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A Curated Personas and Design Guidelines Tool for Better Supporting Diverse End-users

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***Abstract*—Many work and living activities in modern society are increasingly dependent on web and app software. However, much existing software lacks consideration of many diverse end-user characteristics, such as age, mental and physical challenges, language proficiency, culture, socio-economic status, educational attainment and so on. Many developers do not have lived experience of most of these challenges, fail to empathise with those who have them, and lack knowledge of how to address them in their software design and evaluation activities. To address this issue, we designed a curated persona and design guidelines tool to help developers consider and address diverse end-user needs during the software development process. Our tool helps software development teams to take a more holistic view of human nature and diverse end-uses during the software development cycle and to design software with multiple diverse end-user needs in mind. Our evaluation with 23 real world software developers shows that the use of such human-centric persona and guideline tools in the early stages of software development can help to reduce software end-user bias and increase software accessibility.**

***Index Terms*—Accessibility, Human-centric design, bias in software, Persona, Guideline, E-shopping, E-education**

I. Introduction

In this era of rapid information technology development, web applications and mobile devices are becoming much more important in people's lives. Such software has many end users, who have diverse age, cultural and educational backgrounds, different levels of proficiency in using technical devices, and various challenges in using web and mobile apps, such as sight, hearing, cognitive differences and mobility. The World Health Organisation reports that 15% of the world's population live with some form of disability [1]. This population is being particularly severely affected during the COVID-19 pandemic when using web and app access to services has become even more critical. In terms of education, over 850 million students worldwide have been affected by COVID-19 [2]. From the perspective of online shopping, around 70% of people shopped on e-shopping platforms during the pandemic and 37% of survey respondents indicated that they would still prefer to use online shopping even after the pandemic [3].

However, designing diverse end-user friendly software in a short development cycle is a challenging task. Software with short development process has a high probability of accessibility issues [4]–[6]. These issues may only be identified later when users provide feedback. However, if specific features and software are implemented based purely on user feedback, this can separate challenged users from the rest of society and make them feel isolated. With most current software development processes, it is easy to overlook the problems that diverse end-users have, especially if most of these end users can not be involved directed in the development process.

The well-established and extensive Web Content Accessibility Guidelines (WCAG) 2.0 provides developers with a set of guidelines to improving the accessibility of web content [7]. Community organisations have also alerted developers to the importance of adhering to accessibility guidelines. However, studies have shown that developers find the guidelines difficult to use, developers are unaware of them, and/or insufficient support tools for developers exist [5], [8]. There are various reasons that developers may neglect to use existing accessibility guidelines [6]. Most current software developers design software from their own point of view, which has limitations and is not suitable for people who have other biases [5], [9]. This leads to "biases" in the software, include not supporting end users with hearing, vision, age, cognitive, physical and device barriers, and any other factors that may make end-users software user experience unpleasant. These users have difficulties in using the software and developers should not ignore these problems. In addition to the internationally recognised standard, WCAG, national laws are also actively encouraging more accessible software design to reduce bias and increase software accessibility [10].

To address this need, we designed and developed a curated persona tool prototype to help developers address challenged end-user needs in their software. A persona is the creation and use of fictional users, an interaction design technique that helps designers understand end-user needs. The fictional user representations can be used as references when developing, designing, and improving products [11]. Common user stories are not enough to help development teams understand the needs of users and empathize with the difficulties they encounter. Our idea was to collect a large number of previously created, published, and used personas to summarise the end-user groups that were challenged by having different characteristics. We also provided guidelines for each curated persona. Clear guidelines bring to the attention of the development team some of the accessibility features that are needed. The guidelines also help software evaluators to identify which accessibility features are missing from the software. For each

persona in the tool, there is a checklist that integrates various published design and evaluation guidelines. Developers are able to find various personas representing diverse end-users. The checklist is used to design and evaluate software to meet the needs of each end-user group and achieve better software accessibility [12]. Our tool evaluation was conducted with 23 software developers to assess whether our prototype would help them to address issues addressing challenged end-user needs in their software development process.

