

Software requirements for **diverse** groups – the value of Design patterns

Prof Ita Richardson
Department of Computer Science &
Information Systems, University of Limerick



HOST INSTITUTION



PARTNER INSTITUTIONS



Talk outline

- Introduction
- Who are diverse groups?
- Research with diverse groups
- Challenges and enablers for software researchers
- Conclusion

Prof Ita Richardson



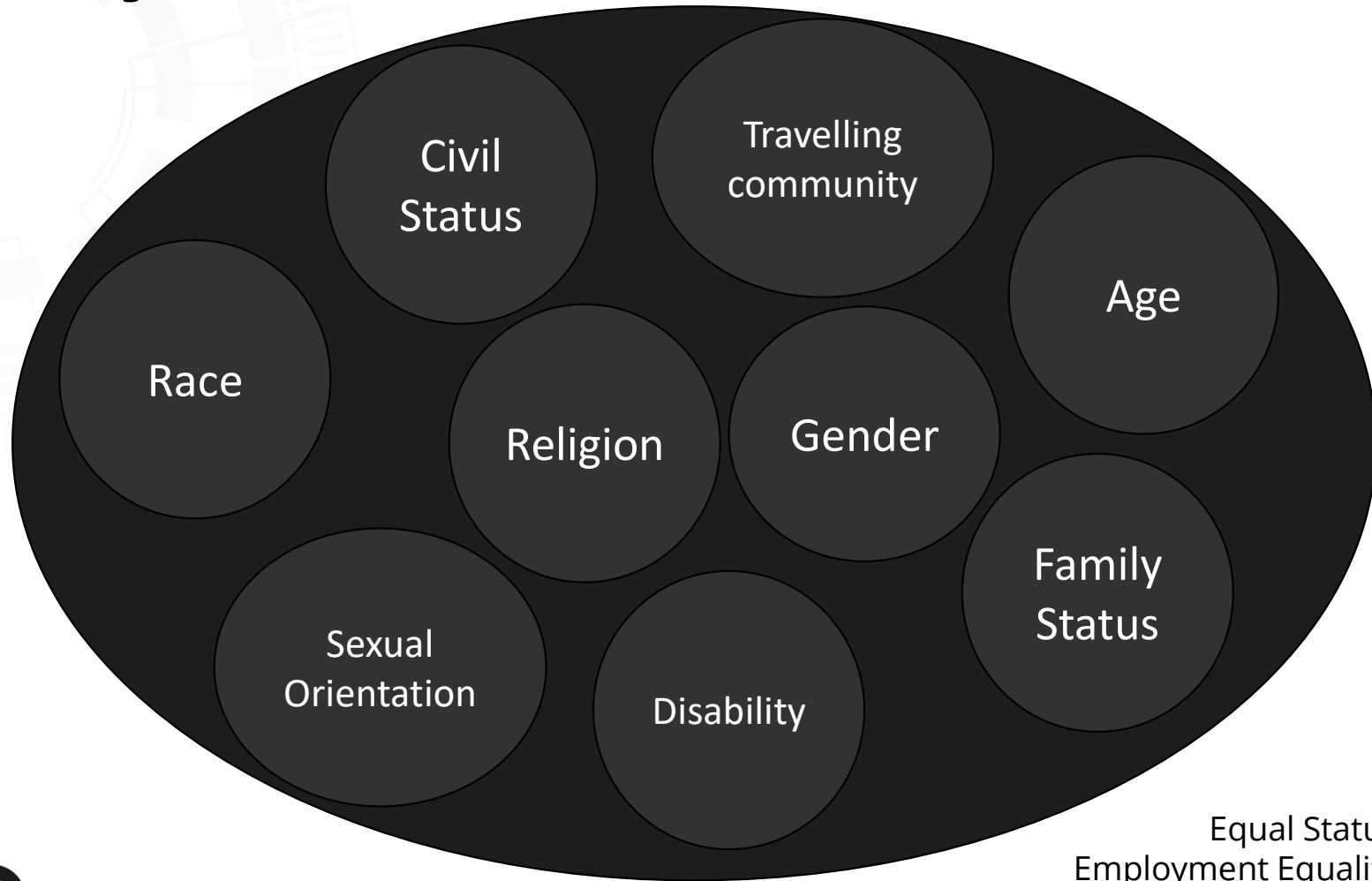
- Research: Global Software Development / Connected Health (Digital Health) Research
- Evolution of software process and healthcare process
- Interdisciplinary:
 - Nursing & Midwifery
 - Physiotherapy
 - Music therapy
- Supervised 19 PhD and 1 Habilitation student to graduation / 250+ papers
- Chair of CSIS/Lero Athena SWAN committee



Diverse groups

- “Different, unlike, distinct;” (Oxford English Dictionary)
- Lero research includes:
 - *Older people, race, gender, people with hearing problems, malnourished children, people with intellectual disability, people with chronic conditions, potential to have specific conditions*

Equality as defined in Ireland



Equal Status Acts (2000-2015)
Employment Equality Acts (1998-2015)

Connected Health for Diverse Groups

Phase 2: A Running Start



Recommendations for Developing Smartphone Applications for an Ageing Population



**Saudi Arabian
Cultural
Bureau**

Recommendations for Developing Health Information System Applications for use by Persons with Mild Intellectual and Development Disabilities



BREASTech: Increasing physical activity in breast cancer survivors through technology-enabled care



On-line music therapy: supporting people living with dementia

LERO

Nothing about us Without us ^[1]

