



MONASH
University

MONASH
INFORMATION
TECHNOLOGY

HUMAN-CENTRED SOFTWARE ENGINEERING (HUMANISE) LAB



HUMANISE

PROGRESS REPORT 2022

A message from our Director

Welcome to the second edition of the HumanISE Lab report. Our first publication covered 2020, 2021 and the impact of COVID-19. This one shares our exciting and significant progress since – including many new and advancing projects driving better software solutions.

In education, we partnered with Futurum to develop a brochure and lab member profiles that promote interest in, and passion for, human-centred software engineering among high school students. We also used the organisation's 'build a diverse persona' worksheet in a two-day Engage Engineers workshop with over 90 high school students to teach them about human values and diverse needs for software.

Another way we're contributing to the future workforce is by supervising Master's and Honours research projects. We also augment relevant IT units by ensuring they are taught or co-taught by our Lab members so students are exposed to real-world human-centric software engineering insights.

In research, we were delighted to welcome three more partners – The University of Auckland, CSIRO and RMIT.

Additionally, in the past year we had several grant successes including contributing to two CSIRO NextGeneration Graduates Programs which will see us help to train over 20 new PhDs, Master's by Research and Honours students with a variety of industry partners. We also had two lab members receive prestigious Google Inclusion grants, which are given out annually in recognition of experts who are empowering marginalised groups.

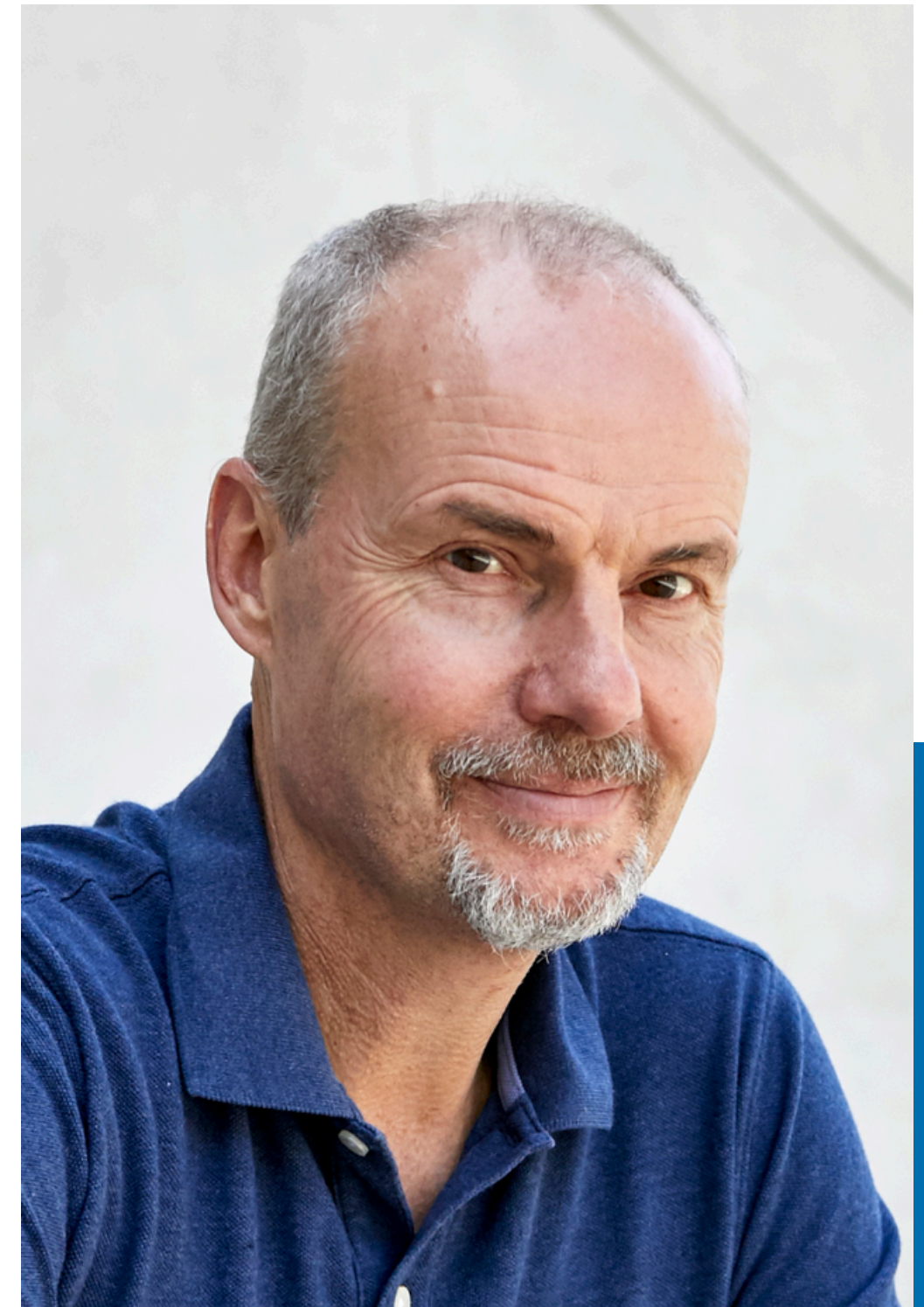
To enhance our internal capabilities, we also ran insightful weekly team presentations as well as several development workshops.

In 2022, we farewelled several staff, wishing them all the best in their new organisations. These included Dr Humphrey Obie (Telstra Health), Dr Waqar Hussein (CSIRO/Data61), Dr Jennifer McIntosh (University of Melbourne), Dr Hourieh Khalajzadeh (Deakin University) and Dr Mojtaba Shahin (RMIT University).

Thank you to all our partners, students and researchers, as well as the broader Department of Software Systems and Cybersecurity, for supporting our Lab's ever-important mission.

As always, we welcome any companies, government bodies and not-for-profit organisations to partner with us. So if you're interested – please get in touch!

We hope you enjoy reading our 2022 lab report.



Professor John Grundy

Australian Laureate Fellow and
Professor of Software Engineering

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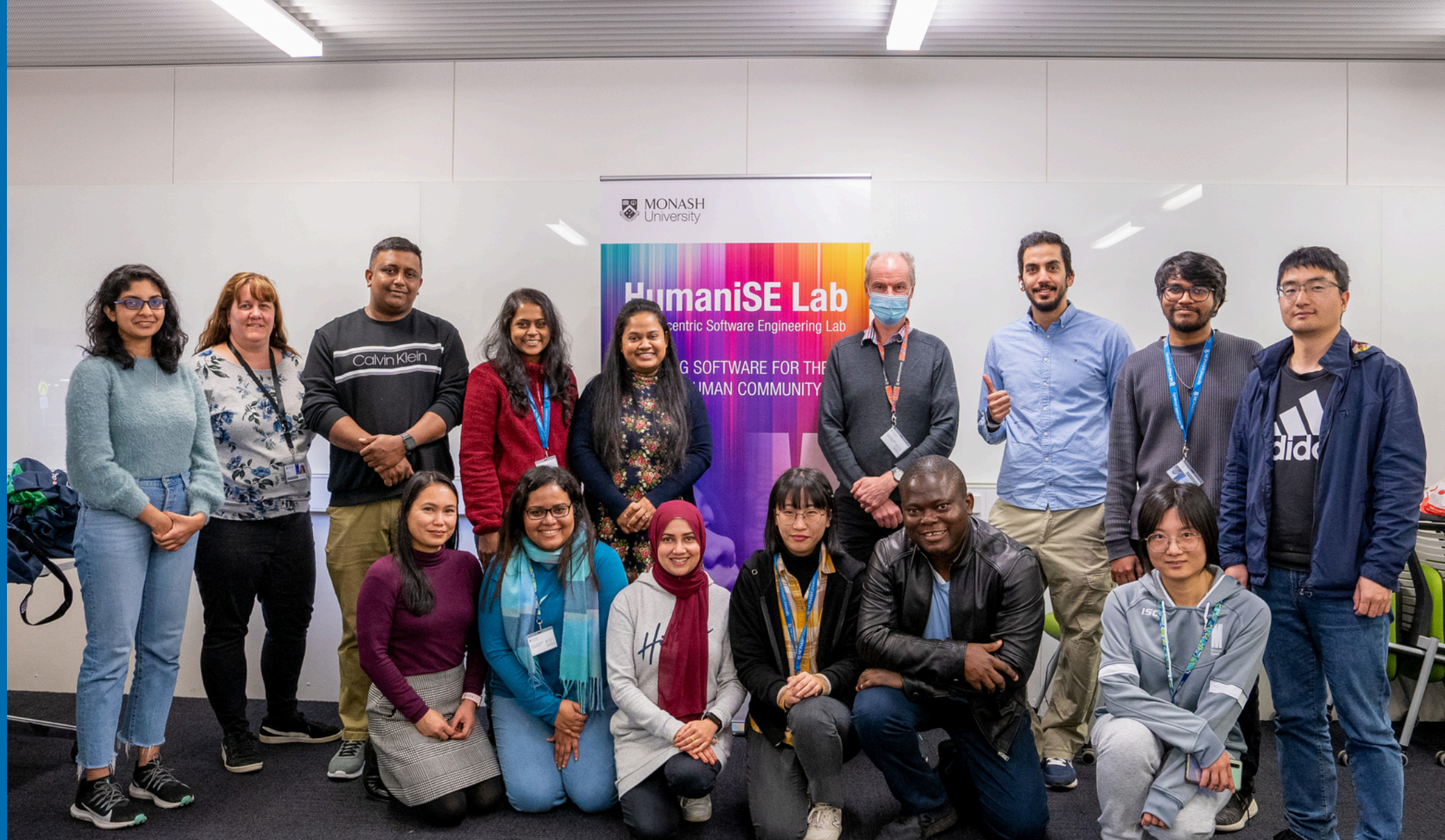
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ABOUT THE HUMANISE LAB

Led by Laureate Professor John Grundy, the HumaniSE Lab is a renowned research initiative that focuses on developing software which incorporates the unique needs of diverse users.

As technology becomes more and more inseparable from daily life, it's crucial to ensure that software serves society's best interests in all its forms – accessibility, usability, emotions, personality, age, gender, human values and culture.

By adopting a human-centric approach to development, we can ensure that future tech is always geared towards the good of humanity.



Meet the team

Our Lab consists of members from many different disciplines, cultures and walks of life.

We're also proud to have a large proportion of women researchers – a norm we hope to see in software engineering more widely.



Director
Professor John Grundy
Lab promotion



Deputy Director
Associate Professor
Rashina Hoda
Lab promotion



Research Fellow
Dr Tanjila Kanij
Diversity advancement



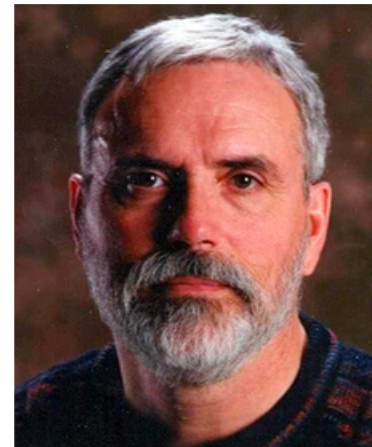
Research Fellow
Dr Anu Madugalla
Student projects



Research Fellow
Omar Haggag
Mentoring activities



Research Fellow
Dr Kashumi Madampe
Living Lab activities



Adjunct Professor
Professor Bran Selic



Research Fellow
Dr Ingo Mueller
Living Lab activities



Project Officer
Susan Vukovic
Mentoring activities, lab
promotion

PhD and Master's students within Monash

Aastha Pant	Enabling Ethical AI – A Socio-Technical Perspective
Ayodeji Ladeinde	How Human-centric Issues are Discussed in Requirement Engineering Documents
Chathurika Amarathunga	Towards Automatic Monitoring and Population Dynamics Modelling of Microscopic Insect Pest-Predator Interactions in Horticultural Crops
Devi Karolita	Human-Centric Issues in Requirements Engineering
Dulaji Hidellaarachchi	How do Human-Centric Issues Impact Requirements Engineering Teams
Hashini Gunatilake	The Effect of Human Aspects on Collaboration between End Users and Software Developers in the Field of Software Engineering
Jonny Low	Diagnosis & Prediction Support for Acute Mental Health Conditions using Machine Learning (ML) in Australia
Maria Graetsch	Human-Centric Requirements Capture and Modelling for Multi-disciplinary Software Analytics Teams
Md. Shamsujjoha	Towards Better Supporting Human Aspects in Mobile eHealth Applications
Mingyi Zhou	Improving the Reliability of Mobile AI Models
Negin Akbari	Human-Centric Scheduling and Resource Management Approaches for Edge Computing Environments
Omar Haggag	Human Aspects of eHealth Apps
Pei Liu	Strengthening Android App Qualities Through Mining Android Frameworks and Apps
Ruchi Sembey	Emerging Technologies in Higher Education
Shavindra Wickramathilaka	Model-driven Engineering (MDE) for Adaptive Accessible User Interfaces (MDE4aUI)
Suyu Ma	Improving the Usability and Accessibility of Mobile UI Design with Generative Adversarial Network
Tingting Bi	Empirical Studies of Software Development Knowledge Management