II. Motivation and Background

A. Motivation

Consider Sally, who wants to buy a pair of shoes online. She goes to eBay and types in a search term. Sally picks a pair of shoes and starts browsing for details, e.g. see Figure 1 . However, Sally is 71 years old and has accessibility difficulties that many seniors have: poor eyesight and limited concentration, making it difficult to extract the information she needs from this dense screen. Sally's situation is not unique. The number of e-shopping domain users has grown rapidly over the past five years, with total sales growth of approximately 179% from 2017 to 2020 and an expected 200% increase in sales in 2021 compared to 2017 [13]. Often software developers do not have the skills, experience or time to address every potential end user's accessibility needs [6].

While personas and guidelines can be useful for developing a wide range of software, each software application domain typically has its own particular challenges and needs. For example, e-shopping site users have particular goals and frustrations: searching for and comparing products; purchasing and having delivered products; etc. E-education users need to find and consume multimedia information, carry out assessment tasks, and sometimes work collaboratively. We started with generic personas and guidelines that have been developed and published to date. We then identified specific domain goals and frustrations for e-shopping and e-education users. We then used these to further tailor our curated personas and guidelines to help developers reduce end user biases in their software design for these two target domains.

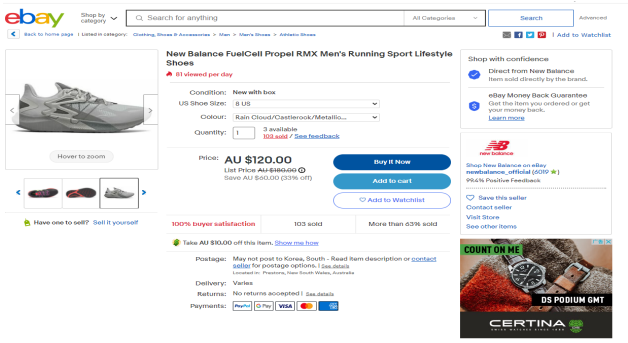

Fig. 1: Example eBay Item Detail

Increased consideration of the needs of all user groups in the design of software can benefit all users [4], [5]. Each person is an individual and each has different characteristics. This includes the way people access information and solve problems, along with their personality, colour preferences, physical characteristics and psychological traits [14]. Every person is different in this society, it is extremely challenging to design a software that can accommodate everyone's needs, while this is a trend in the software development industry [9]. Adherence to a more human-centric development model needs to be central to the future of software development [14]. High quality software should take into account all aspects of different user's accessibility needs. However, when software development practitioners focus on a general user group, often much like themselves, they can overlook many accessibility challenges other user groups have [4], [6].If a piece of software is designed to be used by people with accessibility barriers, then it will also typically be more inclusive for all users [4], [15]. Software development practitioners worldwide should thus strive to be inclusive of those who have barriers to using software, to improve accessibility and to ensure software is more accessible to every user [16]. Based on our two domains, e-shopping and e-education, we chose to target our persona templates with user groups based on age, cognitive impairment, hearing impairment, visual impairment, physical disability, and other types of impairment [17]–[22].

B. Key Research Challenges and Questions

Developers are usually not very representative of many of their end users, particularly those with accessibility challenges [14]. Many developers have limited training in UX, let alone understanding and supporting challenged end user accessibility needs [23]. Currently most software development practitioners are relatively young in age, highly educated, relatively wealthy, high language proficiency, and often lack other forms of diversity [24]. It is difficult for them to be sufficiently aware when analyzing user needs, including systematically analyzing the software requirements of the elderly [15], physical accessibility issues [5], [6], low language proficiency [14], cognitive challenges [23], and so on. The goal of our research is thus to assist developers in reducing bias when designing their software. To do this we provide a Persona Tool for these developers to help them better understand their diverse end-user needs, along with concrete design guidelines to help them meet these needs. Our tool provides them with different persona profiles, making it easier for them to understand and address each particular user's accessibility needs. Developers can use our tool to better and more efficiently fulfil usability and accessibility requirements [25]. We wanted to answer the following key research questions:

RQ1: Can we help software developers to better address their diverse end-user accessibility challenges and counter potential developer biases by using rich human-centric personas?

