

Annual Report 2014–15



Welcome & Introduction

Welcome to the Melbourne Networked Society Institute's Annual Report for the period 1 July 2014 to 30 June 2015.

The past twelve months has been a year of change and transition. The Institute has a new name and a refined research focus. These changes have been the result of a comprehensive update of the Institute's strategic direction.

The technology landscape is dynamic and fast moving. What was once an emerging issue ten years ago is now commonplace. The Institute, established as the Institute for a Broadband-Enabled Society, has developed a strong research program that has supported innovation in the development, application and understanding of broadband within society.

As broadband becomes an underlying enabler connecting people, places and things. This connectivity is what underpins the networked society. To capitalise on this emerging trend the Institute has developed a strategy to guide activities and research over the next five years.

The Institute has been repositioned around interdisciplinary research on the connectivity between people, places and things to tackle the challenges and find the opportunities of the networked society.

To support this, the Institute has invested in research through seed funding and its technical infrastructure through the development of a suite of activities, including development and training at the C-Lab.

This annual report is the last for the Institute for a Broadband-Enabled Society and provides a detail overview of our people, projects and new initiatives. I hope you find it an engaging overview of the Institute's activities over the past year.

I would like to thank and acknowledge the generous support the Institute has received from the Victorian State Government and our industry partners, which include Alcatel-Lucent, Cisco, Google and Microsoft.



Thas Nirmalathas Institute Director



Contents

Welcome & Introduction	2
Overview	4
The networked society	4
Building upon a rich history	5
People	5
Engagement	7
Research	9
Funding	q
Cood Funded Drojecte 2015	
Active Defence	10
Active Deletice	
The Digital Vinevard	12
Mapping the Melbourne Sharing Economy	
Driving for Change	14
Protecting Personal Data	15
Seed Funded Projects 2014	
Domestic 3D Printing Research Initiative	16
Colourimetric Sensor Chips for Lab-on-a-Smartphone	17
Super-Participation and Everyday Political Talk Online	18
New Generation EEG Devices	18
Culturally and Linguistically Diverse Ethics and Research Resources	19
Hallmark Disability Research Initiative Seed Funding	
Crowdsourcing of Mobility Hazards to Enhance the Safety and Independence of the Vision-Impaired	20
Topographical Community Accessibility Modelling for People with Mobility Impairments	21
Continuing Projects	
Wadeye IPTV	22
Creating Musical Futures for Students in Rural and Remote Communities	23
Open Food Network (OFN)	24
Making the Invisible Visible	25
From Information Kiosks to Community Hubs	
Non-Contact 3D Falls	
Blended Learning Across the Secondary - Tertiary Divide	2/
Completed Projects	
Kinect Technology for Remote Assessment of Interventions for Young Children with Autism Spectrum Disorders	
Televerk and Disability	
Improving the Language Learning and Technology Connection	
Cultural Respect Encompassing Simulation Training (CREST)	32
Health Provider Broadband Connectivity	
Postgraduate Students	34
Full Scholarshins	34
PhD Supplementary Scholarships	
Affiliated Research Control	
Microsoft Research Centre for Social Natural User Interfaces (SocialNUI)	
Centre for Energy-Efficient Telecommunications (CEET)	
C-Lab	
C-Lab Development Fund	
C-Lab Project: Melbourne School of Design Building – Donor Wall	40
C-Lab Interns	41
Appendix A: People	46
Appendix B: Publications	50
Appendix C: Finance	52

Overview

The past year was one of transition and change. The Institute changed its name and repositioned its research focus. A central activity was the planning, development and subsequent execution of a new strategy to support the interests of the Melbourne Networked Society Institute.

The Institute aims to be a global leader in research on the networked society. The focus on the networked society marks the natural evolution of the research agenda from focusing on universal access to broadband and its users, to the complexity, scale and speed of connectivity underpinning the networked society. Our mission is to undertake **interdisciplinary research on the connectivity between people, places and things to further the networked society**.

The Networked Society

As networks and connectivity increase their basic functions, key elements of society are undergoing transformative change. This transformation is seeing a reorientation of society where networks that transmit data, information and commands are integral to the existence and operation of people, places and services.

The networked society is transforming the technological and social landscape, presenting challenges and opportunities for research, industrial development and innovation. New and exciting immersive and pervasive ambient computing environments provide massive volumes of information permeating every aspect of existence. The data generated by these technologies can be automatically converted into knowledge capable of supporting decision making. This enables the fusing of intelligent mapping of real and social worlds at a global scale. A range of augmented reality and wearable devices is changing how rudimentary tasks are performed, affording a massive improvement in the guality of life.

Many sectors of the economy face significant disruption as a result of the networked society. Automated processing of information through ambient computing environments and their capabilities will transform the provision of services. The ubiquity of transaction monitoring has reduced the cost of data collection, driving changes in service delivery. Additionally, the nature of work is changing with the blurring of boundaries between business and personal life. This will transform future work place arrangements, enable productivity gains, drive economic growth, and provide significant opportunities for government policy development.

The networked society also presents many challenges. There are key issues in relation to how information is obtained, processed, stored and used when networks transcend jurisdiction. The growing amount of personal data transmitted across networks has privacy and security implications. Additionally, the networked society is transforming cultural and social practices through the use of communications technologies allowing greater connectivity between people. This requires a rethink in understanding information security and integrity challenges from societal, cultural, legal, and governance perspectives.



Building Upon a Rich History

The Institute is fortunate to build on the history of IBES. Since 2009 the Institute has developed an interdisciplinary research community comprising over 100 researchers from the University of Melbourne and numerous external collaborators from other universities, industry, government and the not-for-profit and community sectors. The Institute has provided funding to 95 research projects, many of which are contained in this report, supported the next generation of research leaders through the provision of scholarships to 29 PhD students, and established important research infrastructure with the support of leading industry partners.

The Institute for a Broadband-Enabled Society has enjoyed strong support and engagement from the Victorian State Government, the University of Melbourne, industry and researchers, and is keen to continue collaboration with our partners to address the challenges of the networked society.

People

People are at the heart of the Institute. As part of the transition process a number of new people have been brought into the Institute. A full list of people affiliated with the Institute is contained in Appendix A.

Institute Staff

The Institute has consolidated its staffing profile over the past year. Emma Dawson, Executive Director finished her role with the Institute in December 2014. While Dr Julian Ridoux, Chief Technology Officer of C-Lab departed in March 2015.

Advisory Board

The Institute welcomed a number of new people to the Advisory Board. These members refresh the composition of the board and support the activities of the Institute as it moves forward with a focus on the Networked Society. A full list of Advisory Board members is contained in Appendix A.

Executive Committee

The Executive Committee plays an essential role in guiding the research of the Institute. Changes over the past year include the addition of Prof Jane Gunn from the Department of General Practice and Prof Terence O'Brien from the Royal Melbourne Hospital Prof Peter Gahan replacing Prof Simon Bell from the Department of Management and Marketing. Fernando Martin-Sanchez resigned from the committee in May 2015. A full list of Executive Committee members is available at Appendix A.



Institute Fellows

The Institute continues to build its impact in interdisciplinary research across the University of Melbourne. To strengthen the Institute's expertise and leadership across key domains eight Institute Fellows have been appointed. Institute Fellows actively support the Institute's activities through research, outreach and collaboration. The Institute supports the Fellows by providing funding to support research activities in selected areas.



Richard Chenhall Institute Fellow (Digital Anthropology)



Bjorn Nansen Institute Fellow (Digital Media)



Victoria Palmer Institute Fellow (Applied Ethics)



Institute Fellow (Data and Security)

Chris Leckie



Marimuthu Palaniswami Institute Fellow (Connected Devices)



Andrew Roberts Institute Fellow (Privacy)



Peter Taylor Institute Fellow (Networks and Traffic Processes)



Stephan Winter Institute Fellow (Urban Connectedness)

Students

The Institute is supporting the development of the next generation of leaders for the networked society. Over the past year 22 PhD students received a scholarship from the Institute. The Institute has also been active in providing trainings for students at the University of Melbourne, hosting student interns at the C-Lab. Eleven Masters students interned at the C-Lab over the past year.



Engagement

The work of the Institute is not performed in a vacuum. Collaborations are essential for the Institute to achieve its vision of supporting innovative interdisciplinary research into pressing societal problems. The Institute hosted a number of events and consolidated its communications activities to support the transition from IBES to MNSI.

Events

The Institute had an active program of events designed to promote and build awareness. Events ranged from research seminars to build collaborations and partnerships through to large scale public forums exploring topical issues. Events hosted by the Institute are listed below.

Institute Launch and Public Forum: Metadata in the Networked Society

The Melbourne Networked Society Institute was officially launched by the Hon Adem Somyurek, Minister for Small Business, Innovation and Trade at the public forum on Thursday, 14 May 2015. The launch of the Melbourne Networked Society Institute recognised the transition from the Institute for a Broadband-Enabled Society and presents the next chapter of the Institute's story.

The Public Forum brought together industry leaders who critically examined the concept of metadata and its potential advantages and disadvantages in fashioning the networked society. The panel, chaired by Institute Director, Thas Nimalathas comprised:

- Vish Nandlall Chief Technology Officer, Telstra
- Peter Leonard, Partner, Gilbert + Tobin Lawyers
- John Stanton, CEO, Communications Alliance

The event was live-streamed and recorded and is available on the Institute's website.



Panel discussion at Metadata in the Networked Society Public Forum. (L–R): Peter Leonard, John Stanton, Vish Nandlall, Thas Nirmalathas



Lectures

- The Future of Mobile Rick Costanzo, Executive Vice President and General Manager of Global Mobility Solutions, SAP 21 August 2014
- Putting the Audience First Mark Scott, Managing Director, Australian Broadcasting Corporation – 13 October 2014
- Social Equity in a Post-Broadband Society: Insights from Disability for a Technology-Enabled Citizenship – Gerrard Goggin, the University of Sydney – 13 November 2014

Seminars

- User Interaction in Focus: In the Context of the Connected World Genevieve Bell, Vice President, Corporate Strategy Office, Intel – 22 October 2014
- Working in the Cloud Cathy Humphries 1 August 2014
- The Need for Change Agents in Exponential Times David Bray, CIO, Federal Communications Commission – 24 February 2015

Workshops

- Seed Funding Workshop 2014: Digital Technology and Society 2 July 2014
- New Application Possibilities and Technologies for Networked Unmanned Aircraft Systems (UAS), with the Defence Science Institute 10 December 2014
- Seed Funding Workshop 2015 30 March 2015

Communications

The new Institute required a new visual identity. As part of the transition, the Institute rebranded incorporating a new network motif to unify the work of the Institute and as a representation of the networks underpinning society.

A new website was developed, in accordance with the University of Melbourne's new web branding guidelines to tell the story of the Institute. The site is accessible at: <u>networkedsociety.unimelb.edu.au</u>. All IBES communications channels were migrated in the first half of 2015. The Institute has a Twitter presence: <u>@MelbNSI</u>. The IBES brand was officially retired at the launch of the Melbourne Networked Society Institute in May 2015.

The Institute has engaged in outreach activities by sponsoring two initiatives, the first was a visit to the University by Prof Peter Scheuermann from Northwestern University to research intrusion detection. The second was becoming a sponsor of the Convergent Science Network – an initiative that promotes an understanding of convergence science to the community.



Research

Research is at the centre of the Institute. Over the the past year the Institute has supported a wide range of innovative interdisciplinary research projects.

Funding

The Institute provides support to a wide range of research projects, contained in the following pages. Over the past year, the Institute held two seed funding rounds and has committed \$517,734 to support innovative interdisciplinary research projects at the University of Melbourne.

The 2015 Seed Funding round closed on 1 May 2015. Twenty-five applications were received, with six projects receiving funding. Details of projects are on pages 10 to 15.

The 2014 Seed Funding round focused on Digital Technology and Society. The funding round closed on 1 August 2014. Twenty-seven applications were received. A total of five projects were funded. Details of these projects are contained on pages 16 to 19.