PhD and Master's students within Monash

Vedant Chauhan	Improving Human-Centric Software Defect Evaluation, Reporting and Fixing
Wei Wang	Applying Domain-Specific Visual Language to mHealth Applications for Teens with Diabetes
Xiaoyu Sun	Demystifying Abnormal Sensitive Behaviours in Android Apps
Yanjie Zhao	Big Code Augmented Software Development
Yonghui Liu	Improving the Static Analysis for Android React Native Apps
Yutan Huang	Optimal Methods for Presenting the Risk of Developing Gestational Diabetes

PhD students external to Monash

Aya Mohamed Zaki Ismail	Extraction of (Semi-) Formal Notations from Natural Language Requirements, Deakin University
Ben Joseph Philip	A Unified Application Platform for mHealth Services, Deakin University
Khlood Ahmad	Requirements Engineering for AI-based Software, Deakin University
Mohamed Osama	Progressive Assessment and Checking of 3C Quality Issues in System Requirements Specification, Deakin University

PhD graduates in 2022

Arif Nurwidyanoro	An Investigation into the Presence of Human Values in Software Repositories Artefacts
Chehara Pathmabandu	Privacy Requirements and Solutions for Smart Buildings
Harsha Perera	Operationalising Human Values in Requirements Engineering
Kashumi Madampe	Understanding Requirements Changes in Software Development and Their Influence on Practitioners
Rifat Shams	Operationalising Values in Mobile Applications: A Mixed-Methods Empirical Study on Agriculture Apps for Bangladeshi Female Farmers
Elton Lobo	Developing Technological Support for Caregivers of People Living with Stroke, Deakin University
Phu Lai	Cost-Effective User Allocation in Mobile Edge Computing, Swinburne University of Technology
Xiaoyu Xia	Data Caching in Edge Computing, Deakin University

PhD graduates from 2019 to 2021

Jiachi Chen	Maintaining Ethereum Smart Contracts by Finding and Detecting Defects
Jirayus Jiarpakdee	Towards Explainable Software Defect Prediction Models to Support SQA Planning
Zhipeng Gao	Intelligent Question and Answering in Software Q&A Community

External affiliates and alumni

Professor Jon Whittle	Director, Data61 CSIRO
Dr Mojtaba Shahin	Lecturer, RMIT
Radhika Jain	University of South Australia, PhD
Dr Waqar Hussain	Senior Research Scientist, Data61, CSIRO
Dr Hourieh Khalajzadeh	Senior Lecturer, Deakin University
Dr Jennifer McIntosh	Associate Professor, University of Melbourne
Dr Humphrey Obie	Telstra Health

Our partners

Education

The HumaniSE Lab partnered with Futurum Careers to produce a [comprehensive article](#) and an activity sheet on human-centred software engineering. They also profiled three members from our Lab, showcasing what a future in the discipline can look like.

The aim of this initiative was to explain, in simple terms, the role and responsibilities of a software engineer to generate interest in the profession among the general public.

The article was distributed as part of a monthly newsletter to the Futurum network, which includes education repositories such as The Times Education Supplement (visited by +25 million teachers annually), the UK Government's Careers and Enterprise Company, libraries and more.

We encourage you to share the resource amongst your networks too.

Research departments and groups

We work with many other research entities within Monash and across the tertiary sector more widely. These include:

- Monash Software Engineering Group
- Action Lab
- Department of Human-Centred Computing
- Monash Faculty of Art, Design & Architecture
- Monash eSolutions
- Turner Institute for Brain and Mental Health
- Monash Faculty of Engineering
- Monash Central Clinical School
- Deakin University
- RWTH Aachen, Germany
- University of the Third Age (U3A)
- Emerging Technologies Research Lab
- Department of General Practice and Centre for Cancer Research
- RMIT University
- University of Wollongong
- University of Minnesota
- University of Oslo
- SINTEF (Norway)
- The University of Melbourne
- Monash Centre for Health Research and Implementation



Industry and community

The HumaniSE Lab is partnering with over 12 organisations across a range of sectors, including healthcare, e-commerce, not-for-profit, IT and more. Here are some of our collaborators.



PROJECTS AND ACHIEVEMENTS

This year we expanded our portfolio with 51 new initiatives on top of the Lab's 95 ongoing projects. With topics spanning age-related accessibility to incorporating empathy, explore some of our exciting research below.

STAFF-LED PROJECTS





Meta-study exploring the impact of empathy on the interactions between software developers and end users

Empathy is an understudied human aspect in software engineering and developers are typically young tech-centric males while end users are often a diverse group with differing values, needs and expectations. Do these impact the way developers and end users interact? Do developers have difficulty empathising with end users and their needs?

Adopting a Grounded Theory approach, we collected, analysed and interpreted qualitative and quantitative data from both developers and end users.

We then used the Questionnaire of Cognitive and Affective Empathy (QCAE) to monitor the self-reported level of empathy of each participant during the project.

For qualitative data, we ran seven usability testing sessions and observed visual and verbal empathy-related clues among the participants.

Project lead: Hashini Gunatilake (PhD student) and Ingo Mueller



Human-centred design and development of a UX recruitment support tool

UX recruitment is a complex task involving activities such as identifying target audiences, creating and distributing recruitment materials, screening participants and scheduling events. Tools are available for each step, but an off-the-shelf integrated platform to help UX professionals simplify the process in any given context is not readily available.

Five final-year Bachelor of Software Engineering (Honours) students created a Firebase proof-of-concept prototype of an integrated recruitment platform, based on a case study provided by the Mobile UX team at Monash eSolutions.

They incorporated Human-Centred Design (HCD) techniques – perspective-taking, user journey mapping and design prototyping with Figma – into an agile software development lifecycle before implementing and evaluating a software prototype.

Project lead: Ingo Mueller

Industry partners: Monash eSolutions Mobile UX Team



Human-centric development of a smart-goal-setting feature

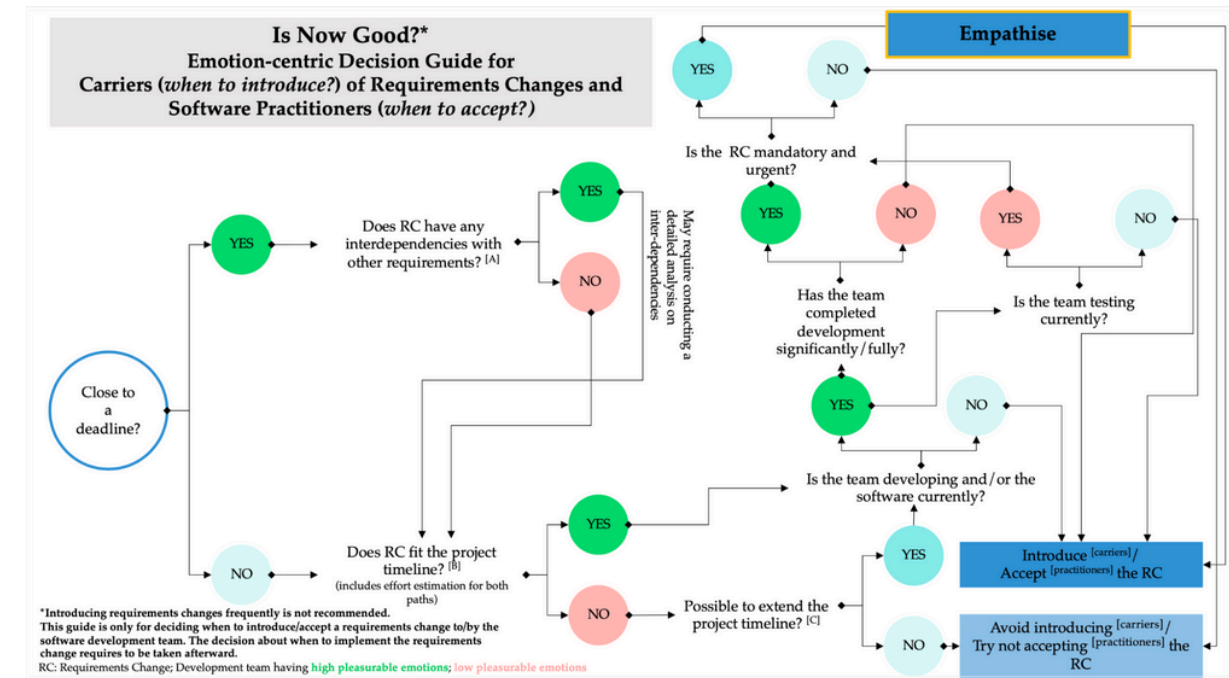
The objective of this project was to design and implement the prototype of an engaging ehealth app feature that allows users to define healthy lifestyle changes using a SMART goal setting process and monitor their progress towards these goals.

This project was conducted as a FIT 4002 final year project in collaboration with the Faculty of Art, Design and Architecture (MADA). We teamed up six Bachelor of Software Engineering students with two Masters of Interaction Design students who, in close collaboration, carried out human-centric software development under the guidance of supervisors from MADA and FIT. The design students led Human-Centred Design (HCD) activities such as user interviews, co-creation sessions and usability testing while gaining insights into agile software development methods led by the IT students.

Our students delivered an interactive design and a subsequent software prototype of a SMART goal setting feature, which was evaluated with users of Monash Centre for Health Research and Implementation (MCHRI)'s AskPCOS ehealth app to ensure a positive user experience.

Project lead: Ingo Mueller

Project team : FIT4002 student team, MADA design students, Jeffrey Janet (MADA), A/Prof Lisa Moran, Dr Stephanie Cowan (MCHRI), Susanne Baker (MCHRI)
 FIT 4002 Supervisors: ABM Russel, A/Prof Yuan-Fang Li
 MADA Supervisors: Jeffrey Janet, Dr Yun Tae Nam



The emotional roller coaster of responding to requirements changes in software engineering

A developer's emotions directly link to their productivity and cognitive and decision-making abilities. Given the critical role emotions play in high-pressure scenarios such as handling RCs, why isn't there a deeper understanding of them?

Surveying 201 software practitioners across the globe, we uncovered that professionals experienced different emotions and that these varied throughout the RC handling lifecycle such as receiving, development and delivery. Our study also investigated common emotional responses and triggering stimuli.

With these insights, we presented pragmatic recommendations for practitioners to follow, including a dual-purpose, emotion-centric decision guide to help determine when to introduce or accept an RC, and some future key research directions.

Project lead: Kashumi Madampe

Collaborators: Rashina Hoda, John Grundy



Design and development of a human-centric learning experience platform

Existing online learning platforms are closed systems that often don't use standardised components and interfaces, and are not interoperable. As a result, creators can't easily share and incorporate content such as text, audio, images and videos across different platforms - presenting a significant barrier for delivering content to larger audiences.

A team of IT students designed and developed a proof-of-concept prototype of an integrated, easy-to-use learning experience platform for Silicon Beach Australia in partnership with THNK.Innovation.

The solution integrates an AWS S3 backend into a Webflow front-end, allowing users to create online courses with shared content, upload and share files, and update notifications if shared content changes.

They also delivered documentation for setting up and configuring the prototype, as well as an overview of encountered technical risks, open issues and future recommendations.

Project lead: Ingo Mueller

Industry partners: THNK.Innovation



Analysis of the ACT Matrix for its suitability for identifying diverse user needs of online exam system

In recent years, universities have started shifting from paper-based exams to online. However, these depart from a well-understood century-old paradigm, potentially violating human values such as safety, privacy or self-determination, impacting how students perform to their potential.

