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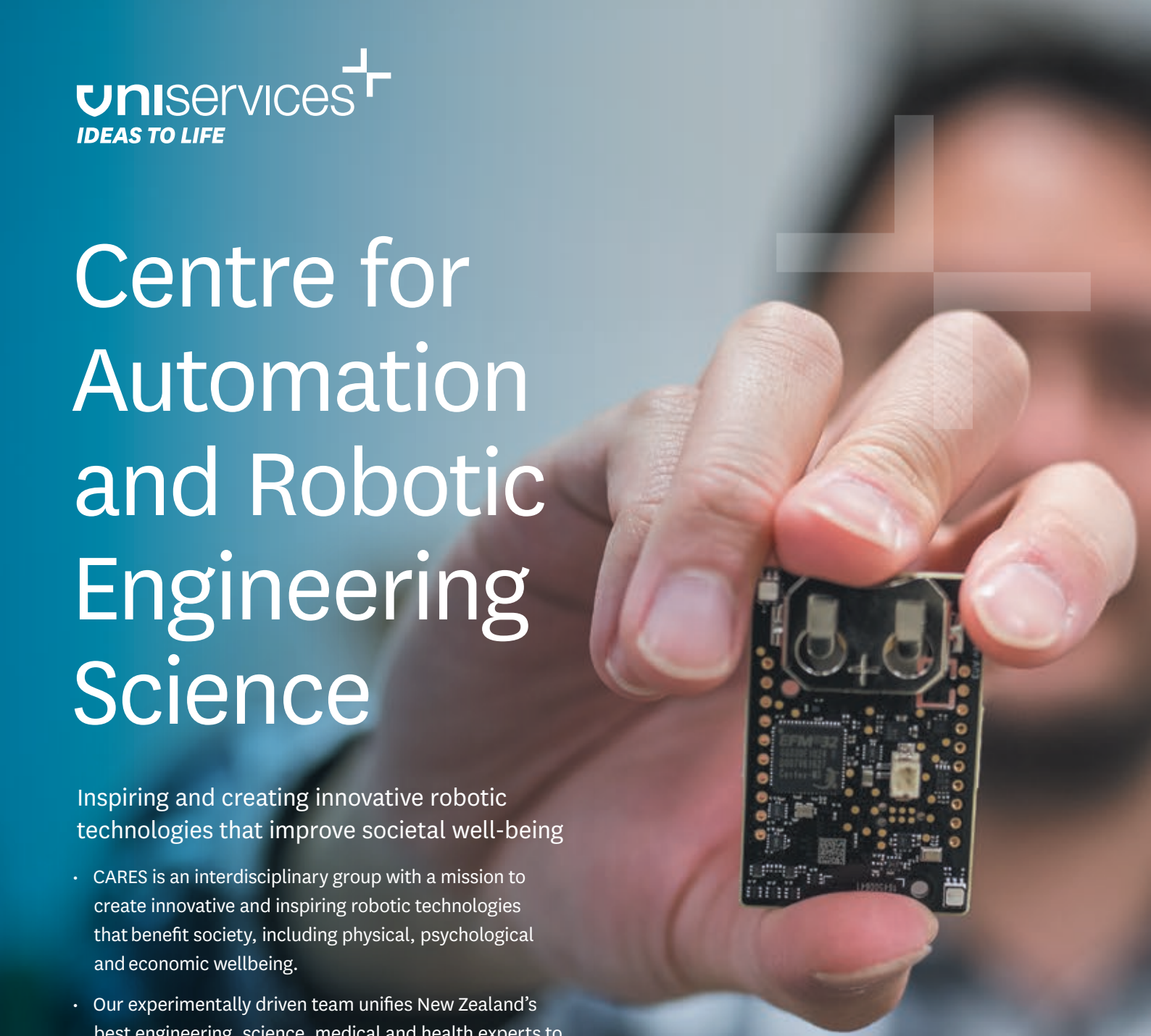
IDEAS TO LIFE

