On the Awareness about Diversity and Inclusion being integrated to Requirements Engineering[*]

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ABSTRACT

Many software companies started to foster diverse and inclusive teams, aiming to increase team satisfaction, enhance process efficiency, spur innovation, and increase profitability. However, diversity and inclusion are often overlooked from a requirements perspective. We explore five key dimensions of diversity: Race and Ethnicity, Gender, Disability, Neurodiversity, and Age. It argues for the integration of diverse and inclusive processes in software development, ensuring that both development teams and target audiences reflect these diversity aspects. This approach is key to creating software that is genuinely inclusive and representative of a diverse user base. We propose actionable points by practitioners and researchers in Requirements Engineering.

Keywords: Requirements Engineering, Diversity, Inclusion

1 INTRODUCTION

Many software companies started initiatives to cultivate more diverse and inclusive teams. While integrating individuals from varied backgrounds and experiences into a cohesive team can be resource-intensive and time-consuming, there is evidence indicating that such diversity can lead to notable improvements in team performance and innovation, despite potential conflicts [11]. The concepts of "diversity" and "inclusion" (D&I) are increasingly being recognized for their role in better representing a wide array of groups, including women, LGBTQIA+[1], people of color, and individuals with physical or mental disabilities. This involves not only acknowledging these groups but also adapting environments to effectively accommodate and welcome them. Particularly in the field of information technology, a sector greatly benefiting from a diverse workforce, these themes have become integral to strategic planning and organizational development [12]. The pursuit of D&I in companies is often linked to increasing representation from minoritized groups in the workforce. Although many tech companies are starting to worry about a diverse workforce, D&I are important human factors for Requirements Engineering that are often overlooked. To build inclusive software, we also need diverse and inclusive processes, where both the team that develops the software as well as its target audience have their diversity aspects taken into account. Considering the concept of "perceived diversity" as the diversity factors with which individuals are born with [20], here we discuss five[2] dimensions of diversity that are explored under a perspective

of requirements engineering: (1) Race and Ethnicity[3]; (2) Gender; (3) Disability; (4) Neurodiversity, and (5) Age.

2 BACKGROUND

Rodríguez-Pérez et al [20] bring the concept of "perceived diversity" as the diversity factors with which individuals are born with, and cite how this concept in Software Engineering has been recognized as a high-quality team property, with companies willing to increase their efforts toward diversity in their work teams. As supporting evidence to the growth of interest in this topic of diversity, due to its importance, several researches in the area of Software Engineering have recently emerged on this topic.

Some systematic literature reviews and mapping studies have already identified the topic of D&I as scarce in the area [20, 22, 5], typically focused on aspects of perceived gender diversity – but less often on other dimensions such as race, age, nationality and disability – and generally with little or no focus on inclusion. In addition, the perception these studies bring is often of work within a team or a project, without any perspective on requirements or users.

3 D&I CHALLENGES FOR SOFTWARE USERS

Race and Ethnicity. Algorithmic racial bias reflects an effect that people tend to recognize faces of their "own race" with more accuracy than faces of "other races". However, ethnic and other biases [21], in general, are not limited to training data, as different biases can occur in different phases (input, algorithm, output, and users). Conversational agents show design bias, using a white people's lexicon and failing to recognize the nuances of black dialects, which leads to misunderstandings/frustration for black users [19].

Gender. Assumptions about underrepresented groups as homogeneous can introduce stereotypes into the software (e.g., games "for girls" that reinforce shallow stereotypes) [17]. Overall, gender issues arise early in development, but there are few approaches for addressing them [17]. Existing literature is limited to a binary male-female perspective that leaves out other forms of gender expression. Aspects related to LGBTQIA+ invisibility, especially the transgender community, as highlighted by Amy J. Ko's RE'21 keynote [13].

Disability. Mobile operating systems offer built-in support for screen readers and voice assistants (e.g., VoiceOver, Talkback), but many popular apps still fall short in providing adequate accessibility and adhering to standards [26]. Developers recognize the importance of specifying and implementing accessibility requirements, yet fail to do so due to companies not prioritizing them [6, 15].

Neurodiversity. Neurodivergent individuals are more sensitive to cognitive overload than people with typical neurodevelopment (i.e., neurotypical) [14]. An app with cognitive overload evokes negative feelings in its users, who prefer applications with a lower cognitive load (e.g., less data input, a limited number of features to choose from) [24]. Autistics take longer and exert higher cognitive effort than neurotypical people to complete the same tasks in apps [27].

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[1]Lesbian, Gay, Bisexual, Transgender, Queer/Questioning, Intersex, Asexual/Allies, and the plus sign meant to cover anyone else who's not included [9]

[2]Although other dimensions merit attention, we focus on these five for conciseness.

[3]These two constructs have many differences and intersections. However, for simplification, they were discussed as a single topic.

