

# Centre for Automation and Robotic Engineering Sciences

Success in robotics requires a highly skilled, diverse group of researchers working collaboratively

**Integration of expertise is the key to the Centre's successful research and development.**

CARES is a multidisciplinary group with a mission to create innovative and inspiring robotic technologies that improve physical, psychological, economic and overall societal well-being.

We have good hands on experience in robotic system development. We are an experimentally driven team focused on research and development in robotics technology and real world field evaluation.

Our strong focus is on human needs and workflow. We have strong relationships with stakeholders including innovative companies, healthcare organizations, government organizations, and research partners, both in New Zealand and internationally.

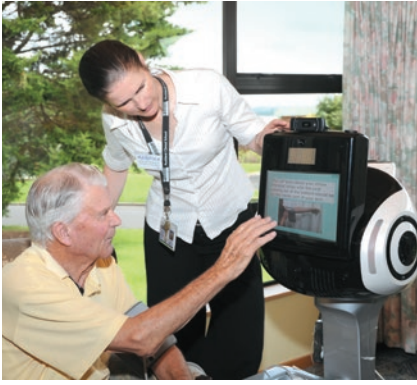
CARES specialist strengths include:

- Human-Robot Interactions
- Robotics End-User Directed Programming
- Interdisciplinary Approach to research and development
- A User Centric focus to applying robotic systems in healthcare, home, industry, agriculture, horticulture.

R&D focusses on six main work streams:



# Research and Development



**Assistive Healthcare Technologies**  
Applying 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.



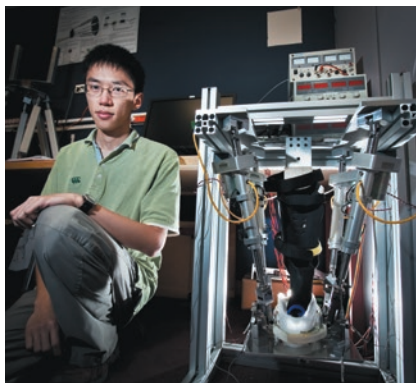
**Robots in Agriculture**  
Applying robotic technology to automate activities in agriculture, horticulture, aquaculture and forestry. This includes outdoor mapping and navigation techniques, mechatronic systems for carrying out operations, sensing systems and algorithms for monitoring.



**Humans and Robots Interacting**  
Understanding how to design robots to be more effective at interacting with humans and how to educate people to work more effectively with robots. One application is designing robots to be effective companions for people.



**Robot Technology Transfer**  
Providing the pathway to industry engagement and commercialisation of developed robotic technology. Interface between industry needs and research to develop robotic specific solutions. Finding commercial pathways for robot technology. Ensuring that robotic research is not isolated from market drivers.



**Robotic Device Technologies**  
Researching smart robotic platforms and their interactions with biological and other complex systems using both fundamental and enabling robotic technologies and system integration technologies.



**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 make it easier for robot developers and also subject matter experts to create robot behaviour for applications.

## New Technologies and Software Developed by the Centre

- Mechatronic design for assistive exoskeleton design
- Chewing robot design
- Brain control of robotic systems using a brain-computer interface
- Actuators and robotics design for upper and lower limb rehabilitation
- Soft object manipulation table for sorting
- Cognitive assistance software for robot delivered therapy
- Medication management system for robot delivery
- Healthcare Robotics Software helping people remain independently living at home
- Cost-benefit analysis for healthcare robots
- Memory games for exercising specific memory areas
- Telehealth software
- Tracking and visualisation for piece order fulfilment
- IMPACT (Immersive Physical Active Cognitive Training technology)
- ClickWorld (robust easy-to-use automatic image-based modelling system)