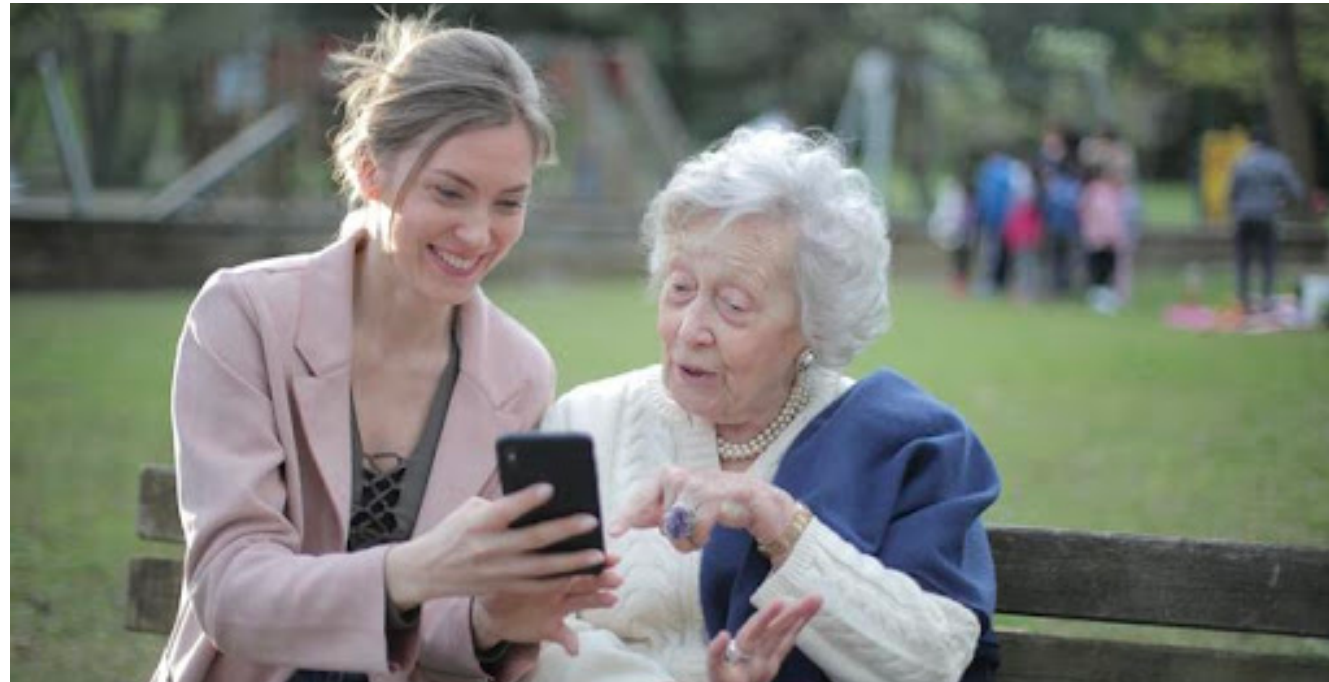
We wanted to determine whether applying the ACT Matrix – a psychological self-assessment tool – was suitable to minimise value violations in online exams. To do this, we surveyed students in the Monash eExam system.

Using the Matrix, students were invited to reflect on their most recent exam experience with respect to their values, violations and related behaviours. They were also prompted to link elements of their Matrices to user stories to describe improvement requests for the system. Preliminary results indicate that the ACT Matrix is a suitable tool for the analysis of end user needs, but its administration poses challenges.

Further research is required to substantiate our findings and the results from this project will be published in a scientific paper.

Project lead: Ingo Mueller

Collaborators: Paul McIntosh (eSolutions), Waqar Hussain (Data61)



[Design and development of a digital literacy tool for senior Australian citizens](#)

Many senior citizens struggle to keep up with today's fast-paced technological changes, resulting in low digital literacy and subsequent social exclusion. Existing online training programs such as Be Connected by the Australian Government fail to provide engaging resources that encourage seniors to improve their skills.

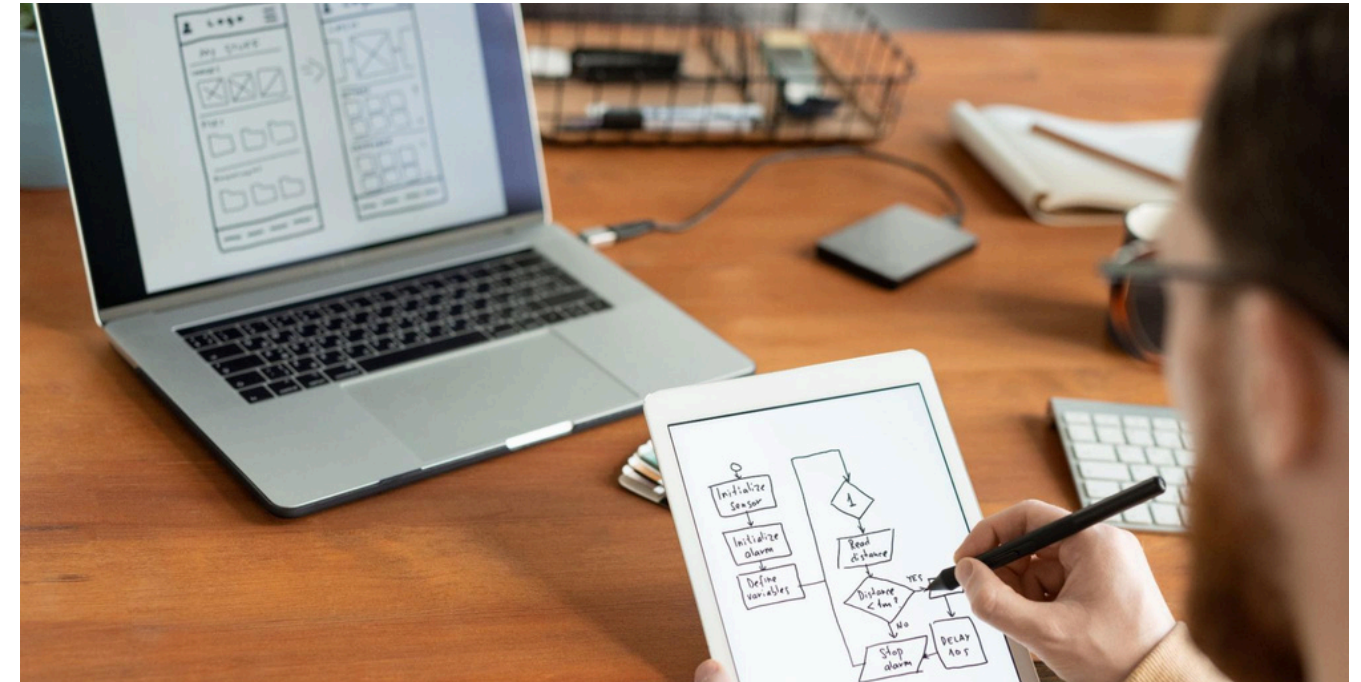
To address this issue, a bespoke interactive digital literacy resource with ShapingConnections, Monash Art, Design and Architecture (MADA), and U3A.

Teams of Master of Interaction Design students used Human-Centred Design to develop design prototypes for a scenario involving accessing an online pharmacy. Working with U3A, they incorporated feedback from seniors which revealed that participants enjoyed using avatars and quizzes but were concerned about privacy risks.

To address privacy concerns, an offline training resource was developed for safe use in U3A's teaching facilities. Plans include refining the prototypes with a wider audience and evaluating a software prototype in real-world conditions.

Project lead: Ingo Mueller

Collaborators: Jeffrey Janet (Faculty of Art, Design and Architecture), Bernardo Figueiredo and Torgeir Aleti (ShapingConnections / RMIT), University of the Third Age (U3A)



[MDE4aUI: model-driven engineering for accessible user interfaces](#)

The user experience of software applications for people with special needs is often limited because their requirements are overlooked, treated as an afterthought or addressed with simple one-size-fits-all solutions.

Model-driven engineering (MDE) approaches to software development (often called 'low-code' or 'no code' development in industry) have the potential to help software developers build accessibility into their applications by default.

We explored state-of-the-art MDE approaches for creating accessible software applications, identifying gaps and open challenges, and reporting them in a systematic literature review journal paper.

Project lead: Ingo Mueller

Collaborators: Hourieh Khalajzadeh (Deakin University), Judith Michael and Lukas Netz (RWTH Aachen, Germany), Shavindra Wickramathilaka (PhD student)



Identification of age-related accessibility needs in mobile apps

Many senior citizens struggle to use mobile applications (apps) effectively because they are often developed without addressing age-related needs, such as vision impairments, cognitive difficulties, decreased motor skills and other requirements. This consequently leads to seniors experiencing stigmatisation and the risk of being disconnected from family, friends and society at large.

In 2022 we embarked on the first step of building inclusive apps that meet age-related accessibility requirements: Identifying and understanding these needs in the community.

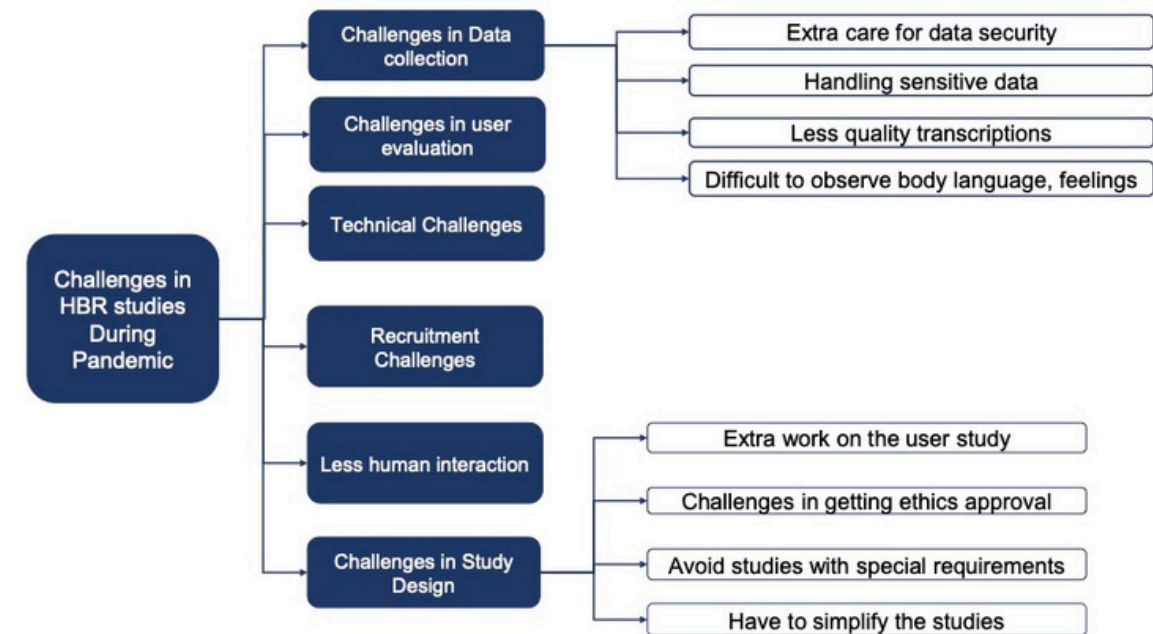
In collaboration with the U3A, we carried out a qualitative focus group study, collecting data at multiple campuses across Melbourne to ensure a representative sample. We will then analyse the data with a thematic analysis and interpret it using a Grounded Theory framework. If necessary, follow-up interviews will be conducted to gain deeper insights.

We will publish our research in a scientific paper and this will contribute to training PhD students.

