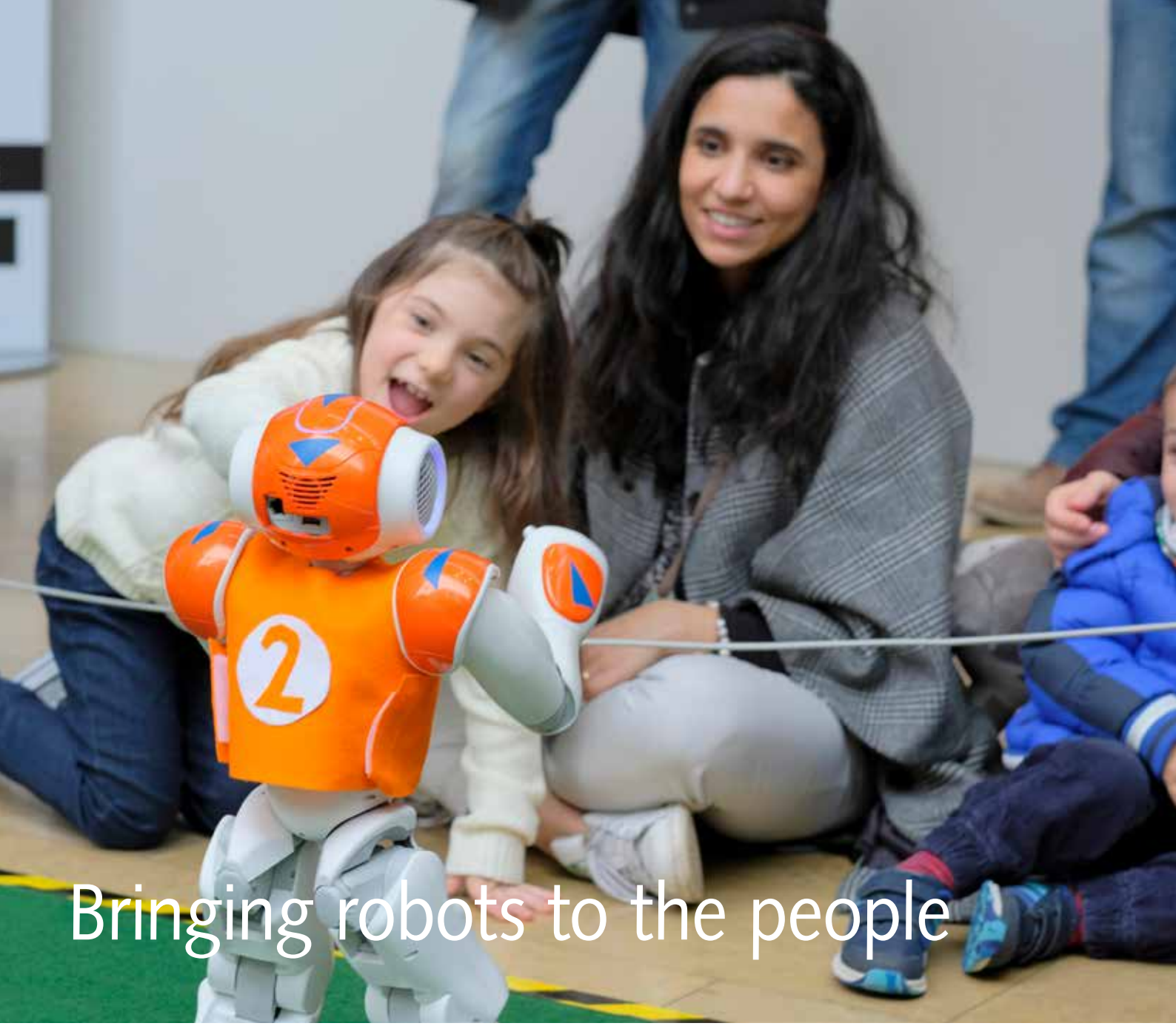

Bringing robots to the people

Text: Dr Patrice Caire[1] and Sebastien Cagnon[2]