# Project Examples

## 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.

## HEALTHCARE ROBOTS:

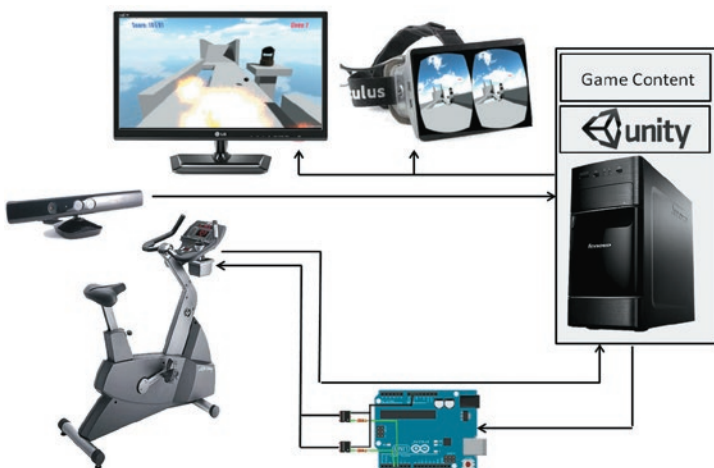
A robot based older care support system including autonomous robots, software applications, medical devices, wireless networks, and back-end servers. The system provides support to medical staff, carers and residents in an older care situation or in a home environment by providing a range of services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

## 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. Our technique is superior to currently available alternative techniques 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. The 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 PIC-based 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 detects ambient environment status, 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.

## SYNTHETIC ROBOT VOICES

Enabling creation of personalised robot synthetic voices, including developing 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 increased human-machine interaction.

## VISION AND 3D SENSOR TRACKING SYSTEM WITH AN AUGMENTED REALITY DISPLAY

Developed for a large international materials handling company to enable the company to track piece order fulfilment.

## Working with CARES

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

- human-robot interaction (eg, speech recognition and expressive speech generation)
- design of human like features, movements and facial expressions on android robots
- wireless communications for mobile robots
- wireless charging for mobile robot battery systems
- meta programming and visual programming tools for giving tasks to robots
- vision process 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 advice and studies.

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

CARES has proven experience in delivering high calibre multidisciplinary research to international organisations and fosters academic and industrial collaborations in Asia and Europe. Collaborating with CARES presents a significant opportunity to expand on local expertise to generate further research funding and commercialisation opportunities. Through CARES, New Zealand's infrastructure and regulatory systems also provides opportunities as a test-bed for robotics in a western style country.

## The University of Auckland

The University of Auckland is New Zealand's world-ranked university. We rank in the top 100 in the QS World University Rankings, and are the only New Zealand university ranked among the world's top 200 universities by the Times Higher Education World Rankings of Universities. The University of Auckland is also the highest ranked New Zealand university in the Shanghai Jiao Tong Academic Ranking of World Universities. The University of Auckland is an international centre of learning and academic excellence. It is New Zealand's pre-eminent research-led institution and has key linkages with many of the world's top research intensive universities. The University actively seeks to work with government, other universities,



research organisations, businesses and commercial consultancies in research, development and education.

Established in 1883, it is New Zealand's largest University with over 5,000 full-time staff, 8,000 casual staff and 40,000 full-time students, including over 5500 international students.

## Auckland UniServices Limited

Auckland UniServices Limited is the commercial research, knowledge transfer and custom education company for the University of Auckland - dedicated to connecting the University's capabilities to business and investors, Government and the community. UniServices is a wholly-owned company of the University of Auckland.

In just 25 years UniServices has grown to produce an income of over NZ\$130 million per annum, far surpassing any similar organisation in New Zealand and Australia. Our income derives from contract research and consulting, customised education programmes for 25,000 students around the world and from transferring intellectual property developed by staff and students at the University to the public and private sectors.

We are a substantial organisation with over 600 employees, working in 37 countries, and with access to many more academic staff from the University of Auckland. The work of UniServices supports the leadership position of the University of Auckland, and allows the University to expand and enhance its capabilities in commercial and basic research.

**uniservices**



## Contacts

### Dr Pau Medrano-Gràcia

International Business Development Manager,  
Science and Engineering  
☎ +64 9 923 6908 or +64 27 406 29 44  
p.medrano@auckland.ac.nz

### Nic Pennington

Business Manager - NZAP  
☎ +64 9 923 8932 or +64 21 545 353  
n.pennington@auckland.ac.nz

## Auckland UniServices Limited

Level 10, UniServices House, 70 Symonds Street  
Private Bag 92019, Victoria Street West,  
Auckland 1142, New Zealand  
☎ +64 9 373 7522  
www.uniservices.co.nz