UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Computer Science & Software Engineering

Research Project Showcase

Haere-Roa
9th October
2020

Computer Science & Software Engineering

Software Engineering Research Project

Showcase

UCSA Haere-Roa Building

Friday 9^{th} October 2020

Contents

Foreword

The *SENG402 Software Engineering Research Project* is a required course for all graduating software engineering students. The research project provides the opportunity for students to demonstrate their preparedness to work as professional software engineers on challenging projects. SENG402 students build on the skills learned through projects they have undertaken in earlier years of the programme, in particular the single-semester project at first Professional Year (*SENG202 Software Engineering Project Workshop*) and the whole-year project at second Professional Year (*SENG302 Software Engineering Group Project*). Still, SENG402 projects offer a specific research-focused venue for students to explore advanced methods or late breaking results into new problems.

The department offers final year students the opportunity to engage with industry on company-sponsored projects. These company-based opportunities complement the range of projects offered each year by academics in the department. This year more than 40 industry and academia projects were offered to the software engineering students with more than 50% of the students engaging with the industry where cutting edge research expertise can be applied to an industrial context.

The presentations are part of the formal assessment for the SENG402 students. But, more importantly, the presentation day provides us all with the opportunity to recognize and celebrate the achievements of our final-year software engineering students as they prepare to graduate. This is also an opportunity to thank all our students for their commitment and contribution to the department, College, University and Industry.

Fabian Gilson, SENG402 course coordinator
On behalf of the Computer Science and Software Engineering Department

Programme

Summarised schedule

	Bentleys	Room of Requirement
8:45–9:00	**Welcome Tea**	
9:00–9:15	**Welcome remarks**	
9:15–10:30	Digital Health I chair: J.Atlas	Geoinformatics chair: A.Willig
10:30–11:00	**Morning Tea**	
11:00–12:00	Computer Vision I chair: A.Cockburn	Varia chair: M.Morales Trujillo
12:00–12:45	**Lunch**	
12:45–13:45	Computer Vision II chair: F.Gilson	Education chair: T.Mitrovic
13:45–14:00	**Afternoon Break I**	
14:00–15:15	Aerospace chair: K.Neshatian	Digital Health II chair: T.Bell
15:15–15:30	**Afternoon Break II**	
15:30–16:15	Human Computer Interaction chair: C.Gritti	Agile Software Development chair: W.Guttmann
16:15–16:20	**Closing Remarks**	
16:20–17:30	**Social Event with Drinks & Nibbles**	

Presentation coloured badges

I Industry project R CSSE staff project P Personal project

Track: Margaret Hamilton

Bentleys

		Presenter/s	Project
9:15–9:30	I	**Ryan Chen** *Mogeo*	AR for Phobia Treatment
9:30–9:45	I	**Matt Mischewski** *Mogeo*	oVRcome Chatbot
9:45–10:00	I	**Lorenzo Fasano** *Komodo Monitr*	Komodo Monitr Strength & Conditioning Programme Builder
10:00–10:30	R	**Torben Klausen, Matthew Minish**	Bubble Buddy
10:30–11:00		**Morning Tea**	
11:00–11:30	I	**Manoj Paladugu, Joel Ridden, Michael Shannon, Aaron Smith** *AgResearch, Scion*	Protecting Our Borders From Biosecurity Threats
11:30–11:45	I	**Kevin Langbroek** *Maaratech*	Synthetic 3D Plant Generation and Manipulation
11:45–12:00	I	**Luke Walsh** *Global Office*	Document Importing Service for 3PL Logistics Software
12:00–12:45		**Lunch**	
12:45–13:15	I	**Gavin Ong, Pryesh Shah** *South Pacific Sera*	Autonomous Carts
13:15–13:30	I	**Max Andrew** *Maaratech*	Orchard and Vineyard Robotic Scanning Platform
13:30–13:45	I	**Vikas Shenoy** *Maaratech*	3D Annotation on High Resolution Orchard Point Cloud Scans
13:45–14:00		**Afternoon Break I**	
14:00–14:30	I	**Exequiel Bahamonde Cárcamo, Ambrose Ledbrook** *DoC, Scion*	Eliminating Wilding Pines by Semi-Automated Spraying from Helicopters
14:30–14:45	I	**Flynn Doherty** *Rocket Lab*	Advanced 3D Visualisation for the Electron Launch Vehicle
14:45–15:00	R	**Sam Shankland**	Smart Inspection – Automated Detection of Engine Blade Defects
15:00–15:15	P	**George Khella**	Fire Fighting Drones
15:00–15:30		**Afternoon Break II**	
15:30–15:45	I	**Sachin Sakthivel** *IntelliHub*	Micro-Services for Human Computer Interaction
15:45–16:00	R	**Ollie Sharplin**	An Interactive Tool for Relational Programs on Weighted Graphs
16:00–16:15	R	**Dylan Carlyle**	Development and Analysis of "Braced Touch" Interactions