RQ2: Can we build a tool for such diverse human-centric personas and what details should be included in a Persona?

RQ3: Does such a human-centric persona tool help developers to produce a website that addresses diverse end-user accessibility and usability needs?

TABLE I: Key challenged end user types, descriptions and sub-categories

End user type	Description	Sub-category
Hearing issues	Users may not be able to receive enough information from listening due to their own or environmental reasons and need the aid of other senses, for instance, visualization.	1.*Hearing impairment:* Deafness, irreparable hearing impairment. 2. *Noisy environment:* Noisy environments or cannot hear clearly.
Vision issues	Vision challenged users may not get enough information visually and need other senses to assist in getting more information, for example, screen readers can be a possible support.	1. *Color blind:* Unable to identify colour information. 2. *Myopia and conjunctivitis:* High prescriptions, poor vision, uncomfortable eye health conditions.
Age-related	Ageing users may experience multiple accessibility issues, including cognitive, sight and hearing decline, and might also be less comfortable or familiar with the process of operating some software or handling the device.	1. *Senior:* Senior users might be unfamiliar with the steps of emerging software and have some mobility, vision and hearing loss. 2. *Children:* Children may not be familiar with how to properly use software so that needs to be supervised/permitted/content protected from them.
Cognitive issues	Cognitively challenged users may have trouble using software or web pages due to their individual cognitive abilities, includes all types of cognitive disorders to cultural differences.	1. *Cognitive Impairment/Intellectual disability:* Some degree of memory impairment or other cognitive difficulties, where memory loss is the most common cognitive impairment. 2. *Illiteracy or limited literacy:* Unable to read or type ; very limited reading/writing language ability. 3. *Culture differences:* Different work orl living environment, language and behavioural rules.
Physical issues	Physically challenged users are affected by physical barriers to using the software. In this study the impact on the use of the software due to handicaps was included.	1. *Unsteady hand:* Hands are unable to use for the moment. 2. *Arms disabled:* Inability to use the hand properly due to illness or injury.
Other issues	Other types of challenged end users might include the problems caused by the user's devices, such as internet connectivity, old device, poor network etc	1. *Device Adaptability:* Different system versions or layouts. 2. *Internet connectivity:* Low-speed internet connection.

III. Our approach

Approach: We outline the key steps in our research below.
Stage1: *Tool requirements and design:* [RQ1 & RQ2]

(1) Identify the target domains – we focused on support for e-shopping and e-education.

(2) Identify several major bias types – we focused on mobility, hearing, vision, age, cognitive differences.

(3) Refine the degree of bias using Persona Spectrum – Persona Spectrum is a method that helps to take different factors into consideration [9].

(4) Initialize one or more persona template(s) for each end user sub-category.

(5) Conduct cognitive walk throughs – using leading existing software or online platforms with each persona to identify a user's key actions for each domain.

(6) Conduct further walk throughs – to find key goals/motivations & frustrations for each persona based on the actions identified in step 5.

(7) Generate associated lists of designs guidelines based on each persona's goals/motivations & frustrations. Identify existing industry solutions or relevant academic studies that help to address this taregt end user's needs.

Stage 2: *Tool prototype:* [RQ2]

(8) Design required tool interfaces and create prototypes.

Stage 3: *Tool evaluation:* [RQ3]

(9) Create tasks and survey for prototype evaluation.

(10) Recruit software developers to participate in survey and conduct cognitive walk-throughs using our prototype.

(11) Evaluate and improve our human-centric persona tool based on feedback collected from developers using the survey.

Domain: COVID-19 has led to rapid uptake of e-shopping platforms and e-education platforms. We chose these as our two target application domains in our persona creation and evaluations [26], [27].