Age. User interfaces for elderly users need to consider specific needs [7]. Many users above 65 years old present visual, psychomotor, and cognitive limitations. The challenges faced by this group can also be encountered by younger individuals with similar disabilities. The concept of AI ageism highlights the marginalization and exclusion of elderly users in AI, underscoring concerns about fairness and bias due to insufficient attention to this demographic [23].

4 ACTIONABLE POINTS

Foster awareness and empathy in software teams. Creating a diverse team is an important aspect, so perspectives from different groups can be taken into account. However, it is not practical to have a team covering each diversity dimension, which does not constitute homogeneous groups. Developers need to improve their empathy with users, when compared to UI designers [6].

Involve diverse stakeholders. Involving stakeholders in user validation, such as through Crowd-based Requirements Engineering [10], is crucial for reaching a broader audience, though it has limitations in diversity [8]. HCI efforts include neurodivergent users in participatory design for neurodiversity [2, 16], and emphasizes inclusion in the design process for elderly users in applications like ambient assisted living [7]. Technology built by and for diverse individuals is more inclusive and holistic [19].

Incorporate Diversity into processes. There is research pointing out the gap concerning accessibility in software engineering processes [18], noting the current focus on visual impairments and the lack of attention to other disabilities such as hearing and cognitive impairments. Concerning **race and ethnicity** biases, data scientists are starting to make decisions aiming to improve the goal of their ML models, by involving new types of requirements such as explainability, freedom from discrimination, or specific legal requirements [25]. A model for Gender-inclusive requirements paves the way to address the gender gap in requirements by offering a taxonomy of gender concepts to aid the elicitation process [17]. Gender Mag [4] is an inspection method that uses customized personas and cognitive walk-throughs, assisting teams in identifying and resolving gender inclusivity issues in software.

Adopt established guidelines. Guidelines extracted from existing studies can also be helpful in many cases, such as recommendations for building UIs for the elderly (e.g., reduced number of interactions, simple and flattened menus) [7]. In the context of neurodiversity, there are straightforward recommendations [16] (e.g., provide clear and accessible instructions, utilize multimodal feedback) as well as more detailed guides, such as GAIA [3] and AutismGuide [1]. The Web Content Accessibility Guidelines[4] (WCAG) offer guidance for creating web applications that are accessible to individuals with **disabilities**, applicable to both web and mobile apps.

5 CONCLUSIONS

It is important to think of possible ways to include diversity and inclusion more explicitly in requirements engineering. Based on the previous discussion, potential possibilities to be taken as action points for practitioners and researchers are:

Foster awareness and empathy in the team. Encourage a team culture that values understanding and empathy towards users of diverse backgrounds, enhancing inclusivity in software development.

Involve diverse stakeholders. Engage a wide range of stakeholders, including underrepresented groups, in the design process to ensure software meets diverse needs,

Adopt established guidelines. Utilize guidelines like WCAG for developing accessible user interfaces, catering to diverse users including those with disabilities, the elderly, and neurodiverse indi-

viduals. Also, research methods such as GenderMag or guidelines issued from literature reviews can be good starting points.

Incorporate Diversity into processes. Integrate diversity into software development processes to create more inclusive products, addressing the needs of a diverse user base.

6 CONCLUSIONS

This position paper brings a discussion that underscores the importance of diversity and inclusion in the software industry. However, current efforts are mostly focused withing teams while requirements engineering – from a user perspective – still needs to advance more on that direction. The integration of these principles in addressing user needs in software development is still emerging. The article has discussions brought various dimensions of diversity, such as race, gender, disability, neurodiversity, and age, and their impact on software requirements, mostly under usability and accessibility.

It highlights that current approaches to incorporating diversity and inclusion in software design are in their early stages. To address this, the paper proposes actionable steps for both researchers and practitioners. These include fostering team empathy towards diverse users, engaging a broad spectrum of stakeholders in design, adhering to established inclusivity guidelines, and embedding diversity considerations into software development processes.

REFERENCES

[1] Y. P. C. Aguiar, E. Galy, A. Godde, M. Trémaud, and C. Tardif. Autismguide: A usability guidelines to design software solutions for users with autism spectrum disorder. *Behaviour & Information Technology*, 41(6):1132–1150, 2022.

[2] L. Benton, A. Vasalou, R. Khaled, H. Johnson, and D. Gooch. Diversity for design: a framework for involving neurodiverse children in the technology design process. In *Proc. of the SIGCHI conference on Human Factors in Computing Systems*, pages 3747–3756, 2014.

[3] T. Britto and E. Pizzolato. Towards web accessibility guidelines of interaction and interface design for people with autism spectrum disorder. In *Proc. of the 9th Intl Conference on Advances in Computer-human interactions*, pages 1–7, 2016.

[4] M. Burnett, S. Stumpf, J. Macbeth, S. Makri, L. Beckwith, I. Kwan, A. Peters, and W. Jernigan. Gendermag: A method for evaluating software's gender inclusiveness. *Interacting with Computers*, 28(6):760–787, 2016.