Additionally, the Institute has provided support for two projects via the Disability Hallmark Research Initiative, two projects as part of the C-Lab Development Fund, and continued support to the ARC project: *Participatory Public Space: A Right to the Networked City*. This ARC Project involves a comparative study of the impact of high-speed broadband networks on public space in three cities: Melbourne, Amsterdam and Songdo City, Korea. The project aims to explore the interplay between regulatory and planning settings, and distinct cultures of use in enabling public participation in networked urban public spaces.

Finally, the Institute supported PhD Students providing scholarships to five students, as part of the University's pool of strategic postgraduate awards and a supplementary scholarship to one student.

External Funding

The Institute, through its support of research projects, has been successful in developing projects which have gone on to attract further research funding. Over the past year \$1,134,267 of external funding has emerged as a direct result of the Institute's support of innovative interdisciplinary research.

- Alcatel-Lucent funding for CEET \$700,000
- Microsoft funding for SocialNUI \$145,000
- Australian Communication Consumer Action Network (ACCAN) "Can I download a car?": Emerging consumer issues for online access, communication and sharing of 3D printer files -\$49,267
- ARC Linkage Developing modelling techniques for energy consumption in next-generation telecommunication networks- \$240,000



Seed Funded Projects 2015

Active Defence

A Novel Risk Management Approach to Network Infrastructure Protection

The security of critical infrastructure that underpins modern society has always been a national priority. However, over the past few decades the security-risk exposure to critical infrastructures has escalated due to increased interconnectivity within cyber infrastructures and between cyber and physical infrastructures. As a result, intelligent adversaries seek new pathways and opportunities, and employ more sophisticated tactics.

Although the responsibility to assure the long-term viability of critical infrastructure falls on government institutions, direct control is frequently delegated to private enterprise. Unfortunately, the private-business mindset of maintaining service availability at the lowest possible cost frequently competes with the need for a high-security environment that provides adequate protection from a complex and evolving threat landscape. Recent research points out that business security strategies rely on passive controls which are not suited to counter intelligent adversaries that use innovative means to exploit vulnerabilities in defensive systems.

This project develops an Active Defence system to support real-time security decision-making for network operators. The Active Defence system consists of two modules. The first module is a network visualisation interface that provides real-time 'situation awareness' of security events to network operators. The module uses new methods of information integration and 'big data' visualisation of disparate sources of security information. The second module is a recommendation system that advises human operators on defensive tactics to be employed while the network is under attack. The module uses risk management techniques to assess the exposure to critical infrastructure, game theory to suggest counter-moves in an ongoing attack, and machine learning to determine patterns of attacks that are anomalous and require human intervention.

- Benjamin Rubinstein Department of Computing and Information Systems
- Atif Ahmad Department of Computing and Information Systems
- Chris Leckie Department of Computing and Information Systems
- Andre Gygax Department of Finance
- Tansu Alpcan Electrical & Electronic Engineering



Music Therapy in Virtual Environments

This project is developing a proof-of-concept online virtual reality platform designed to deliver telehealth group singing interventions for people with quadriplegia to improve respiratory function, voice, mood, and social connectedness. Quadriplegia is the reduction or loss of function in the arms, trunk, legs and pelvic organs as a result of cervical spinal cord injury. Respiratory dysfunction is a major cause of illness and death following quadriplegia. Previous clinical research has demonstrated that group singing can help people with quadriplegia to breathe better, speak louder and to make social connections.

Many of the motivational and emotional benefits come from singing with others rather than in isolation. Disproportionately high numbers of people with quadriplegia live in rural and remote areas; areas often poorly served by traditional health services however, telehealth is becoming an accessible and cost-effective means to treat patients in their homes. Currently thousands of Australians with quadriplegia are significantly disadvantaged in terms of accessing the group music-making that ablebodied people take for granted. Successful demonstration of this proof-of-concept in this particularly vulnerable group will provide future scope to benefit other groups who are unable to access face-to-face music participation due to physical or geographical constraints.

The main technical issue that this project is addressing is latency – the delay between when someone starts singing and when the person hears it at the other end of a videoconference. This latency is due to the time it takes for the signal to travel from one computer to the other over the internet and causes difficulties in allowing for synchronous point-to-point live music performance. This project will attempt to deal with the latency effect by developing a clinician-controlled method of recording all singing voices, and automatically mixing and synchronizing these so that a new recording combining all voices can be played out to each participant system by the clinician, allowing them to sing along.

This will create a group singing effect, which theoretically will have the same effect as singing with other people in the same room.

New advancements in virtual reality technology will be incorporated into the environment to enhance the depth of the group's participation experience. The project will design and test a virtual environment (such as performing on stage in front of a virtual audience) that will enrich both the group's experience and the participant's motivation to sing.



A Virtual Reality Trial

- Jeanette Tamplin Melbourne Conservatorium of Music & Victorian College of Arts
- Ken Clarke Melbourne Networked Society Institute
- Ben Loveridge Learning Environments
- David Berlowitz Institute for Breathing & Sleep



The Digital Vineyard

Wine is one of Australia's chief exports. Australia is the world's fifth largest exporter of wine and the seventh largest producer of wine in the world. The wine industry is a significant contributor to the Australian economy. Growing conditions are, however, predicted to change with higher average temperatures, water scarcity and more pressure on land use from a growing population. The result is that wine makers will need to manage resources much more efficiently without comprising wine quality.

In the vineyard of the future, growers will use data from in-ground sensor and drones flying overhead taking multispectral images to better manage their crops and the environment within their vineyards. The



The Viticopter II, designed and built by Melbourne University, aloft at Curly Flat winery carrying a multi-spectral camera



A Near Infrared Image ortho-mosaic of the Curly Flat vineyard stitched together from multiple images taken by Viticopter II

ground sensor data and aerial imagery can be combined into metrics that growers can easily use to make decisions about growing conditions and when and where to irrigate and apply fertiliser. This is a form of precision agriculture that can target anything from larger blocks within a vineyard to small collections of plants that may need special attention.

This project takes a significant step towards this vision by developing the algorithms and software to acquire, combine, analyse and disseminate data from in-ground sensors and the multi-spectral images taken from drones. In-ground sensors provide a wealth of data about the condition of the soil such as the soil temperature, soil moisture content, salinity, pH levels and some other factors, while drones map valuable metrics for growth, early symptoms of undesirable plant health conditions, and indicators for fruit quality.

The project is developing key elements of sensor network and camera calibration, research and methods for combining the data from the different types of sensors and developing data analysis methods that will provide actionable metrics for growers. Development will focus on designing a standardised optical sensor calibration procedure, automated optical image geo-referencing and ortho-mosaic generation, dissemination and visualisation to end users.

Aerial and ground data will be collected from the Curly Flat vineyard in Lancefield (Victoria), Wynns Coonawara Estate vineyard (Treasury Wine Estates) in South Australia and Murray Valley Winegrowers vineyard in Victoria. The output will be able to produce metrics as well as clear visualisations of the winery overlaid with meaningful data.

- Ed Kazmierczak Department of Computing and Information Systems
- Dongryeol Ryu Department of Infrastructure Engineering
- Sigfredo Fuentes Department of Agriculture and Food Systems
- Richard Collman V3 Alliance
- Mark O'Connell Department of Economic Development, Jobs, Transport and Resources



Mapping the Melbourne Sharing Economy

The new services that form the sharing economy are becoming widespread and are used regularly by members of the public, both in Victoria and internationally, with many of the commercial companies that form part of this economy having a market value in the billions. A critical understanding of how sharing occurs through digital technologies; how sharing itself is conceptualised by individual, community, and corporate actors; and the wider implications of these networks for our social and economic relations is urgently needed. Sharing has recently become a topic of interest to consumer regulators; local councils; the popular press; and urban planning policy makers. This research project aims to make a significant evidence-based contribution to these important debates through documentation and analysis of these networks. The findings will be of wide public relevance, of interest to regulators, professionals and institutions involved in the sharing economy, and to scholars concerned with sharing practices, sociotechnical relations, and digital media.

This project is conducting a survey exercise, mapping the services, networks and discourses around the sharing economy across Melbourne – a recognised 'sharing city'. The sharing economy is an emerging mode of exchange facilitated by mobile and digital media, which includes well-known commercial services such as *Uber* and *AirBnB*, along with non-commercial forms of peer-to-peer exchange, such as *Freecycle*, which allow people to share household possessions and services with their neighbours.

The project maps the services, geographies and technologies entwined with the local sharing economy. The project also synthesises the local sharing economy through the analysis of publicly available documents, data analytic tools such as web scraping and discursive analyses of sharing platform interfaces. This data can be used to map the diversity and scale of the local sharing economy in terms of services, technologies and geographies, and to trace the histories, discourses and debates around the emergence of the sharing economy.

- Michael Arnold School of Historical and Philosophical Studies
- Martin Gibbs Department of Computing and Information Systems
- Tamara Kohn School of Social and Political Sciences
- Bjorn Nansen School of Culture and Communication
- Jenny Kennedy Department of Computing and Information Systems



Driving for Change

Depression affects around 6% of Australians annually resulting in enormous social and economic costs, estimated to account for up to six million days of lost productivity, or approximately \$12.6 billion. Many men with depression feel ashamed. They blame themselves for their depression, seeing it as a failure to cope with normal problems of life. As a result, they withdraw from their social networks and do not seek the help they need – factors which contribute to ongoing symptoms.

This project is developing and testing an online video game that embeds evidence-based strategies for reducing depression into game-play and uses the online component of the game to increase social connectedness and help-seeking via the networked society.

The game targets men at high risk of mental health problems who may not be in contact with health services. This will be achieved by targeting a male-dominated occupational group who are vulnerable to mental health problems – those in the taxi industry. Taxi drivers have many risk factors for poor mental health, including high stress, unregulated competitors, abuse, threats to personal safety, long and irregular working hours, unstable income, sedentary lifestyle, changing regulations and lack of bargaining power. In addition, two-thirds of drivers are born overseas, with many being recent arrivals. Migration contributes to a lack of supportive social networks among these men. Despite their high health needs, studies indicate that taxi drivers have very low levels of help-seeking. The initial design will target taxi drivers, but it is envisaged that the prototype will be able to be adapted to other high-risk groups.

There is enormous, but as yet unrealised, therapeutic potential in combining video games with the communicative aspect of the internet. Video games, which frequently incorporate rehearsal and feedback, are conducive environments for the type of cognitive-social learning used in psychological treatments for depression. In video games, players can do things they cannot do in the real world. This allows players to practice new ways of responding to a situation, and to do this repeatedly. Practice and repetition are key factors in changing patterns of thinking and can be effective in reducing depressive symptoms.

Social interaction is integral to online gaming. Multiplayer functionality allows players to connect, interact and learn from each other. Not only must players communicate to accomplish the game's objectives, content analysis of social interactions within online gaming spaces shows that emotional communication is more prevalent than task-oriented conversations. Co-players are seen as valued sources of offline advice and up to 75% of game players report having 'good friends' in their gaming communities. The project will leverage the connectivity between players to promote supportive connections and encourage help-seeking when it is needed.

- Sandra Davidson Department of General Practice
- Greg Wadley Department of Computing and Information Systems
- Nicola Reavley Melbourne School of Population and Global Health
- Penni Russon Centre for Youth Mental Health
- Jane Gunn Department of General Practice
- Blair Davies Australian Taxi Industry Association



Protecting Personal Data

Do the Australian Privacy Principles work with the Internet of Things?

The Internet of Things (IoT) promises a new world where almost every conceivable physical item sends and receives data via the internet. The potential to transform physical 'things' such as toothbrushes and pacemakers into interconnected and intelligent devices from which data can be generated, shared, and analysed, ushers in unprecedented business opportunities, with an estimated value of US \$4.5 trillion.

However, the prospect of such comprehensive and all-encompassing collection of data that is inextricably linked to the lives of human-beings raises troubling scenarios – such as consumer surveillance, identity theft, invasive marketing, and more potent hacking methods affecting personal lives, including the most sensitive private information.

The *Privacy Act 1988* (Cth) is the main Australian legislation regulating the collection, use, storage and disclosure of personal information as well as access to, and correction of, the information. The Act consists primarily of 13 Privacy Principles (APPs) that apply to all public agencies and private organisations (with \$3 million or more annual turnover). A recent Australian study found that, despite the protection of personal information apparently enshrined in the Act, it is unclear how effective these provisions are in protecting the privacy of individual consumers, especially in the emerging context of the IoT.

