The Royal Academy of Engineering

walking with robots

Young People's Views on Advanced Robotics

Vision for the Future

LONDON ENGINEERING PROJECT

About us

Walking with Robots
Walking with Robots is a three-year programme of events and activities designed to delight audiences with the potentials of robotics research whilst encouraging them to consider the technical challenges and ethical implications of that research.

The Walking with Robots network brings robotics researchers together with leading science communicators to promote a wider public engagement with the reality of contemporary robotics research.

Walking with Robots is led by the Universities of the West of England (UWE), Bristol, Essex and Sheffield, and is coordinated from the Science Communication Unit at UWE, Bristol.

The Royal Academy of Engineering
As Britain's national academy for engineering, we bring together the country's most eminent engineers from all disciplines to promote excellence in the science, art and practice of engineering. Our strategic priorities are to enhance the UK's engineering capabilities; to celebrate excellence and inspire the next generation; and to lead debate by guiding informed thinking and influencing public policy.

The Academy's public engagement programme aims to raise awareness and create platforms for wider debate and dialogue on the applications and implications of engineering and technology in society.

London Engineering Project
Led by The Royal Academy of Engineering, the London Engineering Project (LEP) is a partnership of schools, colleges, universities, science and engineering education charities, industry and Government.

Its aim is to create more people with engineering skills in the capital, forming a pipeline that takes students from school, through FE and HE and into the profession. It particularly seeks to engage women and Caribbean, Bangladeshi and Pakistani students, all of whom are currently under-represented in engineering.

Credits

Project Manager
Dr Claire Rocks, Walking with Robots, University of the West England (UWE)

Project Team
Dr Lesley Paterson, The Royal Academy of Engineering
Dr Karen Bultitude, Science Communication Unit, University of the West England (UWE)
Professor Alan Winfield, Hewlett-Packard Professor of Electronic Engineering at the University of the West of England (UWE)
Heather Hawthorne, London Engineering Project

Evaluation
Dr Laura Grant, Laura Grant Associates

Design
Angus Dawson, www.angusdawson.com

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Executive summary

The UK's first young people's robotics Vision Conference was a pilot project run as a partnership between Walking with Robots, The Royal Academy of Engineering and the London Engineering Project. The conference provided the participants, who were aged 16 and over, with the opportunity to explore advanced robotics research, have their views heard on how these new technologies could be used in the future and explore their potential impact on society.

Vision Conferences enable groups of people to create visions for the future about a specific theme [1]. The purpose of these conferences is not just about generating ideas but about helping to develop and inform strategies for the future.

Twenty young people from selected London schools attended the two-day conference, which took place at The Royal Academy of Engineering in December 2007. The conference participants took part in a range of facilitated activities over the two days, including plenary sessions, interactive group work, discussions and debates.

A summary of the young people's views

- Robotics has many benefits to offer future society but policy makers, scientists and engineers need to think carefully about the motivations behind robotic developments and their potential consequences.
- Particular advantages of robotics were considered to be the ability to increase safety, speed, accuracy and productivity of certain tasks, and to undertake mundane chores and jobs.
- The strongest concerns raised were those relating to 'human replacement' including the potential loss of jobs, a reduction in human-to-human contact (for example, if robots were to care for the elderly) and a decline in human experiences.
- It was felt that humans should always maintain the ability to 'turn off' intelligent robots, in the event of misbehaviour, malfunction or if their actions had the potential to cause damage or harm.
- The nature of human-robot relationships was explored, with the participants noting that collaborative working was preferred as opposed to the complete replacement of humans, or humans having absolute control.
- The young people were very interested in engaging with policy decisions relating to the field of robotics and made it clear that they wished to be kept informed and involved as advances continue.

This report is being made available to policy makers, the science and engineering community and public engagement practitioners to:

- Encourage a greater awareness of young people's views, concerns and recommendations regarding the future development of this technology.
- Demonstrate the effectiveness of the 'Vision Conference' format in enabling young people to explore their hopes, concerns and expectations on a complex socio-technological issue.
- Raise awareness of the value of engaging young people in serious dialogue.