Project lead: Ingo Mueller

Collaborators: Shavindra Wickramathilaka (PhD student)

Industry partners: University of the Third Age (U3A)



Influence of the pandemic on software engineering researchers

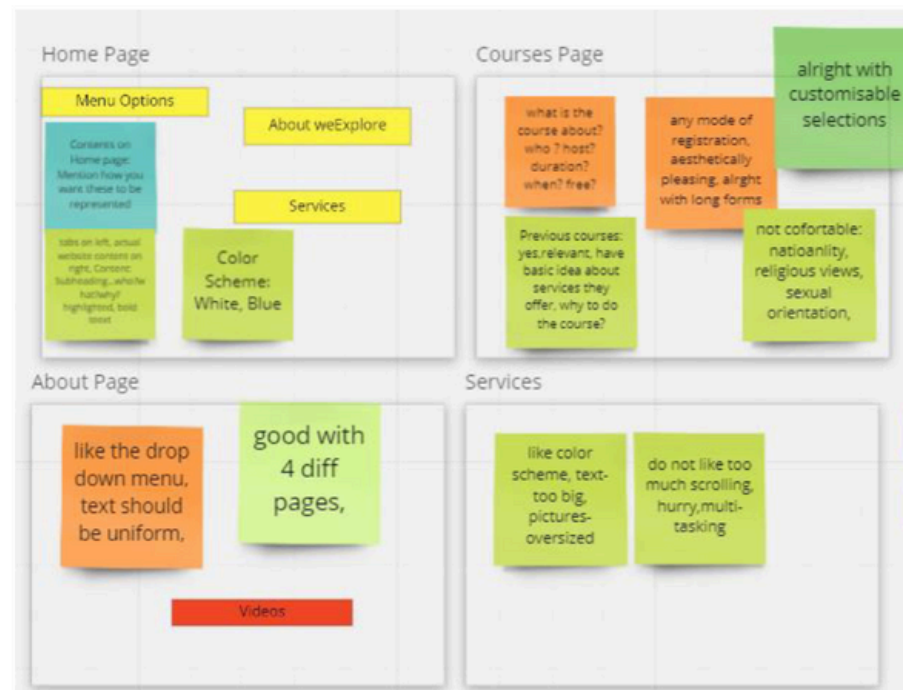
The COVID-19 pandemic changed the way we live, work and conduct research. The impact of lockdowns and social distancing was severely felt by researchers who normally interact closely with people, such as empirical software engineering researchers.

We surveyed 89 empirical software engineering researchers to understand the extent of this impact. Our findings revealed that many overcame the challenges by adapting their methods of recruiting participants, collecting data and designing their studies – with 30% sharing that they didn't want to revert back to 'the old ways' of doing human-based research.

We created a model linking the challenges, adaptations and benefits driven by the pandemic. We also recommended ways to conduct effective, remote human-based studies when face-to-face interaction is not possible or there are geographically diverse participants.

Project lead: Anuradha Madugalla

Collaborators: Tanjila Kanij, Rashina Hoda, John Grundy, Dulaji Hidellarachchi, Aastha Pant



Adaptive UI based on persona

End users have myriad user interface (UI) preferences for software based on their age groups, culture, personality, values, digital literacy and other factors. Current development tools have not successfully created UIs that can alternate based on different preferences.

To help developers meet the diverse needs of end users, we proposed an approach which embeds UI creation and adaptability of software UI based on different user facets.

We conducted broad-scale surveys and interviews of an existing website to understand different user facets and UI preferences. We then developed three personas and a UI prototype for each one, which were evaluated by 10 participants resulting in mixed responses.

Project lead: Tanjila Kanij

Collaborators: Yutan Huang and Shruti Mahajan

Developing software for end users with low socio-economic status

As part of PROTIC II, we conducted exploratory research to develop software for fisherfolk in Bangladesh. Due to their low socio-economic status, low digital and general literacy, and other similar factors, it was important to understand the unique characteristics of the end users before designing software.

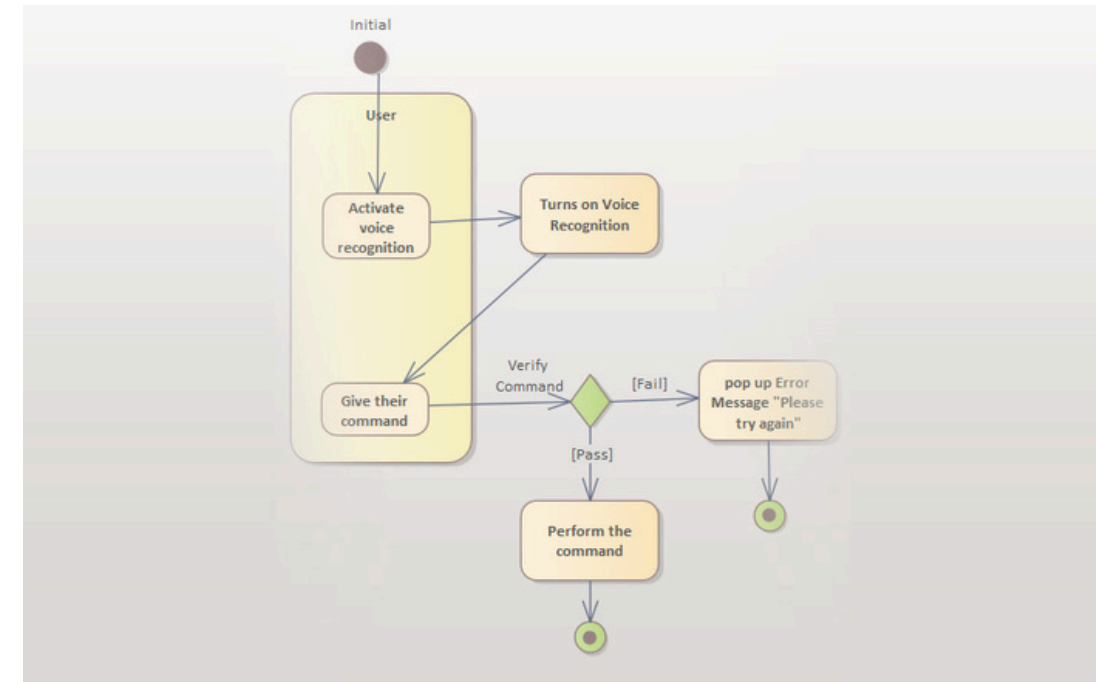
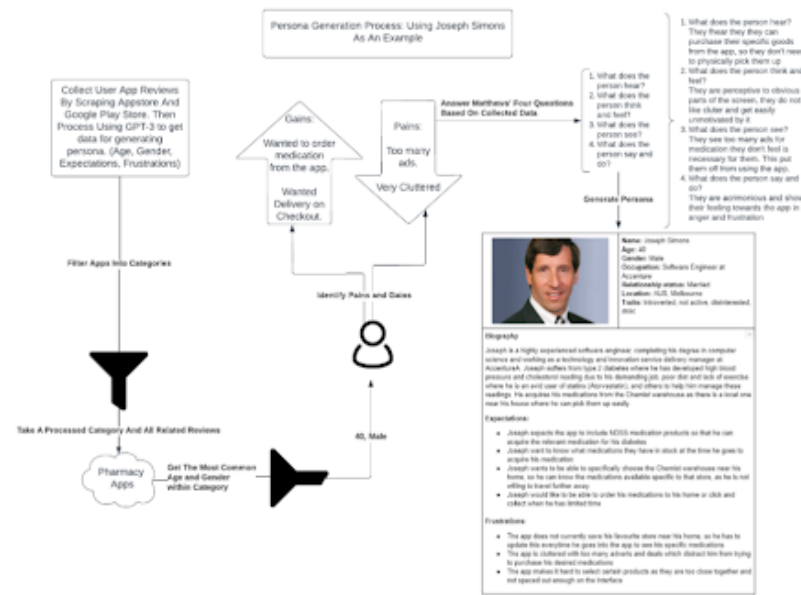
After reviewing literature and hearing from experts who work closely with fisherfolk, we identified that senior boat captains possess important knowledge that are not systematically transferred to apprentice captains.

We conducted a number of focus groups with the captains and adopted a co-creation process to design a prototype software for record-keeping and sharing of tacit knowledge among them.

In our report we proposed specific recommendations for future software development for end users from low socio-economic backgrounds.

Project lead: Tanjila Kanij

Collaborators: John Grundy, Gillian Oliver, Md Khalid Hossain, Misita Anwar



Developing persona from app reviews

End users are diverse by nature and their different backgrounds influence the way they use software. To understand their unique needs, we need to engage with them during requirement engineering, for example through user application reviews.

However, recruiting User App users during the requirement engineering phase can be challenging.

We proposed an innovative approach to develop user personas from a dataset of e-commerce application user reviews by using GPT-3 and PATHY. This allows software development teams to see different demographic data, as well as overall frustrations and expectations that their platform's users have so they know how to enhance their solutions. This will also be helpful to those developing new e-commerce applications.

Project lead: Tanjila Kanij

Collaborators: Kevin Balapitiya, Dylan Clements, Fi Crowe, Elysia Giannis, Jason Marshall, Paul Papadopolous

Semi automated test case generation from persona

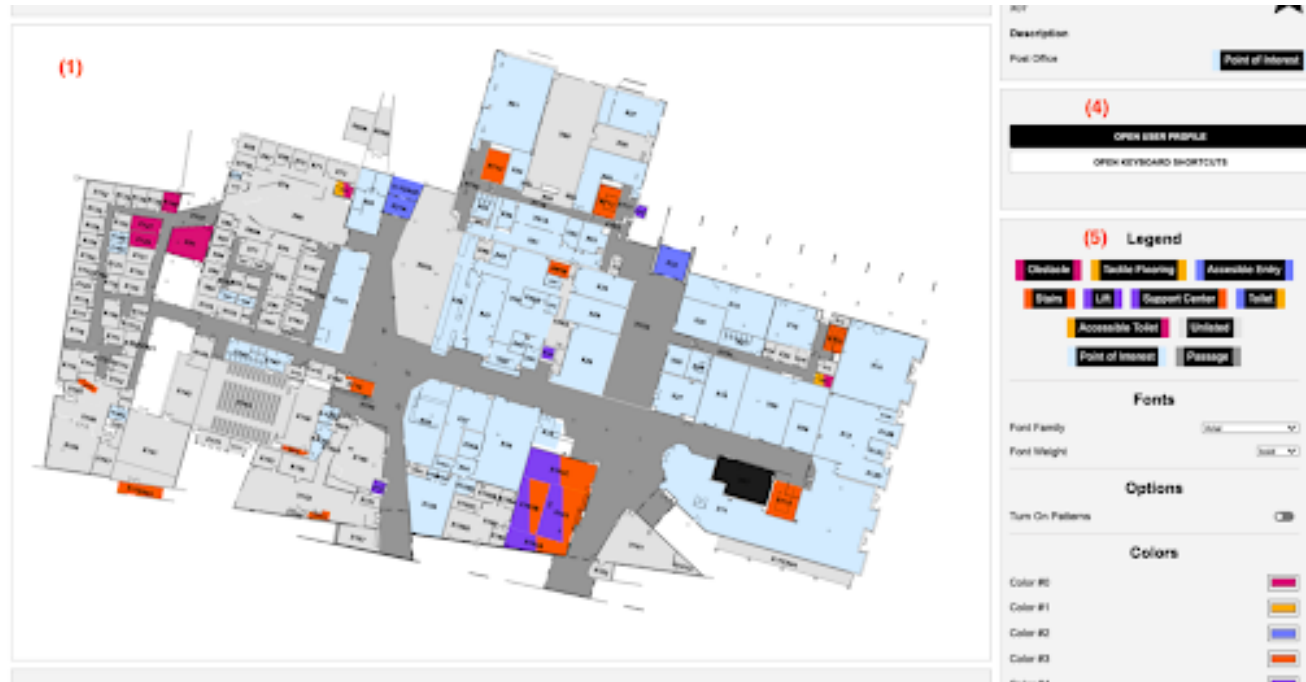
Understanding end user preferences and integrating them into usability requirements is crucial for effectively testing the usability features in software. This can be achieved by generating test cases relevant to personas which offer insights into possible needs, goals, pain points and more.

In most software initiatives however, usability features are overlooked due to the time and resources it takes to test them.

We proposed a semi-automatic framework that generates usability test cases from personas. It focuses on automating certain parts of usability testing to speed up the process and minimise the risk of missing major issues. We also analysed the current implementation of the framework, discussed its potential and future improvements, and tested modules to maintain coherence and quality assurance.