End user needs: We wanted our prototype to include as diverse and representative end user accessibility challenge types as possible. To do this we created our own persona spectrum by referring to the most common challenged end user types found in prior studies. This also ensured that the main types of end users covered by the prototype could be easily extended in the future. Table I shows our six key challenged end user types and their descriptions.

Persona Categorization: We populated our Persona Spectrum by searching academic papers and industry reports or studies using domain and bias keywords. We referred to the Microsoft inclusive toolkit manual to guide us in breaking down the end user types [9]. If the users of e-shopping are divided by age group, users aged 5-24 and 55-74 are growing faster than those in the middle [28]. We have therefore used these two age groups as categories when developing the prototype. For example, senior users might need shopping assistance, while junior users should have more restrictions in the software. Table I shows some sub-categories and descriptions based on our basic challenged end user types.

Walk-through: To find out the key goals and frustrations for our persona templates for e-shopping and e-education domains, we conducted a walk-through of leading products from these domains. Based on the descriptions and categorisations in Table I, we created personas for each sub-categorised bias and provided detailed demographic information that matched the bias. We have generated 14 personas for each domain, in total 28 personas. The avatars and names of the personas were generated with the assistance of existing online persona creation tools. In order to standardise the process for each of

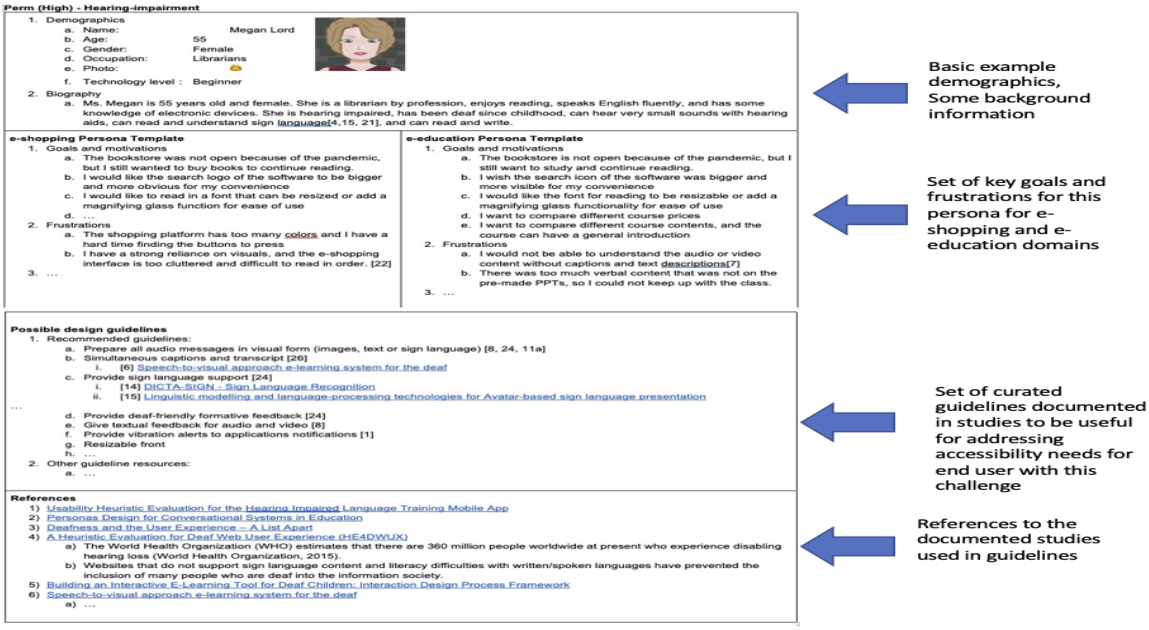

Fig. 2: An example persona curated from various published sources

the personas, we created two lists of actions for each domain. With a clear set of actions to be taken when using the software, we put ourselves into the roles of the different personas and simulated the process of using the e-shopping and e-education software based on the identified steps.