Ageing Population



250 + older adults

Focus groups,
Prototype evaluation,
Surveys, Interviews

Persons with mild IDD



Hail, Saudi Arabia

Participative focus groups

19 men, 7 women

Qualitative study

Breast cancer survivors ^[2]



Two Breast cancer survivors on research team

Workshop (15 women)
Interviews (15 women)

Photovoice

People living with dementia ^[3]



Action research project

Participation from people with dementia, carers, music therapists

Stakeholder Feedback

Patient & Public Involvement

Today's discussion

1. A Multi-method Approach for Requirements Elicitation for the Design and Development of Smartphone Applications for Older Adults⁴
2. Design Recommendations for Developing Health Information System Applications for use by Persons with Mild Intellectual and Developmental Disabilities⁵
3. Recommendations presented in Design Pattern format
Each pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice⁶

Recommendation	Control number of choices available for the user when they are progressing through the application
Category	Graphical User Interface
Problem or goal	Experts agreed that software developers should reduce the number of choices available in HIS applications for persons with IDD to ease cognitive load [a-c].
Evidence/Proof	<p>[a] Seale J, Garcia-Carrisoza H, Rix J, Sheehy K, Hayhoe S. A proposal for a unified framework for the design of technologies for persons with learning difficulties. <i>Technology and Disability</i>. 2018 Jan 1;30(1-2):25-40.</p> <p>[b] Gibson, R.C., M.-M. Bouamrane, and M. Dunlop, Design Requirements for a Digital Aid to Support Adults with Mild Learning Disabilities During Clinical Consultations: Qualitative 179 Study with Experts. <i>JMIR rehabilitation and assistive technologies</i>, 2019. 6(1): p. e10449.</p> <p>[c] Mobile app reviewer “This is an awesome app that is customizable for each user even down to two choices at a time.”</p>
Solution	Allow users to control the speed they move through the game by controlling the number of choices available as they progress through the application. This could be done through setting up a ‘number of choices at decision point’ when users are setting up the game, for example. Remember that people with any learning or cognitive difficulty can be slow in their performance and responses.

Data Sources



Literature
Standards
Commentary on Apps





User groups
Software Engineers
Experts

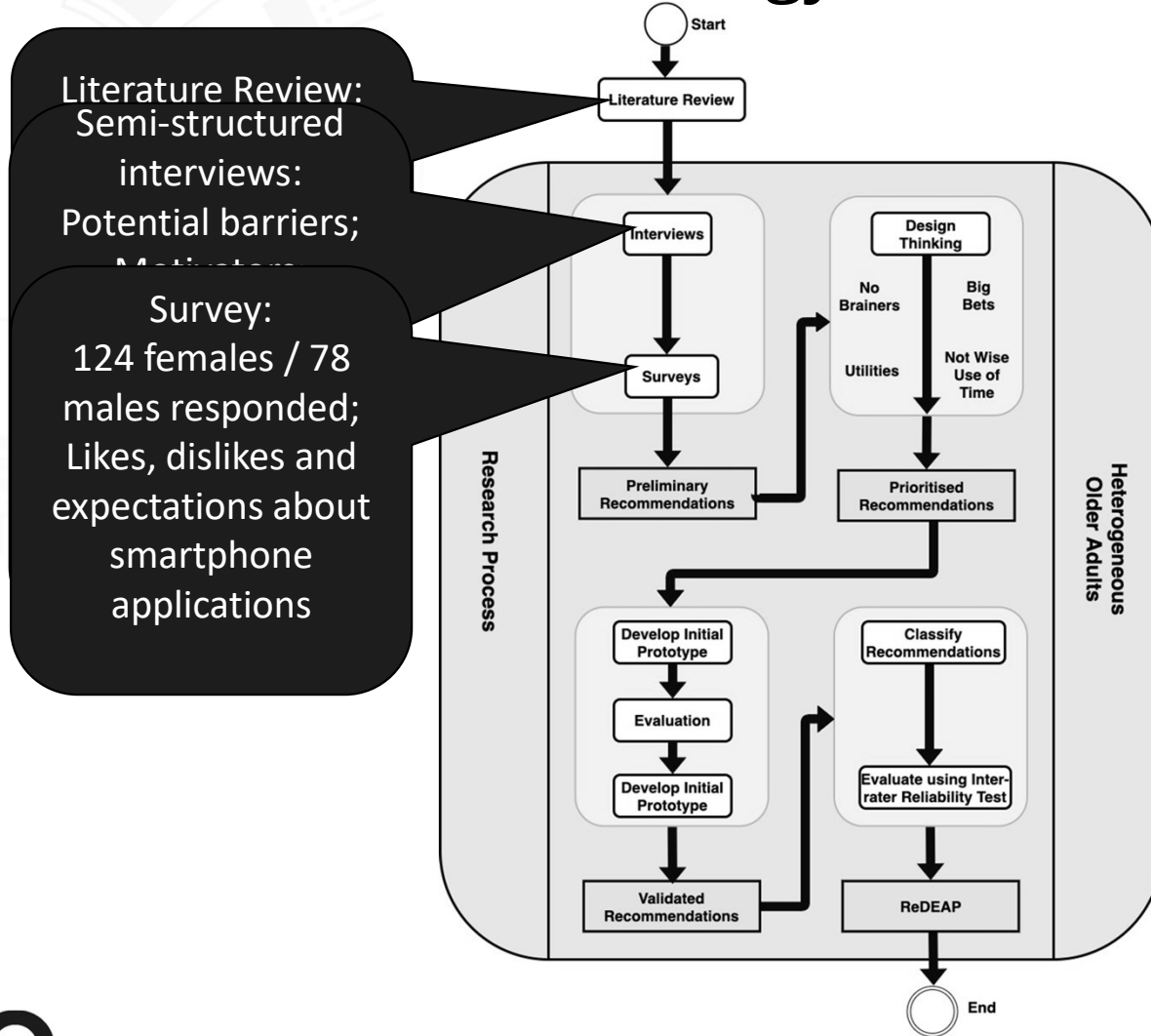


Research Project /1

RQ: What are the recommendations that need to be considered by software engineers to make smart phone applications usable and accessible for older adults?