The study poses the following formal research questions. In the context of the IoT, is the level of individual data protection afforded by the APPs adequate in practice? Do consumers want higher security for their information? How can 'privacy by design' be effectively built into the IoT without stifling innovation?

This research project is being conducted in two interlinked phases. The first examines the privacy by design literature to determine the gap between the protection afforded by the APPs and the specific personal information challenges posed by the IoT. Following this, case studies will focus on IoT technology trend areas with in-depth interviews conducted with consumers, technology designers and third-party users of IoT data. This research will identify privacy by design challenges in the context of the APPs and how IoT devices might be redesigned to provide operationally for the level of protection of personal data required by Australian law and/or desired by consumers.

- Rachelle Bosua Department of Computing and Information Systems
- Megan Richardson Melbourne Law School
- Atif Ahmad Department of Computing and Information Systems
- Karin Clark Melbourne Law School
- Sean Maynard Department of Computing and Information Systems





Seed Funded Projects 2014

Domestic 3D Printing Research Initiative

Domestic and Commercial Models of Use for Additive Manufacture

This research project investigates the opportunities and implications of 3D printing in the context of its early commercial and cultural presence within Australia. This project aims to explore the meanings, practices, and expectations of 3D printing from multiple stakeholder perspectives (end users, internet intermediaries, retailers, community collectives, industry, policy). The scope of the research addresses social meanings, user practices, and economic implications associated with the technological affordances and barriers presented by such additive manufacturing technologies. By investigating a broad range of perspectives on the potential economic and social implications of 3D fabrication in the early stages of its innovation and adoption, this project will move beyond specific issues, such as legal implications, to consider the potential of fabrication applications in a range of domestic, community and commercial contexts.



Photo of 3D printed titanium heart valve, taken at the Inside 3D printing expo.

This project established the foundation for a \$50,000 research grant from the Australian Communication Consumers Action Network (ACCAN) on consumer perspectives on 3D printing, titled: "Can I download a car?": Emerging consumer issues for online access, communication and sharing of 3D printer files.

- Bjorn Nansen School of Culture and Communication
- Michael Arnold School of Historical and Philosophical Studies
- Robbie Fordyce School of Culture and Communication
- Luke Heemsbergen School of Culture and Communication
- Thomas Apperley University of New South Wales
- Thomas Birtchnell University of Wollongong



Colourimetric Sensor Chips for Lab-on-a-Smartphone

Recent years have seen a staggering uptake in smartphones. This presents exciting opportunities for laboratory instruments for applications that range from medical diagnostics to environmental pollution monitoring. Such instruments would be very small and lightweight in comparison to traditional approaches because the imaging (digital photography), computation, communication, and user interface (touch-sensitive screen) functions of the instrument would be provided by the smartphone.



Scanning electron microscope (SEM) image of array of silicon nanorods



Optical microscope images of arrays of silicon nanorods with different diameters (~68 nm to ~163 nm)

This project is developing colourimetric sensor chips built upon silicon and has already delivered promising results. Silicon normally appears a grey or silver colour. However, this project has demonstrated that very small silicon rods exhibit vivid colours. As the rod diameter is increased, the colour varied from blue to green, yellow, orange and pink. Furthermore it was shown that, when immersed in liquid, the colour varied with the refractive index of the liquid. This phenomenon could be employed in the future for the realisation of refractive index sensors. It is anticipated that the chip can be used to modify smartphones allowing them to operate as a lab, increasing access to high quality analytical tools. Such devices could revolutionise personal medicine as consumers monitor their own health using devices attached to their smartphones.

Research Team

- Kenneth Crozier Department of Electrical and Electronic Engineering and School of Physics
- Wuzhou Song School of Physics
- Shiqiang Li Department of Electrical and Electronic Engineering
- David Manton Melbourne Dental School
- Rodrigo Mariño Oral Health CRC, Melbourne Dental School



Super-Participation and Everyday Political Talk Online

A Comparative Analysis of Culture and Communication

This project is developing a new agenda for online deliberation research: the study of everyday political talk in formally non-political online third spaces. The project is comparatively analysing the impact of *super-participants* on political talk in discussion forums and micro-blogs (Sina Weibo and Twitter) across China and Australia.

This project provides the first detailed empirical analysis of everyday online political talk in Australia and China. It has broken new methodological ground in its techniques for collecting data; in its approach to analysing everyday political talk; and in its use of innovative data visualisation strategies. This work is being made visible to a broader academic audience via publications on research methods in relation to digital data and political talk online.

Research Team

- Scott Wright School of Culture & Communication
- Garry Robins Melbourne School of Psychological Sciences
- Andrea Carson School of Social and Political Sciences
- Todd Graham University of Groningen
- Shaojing Sun Fudan University Journalism School

New Generation EEG Devices

Psychosis is a severe mental disorder comprising multiple aspects of everyday functioning and quality of life. Previous research has revealed abnormal neural oscillations in resting state EEG measurements of patients with psychosis. However, studies of at-risk populations are scarcer with some preliminary results on possible prediction of transition to psychosis. The successful identification of reliable biomarkers for the transition would facilitate early intervention to reduce human suffering and economic cost.

This project examined the directional variances of EEG data and investigated whether they are dependent on transition status. The participants at ultra-high risk (UHR) for psychosis who subsequently transitioned to psychosis (UHR+) were shown to differ from those who did not transition (UHR-) in terms of the maximum directional variance of resting state EEG measurements. These results indicate that UHR+ are characterised by reduced maximum directional variances in resting EEG and are essential for the development of psychosis prediction devices.

The project is currently investigating whether the prediction can be made using a subset of standard electrodes, looking into the ways how light-weight simple-to-use EEG systems can be developed.

- Stan Skafidas Department of Electrical & Electronic Engineering
- Christos Pantelis Department of Psychiatry
- Wanzhi Qiu Department of Electrical & Electronic Engineering



Culturally and Linguistically Diverse Ethics and Research Resources

(The CALDER Pilot Study)

Australian hospitals are culturally and linguistically diverse places, with resources such as medical interpreters who can facilitate patients' access to healthcare. Australian hospitals are also sites of patient recruitment into clinical trials. Trial participants are predominantly English speaking and of Anglo-Celtic descent. The unrepresentativeness of trial participants is a problem for medical researchers both in Australia and in other

migrant destination countries.

Ethics committees require that patients give informed consent to participate in clinical trials. For patients with limited knowledge of English and interrupted education, the lengthy and complex participant information consent forms (PICF) present a barrier to participation. Patients may also not understand the purpose of medical research. Limited research funding means that PICFs are unlikely to be translated or interpreters utilised. More inclusive participation in medical research is needed as part of addressing health inequalities for migrant groups in Australia.

This project is investigating the barriers to participation in clinical trials from the perspectives of older migrants and their families, researchers, and hospital ethics committee members. Additionally, the project is exploring the acceptability of a



CALDER features in the Italian language newspaper Il Globo

technological aid, such as a mobile app to assist trial recruitment.

Findings from interviews with elderly Italians suggest that firstly patients need a better understanding of what medical research is, and what participation in research involves. Researchers are currently developing a bi-lingual App, Medical research, what's that? *Ricerca medica, che cos'è*? to be trialled at St Vincent's Hospital.

- David Story Anaesthesia, Perioperative and Pain Medicine Unit
- John Hajek School of Languages and Linguistics
- Ute Knoch School of Languages and Linguistics
- Robyn Woodward-Kron Medical Education Unit, Melbourne Medical School
- Anna Parker Anaesthesia, Perioperative and Pain Medicine Unit
- Tuong Phan St Vincent's Hospital



Hallmark Disability Research Initiative Seed Funding

The Hallmark Disability Research Initiative was established to support interdisciplinary research on disability across the University of Melbourne. The Initiative's aim is to help to coordinate interdisciplinary projects with the involvement of community partners and those with personal experiences of disability. The Initiative will develop high-quality applied research, policy and education programs.

The Institute, along with three other research institutes, is supporting the Disability Research Initiative's seed funding round: Melbourne Social Equity Institute, Melbourne Neuroscience Institute and Melbourne Sustainable Society Institute.

Crowdsourcing of Mobility Hazards to Enhance the Safety and Independence of the Vision-Impaired

Together with partners, Vision Australia and Guide Dogs Australia, researchers are currently investigating the first portable vision device to specially detect non-protruding obstacles such as potholes and descending curbs, which are genuine fall risk factors for the vision impaired, particularly those using wheelchairs and walking frames. This project will also implement a hazard database that is accessible to the vision-impaired through a simple-to-use mobile app. Such a feature, alongside the function of the device itself, will be critical in enhancing the independence of the vision-impaired.

Researchers & Collaborators

- Elaine Wong Department of Electrical and Electronic Engineering
- Marimuthu Palaniswami Department of Electrical and Electronic Engineering
- Jayavardhana Gubbi Department of Electrical and Electronic Engineering
- A Rao Department of Electrical and Electronic Engineering
- Nicola Misso Vision Australia
- Sandro Ciriani Guide Dogs Australia



Topographical Community Accessibility Modelling for People with Mobility Impairments

People with mobility impairments face inequities navigating the urban environment. Accessibility modelling tools currently openly available to the community do not account for physical barriers such as stairs or topography.

This project is developing and testing novel digital design and modelling tools combining animated pedestrian accessibility, topographical mapping and flexible three dimensional modelling, exploiting spatial datasets from Australia's first open source geospatial laboratory (AURIN).

The research will allow people with mobility impairments, disability groups, and urban planners to model and understand accessibility in their community, providing tools to design and advocate for more inclusive urban environments. The research is immediately relevant to the disability community, and will be increasingly relevant to the wider community as the population ages.

This project is jointly funded with the Melbourne Social Equity Institute.

- Marcus White Melbourne School of Design
- Geoff Kimm Melbourne School of Design
- Nano Langenheim Melbourne School of Design
- Marija Groen Housing Resource & Support Service
- Jen Hargraves Women with Disabilities Victoria
- Debra Dean City of Moreland



Continuing Projects

Wadeye IPTV

Delivering Audiovisual Archives to Remote Aboriginal Communities

In partnership with Kanamkek Yile Ngala Museum and the Thamarrurr Regional Authority Aboriginal Corporation in Wadeye, a remote Aboriginal community in Australia's Northern Territory. This research project is trialing how culturally significant and endangered audiovisual material might be most effectively and appropriately preserved and made accessible for present and future generations. The delivery of locally relevant content in local languages offers hope to communities, such as Wadeye, seeking to maintain their language, lores, customs, and cultural heritage. But, given the complex technical issues relating to the digitised world it has become clear over time that the speed of information technology developments and lack of capacity in Australian Aboriginal communities can often lead to information and knowledge loss.

The Wadeye community has an audiovisual collection spanning more than 53 years and holding significant cultural material covering at least four different Aboriginal language groups, many of which are now highly endangered therefore making this material irreplaceable. The aim of this project is to explore new technologies that would make it possible for Wadeye community members to view historical audiovisual footage, add information about the people and events recorded, and to produce contemporary audiovisual histories via the Internet.



Digital workstation in Wadeye

A key outcome from this project is the establishment of a local narrowcast television station in Wadeye, to be be launched in December 2015. This will enable local community access to local language content and delivery of community messages.

This project has attracted additional funding to further the research including \$240,000 Aboriginal Benefits Account Grants to engage young people in the process of converting analogue VHS, MiniDV and SVHS compact tapes into a digital format, and \$300,000 Community Development Program funding to support the rollout of the narrowcast digital TV station.