A mere glimpse into the future, or what the future could actually hold for us? What can the interaction between humans and robots look like, and how might they constructively, purposefully and efficiently interact? What sounds like science fiction has in fact already become reality…

About two years ago, many visitors at the *MUDAM* in Luxembourg had the chance to experience the demonstrations of the *CoRobots* project during the exhibition *Eppur si Muove*. *CoRobots*, the code name of the project and an abbreviation for *Collaborative Robots*, allowed the museum visitors to get acquainted with the latest robot technologies developed at the *SnT* (*Interdisciplinary Centre for Security, Reliability and Trust*) at the University of Luxembourg. A team of researchers, professionals and students of the *SnT* demonstrated how robots of different kinds would, in the future, be able to cooperate with humans as well as with each other. During the exhibition, the team provided a concrete idea of how autonomous robots might collaborate with each other in the not-too-distant future, and encouraged the public to interact with the humanoid *Nao* robots engaging them in a number of fun games.

A 'convivial' form of artificial intelligence

The project in question was launched by the *Social Robotics Lab,* which is part of Prof. Voos *Automation and Robotics Group*. The team of the *SnT* has focused its research on the feature of 'conviviality' and uses artificial intelligence the way it is applied to ambient intelligence, used for example in smart homes. In other words, the team of the *SnT* develops robots that are meant to interact with humans in given social situations, for instance assisting older people at their home, during visits to the museum or in contexts such as the *MUDAM's* of last year. Currently, you have the possibility to witness the robots' skills yourself at the *Museum of History of Ville de Luxembourg* (*MHVL*).

[1] Dr Patrice Caire launched the Social Robotics Lab, which she also currently leads.
[2] Sebastien Cagnon has launched his own consulting company to create robotics applications in Tokyo, Japan.

Going Social!

The *Social Robotics Lab's* main objective is to design and develop autonomous robots able to interact and communicate with humans and other autonomous physical agents by following particular social behaviours and rules attached to their defined roles. The activities of the Lab include:

- The launch and development of *Luxembourg United*, the country's first national robot football team to take part in an international competition, most notably the *RoboCup* in the Standard Platform League (*NAO*). This on-going project started on January 2016 and has already been awarded the first prize by *Banque de Luxembourg* at the *Innovation Forum*, organized last June by *Deloitte*, the *Fond National de la Recherche* and *Luxinnovation*.
- Creating concepts, models and prototypes for the *Humanoid Robot Assistant* currently under development at the *Social Robotics Lab* for the *MHVL*, in partnership with the City of Luxembourg, using *Softbank robotics'* most advanced robot: *Pepper*. This project is scheduled to run until the end of 2018.
- Developing *cooperative robots* interacting with each other as well as with the public. Examples are the humanoid robots and the drones in the *CoRobots* project.
- Engaging in health- and wellness-related topics such as the *COPAINS* project – *COPAINS* standing for *Conviviality and Privacy in Ambient Intelligence Systems*. The follow-up of this project will focus at reducing the number of false alarms in the case of patients wearing safety bracelet at home. Another proposal currently on the table is a cooperation with *Imperial College London* and *University College London*. A collaborative article has already been published and presented at the *International Conference for Artificial Agents Technology* ealier this year.