- PhD 2020: Dr Bilal Ahmed, supervised by Prof Ita Richardson and Dr Sarah Beecham
- Software Process: Requirements Engineering
- Mixed methods (qualitative and quantitative)
- Industry partner: 
- Collaborator: 

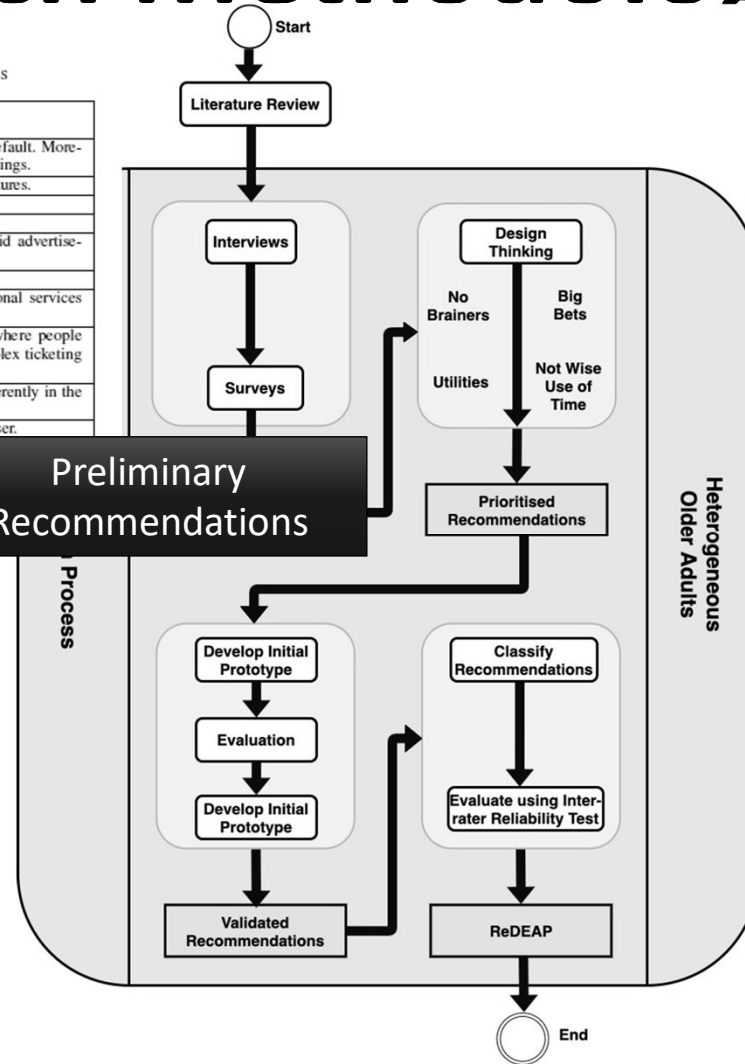
Research Methodology



Research Methodology

TABLE II
SUBSET OF PRELIMINARY RECOMMENDATIONS

Sr. No.	Recommendation Description
1.	Ensure increased privacy in the application by default. Moreover, clarify, simplify and tailor privacy and settings.
2.	Avoid pressurizing techniques, reminders or features.
3.	Avoid games, apps and irrelevant functionality.
4.	Use a simple layout on the site.
5.	Remove unnecessary content i.e. reduce or avoid advertisements.
6.	Avoid technical terminology in the application.
7.	Avoid using small print check-boxes for additional services or information sharing.
8.	Avoid similar designs to sites or applications where people hold negative assumptions e.g., typical and complex ticketing applications.
9.	Ensure that different genders are not treated differently in the application.
10.	Generate or promote local events close to the user.
11.	Use colors that work together to provide a good user experience.
12.	Make the text legible in the application.
13.	Avoid complex signing up and login processes.
14.	Make the app require less memory or space.
15.	Incorporate a volunteer hub feature in the application.