Track: Barbara Liskov

Room of Requirement

		Presenter/s	Project
9:15–9:30	I	**Adam Conway** *Bodeker Scientific*	Weather Prediction with Deep Learning
9:30–9:45	I	**Matthew Kenny** *Seequent*	Pocket Rockface Scanner
9:45–10:00	I	**Sam Dravitski** *Seequent*	Geology Underfoot
10:00–10:15	R	**Clarke Mcfadzien**	An API for Reproducible Research on Josis (Open-Access Spatial Inf. Sc. J.)
10:15–10:30	R	**Sam Verdellen**	Guide for Setting/Storing Bouldering Wall Problems
10:30–11:00		**Morning Tea**	
11:00–11:30	R	**Jason Little, William Wallace**	Exploratory Search Engine for Research Papers
11:30–11:45	R	**Viktor Bubanja**	Cloud-Assisted Access Control for the Internet of Things
11:45–12:00	R	**Luke Parkinson**	Supporting Prover9 in Isabelle/HOL
12:00–12:45		**Lunch**	
12:45–13:00	R	**Dana Lambert**	Implementing Python for CS Unplugged "Plugging It In"
13:00–13:15	R	**Andrew Holden**	Custom Game Server for COSC367
13:15–13:30	I	**Ri Sheng Huang** *Lab3*	Dictionary Augmented-Reality App
13:30–13:45	R	**Christopher Worrall**	SQLMiner - Gamification in Educational Contexts
13:45–14:00		**Afternoon Break I**	
14:00–14:15	I	**Claudia Field** *UC's Speech & Hearing*	Speech Analysis App
14:15–14:30	I	**Isaac Worsley** *Rose Centre*	Develop. of Home-based Biofeedback Device for Swallowing Impairment
14:30–14:45	R	**Harry Feasey**	Retinal Imaging
14:45–15:00	R	**Jack Orchard**	Protocol and Sensor Software Development for Fracture Healing
15:15–15:30		**Afternoon Break II**	
15:30–15:45	R	**Fergus Meldrum**	Effective Feedback for Professional Development in the Software Industry
15:45–16:00	R	**Sam Annand**	Recording Design Decisions on-the-fly from Slack
16:00–16:15	R	**Vincent Jamieson**	Agility in Small Software Development Organizations

Session: Digital Health I

(time: 9:15–10:30)

Chair: James Atlas

AR for Phobia Treatment

I

Ryan Chen Adam Hutchinson, Mogeo

Supervisor: Fabian Gilson

(Bentleys, 9:15 – 9:30)

Phobic anxiety disorders hold a high lifetime prevalence rate within the general population, affecting a significant number of people. These disorders can seriously disrupt the daily lives of those who are affected and cause harm to physical and mental health. Most are hesitant to undergo exposure therapy as it is a big step to confront their fears directly. However, studies show that virtual and augmented reality exposure therapy is equally as efficacious, making it a cost-effective and practical alternative.

Mogeo want to provide an innovative solution for both virtual and augmented reality exposure therapy as an intermediate step to aid in treating anxiety phobia. Working with Adam of Mogeo, I have designed and implemented an augmented reality exposure therapy solution in the form of a mobile application which serves as a simple and cost-effective method to treat patients.

oVRcome Chatbot

I

Matt Mischewski Adam Hutchinson, Mogeo

Supervisor: Fabian Gilson

(Bentleys, 9:30 – 9:45)

The oVRcome project is an application which focuses on helping people to overcome various fears and phobias they may have, through the use of virtual reality. This virtual reality allows users to experience and adapt to situations that they might feel uncomfortable in, without having to actually be exposed to the situation in real life, so that when they do come across such situations in the real world, they will better be able to handle them.

My task on the project is to create a chatbot as a "virtual assistant" for any users. This chatbot will talk to and interact with the users, helping them out and asking them questions. The chatbot will make it easier for users to use the application and figure out the different aspects of the programs within it.

Komodo Monitr Strength & Conditioning Programme Builder

I

Lorenzo Fasano Komodo Monitr

Supervisor: Miguel Morales Trujillo (Bentleys, 9:45 – 10:00)

Komodo Monitr is a SaaS company that provides athlete monitoring tools for sports organisations. A small yet fast-growing company, Komodo Monitr provides their clients with a wide range of functionalities while maintaining high development standards. Earlier this year, the company saw an increase in demand for a tool to help coaches plan their athletes' trainings. During this time the development team showed an interest in adopting GraphQL to improve the flexibility of the company APIs.

The project was then born with the aim to deploy a Strength & Conditioning Programme Builder using GraphQL for both its Frontend and Backend. All development was conducted following the company Kanban process. This was done to provide a realistic environment to test GraphQL potential while developing a key feature for the growth of Komodo Monitr's product.

The user interface and functionalities of the service were inspired by existing competitors and feedback from Komodo Monitr's customers; this contributed to the creation of a coach-centric product that solved a well-defined issue. The successful employment of GraphQL by tech giants such as GitHub, Facebook and Airbnb helped understand how GraphQL can be leveraged to its full potential.

The initial version of the Strength & Conditioning Programme Builder was successfully completed and reviewed by a subset of Komodo Monitr's customers. GraphQL proved to be an excellent tool that easily integrated within the existing system. Its success within the project also convinced Komodo Monitr to adopt the new technology stack in the development of all new features going forward.

Bubble Buddy

Torben Klausen, Matthew Minish University of Canterbury

Supervisor: Moffat Mathews (Bentleys, 10:00 – 10:30)

Bubble Buddy addresses the need for personal wellbeing awareness and strategies highlighted during the COVID-19 pandemic. The quarantine measures put in place around the world have highlighted and added to many existing issues regarding personal wellbeing. This project seeks to provide a solution to facilitate positive personal wellbeing behaviours during the COVID-19 pandemic and beyond.

The proposed solution is two-fold. Firstly, a web-based application that users will interact with to manage, share, and ultimately attain goals with positive wellbeing effects - these goals are related to physical, mental, or social aspects of personal wellbeing. Secondly, a machine learning system that analyses the usage patterns of the aforementioned client application, in order to track the wellbeing of its users and provide personalised recommendations (through the client application) to each user for maintaining and improving their personal wellbeing.

The web-based client application has been created by Matthew Minish, and the machine learning system by Torben Klausen. It is the combination of these two applications that forms the overall Bubble Buddy system.