Centre for Automation and Robotic Engineering Science



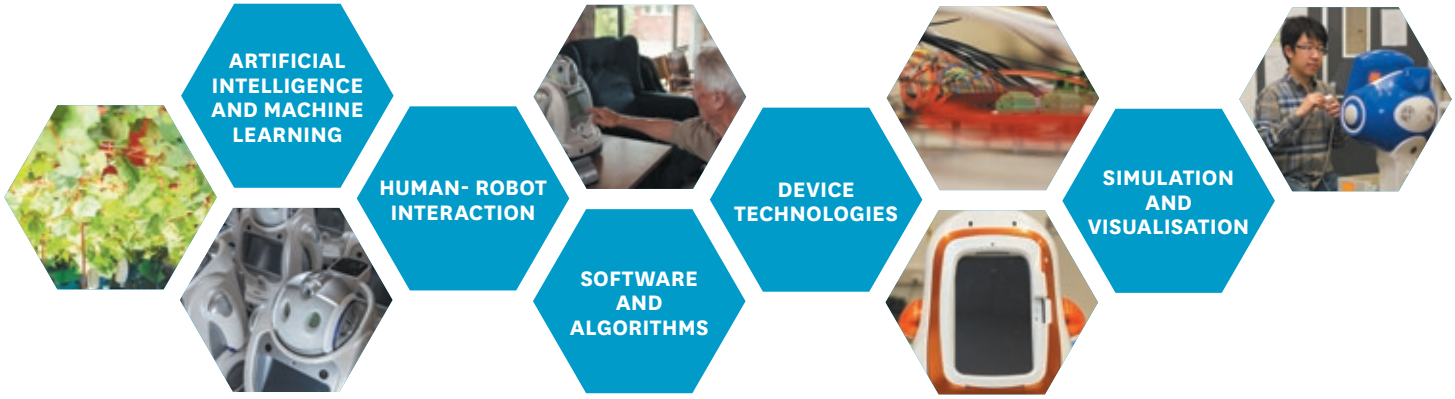
Inspiring and creating innovative robotic technologies that improve societal well-being

- CARES is an interdisciplinary group with a mission to create innovative and inspiring robotic technologies that benefit society, including physical, psychological and economic wellbeing.
- Our experimentally driven team unifies New Zealand's best engineering, science, medical and health experts to deliver pioneering research and development in robotics technology for diverse applications spanning healthcare, service delivery to primary industries and beyond. Founded on robust science, our excellent hands-on experience in robotic system development is validated through real world field evaluations.
- Our strong focus is on human needs and workflow. We have enduring relationships with stakeholders including innovative companies, healthcare organisations, government organisations, and research partners, both in Aotearoa-New Zealand and internationally.

CENTRE FOR AUTOMATION AND ROBOTIC ENGINEERING SCIENCE

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

Research and development themes



Mission-led research

Assistive Healthcare Technologies

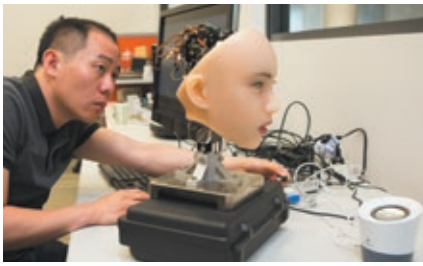
Development and application of assistive technology to create healthcare benefits. This includes robots as cognitive, physical and mobility aides for patients, prosthetic devices, intelligent environments, and related technology to provide healthcare services.

Robots for Primary Industries

Engineering robotic technology to automate activities across primary industries: agriculture, horticulture, aquaculture and forestry. This includes outdoor mapping and navigation techniques, mechatronic systems for carrying out operations, sensing systems, machine learning and algorithms for monitoring and detection.

Robotic Device Technologies

Researching smart robotic platforms and their interactions with biological, environmental and other complex systems using fundamental, robotic and integration technologies.



Humans and Robots Interacting

Understanding how to design robots to be more effective at interacting with humans and how to help people work more effectively with robots. This knowledge is applied when designing robots to be effective companions and to enhance social interactions for service delivery functions.

SOFTWARE SYSTEMS FOR ROBOTICS

Providing the software frameworks, tools, programming languages and techniques to improve software engineering of robotic systems. Creating specific tools to augment existing software framework systems and, in particular, to simplify behavioral work-flow for robot developers and subject-matter experts in different applications.

RESEARCH EXCELLENCE

We deliver and disseminate high impact and internationally-renowned robotics research and technologies.

IMPACT

We are changing the world by providing innovative and effective solutions to challenges in healthcare, manufacturing, primary industries, education, service industries and fundamental science.