Research Methodology

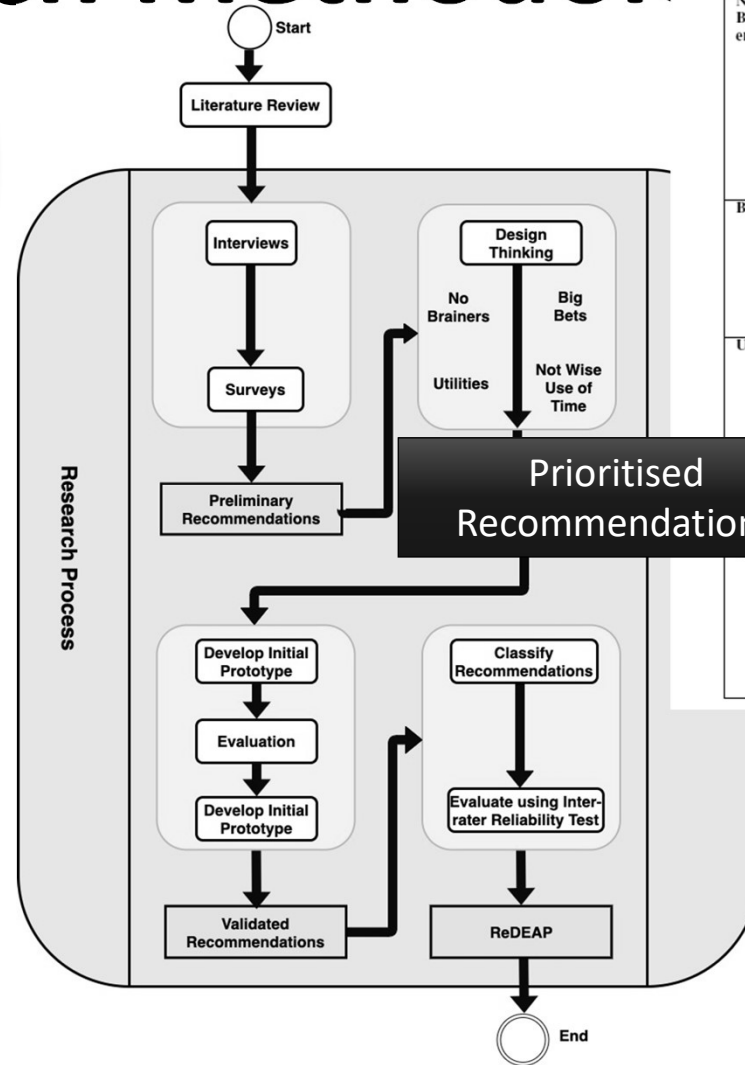
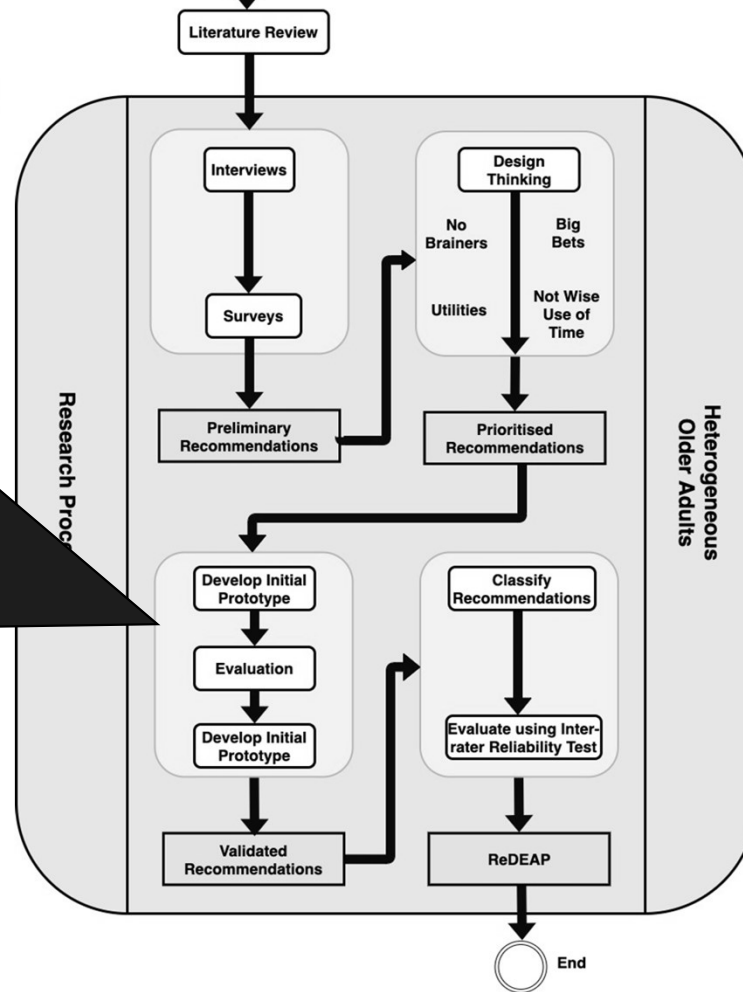


TABLE III
PRIORITISED RECOMMENDATIONS

Category	Recommendation Description
No Brainers	<ol style="list-style-type: none"> 1) Include vetting feature in the application via friends and family members. 2) Provide a feature to request volunteer services. 3) Allow to view existing requests for volunteer services. 4) Allow to add new volunteer services. 5) Incorporate a feature for daily routine planning. 6) Allow to give ratings to the provider or receiver. 7) Add a feature that shows the achievements. 8) Add a feature to assign badges or stars to the users based on their usage of the application.
Big Bets	<ol style="list-style-type: none"> 1) Allow voice-enabled interaction with the application like Siri or Alexa. 2) Add testimonials of existing users. 3) Block and report malicious and anti-social users. 4) Add a feature to conduct group volunteering. 5) Add a feature to track the users via GPS.
Utilities	<ol style="list-style-type: none"> 1) Add a feature that allows access to local and international news. 2) Connect the application with social media profiles. 3) Allow users to edit the profile. 4) Add multiple parameters to filter the volunteer services such as interests, specific location, domain. Incorporate a Save Our Souls (SOS) feature.
	<ol style="list-style-type: none"> 1) Grant physical rewards / certificates to the user upon completion of certain services through the application. 2) Incorporate a step counter feature in the application. 3) Incorporate additional health-tracking features in the application. 4) Incorporate emotions/sentiment analysis in the application. 5) Verify the identity of the users through accessing government services / databases in the application.

