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Multimodal Agents for Ageing and Multicultural Societies

Communications of NII Shonan Meetings

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Preface

Nowadays, intelligent agents are omnipresent and used by almost all generations. Furthermore, we live in a globally mobile society in which populations of widely different cultural backgrounds live and work together. The number of people who leave their ancestral cultural environment and move to countries with different culture and language is increasing. This is not free of challenges. Especially in the case of care, migrants often face two issues: (i) not being able to speak the language and not being acquainted with the culture of the resident country, and (ii) being unfamiliar with the care and health administrations of the country. As a consequence, e.g. elderly migrants in care homes suffer from social exclusion, with their relatives also struggling with getting the right information and interacting with the administration, migrants at home are often reluctant to go to see the doctor in case of health issues, a tendency that is often further aggravated by cultural matters. Migrant temporary care workers face the problem of isolation and deficient communication.

We believe that time is ripe to gather experts with a background in assistive technologies for elderly care, culture-aware computing, multimodal dialogue, social robotics and synthetic agents to learn about their insights and approaches on how to meet the resulting societal challenges. The overall objective of the Shonan meeting entitled "Multimodal Agents for Ageing and Multicultural Societies" has been to explore and discuss theories and technologies for the development of socially competent and culture-aware embodied conversational agents for elderly care. The results of the discussions will help to foster the understanding of the emerging field and the identification of promising approaches from a variety of disciplines. In order to share this knowledge, the results of the meeting are published within this book.

Chapter 1 presents a vision of an intelligent agent to illustrate the current challenges for the design and development of adaptive systems. These are analysed following the what-which-how-then model to cover all aspects including which features to adapt, what to adapt to, when to adapt and how to adapt. A special emphasis is given to multimodal conversational interaction. It becomes clear that there is no single system behaviour that fits all users as contemporary societies are comprised of individuals very diverse in terms of culture, status, gender and age. Multicultural and ageing societies demand *adaptive* interactive systems with the ability to learn about and from their users and adjust their behaviour accordingly.

Chapter 2 examines how notions of *trust* and *empathy* may be applied to human-robot interaction and how it can be used to create the next generation of emphatic agents, which address some of the pressing issues in multicultural ageing societies. In order to do so, some examples of possible future services are given. The authors discuss how existing descriptive models of trust can be operationalized so as to allow robot agents to elicit trust in the human partners. Another topic is to determine how the robot agents can detect and alter trust levels to have transparency to be included in the interaction design. With regard to future computational models of empathy, fundamental challenges are formulated, and psychological models of empathy are discussed for their appliance in computational models and their use of interactive empathic agents.

Chapter 3 discusses multimodal machine learning as an approach to enable more effective and robust modelling technologies and to develop socially competent and culture-aware embodied conversational agents for elderly care. With the goal of better understanding and modelling the behaviour of ageing individuals, four key challenges are identified: (i) *multimodal*, this modelling task includes multiple relevant modalities which need to be represented, aligned and fused; (ii) *high variability*, this modelling problem expresses high variability given the many social contexts, large space of actions and the possible physical or cognitive impairment; (iii) *sparse and noisy resources*, this modelling challenge addresses unreliable sensory data and the limitation and sparseness of resources that are specific for the special user group of ageing individuals; and (iv) *concept drift*, where two types of drift were identified, namely on the group level (as the target group of usage is not fully known at the moment of development of according interfaces given that it is yet to age) and the individual level (given that ageing may lead to drifting behaviour and interaction preferences throughout the ongoing ageing effect).

Chapter 4 explores the challenges associated with real-world field tests and deployments. The authors review some of the existing methods and their suitability for studies with multimodal and multicultural agents. Moreover, ethical concerns related to field studies with sometimes vulnerable users are investigated. Moving out of the laboratory poses a number of challenges that are not present in controlled settings and requires to thoroughly prepare for the unpredictability of the field. Fortunately, it is not necessary to start from scratch but some of the methods developed in the human-computer interaction community for studies outside the lab can be re-uses.

Chapter 5 gives a short introduction to Socio-cognitive Language Processing which describes the idea of coping with everyday language (including slang and multi-lingual phrases and cultural aspects), irony, sarcasm, humour, paralinguistic information such as the physical and mental state and traits of the dialogue partner (e.g. affect, age groups, personality dimensions), and social aspects. Additionally, multimodal aspects such as facial expressions, gestures or bodily behaviour should ideally be included in the analysis where possible. These aspects may render future dialogue systems more 'chatty' by not only appearing natural but also by being truly emotionally and socially competent, ideally leading to a more symmetrical dialogue. To do this, the computer should be enabled to experience or at least better understand

emotions and personality so that that they have 'a feel' for concepts like having a 'need for humour', an 'increase of familiarity'.