Session: Computer Vision I

(time: 11:00–12:00)

Chair: Andy Cockburn

Protecting Our Borders From Biosecurity Threats

I

Manoj Paladugu, Joel Ridden, Michael Shannon and Aaron Smith AgResearch and Scion

Supervisor: James Atlas (with Richard Green)

(Bentleys, 11:00 – 11:30)

The Port of Tauranga has set out to reduce the risk of contaminants entering New Zealand via shipping containers and agreed to the biosecurity excellence in port communities initiative. With funding from AgResearch and Scion this project set out to discover ways of spotting contaminated containers entering the port of Tauranga. But we needed to do this in a way that would not impact port operations, so we decided to look into computer vision and deep learning techniques to automatically detect contamination on the exteriors of the incoming shipping containers. The created solution is a combination of four connected projects, from image acquisition to the notification of contaminants to port authorities.

We designed and implemented a solution using a segmentation network to identify any surface anomalies that can be found on the surface of a container. A decision network processes the output of the segmentation network and calculates a likelihood that a section of the container was contaminated. Then a database system manages and efficiently stores the potential millions of incoming container data and contaminated information from the decision network. A user interface was developed for notifying and viewing up-to-date images and information of contaminants found on containers.

Synthetic 3D Plant Generation and Manipulation

I

Kevin Langbroek Maaratech

Supervisor: Richard Green

(Bentleys, 11:30 – 11:45)

Vineyard grapevines are pruned to obtain a desired quality of grapes through experience and physical labour. Vines are pruned by human workers when appropriate weather conditions are met. During the pruning season, days containing rain will slow down the speed of which the vines are pruned. Therefore, robotic technology is being developed to prune vines without human interference while attaining consistent results. An Artificial Intelligence (AI) is created to compute the most optimal pruning decision when analysing the grapevines.

To train the AI, a dataset of pruning decisions is required for it to learn and compute solutions. The proposed software solution will allow experienced pruners to label numerous synthetically three-dimensional (3D) generated grapevines. The user can import a singular or folder of generated vines into the application. The camera can be manoeuvred using the mouse to display the 3D vine models from different angles. The software guides the user through multiple labelling steps. Each step asks the user to select a cane to keep as either a spur or bearer cane. Upon completing the steps, the vine model is rated for realism and the difficulty of decisions. This process is repeated for each imported vine model and will allow the software to gather and export the pruning decisions of the user.

Document Importing Service for 3PL Logistics Software

I

Luke Walsh Global Office

Supervisor: Fabian Gilson

(Bentleys, 11:45 – 12:00)

DIS (Document Importing Service) is a semi-automated consignment data extraction system, utilising Computer Vision techniques to recognise and extract instructions from document-based consignments. The problem exists due to the repetitive and excessive time the extraction is currently taking. Implementing a semi-automated solution reduces human interaction allowing clients to focus on less trivial tasks. A predefined template matches the required context with specific document regions. Each region is treated independently and passed through a series of pre-processing and data extraction algorithms. Geometric transformations and morphological operation pre-processing techniques will be applied to enhance the expected output.

The proposed solution uses an optical character recognition algorithm to extract text from the modified images. The use of optical character recognition techniques automates the data extraction process. Combining computer vision techniques with predefined context regions allows for specific data extraction with minimal human interaction. Therefore, the proposed solution is adequate to the stakeholders' problem of creating a semi-automated consignment information extraction tool.

Session: Computer Vision II

(time: 12:45–13:45)

Chair: Fabian Gilson

Autonomous Carts

I

Gavin Ong, Priyesh Shah Scott Spooner, Lachlan Brewster, South Pacific Sera

Supervisor: Richard Green (Bentleys, 12:45 – 13:15)

In order to reduce labour costs, South Pacific Sera wanted a cost-efficient autonomous cart system that could move cargo around a warehouse to be processed in multiple stations.

Our cart design uses magnetic tape navigation and omnidirectional travel via mecanum wheels to carry cargo around the warehouse. The carts are controlled by a Supervisory Control And Data Acquisition (SCADA) system, which controls traffic and sends instructions to the carts via wireless signals.

We implemented software for the locomotion, management and navigation of the carts between stations based on our proposed design, and ported it into a downsized prototype developed by South Pacific Sera to demonstrate our working system.

Orchard and Vineyard Robotic Scanning Platform

I

Max Andrew Maaratech

Supervisor: Richard Green

(Bentleys, 13:15 – 13:30)

Autonomous vehicles for row following in horticultural applications have existed for many years. These vehicles allow many tedious manual labour tasks like row scanning and pruning to be achieved autonomously. However, the navigation solutions often use sensors facing directly towards the row of plants. Therefore, the vehicle is navigating in a direction of no observation. Large autonomous vehicles navigating blindly cause a threat to plants, equipment, and humans. To account for obstacle avoidance, many systems implement multiple sensors. However, the cost of multi-sensor solutions is often very high.

The proposed solution to this problem consists of a single mounted RGB-D camera facing the vehicle's direction of movement. The vehicle autonomously navigates down a vineyard or orchard row using a two-part navigation method. The first part is corridor navigation in the direction of the camera. This handles object avoidance and rough row navigation. The second part of the method uses plane estimation to calculate the distance and angle to one side of the plant row. These estimates are used to make small changes in navigation for precise row following. This is a low-cost solution that allows both row following and object avoidance with a single sensor.

3D Annotation on High Resolution Orchard Point Cloud Scans

I

Vikas Shenoy Maaratech

Supervisor: Richard Green

(Bentleys, 13:30 – 13:45)

Maaratech Human Assist is a cross-university research project aiming to create robots and artificial intelligence technologies for use in New Zealand's horticulture and viticulture industries. This project involved the creation of a program for Maaratech which allows users to efficiently label features on point cloud scans taken in vineyards. The project was particularly focused on labelling long, thin objects like wires and canes. In the future these annotated point cloud scans can be used as training data to create a program which classifies objects in a vineyard point cloud scan without human assistance, using machine learning.