Research Team

- Lyndon Ormond-Parker Centre for Health Equity, Melbourne School of Population and Global Health
- Marcia Langton Centre for Health Equity, Melbourne School of Population and Global Health
- Sharon Huebner Centre for Health Equity, Melbourne School of Population and Global Health
- Caden Pearson Centre for Health Equity, Melbourne School of Population and Global Health
- Jasper Coleman Centre for Health Equity, Melbourne School of Population and Global Health
- Rachel Nordlinger School of Languages and Linguistics
- Robyn Sloggett Centre for Cultural Materials Conservation
- Ken Clarke Melbourne Networked Society Institute
- Mark Crocombe Kanamkek-Yile Ngala Museum
- Jacinta Crocombe Kanamkek-Yile Ngala Museum



Creating Musical Futures for Students In Rural and Remote Communities

A major disadvantage experienced by music performance students living in rural and remote communities in Australia is the lack of access to specialist instrumental tuition. However, high-speed, low-latency video and audio communication technologies, available via the NBN or other high-speed networks such as AARNet, offer the potential for these students to receive expert tuition online from specialist teacher-musicians located in capital cities. This enables them to achieve their full musical potential during their secondary school years. At the outset of the project, a reference background and technical report, covering sources of signal delay, bandwidth limitations, and video and audio requirements for the project was prepared.



Ballarat Clarendon College singing student receives an online lesson from teacher Louisa Rankin located at the Melbourne Conservatorium of Music

One of the principle objectives of the project was to identify, test and evaluate a range of digital hardware and software infrastructure that were utilised by a team of specialist instrumental teachers operating from the University's Parkville Campus and students located at a selected rural test site in Ballarat. Initially, *VSee* videoconferencing was utilised and various items of hardware and videoconferencing software were trialled during the course of the project. *VSee* was later supplanted in the on-going Ballarat trials by a more effective system, *Zoom*. This part of the project has also enabled on-going refinements to audio and video transmission and capture (recording) procedures as well as studio set-up and teaching protocols.

The project also trialled and documented methods and techniques for implementing internet-based teaching, chiefly the effectiveness of student-teacher interaction and online pedagogy. A team-based action research approach has involved specialist teachers giving online tuition in voice, oboe and drums to senior secondary school students at Ballarat Clarendon College. All participants—online teachers, instrumental students and the research team—have contributed data which is currently being analysed and from which valuable guidelines for future implementation of online teaching in the Australian context will result.

- Gary McPherson Melbourne Conservatorium of Music
- Graham Moore Melbourne School of Engineering
- Robin Stevens Melbourne Conservatorium of Music
- Sarah Barlow Ballarat Clarendon College



Open Food Network (OFN)

Connecting and Supporting the Sustainability of Regional Food Supply Chains

The Open Food Network (OFN) is a prototype of a networked e-commerce system for activating online regional food marketplaces. OFN will enable farmers, consumers and independent food enterprises, to

connect, trade, manage Food Hubs and coordinate logistics. It aims to reduce transaction costs by networking small and medium food enterprises, and improve both farmers' access to local and regional markets and consumers' access to fresh local produce. The broad aim of the study is to evaluate the effectiveness of the Open Food Network (OFN) in connecting and supporting the sustainability of regional food supply chain communities. As part of this study, existing Food Hubs in Australia were investigated, identifying their roles, benefits to the community, as well as the enablers and barriers to their sustainability. This project is contributing to the on-going development of the system and is part of a larger research program exploring how ICT/broadband can support sustainability and resilience in food supply chains, in particular, and organisations in general.



Pizza making at the Open Food Network Launch, July 2015

The Open Food Network has been recognised for its innovation, winning the Ouishare Awards 2015, which supports collaborative economy initiative development. Additionally, the OFN is growing internationally with pilots in various stages of development in the United Kingdom, Scandinavia, South Africa, Canada and France. The research team is currently investigating potential partners in Brazil and India.

The Australian Open Food Network was launched on 26 June 2015. For more information, visit <u>openfoodnetwork.org.au</u>.

- Sherah Kurnia Department of Computing and Information Systems
- Kirsten Larsen Victorian Eco Innovation Lab
- Prakash Singh Department of Management and Marketing
- Rahim Md Mahbubur Monash University
- Patrice Braun Federation University



Making the Invisible Visible

Digital Storytelling for Neighbourhood Social Cohesion

This project explored the opportunities that digital technologies can provide for people who are predominately housebound, to enable them to contribute to the social and cultural life of their local community. The project achieved this by supporting three housebound residents to create digital stories about their everyday lives and experiences. The digital stories (short visual narratives created from digital photographs, text, audio, and video) were created from conversations with participants and photographs of artefacts in their homes. With the support of a digital artist, Gretel Taylor, and researcher Hilary Davis, the participants co-created engaging and informative stories about their lives, which they wanted to share

with local audiences.

An interactive digital display was created and used to showcase the digital stories at events arranged by the project's partner organisation, Darebin Community Health. Participants were all clients of this organization. The stories were shown at the Darebin Community Health Open Day in



The display showing a digital story with an audience message



Audience members viewing the digital stories, Darebin Community Health Open Day 2014

October 2014, which was attended by local residents, as well as staff and clients of the community health provider. Audience members were able to view the stories on the display and write responses, in the form of short text messages. These were sent to a database for moderation by the research team and, once approved, appeared on the display the next time the stories were shown. The responses, which all expressed support for the digital stories, were relayed back to the storytellers, in order to provide them with a sense of connection to the local community.

A final showcase event, held at Darebin Community Health in July 2015, was attended by a large group of staff and two of the storytellers. At this event, community health staff provided positive feedback about the digital stories and the project as a whole. They commented on the opportunities the project provided for "making the invisible visible" by enabling housebound clients to share their stories and have their voices heard. An important achievement for the project was a successful collaboration with staff from Darebin Community Health, who expressed a desire to see opportunities for their clients to use digital technologies in creative ways extended in future work.

- Jenny Waycott Department of Computing and Information Systems
- Hilary Davis Department of Computing and Information Systems
- Deborah Warr Melbourne School of Population and Global Health
- Fran Edmonds School of Culture and Communication
- Joanne Grigg Darebin Community Health



From Information Kiosks to Community Hubs

Information Provision in Indigenous Communities in an NBN Environment

Digital technologies can be used as an effective means to overcome Indigenous disadvantage by improving capacity to build local economies, affirming Aboriginal identity, and providing culturally

relevant information to rural and remote communities in areas of health and education.

This project investigates user practices of the Hitnet kiosks to improve the service. Hitnet kiosks are a network of approximately 70 interactive touch screen kiosks installed at different locations across Australia in remote, regional and urban communities. The kiosks are designed to address the 'information disadvantage' by using digital technologies to improve and maintain community connectedness, digital development and digital social inclusion.

Key findings show that Hitnet has the potential to successfully provide culturally relevant information to hard-to-reach regional and remote communities, addressing the current digital divide between Indigenous and non-Indigenous Australians. The content provided has greater potential for 'stickiness'



Local children accessing the newly launched HITnet kiosk (September 2014) in the Pormpurkuukyikngathar Culture, Knowledge and Learning Centre in Pormpuraaw. Photo: Kristen Smith

when local people and communities drive and shape content, as it increases engagement and ensures highly contextualised social and cultural relevance. As such, the Hitnet methodology for content co-production with local Aboriginal communities has been very successful.

The Hitnet touchscreen technology and content is designed to cater to low literacy and inexperienced technology users, with the majority of people in the study agreeing that the kiosks are easy for most people to use. However, tying this technology to smart phones could be a means of progressing the technology so that it has the potential to be more successful in narrowcasting information, and enabling the production of more local content in regional and remote contexts. However, the study found that although some people in remote contexts have access to smart phone and tablet technologies, the vast majority do not.

Although the current application of Hitnet kiosks is relatively narrow there are potential opportunities to increase the regularity of new of content by expanding their use.

- Richard Chenhall Melbourne School of Population and Global Health
- Scott McQuire School of Culture and Communication
- Kristen Smith Melbourne School of Population and Global Health
- Emma Kowal Deakin University
- Helen Travers Hitnet
- Julie Gibson Hitnet
- Ernest Hunter Hitnet, James Cook University



Non-Contact 3D Falls

Detection, Prevention, and Behavioural Monitoring in Aged Residential & Home Environments: Developing a Clinical Evaluation and Application Framework

The population of those aged 65 years and older in Australia will increase over the next 10 years, placing additional stress on society's ability to care for the elderly. Serious falls impact around one in three elderly people and often result in hospitalisation. New approaches and supporting technology are required to address this area and improve outcomes. Evidence suggests that intelligent personalised sensor systems can monitor behaviour - detecting unusual sequences, altered activities, or lack of movement. When installed in the home or residential setting, these non-contact sensors alert carers or staff to potentially dangerous behaviours.

This pilot project is monitoring pre- and post-fall movement patterns using unobtrusive, privacypreserving 3D sensors. Multiple sensors will be located in individuals' residences, to track their usual activities over a fixed time period. The resulting data will be aggregated so that researchers using big data analysis techniques can investigate whether the monitoring accurately provides warning of falls and behaviour indicating deterioration in older people. The project is also evaluating the feasibility of the sensor technology and will attempt to provide a framework for its implementation into the clinical environment.

Research Team

- Fernando Martin-Sanchez Health and Biomedical Informatics Centre
- Kathleen Gray Health and Biomedical Informatics Centre
- Cecily Gilbert Health and Biomedical Informatics Centre
- Udaya Parampali Department of Computing and Information Systems
- Catherine Said Austin Health
- Michael McGrath Semantrix
- Frank Smolenaers Australian Centre for Health Innovation
- Damien Malone Ti Tree Lodge Pty Ltd

Blended Learning Across the Secondary - Tertiary Divide

Despite the central role of computation in our society and economy, the underlying science is absent from the secondary curriculum in Victoria. The Victorian Curriculum and Assessment Authority (VCAA) has recognised this problem and is working with Monash and Melbourne universities to create new units in computer science. In order to increase access to computer science different models of delivery are required.

This project, supported by Google, is orientated around a graphical programming language called Snap! which will form the basis of a platform to establish an educational platform and evaluate its effectiveness for delivering tertiary computer science content at secondary level. The project team are extending the functionality of Snap!, supporting the logging of student programming and engagement to provide assessment and ways to tailor teaching that adapt to the complex interactions between attitude, engagement, gender and achievement. It is envisaged that this program will increase the uptake and interest of students in computer science and related careers.

- Steven Bird Department of Computing and Information Systems
- Wally Smith Department of Computing and Information Systems
- Shanton Chang Department of Computing and Information Systems



Completed Projects

Kinect Technology for Remote Assessment of Interventions for Young Children with Autism Spectrum Disorders

The prevalence of Autism Spectrum Disorder (ASD) is increasing. There is evidence that early intervention is beneficial in developmental outcomes. Accessing such services is problematic for many families. The potential for tele-health to improve service access for all families, particularly those in rural and remote areas, was the motivator for this project.

Firstly, this project investigated the feasibility of delivering intervention remotely into the home of parents of young children with ASD, using telepractice and video-conference technology. The intervention, *Hanen More than Words*, was successfully implemented with two families using video-conferencing between August and November 2014. This pilot data demonstrated the technology was fit for purpose and that families found the form of delivery very acceptable.



Mother and child in class

Secondly, the project evaluated automated tracking and analysis for assessing and monitoring childparent interaction using readily available technologies in the form of Kinect sensors. The preliminary findings are encouraging. The hardware collects motion data from the parent-child interaction, and the software is 'trained' to pick up important characteristics of the interaction (for example, mimicking behaviour, touch and proximity). Future plans are to do larger controlled comparative studies of the traditional delivery of the *Hanen More than Words* program versus that delivered via telepractice. It is expected that the software will also be improved over time with the assessment analysis becoming more accurate and efficient.

- Patricia Eadie Department of Audiology and Speech Pathology
- Bronwyn Davidson Department of Audiology and Speech Pathology
- Robyn Garnett Department of Audiology and Speech Pathology
- Ken Clarke Melbourne Networked Society Institute
- Zaher Joukhadar Melbourne Networked Society Institute



Telerehabilitation for Chronic Obstructive Pulmonary Disease

Optimising the Model

Chronic obstructive pulmonary disease (COPD) is a debilitating condition affecting over 700,000 Australians. COPD is characterised by breathlessness on exertion, fatigue and reduced exercise capacity. Pulmonary rehabilitation is highly effective in improving symptoms and reducing hospital visits in people with COPD, however many patients are unable to access a program due to disability or geography.