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Chapter 1
Adaptive Systems for Multicultural and Ageing Societies

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1.1 Vision/Use Case

Ruth and Daniel are both 78 years old, they have been married for 50 years and live together in their house in a quiet neighbourhood on the outskirts of the city. Although they are retired now, they have very busy agendas, especially since their daughter Eva has a child, Alex.

Ruth enjoys cycling and taking dancing lessons with her friends. She also does voluntary work at the public library two days a week. She has always been very active, so she tries to do as much exercise as possible in her daily life, walking or cycling to her destinations when possible, using the stairs, and making plans with her friends that include some type of mild physical activity (e.g. walking outdoors). Unfortunately, she is losing her vision as she gets older.

Daniel used to be very sporty, but his joints ache now due to arthritis and he can only walk short distances. He takes care of a little garden and enjoys cooking the

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vegetables that he grows there in order to keep his blood pressure and sugar levels at a healthy level, as he had problems before. He also meets with friends at the local bar to watch sport together as often as he can, especially when his favourite team is playing. Every now and then he gives lessons to their neighbour's children who need help with maths at school.

Apart from their regular activities, they have frequent appointments with doctors to take care of their conditions (blood pressure, sugar level, sight…) and they take turns at taking their grandchild to school and every now and then they babysit at home or at their daughter's when she has to stay late at work.

Eva lives near her parents, approximately 30 min walk to Alex's school. She usually takes him to their house in the morning and goes to work, as school starts later. She is passionate about new technologies and has always been very active. She holds a responsible position within her company, so her agenda is always full, especially since her son was born.

Coordinating the agendas in this family is not easy, that is why Eva suggested to use an intelligent reminder agent (Rob). The system is connected to a smart speaker and a screen in Ruth and Daniel's kitchen, a smart speaker and screen in Eva's living room and to all of their smartphones. As Eva regularly uses her smartphone hands-free in her car, the system is also in some sense connected to Eva's car. The system has conversational capabilities, so it is possible to engage in a dialogue with it. This is very convenient for Ruth who cannot operate devices with tiny fonts and for Daniel who is usually in the kitchen. Eva is always on the run, so she can check her agenda while she is driving to work or tidying Alex's mess in the living room.

In addition, the system is able to adapt to everybody's needs, both permanent (e.g. considering Daniel's restrictions for walking) and transient (e.g. a broken leg). The next sections show some example interactions.

1.1.1 Example 1. Same Appointment, Different Contexts

Daniel has an appointment with the doctor at 17:00. Rob knows that the distance to the doctor is too long for Daniel to walk. It takes 20 min by taxi given the current traffic.

16:00

Rob: Hi Daniel, you have an appointment with Dr. M. at 17:00, shall I call a taxi for 16:30?

Daniel: Yes, please.

16:20

Rob: Your taxi will arrive in 10 min.

Ruth has an appointment with the doctor at 17:00. It takes 30 min by bike. This time, Rob reminds a little earlier, as it usually takes longer for Ruth to get ready to go out.

15:30

Rob: Hi Ruth, you have an appointment with Dr. M. at 17:00, if you are taking the bike you should leave in an hour.

Ruth has an appointment with the doctor at 17:00 again, this time there is a very heavy storm.

15:30

Rob: Hi Ruth, you have an appointment with Dr. M. at 17:00, it will be raining heavily, will you consider taking a taxi?

Ruth: Yes, that will be better.

Rob: Shall I order it for 16:15? It may take longer with the rain.

Ruth: Sure.

16:05

Rob: Your taxi will arrive in 10 min.

1.1.2 Example 2. Synchronizing Agendas

Eva is busy in the office, she wants to arrange a meeting for Tuesday, but she will need her parents to take care of Alex meanwhile. She does not have time to call them, so she asks Rob to attempt to synchronize agendas.

Eva on the phone

Eva: I have to arrange a meeting next Tuesday. Can somebody take care of Alex?

Rob: Ruth will be on a trip and Daniel is busy from 10:00 to 12:00.

Rob does not disclose why Daniel is busy unless Daniel specifies that it is a public task when creating the appointment.

Eva: OK, check if Daniel can manage from 13:00 to 17:00.

At Daniel's kitchen with the smart speaker

Rob: Hi Daniel, Eva is asking for babysitting.

Daniel: When?

Rob: Next Tuesday from 13:00 to 17:00. You are giving maths lessons earlier from 10:00 to 12:00.

Daniel: OK, schedule babysitting.

Rob: OK, I have scheduled babysitting from 13:00 to 17:00 on Tuesday 3rd November.

Rob knows that it should not interrupt Eva at work with phone calls, so it uses text messages to communicate with her.

Text chat with Eva

Rob: Babysitting scheduled for Daniel next Tuesday from 13:00 to 17:00.

Eva: Ok, schedule a meeting with the development team next Tuesday at 14:00 in the blue room.

Rob: Done.