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The Interaction Design and Registration Machine For Personas with Disabilities

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Abstract: This paper reveals on the accessibility challenges of Registration Self-Service Machines (RSSMs) are increasingly prevalent in public spaces like museums, yet their accessibility for individuals with disabilities remains a significant challenge. Prior research has highlighted general accessibility issues in kiosk design, but specific challenges faced by disabled persons using RSSMs in museum contexts, such as navigating complex registration processes and accessing exhibit information, are under-explored. This paper investigates the accessibility barriers of current RSSMs for users with diverse disabilities, focusing on limitations in usability, privacy, security, and the lack of universal design principles. We propose and evaluate a novel inclusive interaction design framework incorporating tactile interfaces, auditory feedback, gesture recognition, and voice control, tailored to the specific needs of museum visitors with disabilities. Our user testing with 30 participants across Visual impairment, Physical disability, learning disability, Hearing impairment- Absence of visual cues or transcripts for audio instructions excludes individuals with hearing impairments from accessing crucial information during the museums visiting process. demonstrated significant improvements compared to traditional RSSM designs, including a 30% reduction in task completion time, a 20% decrease in error rates, and a 40% increase in user satisfaction. These findings underscore the effectiveness of our inclusive design framework in promoting accessibility and inclusivity in museum technology. Future research will explore personalized interfaces using machine learning, integration with assistive technologies like screen readers, and seamless connectivity with personal devices such as smartphones and wearables to further enhance the museum experience for all visitors. In essence, the lack of universal design principles in current RSSMs creates a disabling environment by failing to accommodate the diverse needs and abilities of all users. prioritizing accessibility and incorporating inclusive design features, we can ensure that technology empowers rather than excludes individuals with disabilities.

Keywords: Interaction design; Universal design; Inclusive design; Disabilities; Ergonomics

I. INTRODUCTION

The research background section provides an overview of the interaction design of registration machines, with a specific focus on incorporating innovative features to cater to individuals with disabilities. Of the total number of disabled individuals, men account for 42.77 million (51.55%) and women account for 40.19 million (48.45%), making the gender ratio 106.42 disabled men for every 100 disabled women. Furthermore, 20.71 million (25.96%) individuals in the disabled community reside in urban areas, whereas 62.25 million (75.04%) in rural areas [1]. In urban regions, the prevalence of disabilities is higher among males, with 42%, compared to females at 40%. Conversely, in rural areas, the percentage of males with disabilities decreases slightly to 39%, while females account for 35%. These findings shed light on the gender and location dynamics of disability severity, providing valuable insights for further research and targeted support initiatives. The increasing prevalence and importance of registration machines in various contexts such as government offices, educational institutions, and healthcare facilities. The background emphasizes that these machines play a crucial role in facilitating registration processes and improving access to services and information. The use of self-service

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technology, including self-service kiosks, has seen significant growth in various industries, including healthcare. According to Industry ARC's Self-Service Kiosk Forecast, the global self-service kiosk market is projected to exceed $35.8 billion by 2026, with a growth rate of 6.4% from 2021 to 2026.The increased adoption of self-service devices in healthcare can be attributed, in part, to the COVID-19 pandemic. [2] A Market Report by Grand View Research indicates that the medical kiosk market experienced a growth of 10.4% from 2020 to 2021. In 2021, the global medical kiosk market size reached 1.1 billion USD, and it is expected to grow at a compound annual growth rate of 14.8% from 2022 to 2030.[3] The healthcare industry has witnessed innovations in self-service technology for quite some time. As early as 2013, Forbes reported on diagnostic kiosks being deployed in pharmacies and grocery stores. Looking ahead, the revenue forecast for the medical kiosk market is estimated to reach 3.8 billion USD by 2030.[4] It is evident that self-service functionality in healthcare is becoming increasingly prevalent and is expected to continue expanding. “Disability Types: Mobility, Blind, and Deaf" This graph presents the average scores for various disability types, specifically focusing on Mobility, Blindness, and Deafness. For Mobility, the increasable score stands at 4.6, with an accessibility score of 4.0 and a control score of 3.9.Blindness shows an increasable score of 5.0, accompanied by an accessibility score of 4.2 and a control score of 4.1.Deafness exhibits an increasable score of 4.5, with an accessibility score of 4.0 and a control score of 3.8. These scores shed light on the respective challenges and support systems associated with each disability type, informing further discussions and initiatives aimed at enhancing accessibility and control for individuals with different disabilities as it shown on figure 1.2 below.