This project developed and tested a model of home-based telerehabilitation for COPD, including multiparticipant videoconferencing and physiological monitoring, so that more people with COPD can experience the benefits of pulmonary rehabilitation. The project successfully demonstrated a feasible and reliable multi-participant home-based telerehabilitation model. By utilising commercially available technology the optimal number of participants, the technical requirements and associated costs of implementing this simple real-time, multi-participant telerehabilitation model have been defined.

To enhance the potential for adoption into clinical practice, an iPad application was developed to remotely monitor individuals' oxygen levels and heart rates. Visible only to the clinician, this mimics clinic-based rehabilitation programs, allowing individualised programs based on critical physiological measures. The project demonstrated that telerehabilitation, with integrated physiological monitoring, could successfully be undertaken from a clinical environment with good audio and visual quality.

The researcher team shows that a simple 'real-time' multi-participant model of telerehabilitation can be achieved using readily available data networks and commercially available devices. This model highlights the potential for telerehabilitation to improve access to important clinical services in a real world setting.

- Christine McDonald Institute for Breathing & Sleep
- Peter Rochford Institute for Breathing & Sleep
- Ken Clarke Melbourne Networked Society Institute
- Anne Holland LaTrobe University
- Alice Watson LaTrobe University
- Doug Farmer AARNet
- Noot Fang Masters of Information Technology Student



Telework and Disability

Exploring Barriers and Opportunities

People with disabilities face unique challenges to access work and participate in a work culture. The increasing uptake of telework is promising from a digital inclusion perspective for people with disabilities.

Disability can take on many forms; it can be any condition that impacts on a person's mental, sensory or mobility functions. A disability can also be temporary, total or partial, lifelong, acquired, visible or invisible. In 2012 Australia had more than 4 million people who were disabled. Of this total, 53% participated in the Australian workforce. In contrast 83% of people without a disability participated. In fact, there has been very little change in workforce participation by people with disabilities over the past 20 years.

This project undertook a qualitative study, and explored barriers and problems of including disabled workers in telework in Australia. The project focused on management and worker perspectives, and findings indicate that both parties face unique challenges. Worker barriers to access telework relate to management attitudes, physical and infrastructure problems, social isolation misconceptions, lack of management trust, insufficient telework opportunities, inadequate management knowledge of IT support, and provision of reasonable adjustments for people with disabilities. Management barriers involve cultural intolerance towards disability and diversity in general, and a lack of policies and processes to create an environment with reasonable adjustments and IT support to accommodate people with disabilities through telework. The project suggests enabling elements to improve the inclusion of people with disabilities in the workforce through telework.

- Rachelle Bosua Department of Computing and Information Systems
- Marianne Gloet Department of Management and Marketing
- Jongsay Yong Melbourne Institute of Applied Economic and Social Research



Improving the Language Learning and Technology Connection

Identifying and Understanding Current Challenges to, and Best Practice in Broadband Enabled Language Learning in Regional, Rural and Urban Schools in Victoria

Language education is a national key learning area for all Australian students. However, the study of languages has failed to gain traction over many decades, with regional, rural and disadvantaged urban schools most likely to struggle with provision of language education. Given that one of the most significant challenges is the supply of appropriately trained and qualified language teachers, particularly in non-urban areas, the effective use of broadband technologies potentially allows for language learning in a range of different ways. The sheer number of web-connected interfaces existing within families, schools and other educational institutions suggests that mobilising computer technology under the direction of specifically designed Computer Assisted Language Learning (CALL) pedagogy presents a crucial tool in overcoming the challenge of effective and viable language learning that Australian educators, policy makers and students face. The question is how best to utilise technology for this purpose – particularly in the case of small and/or rural and regional schools. Answering this question requires understanding which solutions to augmenting language lessons - for example video-conferencing and Web2.0 technologies - may be more effective and viable over the longer term.

This research project has focused on four different networks of schools and their use of technology to deliver and/or augment language education. Case studies have been developed around two models of blended provision of language education, identifying key components of best practice for both technological and educational aspects of the models, as well as areas which require further research and development. This includes financial models, the technology and pedagogy nexus, curriculum challenges, physical infrastructure and staff training in technologies, and school, staff and community attitudes and support mechanisms. A case study was developed, focusing on how ICT, particularly Web2.0 technologies, can best be harnessed for language education in primary schools.

The outcomes of this project have immediate relevance for schools in rural and regional areas, as well as for those within urban settings, and are accessible through a set of guidelines. These guidelines provide an overview of best practice and challenges in the use of technology in language education. The guidelines will provide information on the effective development of tools, technologies and policy to deliver language education to all Victorian school children.

Research Team

- John Hajek School of Languages and Linguistics
- Shanton Chang Department of Computing and Information Systems
- Suelette Dreyfus Department of Computing and Information Systems
- Wally Smith Department of Computing and Information Systems
- Yvette Slaughter School of Languages and Linguistics
- Sarah Webber Department of Computing and Information Systems
- Thérèse Mercader Department of Education and Training, Victoria



Cultural Respect Encompassing Simulation Training (CREST)

This project tested the potential of expanding and improving the delivery of the Cultural Respect Encompassing Simulation Training (CREST) modules to rural Victoria using videoconference technology. The project investigated the cultural sensitivity of the streamed interactions between the CALD simulated patients and health professional students and trainees.

Six videoconference sessions were successfully piloted to 4 sites: The University of Melbourne's Rural Health Academic Centre (RHAC) Shepparton Campus, Wangaratta Campus, Goulburn Valley Health, and La Trobe University's Rural Health School Shepparton Campus. A total of 45 participants were involved in the pilots and comprised 28 first year nursing students, 10 second year medical students and 7 medical practitioners.

Participants reported statistically significant improvement in 4 of 5 domains, particularly in cultural skills, followed by encounters, knowledge and awareness. Some participants affirmed their own attitude towards cultural diversity such as not being judgemental, acknowledging differences, communicating openly and frankly. Others described a change in perspectives akin to a 'light bulb' moment when they realised that in fact they did not know as much about culturally sensitive communication as they originally thought. The ability to remotely access such learning resources was seen as important. Several participants commented on the quality of the teaching and the way the sessions complemented and supplemented the learning that they were currently receiving from their courses.

Cultural sensitivity education such as CREST, using live video-streaming and simulation, can contribute to health professionals' learning and is effective in improving cultural competency. A dedicated simulation room with high-resolution videoconferencing equipment and on-site technical support would improve the authenticity and fidelity of simulation, and facilitate CREST's delivery to rural and remote learners.

Importantly, this project addressed issues of health inequalities arising from a lack of cultural sensitivity training for health professionals. As a result, CREST is now embedded within the MD program and the advanced nursing program.

- Phyllis Lau Department of General Practice
- Robyn Woodward-Kron Medical Education Unit, Melbourne Medical School
- Kris Elliott Medical Education Unit, Melbourne Medical School
- R McNair Melbourne North West Academic Centre Node, Melbourne Medical School
- G von Gutter Rural Academic Health Centre
- Patricia Nicholson Victoria University
- Carole Maddison Goulburn Valley Health
- J Tumney Goulburn Valley Health
- J Doyle LaTrobe University



Health Provider Broadband Connectivity

Mapping a Path for a Broadband-Enabled Healthcare Future

Greater availability of high-capacity broadband enables a number of new services in the health sector, including telemedicine consultations, electronic health records, e-learning for clinicians, and personalised medicine and participatory healthcare. Improved connectivity will also enable healthcare organisations to upgrade and transform business processes, such as inventory and supply chain management, telephony, and health data reporting.

To plan for broadband capability, healthcare organisations need information on connectivity standards and best practice in telecommunications network design and data traffic management. In addition, little is known about current network planning practices in Australian health provider organisations. This project aimed to discover the details of guidance and practice in connectivity planning for broadband-enabled healthcare in Australia.

Answer Choices	Responses	
Our organisation will need greater capacity and/or bandwidth to continue current services	85.71%	n = 12
Shift to improved connectivity methods	78.57%	n = 11
Our organisation will commence new patient-care services that require higher specifications	71.43%	n = 10
Our organisation will commence other (non-patient care) services that require higher specifications	42.86%	n = 6
Other	35.71%	n = 5

Drivers for upgraded network connectivity in Victorian health provider organisations

A review of the international technical and policy literature found no relevant published standards on this topic, nor strong documentation to guide planning. Extensive consultation through surveys and interviews was undertaken with major Victorian healthcare Chief Information Officers (CIOs) on current network infrastructure and anticipated future needs. The group identified three high-priority areas for future service delivery models. Through this mapping and empirical research, the project has synthesised available evidence to enable better-informed business practice in planning for increasing broadband connectivity.

- Kathleen Gray Health and Biomedical Informatics Centre
- Fernando Martin Sanchez Health and Biomedical Informatics Centre
- Cecily Gilbert Health and Biomedical Informatics Centre
- Shanika Karunasekera Department of Computing and Information Systems
- Vikram Bhakoo Department of Management and Marketing
- Susan Walker Australian Centre for Health Innovation
- Frank Smolenaers Australian Centre for Health Innovation
- Joanne Egan Australian Centre for Health Innovation



Postgraduate Students

The Institute supports postgraduate students through the provision of a range of scholarships. PhD students work on a variety of projects that are increasing the understanding and application of the networked society. Over the past twelve months, the Institute has awarded four full PhD Scholarships to students and one top-up scholarship.

Full Scholarships

The Institute, via the Melbourne Research Office has been able to support emerging researchers through the provision of full scholarships, comprising of an Australian Postgraduate Award and additional funding for travel and equipment. The Institute awarded four scholarships in 2014-5.

Estelle Boyle

Department of Culture and Communication Mediating Social Exclusion: ICT Access in Australian Refugee Communities

This project examines the association between information and communications technology access and social exclusion among refugee communities in Melbourne. The research involves discovering settled refugees' level of technological literacy and access to ICTs in order to better understand how and why refugees are (or are not) using this technology in their daily lives. This project aims to offer an insight into a relatively under-researched area in media and communications, providing a bottom-up perspective on refugees' position in Australia.

Alexa Scarlata

School of Culture and Communication Producing Pirates: The Cultural Legitimisation of Television Piracy in Australia

The project examines the Australian television industry's responses to the opportunities and challenges created by the network society. The project examines how broadband has altered the behaviour and attitudes of Australian television audiences through the examination of illegal downloading. Piracy in Australia is different, it is not an avenue for free speech but for access to content. The research asks how has the constant reproduction of an obviously illegal activity as more than conventional, as reasonable and necessary, generated an illusion of legitimacy in relation to television piracy?

Kevin (Kwang Baek) Lee

Department of Electrical and Electronic Engineering Low Energy Routing Protocol in IoT (Internet of Things)

The Internet of Things is impacting many application areas such as health, transport and the home. IoT networks have a different character and network topology from traditional network architectures. This research project will develop new communication protocols that are more effective in managing the IoT networks to minimise the latency in transferring packets and maximise energy-efficiency.



Thedchanamoorthy Gnanakumar

Department of Electrical and Electronic Engineering Nth Order Assortativity Influence Modelling

This PhD project examines how network nodes attach to each other and their impact to better understand real-world networks. Nth order assortivitiy will increase the understanding of information propagation in the Internet of Things.

PhD Supplementary Scholarships

The Institute provides supplementary scholarships for full-time graduate research students undertaking research connected to the Institute. The scholarships are in addition to students' primary research scholarship and provide \$5,000 to students annually. The Institute awarded one scholarship in 2014-5.

Fernando Estrada

Department of Computing and Information Systems Users' Perceptions of Mobile Applications for Mental Health

Mental health disorders are among the leading causes of disability in the world. Resources to support patients with mental health disorders are scarce. However, mobile phone applications can support patients to self-manage their symptoms and learn skills to help them cope with their daily life have been introduced to help bridge this gap. Recent literature notes high levels of non-use of these applications. The aim of this research is to obtain an in-depth understanding of patients' assumptions, beliefs and understandings of mobile applications for mental health, in order to understand how to improve design to increase patients' satisfaction, encourage adoption and sustain use.

Continuing PhD Supplementary Scholars

The following students continued the PhD projects throughout the year.