Research Methodology

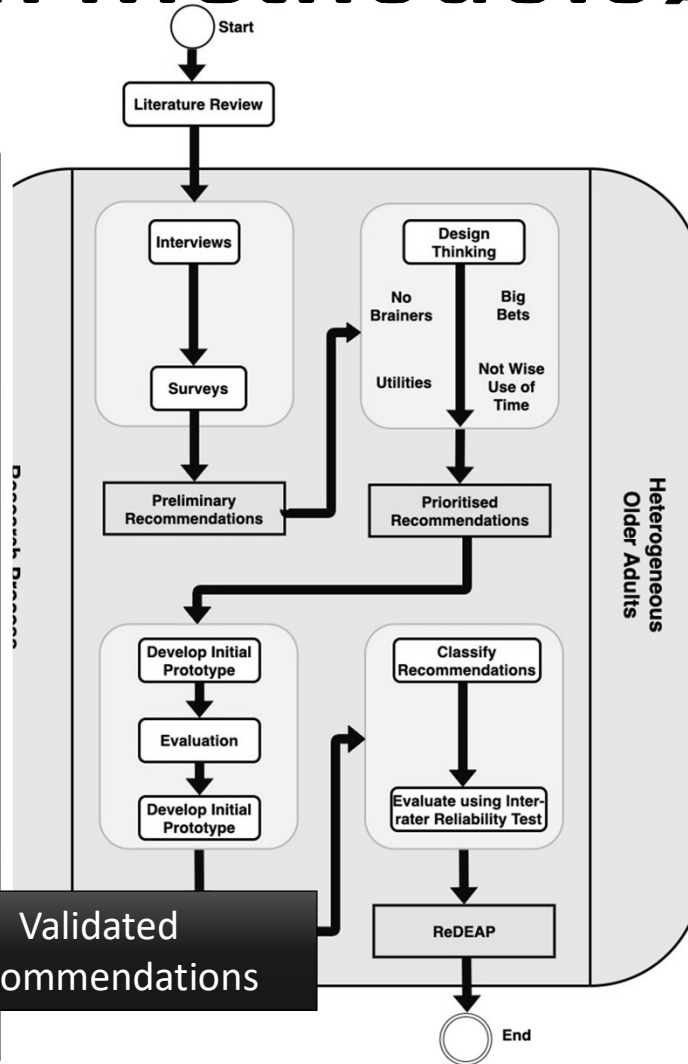
Prototype development:
Dual-benefit social
volunteering
networking
smartphone
application;
Evaluation by 11
females / 9 males
on System Usability
Scale