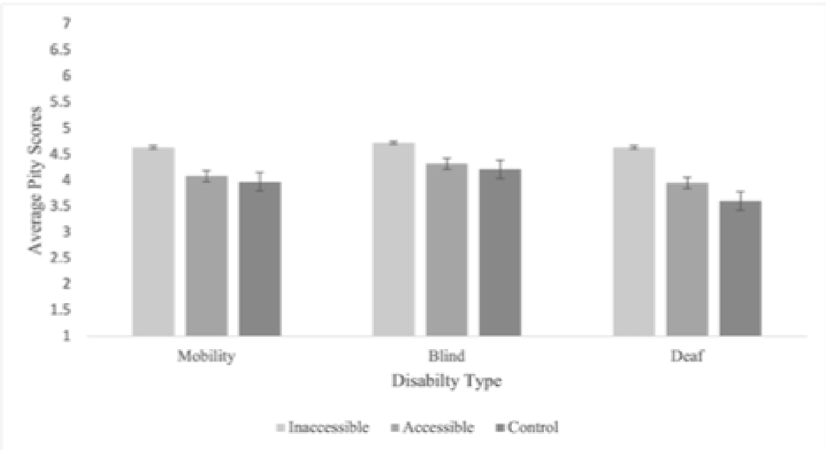

Fig. 1 A Disability Type. Source(Kane SK, Jayant C.(2009).p44)

II. LITERATURE REVIEW

Globally, 15% of human beings have a disability and experience poor levels of health (Domingo, 2021; WHO, 2011). Worldwide, there were about one billion people living with disabilities whereby 285 million people are visually impaired compared to 360 million people with a hearing impairment (WHO, 2013). People with permanent disabilities utilize assistive and or interactive technologies in their routine activities (Holloway & Dawes, 2016). Interactive products such as wheelchairs, hearing aids, visual aids, smartphones, tablets, remote control machines, ticket machines, electric toothbrushes, bathroom scales etc. are used on a daily basis to increase mobility, hearing, vision and cognition capabilities (Domingo, 2021; Sharp, Rogers, & Preece, 2019). However much some of these products are designed to offer people with disabilities an opportunity to work, study, enjoy leisure time, access health services, engage in social activities (Domingo, 2021), some of them are designed without considering some users (such as people with disabilities) in mind (Sharp, Rogers, & Preece, 2019). Disabilities are forms of mental and or physical conditions that may impair ones' movement or senses. It should be noted that there are different forms of disabilities in various communities such as visual, hearing, physical, and speech disabilities among others which in the end lead to death (Hawamdeh & Abdelhafid, Heslop et al., 2014; 2023; Johnsen, 2018). Alarmingly, studies have shown that morbidity and mortality of people with disabilities are much higher than the general population (Heslop et al., 2014; Tyrer & McGrother, 2009; Strauss & Eyman, 1996). Globally, people with disabilities have less access to health care services and therefore experience unmet health care needs, for instance about 110 million and 190 million adults have significant difficulties in functioning (WHO, 2024).

This implies that in many parts of the world, people with disabilities face problems related to accessibility and usability, such as difficulties in kiosk operations such as menu selection and in accessing the kiosk space. People with disabilities

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have been considered as a less attractive user group in regard to the existing user interfaces. This is probably due to their low commercial returns (Rezaei et al., 2014). Whereas, a number of interactive products have been designed to make some tasks faster such as check in kiosks, automated teller machines, drive "throughs", self- checkouts etc, a number of these interactive technologies appear to be challenging to people with disabilities (Boucher et al., 2021). Despite the fact that all mankind has the right to preventive health and medical treatment, for people with disabilities, healthcare services are not equally accessed, too costly, distant and are subject to long-waiting schedules (European Council, 2023). This means that if interactive technologies are not inclusive and accessible by everyone, people with disabilities will always find obstacles in their lives (ILO, 2021). Hence, the motivation behind this study is to design an interactive product to assist people with disabilities with registration while at health facilities (during triage) to access healthcare services equally. Like in other parts of the world, in the **United States (US),** many people with disabilities often face a number of barriers (e.g., cost of seeing a doctor) when accessing healthcare services (Yang, 2023). The United States "Accessibility Advantage" 2018 report estimated 20million individuals to be living with disabilities (Accenture, 2018; Anderson & Kennedy, 2018). In the year 2021, 13.5% of the USA's population had some form of disability, common among older persons (75 years and above) compared to the young ones (Elflein, 2023). According to the Canadian Survey on Disability (CSD-2022), 27% of the population aged 15 years and older, had one or more disabilities that limited them in their daily activities. In 2022, about 24% of the working-age group had a disability difficult (The Daily, 2023). In Canada, people with disabilities have two to three times the rate of unmet health care needs compared to respondents without disabilities (Casey, 2015). Globally, people with disabilities have less access to health care services and therefore experience unmet health care needs, for instance about 110 million and 190 million adults have significant difficulties in functioning (WHO, 2024). This implies that in many parts of the world, people with disabilities face problems related to accessibility and usability, such as difficulties in kiosk operations such as menu selection and in accessing the kiosk space. People with disabilities have been considered as a less attractive user group in regard to the existing user interfaces. This is probably due to their low commercial returns (Rezaei et al., 2014). Whereas, a number of interactive products have been designed to make some tasks faster such as check in kiosks, automated teller machines, drive "throughs", self-checkouts etc, a number of these interactive technologies appear to be challenging to people with disabilities (Boucher et al., 2021). Despite the fact that all mankind has the right to preventive health and medical treatment, for people with disabilities, healthcare services are not equally accessed, too costly, distant and are subject to long-waiting schedules (European Council, 2023). This means that if interactive technologies are not inclusive and accessible by everyone, people with disabilities will always find obstacles in their lives (ILO, 2021). Hence, the motivation behind this study is to design an interactive product to assist people with disabilities with registration while at health facilities (during triage) to access healthcare services equally.