- Andrea La Nauze (Department of Economics) Tell Me Something I Don't Already Know: Consumer (un)informedness and the Impact of New Technologies on Residential Energy Consumption
- Ibraham AL-Mahdi (Health and Biomedical Informatics Centre) An evaluation of Online Medical Consultation, Examining Theory, Practice, Sustainability Challenges and Consumer Perspective
- Tshepo M Rasekaba (Department of General Practice) Telemedicine for Insulin Treated Gestational Diabetes Mellitus
- Kate O'Connor (Melbourne Graduate School of Education) Disciplinarity, Epistemic Authority and Curriculum: New Online Course Forms and the Production of Knowledge in Changing Times
- Robbie Fordyce (School of Culture and Communications) Post-Autonomist Political Theories and Philosophies of Networked Communication



- Manal Almalki (Health and Biomedical Informatics Centre) Developing a Model for Effective Health Data Management in the Context of Self Quantification and Personal Knowledge Management
- Paula de Barba (Centre for the Study of Higher Education) Motivation and Autonomous Learning in Online Learning Environments
- Lili Wilkinson (School of Culture and Communication) Don't Forget to be Awesome: Young Adult Literature, Heterotopia and Adolescent Civic Engagement Online
- Joji Mori (Department of Computing and Information Systems) Situated and Connected Digital Memorials: Technology to Commemorate Natural Disasters
- Veronica Fitzgerald (Asia Institute) Unpacking the Ultranet: Home-School Uses
- Konstantinos Kazakos (Department of Computing and Information Systems) Understanding the Role of Broadband Technologies in Periodically Reunited Families with Preteen Children
- Mark Merolli (Health and Biomedical Informatics Centre) How Can the Use of Social Media be Optimized in the Effective Management of Chronic Health
- Marian Lok (Department of Social Work) Crisis Information from the Internet User's Perspective: An Exploratory Study of Individual Online Experiences Following a Disaster

PhD Completions

The following MNSI PhD Scholarship recipients completed their PhDs.

- John Downs (Department of Computing and Information Systems) Exploring Technology-Mediated Unstructured Play
- Marcus Carter (Department of Computing and Information Systems) Online Communities in Massively Multiplayer Online Games
- Marcos Pereira Dias (School of Culture and Communication) New Forms of Social Interaction through Universal Broadband Access in Public Spaces
- Yun Zhou (Computer Science and Software Engineering) Developing Decision-making Skills Using Immersive VR



Affiliated Research Centres

Microsoft Research Centre for Social Natural User Interfaces (SocialNUI)

SocialNUI is a place of collaborative research for creating and understanding innovative Natural User Interfaces (NUI) that facilitate human communication, collaboration and social interaction.

The Microsoft Research Centre for Social Natural User Interfaces (SocialNUI) is an academic–industry research centre located within the Department of Computing and Information Systems at the University of Melbourne. In December 2013 Microsoft Australia, Microsoft Research, the University of Melbourne and the Victorian State Government launched SocialNUI in Melbourne. Academics and students have an opportunity to collaborate with worldleading Microsoft Researchers through the Centre.



Collective Bodies, Creative Spaces: Public Displays Project Through the development of an interactive networked game the research team explored how people socialise in fun and playful ways in public spaces. The team installed 3 displays around the University of Melbourne campus and created a game that challenges participants to mirror body poses of other people via public displays equipped with Microsoft Kinect devices.

SocialNUI's research agenda addresses new forms of human-computer interactions offered by emerging technologies beyond those with keyboard and mouse, in particular those supporting gesture, gaze, movement and voice. The research within the Centre broadly addresses four domains of the home, public spaces, health and education. SocialNUI Research projects included:

- 1. Designing Technologies for Indigenous Knowledge
- 2. OneBody: A system for Motor Skill Training
- 3. Tele-Consultation: NUI Interactions between Clinicians and Patients
- 4. Wearable Technology for Monitoring Health
- 5. Collective Bodies, Creative Public Spaces
- 6. Around the Table
- 7. Kinecting with Orang-utans

Key Achievements and highlights

- Recruited and funded 4 Research Fellows
- Enrolled 6 Postgraduate Students
- Commenced 7 Research projects
- Published 7 Research Papers
- Collaborated with 10 Microsoft partners
- Hosted visiting academics and Microsoft Research.



Centre for Energy-Efficient Telecommunications

The Centre for Energy-Efficient Telecommunications (CEET) was formed in mid-2011 as a partnership between Alcatel-Lucent, the State Government of Victoria and the University of Melbourne. CEET has become a leader in researching the energy consumption of the Internet and continues to contribute to the wider discussion on the energy efficiency and sustainability of the information and communications technology (ICT) industry.

A major trend in ICT is the massive take-up of mobile devices for data services and the update of personal cloud services. More recently, the growth of the Internet of Things will add more equipment to the ever increasing pool of telecommunications devices. All of these require electrical power.

CEET has shifted its research focus to cloud and content delivery services, the Internet of Things, energy efficient wireless and low energy access technologies. Therefore, CEET has continued to develop service-based energy models, most recently including mobile services.

Recent research from CEET's work has shown that: although cloud and Content Delivery Networks (CDN) almost certainly improve the energy efficiency of services for corporations and enterprises, they may not be the most energy efficient platform for providing these services to consumers. Redesigning handset receivers can result in energy savings in mobile networks of around 10%. CEET developed and demonstrated a transceiver that can reduce this power consumption by a factor of between 32 and 53, depending upon the length of the link. The additional energy consumption resulting from the economic stimulus generated by a well-designed National Broadband Network will overwhelm the energy savings resulting from consumers and industry moving to energy efficient alternatives – deploying ubiquitous broadband is not, of itself, enough to secure energy (and carbon emission) reductions. Finally, models developed by CEET can calculate the energy consumption of a service in network equipment such as routers and mobile base stations. The router-based model has been accepted for standardisation in the ITU.

Members of the CEET team have presented their findings at more then 15 International Conferences in the past year and published more than 8 papers in peer-reviewed journals. They continue to work together in partnership with their industry partners at Alcatel-Lucent to produce world leading research outcomes, which aim to reduce the environmental impact of the ICT industry.

GreenTouch

CEET continues its close collaboration with its Bell Laboratories partners and partners in the GreenTouch consortium. The aim of GreenTouch is to provide a roadmap for communications technologies that will enable a 1000x improvement in the energy efficiency of the Internet. To assess the energy efficiency improvements attained by GreenTouch, it has introduced the Green Meter. The GreenTouch Green Meter is a collection of tools and techniques that quantify the energy efficiency improvements provided by the roadmap.

In June 2015 GreenTouch announced that it had successfully developed a roadmap that will improve the energy efficiency of the mobile access network by 10,000 the Wireline access network efficiency by 254 and the core network efficiency by 316. GreenTouch's roadmap provides a 98% reduction in network energy consumption, even though the overall traffic in the network will increase by around 12-fold between 2010 and 2020. During the lifetime of GreenTouch, CEET has been a key contributor to the technology roadmap and Green Meter.



C-Lab

The C-Lab, C for Connectivity, provides a space to bring together researchers and industry to nurture and develop innovation by improving access to Internet and network technologies to aid the development of prototypes, providing technical proof-of-concept demonstrators and transforming research outputs into intellectual property for innovative start-ups, and delivering training and hands-on experiences for students and early career researchers in the best digital innovation environment in Australia.



C-Lab leverages existing connectivity to bring resources, access and expertise to industry and research. As part of a University-wide network of labs and centres, C-Lab provides expertise and support to interdisciplinary research projects throughout the University and is enabling a more entrepreneurial culture.

The C-Lab plays an essential role in the training and development of the next generation through its internship program, which provides talented Masters students at the University of Melbourne to work on cutting edge technical research projects under the supervision of Institute staff.

C-Lab is evolving, moving from being a pure telecommunications environment to a laboratory that embraces software and services to support new and emerging applications. Plans for the C-Lab are to retool into an operational centre for Internet of Things innovation, and as the central node in an emerging living lab initiatives to be rolled out in 2016.

C-Lab Development Fund

Many projects require technical development to ensure their success. Examples include the development of apps, websites, hardware prototypes, and databases. The C-Lab Development Fund provides small-scale support to projects arising from student internship projects or competitive funding rounds to create workable prototypes.

I want to feel like I'm not the only one

Development of an online interactive repository of survivor stories for women experiencing domestic violence

This project is developing an online interactive repository of survivor stories for women experiencing domestic violence. It will aim to improve women's mental health and wellbeing, as well as reduce stigma, by creating a virtual community linked by shared experiences. The repository will be accessible either as a responsive website or as a mobile app with desktop interface.

This project is being supported via the C-Lab Development Fund who are providing resources and technical expertise to support the design, development and production of the website.



Community-based Participatory Research (CBPR) App

This project is developing an app to support students undertaking the class Community-based Participatory Research. The objective of the class is to understand and find best practice on inclusion and diversity issues across campus. Students are required to share their thoughts about the topic using a variety of means such as images and sounds.

Master of Information Technology Interns at the C-Lab designed and developed a mobile application to support the qualitative capture and assessment of data. The C-Lab development funding is continuing this work to deliver a prototype that will be deployed to students undertaking the CBPR subject in Semester 1, 2016.

C-Lab Project: Melbourne School of Design Building – Donor Wall

C-Lab was commissioned by the Faculty of Architecture, Building and Planning to build a display matrix for supporters of the new building. Rather than building a static donor wall, the Melbourne School of Design Donor Wall displays images, an important part of a visual discipline, which acknowledge the donors and highlight the accomplishments, expertise and ingenuity of ABP alumni and supporters.

Custom software was developed, which powers a 6-by-6 matrix of displays which shows the images of supporters to the Melbourne School of Design project, such as architects and builders. The display is interactive, with the database of images being searchable via a web-based application, on a tablet or mobile phone. Users can also display each image in full screen view covering all 36 screens, and look up. The software was built upon open source libraries and uses a web browser to display the content making it a cost effective alternative.



Screen Matrix



C-Lab Interns

The Institute supports the training and development of students through the provision of internships to students enrolled in the Master of Information Technology, Master of Information Systems and Masters programs in the Department of Electrical and Electronic Engineering. Over the past year, the C-Lab hosted 11 students, who worked on a diverse range of projects.

Alex Thomas

Masters of Information Technology (Health) – Semester One 2015 A Kiosk-Based Health and Wellbeing Information Network for Remote Australian Aboriginal and Torres Strait Island Communities

Hitnet operate an Australia-wide network of about 50 interactive touch-screen kiosks that are typically located within the waiting rooms of remote, rural and urban health and community service provider facilities, but also correctional and other facilities such as schools. This project focused on a specific technical problem in relation to the Hitnet Kiosks solved, which is that the high cost of mobile data plans (if even available) is a barrier to community members, contributing their personally created social media content for incorporation into Hitnet's health information network. The solution presented is a prototype kiosk-hosted file uploading service. It is based on an overall technical vision of extending Hitnet's network of interactive kiosks with wi-fi services. Specific parts of the solution were co-created and implemented with the ISYS90080 student Xuan Lih, along with the support of MNSI supervisors, and this assignment goes further to include a design component of consent.

Jaime Francisco Martinez Castillo

Master of Information Technology – Semester One 2015

Centrally Controlled Video-Conferencing System for Music Therapy

Recent research suggests that group singing, as part of music therapy, for people with quadriplegia improves physical status like vocal intensity. It also notably improves energy, mood, social interactivity and quality of life. Unfortunately, there is a large proportion of people with this diagnosis that live out in the country, far away from cities or music therapy centres. The purpose of this project was to design an online system to be used by clinicians in music therapy in order to have singing lessons with people in remote locations diagnosed with quadriplegia. Having an online system that allows group singing will help clinicians to keep interacting with, and treating, these people. The system was built on an existing web conference service that was implemented by a previous intern. The system records all singing voices under the control of the clinician, automatically mix and synchronise all of them so that the new recording can be played out to each participant system by the clinician allowing them to sing along. This would create a group singing effect, which theoretically will have the same effect as singing with other people in the same room.