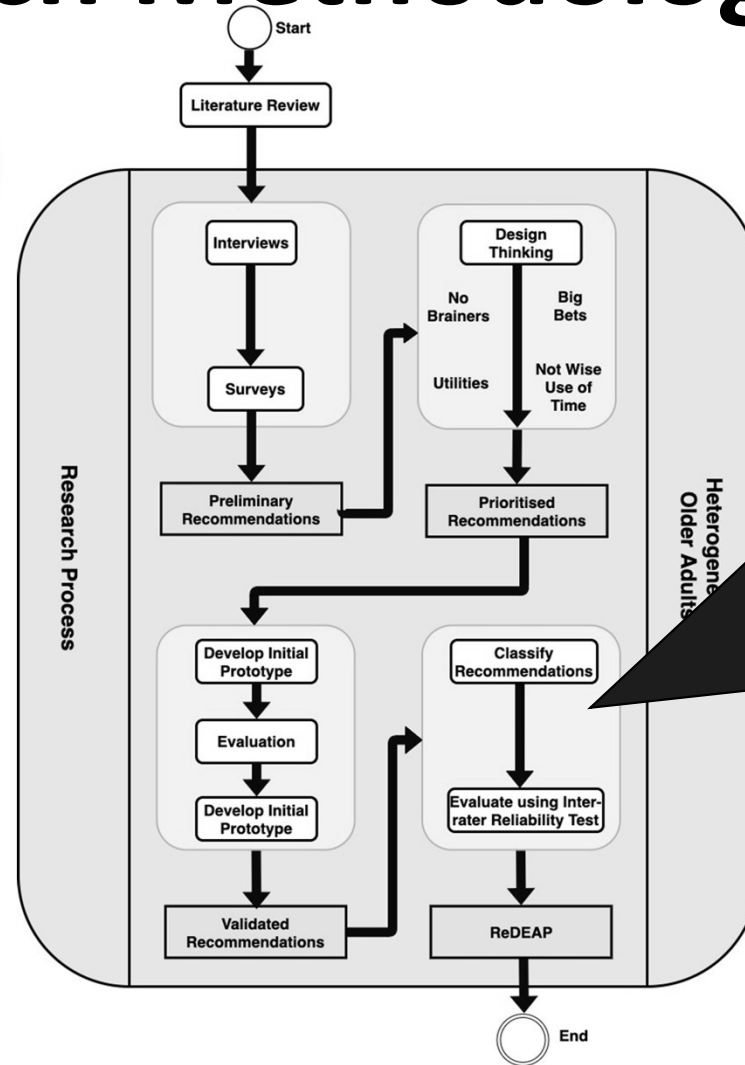
Research Methodology

TABLE IV
VALIDATED RECOMMENDATIONS

Category	Recommendation Description
Accessibility and Formatting	<ol style="list-style-type: none"> 1) Avoid scrolling in the application. 2) Do not have a pre-specified range for input controls in the application. 3) Use attractive and limited number of colors. 4) Avoid using caricatures and include photos that depict older adults in a positive outlook. 5) Enlarge the size of components within the application. 6) Incorporate voice-enabled interaction in the application. 7) Make the application easy to use.
Abstraction	<ol style="list-style-type: none"> 1) Keep complex features hidden from new users. 2) Focus on active social engagement in the application rather than being another tool for online communication only.
Privacy	<ol style="list-style-type: none"> 1) Store the identifiable details of the users, older adults, in an encrypted format. 2) Incorporate privacy and security regulations within the application e.g., GDPR, EFF. EFF provides funds for legal defense in court, presents amicus curiae briefs, defends individuals and new technologies from what it considers abusive legal threats, works to expose government malfeasance, provides guidance to the government and courts, organizes political action and mass mailings, supports some new technologies which it believes preserve personal freedoms and online civil liberties, maintains a database and web sites of related news and information, monitors and challenges potential legislation that it believes would infringe on personal liberties and fair use, and solicits a list of what it considers abusive patents to defeat those that it considers without merit. https://www.eff.org/.
Functional	<ol style="list-style-type: none"> 1) Incorporate a feature for active social engagement in the application, e.g., a 2) Incorporate a feature that increases engagement of older adults, e.g., an information 3) Incorporate a feature that helps older adults keep track of and maintain their healthcare hub. 4) Verify/Vet the users of the application. 5) Allow older adults to manage their daily routines through the application.

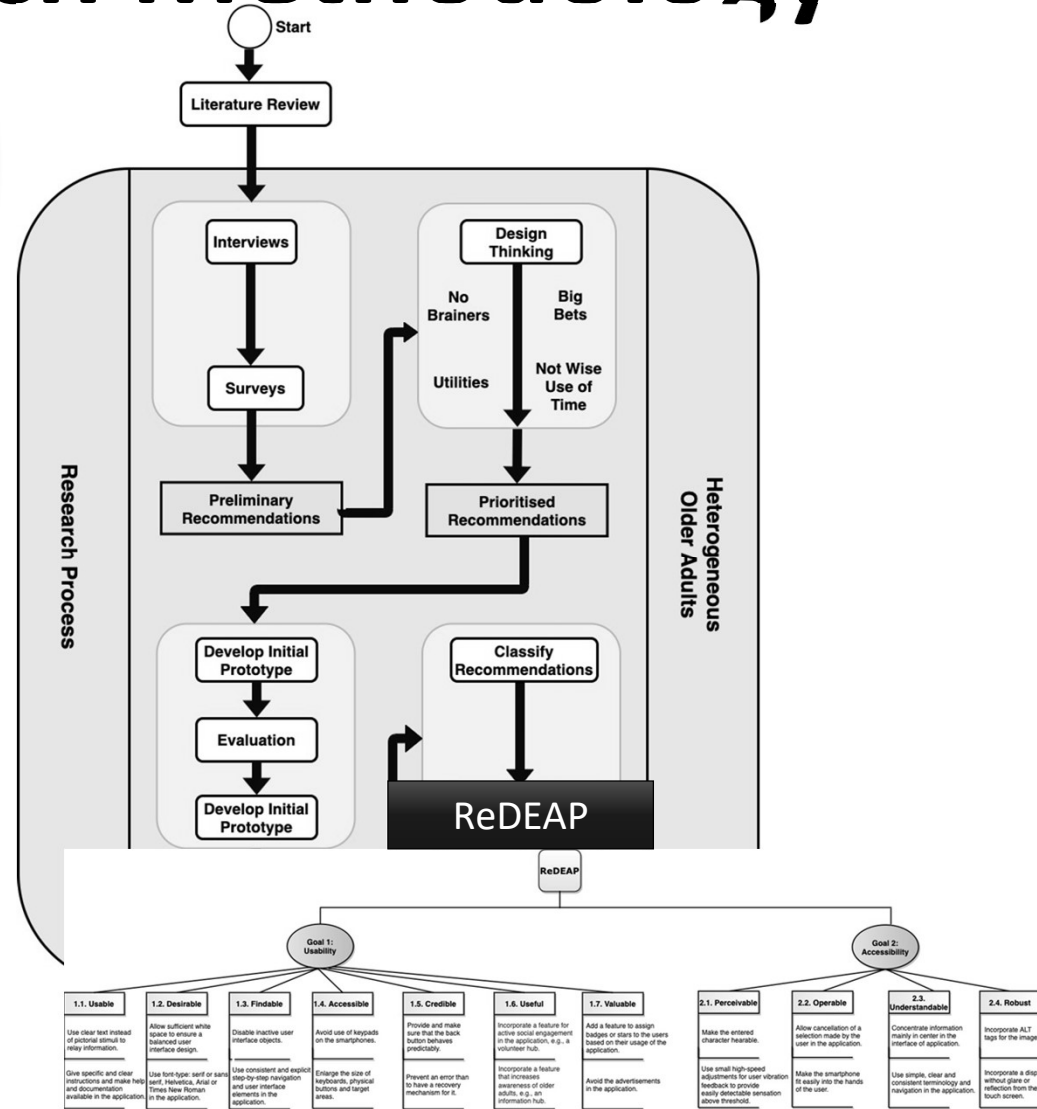


Research Methodology

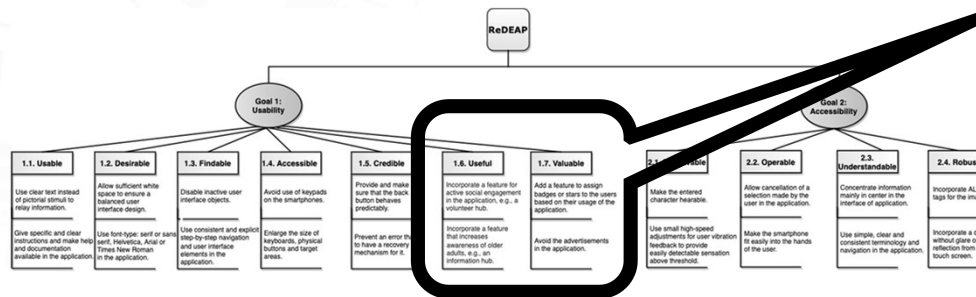


Recommendations classified:
Usability – Morville’s Usability Honeycomb;
Accessibility – POUR Perceivable, Operable, Understandable, Robust (W3C);
Inter-rator reliability

