Autonomous collaborative robots for agri-food processes

Uldanay Bairam, Marc-Jeroen Bogaardt, Simone van der Burg, Aneesh Chauhan, Eline van Elburg, Janne Kool, Kees Lokhorst, Jochen Hemming, Angelo Mencarelli, Ard Nieuwenhuizen, Wijbrand Ouweltjes, Inge La Rivière
Wageningen University and Research

WAGENINGEN
UNIVERSITY & RESEARCH

Background and objective

This project aims to develop teachable, self-learning and collaborating robots to work in unstructured dynamic settings where **robot-human-plant-animal** interactions are frequently found. The overall objective is to define the architectures and frameworks for the development of autonomous collaborative robots in precision agriculture and food production processes. The focus is on autonomous actions in production systems and the pathways to develop these actions. Robot-innovation must go hand in hand with a demanding social and evaluative re-orientation. Therefore, ethical and governance aspects for the farmers are also investigated, when autonomous robots acquire a more prominent role on farms.

Activities

Core robotics activities:
- For open field robotics the interaction between nature based obstacles and dynamic decision making on route planning is further extended. This will facilitate cooperating behavior between multiple mobile field robots when doing operations in the field.
- For greenhouse, postharvest and food processing robotics, the concepts for learning from demonstration and self-learning for dexterous handling and manipulation of agri-food products are further explored. This will facilitate easier adaptation to new tasks for the robot, thereby widening application areas.
- For livestock robotics two application areas for collaborative robots are foreseen, observation and monitoring robots for detection of manure, human people and dairy cows inside in a barn environment and outside.
- For seaweed farming potential remote monitoring techniques are explored.

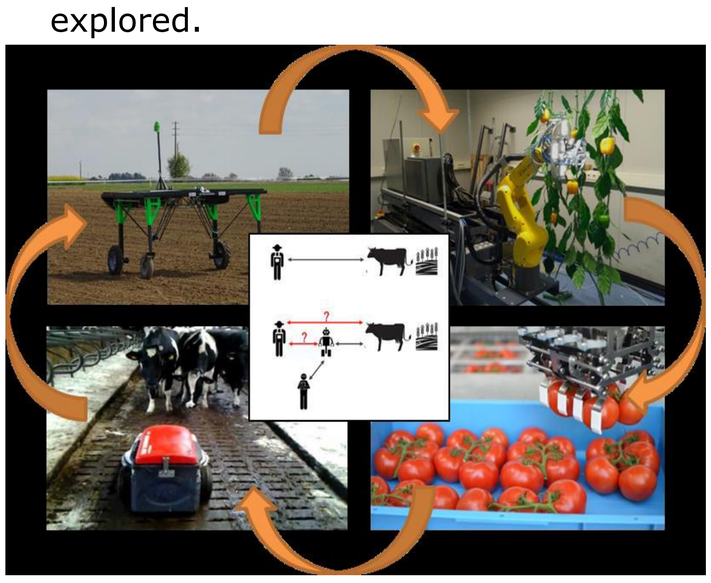

Figure 1. Interaction between the application areas for the robotics research.

Ethics focused activities:
- A literature study on ethical issues related to autonomous robots in various contexts of application: such as industrial robotics, surgery robots, care robots, and farm robots.
- A concept interview guide development for stakeholders of autonomous farm robots.
- Interviews of stakeholders of autonomous farm robots. In later years, other use-cases will also be addressed.
- Based on the interviews, identification of the values and norms that are most important.
- The list of values and issues to be discussed with robotics technology designers, and together build and inventory of technical possibilities to attend to the values and norms we identified in the context of use.

Results

Advances were made in pose estimation framework applications for robot learning as well as in robot teleoperation using a motion capture system to record poses and movements of a human hand.

Figure 2. Demonstration of robot teleoperation for picking sweet pepper.

From the activities several demonstration outputs were generated. These are shown in Figure 2 and 3. Teleoperation, learning from demonstration and the ethics focused activities were performed in 2019.

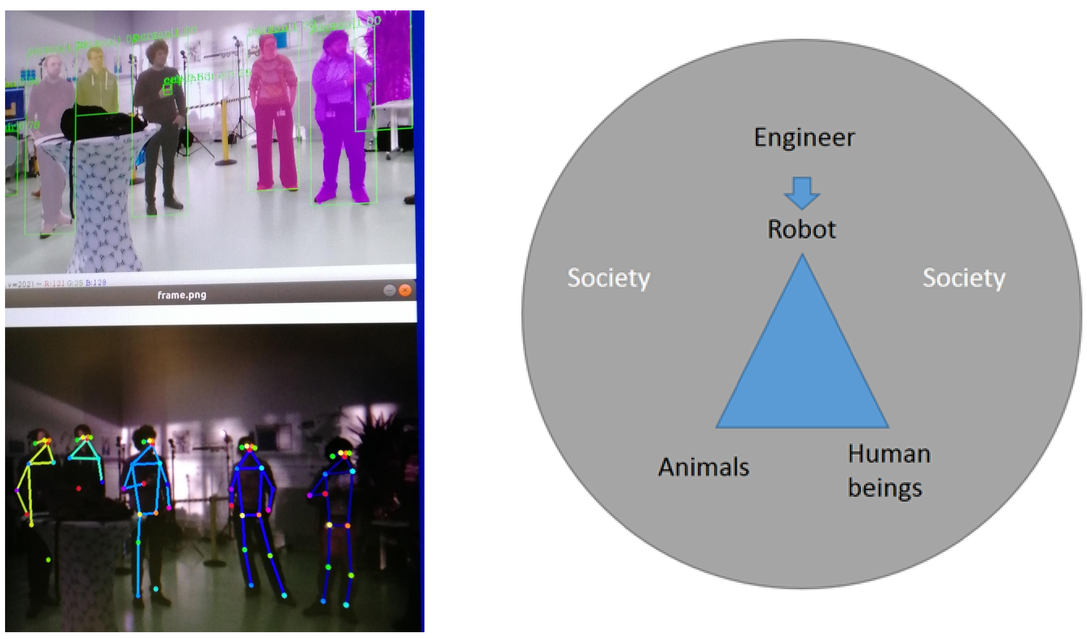

Figure 3. Object recognitions and Pose estimation for learning from demonstration (left). Overview of actors on robot system design from ethical perspective (right).

Next steps

The demonstrators that were shown in December 2019 will be further extended to better fit to real world scenarios in arable farming, livestock, greenhouse food production and seaweed farming.

Acknowledgements

Thanks to the programme team of Knowledge Base programme Data Driven High Tech, and the Wageningen University and Research board for providing the funds for this knowledge building project.

Wageningen University & Research
Ard Nieuwenhuizen, ard.nieuwenhuizen@wur.nl +31 (0)317-488492
P.O. Box 16, 6700 AA Wageningen, The Netherlands
www.wur.nl