[5] E. D. Canedo, H. A. Tives, M. B. Marioti, F. Fagundes, and J. A. S. de Cerqueira. Barriers faced by women in software development projects. *Information*, 10(10):309, 2019.

[6] V. L. de Almeida and K. Gama. Mobile accessibility guidelines adoption under the perspective of developers and designers. In *2021 IEEE/ACM 13th Intl Workshop on Cooperative and Human Aspects of Software Engineering (CHASE)*, pages 127–128. IEEE, 2021.

[7] C. Dodd, R. Athauda, and M. Adam. Designing user interfaces for the elderly: a systematic literature review. 2017.

[8] M. Glinz. Crowdre: Achievements, opportunities and pitfalls. In *2019 IEEE 27th Intl Requirements Eng. Conference Workshops (REW)*, pages 172–173. IEEE, 2019.

[9] M. Gold. The ABCs of L.G.B.T.Q.I.A.+. 2018.

[10] E. C. Groen, J. Doerr, and S. Adam. Towards crowd-based requirements engineering a research preview. In *Requirements Engineering: Foundation for Software Quality: 21st Intl Working Conference, REFSQ 2015, Essen, Germany, March 23-26, 2015. Proceedings 21*, pages 247–253. Springer, 2015.

[11] V. Hunt, S. Dixon-Fyle, S. Prince, and K. Dolan. Diversity wins: How inclusion matters., 2020.

[12] V. Hunt, S. Prince, S. Dixon-Fyle, and L. Yee. Delivering through diversity. *Mckinsey & Company.*, 26:2018, 2018.

[13] A. J. Ko. Requirements of oppression - keynote. In *2021 IEEE Intl Requirements Eng. Conference*, 2021.

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[4]https://www.w3.org/WAI/standards-guidelines/wcag/

[14] M.-A. Mackie and J. Fan. Reduced efficiency and capacity of cognitive control in autism spectrum disorder. *Autism Research*, 9(3):403–414, 2016.

[15] D. Miranda and J. Araujo. Studying industry practices of accessibility requirements in agile development. In *Proc. of the 37th ACM/SIGAPP Symposium on Applied Computing*, pages 1309–1317, 2022.

[16] V. G. Motti. Designing emerging technologies for and with neurodiverse users. In *Proc. of the 37th ACM Intl Conference on the Design of Communication*, pages 1–10, 2019.

[17] I. Nunes, A. Moreira, and J. Araujo. Gire: Gender-inclusive requirements engineering. *Data & Knowledge Engineering*, 143:102108, 2023.

[18] D. M. B. Paiva, A. P. Freire, and R. P. de Mattos Fortes. Accessibility and software engineering processes: A systematic literature review. *Journal of Systems and Software*, 171:110819, 2021.

[19] Y. A. Rankin and K. K. Henderson. Resisting racism in tech design: centering the experiences of black youth. *Proc. of the ACM on Human-Computer Interaction*, 5(CSCW1):1–32, 2021.

[20] G. Rodríguez-Pérez, R. Nadri, and M. Nagappan. Perceived diversity in software engineering: a systematic literature review. *Empirical Software Engineering*, 26(5):1–38, 2021.

[21] S. Silva and M. Kenney. Algorithms, platforms, and ethnic bias. *Communications of the ACM*, 62(11):37–39, 2019.

[22] K. K. Silveira and R. Prikladnicki. A systematic mapping study of diversity in software engineering: a perspective from the agile methodologies. In *2019 IEEE/ACM 12th Intl Workshop on Cooperative and Human Aspects of Software Engineering (CHASE)*, pages 7–10. IEEE, 2019.

[23] J. Stypinska. Ai ageism: a critical roadmap for studying age discrimination and exclusion in digitalized societies. *AI & society*, 38(2):665–677, 2023.

[24] D. Szinay, O. Perski, A. Jones, T. Chadborn, J. Brown, and F. Naughton. Perceptions of factors influencing engagement with health and well-being apps in the united kingdom: qualitative interview study. *JMIR mHealth and uHealth*, 9(12):e29098, 2021.

[25] A. Vogelsang and M. Borg. Requirements engineering for machine learning: Perspectives from data scientists. In *2019 IEEE 27th Intl Requirements Engineering Conference Workshops (REW)*, pages 245–251. IEEE, 2019.

[26] S. Yan and P. Ramachandran. The current status of accessibility in mobile apps. *ACM Trans. on Accessible Computing (TACCESS)*, 12(1):1–31, 2019.

[27] V. Yaneva, L. A. Ha, S. Eraslan, and Y. Yesilada. Adults with high-functioning autism process web pages with similar accuracy but higher cognitive effort compared to controls. In *Proc. of the 16th Intl Web for All Conference*, pages 1–4, 2019.