The algorithmic side of the project was completed by building a graph based on the point cloud and using Dijkstra's shortest path algorithm to find a path between points. This allows the user to quickly label wires and canes in the scenes by selecting multiple endpoints on the object. The points are connected via path search and points in the neighbourhood of the path points are then selected to label the feature. A GUI was also designed and built, which allows the user to load and view point cloud files, adjust parameters for pre-processing and create feature annotations.

Session: Aerospace

(time: 14:00–15:15)

Chair: Kourosh Neshatian

Eliminating Wilding Pines by Semi-Automated Spraying from Helicopters

I

Exequiel Bahamonde Cárcamo and Ambrose Ledbrook (with Rebecca Emanuel, Josh Hudson, Liam Hunn and Jack Taylor) James Griffiths, Department of Conservation and Brian Richardson, Scion

Supervisor: Andreas Willig (with Mark Jermy)

(Bentleys, 14:00 – 14:30)

Wilding pines are invasive and aggressive introduced pests that threaten our country's environmental, cultural, and economic values. They thrive in the wild, competing with native species, and lowering the fertility of the soil. Recently, wilding pines have been fuelling bush fires in the South Island.

The Department of Conservation (DOC) is concerned about further damage to NZ if wilding pines are left uncontrolled. DOC's current solution for controlling pines works but, it is time and cost inefficient and affects non-targeted vegetation. Hence, a better solution to the control of wilding pines is required.

Working with six students in Mechanical, Mechatronics, and Software Engineering we were tasked with building a system to semi-automate spot spraying of discontinuous canopies and individual trees from a helicopter. The Software Engineering aspects included: creating a user interface for the system, integrating with actuator systems developed by the Mechatronics Engineering students, and integrating physics models developed by the Mechanical Engineering students.

Field tests were conducted in a simulated environment to evaluate the effectiveness of the system, with plans to evaluate the system in a helicopter.

Advanced 3D Visualisation for the Electron Launch Vehicle

I

Flynn Doherty Simon Matthews, Rocket Lab

Supervisor: Andreas Willig

(Bentleys, 14:30 – 14:45)

Rocket Lab is a small-satellite launch company whose mission is to make tangible improvements to life on Earth by going to space. Every mission, billions of data points are generated by the vehicle and sent to operators and engineers on the ground. This amount of data is difficult to visualise in a way that is intuitive and interactable with traditional data visualisation techniques.

Rocket Lab required a visualisation solution that would clearly communicate the state of the vehicle at any point during a mission. The developed solution leveraged the Unity3D rendering engine to reconstruct the vehicle and place it inside a virtual world. The developed visualiser needed to be generalised in order to remain totally flexible to mission-specific configuration changes of the vehicle's physical structure and sensors. Since the visualiser streams all of the data in real-time, networking performance and scalability was an important consideration. This motivated the evaluation and comparison of various networking technology implementations such as pure UDP, gRPC and NATS.

Smart inspection – Automated Detection of Engine Blade Defects

R

Sam Shankland University of Canterbury

Supervisor: Tanja Mitrovic (with Ramakrishnan Mukundan) (Bentleys, 14:45 – 15:00)

This project aims to assist engineers in detecting defects in jet engine compressor blades. These defects do not occur often enough for a neural network or a deep learning model to be reliably trained. Therefore, a solution which utilizes image processing techniques and logical reasoning is required. In order to develop a solution, identifying the patterns that constituted engine blade damage was done and a blade model was trained. This model was able to identify defects that are present on the leading and trailing edges of the engine blades. These defects include nicks, cracks and tears.

The software takes an image of an engine blade and can locate any present edge defects. It will then draw a bounding box around the defect and "describe" the defect by measuring the mathematical properties of the defect. These properties can assist engineers in their decision of whether or not to replace the blade.

Fire Fighting Drones

P

George Khella University of Canterbury, Scion

Supervisor: Richard Green

(Bentleys, 15:00 – 15:15)

Currently, wild-fires wreak havoc annually across the globe with significant damage to homes, people, wild life and agriculture. This project aimed at creating software to identify fires to enable the use of fire-fighting drones – either autonomous or operator assisted.

Using a state of the art deep learning detector combined with a colour filter, a 76% accuracy rate was achieved. It is possible to achieve 99% using only the colour filter but multiple false positives (such as smoke, reflection) may exist in the result. This system can be further extended to include prediction of the fire's path of spread and optimal fire-fighting positions.

Session: Human-Computer Interaction (time: 15:30–16:15)

Chair: Clémentine Gritti

Micro-Services for Human Computer Interaction

I

Sachin Sakthivel Mark Cargin, Intellihub

Supervisor: Matthias Galster (Bentleys, 15:30 – 15:45)

Intellihub is a utility based service company focused on electricity, gas and water metering services. Intellihub wants to create a new web application to analyse these metering services. They want to decide between web technologies; web components and single-spa to create this application.

I was required to recommend the most suitable technology by evaluating them through using my experiences creating multiple small-scaled proofs of concepts and a comparison framework.

An Interactive Tool for Relational Programs on Weighted Graphs

Ollie Sharplin University of Canterbury
Supervisor: Walter Guttmann (Bentleys, 15:45 – 16:00)

A relational programming language is a language which allows a programmer to specify operations which can be performed on relational objects. Relating this to graph theory, a relational programming language should allow users with little to no experience in programming to create and perform operations on graphs with a variety of edge weight types. This project aims at creating a system which abstracts the underlying computations from the users and provides them with a simple programming language which allows them to perform graph theory calculations.