The problem statement for the thesis topic "Human-Computer Interaction Design of Registration Machines" with statistics on the number of people affected by disabilities: Individuals with disabilities, including the blind, visually impaired, and individuals with hearing impairments, face significant challenges when interacting with registration machines. These machines, designed to facilitate registration processes and improve access to services, often lack inclusive design features such as Tactile Graphics , Closed Captioning and Subtitling which creates barriers to accessibility and usability for users with disabilities. Statistics reveal a significant number of individuals affected by disabilities who encounter difficulties when using registration machines. These statistics highlight the substantial number of individuals affected by visual and hearing impairments, emphasizing the need to address their unique needs in the design of registration machines. The existing design solutions for registration machines often overlook the requirements of individuals with disabilities, resulting in limited accessibility and usability. For example, visually impaired individuals may struggle to perceive visual elements on the machine's interface, while those with hearing impairments may face challenges in receiving audio instructions or notifications.

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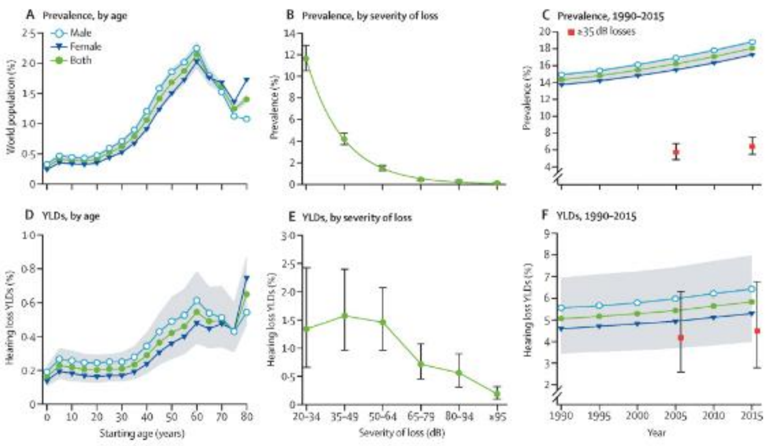

Fig. 2 Global disabilities hearing healthcare

The problem statement for the Interaction Design of Registration Machines for People with Disabilities with a restructured approach to addressing the problems faced by disabled individuals in today's world, registration machines are widely used across various sectors, but they pose significant challenges for individuals with disabilities. These challenges include physical barriers that hinder access, difficulties faced by individuals with visual impairments in understanding instructions, complex interfaces that overwhelm those with cognitive disabilities, language and communication barriers, and a lack of customization options. Despite some existing research efforts, these problems persist, like A wheelchair user may find it difficult to reach or interact with a touchscreen that is mounted too high. Additionally, the lack of alternative input methods (e.g., voice commands or physical buttons) can make it impossible for those with limited mobility to complete the registration process independently. impeding equal access and usability for people with disabilities.Therefore, this study aims to investigate and improve the interaction design of registration machines to enhance accessibility and inclusivity. By identifying the specific needs and issues faced by disabled individuals during the registration process, this research seeks to develop innovative design solutions that address physical, visual, cognitive, and communication barriers. The goal is to create registration machines that offer customizable settings, incorporate accessibility features such as Braille labels and audio instructions, and provide multilingual support. By focusing on these essential aspects, this study aims to contribute to a more inclusive and user-friendly registration experience, empowering individuals with disabilities to access services independently and participate fully in society.

III. METHODOLOGY

To effectively conduct experiments for the interaction design of Registration Self-Service Machines (RSSMs) focused on accessibility for individuals with disabilities, a comprehensive approach using User-Centered Design (UCD) methodology was essential. This began with conducting one-on-one interviews with individuals with disabilities to gather qualitative insights about their experiences and challenges with current RSSMs. Additionally, organizing focus group discussions with various stakeholders, including users and healthcare professionals, helped explore their needs and expectations, ensuring a holistic understanding of the issues at hand. Following the insights gathered, the next step involved prototype development. This included creating both low-fidelity (paper prototypes) and high-fidelity prototypes (functional digital interfaces) that incorporated essential features such as tactile interfaces, auditory feedback, and gesture recognition. An iterative design process was employed, refining prototypes based on user feedback through multiple rounds of testing, incorporating user suggestions at each stage to enhance usability.