Design and Evaluation Guidelines: Guidelines were generated based on the goals and frustrations of each persona. Under each guideline, we also collected a listing of detailed sub-guidelines. These detailed sub-guidelines are intended to help the software development team in implementing the usability and accessibility of the software. Our design guidelines collected with each persona were derived from research literature, GitHub resources, StackOverflow answers, industry tutorials, and any other useful resources that have been shown to support developers in addressing, or at least thinking about, key accessibility and usability issues for the target end user group represented by each persona.

We designed two guideline modes in our prototype – developer mode and evaluator mode. The developer mode has all the most detailed descriptions and links to the relevant guidelines that we found. The evaluator mode contains a short descriptive checklist. These were designed for different tool users to use the guidelines for both development-process and post-development software checks against the guidelines. In the development mode, the guidelines include consideration of what functionality is needed. In the evaluator mode, the guidelines include evaluating whether the software has specific features. An extract from an example persona and curated guidelines is shown in figure 2. Our full set of detailed curated personas and associated guidelines can be found at: https://figshare.com/s/dcfdac2c16e3d5e4911f.

Developer Survey: We created a survey to get feedback on our prototype to: 1) Refine and improve our personas, guidelines and tool design; 2) Evaluate the usability and accessibility of the tool and whether it would be useful to developers; and 3) Explore key future directions for the study.

In order to protect the privacy of the participants and to ensure the safety of the participants and the team during the COVID-19 pandemic, we did not interview our participants face-to-face, but instead used an online survey. Our research survey was formally approved prior to begining by our university's ethics committee. We provided survey participants with a video tutorial showing how the tool could be used during development and evaluation.

IV. Tool prototype

Minimum Viable product: Our idea was to develop a web page using the React framework, which would provide a GUI that would allow developers to access the personas and associated guidelines that they were interested in. The minimum viable product functionality for the tool was identified as: (1) It should be enable develoeprs to search for key challened end user related keywords to find relevant templates; (2) it should provide prefilled persona and guideline checklist templates to the developer; (3) Persona templates should contain demographics, challenges, key goals, frustrations and design and actionable evaluation guidelines; (4) For each domain, the tool should have multiple persona templates to help developers reduce bias in their produced software; and (5) The content in persona templates should be editable to tailor them to particular software projects under development.

A. Prototype Front-end:

We used Figma to design the UI concept for the tool. The advantage of using Figma is that it gave us a clear idea of the look and feel of our intended finished tool enabling

Fig. 3: Prototype home page

evaluation and refinement. It was also code-free, allowing rapid implementation of our personas and guidelines. After confirming the design, we developed the front-end for our prototype tool. Figure 3 shows the tool homepage, with two large headings indicating the two domains we focus on, and two buttons underneath the two headings. Users can select the domain they are interested in to learn more. We also provide users with the ability to switch languages by clicking on the language button, which is located at the top right corner of the screen.

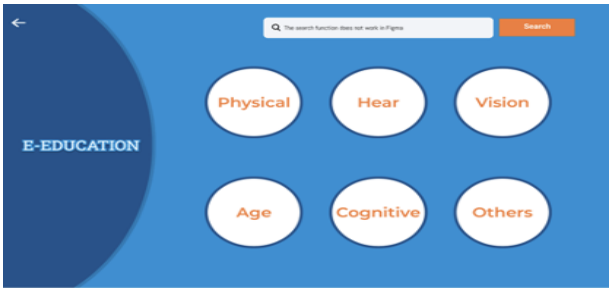

Fig. 4: Prototype general end user types selection

Once the developer has selected a domain, they are redirected to a new page, as shown in Figure 4. Each end user type is clickable and the user can select the bias to get more information. At the top of the page, there is a search bar. When there are many end user types, users can filter the information by entering keywords to find the ones that they are looking for.