INTERDISCIPLINARY

Our team of mechanical, electrical and software engineers, health practitioners, gerontologists, psychologists and computer scientists are highly collaborative throughout all stages of research. Collectively, we partner to co-create and strategise.

USER-CENTRIC

We consistently involve end-users and stakeholders in the design and development of solutions and have ready-access to industry, clinical experts and patients for user trials and test facilities.

IDEAL TEST BED FOR NEW TECHNOLOGIES

Unique opportunities in a small and heterogenous market with an accessible regulatory framework, with ready-access to industry and clinical experts, patients for user trials and test facilities. NZ has been ranked least corrupt country in 2016 and is an ideal test-bed for new technologies.

GLOBAL PARTNERSHIPS

Based at New Zealand's leading university, the most innovative in New Zealand and Australia, we have access to the top research commercialisation company of its kind in Australasia, UniServices, and have established commercial and research partnerships across the globe.

BROAD CAPABILITIES

Our highly talented and diverse team have experience across the field of robotics and automation, including in the areas of human robot interaction, artificial intelligence, virtual and augmented reality, robot software, sensing, speech, navigation, and hardware technologies.

Project examples

Companion robotics

Researching the relationships people form with robots compared to computers or avatars, and investigating the most acceptable kinds of robot appearance and behaviour. One application is designing robots to be companions for people and conducting real world trials to test their effectiveness.

Healthcare robots (Healthbot™)

A robot-based older care support system including autonomous robots, software applications, medical devices, wireless networks, and back-end servers. The system provides support to medical staff, carers and residents in older-care or home environments by providing a range of services including vital sign monitoring, scheduling, medication reminding and delivery, and telecommunication. Trials and cost benefit analyses have been conducted in care facilities and in homes which have demonstrated the acceptability, feasibility, risks and benefits of deploying robotic technology to patients.

IMPACT (Immersive Physical Active Cognitive Training Technology)

A novel exergaming platform which employs an infinite procedurally generated game environment, uses immersive technologies, and can be customized to take into account patient requirements.

The exergaming platform has two functions:

1) Simplified development of a novel targeted exergaming intervention with potentially significant health benefits
2) A major new research platform for testing different interventions, exercise equipment, and exercise protocols.

Clickworld (robust easy-to-use automatic image-based modelling system)

A technique to create 3D digital models using images acquired by any standard consumer level digital camera or a mobile phone/tablet camera. In contrast to alternative technologies, such as laser scanners, structured lighting (Kinect), and sets of calibrated cameras, our approach can be used by everyone having access to a consumer-level camera. It is robust under different environmental conditions and works for objects of different scale. Clickworld has been used to assess and manage fish quota, and to provide smart 3D vision systems for intelligent homes. Our technique is superior to currently available alternatives and is comparable to that of a laser scanner for a fraction of the price, and without restrictions on the size and location of the scanned object. The technique has been used for creating exhibits for virtual galleries, interior design, and consumer-level applications.

Wireless sensor networks and m2m in rural applications

Machine-to-machine IP-based communication infrastructure supporting mobile and internet enabled devices for rural farming applications. This Internet-of-Things (IoT) hardware/software infrastructure allows information to be monitored and exchanged and control provided in a remote fashion.

Inductive loop sensor for real-time bicycle detection

Evaluating, designing and implementing an inductive loop sensor for detecting bicycle passage in real-time. The sensor provides feedbacks into a microcontroller for performing signal processing and identifying the type of passing vehicles (e.g. bicycle, motorcycle, car, truck). The microcontroller activates suitable traffic lights when a bicycle is detected.

Smart switch for user behaviour capture and household appliances control

A digital controller that that senses the environment, such as light intensity and temperature; and controls up to three electrical/mechanical devices, such as lighting and ventilation devices. The digital controller can perform reactive controls according to pre-designed control rules and environmental events, and can also communicate with a computer to record user actions with time stamped environmental status.

Chewing and swallowing robots

A chewing robot was developed to establish biologically inspired specifications for the mechanical modelling of the peristaltic transport mechanism as observed in the human oesophagus.

Synthetic robot voices

Enabling creation of personalised robot synthetic voices, through building models of speech articulators, and acoustic phonetics to develop voices with a local accent. These have been shown to increase human acceptance of the robot and to enable a choice of robot voices for enhanced human-machine interaction.