Project lead: Tanjila Kanij

Collaborators: Shafia Husna, Abhijeet Mondal, Guo Ng



Adaptive accessible floorplans

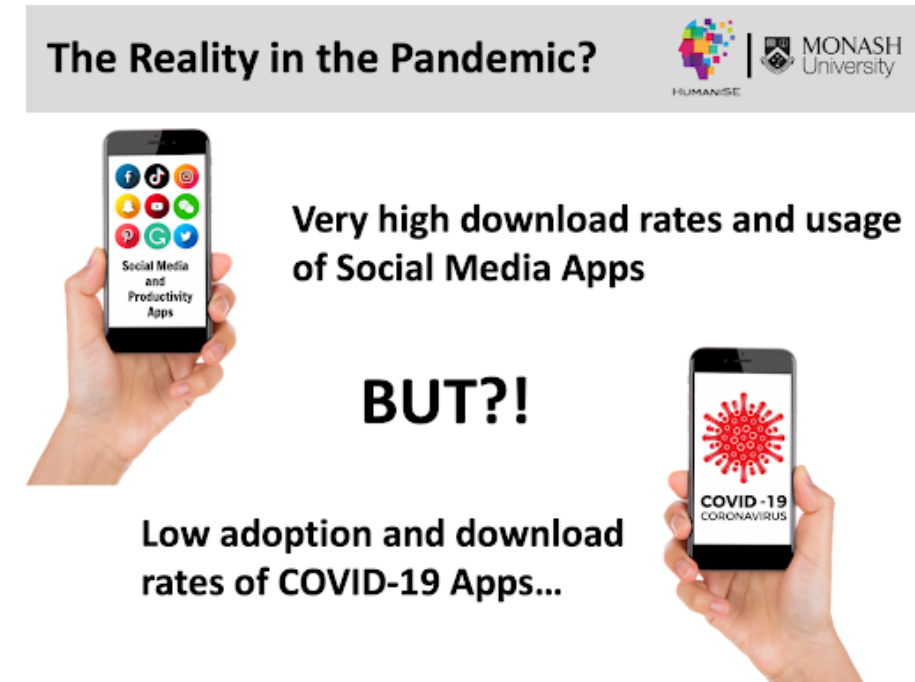
This research investigates how floor plan graphics can be improved to support adaptability, in order to better address the accessibility needs of users with disabilities, including low and colour vision impairments, dyslexia and mobility needs.

We propose augmenting Scalable Vector Graphics (SVG)-based floorplans to enable a suite of accessibility features. This solution queries the user's accessibility needs and adapts its colours, fonts and points of interest accordingly.

A study was also conducted involving two users with physical disabilities, and a secondary evaluation of the tool was undertaken with 12 participants who adopted personas representing one or more of our target groups.

Project lead: Anuradha Madugalla

Collaborators: John Grundy



Better addressing diverse accessibility issues in emerging apps: A case study using COVID-19 apps

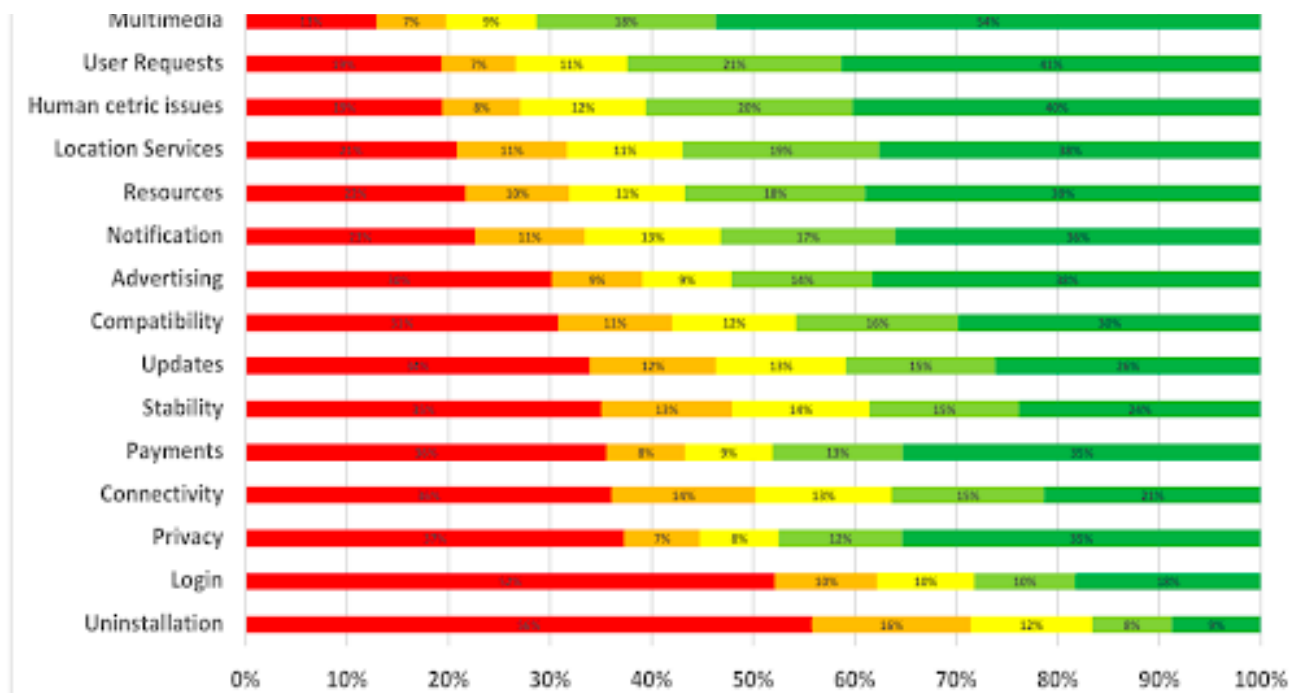
In response to the COVID-19 pandemic, there was a rapid surge in 'emerging apps' to the market. This will likely recur in future upcoming emergencies such as bushfires, floods and future pandemics.

We carried out an in-depth analysis of user reviews and version history release notes for 30 COVID-19 apps that were developed and deployed quickly in 2020. From this, we identified many diverse accessibility issues, including the ability to register, access, download and use apps from different stores, countries and for different end-users.

From this large-scale analysis, we developed a new advisory tool for software developers of 'emerging apps' to avoid many of the aforementioned issues.

Project lead: Omar Haggag

Collaborators: John Grundy, Mohamed Abdelrazek, Sherif Haggag



A large scale analysis of mHealth app user reviews

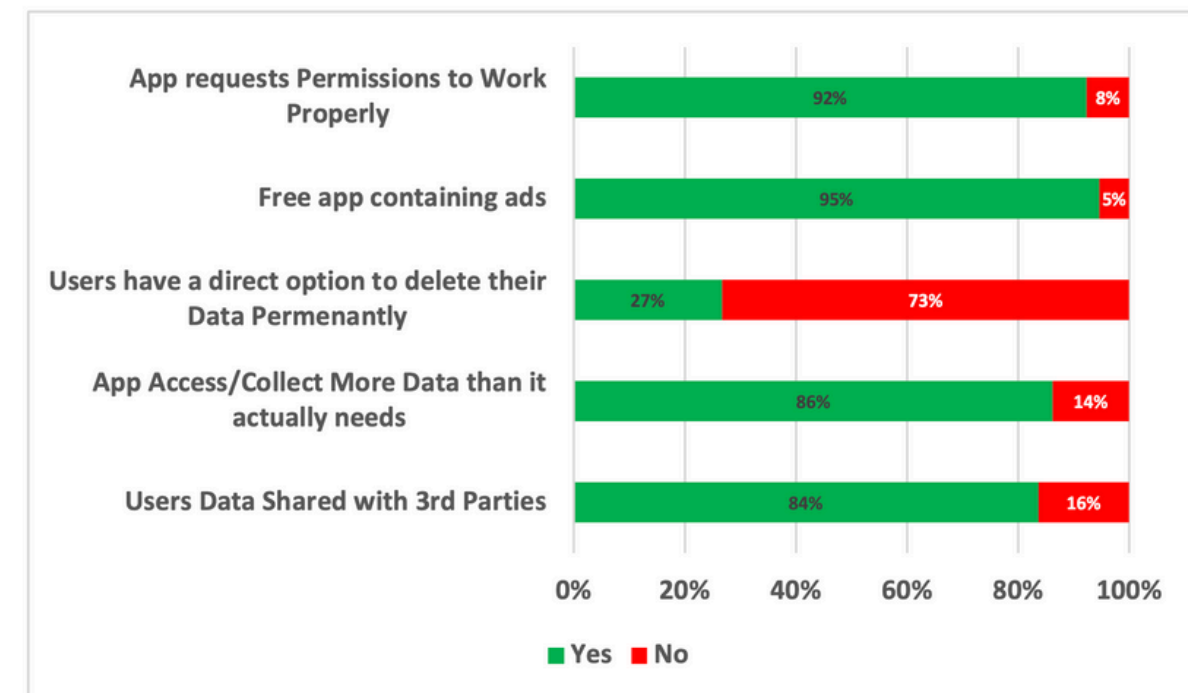
Since the COVID-19 pandemic, the global mHealth app market has rapidly expanded. But based on user reviews, many of these have serious issues. User reviews are a key method for developers to improve the quality and uptake of their apps – however many are limited in scope, size or analysis.

We extracted and translated over 5M user reviews across 278 mHealth apps, classified them into 14 categories of issues and examined the results. Based on our findings, women's health apps had the highest satisfaction ratings while fitness activity tracking apps received the lowest and most unfavourable ratings.

In our report we delved into the specific aspects of fitness apps that users found unsatisfactory and proposed recommendations for mHealth app developers.

Project lead: Omar Haggag

Collaborators: John Grundy, Mohamed Abdelrazek, Sherif Haggag



Better analysis of privacy Issues in eHealth apps

Some work has been done to analyse the privacy policies of mobile apps, however, no work has been done to deeply understand and analyse the most common privacy issues reported in eHealth app user reviews on a large scale. We wanted to identify the challenges that users face while reading and reviewing the privacy policies of eHealth apps and let them end up accepting the privacy policies and data use agreements without fully understanding them or knowing how app creators use users' collected data.

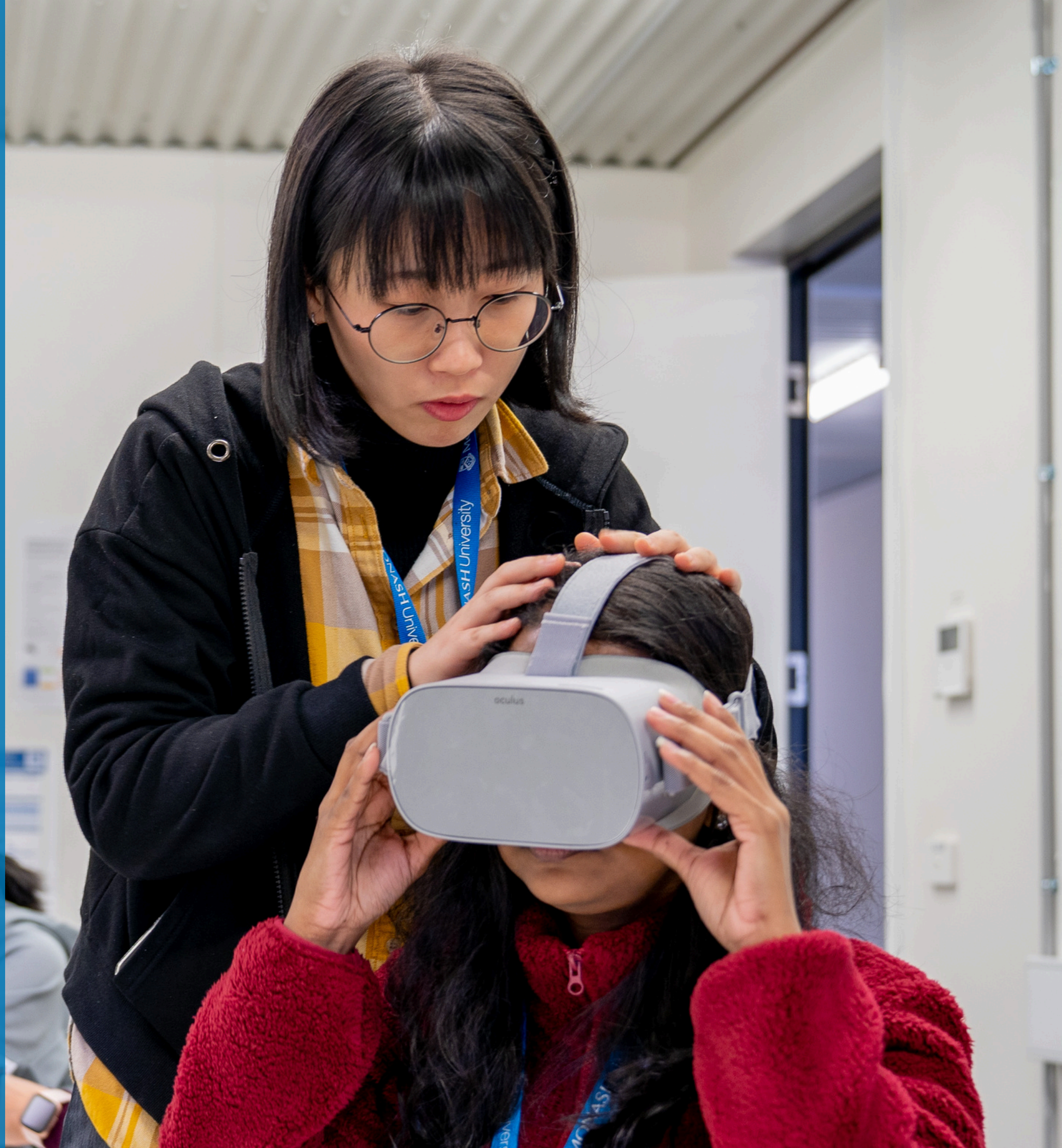
In this study, we did a large-scale detailed analysis of privacy policies and data use agreements of commonly used eHealth apps. We found that better approaches are needed to ensure that users are fully aware of the apps' privacy policies before using them. Also, we developed a tool to calculate the readability of privacy policies and the estimated time users need to fully read them. We found that most eHealth apps' privacy policies are complex and require over 15 minutes to be read by users. In addition to providing evidence-based recommendations for developers of eHealth apps to ensure that their app descriptions and policies are better understood by users.