1 Vidal, R. V, (2004), The Vision Conference: Facilitating Creative Processes, Systemic Practice And Action Research, Vol. 17; Number 5, Pp 385-405

Contents

1.0 Aims and context

1.1 Project aims

- To enable young people to explore and engage with a complex technological issue.
- To enable young people to identify the areas of society they see robotics having the biggest impact on in the future.
- To give young people the opportunity to have their voices heard by policy makers and other stakeholders (for example, the research community).
- To assess the effectiveness of the Vision Conference as a public dialogue format capable of generating tangible feedback that is useful for informing policy makers and other stakeholders.

... to give young people the opportunity to have their voices heard by policy makers and other stakeholders ...

1.2 Robotics

Advanced robotics will undoubtedly have a major impact on our lives. Experts, such as Bill Gates, have commented that robotics will become as embedded into our future society as personal computers are today[2]. Robots are already used in everyday life and have a variety of applications ranging from space exploration to social and healthcare practice.

Future applications of robots are diverse and many of them centre on humans and robots occupying the same working or living spaces. The use of these 'service' robots is expected to boom and it is predicted that by 2011 there will be 54,000 new robots worldwide in areas such as defence, rescue, security, cleaning and medicine[3]. The predicted number of personal robots is even greater, reaching over four million for domestic use (for example, lawn mowing, vacuuming or window cleaning), and over seven million robots for use in the entertainment and leisure industry, such as toys or personal companions.

The UK is currently undertaking research across the spectrum of robotics applications. At a parliamentary seminar on intelligent robotics that took place in April 2008, UK-based research groups and industry showcased a variety of robots including those for use in assistive surgery, mediating relationships with children with autism, environmental monitoring, space exploration and personal care. Many of these applications are likely to have a significant impact on our lives within the next few decades.

Policy makers and researchers are becoming increasingly aware of the impact that advances in robotics and artificial intelligence will have on society. An example of this is the growing field of robot ethics, as indicated by the recent EURON Roboethics Roadmap[4] and the South Korea Robot Ethics Charter[5]. It is also essential that the wider public are able to explore and voice their thoughts on how we should adopt such robotic technologies, considering both their applications and potential implications.

1.3 Public engagement

Public and stakeholder views on the future direction of science and engineering are becoming an increasingly used source of evidence for policy-making. Engaging the public at the early development stage can lead to technology progressing with an understanding of wider societal concerns and expectations, and therefore greater support for the resulting legislation[6]. Public dialogue is particularly timely for intelligent robotics, which is at the stage where research direction and regulation can still be guided.

This changing culture towards early dialogue with the public has given rise to a number of initiatives, such as the Government-funded programme *Sciencewise*[7], which aims to help policy makers commission and use public dialogue to inform policy decisions on emerging areas of science and engineering.

2 Scientific American; Jan 2007, Vol. 296 Issue 1, p58-65
3 www.worldrobotics.org/downloads/2008_executive_summary.pdf
4 www.roboethics.org/site/modules/tinycontent/index.php?id=14
5 http://news.bbc.co.uk/1/hi/technology/6425927.stm
6 Policy through Dialogue: informing policies based on science and technology, March 2005
7 www.sciencewise-erc.org.uk

2.0 Project methodology

2.1 Vision Conference

Twenty young people from seven London schools took part in the Vision Conference at The Royal Academy of Engineering, London in December 2007. The demographic of the group was a follows: 17 male, 3 female; predominately black African and black Caribbean 16-20 year olds (two participants were over 20 years old). The majority of the participants were recruited from schools that had been involved in the London Engineering Project[8].

The event took place over two consecutive half-days, a divergent phase (day one) and a convergent phase (day 2), during which there was a mixture of plenary sessions, activities, facilitated discussions and debates.

A conference programme can be found in the Appendix, page 16.

2.2 The divergent phase (day one)

The divergent phase provided an environment for the conference participants to explore, consider and discuss the current and future state of advanced robotics in the 21st century.

Introduction
Following an introductory plenary session, the participants were divided into three groups. Each group was provided with a facilitator and took part in an ice-breaking session.

Exploration
In their groups, the participants were prompted to explore what issues in society were important to them. The outcomes of each group's discussion were shared in a plenary session.

Plenary presentation and discussion
A leading roboticist[9] presented an overview of current robotic technology and its potential future applications after which the participants were able to ask questions, provide comments and further explore any areas of particular interest in more depth.

Facilitated discussions and activities
The participants returned to their groups for a series of three activity-based facilitated discussions to provide stimulus for thought and to explore different applications of robots.