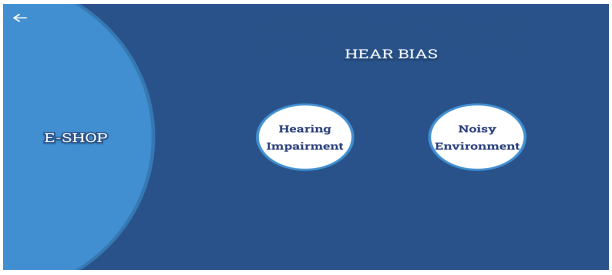

Fig. 5: Prototype detail page

For each general type of challenged end user, we have subdivided them into several specific cases, as shown in Figure 5. Consider when the user selects a hearing challenged end user type: we have provided a persona template for two different situations causing hearing-related challenges. One of these is hearing impairment, and the other is temporary loss of auditory function caused by noise in the external environment. Given that people with different conditions have different needs, users can design and provide additional help in the target software application for each of these users.

Fig. 6: Prototype persona template page

Figure 6 shows an example persona template, where we categorise different groups of end-users to form different personas. Each persona is a fictional character who is a representative of a group of challenged end-users. In addition to the basic information about the persona, the needs of the end-users, the inconveniences and difficulties they encounter in using the software are also recorded. In order to reduce accessibility challenges and provide a better user experience for end-users, we provide suggestions to the developers based on the needs of the persona and what they are not satisfied with software. This enables them to design and develop their software with additional help for each ofd the different end-user groups.

Our target tool users are not only software developers bubut also software evaluators. There are two modes to choose from the persona template guideline section: developer mode and evaluator mode. The advice given to the developer will be oriented towards providing them information on software design concepts, which requires some level of technical background. The advice given to the evaluator is based towards what features they should find present when testing the software to reduce end user accessibility and usability challenges.

In the bottom right corner of the page there is a show more option button. After selecting it, the content of the guideline section will be expanded. At the bottom of each guideline, references are displayed providing further published information about the guidelines given. A list of published papers and software that provides relevant functionalities to address this challenged end user needs are also displayed. The idea is to give developers and evaluators (i) more detail about how to design or evaluate for the target end user's likely accessibility needs; and (ii) evidence-based guidelines i.e. ones that we have checked and validated that have been shown in academic or industry studies to be helpful in addressing the

target persona end user needs. These materials that we curated include academic publications reporting techniques and evaluations of techniques; industry tutorials; good exemplars of addressing the accessibility issues; and software or tools that may aid in addressing and/or evaluating the issues.

B. Prototype Back-end

We chose the MongoDB database to store our persona template data. Our prototype is implemented as a Node.js based application, written using JavaScript. In order to integrate the front-end and back-end, we defined two sets of APIs. Get requests fetch specific data based on the data id and fetch all the data within the entity. Post requests allow the user to add new data. Patch requests allow the user to update existing data based on the data id. Delete requests delete existing data based on the data id. When the user interacts with the front-end, different HTTP requests are sent to manipulate the persona database according to the user's actions and update the content on the web page as it changes.

V. Prototype Evaluation

A. Evaluation Design

We used a survey given to our participants to assess the usefulness of our tool and to gather additional suggestions for improvement. Our evaluation methodology and instruments were approved by our university's ethics committee. We invited current IT students and software practitioners with real-world software development experience from our professional networks to be our evaluation participants.

Our survey was divided into three parts. Firstly, we provided our participants with a background on the target e-shopping and e-education domains we aimed to address and provided a recorded a video of our tool in use by developers. In the video, we explained that the prototype shown to them was created using Figma. Some functions such as multilingual and search were not implemented in the Figma prototype. A link to the Figma prototype was also provided so that the participants could look through the existing content of the tool after a rough understanding of its functionality. Participants were able to select a field of interest in the prototype and continue with working through the corresponding development or evaluation scenario. Within their chosen domain, they could select a persona and any sub-category in the next screen. Then they were able to read through the corresponding goals, frustrations and guidelines given.The second part of the survey asked about the background and development experience of the participants. This allowed us to understand whether different backgrounds and work experiences had different levels of impact on the perception of software accessibility. The third section of the survey asked for feedback on how our tool is perceived after use, and its strengths and limitations as perceived by the participants. We asked questions about whether it was thought that it could help to address accessibility issues for diverse end users. We also wanted to know if our tool had a positive social impact, making it easier for developers empathise with diverse end users and to design more human-centric software.