Project lead: Omar Haggag

Collaborators: John Grundy, Mohamed Abdelrazek and Sherif Haggag

NOTABLE STUDENT-LED PROJECTS

We have over 24 PhD candidates, as well as several FIT4003 student teams and master's and honours projects. In 2022, nine PhD students and two external students successfully finished their studies. On top of their theses, our students are also involved in other key activities across the Lab – such as staff-led initiatives, mentoring, professional development, events and symposia.





Addressing age-related accessibility needs of senior users though model-driven engineering

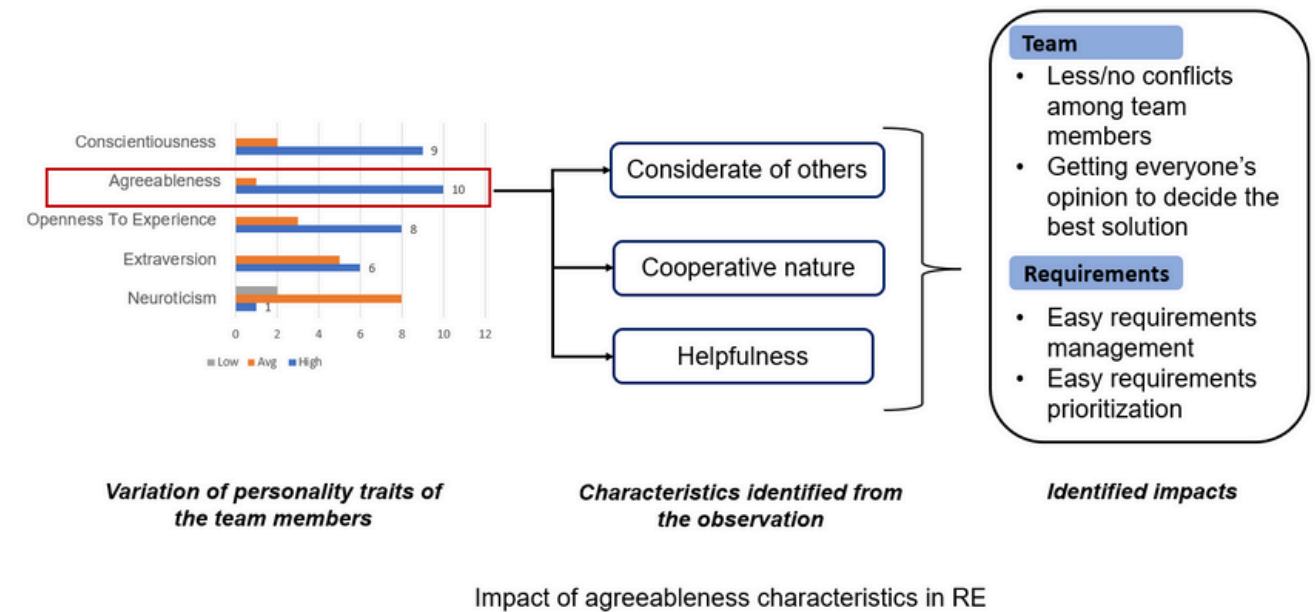
Age-related user interface (UI) needs of seniors are often not properly accounted for in software applications, resulting in many facing accessibility barriers. While existing solutions propose model-driven engineering based UI adaptations, they lack thoroughness when it comes to integrating accessibility.

We propose a model-driven and accessible-adaptive UI development approach that is Web Content Accessibility Guidelines (WCAG) compliant by:

- eliciting age-related UI accessibility-adaptation requirements from senior users
- designing domain-specific languages (DSL) to model diverse accessibility scenarios
- developing a model-driven process pipeline to generate compliant and executable UI from software models defined with the novel DSLs
- evaluating the generated UI in a user study for improvements.

Project lead: Shavindra Wickramathilaka

Collaborators: Ingo Mueller, John Grundy



eSolutions team observations — a case study on identifying the influence of personality and motivation on requirements engineering (RE)-related activities

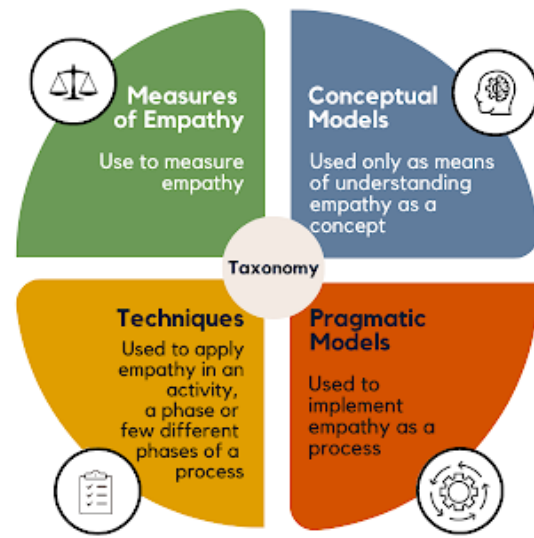
Previously we identified the importance of observing software development teams to examine how they are involved in RE-related activities in practice. In this study, we identified challenges they face due to personality and motivational factors, and how we can improve RE and software engineering activities.

We collaborated with Monash eSolutions, shadowing their meetings, conducting personality tests and running interviews. From our analysis we identified the top traits and characteristics of the group and how their personality differences impact their motivation for work.

Our findings will be used to enhance our theoretical framework, strategies and guidelines developed in prior studies.

Project lead: Dulaji Hidellaarachchi

Collaborators: Monash eSolutions, John Grundy, Rashina Hoda, Ingo Mueller



Investigating the Influence of Empathy on Developer-User Interactions in Software Engineering

Empathy is an under-researched concept within software engineering. There are many diverse models, frameworks, techniques and measures, but no proper taxonomy to distinguish them.

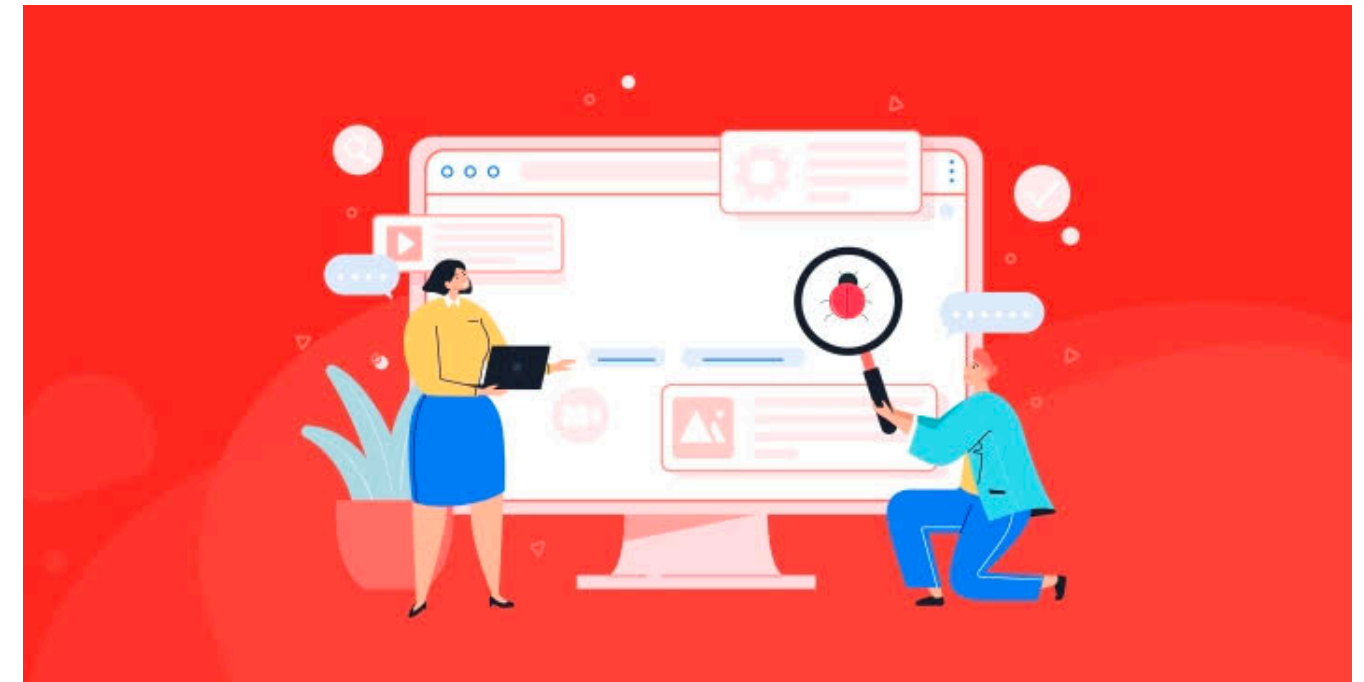
We have developed a preliminary empathy taxonomy consisting of four categories:

- Models of Empathy (conceptual models) to understand empathy as a concept
- Models of Empathy (pragmatic models) to implement empathy as a process
- Techniques of Empathy to apply empathy in an activity or process (as one or several phases)
- Measures of Empathy to assess empathy levels.

Our report also contained suggestions for future research into empathy in software engineering.

Project lead: Hashini Gunatilake

Collaborators: John Grundy, Rashina Hoda, Ingo Mueller



How do software developers and reporters currently perceive human-centric defects?

Human-centric defects (HCDs) are flaws in software caused by variations in user characteristics such as age, gender, culture and disabilities.