Guy Hoffmann

The Luxembourg United Kicker Peppa ready for a penalty shoot out against the Oranje robot team

Furthermore, the *Social Robotics Lab* is involved in a number of interdisciplinary collaborations such as the following:

- A museology study of the potential roles of robots in the realm of museums, and the perception of robots by the public, with the *Identity, Politics, Society and Spaces* (*IPSE*) group: The results of a study with 300 questionnaires gathered during the *CoRobots* exhibition were presented at the Museums conference 2016 in Namur.
- Modeling and improving *Human Robot Interaction* (*HRI*) using conversation analysis and dialogism (reciprocal dynamics of real-time interactions) with the *Science of Education & Society* (*ECCS*) group. Upcoming publication in the *International Journal of Social Robotics*, 2017.
- Interactive media study of multi-modal human-robot interaction and interaction models using 'activity theory', with the *Digital Interaction and Communication Analysis* (*DICA*) group of Prof Max.
- On-going work and joint presentation with *Ville de Luxembourg (VdL)*, such as with art historian Mrs Marie-Paule Jungblut who is part of the team of Mrs Danièle Wagener (Director of the *MHVL* and the *Villa Vauban*) at the 2016 Digital Museums conference in Liège.

Dr Patrice Caire setting up Speedy as a Kicker for the Oranje team

Getting robots to collaborate

The *CoRobots* at *MUDAM* project were sponsored by the *VdL* and illustrated a potential use in the city's various environments, such as in its museums, institutions and other public buildings. Following the success of *CoRobots*, a new research project was launched with the *MHVL*. To pursue and implement this project, the *SnT Social Robotics Lab* sought and obtained the most advanced humanoid robot capable of interacting with humans and of capturing as well as conveying human emotions: *Pepper*. ➤

Bringing robots to the people

Pepper discovers Luxembourg

In July 2016, researchers and students of the *Social Robotics Lab* were very excited by the arrival of *Pepper* at the University of Luxembourg. The leader of the *SnT* conducted the long and very competitive negotiation for the *SnT* to be among the first institutions in Europe and the USA to welcome *Pepper* for scientific research purposes. Finally the *SnT* was chosen by *SoftBank Robotics*, the leader in humanoid robotics for the public, to pursue research activities with their latest robot, *Pepper*. This is the result of *SnT*'s high-quality research with *Nao*, the first humanoid robot developed by the Japanese company, and especially its work concerning interaction between humans and robots.

In its past work, the team of the *SnT* has combined the interactive skills of *Nao* with the mobility of a quadrotor drone. This way, the *SnT* demonstrated a new way for robots to collaborate with one another and with humans based on social skills. The installation was very successful with children and adults alike. A total of fifty thousand visitors enjoyed it. Furthermore, since the exhibition happened during the presidency of Luxembourg to the *Council of the European Union*, many Presidents, Ministers and international personalities were able to visit the exhibition as well. This attention supported the international influence of Luxembourg with regards to technology and innovation. Furthermore, *CoRobots* demonstrated the new opportunities offered by artificial intelligence and helped gathering valuable feedback for future projects.

The Oranje Kicker shooting a second goal, while the Luxembourg United Goalkeeper tries to anticipate its move.

Why choosing Pepper?

Pepper was designed specifically to help stores and institutions improve their services. The robot is already used in many places around the world to help clients and visitors. In the stores of a Japanese telecom operator, *Pepper* for instance entertains customers waiting to be served. For a multinational coffee producer, *Pepper* engages customers in order to improve information about special offers regarding their coffee machines. Further examples involve banks, where social robots use their multi-lingual skills to guide foreign visitors and explain basic bank procedures.

Being bigger than the *Nao* robot, *Pepper* makes for a genuine presence in the room. Using the tablet integrated in its chest, *Pepper* gives explanations using videos and images, or provides subtitles for reasons of accessibility. Moreover, *Pepper* can move safely around spaces to guide visitors within given areas, such as exhibition spaces in museums. In terms of social interactions, *Pepper* and *Nao* are among the most advanced robots since they can be programmed with conversation patterns that guide the visitor while considering requests or needs they might express.