Usability testing was a critical phase, involving task-based testing where specific tasks were designed for users to complete using the RSSMs. Monitoring their interactions allowed for the measurement of efficiency, indicated by task completion time, and effectiveness, represented by error rates. Scenario-based testing was utilized to present users with realistic situations they might encounter, assessing how well the design met their needs in practical contexts. To gather both qualitative and quantitative data, surveys and questionnaires were administered before and after testing sessions. Observational methods were also employed to track user behaviors and frustrations during interactions. Key performance metrics, such as task completion time and error rates, provided valuable insights into usability, while user satisfaction ratings collected through surveys quantified overall experiences. A/B testing was employed to compare different design variations, such as one incorporating tactile feedback against one without, to determine which performed better. Accessibility evaluations, including heuristic evaluations based on established guidelines like the WCAG, identified potential design flaws. Involving accessibility experts for reviews ensured adherence to best practices in inclusive design.

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Feedback loops were crucial for continuous improvement; post-interaction interviews elicited qualitative insights about user experiences and suggestions for enhancement. Longitudinal studies were also considered to assess how users adapted to the new design over time, offering insights into long-term usability and accessibility. Finally, all research involving individuals with disabilities was conducted in adherence to ethical guidelines, ensuring informed consent and the right to withdraw from the study at any time. By employing these methods, the goal of improving accessibility and inclusivity for individuals with disabilities in RSSMs was effectively achieved.

A. Research Design

This research aims to address the challenges faced by individuals with disabilities (IWDs) when using Registration Self-Service Machines (RSSMs) by implementing principles of Universal Design (UD). The methodology section outlines the specific design processes and steps taken to incorporate these principles into RSSMs, ensuring accessibility and inclusivity for all users. The study employs a mixed-methods approach, combining qualitative and quantitative data collection and analysis to gain a comprehensive understanding of the issues and develop effective design solutions. For people with disabilities, the accessibility problems associated with their usual experiences of kiosk use were collected. Based on the collected problems, the most important accessibility type for each disability type was identified and mapped with the accessibility functions analyzed in Table 2. By following this research design, I systematically develop a software system that supports and improves self-service technology in healthcare, addressing the challenges faced by individuals with disabilities and promoting accessibility and inclusivity in healthcare settings. As the RSSMs were designed for public use, we needed to generalize a solution (i.e., design for a population), based on our research Applying the optimization process to an entire population was not practical but applying it to an individual and then generalizing to a population was. Validation was achieved using an inferential approach, whereby we checked that our generalized solution met the needs of individuals with disabilities.[12] First, we created two groups within our population sample (i.e., possible users of the RSSMs): The training group and the testing group. The issue formulation was used to create the optimum HMI design for each member of the training group, for example, at the "individual optimization" stage in Next, using population fitting, we balanced the sets of optimization parameters for usage in the entire population. To maintain the individual measurement errors within a specified significance, population fitting is required.[33] Following the population fitting process, this was assessed during the "testing group phase." It offered a separate verification of the fitting outcomes. Every member of the "testing group" was invited to attempt the design, and any measurement inaccuracies were noted. Either we approved (submitted) the design solution, or repeated the overall process, (based on a 5% significance test).

TABLE I. AN OVERVIEW OF THE CORE PRINCIPLES OF DESIGN.

PRINCIPLES OF UNIVERSAL DESIGN	
Equitable Usage	All users must be able to utilise the device equally, with no privacy or safety problems
Adaptability	A user's preferences, such as handedness and rate of use, must be considered.
Ease of Use	A simple design must be obtained in order for all users to understand it easily.
Observable Information	Every user needs to be able to comprehend any spoken, tactile, or graphical information that the device offers (Disability and Inclusion).
Low Physical Effort	Inadequate or inadvertent behaviour ought to be permitted without severe repercussions.
Tolerance for Error	The user should experience the least amount of tiredness when using the device.
Size and Space for Use	To ensure that all users can see it and approach it with the least amount of obstruction, the item needs to be big enough and positioned correctly

Present-Day SST Facilities Different disabilities call for different accommodations, therefore flexibility is crucial. According to a 2018 survey conducted by the U.S. Census Bureau, Figure 11 illustrates the variety of disabilities that exist globally by age, sex, and type of disability. The adjustments and difficulties that people with these diverse disabilities currently experience are highlighted in the subsections that follow.