RelView is an existing tool for supporting manipulations of relations represented as graphs with no edge weights. Its feature set is very useful, and it supports a relational programming language. However, its limitations are that it does not support edge weights, and that it is no longer being updated. This project not only intends to incorporate these useful features of the existing RelView system, but it will also include a new range of features. The most fundamental of these is the incorporation of edge weights. This feature will allow a new range of operations and algorithms to be performed on graphs. Graphs edge types will be able to be chosen from the set of built-in types (Boolean, number, regular expression), or will be able to be created by the user.

Having user-defined or "custom" edge weight types opens this interactive tool to a new wide range of possible use cases. Users will implement basic functions which can be imported and executed by the system at runtime to evaluate graphs of custom types. This project also has a built-in programming language for performing operations. This can be utilized through an interactive shell or through the importing and running of programs written by users.

Development and Analysis of "Braced Touch" Interactions R

Dylan Carlyle University of Canterbury

Supervisor: Andy Cockburn (Bentleys, 16:00 – 16:15)

A recent study showed that touchscreen interaction during turbulence can be improved through the use of a braced touch posture, in which multiple fingers contact the screen at once to increase stabilization. Previous work on braced touch has only studied tap gestures and therefore limits the capabilities of interaction. The problem space addressed by this research project is to develop a more advanced gesture recognition engine that can reliably identify tap, drag, rotate, scroll and pinch gestures.

The engine was implemented into a gesture testing platform, which is aimed to analyse how efficiently users can perform tasks through the braced posture. Future work may evaluate the overall effectiveness and reliability of braced touch gestures in comparison to similar projects.

Session: GEOINFORMATICS

(time: 9:15–10:30)

Chair: Andreas Willig

Weather Prediction with Deep Learning

I

Adam Conway Leroy Bird, Bodeker Scientific

Supervisor: Kourosh Neshatian

(Room of Requirement, 9:15 – 9:30)

Bodeker Scientific is an Otago-based research company which specializes in atmospheric and climate research. One of their areas of focus is applying deep learning techniques to improve current atmospheric, climate, and regional models in New Zealand.

Traditional methods of high-resolution weather prediction are both computationally and time-intensive. This means short-term weather forecasts are outdated as soon as they are produced. The application of deep learning techniques has the potential to reduce the time taken to generate weather predictions to a fraction of the cost of traditional methods.

The proposed model aims to generate an ensemble of accurate rainfall predictions up to 8 hours into the future. The model was trained and validated using historic weather data and leverages modern deep learning architecture to generate forecasts.

Pocket Rockface Scanner

I

Matthew Kenny Tim Schurr, Seequent

Supervisor: Andrew Bainbridge-Smith

(Room of Requirement, 9:30 – 9:45)

Seequent is a geological modelling software company that provides solutions that model and display digital representation of the earth's crust and what types of rock and minerals lie in those areas. Seequent have identified a need by their clients within the mining and minerals industry to improve the workflow of mining geologists charged with planning the best path that mining tunnels should follow to reach valuable minerals such as gold.

Existing methods often present a two-dimensional perspective of tunnel heads. Seequent wants to provide a three-dimensional perspective of such tunnels to provide these geologists with improved context to take on their problem. All of the data is to be collected, processed and displayed on a man-portable device such as a smartphone or tablet.

We developed an iOS application using Apple's augmented reality technology that scans the environment through the device's camera. A point cloud of the rock is stored and later processed to create a mesh that the user can view and export to an existing geological model.

Geology Underfoot

I

Sam Dravitzki Tim Schurr, Seequent

Supervisor: Andrew Bainbridge-Smith (Room of Requirement, 9:45 – 10:00)

Seequent is a Christchurch based organisation which provides software-based solutions for problems within the Geoscience domain. A set of their current products provide tools to Geologists for modelling a Geological site of interest interpreted from varying forms of source data. These tools are highly useful for the creation and visualisation of geological models, but require non-portable desktops to be used.

Geologists frequently venture out of the office to the field where high power devices to interact with these models are not always accessible. The solution proposed is a prototype application mobile devices such as smart-phones and tablets in which allows a user to view and manipulate these models within the field. The addition of portability opens up new doors in the visualisation of Geological models. Further exploring visualisation through the use of GPS, mapping the users' location and heading into the virtual world and onto the model.

An API for Reproducible Research on Josis, an Open-Access Spatial Information Science Journal

Clarke Mcfadzien University of Canterbury

Supervisor: Ben Adams

(Room of Requirement, 10:00 – 10:15)

The Journal of Spatial Information Science (JOSIS) is an open-access journal open to submissions from around the world. The JOSIS website (josis.org) provides a platform for submission and peer review of papers for the journal. It also allows anyone to read the most recently published journal issue or purchase previous ones. But josis.org currently lacks a way to host the code and data used to produce the scientists' findings.

We have produced a new Application Programming Interface (API) platform for JOSIS, centred on adding the functionality necessary to present reproducible research. The new platform gives JOSIS a way to accept code and data submissions to test the submission's reproducibility. We have used GraphQL APIs, a Dockerised CoCalc JupyterLab, and a React front end to accomplish this. This, combined with the ability to submit and review papers, will allow submissions to bring JOSIS to a new chapter of reproducible spatial information science.

Guide for Setting/Storing Bouldering Wall Problems

R

Sam Verdellen University of Canterbury

Supervisor: Andy Cockburn

(Room of Requirement, 10:15 – 10:30)

Rock climbers like to challenge themselves by setting climbing 'problems' for climbing walls. A 'problem' is a route up the wall comprised of only a subset of the holds on the wall. Currently, because there is no alternative, climbers need to memorise these routes or manually draw/write them down. Manually drawing/writing routes down is difficult, time consuming and cumbersome.