- 'Robot or Nobot': the groups sorted photographs of different technologies (for example, a washing machine, a toy, and an android) into categories of 'robot' or 'nobot', while discussing their reasoning for selection;
- Robots in the home: using a storyboard scenario of robots in the home, developed as part of a previous public engagement project[10], the participants explored what they liked and disliked about the technology and the scene presented;
- Robots in the headlines: the participants were given extracts from a number of newspaper articles related to the uses of robots and discussed the issues raised.

Vision building
In the final session of day one, the grouped participants took part in a facilitated brainstorming session to propose and explore alternative visions of robots in the future and their potential applications and societal consequences.

8 http://www.thelep.org.uk/
9 Dr Kevin Warwick, Professor of Cybernetics, University of Reading
10 www.sciencehorizons.org.uk

2.3 The convergent phase (day two)

The convergent phase consisted of a series of sessions to help the participants select and develop their visions.

Plenary panel debate
A panel of seven scientists and engineers (see Appendix, page 16) each provided a brief introduction to their own field in robotics, before taking questions and comments from the conference participants.

Vision exploration
The participants rejoined their groups to further discuss their potential visions for the future, before reconvening in a plenary session to select three visions for further exploration and discussion.

Vision development
Each of the three groups choose one of the three selected visions to explore in much greater depth for the remainder of the conference. Each group then took part in a facilitated discussion to further develop their chosen vision. Each group was also joined by up to two of the expert panel members, who also took part in the discussion. At the end of this session, each group had produced a 'Vision for the Future' under their chosen area.

Vision presentation
The participants reconvened into a plenary session and each group presented their Vision for the Future, including both the advantages and disadvantages for society.

Feedback
In groups, the participants took part in a facilitated discussion to consider what specific feedback they wanted to give to three target audiences about advanced robotic technology and its development. The three target audiences were: policy makers; scientists and engineers; and their peers.

2.4 Reporting and evaluation

Reporting
The key points of each discussion that took place throughout the conference were recorded onto flipcharts by the facilitators. The feedback from the participants regarding 'what they wanted to say' to the three target audiences was recorded verbatim. The findings from the three groups were collated together by session.

Evaluation
An independent evaluation took place during the conference that explored: the participants' attitudes to robotics and roboticists; the impact of the conference on the participants and the participants' views of the conference. The evaluation questions were posed at the start of the conference, the middle, and at the end, using electronic voting technology and paper questionnaires to gather the evidence.

3.0 Project findings

3.1 Visions for the future

The participants selected the following three visions in which they believed robotics would have the biggest impact on in the future:

Healthcare
The participants proposed that future applications in healthcare would include operations, surgery, diagnostics and investigatory procedures. The participants also proposed that robots could be used in patient care in homes and hospitals, and discussed how robots could aid mobility and prosthetics.

Exploring hostile environments
The participants predicted that robots will be widely used for a variety of activities that take place in space, the deep sea, the Arctic, volcanoes, mines, battlefields and areas of severe weather.

Manufacturing and labour
The participants identified robotic applications in civil engineering such as tunnelling or construction work and for use in dangerous environments and driverless transport.

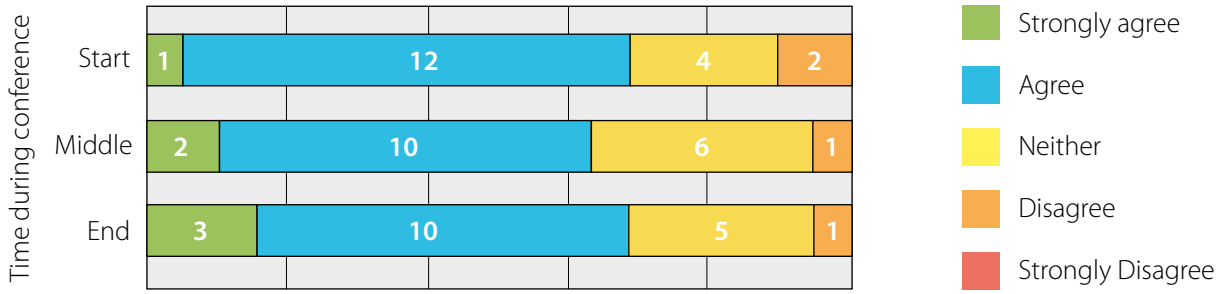
3.2 Cross-cutting issues

There were a number of issues and themes that were frequently raised throughout the duration of the conference, irrespective of the particular session or the overarching topic being discussed. The following section provides a summary of these cross-cutting themes. Where appropriate, the findings from the evaluation questions [11] are displayed.

