022] is an important one. While some architectures used to develop intelligent virtual agents have been strongly informed by cognitive models – for example FAtiMA (Mascarenhas et al 2022) and EMA-SmartBody (Marsella and Gratch 2009), as discussed in Volume 1 part III, it is sometimes less clear how the social interaction theories discussed in Part IV are actually operationalised in the applications in Part V. This is an area where much remains to be done, though work in culturally-specific agents, covered in Chapter 13 on "Culture for Socially Interactive Agents" [Lugrin and Rehm, 2021] of Volume 1 of this handbook [Lugrin et al., 2021], is one motivation for a deeper use of social theories [Mascarenhas et al 2016].

That said, the level of activity in applying SIA technology is substantial and growing. It is important to understand that, as with other systems using AI components, generalisation

across domains is not feasible in practice, especially for social robots, where real-world constraints are very tough. Trying to build a generalist system soon exposes the limitations of the current state of the art. Thus the commercially-available generalist technologies of Alexa, Google Home, Siri and others – all disembodied – work well as QA interfaces to the internet but have so far failed to make the leap into commercial deployment of connected conversation in spite of substantial research effort driven in some cases by competitions [Ram et al., 2018].

However in specific niches, SIA technology can be a very positive factor. Two strong examples of such SIAs making real-world contributions can be seen in the Paro seal robot [Wada and Shibate, 2007], used to increase interaction for elderly dementia sufferers, with clinically proven benefits, and the successful SIA that motivates patients to continue with their post-hospital health regime [Bickmore et al., 2007].

In Part V, the Handbook focuses on the three areas in which most activity has taken place: assistive/health technologies, education and computer games/interactive narrative. This is not an exclusive list, since as with all flourishing research areas, new ideas are continually being explored, while specific elements gradually make their way into marketed applications, as with online corporate chatbot help systems.

However many, if not most, of the systems discussed represent applied research rather than immediately deployable commercial technology. One should not underestimate the time it takes to move from an initial research concept to a real-world technology. The Paro seal robot was conceived in the 1990s [Sibata and Irie, 1997] and was already being evaluated with its target population in the early 2000s. It took at least a further ten years to complete clinical trials proving its benefits so that it could be used in real-world settings with elderly dementia sufferers. A deployed product has to work over the long term and not just in a limited lab-based interaction. As we see in Chapter 19 on “Long-Term Interaction with Relational SIAs” [Kory-Westlund et al., 2022] in this volume, robust long-term interaction comes with a set of specific challenges.

Work in the very promising use of social robots for support of children with autism, discussed in Chapter 25 on “Autism and Socially Interactive Agents” [Nadel et al., 2022], is an example of a technology on the path to deployment which has not yet attained a commercial product. Pioneered by a few groups, for example that at University of Hertfordshire in the UK with its Kaspar robot [Wood et al., 2021], and now researched in numerous centres, this has advanced to the stage of small-scale studies with the target population, showing definite benefits, but has yet to arrive at the stage of a full clinical trial. The chances seem good that it will do so at some point in the near future.

While the abilities of ‘AI’ have been hyped in the recent period, in practice fully autonomous intelligent agents still represent a source of risk for commercial providers. Natural language engineering is a bottleneck in that commercial organisations want to know what a system they deploy ‘will say’ over a customer base that may run into millions. Tailored dialogue systems grounded in known semantics are usually used in health applications for this reason, as we see in Chapter 15 on “Socially Interactive Agent Dialogue” [Traum, 2022]. Large language models, as in Googles’ GPT3 and other like systems, operating as pure

pattern-matchers, can be lamentably unpredictable in their output, not to mention inappropriate or plain wrong [Dale, 2021]. The issues relating to robust dialogue are one reason why intelligent virtual agent SIAs, in principle easier to deploy than robotic SIAs, still face obstacles to commercial deployment.

In education SIAs have appeared in most cases as adjuncts to existing intelligent tutoring systems. They are therefore dependent on the capacities of those systems, which themselves are not widely deployed. Chapter 21 on "Pedagogical Agents" [Lane and Schroeder, 2022] on Pedagogical systems examines the specific challenges. Language learning is one educational niche in which the motivating effect of an SIA is seen as a positive factor. This is a benign domain in that it is based on short interactions, where repeated practice is one of the main pedagogical requirements, and it has long been computerised.

However the perceived unpredictability of autonomous operation can be an issue in education too, since the point of educational applications is to reach definite pedagogical goals. Educationalists feel much happier if there is hard evidence that they do so. In thinking about the limits of autonomy, it is worth pointing out that social interaction normally limits human autonomy, whether through social norms, peer-group pressure or law, and that social intelligence involves understanding what range of actions is open to you in the current social situation.,

A lower risk educational area is the one that overlaps with computer games, which is discussed in Chapter 28 on "Serious Games with SIAs" [Gebhard et al., 2022]. Serious games are usually viewed as an adjunct to other educational materials and as a motivating force rather than a core educational resource. SIAs can open up an experiential role-play based approach that is much harder to organise live in a classroom.

The focus on socially-useful and entertainment applications is one way in which some of the difficult ethical issues around anthropomorphism discussed in Volume 1 can be body-swerved. There is no question that SIAs draw on a human need to anthropomorphise that is hardwired into our social brains. When the point of the SIA is to improve your health or educate you, the potential benefits should outweigh the inherently deceptive presentation of a computer artefact as a person. Whether this is true of some of the corporate support bots, of very limited 'intelligence', social or otherwise, and apparently designed to block customers from any human support, is a different question.

If this volume of the Handbook were to go to a second edition in say five year's time, there is no doubt that new application areas and greater commercial deployment would feature. This is an exciting area in which the known issues are being attacked with verve and energy. Most researchers of SIAs do not expect the world to be full of them in the immediate future, but there is no question that the future of technology has to be social.

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