From the feedback we received a number of suggestions to improve our tool. This feedback was also used to reflect on whether the research was helpful to the developers and to judge the efficiency of the tool.

B. Results

We received 23 responses from anonymous participants. Figure 7 shows more than half of our participants have been working in industry for more than three years. The participants also had diverse cultural and location backgrounds, encompassing different perspectives and viewpoints. We asked the participants about their understanding of different end-users. From their feedback, many participants were able to learn more about the diverse end-user through the personas in our tool that they had not considered before. The tool helped them to find out more about the potential difficulties of users and the problems that developers may neglect in their designs.

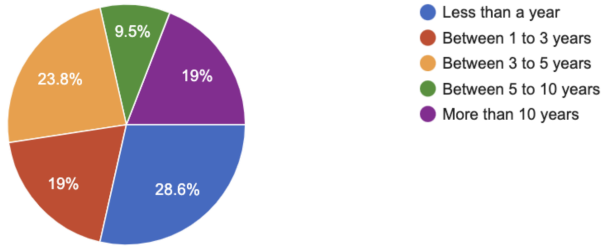

Fig. 7: Participant work experience

The survey first asked participants about their understanding of diverse end-users. The majority of responses described users with different backgrounds, including age, gender, language, and education level. Some participants have also considered users who use different electronic devices. Secondly, participants perceived that different end-users had difficulties in using software due to having different cultural backgrounds, language barriers, overly complex interfaces, physical disabilities and inability to use electronic devices proficiently. Two thirds of participants wanted to help better support diverse end-users in the development process. Making software multilingual and developing a simpler and clearer UIs for challenged users were the most common reasons. Just over half indicated that in their own work they had provided some accessibility support for some target users. Mentioned features included multilingual support, colour blind mode, screen reading and a simpler and easier to understand UI.

In terms of the logical nature of the prototype, 20 participants felt that the content was generally well-organised and logical. Almost all were satisfied or highly satisfied with the template personas provided. Some suggested that the display order of goals and frustrations should be swapped, developers would prefer to understand the frustrations first and then the goals. Some participants felt that some of the frustrations and guidelines were not relevant enough, or were not practical and difficult to implement. Over half of the participants were satisfied with the number of personas we had, but some

suggested that there could be more groups, or better quality personas instead of a larger number of personas. Over three quarters of the participants felt that the prototype itself was very concise and straightforward to use, and the developer and evaluator mode that came with the software was convenient. Over half of the participants said that the prototype gave them a better understanding of the diverse end-users and their potential bias, which allowed them to empathise with the users when designing the software. Several participants felt that our tool could help developers become more empathetic with their challenged end users.

Several participants stated that our prototype is not sufficiently mature enough for developers to use as is. It was stated by a few participants that the persona is not only used in the design phase, but also before and after design to change user requirements. The limiting of our personas to e-shopping and e-education domains was felt not relevant for several participants who work in different domains. A couple of participants noted that developers may not have access to the academic papers we provide links to in the guideline, for which open-source tools may be more appropriate and intuitive, including open-source projects on GitHub. A few participants suggested that users be enabled to prioritise different design guidelines. Several participants felt that our guidelines had too much text and references making them hard to follow. A few stated that end-users are broad in nature and that in their view it is impossible to design a piece of software to meet everyone's needs. Thus the design team may need prioritised guidelines to make development more efficient. It was noted that many end users have multiple challenges spanning two or more challenged end user persona categories, and that combining multiple persona templates into one could also be a useful enhancement. Several participants said that they were unsure just how and when they would integrate a tool like ours into their development processes.

