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Hindriks, Koen; Boumans, Roel; van Meulen, Fokke; Neerincx, Mark; Olde Rikkert, Marcel

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An Interview Robot for Collecting Patient Data in a Hospital

by Koen V. Hindriks (Delft University of Technology), Roel Boumans (Delft University of Technology and Radboud university medical center), Fokke van Meulen (Radboud university medical center), Mark Neerincx (Delft University of Technology), Marcel Olde Rikkert (Radboud university medical center)

We are designing a social robot to collect patient data in hospitals by interviewing patients. This task is crucial for improving and providing value-based care. Currently, professional caretakers administer self-reported outcome questionnaires called patient reported outcome measures (PROMs) to collect this data. By delegating this task to a robot, time spent on administration is significantly reduced.

Social robots are finding applications in many domains but are particularly interesting for addressing healthcare related problems [1]. We are researching and developing a social robot as an interview robot for administering PROMs [2]. The Radboud university medical center (Radboudumc) Alzheimer Center [L1] and Delft University of Technology Interactive Intelligence Group [L2] have joined forces, combining their expertise on patient measures and providing value-based aged care with complementary expertise on social interaction between robots with patients. The design of the robot is evaluated in the actual care setting where patients are treated at the Radboudumc.

The quality of health care has significantly increased over recent decades as evidenced by the increase in average life expectancy and the high quality of life of elderly people today. Value-based healthcare has been vital in shifting the focus from the medical interventions performed to the value, i.e., the quality of life, that is delivered. Patient reported outcome measures (PROMs) have been crucial for assessing the quality of life of patients, supporting physicians and nurses in delivering personalised healthcare, and institutions in monitoring the effectiveness and efficiency of their services. However, in practice, the administration of PROMs requires considerable effort on the part of healthcare professionals and thus puts a large burden on the healthcare system. Efforts to have patients fill out paper questionnaires or use tablets have not worked well and in practice also require assistance from caretakers. We are evaluating the hypothesis that a social humanoid robot that interacts using voice will be able to autonomously, reliably, and comfortably provide more fitting support to help patients complete PROMs.

Figure 1: Using the Pepper as interview robot, self-reported patient outcomes can be collected autonomously, reliably, and efficiently at the Vlietland hospital. Source: RTV Rijnmond.

Autonomous here means that the robot is capable of administering questionnaires without any intervention or support from a caretaker. Reliable data collection means that the answers the robot collects from patients match those that would have been collected by a caretaker. Comfort, or more broadly acceptance, means that the robot is easy to use and patients feel comfortable while being interviewed by it. A user-centred methodology called situated cognitive engineering has been used to design our interview robot, taking into account both human factors and operational demands. Our approach moreover has been informed by the current social practices in the hospital. Our aim is to provide a context that is as natural as possible and provides a setting that is as realistic as possible for deployment of the robot. In the scenario we designed, a healthcare professional receives patients, introduces, and performs a handover to the robot.

Our focus in the design of the robot has been on integrating various dialogue components for asking PROM questions, asking for confirmation, allowing patients flexibility by skipping questions that do not apply to them, and by integrating a patient-initiated explanation component in case patients need help with a question. The robot welcomes patients by name and explains the interview procedure. The questions asked by the robot are also displayed on the robot's tablet, and the robot repeats a question if too much time passes before an answer is received. Because reliability is essential, the robot recorded answers are replayed and also displayed on the tablet for confirmation. Explanations are based on advice and experience of professional caretakers. Upon completion, the robot sends the answers to the caretaker by mail. Variation in the dialogue (e.g., for introducing the next question) has been achieved by including minor variations to avoid the dialogue from becoming monotone.

We evaluated the first prototype of our interview robot with participants aged 70+. Patients were interviewed in a hospital examination room twice: once by the robot and once by a nurse. A counterbalanced design to control for order effects was used and the interviews were scheduled with two-week intervals in between. After completion of the robot interviews the nurse returned and performed a post-interview with the patient, to obtain insight into acceptance of the robot. We found that bias of the interview robot compared with the nurse was low using Bland-Altman plots and reliability overall was acceptable. The robot takes longer to administer a PROM but efficiency is acceptable too. Overall, patients indicated that they felt comfortable interacting with the robot but also that there is room for improvement.

Key next steps are to improve the robot's responsiveness, for example, to additional clarifications that patients share voluntarily. We aim to extend dialogue capabilities to allow for such digressions. Another limitation of the robot is that it is not sensitive to emotional responses of patients who are being questioned about their quality of life. We plan to add emotion detection capabilities to improve the robot's handling of these situations. It will be very challenging to get this completely right though, thus a key issue will be how we can make the robot aware of its limitations in these situations and provide it with the capability to handover to a caretaker.

Links:
[L1] https://kwz.me/hty
[L2] https://kwz.me/htH

References:

[1] J. Broekens, et al.: "Assistive social robots in elderly care: a review", Gerontechnology 8:2, 94–103. 2009.
[2] C.B. Forrest: "Digitization of patient reported outcomes", Value Health, 16:4, 459–460, 2013.

Please contact:

Koen Hindriks
TU Delft, The Netherlands
+31 15 2782523
k.v.hindriks@tudelft.nl

ComBox – a Multimodal HRI Strategy for Assistive Robots

by Eleni Efthimiou and Stavroula-Evita Fotinea (Athena RC)

ComBox incorporates a multimodal user-centred intelligent human-robot interaction (HRI) framework that uses different technologies and user modalities to create à-la-carte HRI solutions. Appropriate HRI approaches are likely to encourage user trust and acceptance of assistive robotic devices.

ComBox is a methodological framework for developing multimodal human-machine interaction environments. It is being developed in the framework of multimodal interaction and robotics research at ILSP/Athena RC, and introduces a customable suite of user-centred HCI/HRI tools, enabling interaction via text, haptic, avatar and voice technology. Assistive robotics provides a major integration framework for ComBox, since the latter proposes an innovative model of user-centred human-machine interaction exploiting a set of modules that can be embedded to different product/service platforms in order to address different accessibility abilities and preferences [1]. Research on ComBox development is crucially directed by the growing geriatric population needs and the associated increased demands for managed healthcare in developed societies, conditions which are driving research in a range of domains, combining assistive robotics, the internet of things (IoT) and smart environments for the elderly.

In this context, human-like interaction has been identified as a critical factor for user acceptance and user trust of robotic devices. To serve the ComBox spectrum of interaction goals, we have been focusing on developing an intelligent multimodal dialogue management system, which is currently under development, that incorporates speech input/output technologies, sensorial data of behavioural patterns and affect features on conversational agent performance, enabling a closer to natural human-machine interaction adaptable to specific use contexts. Thus, ComBox advances the current state of the art in HRI, incorporating in its design cognitive support mechanisms and affect features, in combination with human behavioural patterns, to create more human-like interactions.

ComBox builds upon many years' experience in building advanced accessible Human-Computer Interaction (HCI) environments and significant effort gathering and annotating multimodal interaction data of elderly subjects in order to develop human-like HRI models, which have been positively validated by targeted user groups in real use environments, as in the case of the MOBOT [L1] rollator end-user evaluation [2]. Assistive robotic device evaluation/validation studies with the targeted user groups reveal a strong tendency for users to accept devices with human-like behavioural characteristics. Such characteristics are highly regarded, increasing user trust and willingness to use robotic products. Direct measurable benefits derived from regular device use include: better rehabilitation, reinforcement effects, socialisation support, help with daily activities and an increased ability to live independently. This happens because the aged user feels sup-