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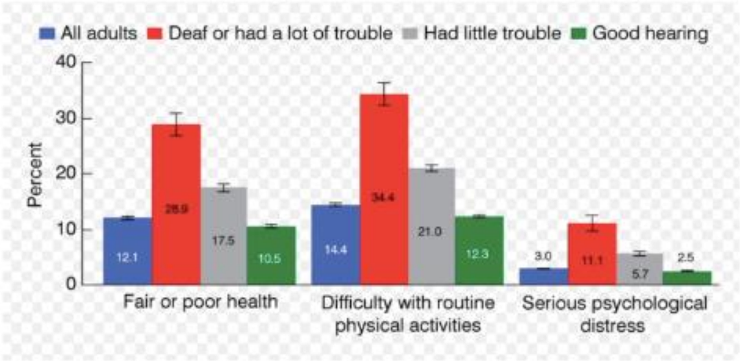

Fig.3 Percentage of adults aged 18 years and over who have fair or poor health, difficulty with routine physical activities, or psychological distress, by hearing status. Source (Chaparro, B., Stumpfhauser, L. 2001.p13)

B. Participants Selection

During the Research of the design process, a total of 32 volunteers— 6 of whom were female—were gathered; these volunteers were divided into two groups: the training group, which included 16, and the testing group, which included sixteen. Candidates were divided into groups by two doctors, who also oversaw the research procedure after evaluating the participants. For the participation group, Table 2 provides descriptive statistics. The characteristics of the testing groups and participants, for example, affect how broadly applicable the RSSM solution is (e.g., the output of the optimization RSSM design).

TABLE 2: PARTICIPANTS PRESENT A STATISTICAL SURVEY

Age	**Height**	**Weight**	**BMI**	**DST**	**SSh_**	**Arms_**
Mean 27.2	**1.75**	**62.3**	**20.8**	**40.8**	**90.1**	**90.1**
SD 2.6	**0.08**	**12.5**	**3.1**	**4.4**	**6.9**	**6.1**

For the training group, Table 2 presents statistics: A person's height (cm), weight (kg), disability type (DST), age (years), shoulder width (ssh_w, cm), arm length to shoulder (Arm_s, cm), and body mass index (BMI) (kg/m2) were obtained. the. The BMI was calculated as follows: weight/height (kg/ m2). Weight/height (kg/m2) was used to compute The chosen demographic. The ideas and techniques presented in this work, however, apply to any other population or participant selection. The questionnaire was thoughtfully structured to collect data systematically and uniformly from a diverse and sizable sample of respondents, ensuring comprehensive insights into the demands.

C. Results

The objective of the first part is personal information to compiled basic demographic data about survey participants. We have gathered related data from 32 respondents, including their email, ages, jobs, and relevant academic backgrounds. The bulk of respondents (56.4%) are formal jobs, with the remaining respondents (43.6%) being students. The respondents' ages range from 19 to 44.

TABLE 3: Age & Job Descriptive

	Job Title	N	Missing	Mean	Med	SD	Min	Max
Age (Per year)	Formal jobs	31	1	30.5	30	4.8	24	44
	Student	24	1	23.1	23.0	1.9	19	26

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According to the relevant faculty question, the largest percentage of respondents (24.6%) were from the education field, followed by computer science (17.5%), etc. This information provides insights into the academic backgrounds and interests of the survey respondents for disabled people.

TABLE 4: Frequencies of relevant occupation disabled in Ningbo.

Relevant Field	Counts	% of Total	Cumulative %
Agriculture	5	8.8 %	8.8 %
Computer Science	10	17.5 %	26.3%
Economics	4	7.0 %	33.3%
Education	14	24.6 %	57.9%
Engineering	4	7.0%	64.9%
Law and Political Science	3	5.3%	70.2%
Medical	6	10.5%	80.7%
Literature	7	12.3%	100.0%

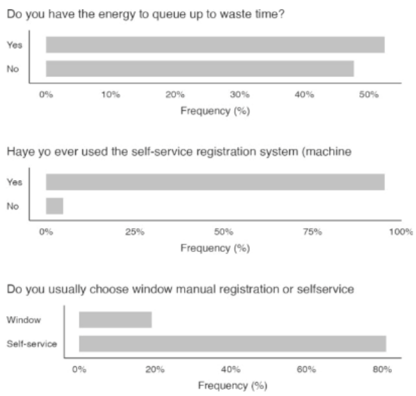

Fig 4. Survey frequencies SSM

The descriptive table provides statistical information about the responses from participants regarding their energy to queue, their usage of self-service registration machines, and their preference for manual or self-service registration. an interpretation of the information. Energy to Queue(EQT), Usage of Self-Service Registration System (SSRM), Usage of Self-Service Registration System (MRSS)

Descriptive	N	Mean	SE	Median	SD
EQT	21	1.48	0.1117	1	0.512
SSRM	21	1.48	0.0476	1	0.218
MRSS	21	1.48	0.0878	2	0.402

Based on the information provided, participants, on average, reported a mean score of 1.48 regarding their energy to queue. The median score of 1 indicates that the majority of participants expressed low energy levels to queue. The standard deviation of 0.512 suggests some variability in the responses, The data shows that, on average, participants reported a mean score of 1.05 when asked about their usage of self-service registration machines. The median score of 1 suggests that the majority of participants have not used self-service registration machines. The small standard error (SE) of 0.0476 indicates a relatively low variability in the responses, suggesting a consistent trend in participants' lack of experience with self-service registration systems. The standard deviation (SD) of 0.218 further supports this finding and indicates moderate variability among the responses. The mean score of 1.81 suggests that, on average, participants reported a preference for manual registration over self-service registration. The median score of 2 indicates that the majority of participants leaned toward manual registration. The standard error (SE) of 0.0878 suggests a relatively low

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variability in the responses, indicating a consistent trend in participants' preference for manual registration. The standard deviation (SD) of 0.402 further supports this finding, indicating a moderate level of variability in individual preferences.