Motivations

- In general, the participants proposed that robotics has many benefits to offer society (see Figure 1).
- The participants repeatedly emphasised that society needs to think carefully about the motivations behind robotics research and its potential consequences.

Figure 1. Robotics makes a good contribution to society



What the participants wanted to say about 'motivations' to…

policy makers

- Robots are a good idea – they make for a better and/or easier future but they should not be seen as the easy answer to society's problems.
- There needs to be a focus on what is needed, what will contribute to society and not just what is wanted.

scientists and engineers

- Do it for passion, not for profits.
- Do not focus on negative uses, such as warfare, focus on the beneficial areas such as social development, and ensure an equal distribution of benefit.
- Think realistically of the consequences, benefits and drawbacks, both current and future, before you start something.

their peers

- Ask why development in a particular area is happening, and is it for a good purpose?

> *Unfortunately, so much money is being put into military research*
>
> Conference participant

11 www.scu.uwe.ac.uk/Files/Visions_conference_evaluation_report.pdf

Human replacement

- It was generally accepted that robots in certain situations, such as manufacturing and surgery, could perform tasks with greater speed and accuracy than humans.
- The use of robots to replace humans in tasks that were impractical or dangerous was acknowledged (for example, space and nuclear power).
- It was noted that robots could take over mundane tasks and therefore provide humans with time for leisure or more rewarding employment.
- There was a high level of concern that an increase in the use of robots would lead to a loss of jobs and a loss of human experience.
- It was noted that humans could become overly dependent on robots for day-to-day tasks, which in turn could lead to higher obesity levels in humans.
- Rather than being replaced, the participants favoured humans working cooperatively and in partnership with robots.

What the participants wanted to say about 'human replacement' to…

policy makers

- Make sure advances in robots don't ruin humankind, retain the human quality of life and don't substitute robot for real life.
- Think carefully about robots meaning less jobs for humans.

their peers

- We don't need a robot in every part of our lives, don't rely and depend on robots too much or let them take over.
- Don't miss out on the value of hard work and real experience.

Manufacturing robots can assist in performing tasks with greater accuracy and improve products

Conference participant

Human-robot relationships

- Robots with artificial emotions (for example, empathy) were seen as necessary for applications such as companionship for the elderly or those with trouble communicating.
- Concerns were raised that forming relationships with robots might lead to particular individuals becoming emotionally detached from other humans.
- The delegates also considered the development of robots with 'real' emotions. Specific questions raised were:
    - Why would this be necessary?
    - Would it be immoral to have a robot with 'real' emotions that would be used as a service provider, potentially creating a new slave race?
    - Should such robots be treated as a new species with accompanying rights and what would the consequences of such actions be?
- The possibility of developing acrimonious relationships was raised, which could result in conflict, or even war although the latter was considered to be unlikely.

What the participants wanted to say about 'human-robot relationships' to…

policy makers

- Monitor when and if human/cyborg rights become necessary.
- Consider new legislation to cover human-robot, robot-human and robot-robot crimes.

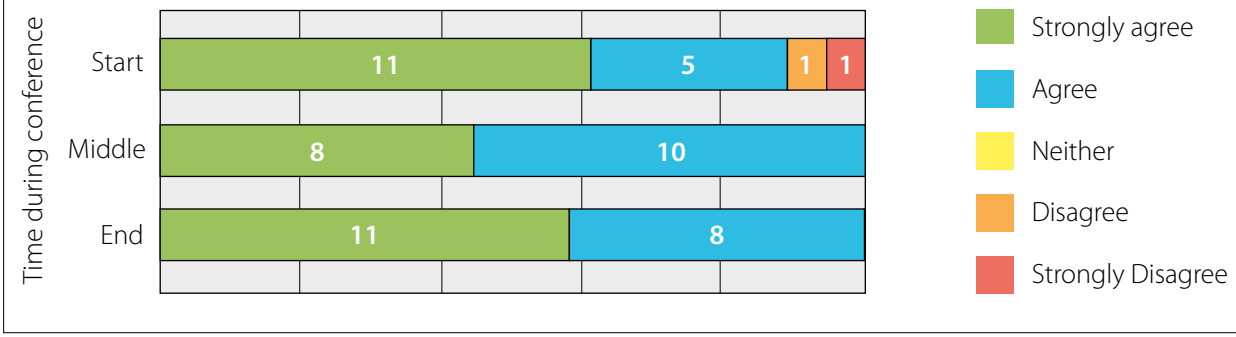
scientists and engineers

- Don't give too much intelligence/human emotion.