C. Future Work

As several participants highlighted, we have a lot of text content in our persona templates. Developers may not have the time or patience to read all of this. Prioritizing the list of guidelines and simplifying some of the persona text may be a better approach to make content more useful for developers. The current content of our persona templates are our summaries obtained by reading and analysing a large number of published literature. This could be improved by having a conversation with different challenged end-users directly. In subsequent work, the analysed published persona and guideline data collected should be reduced and streamlined. The MoSCoW method could be used to assign a priority to each guideline.

Currently, our study has only focused on two domains, with 6 general types of challenged end users, 13 sub-categorised user groups, and 14 personas created for each domain. We want to extend this with more domains and personas, so that more development teams can benefit from our software. We want to also reach out to diverse end-user groups and interview them directly to understand their needs more effectively and more accurately and whether these match up with our literature sourced guidelines, goals and frustrations.

VI. Related Work

Improved accessibility of software allows users to better integrate into the information society and avoid 'digital exclusion' [10].Personas can be used to help developers better understand diverse user requirements in order to develop software that better meets the needs of users [29]. By focusing on more detailed persona requirements, software can be developed into a product that can be accessed and used by a wider range of people [12]. By using personas, companies can analyse software requirements based on the personal backgrounds, goals and frustrations of fictitious users. The MoSCoW method may also used to explicitly list requirements for priority delivery and improve accessibility beyond the basic functionality [**?**].

There are a wide range of software, tools and manual testing methods available to test software accessibility [30]. Despite the emphasis on software accessibility by many companies, available research shows that it is still unsatisfactory. In the area of e-shopping, there are still many websites that failed accessibility tests, with the most commonly affected being the high prioritised pages on the website [31]. Hamid et al.'s study [32] randomly selected a number of online shopping platforms to examine and also found that many of them failed to meet the test requirements and violated the WCAG regulations. A study showed that the sampled websites of higher education institutions had few or no accessibility components added [33]. Even with online education websites specifically designed for people with impairments, only 25% of the websites met the criteria of WCAG requirements [34].

Limited tools exist for software developers to address accessibility issues [4], [5]. The "Human-Fundamental Accessibility Portal" – https://www.a11yportal.com/index.html – has some similar ideas to our prototype. However, our prototype is more tailored to specific e-education and e-shopping platform user needs, and under each persona templates details key frustrations, goals, and a list of guidelines has been collected and documented. To better support the needs of software development, our guidelines were presented to developers in the form of checklists. Each our our guidelines also identifies the source of the reference so that developers could easily find relevant technical support. We have also set up an evaluator mode to provide non-developer users with clearer and more understandable content. Leong et al propose an 'experiential persona' tool allowing creation of personas with richer, interactive content [35]. Their work is aimed at designers, and lacks our curated guidelines and checklists. Helton et al propose a persona and use case based too to aid in business process development, rather than web and app development [36].

In recent years, many companies have been progressively improving the accessibility standards of their software. Amazon [37] has stated its commitment to designing human-centric interactive interfaces to help people with disabilities shop online. They have also added to the basic functionality with

four assistive features: vision, hearing, mobility and speech. Online education platforms such as Coursera [38] and meeting platforms such as Microsoft Teams and Zoom [39] also offer accessibility features to make their platforms more accessible to a wider public.

VII. Summary

We wanted to better support software developers to meet the accessibility needs of diverse end users. We designed a tool to help capture a range of personas representing diverse end users, providing developers with support during software design to consider a wide range of issues such end users may encounter when trying to use their software. Our tool provides personas for a range of common end user accessibility challenges, as well as key goals and frustrations such users have for e-shopping and e-education platforms, together with a curated set of recommended guidelines for addressing these issues. During evaluation of our prototype tool our study participants agreed that the tool helped them to be more aware of a wide range of diverse end-user challenges and to increase their empathy so that they could effectively develop more user-friendly software for them.

Acknowledgements

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