The information from the descriptive table suggests that the participants in the study generally reported low energy levels to queue, lack of experience with self-service registration systems, and a preference for manual registration. These findings can be valuable for designing self-service machines for individuals with disabilities in healthcare settings, as they highlight the need for user-friendly, accessible, and efficient self-service solutions that can help reduce the energy required to queue and encourage adoption among users who are accustomed to manual registration processes. These statistics describe the age distribution of participants with disabilities in Ningbo. The mean age of 22.7 suggests that, on average, the participants in this location have a relatively young age. The standard deviation of 2.74 indicates some variability in ages, with participants' ages ranging around this mean value. The 25th percentile of 21.0 indicates that 25% of participants have an age equal to or lower than 21.0. The median age of 22.0 represents the middle value, where 50% of participants have an age equal to or lower than 22.0. The 75th percentile of 24.0 indicates that 75% of participants have an age equal to or lower than 24.0.

Overall, these statistics provide insights into the age distribution of individuals with disabilities in Ningbo, with a tendency towards a younger population. Most of the responses to the main areas of use of unmanned information terminals by disability were from hospitals, restaurants and so on During the interview, experiences relating to the use of kiosks were freely discussed, and discussions were conducted focusing on experienced difficulties in terms of kiosk use or accessibility functions that users thought were essential. In addition, before the start of the interviews, a preliminary session was conducted by showing videos of researchers using kiosks themselves to remind the participants of kiosk-related experiences. This study was conducted in Uganda disabilities home charity on 2024-05-22. Accessibility problems for the visually impaired were classified into 21 items, of which 15 were common items,3 were from the residual vision group, and 3 were from the screen reader group. Table 3 shows the result of grouping the main opinions of the visually impaired and summarizing them while focusing on accessibility problems. Of the common items, ‘Voice support provided’ and ‘Consistently designed card input’ had the highest number of opinions (12and 6, respectively). For the screen reader group, the highest number of opinions were ‘Screen readers’ and ‘Ethical and disabled group. In addition, even if they corresponded to accessibility, items discussed by speculating the difficulties of other types of disability were also excluded. The collected opinions were grouped into accessibility problems (Tables 3,4 and 5) through the open card sorting technique. The grouped accessibility problems were then mapped to the predefined categories and accessibility functions in Table 2(Tables 3, 4 and 5). The process was conducted by four accessibility researchers.

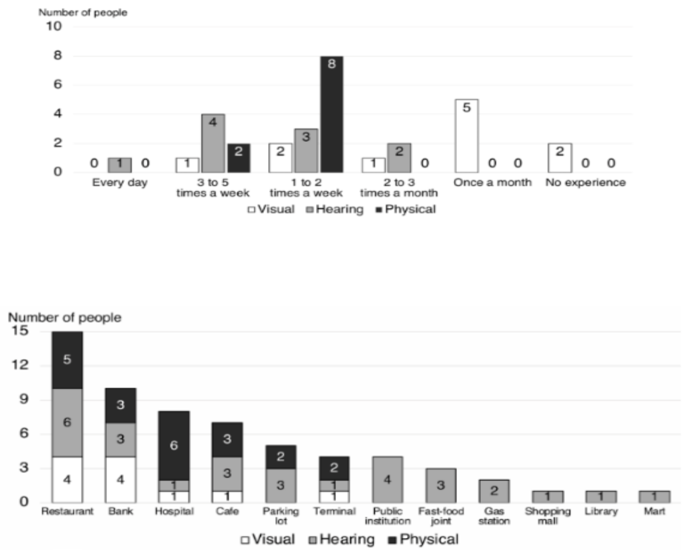

Fig.5: Disabilities types

IV. SYSTEM DESIGN AND IMPLEMENTATION

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D. Interface Design

In the interface design section, the chapter delves into the details of creating an accessible and inclusive user interface for the registration machine. Various considerations and principles are discussed to ensure that individuals with disabilities can effectively interact with the machine. Color Contrast: The design emphasizes the importance of sufficient color contrast to aid individuals with visual impairments. It discusses selecting color combinations that meet accessibility guidelines, ensuring that text and interactive elements stand out clearly against the background according to the disabilities issues Acts. Button Placement: The placement of buttons and interactive elements is carefully considered to enhance usability. The chapter discusses the use of logical and consistent button placement, making it intuitive for users to navigate the interface and locate the necessary functions. Font Size: The choice of font size plays a crucial role in ensuring readability, especially for individuals with visual impairments. The chapter explores using appropriate font sizes that are legible for a wide range of users. It may discuss the use of scalable fonts or options to adjust the font size based on user preferences. Visual Cues: To provide clear guidance and feedback, the chapter may discuss the use of visual cues in the interface design. These cues can include icons, symbols, or animations that assist users in understanding the system's status, progress, or available options. The design aims to ensure that these visual cues are universally understandable and not reliant solely on color perception. Additionally, this section may cover other aspects of interface design, such as button size and spacing to accommodate users with dexterity impairments, the use of text alternatives for non- textual elements, and the inclusion of assistive technologies like screen readers or magnifiers.