Intelligent robotic exoskeleton therapy

Development of a lightweight exoskeleton device with biomechantronic functionally for therapeutic applications.

Research into the smart exoskeleton will aid with movement and posture for children with cerebral palsy or people with other physical disabilities, particularly stroke patients or people with spinal cord injuries, to assist with gait training and mobility. The prototype will be clinically validated through real world pilot studies.

Intelligent Vision Systems

Intelligent Vision Systems have been designed resulting in a proprietary multi-camera systems applied in Body Condition Scoring for agriculture. Further development in projects includes real-time 3D modelling applications for tree logs for inspection, fish volume assessment for fish quota management and 3D stereo-vision for intelligent homes. Other tailored solutions can be designed and developed, covering the acquisition systems, data analysis and 3D visualisation.

Multipurpose Orchard Robotics

A research collaboration between Plus Group's RoboticsPlus Ltd, the University of Auckland, Plant and Food Research, and the University of Waikato is developing an Autonomous Multipurpose Mobile Platform (AMMP). This modular robot is capable of navigating autonomously in orchards, with a vision system capable of sensing of flowers and fruit for kiwifruit and apples in orchards, fast-acting directional control mechanisms for precision targeted spraying of pollen and other material on moving flowers, grippers for harvesting and soft robotic handling for kiwifruit and apples.

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Working with CARES

The Centre includes internationally recognised expertise in the underlying systems that are essential in a variety of robotics applications, such as:

- human-like interaction (eg, speech recognition and expressive speech generation)
- design of human like features, movements, emotions, personality and facial expressions on android robots
- wireless communications for mobile robots
- wireless charging systems for mobile robot battery systems
- meta-programming and visual programming tools for giving tasks to robots
- intelligent vision systems and processes for robot sensing
- safe and time critical expression of robotic tasks
- physical human-robot interaction and rehabilitation
- dynamic control
- intelligent manufacturing systems
- advanced materials for robotic actuators
- visualisation for robot data
- psychological and healthcare technologies and trials.

Such comprehensive capabilities in robotics research are rare, enabling CARES to offer unique collaborative opportunities and solutions to organisations and companies.

CARES has proven experience in delivering high calibre inter-disciplinary research to international organisations and fosters academic and industrial collaborations globally. Collaborating with CARES presents a significant opportunity to benefit from New Zealand's best expertise, adding value and innovation to your research and commercialisation endeavours.

New Zealand – an ideal test bed for new technologies

CARES researchers are located across the multiple campuses at The University of Auckland and engaging in inter-disciplinary research with cutting-edge technologies. The robotics laboratory is located at the Newmarket Innovation Precinct. We are able to access existing test facilities and through our strong connections, establish new test sites to conduct transparent, robust and reliable testing of new technologies.

The University of Auckland

The University supports economic growth locally and nationally through innovation and entrepreneurship, creating quality jobs and high-value businesses, producing graduates that contribute to and strengthen our economy and society, to the benefit of all New Zealanders. The University of Auckland is New Zealand's leading university. It is the only New Zealand University ranked in in the top 100 in the QS World University Rankings. It is also the highest ranked New Zealand university in the Times Higher Education World University Rankings*.

UniServices

At UniServices, we bring ideas to life. We partner with the best minds in academia and business to apply intelligent thinking to ideas that have the potential to change the world.

Together with our partners, we look to the future, imagine the possibilities, and innovate for public and private good. For nearly 30 years, we've collaborated with hundreds of organisations on thousands of projects in New Zealand and around the world.

We have been identified by a Massachusetts Institute of Technology (MIT) study as one of the world's leading entrepreneurial universities "under challenging conditions" (MIT Skoltech Initiative)**. We are also the most innovative university in New Zealand in Reuters' Top 75: Asia's Most Innovative Universities rankings†.

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*http://www.topuniversities.com/university-rankings/world-university-rankings/2016
https://www.timeshighereducation.com/world-university-rankings/university-of-auckland

**http://web.mit.edu/sktech/sktech-program/entrepreneurship-innovation/benchmark.html

†http://www.reuters.com/article/us-asiapac-reuters-ranking-innovative-un-idUSKBN18Y24R