This project addresses this issue by producing an application which allows climbers to store and recall climbing problems on an Android mobile device. Climbers are able to photograph a climbing wall and then draw on each hold with their fingers. They can then create problems by tapping a collection of the holds. The problems that they create are stored so the climber can recall them. Climbers can also assign each problem a tag, and a difficulty rating. This makes it easier for climbers to explore their problems and find one to attempt. The application allows climbers to store multiple climbing walls, with multiple problems against each wall.

Allowing climbers to enter, store and recall visual representations of climbing problems on a photo of a climbing wall will be of great benefit to climbers. It will be much easier, and much quicker, to identify the holds used in each problem.

Session: Varia

(time: 11:00–12:00)

Chair: Miguel Morales Trujillo

Exploratory Search Engine for Research Papers

R

Jason Little and William Wallace University of Canterbury

Supervisor: Ben Adams

(Room of Requirement, 11:00 – 11:30)

Hundreds of millions of research publications and scientific literature are available online, however the tools in existence to find and discover relevant knowledge for someone doing research are quite limited.

The problem this project highlights is the lack of visual tools and personalisation in exploratory search that existing search engines, such as Google Scholar, have an absence of in their current design. In collaboration with the Curtin Open Knowledge Initiative (COKI) group at Curtin University in Australia, an exploratory search engine web application with a refreshing user interface has been developed.

This project builds upon the existing web application, introducing new and unique features such as: user logins and profiles, search history, favouriting research publications and the ability to pull together similar articles on the fly while carrying out exploratory search.

Cloud-Assisted Access Control for the Internet of Things

Viktor Bubanja University of Canterbury
Supervisor: Clémentine Gritti

(Room of Requirement, 11:30 – 11:45)

The Internet of Things (IoT) is a rapidly growing technology that has already brought significant benefits to a range of industries. Its development is not slowing down and it is promising to enable seemingly limitless possibilities, such as smart cities, smart factories, and self-driving cars. However, the increase of data transfer and interconnection between devices also brings an added security risk. Furthermore, the limited storage capacity and computational power of IoT devices poses a unique problem.

CHARIOT, an authentication protocol, proposes a potential solution. To validate the performance and suitability of CHARIOT, a prototype was implemented that enables testing and benchmarking in an environment that simulates a realistic IoT environment. The implementation also allows for the experimentation of system parameters to find ideal tradeoffs between security and performance.

Supporting Prover9 in Isabelle/HOL

Luke Parkinson University of Canterbury

Supervisor: Walter Guttmann (Room of Requirement, 11:45 – 12:00)

Isabelle/HOL is an interactive theorem prover used to help users verify mathematical proofs. These proofs can be used to formally verify the correctness of circuits and software. Isabelle/HOL uses different external provers to find proofs.

The goal of this project is to allow users of Isabelle/HOL to use another external prover, so that more options are given to the user. Prover9 was the automated theorem prover chosen to support. Adding the ability to use Prover9 with Isabelle may allow proofs to be found that the current automated theorem provers are unable to find in a reasonable time.

My work on supporting Prover9 in Isabelle/HOL has been in the form of creating an external tool that converts between the language used by Isabelle/HOL, to the languages used by Prover9. This method allows us to take a goal from Isabelle/HOL translate it for use with Prover9, and then translate the output back into the language of Isabelle/HOL.

Session: Education

(time: 12:45–13:45)

Chair: Tanja Mitrovic

Implementing Python for CS Unplugged "Plugging It In"

R

Dana Lambert University of Canterbury

Supervisor: Tim Bell

(Room of Requirement, 12:45 – 13:00)

CS Unplugged is a popular website designed to enable teachers to teach computer science concepts kinesthetically away from digital devices. Research is emerging that shows that it is valuable to link CS Unplugged activities to computer programming. An existing "Plugging it in" section of the website does this where students can complete a series of programming exercises available in Scratch and Python following on from the unplugged activity. However, the existing Python "Plugging it in" content is not interactive, hard to find and is not a well-known feature of the website. Since research has suggested a combination of unplugged and "plugged" learning is an effective teaching method, we believe it is important to invest time into improving this feature.

The solution introduces a new "Plugging it in" section to the website available from the CS Unplugged home page, designed for students rather than teachers. It features an interactive editor with automatic question checking for Python in the style of an online IDE. Users can download, save previous attempts, navigate challenges and keep track of their challenge completion status. The platform also supports students with challenge hints, syntax reminders and error explanations. We expect that the improved navigation, ease of use, accessibility and interactivity of the "Plugging it in" section, combined with feedback from NZ teachers, will further enhance and encourage the use of this feature.

Custom Game Server for COSC367

Andrew Holden University of Canterbury

Supervisor: Kourosh Neshatian

(Room of Requirement, 13:00 – 13:15)

Each year at the University of Canterbury, the COSC367 - Artificial Intelligence class learns how to code up automated players for games. The aim of this project is to build a game server for this class so that they can test their skills against one another. Games will be written in Python code by the course admin and uploaded to the game server so as to make them available to students. Students can then create automated players for these games in Python. These players are then pitted against each other by the server in a sandbox environment to determine the winner.

The server was developed to run on an open-sourced Unix type operating system and the client was developed as a single page application, compatible with an assortment of modern browsers.

Dictionary Augmented-Reality app

I

Ri Sheng Huang Lab3

Supervisor: Andy Cockburn

(Room of Requirement, 13:15 – 13:30)

The Dictionary Augmented-Reality app is a project to explore the practical application of optical character recognition (OCR) together with augmented reality (AR) technologies into a Kotlin based mobile application. The application is designed to enrich and simplify the user experience of isolating and searching up the definitions of words that a user does not understand.