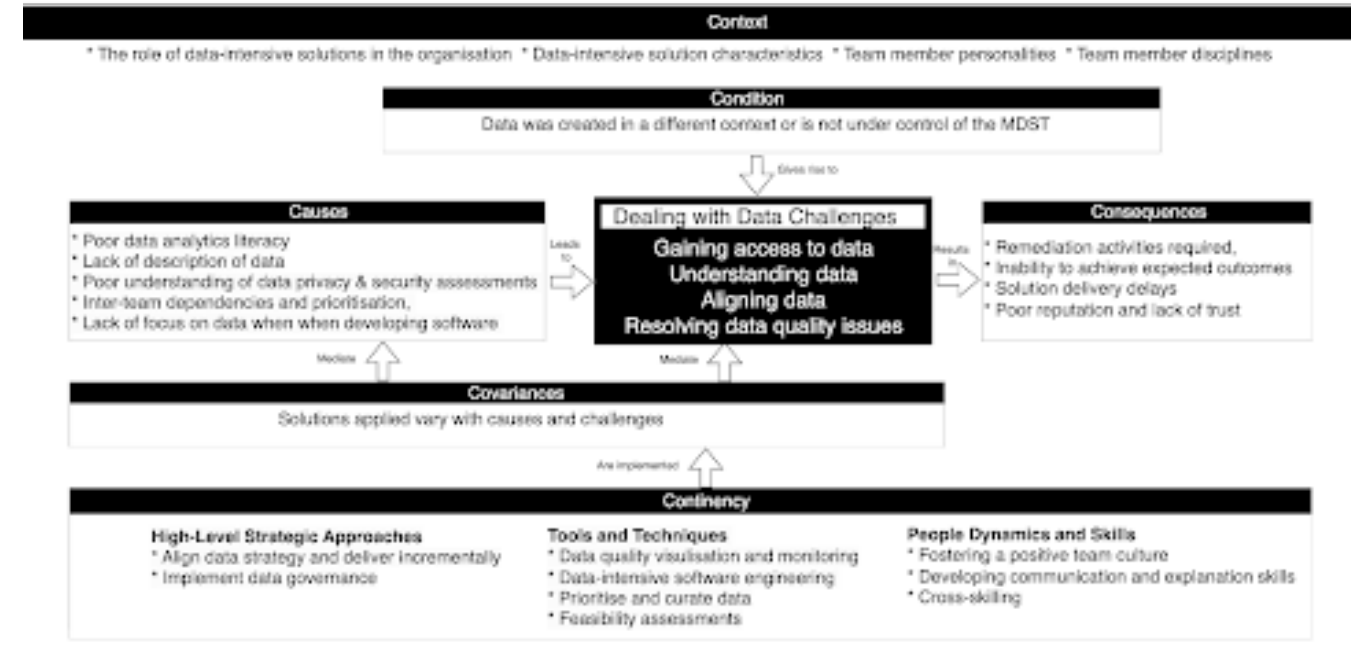
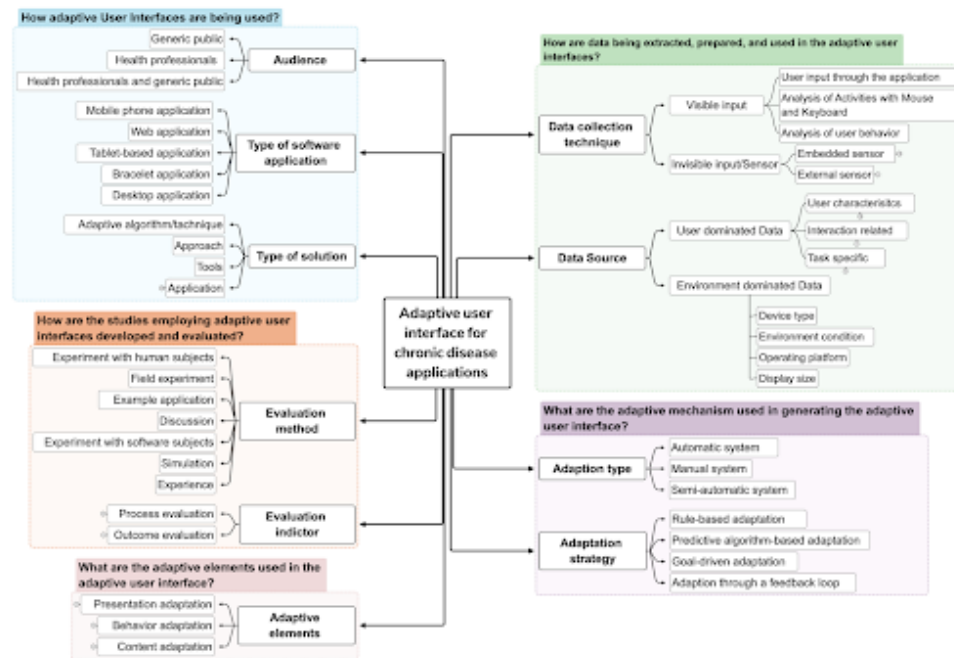
This project aimed to understand how software practitioners perceive HCDs as well as the challenges they face in reporting, understanding and fixing them. It also provided recommendations for managing HCDs.

Through surveys and interviews with practitioners, we found gaps in managing HCDs due to a lack of awareness and attention to human-centric aspects in software development.

We recommend a feedback process with end-users, a descriptive taxonomy and automation to improve the handling of HCDs. Our report also highlights the need for more awareness and support in the software engineering community regarding human-centric aspects.

Project lead: Vedant Chauhan

Collaborators: John Grundy, Chetan Arora, Hourieh Khalajzadeh



Towards adaptive user interfaces: A model driven approach for mHealth applications targeting chronic disease

Chronic diseases are a significant challenge for healthcare, and mHealth technologies are increasingly used for self-management. However, it's difficult to provide tailored support due to the diverse nature of the illnesses. Adaptive user interfaces (AUI) could improve these conditions.

This research used a model-driven approach to analyse existing literature, model user preferences, and evaluate the generated AUI in a large-scale study to investigate acceptance and user-friendliness.

Project lead: Wei Wang

Collaborators: John Grundy, Anuradha Madugalla, Hourieh Khalajzadeh

Dealing with data challenges with delivering data-intensive software solution

The demand for data-intensive solution development is driving the need for software, information and domain experts to effectively collaborate in multidisciplinary data-intensive software teams (MDSTs).

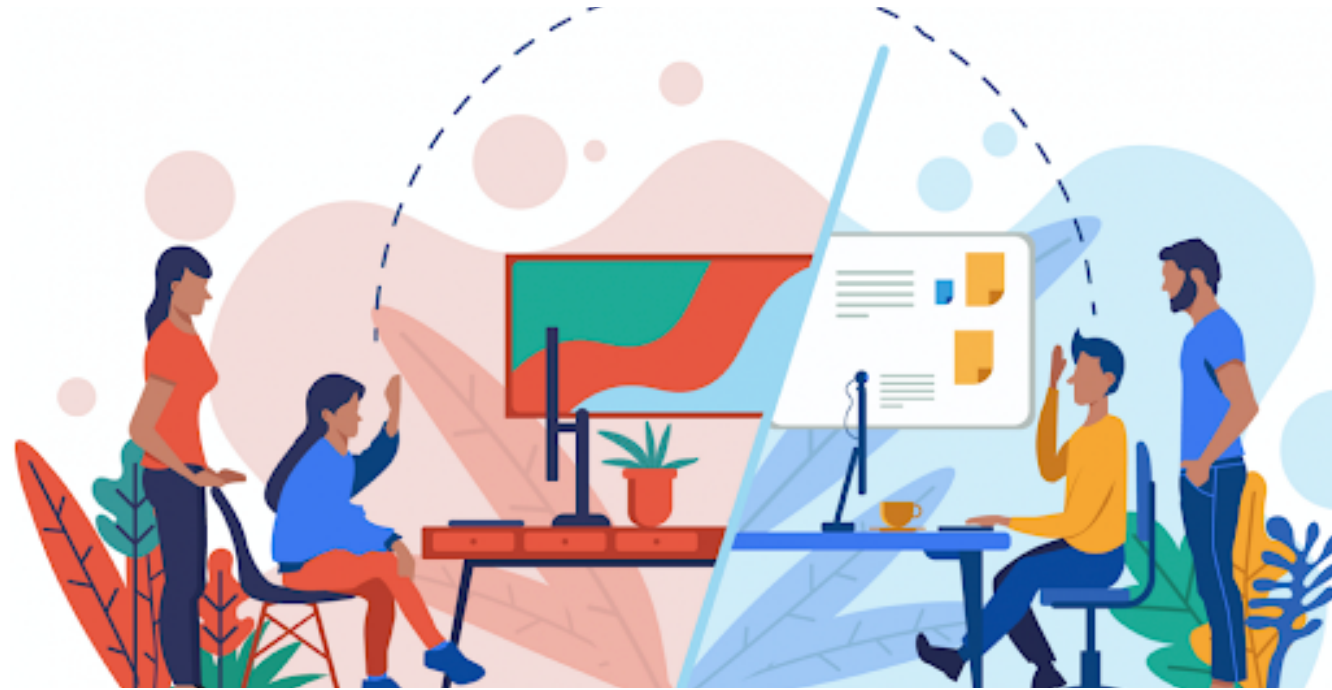
We conducted a socio-technical grounded theory study to better understand the issues these teams face when delivering such software solutions. Key concerns were around addressing data-related challenges.

We developed a theory of dealing with these problems that explains the challenges faced by MDSTs and identified contingencies or strategies to overcome them.

Our findings have direct implications for practitioners and researchers to better understand the landscape of data challenges.

Project lead: Maria Graetsch

Collaborators: Hourieh Khalajzadeh, Mojtaba Shahin, Rashina Hoda, John Grundy



Human-centric tool for software engineering researchers

In software development, producing human-centric solutions relies heavily on conducting effective research with diverse groups of participants, yet researchers perceive and experience many barriers in this process.

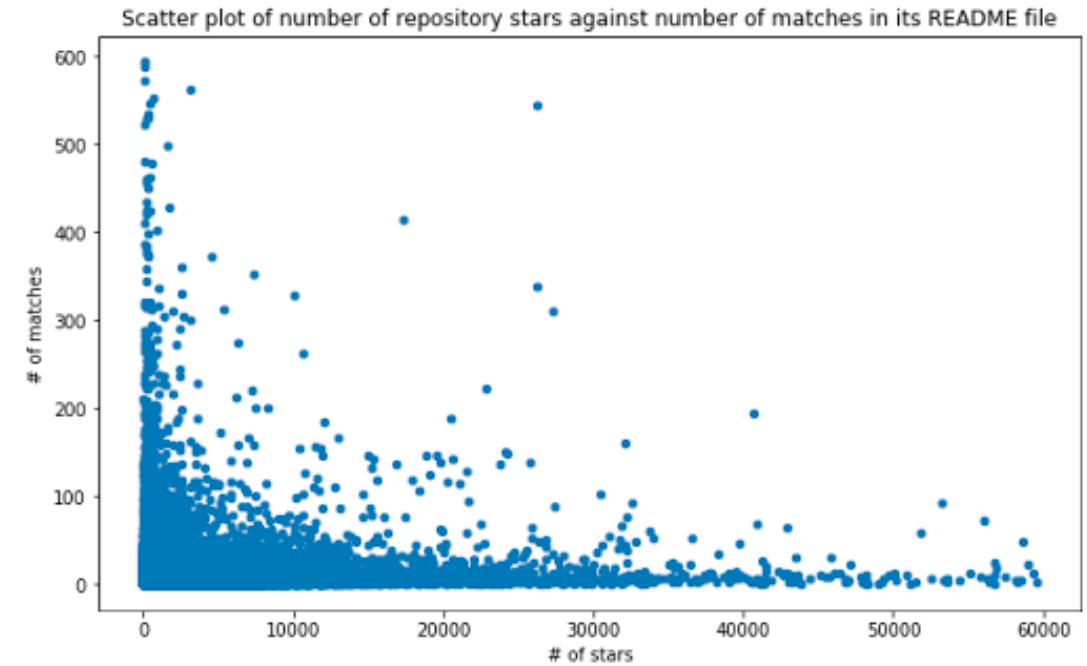
This project focused on building a tool to facilitate knowledge sharing within the community concerning best practices for conducting research with specific end-user cohorts. It aims to allow researchers to easily identify the appropriate framework and tools.

The tool was evaluated via surveys and interviews conducted with experienced software engineering researchers, which revealed that there's a strong need for establishing and sharing top practices. While the tool in its current state demonstrated potential to improve outcomes, there is further work needed.

The improvements would ensure the tool provides relevant insights for a variety of research demographics and that its content remains relevant over time.

Project lead: Anuradha Madugalla, FIT4003 students

Collaborators: Tanjila Kanij



A pattern matching analysis of non-inclusive language in README files

In recent years, there has been growing interest in inclusive, bias-free communication among tech firms and the software industry – with a particular emphasis on technical documentation.

With a focus on open-source software, this project aimed to classify non-inclusive language into categories and develop a prototype tool that uses data intelligence and natural language processing to detect and address areas of concern.

Our research found that over 72 percent of artefacts contained some form of non-inclusive language, indicating a widespread problem.

The tool's effectiveness was evaluated using a heuristic evaluation methodology.