Safety and control

- Particular concerns were raised about humans losing control over very intelligent and/or autonomous robots (see Figure 2).
- The participants raised the issue of humans sabotaging robots which could result in accidents, damage and harm.
- There were also concerns that robots could learn 'bad' behaviour or question human decisions.

Figure 2. We need to proceed carefully in robotics reasearch to avoid robots getting out of control



What the participants wanted to say about 'safety and control' to…

policy makers

- Don't make them too intelligent, be careful of robots learning from themselves, get too clever, spiral out of control. It's important that humans remain in control.
- Think hard about what you are making because you don't know what will happen and you can't go back. Take responsibility for mistakes – accountability.
- Keep control of developments so they [the robots] cannot be abused.

scientists and engineers

- Make sure that products are dependable and reliable before manufacturing and have a contingency plan in case of robot failure – don't depend on them.
- Be aware of manipulation for the wrong/negative purposes.

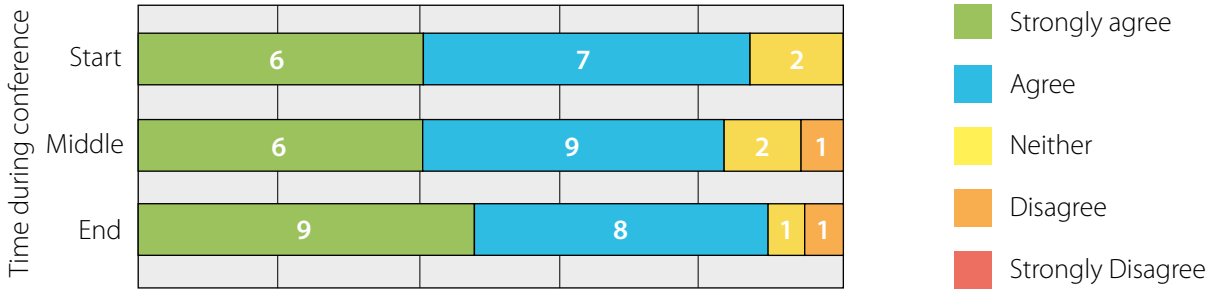
their peers

- Inform yourself of the consequences and be aware of the impact.

Engagement

- The participants were clear in their belief that informing and consulting the public was crucial to the debate on the development of advanced robotics.
- The young people valued the opportunity to contribute, and expressed a desire for further opportunities to be involved in other robotics events, in addition to other debates around the impact of science and engineering on society.
- The majority of participants agreed that roboticists should listen more to what ordinary people think (see Figure 3).
- Some participants expressed a sense that their opinions would make little difference to future developments in this area.

Figure 3. Roboticists should listen more to what ordinary people think



What the participants wanted to say about 'engagement' to…

policy makers

- Be open and transparent with the public to stop myths developing.
- Allow the public to decide this through a referendum? How do we know what we need?

scientists and engineers

- Inform and consult the public before researching ideas:
  - Educate public.
  - Involve public.
  - Use public to develop ideas better.
  - Use conferences, websites, questionnaires and more accessible forums to allow the public to access information.
  - Communicate the benefits.

their peers

- Robotics is not what you see in the movies, realise where robotics is now.
- Communicate the pros and cons, let your voice be heard.
- Don't be ignorant, educate yourselves and counter the fear of the unknown.