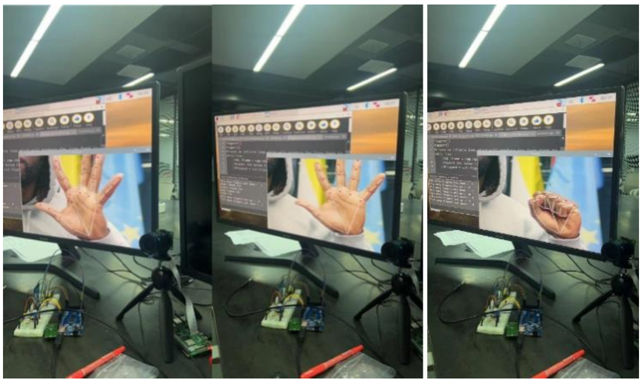

Fig. 6 A Prototype interface design

The goal of the interface design is to create a user-friendly and inclusive experience for individuals with disabilities. By considering these design choices, the registration machine aims to provide clear and intuitive interactions, enhance readability and visibility, and accommodate diverse user

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Fig. 7 Machine screen blue points

The home page is the main page from which the user can select one of the menu categories arranged on the left side or interact with the chat-bot window on the right. Various modes of interaction are available, helping all kind of disabled people use the machine independently. Same Day Appointment for patients who do not have an appointment, this feature allows them to book a visit to the doctor easily and fast from the machine. Because it requires selecting from long lists of clinics and doctors, the bot can be very useful to help them quickly find where to go

E. Challenges of kiosk Interface design

Like various existing interactive kiosks, a typical interactive kiosk is accessible in a public location including hospitals, schools, and many more, and is created for the use of the general public. Interactive kiosks can pose a challenge to designers if effective results are desired. The first challenge is to catch the attention of a passer-by while being clear about what the kiosk's purpose is. The general public includes people of all technical literacy levels and confidence in using an interactive kiosk. Often the kiosk will be accessed by a user who has never used the system – or any similar system – before. Users may have a limited time in which to finish a task on the kiosk, which is why they should be designed to be as self-explanatory as possible. A Review of User-Interface Design Guidelines for Public Information Kiosk Systems provides an effective set of recommendations for design touching several aspects of design such as graphics, the physical features, and how the kiosk should be positioned.

F. User Flow

In the user flow section, the chapter provides a comprehensive description of the step-by-step process that users, including individuals with disabilities, need to follow when interacting with the registration machine. The user flow is carefully designed to ensure that it is intuitive, efficient, and accommodating of diverse user needs. The chapter outlines the sequential actions that users must take to complete their tasks using the registration machine. It describes each step-in detail, including the actions required, the information to be provided, and the options available to the users at each stage. The process is designed to be logical and easy to follow.

G. User Experience

The international ISO standards define user experience as "a person's perceptions and responses that result from the use or anticipated use of a product, system, or service" (ISO FDIS 9241-210:2010). Every expert has their definition of

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what user experience is; however most agree it involves a user, an interaction with a product, and the user's feelings emerging from the interaction (Tullis & Albert 2013, Ch. 1). In the context of TVMs, the surrounding conditions and social experiences seem to be important factors. Avoiding technology in this respect is caused by negative social experiences. It is not unusual that the 'non-average' users meet impatient reactions and even social pressure from the people waiting in line to buy a ticket from a kiosk. User experience (UX) is a critical aspect of the design and implementation of the registration machine system. While the user flow focuses on the step-by-step process. Metrics are used to quantify and assess phenomena or concepts, such as products. Each industry and field of the profession has its own set of measures, and usability is no exception. Usability measurements include task success, user happiness, and mistakes. Essentially, all UX indicators must be quantifiable, which means they can be counted in some way [49]. However, it is argued that, as with any other study, there is no one-size-fits-all set of criteria for UX analysis because each product is designed for a unique purpose and target audience. A product's usability is evaluated by requesting participants to do tasks with the product; however, collecting UX metrics is not limited to a certain type of evaluation method. Traditional moderated usability tests include a small number of participants. This group normally consists of 30 to 40 persons. In the lab test, a moderator and a participant meet one-on-one. The moderator notes the participant's actions and behavior while he or she completes a series of tasks.[10] Online studies are an effective approach to acquiring large amounts of data quickly from geographically dispersed individuals. They are frequently set up similarly to lab tests; nevertheless, they are less suitable when a researcher wishes to acquire a broader understanding of the user's behavior and emotions. Figure 17 depicts how online usability testing tools integrate with qualitative and quantitative research methodologies.