Research Methodology



ReDEAP: Recommendations for DEveloping smartphone Applications for an aging Population



1.6. Useful	1.7. Valuable
Incorporate a feature for active social engagement in the application, e.g., a volunteer hub.	Add a feature to assign badges or stars to the users based on their usage of the application.
Incorporate a feature that increases awareness of older adults, e.g., an information hub.	Avoid the advertisements in the application.
Incorporate a feature that helps older adults to keep track of and maintain their health. It can be presented in pie charts and graphs for tech-savvy OAs.	Grant physical rewards / certificates to the user upon completion of certain services through the application.
Incorporate fraud protection features in the application.	Provide an alternative paid version which does not contain commercial advertisements.

Conclusions from PhD 2020: Dr Bilal Ahmed

- Empirically derived a set of recommendations for the design of smartphone applications for older adults⁷
- Objectivity of qualitative data analysis: series of inter-rater reliability tests with three researchers
- Recommendations aim to help the development of usable and accessible smartphone applications for older adults

Research Project /2

RQ: What guidance can be provided for software designers and developers to make Health Information Systems (HIS) more user-friendly for adults with mild IDD?

- PhD (post-viva): Muneef Alshammari, supervised by Prof Ita Richardson and Dr Owen Doody
- Software Process: Requirements Engineering
- Interdisciplinary: Nursing & Midwifery
- Qualitative research
- Collaborators: Organisations who provide care to people with Mild IDD

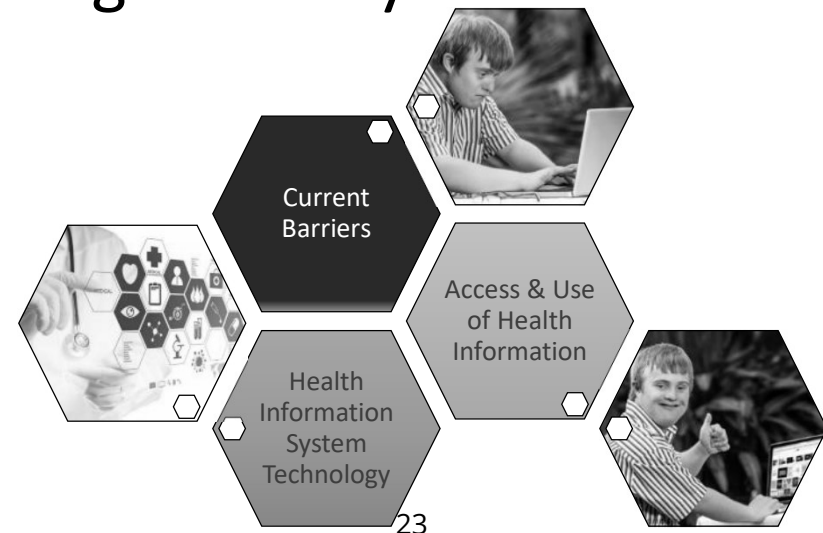
Terms

- Intellectual and developmental disability (IDD) is defined as “a disability characterized by significant limitations both in intellectual functioning (reasoning, learning, problem solving) and in adaptive behavior, which covers a range of everyday social and practical skills. This disability originates before the age of 18”⁸.
- IDD is identified as profound, severe, moderate and mild, with the majority classified as having mild IDD⁹.