Working with experts

In addition to that, the use of human animations can help render the communication between visitors and *Pepper* more efficient. To fully take advantage of the robot's potential, Sebastien Cagnon was asked for advise and support. He has been working on *Nao* and *Pepper* for the past 6 years, including 4 years as an application developer for Aldebaran/ Softbank Robotics. After playing a key role during the launch of *Pepper* in Japan, Mr. Cagnon has been working on developing business solutions for both *Nao* and *Pepper* robots. He has been involved in the creation of applications for a robotic hotel receptionist as well as other educational, financial and health-related projects. Last year, Mr. Cagnon worked as a volunteer to support the *Social Robotics Lab* on their *MUDAM* project.

As an official partner of the *Social Robotics Lab Luxembourg United* robot soccer team, Mr. Cagnon is now obviously taking great interest in the *MHVL* projects with *Pepper*. *"I believe this project can really pave the way for a new type of services to guide visitors and enrich their experience. Pepper can truly engage the visitor by producing a completely new type of multimedia experience."*

Exciting young crowd watching football game in the MHVL

Guy Hoffmann

A robotic assistant at the MHVL

Responding to the needs of the museum, *SnT* researchers are now working on the possibility of a set of questions and answers to engage, help and entertain visitors. In other words, *Pepper would:* interact in a playful manner with the visitors while providing them with relevant information; engage the visitors and make them discover the museum's various pieces on display using its integrated tablet to give additional information or show archival material whenever needed; localise itself and the visitors to enhance their personal experience of the museum.

The first step of the project regards the panorama *"Le Marché-aux-Herbes vers 1650"*. In this circular room, visitors can go back to the 17th century and immerse themselves in this long-standing marketplace. In this space, *Pepper* will explain in an interactive and role-playing way how people lived and worked there at the time, and how important this square actually used to be.

In partnership with *Ville de Luxembourg*, a steering committee was set up, composed of researchers and representatives of the city as well as of the museum. To date, the latest meeting took place in October 2016 and the first tests conducted with *Pepper* have proven very promising so far. The official presentation of *Pepper* at the *MHVL* is scheduled for the first semester of 2017. In the meantime, curious visitors can already attend training sessions of the *Luxembourg United* robots in the context of the *museum's* exhibition entitled *"Football Hallelujah!"*

Guy Hoffmann

The Luxembourg United human team from the Social Robotics Lab in action. From back to front: Valentina Zabrian, Ivan Tishchenko and Yan Medernach

Luxembourg United: a new educational tool

We launched the *Luxembourg United* robot soccer team with the *Social Robotics Lab* team in January 2016. Following the above-mentioned prize of the *Banque de Luxembourg* at the *Innovation Forum*, the team received funding from the *SnT* and the *RoboCup* Project was born. Its objective is to bring our *Luxembourg United* team to successfully compete in the *Standard Platform League* (*SPL*) of the *RoboCup* world championship. Important objectives of the projects are to:

- address research questions leading to market applications;
- encourage students to become expert programmers and researchers;
- provide the industry with expert programmers formed in our *Social Robotics Lab* and
- give international visibility and recognition to the *SnT*, the *University of Luxembourg*, the City of Luxembourg and the Grand-Duchy as a whole.

The *RoboCup* competition is a soccer world cup for robots. Its goal is to promote continuous development in robotics. Estimations are that by 2050, robot teams will be able to win against teams of human world soccer champions playing according to the *FIFA* rules. Universities around the whole world are programming such robot teams, making such a contest extremely challenging and competitive. The best artificial intelligence theories, algorithmic language and technologies are being used, quite similarly to the ones used for *Pepper* in the museum project. ◆

The Steering Committee VdL-SnT, from left to right: Alexander Eyjolfsson, Patrice Caire, Marie-Paule Jungblut, Christiane Sietzen, Danièle Wagener, Pepper, Christiane Schaul, Holger Voos and Gary Cornelius

Conclusion written by Pepper

"I wish I could join the Luxembourg United team and play soccer with them, but I don't have any feet! In the meantime, I like what I saw in Luxembourg City and can't wait to get started and interact with the visitors of the museum!"