Xuanli He

Master of Information Technology – Semester Two 2014 Enabling Content Upload in Next Generation Hitnet Kiosk

Aboriginal and Torres Strait Islander communities face chronic health issues across Australia. To help them improve their overall health and wellbeing, Hitnet has developed a kiosk delivering healthrelated information. However, one-way communication cannot meet users' requirements. Hence, an extended kiosk was developed. This new kiosk enhances the interaction among indigenous communities with the aid of an Android app. Users are able to use their smartphones to connect to WIFI hotspots around the kiosks so that they can upload their multi-media files via the Android app and browse pre-approved websites. Users can upload the content in a few simple steps, instead of struggling with complex operations and confusing navigation. All interaction between servers and clients are transparent to users. Hitnet kiosks receive user-generated content and wait for a central server to synchronise these files.

Anchalee Laiprasert

Master of Information Technology – Semester One 2015 Developing Technologies for Intersecting Platforms: Constructing a Multipurpose App and a Database for Managing App Information

This project is developed to support students' activities in a Community-Based Participatory Research (CBPR) class, offered by School of Population and Global Health at the University of Melbourne. The objective of the CBPR class is for students to understand and find best practice relating to inclusion and diversity issues across campus. Students are required to share their thoughts about this topic using photos and audio recordings. Students need to conduct the interview sessions, questioning people about their experiences and perspectives.

This project developed a mobile application called *CBPR*. The app was developed to support students' activities in data collection and gathering. The app is supported by a web interface to allow the lecturer to analyse the collected information. To accommodate the potential high volume of users and data a flexible system architecture was adopted.



Fabian Fernando Jurado Lasso

Master of Telecommunications Engineering – Semester Two 2015 Internet of Things: MQTT Protocol in Edge Computer

This project provided an analysis and implementation of the MQTT protocol for the Internet of Things. The MQTT protocol is implemented to work under a scalable architecture. The analysis of different MQTT clients and brokers are studied in detail during the course of this work. The benefits it offers to devices that are required to work under the constraints of bandwidth and power consumption are studied. Experimentations on different clients and brokers configurations were conducted. The results indicated the best broker configuration to maintain the system working under a secure environment and make the system scalable. Moreover, best broker configuration to maintain the system security by preventing unauthorised devices from publishing and subscribing was also pointed out. Besides, it shows the benefits for devices that work under battery and bandwidth constraints. Also, it studies the suitability to support different clients. It is recommended to use a secure access network to improve the security in the system and use it within a secure environment, for remote use through the Internet its better to use strong authentication and encrypted information.

Akilandeswary Palaniappan

Master of Information Technology – Semester One 2015 WebRTC for Real-Time Collaboration and Music Education

New generation communication technologies are bringing people closer in every field and enabling them to collaborate elegantly in real time. However, networking musical performance when musicians are geographically separated is still a challenge due to synchronisation issues over the internet. Creating a solution to address this challenge could pave way to connect the remote and urban musical communities. The solution will also enable applications like music education, remote music therapy, and virtual performances to become a reality. In this project, an application is developed to enable virtual group musical sessions through the internet. Although the musicians will be in different remote locations, the solution will provide the effect as if they were in the same place. This application is developed using an open source technology called WebRTC. The WebRTC provide the most efficient, reliable APIs for integration while allowing web browser to directly engage in video conferencing without the requirement of additional plugins.

Yichen Li

Master of Information Technology – Summer 2015 Internet of Things Based on Micro-controller and Cloud Data Visualisation

Internet of Things (IoT) has opened a new world where a wide range of physical devices can be connected to each other and share information enabling remote users to access data or reports from end user device applications across communication protocols. This project aimed at implementing an IoT system, processing data in various sources such as data sets from a new school building for architecture students as well as data acquisition from physical sensors and micro-controllers. The developed system also allows users to access the data reports and analyse results via data visualisation.



Kendra Lai

Master of Information Technology – Summer 2015 Internet of Things: Data Acquisition and Scalable System Architecture

This project built an IoT system architecture for a sensor network which facilitates the connection of new devices to a server. The system simplifies the process of collecting, storing and retrieving data by creating a single solution that facilitates data acquisition from various type of sensors.

Anela Chan

Master of Information Technology – Semester Two 2014 Sonic Japan Web Application

Web-based platforms can be used to deliver a wide range of media to everyday users. Combining these media with location-based technologies, these platforms can provoke a host of interesting analyses and engage everyday users with an information-rich experience. Sonic Japan is a web application that shares soundscapes field-recorded in various contexts in urban Japan. The application was created as a web development project for an internship with Institute for Broadband-Enabled Society, serving customers in academia. With only a vague idea of what was desired in a web application, the project encompassed domain research, product design, software design and modelling as well as implementation, with various decisions over methodology and design made along the way. Further Information: http://sonicjapan.clab.org.au/

Jemie Effendy

Master of Information Technology – Semester One 2015 Distributed Video Player

The University of Melbourne is deploying a new interactive digital wall, allowing any interaction. On the installation, it needs graphic cards that are powerful enough for the displays to synchronise and share the screen together. However, the cost of this card is expensive. An alternative cheaper solution is to make use of the web service as the synchronisation medium. Since the display is shared across the displays, high accuracy synchronisation is needed, especially when playing video. This project focused on investigating and enabling video synchronisation over the web and producing a proof of concept to distribute the video player.



Sreenath T Vadakkeveettil

Master of Information Technology – Semester One 2015

Multi Camera Video Conferencing for Online Music Learning: Approaches to Real Time Sharing of Music Sheet and Annotations

With the availability of high speed and high bandwidth internet connections, it is now possible to carry out many functions using video conferencing instead of physically travelling to different locations. While more challenging than the other applications, online music teaching is one of such potential applications. Main aspects in online music learning are video conferencing and real time sharing of music scores between teacher and student. The inability to share the same physical music sheet is one of the major challenges in distant music learning. This project built an online music score sharing application that allow teachers to share music sheets with students in different locations, while allowing other features such as annotations, highlighting, scrolling etc.



45

Appendix A: People

Institute Staff

Thas Nirmalathas, Institute Director Fiorella Chiodo, Executive Assistant Ken Clarke, Senior Research Fellow Roger Hughes, Finance Manager Chamil Jayasundara, Software and Systems Engineer Zaher Joukhadar, Research Assistant Adam Lodders, Executive Officer

Executive Committee



Thas Nirmalathas Institute Director



Jason Bosland Melbourne Law School



Peter Gahan Department of Management & Marketing



Jane Gunn Department of General Practice



Scott McQuire School of Culture and Communication



Terence O'Brien Medicine, Roval Melbourne Hospital

Frank Vetere

Interfaces

Microsoft Research Centre

for Social Natural User



Elizabeth Ozanne Department of Social Work



Nick Reynolds Melbourne Graduate School of Education

Fernando Martin-Sanchez, Health and Biomedical Informatics Centre (to May 2015)

Advisory Board



Steve Wood (Chair) Vice President, Aruba Networks, an HP company



Mark Ablett Senior Vice President and GM Asia Pacific, Hitachi Data Systems



Genevieve Bell Intel Fellow and Vice President, Corporate Strategy Office, Intel



Steve Coad Country Manager, Australia and New Zealand, Aruba Networks, an HP company

Tim Fawcett

Executive General

Manager Corporate Affairs,

Cisco Systems Australia Pty

Anthony McLachlan Vice President & General Manager, Asia Pacific, Ciena



Kate Cornick Managing Director and CEO, Rision



Brian Fitzpatrick Account Executive, **Dialog Information** Technology

Håkan Eriksson CEO, Ericsson Australia and New Zealand



Chris Hancock CEO, AARNet



Melbourne Networked Society Institute

Ltd



Institute Fellows

Richard Chenhall, Institute Fellow (Digital Anthropology) Chris Leckie, Institute Fellow (Data and Security) Bjorn Nansen, Institute Fellow (Digital Media) Marimuthu Palaniswami, Institute Fellow (Connected Devices) Victoria Palmer, Institute Fellow (Applied Ethics) Andrew Roberts, Institute Fellow (Privacy) Peter Taylor, Institute Fellow (Networks and Traffic Processes) Stephan Winter, Institute Fellow (Urban Connectedness)

PhD Students

Ibraham Al-Mahdi – Health and Biomedical Informatics Centre Manal Almalki - Health and Biomedical Informatics Centre Paula de Barba – Centre for the Study of Higher Education Estelle Boyle - Department of Culture and Communication Marcus Carter - Department of Computing and Information Systems John Downs - Department of Computing and Information Systems Marcos Pereira Dias - School of Culture and Communication Fernando Estrada – Department of Computing and Information Systems Veronica Fitzgerald – Asia Institute Robbie Fordyce - School of Culture and Communications Thedchanamoorthy Gnanakumar - Department of Electrical and Electronic Engineering Konstantinos Kazakos - Department of Computing and Information Systems Kevin (Kwang Baek) Lee – Department of Electrical and Electronic Engineering Mark Merolli - Health and Biomedical Informatics Centre Joji Mori - Department of Computing and Information Systems Andrea La Nauze – Department of Economics Marian Lok – Department of Social Work Kate O'Connor – Melbourne Graduate School of Education Tshepo M Rasekaba - Department of General Practice Alexa Scarlata – School of Culture and Communication Lili Wilkinson - School of Culture and Communication Yun Zhou - Computer Science and Software Engineering

Interns

Alex Thomas Jaime Francisco Martinez Castillo Xuanli He Anchalee Laiprasert Fabian Fernando Jurado Lasso Akilandeswary Palaniappan Yichen Li Kendra Lai Anela Chan Jemie Effendy Sreenath T Vadakkeveettil



Researchers by Department/School

Anaesthesia, Perioperative and Pain Medicine Unit - David Story, Anna Parker

Department of Audiology and Speech Pathology – Patricia Eadie, Bronwyn Davidson, Robyn Garnett

Centre for Cultural Materials Conservation - Robyn Sloggett

Centre for Health Equity, Melbourne School of Population and Global Health – Lyndon Ormond-Parker, Marcia Langton, Sharon Huebner, Caden Pearson, Jasper Coleman

Department of Agriculture and Food Systems – Sigfredo Fuentes

Department of Computing and Information Systems – Benjamin Rubinstein, Atif Ahmad, Chris Leckie, Steven Bird, Jenny Waycott, Hilary Davis, Udaya Parampali, Ed Kazmierczak, Martin Gibbs, Jenny Kennedy, Greg Wadley, Rachelle Bosua, Sean Maynard, Shanton Chang, Suelette Dreyfus, Wally Smith, Sarah Webber, Sherah Kurnia, Shanika Karunasekera

Department of Electrical & Electronic Engineering – Shiqiang Li, Kenneth Crozier (and School of Physics), A Rao, Elaine Wong, Marimuthu Palaniswami, Jayavardhana Gubbi, Tansu Alpcan, Stan Skafidas, Wanzhi Qiu

Department of Finance – Andre Gygax

Department of General Practice – Jane Gunn, Sandra Davidson, Phyllis Lau

Department of Infrastructure Engineering – Dongryeol Ryu

Department of Management and Marketing – Marianne Gloet, Prakash Singh, Vikram Bhakoo

Department of Psychiatry – Christos Pantelis

Health and Biomedical Informatics Centre - Fernando Martin-Sanchez, Kathleen Gray, Cecily Gilbert

Learning Environments - Ben Loveridge

Medical Education Unit, Melbourne Medical School - Robyn Woodward-Kron, Kris Elliott

Melbourne Conservatorium of Music – Gary McPherson, Robin Stevens

Melbourne Conservatorium of Music & Victorian College of Arts - Jeanette Tamplin

Melbourne Dental School - David Manton

Melbourne Institute of Applied Economic and Social Research - Jongsay Yong

Melbourne Law School – Megan Richardson, Karin Clark

Melbourne North West Academic Centre Node, Melbourne Medical School - R McNair

Melbourne School of Design - Marcus White, Nano Langenheim, Geoff Kimm

Melbourne School of Engineering - Graham Moore

Melbourne School of Population & Global Health – Richard Chenhall, Nicola Reavley, Deborah Warr, Kristen Smith

Melbourne School of Psychological Sciences – Garry Robins

Oral Health CRC - Rodrigo Mariño (Melbourne Dental School)

Rural Academic Health Centre – G von Gutter

School of Culture and Communication – Bjorn Nansen, Robbie Fordyce, Luke Heemsbergen, Scott McQuire, Fran Edmonds, Scott Wright