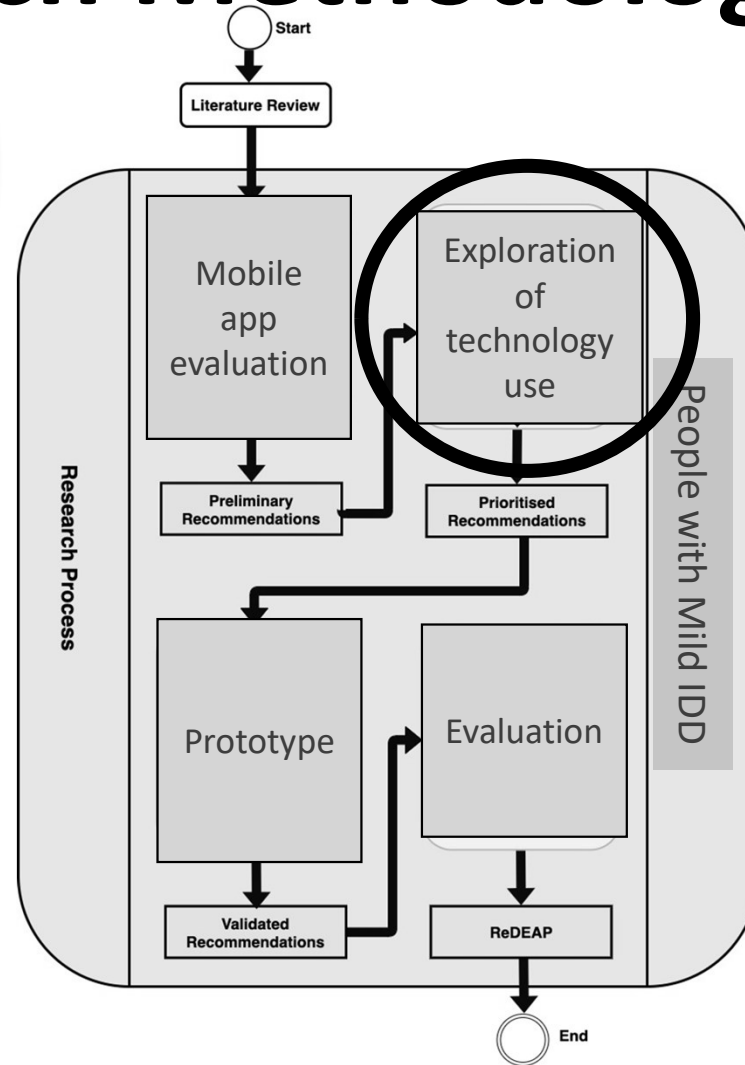
Context

“The use of technology by persons with an intellectual disability (ID) is a neglected area of research and practice”¹⁰.

Studies have repeatedly shown that persons with intellectual disabilities,, can gain many benefits from the use of the technology¹¹.



Research Methodology



Methodology



19 male, 7 female study participants, aged between 18 and 35 years with mild IDD. 6 groups were held, each group with 4-5 participants.



Conducted in two disabled service providers in Hail, Saudi Arabia



Round 1:

Semi-structured focus groups facilitated by researcher



Round 2: Each participant was given specific tasks such as accessing apps or finding information, observed by the researcher.



Devices used were laptop, iPad, and smart phone

Ethical guidelines were followed when conducting this research with people with IDD [9], and ethical approval was received from the University of Limerick (2019_02_06_S&E)

Conclusions from PhD 2022 :

Muneef Alshammari

- Persons with IDD can learn about health information through using digital technology
- Software designers/developers and need to work with persons with IDD, families, carers and health care staff
- Gaming technology, which can enhance motivation, is being used increasingly to develop interventions that improve health knowledge.

Challenges and enablers for software researchers

- Regulations
 - Software as a medical device
- Accounting for diverse groups
 - ICSE2019: 6 'Developers do' papers in session, 3 mentioned % of women, 1 gave (limited) results regarding women
 - Tools and education developed for male Software Engineers
- Ethics
 - Ensure you apply to your University ethics committee
 - Be aware of, but don't be put off by, the difficulties
- Interdisciplinarity
 - Strengthens your research topic and research methods
 - May be difficulties publishing, but when you do, impact factors can be higher!

Conclusion

- Software is pervasive
- Software is interdisciplinary
- Software is diverse
- Software can hinder or help people of diversity

It is incumbent on us as professional software researchers and software engineers to account for this in our work

This work was supported, in part, by Science Foundation Ireland grant 13/RC/2094, co-funded under the European Regional Development Fund through the Southern & Eastern Regional Operational Programme to Lero - the Irish Software Research Centre (www.lero.ie).

It was also funded by:

IBM Ireland;

College of Public Health and Health informatics, University of Hail, Saudi Arabia;



References

1. Disability rights movement mantra /James I. Charlton, Nothing About Us Without Us - Disability Oppression and Empowerment, University of California Press 1998 doi.org/10.1525/9780520925441
2. Michelle Norris, Ita Richardson, Pauline Meskell, Yvonne Davis, Vidette Ryan Molyneaux, Karen McAree, No longer whole but still strong https://issuu.com/michelle.norrismoloney/docs/no_longer_whole_but_still_strong_-_a_photovoice_pr
3. Lisa Kelly, Music, Technology & Dementia A short documentary <https://youtu.be/SDb0TLToTyU>
4. C Alexander, 1977. A pattern language: towns, buildings, construction. Oxford university press
5. Bilal Ahmad, Ita Richardson and Sarah Beecham, Usability Recommendations for Designers of Smartphone Applications for Older Adults: An Empirical Study, in Software Usability, edited by Castro, L & Cabrero, D & Heimgärtner, R, InchtchOpen, DOI: 10.5772/intechopen.96775, ISBN 978-1-83968-967-3
6. Alshammari, Muneef, Owen Doody and Ita Richardson, 2020, August. Software Engineering Issues: An exploratory study into the development of Health Information Systems for people with Mild Intellectual and Developmental Disability. In 2020 IEEE First International Workshop on Requirements Engineering for Well-Being, Aging, and Health (REWBAH) (pp. 67-76). IEEE, 31st August.
7. https://lero.ie/sites/default/files/2021_TR02_Design_Patterns_ReDEAP.pdf
8. American Association on Intellectual and Developmental Disabilities (AAIDD). 2017.
9. Gargiulo, R.M. and E.C. Bouck, Instructional strategies for students with mild, moderate, and severe intellectual disability. 2017: Sage Publications.
10. Boot, F.H., Dinsmore, J., Khasnabis, C. and MacLachlan, M., 2017. Intellectual disability and assistive technology: opening the GATE wider. *Frontiers in public health*, 5, p.10.
11. Werner, S. and Shpigelman, C.N., 2019. Information and communication technologies: where are persons with intellectual disabilities?. *Israel journal of health policy research*, 8(1), pp.1-3.



Thank you

LEERO