My application design builds upon libraries of cutting edge OCR and AR technology developed by Google and encapulates the required technologies together to provide an app that delivers an experience for the user that focuses on ease of use and minimalist design that can easily be built upon and further tailored for different types of consumers in the future. The application enables a user to parse text from their mobile camera which will then be used to extract the dictionary definition to be displayed in augmented reality to the user overlayed on top of their mobile screen.

While a similar functionality currently exists in Google lens, other developers are not able to integrate it into their own applications and Lab3 will be able to either further expand upon this project in the case that they want to target a specific demographic or use it as a template for future projects dealing with OCR or AR technologies.

SQLMiner - Gamification in Educational Contexts

Christopher Worrall University of Canterbury
Supervisor: Miguel Morales Trujillo (Room of Requirement, 13:30 – 13:45)

Gamification is the incorporation of game elements in non-game related contexts. Since 2011 there has been a noticeable growth of gamification papers published across all fields including Computer Science. Previous gamification solutions have incorporated game elements to help students enrolled in introductory relational database courses to learn SQL queries. This project aimed to investigate whether the incorporation of competitive game elements, such as timers and leaderboards, could assist in student engagement, achievement, and motivation when learning SQL queries.

The project consisted of two main phases: a research phase and a development phase. During the research phase, a literature review was conducted to determine the best gamification elements to incorporate into a competitive gamified SQL query practice solution. From reviewing the findings of both primary and secondary studies, the game elements leaderboards, badges, ranks, and countdown timers were selected as appropriate game elements for the intended solution.

The developed product, SQLMiner, was designed around two core features; training questions and campaigns. Training questions were designed so that students had to race against a clock to complete SQL query questions before a timer ran out. Campaigns, alternatively, provided more complex questions where students aimed to complete each query as fast as possible to gain more points. The incorporation of a points system, ranks and badges further motivates students to become more fluent in writing SQL queries assisting in student engagement and achievement.

Session: Digital Health II

(time: 14:00–15:00)

Chair: Tim Bell

Speech Analysis App

I

Claudia Field UC's Speech & Hearing

Supervisor: Walter Guttmann

(Room of Requirement, 14:00 – 14:15)

Speech Language Pathologists (SLPs) play an important role in the development of children. They have a high work load and often have a long waiting list. SLP's develop their therapy programs specifically for each child based on the results of an initial analysis. Currently this analysis process is conducted entirely by hand. It is time consuming and requires the SLP to manually calculate the various values.

This project has seen the creation of an application which allows SLPs to select the individual sounds each child makes for the various words. Once all words in the assessment are completed, the application preforms the analysis of the sounds the child has made. It establishes patterns and areas the child needs help with. It is hoped this will greatly reduce the time required by SLPs to conduct these assessments, giving them more time to work with the children on improving their speech.

Development of Home-based Biofeedback Device for Swallowing Impairment

I

Isaac Worsley Maggie-Lee Huckabee, Rose Centre for Stroke Recovery and Research

Supervisor: Clémentine Gritti

(Room of Requirement, 14:15 – 14:30)

The Rose Centre for Stroke Recovery and Research is a state of the art facility at St. George's Medical Centre that helps individuals with swallowing and communication disorders recover function or improve sufficiently to gain the best possible quality of life.

The development of the biofeedback device and application comes as part of transferring the existing desktop PC software that the Rose Centre currently employs to a more suitable and modern Android mobile application, called BiSSkApp.

Interaction between BiSSkApp and a wireless surface electromyography (sEMG) device allows for this modern and portable approach. BiSSkApp is intended to provide clinicians and their patients with the opportunity to regularly interact and complete rehabilitation and training exercises, which are an essential part of stroke recovery. The BiSSkApp mobile application is also accompanied by a web-based application that is intended to be used by clinicians to monitor their patients' progress. The BiSSkApp Android application and React web application is built on top of Google's Firebase cloud service; which provides the necessary authentication, database storage and deployment features that are vital for an application of this scale.

Retinal Imaging

R

Harry Feasey University of Canterbury

Supervisor: Andrew Bainbridge Smith

(Room of Requirement, 14:30 – 14:45)

Diabetic Retinopathy (DR) is a preventable complication with diabetes. If not detected and treated in time, it can lead to severe vision loss and blindness. Currently detection of DR is handled through a manual process which requires retinal images to be screened by experts from around the country. Additionally, a percentage of the images are not fit to be used for screening due to issues with focus, lighting/glare and obstructions. These images may need to be retaken before a diagnosis can be made. Deep learning shows promise in speeding up this process, however a good dataset requires these un-fit images to be labelled as such.

In this project, a solution to automatically identify such faulty images using traditional computer vision techniques is showcased.

Protocol and Sensor Software Development for Fracture Healing

R

Jack Orchard University of Canterbury

Supervisor: James Atlas

(Room of Requirement, 14:45 – 15:00)

Assessing the progress of a healing fracture is difficult. To address this problem, the Mechanical Engineering Department are researching the use of microelectronic strain sensors. Software is needed to use the data generated from these sensors to help track the fracture healing process.

We developed a machine learning model which classifies activities, such as walking and standing, using strain sensor capacitance time-series data. The model accurately distinguishes these activities in a drill press test setup. Our model enables comparison over time of similar activities to assess healing progress.

Session: Agile Software Development (time: 15:30–16:15)

Chair: Walter Guttmann

Effective Feedback for Professional Development in the Software Industry

R

Fergus Meldrum University of Canterbury

Supervisor: Matthias Galster

(Room of Requirement, 15:30 – 15:45)

This research study addresses the problem of poor feedback practices occurring in the software industry. A lot of the time in the industry poor feedback practices are being carried out. These poor practices can stall, and even reverse, the professional growth of employees. The aim of this study is to understand what are, and what are not, effective feedback practices in the software industry, and, to provide recommendations to the software industry on some core feedback practices to follow to make feedback effective.

