Applications of Personal Robotics for Interaction and Learning

Rapports

Informations projet

APRIL

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Résumé du contexte et des objectifs généraux du projet

The aim of personal robotics, as for companies like Aldebaran Robotics and for research at the Plymouth CRNS, is to design companion robots that can live and interact with human users in a very intuitive way. This requires that a robot develops a comprehensive understanding of human beings and appropriately adapts its behaviour to the context. More specifically, adaptive behaviours and

learning are critical to accommodate unknown and changing environments, tasks and users, and developmental robotics is one of the most promising approaches to providing such behaviours.

The APRIL EID objectives to achieve such an innovative scientific, technological and training vision are:

I. To establish the leading EID centre for cross-disciplinary and cross-sectorial training in developmental and social cognitive systems, human-robot interaction and personal robotics. Training and research activities will be organized around the four pillars of Scientific Excellence, Technological Innovation, Future Leaders, and Entrepreneurship.
II. To train doctoral candidates for the development of domain-specific knowledge and skills for an integrative approach to the investigation of five scientific and technological challenges in personal robotics: (i) Sensorimotor schema development; (ii) Emotional bootstrapping; (iii) Contingent interaction; (iv) Grounded communication; (v) Deep learning for abstract reasoning capabilities.
III. To provide hands-on experience of robotics research through access to state of the art platforms including humanoid robots (NAO, Pepper, iCub, Baxter) and mobile robots (Scitos G5).
IV. To use integrated pedagogical approaches allowing doctoral students to acquire multi-methodological and cross-discipline knowledge and skills in humanoid and mobile robotics, AI, machine learning, software and electronic engineering, control theory, and ethics and legal issues.
V. To support doctoral candidates through an innovative Coaching Programme and an Individual Skills Development Plan based on the latest Vitae RDF Planner, to develop complementary transferrable skills and leadership skills and appropriate research career pathways, supporting the transition from taught students to independent researchers and future leaders.
VI. To extend academic training and entrepreneurial skills with extended industrial research training experience at the Aldebaran Robotics industrial beneficiary site (18 months per fellow), and the additional research and secondment opportunities in the associates partners' site in academia, industry and user groups in Europe, Japan and USA.

Travail effectué depuis le début du projet jusqu'à la fin de la période considérée dans le rapport et principaux résultats atteints jusqu'à présent

"The APRIL consortium hired 5 ESRs. They were all enrolled in the PhD programme of Plymouth University. Two students have submitted their thesis (one already passed; one exam date pending) and the others are on track to submit PhD theses in the coming months.

During the project, the APRIL EID organised nine training events (i.e. Training Milestones 1-9). Below is a short summary of the event, but see https://www.fose1.plymouth.ac.uk/socem/crns/april/#Meetings for access to the events' programme and list of talks and activities.

Below is an highlight of the results of the ESRs' research.

ESR1 Pontus Lovinek: The main contribution of the PhD research is to provide a framework for solving a control learning problem, previously largely unexplored with no obvious solutions, but with strong analogies to, for example, early learning of body orientation control in infants. This thesis examined two quite different implementations of the proposed framework, and showed success in both cases for two different control learning problem.

ESR 2 Asimina Marmpena: The PhD focusses on using multiple pre-symbolic affective channels (e.g. voice, tactile sensing, body language) to improve emotion synthesis and expression. She also developed an emotional body language synthesis method based on machine learning. These affective strategies were tested in human-robot interaction results.

ESR 3 Bahar Irfan: This PhD focused on improving user recognition in real-time long-term interactions through multi-modal information. She created a multi-modal long-term user recognition dataset based on several images of 200 users and used proprietary algorithms of the Pepper robot to obtain multi-modal biometric information from these images.

ESR 4 Alexandre Antunes: This developed robot learning models for action and language model based on the Multiple Timescales Recurrent Neural Network (MTRNN). This project brings three major contributions: the MT-LSTM model, the bi-directional training/testing method, and the generation of both motor actions and language using the same model.

ESR 5 Oksana Hagen: The PhD research set up an evaluation framework based on a reinforcement learning algorithm (A3C). She used a simulated environment with rich visual input (DeepMind Lab) to be able to iterate over many approaches in the early development stage. Simulation consists of a 3D maze and an agent.

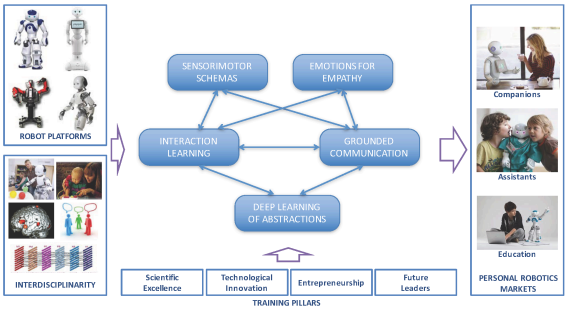
The ESRs also collaborative worked on three integration scenarios: Companion robots for care, Assistive robots for children, Edutainment robots. These results were showcased during talks and events at international conferences."

Progrès au-delà de l’état des connaissances et impact potentiel prévu (y compris l’impact socio-économique et les conséquences sociétales plus larges du projet jusqu’à présent)

The strategic cross-sectorial, entrepreneurship and highly interdisciplinary nature of the APRIL research and training programme endows the PhD students with the knowledge base and skills set to become the future leaders of research and development in the innovation field of personal robotics, thus contributing to their career aspiration and facilitating the impact of their work in such a new field. Below we highlight the immediate and longer-term benefits that the APRIL research and training program and environment will bring to the students and the further benefits of the EID inclusion within

a wider international research and training community.

Immediate and longer term benefits to individual researchers. The APRIL training network provided a unique interdisciplinary research training opportunity for enhancing the career development of early stage researchers in the field of personal robotics and cognitive systems. Students will be supported to achieve scientific and entrepreneurial excellence through the extensive range of training opportunities available within the APRIL programme, and its strong culture of exploration, explanation and exploitation. The structure of the programme will ensure that students gain a broad education across a wide range of disciplines and deep knowledge of a specialist field. In this way they will be better prepared for future careers in which interdisciplinarity and intellectual flexibility are increasingly being seen as crucial factors for success. Their early research experience will provide them with the ability to communicate effectively across disciplines and sectors. In this respect, care will be taken to enhance the communication skills, both spoken and written, of non-native English speakers and to provide them with the necessary support to achieve a mastery of English comparable with that of native speakers.



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