School of Historical and Philosophical Studies – Michael Arnold

School of Languages and Linguistics – John Hajek, Ute Knoch, Yvette Slaughter, Rachel Nordlinger

School of Physics - Wuzhou Song

School of Social and Political Sciences – Tamara Kohn, Andrea Carson





External Collaborators

AARNet – Doug Farmer Austin Health - Catherine Said Australian Centre for Health Innovation – Joanne Egan, Frank Smolenaers, Susan Walker Australian Taxi Industry Association - Blair Davies Ballarat Clarendon College - Sarah Barlow Centre for Youth Mental Health – Penni Russon City of Moreland – Debra Dean Darebin Community Health – Joanne Grigg Deakin University - Emma Kowal Department of Economic Development, Jobs, Transport and Resources, Victoria - Mark O'Connell Department of Education and Training, Victoria - Thérèse Mercader Federation University - Patrice Braun Fudan University Journalism School – Shaojing Sun Goulburn Valley Health - Carole Maddison, J Tumney Guide Dogs Australia – Sandro Ciriani Hitnet – Helen Travers, Julie Gibson, Ernest Hunter (James Cook University) Housing Resource & Support Service - Marija Groen Institute for Breathing & Sleep - David Berlowitz, Christine McDonald, Peter Rochford Kanamkek-Yile Ngala Museum – Mark Crocombe, Jacinta Crocombe LaTrobe University - Anne Holland, Alice Watson, J Doyle Monash University - Rahim Md Mahbubur Semantrix – Michael McGrath St Vincent's Hospital – Tuong Phan Ti Tree Lodge Pty Ltd – Damien Malone University of Groningen - Todd Graham University of New South Wales – Thomas Apperley University of Wollongong - Thomas Birtchnell V3 Alliance – Richard Collman Victoria University – Patricia Nicholson Victorian Eco Innovation Lab – Kirsten Larsen Vision Australia - Nicola Misso Women with Disabilities Victoria - Jen Hargraves



Appendix B: Publications

Books, Book Chapters and Journal Articles

L Hopkins, G Wadley, F Vetere, M Fong, J Green (2014) 'Utilising technology to connect the hospital and the classroom: maintaining connections using tablet computers and a "Presence" App' Australian Journal of Education

R Marino, Clarke K, Manton D, Hallett K, Collman R, Borda A, 'Teleconsultation and telediagnosis for oral health assessment: an Australian perspective', Chapter 10, pp101-112, in 'Teledentistry' book, ISBN 978-3319089720, published by Springer, September 2014.

R Mariño, Tonmukayakul U, Marwaha P, Collmann R, Hopcraft M, Manton D, Stranieri A, Clarke K. Teleconsultation/telediagnosis using teledentistry technology: a pilot feasibility study. International *Journal on Advances in Life Sciences*, v 6 n 3&4, 291-299. Dec 2014.

Kathleen Gray, Ken Clarke, et al 'Internet protocol television (IPTV) for personalised home-basedhealth information: design-based research on a diabetes education system' *JMIR Res Protoc* 2014 (Mar 10); 3(1):e13.

Gray K, Gilbert C, Martin-Sanchez F, Karunasekera S, Bhakoo V, Harrison S, Smolenaers F, Egan J. (2014). Planning for health provider organisations' broadband connectivity. In: *e-Health – For Continuity of Care* Medical Informatics in Europe 2014 Conference, Istanbul, Turkey. Proceedings, edited by Christian Love et al.

F. Al-Dirini, F. M. Hossain, A. Nirmalathas, and E. Skafidas, "All-Graphene Planar Self-Switching MISFEDs, Metal-Insulator-Semiconductor Field-Effect Diodes," *Scientific Reports*, vol. 4, Feb 5 2014.

F. Al-Dirini, F. M. Hossain, A. Nirmalathas, and E. Skafidas, "Asymmetrically-gated graphene self-switching diodes as negative differential resistance devices," *Nanoscale*, vol. 6, pp. 7628-7634, 2014.

C. Jayasundara, M. Zukerman, T. A. Nirmalathas, E. Wong, and C. Ranaweera, "Improving Scalability of VoD Systems by Optimal Exploitation of Storage and Multicast," *leee Transactions on Circuits and Systems for Video Technology*, vol. 24, pp. 489-503, Mar 2014.

C. Ranaweera, E. Wong, C. Lim, A. Nirmalathas, and C. Jayasundara, "An Efficient Resource Allocation Mechanism for LTE-GEPON Converged Networks," *Journal of Network and Systems Management*, vol. 22, pp. 437-461, Jul 2014.

K. Wang, A. Nirmalathas, C. Lim, E. Skafidas, and K. Alameh, "Experimental demonstration of free-space based 120 Gb/s reconfigurable card-to-card optical interconnects," *Optics Letters*, vol. 39, pp. 5717-5720, Oct 1 2014.

R. Fordyce, 'Manufacturing Imaginaries: Neo-Nazis, Men's Rights, Activists and 3D Printing' Journal of Peer Production (2015) 6.

Y Slaughter, & J Hajek. (2014). RUMACCC. Helping to understand and support language education. *Languages Victoria*. 18(1), 41-43.

Conference Papers

R Chenhall, 'Cosmopolitian Anthropologies' Combined ASAAANZ/AAS Conference 2014, Queenstown, New Zealand, 10-13 November 2014.

H Davis, Waycott, J., Warr, D., & Edmonds, F. (2014) Sharing Housebound Experiences via Online Videos: Opportunities to Enhance Wellbeing? Paper presented at the *Smart Health and Body in Design Workshop, OzCHI* 2014, 2 December.

S McQuire, K Smith 'Surveying the Technology Frontier and How Industry and Government are Taking Advanced Ideas to the Market' *Carlton Connect Conference 2014: Challenges, Partnerships, Solutions,* Carlton, September 2014.

R Mariño, Clarke K., et al, 'Field testing of Teledentistry in residential aged-care facilities: opportunities and challenges', poster presentation *5th ASSCID Gerodontics and Special Needs Conference*, Nov 2014, Newcastle, NSW

I. Akhter, C. Ranaweera, C. Lim, A. Nirmalathas, and E. Wong, "Small-Cell Network Site Planning: A Framework Based on Terrain Effects and Urban Geography Characteristics," *2014 Optoelectronics and Communications Conference and Australian Conference on Optical Fibre Technology (Oecc/Acoft 2014)*, pp. 422-424, 2014.

F. Al-Dirini, F. M. Hossain, A. Nirmalathas, and E. Skafidas, "Asymmetrically-gated graphene self-switching diodes as negative differential resistance devices," *Nanoscale*, vol. 6, pp. 7628-7634, 2014.

B. J. Gouhier, K. L. Lee, A. Nirmalathas, C. Lim, and E. Skafidas, "Investigation on the Performance of a 20 GHz Electro-Optic Probing Scheme Using Balanced Heterodyne Detection," *2014 Optoelectronics and Communications Conference and Australian Conference on Optical Fibre Technology (Oecc/Acoft 2014)*, pp. 100-102, 2014.

C. Lim, Y. H. Yang, and A. Nirmalathas, "Transport Strategies for Broadband Wireless Signals Distribution in Fiber-Wireless Links," 2014 Optoelectronics and Communications Conference and Australian Conference on Optical Fibre Technology (Oecc/Acoft 2014), pp. 123-125, 2014.



C. Ranaweera, E. Wong, C. Lim, A. Nirmalathas, and C. Jayasundara, "An Efficient Resource Allocation Mechanism for LTE-GEPON Converged Networks," *Journal of Network and Systems Management*, vol. 22, pp. 437-461, Jul 2014.

K. Wang, A. Nirmalathas, C. Lim, E. Skafidas, and K. Alameh, "Experimental demonstration of free-space based 120 Gb/s reconfigurable card-to-card optical interconnects," *Optics Letters*, vol. 39, pp. 5717-5720, Oct 1 2014.

L Ormond-Parker, 'Wadeye Audiovisual Collection: Practical Challenges and Copyright' *Copyright and the Digital Economy Symposium Focus On Educational and Cultural Institutions and Government*, 2014, Sydney

M Langton, L Ormond-Parker, S Huebner, 'Wadeye Audiovisual Project', *Ethics in Visual Methodologies*, 2014, Melbourne

L Ormond-Parker, 'Developing, Caring For And Digitising Your ATSI Audiovisual Collection', *Indigenous Remote Communications Association Workshop* May 2015, Darwin

L Ormond-Parker, 'Audiovisual Archives in Wadeye and Community Access', *Broadband for the Bush Forum IV:* Unlocking the Digital Potential of the Bush. July 2015, Darwin

S Kurnia, (2015) Open Food Network (OFN) System: Connecting and Supporting the Sustainability of Regional Food Supply Chain Communities, *SMART Supply Chain Conference*, 26-27 May 2015, Melbourne.

S Kurnia, Hill, S., Larsen, K., Mahbubur, R., Braun, P., (2015) Exploring E-Market Enabled Food Hubs to Support Regional Food Supply Chain in Australia, *Pacific Asia Conference on Information Systems*, 6-9 July 2015, Singapore

Q Munajat, and Kurnia, S. (2015) Identifying Organisational Capability for Sustainability Practices, *Pacific Asia Conference on Information Systems*, 6-9 July 2015, Singapore

H Davis, & Waycott, J. (2015). Ethical encounters with housebound people: Location, timing, and personal storytelling. Paper presented at the CHI 2015 Workshop on Ethical Encounters in HCI: Research in Sensitive Settings

Media Coverage

'Cloud technologies to help ABC find savings, says Mark Scott' *Computerworld*, 14 October 2014 'Work flexibility: how much is too much?' *HC Online*, 17 October 2014

'Patients in remote areas to get virtual dental checks' Research Professional, 16 July 2014

Price asks listeners for their reaction in regard to the major budget cuts to the ABC, 2GB Radio, Sydney, 13 October 2014

'Abbott risks political pain with cuts to ABC, warns Scott' Sydney Morning Herald, 14 October 2014

'Mid-deal funding cuts very rare: Scott' The Australian, 14 October 2014

Mark Scott ABC cuts story, ABC News Breakfast, ABC News 24, 14 October 2014

Mark Scott ABC cuts story, 666 ABC Canberra, 891 ABC Adelaide, 936 ABC Hobart, 14 October 2014

'Cloud technologies to help ABC find savings, says Mark Scott' Computerworld, 14 October 2014

'Cuts to hit ABC services' Canberra Times, 14 October 2014

'Work flexibility: how much is too much?' HC Online, 17 October 2014

Telco expert stands by controversial broadband projections' Australian Financial Review, 27 October 2014

'High-speed broadband backers expect benefits to flow' The Age, Sydney Morning Herald, 29 October 2014

'Tight purse-strings thwart tech research' Australian Financial Review, 9 December 2014

'Bridging the digital divide in Indigenous communities' The Age, 5 February 2015

'NBN Co chief Bill Morrow says HFC NBN will be as fast as Labor's FTTP', Australian Financial Review, 2 March 2015

'Australian and New Zealand businesses cut the cord' CSO, 25 March 2015

'Virtual dentistry for remote Australia' Science Meets Business, undated

'Virtual dentistry: the future for regional and remote Australia?' RN Afternoons, undated

'New Victorian networking research org builds on IBES's work' Computerworld, 15 May 2015

'Metadata net will only get wider' The Australian, Daily Telegraph, Business Spectator, 15 May 2015

'Think tank expands connections' PS News Online, 20 May 2015

Thas Nirmalathas, 'A new space race is on to bring the internet to the whole world' The Conversation, 18 June 2015



Appendix C: Finance

Contributions (Cash and In-Kind)	
University of Melbourne	\$3,330,838
Victorian Government	\$1,000,000
External Grants/Funding	\$1,134,267
Total Contributions	\$5,465,105

Cash Expenditure	
Salaries & Oncosts	\$1,076,870
Research Seed funding	\$721,331
Scholarships	\$27,250
Sponsorships	\$9,998
General Operating	\$14,654
Travel, Conference & Promotional Activities	\$53,047
Total Expenditure	\$1,903,150





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