Effective feedback in this study is defined by those who receive feedback because these are the people for which it has the greatest impact. To achieve the aim of this study a survey was conducted in the software industry. The survey obtained the opinions of industry members about what they define effective feedback to be. The results of this survey are analyzed and summarized to give recommendations to the software industry of effective feedback practices.

Recording Design Decisions on-the-fly from Slack

Sam Annand University of Canterbury

Supervisor: Fabian Gilson (Room of Requirement, 15:45 – 16:00)

This project surrounds an emerging problem in the software engineering industry: developers rarely document their design decisions, despite the researched and documented benefits of doing so. Through initial background research for this project, we identify that a reason for this is that the process of documenting design decisions is perceived as cumbersome.

With the recent emergence of Slack in software teams, we can leverage its platform, as well as chat bot, and natural language processing technologies to extract design decisions from user messages. In doing so we place the system for recording design decisions into an environment that is already commonplace for software teams, dramatically reducing the barriers involved with recording design decisions. An initial iteration of this solution was completed last year, however upon analysis, still contained barriers preventing meaningful use by a real software team.

This year, we have built on the previous project iteration with a focus on reducing the installation barriers of the previous solution. To do this we containerised the system, and hosted it in the cloud using Amazon Web Services. To support this, we also added an authentication layer to the system, allowing many different teams to use the same pre-existing backend. Finally, we added an extra feature allowing users to search the decision database – a wish list item from the previous iteration - as well as experimented with moving towards a dialogue based approach for extracting the design decision information, as opposed to natural language processing.

Agility in Small Software Development Organizations: an Exploratory Study of New Zealand

R

Vincent Jamieson University of Canterbury

Supervisor: Miguel Morales Trujillo

(Room of Requirement, 16:00 – 16:15)

The New Zealand Information Technology industry is experiencing some of the highest growth of of any industry in the nation, with software development being a key motivation for this trend. The primary drivers for this are small enterprises, for they constitute 73% of the New Zealand software industry. However, little research has been conducted on the practices used by these businesses to manage their software development. Hence, we researched this emerging area of our economy to get a snapshot of how small software businesses are working so that future process improvements can be proposed. Specifically, we focused on the use of agile methodologies and how closely they are followed. In pursuit of this, a systematic mapping study was conducted before we surveyed small software companies nation-wide.

Thanks to our sponsors

UC UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Computer Science & Software Engineering

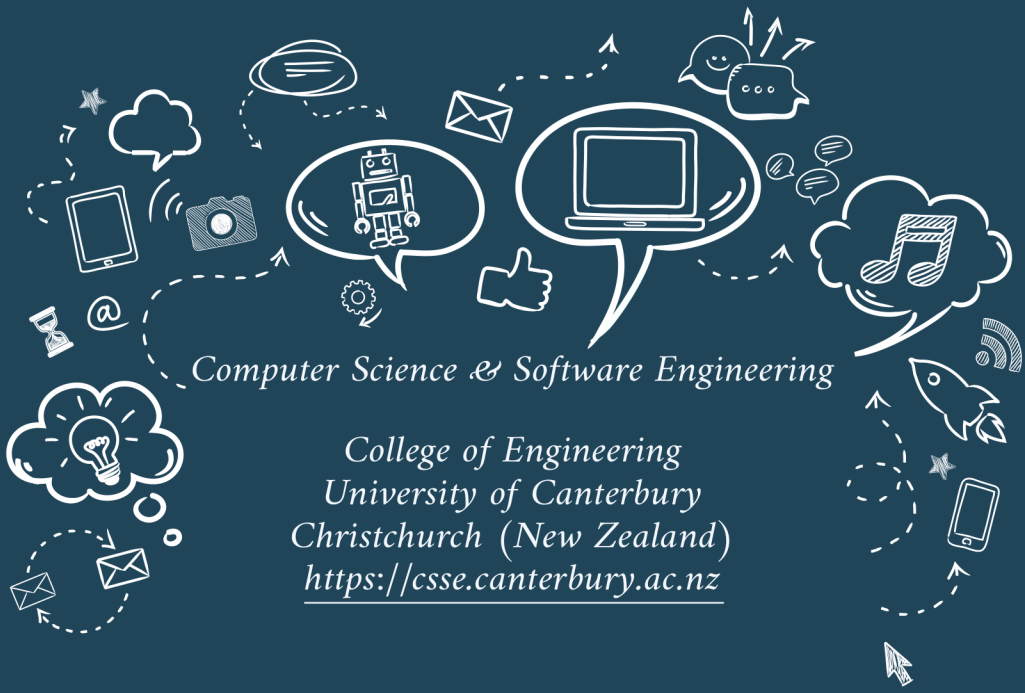
Our sponsors make such events possible. We truly appreciate their support. If you would like to be a sponsor for Computer Science and Software Engineering events, please contact **csse@canterbury.ac.nz**.

Photos and videos

Photos and/or video will be taken at this event. The official photos/videos will only be used for promoting the university and its courses. Please let the event co-ordinator know if you do not want your photo taken so that the photographers will avoid to take pictures of you and blur your face in the final product, if necessary.

Credits

This booklet has been prepared by Fabian Gilson and has been adapted from the work of Maxime Lucas, Pau Clusella and Thomas Kreuz. The original files are available at `https://github.com/maximelucas/AMCOS_booklet`.



Computer Science & Software Engineering

College of Engineering
University of Canterbury
Christchurch (New Zealand)
https://csse.canterbury.ac.nz