Project lead: FIT4003 students

Collaborators: John Grundy



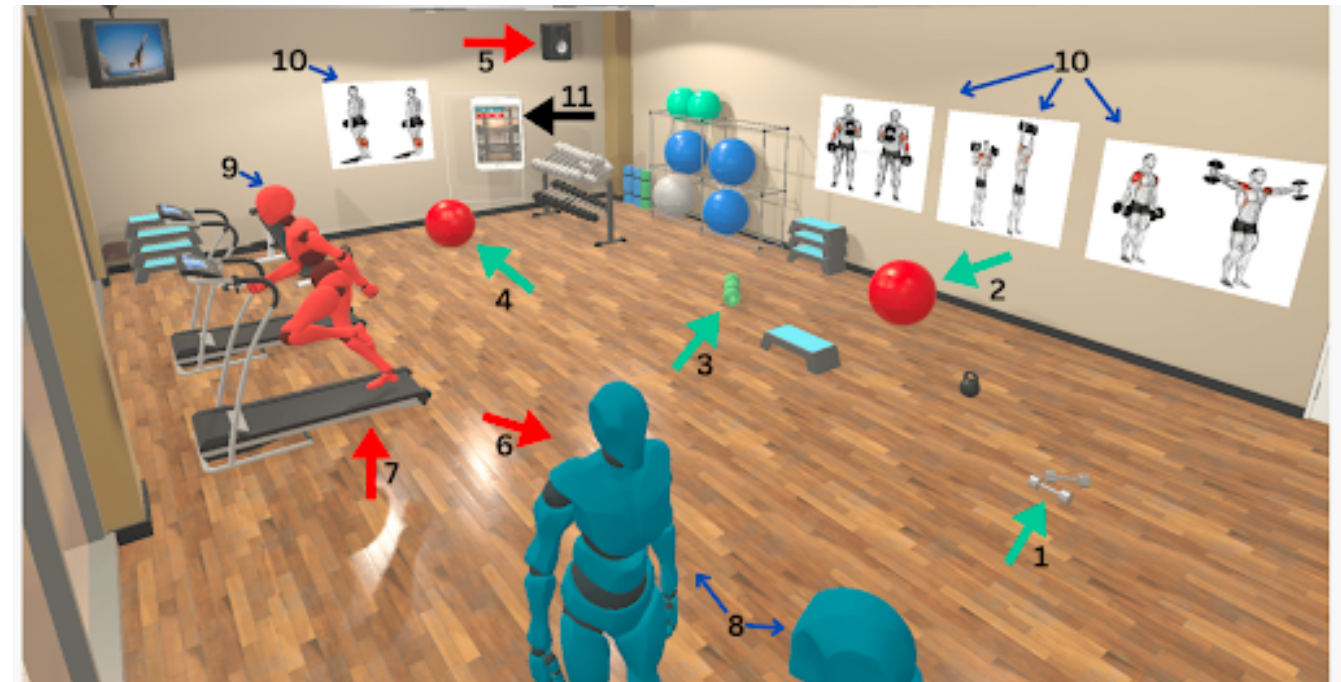
Motive Metrics: A Jira plug-in for personality, motivation and performance tracking

We developed a prototype application called Motive Metrics to improve requirements engineering activities by allowing managers to track developer personalities and motivations, as well as their impact on performance and satisfaction.

An extension to Jira, the tool was created through rapid prototyping and then its effectiveness and usability were evaluated by student teams split into managers and members. 18% of participants rated 5 and 45% rated 4, indicating that the tool functionally captures developer outcome metrics.

Project lead: FIT4003 students

Collaborators: John Grundy, Dulaji Hidellaarachchi



An empathetic approach to human-centric requirements engineering using virtual reality

We explored the use of virtual reality (VR) in assisting software engineers to better understand the perspectives of the end user for the purpose of human-centric requirements elicitation, with a focus on users diagnosed with attention-deficit/hyperactivity disorder (ADHD).

We conducted a pilot experiment using a virtual gym environment, instructing the participants to complete activities while facing visual and auditory distractions similar to symptoms of ADHD.

Results indicated an increase in understanding the perspectives of someone with ADHD and an awareness of potential challenges with software not intentionally designed for such users.

Project lead: FIT4003 students

Collaborators: John Grundy



Secure coding for software developers

Software security continues to be a matter of concern for both end-users and developers. The cost of potential lapses is expected to become larger as software plays a larger role in society. And, organisations are not achieving the expected success rate despite investments in secure coding training programs. One often overlooked reason for this is that current initiatives are not tailored to consider diversity among software developers relating to human aspects.

In this research, we gathered data from developers of various backgrounds on their perceptions of secure coding training and their needs for such a program. Barriers they may encounter when learning from these programs were also considered.

The findings of this paper suggested that developers:

- with personality traits of agreeableness tend to ignore secure coding standards
- with more work experience tend to demand storage management, responsible use of privileges, security and privacy laws, and testing topics to be included
- with personality traits of openness tend to demand hands-on training to be included.

This study's findings will help future researchers and organisations design more adaptive secure coding programs that suit diverse developers.

Project lead: Anuradha Madugalla, FIT4003 students

Collaborators: Tanjila Kanij, Asangi Jayatilaka

RESEARCH ENGAGEMENTS AND INSIGHTS

From presentations to papers, throughout 2022 we shared our research insights to the broader community in a variety of ways.



Presentations and talks

- Selic, B., **Software with a Human Face – Educating the Next Generation of Software Professionals**, Malardalen University
- Selic, B., **A Retrospective of Lessons Learned from 50 Years of Involvement in Industry Academia Collaborations**, Malardalen University
- Selic, B., **Facing Uncertainty in the Design of Complex Software Systems**, Malardalen University
- Selic, B., **What's Wrong with 'Users'?**, HuFaMo-2022 Workshop, MODELS 2022
- Grundy, J., **A curated personas and design guidelines tool for better supporting diverse end users**, COMPSAC 2022
- Kanij, T., **Human Aspects of Software Engineering**, ICCSET (International Conference on Computer Science and Engineering Technology) 2022
- Grundy, J., **Human-centred Software Engineering**, University of Technology Sydney, March 2022
- Hidellaarachchi, D., Grundy, J., Hoda, R., Mueller, I., **The Influence of Human Aspects on Requirements Engineering-related Activities: Software practitioners' Perspective**, (ESEC/FSE 2022: Journal-first Track). November 2022
- Hoda, R., **Socio-Technical Grounded Theory for Software Engineering**, Journal First Talk, ICSE 2022
- **WholsAgile – Watch Here** featuring Rashina Hoda, interviewed by Yves Hanoulle
- Hoda, R., **“Demystifying AI: Your Top Concerns”** Panel presented by Monash Tech Talks as part of the Melbourne Knowledge Week, May 2022



Key papers

- Zhai, Q., Kanij, T., Grundy, J.C. [An investigation of factors influencing online shopping behaviors in the context of China and Australia](#), November 2022
- Haggag, O., Grundy, J., Abdelrazek, M., Haggag, S. [A large scale analysis of mHealth app user reviews](#), October 2022
- Sun, X., Chen, X., Zhao, Y., Liu, P., Grundy, J.C., Li, L. [Mining Android API Usage to Generate Unit Test Cases for Pinpointing Compatibility Issues](#), October 2022
- Liu, P., Sun, X., Zhao, Y., Liu, Y., Grundy, J.C., Li, L. [A First Look at CI/CD Adoptions in Open-Source Android Apps](#), October 2022
- Anderson, L., Barker, B., Reid, A., Lin, K., Khalajzadeh, H., Grundy, J.C. [Node-Read: A visually accessible low-code software development extension](#), October 2022
- Khalajzadeh, H., Grundy, J.C. McIntosh, J. [Vision: Developing Collaborative Model-Driven Apps for Personalised Care Plans](#), October 2022
- Obie, H.O., Ho, D., Avazpour, I., Grundy, J., Abdelrazek, M., Badnarz, T., Chua, C. [Gravity++: A graph-based framework for constructing interactive visualization narratives](#), August 2022
- Krishtul, S., Shahin, M., Obie, H., Khalajzadeh, H., Gai, F., Nasab, A.R., Grundy, J.C. [Human Values Violations in Stack Overflow: An Exploratory Study](#), June 2022
- Obie, H., Ilekkura, I., Du, H., Shahin, M., Grundy, J.C., Li, L., Whittle, J., Turhan, B. [On the Violation of Honesty in Mobile Apps: Automated Detection and Categories](#), May 2022
- Haggag, O., Grundy, J.C., Abdelrazek, M., Haggag, S., [Better Addressing Diverse Accessibility Issues in Emerging Apps: A Case Study using COVID-19 Apps](#), May 2022
- Liu, P., Zhao, Y., Cai, H., Fazzini, M., Grundy, J.C., Li, L. [Automatically Detecting API-induced Compatibility Issues in Android Apps: A Reproducibility Study](#), July 2022
- Liu, P., Fazzini, M., Grundy, J.C., Li, L., [Do Customized Android Frameworks Keep Pace with Android?](#) May 2022
- Zhao, Y., Li, L., Liu, K., Grundy, J.C. [Towards Automatically Repairing Compatibility Issues in Published Android Apps](#), May 2022
- M. Fazzini, H. Khalajzadeh, O. Haggag, Z. Li, H. Obie, C. Arora, W. Hussain, J. Grundy, [Characterizing Human Aspects in Reviews of COVID-19 Apps](#), May 2022
- Zhao, Y., Li, L., Sun, X., Liu, P., Grundy, J.C. [Code Implementation Recommendation for Android GUI Components](#), May 2022
- Mueller, I., Hussain, W., Grundy, J.C. [So who is impacted anyway – a preliminary study of indirect stakeholder identification in practice](#), May 2022
- Khalajzadeh, H., Shahin, M., Obie, H., Grundy, J.C., [How are Diverse End-user Human-centric Issues Discussed on GitHub?](#) May 2022
- Madampe, K., Hoda, R., Grundy, J.C., [The Emotional Roller Coaster of Responding to Requirements Changes in Software Engineering](#), May 2022
- Hidellaarachchi, D., Grundy, J., Hoda, R., & Mueller, I. (2022). [The Influence of Human Aspects on Requirements Engineering-related Activities: Software Practitioners' Perspective](#). ACM Transactions on Software Engineering Methodology, 1(1).
- Abd El-Migid, M. A., Cai, D., Niven, T., Vo, J., Madampe, K., Grundy, J., & Hoda, R. (2021). [Emotimonitor: A Trello power-up to capture and monitor emotions of Agile teams](#). Journal of Systems and Software, 111206.

Grants

Here are some key funding and projects we contribute to:

- Jul 2017 - Jun 2022: [ARC Industry Transformation Research Hub for Digital Enhanced Living](#), IH170100013, \$4M.
- Jul 2018 - Jun 2023: [ARC Research Hub for Driving Farming Productivity and Disease Prevention](#), \$9M.
- Jul 2019 - Jul 2023: [PROTIC2 - Participatory Research and Ownership with Technology, Information and Change, Empowerment Charitable Trust](#), \$2.2M.
- Jan 2020 - Dec 2024: [ARC Laureate Fellowship](#), Human-centric, Model-driven Software Engineering, \$3M.
- Jan 2020 - Dec 2022: [ARC Discovery Grant](#), Values-oriented Defect Fixing for Mobile Software Applications, \$390K.
- Apr 2020 - Apr 2027: **Building 4.0 Co-operative Research Centre**: Better buildings, new efficiencies through technology and collaboration, \$28M + Industry, ~\$15M.
- Jul 2021 - Jun 2026: **ARC Industrial Transformation Training Centre for Optimal Ageing**, \$5.5M.
- Dec 2021 - Jan 2022: [SummerTech Live](#), addressing innovative tech challenges of Victorian businesses, partnered with THINK.innovation, \$11000.
- 2021 - 2026: NHMRC Targeted Grant. SMARTERscreen: a randomised controlled trial of patient SMS messaging in general practice to increase participation in the National Bowel Cancer Screening Program. Jenkins and McIntosh, \$1.5M.
- 2021 - 2022: Monash Institute of Medical Engineering (MIME) Seed Grant, Innovative methodologies in AI-powered risk prediction and risk communication in pregnancy, McIntosh and Lim, \$50K.

- Jul 2022 - Dec 2025: **Building National Cybersecurity Capabilities for Digital Transformation in Manufacturing**, CSIRO Next Generation Technology Graduates Programme, \$1.1M.
- 2022 - 2026: **NHMRC Synergy Grant Scheme The development trial for a complex intervention to increase uptake of the National Bowel Cancer Screening Program**, Jenkins and McIntosh, \$5M.
- 2022 - 2025: **Medical Research Future Fund Optimising the delivery of antenatal interventions in public healthcare** Harrison and McIntosh, \$1.4M.
- Jan 2023 - Dec 2023: **Towards a More Inclusive Computer Science Teaching and Learning Environment**, Google Award for Inclusion, John Grundy and Tanjila Kanij, \$60K USD.
- Jan 2023 - Jun 2026: **RAISE: Creating Responsible AI Software Engineering Capability**, CSIRO Next Generation AI Graduates Programme, \$750K.



More research outputs

[Available on our website](#), the Lab also produces academic publications, industry reports and guidelines, presentations, podcasts, videos, tools and datasets for researchers, professionals and organisations to use.




Partner with the HumaniSE Lab


We're always looking for new collaborations around student placements, case studies, R&D projects and consulting.

Through the Lab, our partners gain new insights into customer satisfaction, improving team productivity, better consumer support, new product and services management – and more. We help them resolve their key challenges and prepare to meet their future workforce needs.

Let's get started

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 HumaniSE Lab

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The information contained in this report was correct at the time of publication (June 2023).
Monash University reserves the right to alter this information should the need arise.