I hope I can have more events, so that our voices are heard to the experts

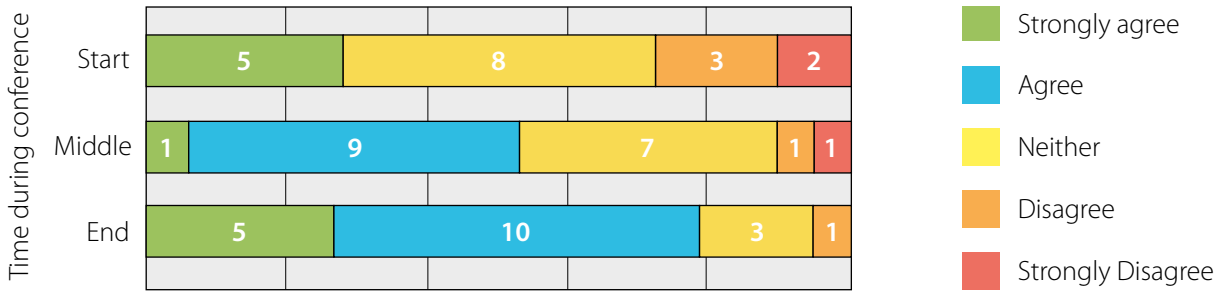
Conference participant

4.0 Benefits and impacts

4.1 Impacts on students

- The conference proved to be a valuable and enjoyable way to engage young people with a complex technological topic and its societal impacts.
- The conference was shown to have a positive impact on the level of knowledge of the participant (see Figure 4).

Figure 4. I feel I know enough about robotics to understand its impact on society



There are many ethical [and] moral aspects to the development of robotics in addition to the technological challenges

Conference participant

4.2 Benefits to policy makers, researchers and other stakeholders

- The conference was successful in enabling the participants to identify and self-select the areas and issues for further discussion, and so produced results in a context meaningful to them, rather than the organisers imposing the framework for the debate.

  NB: it should be noted, however, that the final selection of materials, activities, presenters and expert panel members undoubtedly influenced the focus of the discussions, and therefore the outcomes.

- The format of this public dialogue event was able to elicit insightful, measured and well articulated feedback that can add value and inform higher-level debates on this issue, providing an informed view from the perspective of young people.

- This project confirms and further explores the findings of a previous dialogue project[13] which also demonstrated that people have strong feelings and views on the development of current and future robot technology, highlighting this as a topic worthy of further public and policy debate.

- The project demonstrates that engagement can lead to an increased interest in young people wanting to becoming involved in policy and decisions that will affect them in the future.

4.3 Lessons learnt for public engagement practitioners

- Much of the conference was focused on deliberation and discussion and therefore the successful recruitment of skilled facilitators who specialised in working with young people, was one of the keys to the success of this pilot project.

- For future events, greater effort should be made to engage policy makers and other stakeholders, to whom we wished to disseminate the results, from the outset.

- Running the event over two consecutive days was very valuable in providing the participants with time and space to reflect and consolidate their ideas between the divergent and convergent phases.

Yes my opinion has changed. It has been changed because of the contribution of others around me in group discussions. I listened to the opinions of others

Conference participant

5.0 Appendix

The program

Day 1

11.45 → Registration
12.00 → Session 1: Introduction to the conference
12.15 → Lunch
12.45 → Break-out: Session 2 – Ice breakers and rule setting
13.00 → Break-out: Session 3 – What do you care about?
13.30 → *Evaluation Session 1*
14.00 → Session 4: What stage are we at in robotics?
14.30 → Break and photograph session
15.00 → Break-out: Sessions 5-8 – Your visions of the future
Exploring the role of robots in the future
16.15 → Session 9: Summary of the day
16.30 → Close

Day 2

08.30 → Refreshments
09.00 → Session 10: Welcome to day 2
09.15 → *Evaluation Session 2*
09.30 → Session 11: Meet the robot experts
Your chance to pose your questions to the robot experts
10.15 → Break-out: Session 12 A – further exploration of your visions
11.00 → Break
11.15 → Break-out and plenary: Session 12 B – do we have similar visions?
A chance to share visions of the future with each other
12.00 → Session 13: What do we want to say?
12.45 → *Evaluation Session 3*
13.15 → Lunch

Experts

Dr Kheng Lee Koay, Research Fellow in the Adaptive Systems Research Group, University of Hertfordshire

Martin Postler, Royal College of Art, Founder of Postlerferguson, Design/Technology Consultancy, London

Dr Tariq Sattar, Acting Head of Engineering, Science and The Built Environment, London South Bank University

Abigail Sixto, PhD student in Robotics, London South Bank University

Dr Matt Studley, Lecturer in Robotics, University of the West of England, Bristol

Prof Alan Winfield, Hewlett-Packard Professor of Electronic Engineering, University of the West of England, Bristol

Dr Birgitta Zics, Artist and Associate Lecturer, University of Plymouth