Robbie the robot passes UN inspection (w/ Video)

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Secretary General of the International Telecommunication Union (ITU) meets "Robbie the Robot" developed for Cork teenager Joanne O'Riordan, who was born without limbs.

Robbie the Robot, a prototype robot built by researchers and engineering

students in Trinity College Dublin for Cork teenager Joanne O'Riordan, who was born with a rare condition known as Total Amelia, was officially unveiled today. Robbie was introduced to the Secretary General of the United Nations specialised agency for information and communication technologies, Dr Hamadoun I. Touré, at a special event in Trinity College Dublin.

In April 2012 Joanne O'Riordan addressed an audience of international delegates at the International Telecommunication Union's (ITU) 'Girls in ICT Day' celebrations in New York and put forward a challenge for someone to build her a robot. Assistant Professor Kevin Kelly in the School of Engineering, Trinity, and a team of young engineers took up this challenge. Thanks to a generous donation of €50,000 from the ITU, the team built a prototype humanoid robot, with a head, arms, torso and a single 'leg' which uses two wheels to move around.

Speaking about the motivation behind the project, Assistant Professor Kelly said: "Anyone who saw Joanne's appearance on the Late Late Show in 2011 couldn't fail to be both impressed and inspired by her, and I was no different. However, it was her appearance at the UN conference that really compelled me to get involved. Firstly, by her presence alone she was inspiring young girls to consider technology or engineering as possible careers – something very dear to my heart, and that I've worked to encourage for many years now. And secondly, the research in autonomous robots and gripping technology that we were engaged in at Trinity seemed an ideal match for what Joanne was asking for. I got in touch with Joanne and her family and we began discussing how we could help."

ITU Secretary General, Dr Touré, who was behind the funding for this project said: "Joanne's courage and energy are formidable – and her enthusiasm for the power of information and communication technologies to help her overcome her challenges and engage with the

world around her is truly inspiring. ITU undertakes a lot of work in the areas of empowering young girls and promoting ICTs for accessiblity – but it took Joanne to show us all the vital importance of these efforts. ITU is very proud indeed to have been a part of this pioneering project."

Following an approach to the O'Riordan family and various meetings with Joanne, the research group embarked on an intensive three month development period to build a prototype robot which could carry out some of the actions Joanne had requested.

"On the face of it, building a robot to pick up dropped items sounds like a straight forward idea - we take it for granted that we can easily do this ourselves. However, there are huge challenges when trying to this with a robot in a domestic environment. Primate evolution spanning 65 million years has got us where we are now whereas we had 3 months to build something!" said Conor McGinn, Chief Engineer and design lead with the Trinity project research team, who is also completing his PhD.

The robot's head is made from 3D printed plastic, with an enclosed 8-inch LCD screen (the face). The body consists of aluminium, carbon fibre and plastic, while 'inside' are lithium-polymer batteries, computers, motors, gearboxes, sensors and communication hardware that act as the 'brain', 'muscles' and 'nervous system' of the robot. When Robbie is in its default kneeling position it can interact easily with Joanne as her head is approximately the same height as the robot's head. This position also allows the robot to bend at the waist to pick up things without falling over. The robot can rise into a standing position where it is about the height and width of a 10-year-old child. Small objects like phones or pencils can be picked up with an extensible arm, on the end of which is a 'hand' (a balloon filled with coffee granules – an idea borrowed from researchers in Cornell University). The balloon can be inflated or deflated and this allows it to conform to and grip a wide range of object shapes, sizes and types.

Speaking about his experience of working on the project, Michael Cullinan, a Masters student working on the research team said: "There have been late nights and long hours but at the heart of it has been the desire to help Joanne begin to realise her dream of having a robot that can assist her with some of the simple tasks that elude her but that could make the achievement of all the other things she does independently a lot easier for her. Joanne is an inspiring individual who really shows what can be achieved when you have determination, will, a great sense of humour, and support. This prototype is only the first step towards Joanne realising her dream of a robot and we hope that Joanne gets the financial support to continue this process and achieve her dream."

Speaking about the challenges with and capabilities of the robot, Assistant Professor Kelly added: "I knew this was a hugely ambitious project, given the timescale and funding constraints, but I was confident that with the calibre of people we have here in Trinity and the goodwill they show, that we could demonstrate something of real potential for Joanne and other people who may have similar needs. The prototype is just the first step on the journey, but we've designed it in a manner that will allow us to develop and extend the capability in any future generations of 'Robbie'. There is still a lot of work that needs to be done with regard to making the design more elegant and the functionality more extensive before the robot would be ready for use outside of our test environment. However, even to get as far as we've done in this time is a tribute to the energy and ability of the team. It has been immensely hard work but sometimes you just have to do the right thing, and ultimately the reward is the satisfaction of seeing something like we have today."

Technical Specifications of the robot:

Design Objective

Build a mobile robot platform which demonstrates ability to reliably perform basic tasks (e.g. retrieving objects from floor) in a variety of human-populated environments (e.g. home, work, school) and to operate and interact safely with people there.

Facts and Figures

- Height: 110cm (kneeling mode), 140 cm (upright mode)
- Width: 70cm
- Depth: 20cm (upright), 80cm (kneeling/resting)
- Overall Weight: 40kg
- Power source(s): rechargeable high density Lithium-Polymer batteries
- 6 computers (in full design – currently being operated with 3), with distributed, dedicated functionality allowing redundancy and fail-safe independence
- High torque motors and gearboxes
- Air compressors and regulators (for arm control and gripping)
- iPad control interface for Joanne, including voice control

System components

1. Physical platform capable of moving around typical environments that Joanne would be in
2. Communication infrastructure to enable data to come to and from sensors and motors, to decision making centre ('brain'), social communication, external command/control
3. Social interface design ('face')
4. Control interface (iPad & voice)
5. Power systems and safety
6. Arm/hand mechanism with capability of retrieving variety of objects in any orientation

Robot Morphology (shape/size)

- Humanoid structure, consisting of:
- Torso (containing computers, most sensors)
- Two arms (including grippers – see below) mounted on shoulder
- Each gripper consists of a rubber balloon filled with coffee granules. This can be inflated with air, where it is soft and can conform to any shape it is pressed against. When the air is sucked out, the granules 'lock' the gripper around the shape allowing it to be picked up. When the arm is moved to the appropriate position the vacuum is removed and the object is released
- Head containing an 7" LCD 'face' which can display emotions and interact with people, and some sensors
- Neck allows head to tilt – similar to human ability, but with much larger range – allowing robot to have head facing backwards
- Hip motors, allowing robot to bend at the waist
- Single 'leg' (mermaid style!), which can bend at the knee and ankle
- Two wheels instead of feet
- Resting (Stabiliser) wheel extending from front of knee to conserve power.

Future plans

In terms of future development, there are a number of technical and strategic possibilities. Our core strength and aim is research-centered, and that is where our focus will lie.

Research directions

- Advanced social interface - can add a recognition detection system with a voice/social aspect, that will autonomously adapt to social situations (currently this is manually initiated via an iPad)
- Sensor fusion
- Efficient and accurate decision making
- Lightweight and accurate 'limbs'
- Increased autonomy and perception - this could be as an advanced navigation system so that Robbie will recognise and avoid obstacles, and adapt to a changing environment

Further functionality

- More sensors
- Communication with other devices (e.g. household electronics, phone/Skype so that Joanne can instruct Robbie to call people)
- New hand types
- Outer skin
- Re-engineering the existing design to improve reliability and performance within the current design paradigm.

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