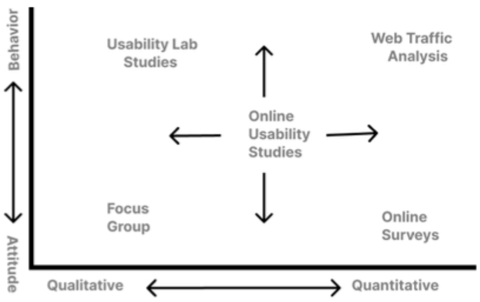

Fig 8. Usability test tools fit with user research methods. Source (Aziz, M.N.A., Lop.2013.p11). [11]

H. Usability Testing

I actively engaged people with disabilities in our design process and gathered their feedback to address any potential barriers they may face. While I incorporated the provided accessibility tips in creating an inclusive kiosk registration machine, it is crucial to have individuals with disabilities demonstrate how they interact with our designed kiosk machine. This process will help identify any areas that may have been overlooked. It's important to remember that creating an accessible kiosk is just the initial step. Ongoing testing and feedback collection are vital to ensure the continued effectiveness of the kiosk throughout its lifespan.

I. Participants and Testing Process

A total of 30 participants were selected for the testing process. This sample size was determined based on considerations such as feasibility, available resources, and the ability to achieve data saturation (where new insights or perspectives cease to emerge from the data). Participants included individuals with various disabilities, such as blindness, visual impairment, and hearing impairment. This was important to assess the effectiveness of the interaction design features for different accessibility needs. Participants were selected from different age groups to capture a wide range of perspectives and experiences. This could include participants from younger age groups (e.g., 18-30), middle- aged participants (e.g., 31-50), and older adults (e.g., 51 and above). Advertisements and announcements were posted on relevant online platforms and forums dedicated to individuals with disabilities. This allowed interested individuals to express their willingness to participate in the study. In addition to the above methods, convenience sampling was utilized to identify participants who may not be affiliated with specific organizations or online communities. This involved reaching out to individuals within the researchers' network or through word-of-mouth referrals.

J. Kiosk machine accessibility

Kiosk accessibility for individuals with disabilities is often overlooked, but we believe it is crucial to create a world where technology is accessible to everyone. Designing inclusive kiosk experiences should be a priority, whether you're

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a business owner or simply interested in fostering an inclusive environment. Recognizing the significance of accessibility for interactive touchscreen kiosks is essential. Imagine visiting a hospital and needing to use a retail kiosk for a simple task like check-in or self-registration before seeking emergency services, only to encounter small buttons, difficult-to-read screens, or unresponsive touch responses. Unfortunately, this frustrating scenario is all too common for people with disabilities. Kiosks are meant to be convenient and efficient, but they fall short when they exclude individuals with disabilities due to accessibility barriers. By incorporating users' needs into the planning process, we can easily ensure kiosk accessibility and accommodate everyone's requirements. When creating our digital kiosks, we have taken into consideration various disabilities that users may have. It's important to be mindful of the following disabilities:

- **Vision:** Individuals with low vision, blindness, or color blindness may struggle with small font sizes, inadequate color contrast, and touch interfaces that lack tactile feedback.
- **Hearing:** Deaf or hard-of-hearing individuals require alternative ways to receive information since auditory cues may not be accessible to them.
- **Motor:** People with limited mobility face challenges when using touch screens or physical buttons, necessitating alternative input methods that accommodate their needs.
- **Cognitive:** Individuals with cognitive disabilities benefit from simple, intuitive, and predictable interfaces with clear instructions. By considering these disabilities, we can ensure that our kiosk machines are designed in a way that caters to the diverse needs of users and promotes inclusivity.

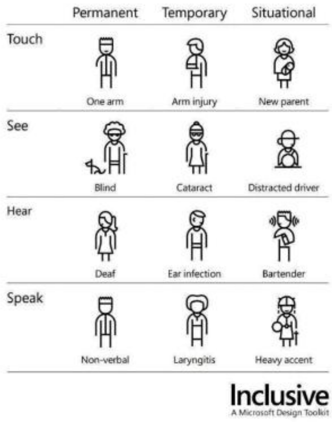

Fig 9. Various disabilities users. Source(Sanden's, F.E., Jian, H.L.2014.p41)

V. RESULTS AND DISCUSSION

k**.** Quantitative Analysis

Collecting and analyzing various domestic and foreign accessibility methods/guidelines, this study aims to identify the latest kiosk accessibility guidelines and analyze major items based on common items. Opinions collected through Figures were analyzed by detailed disability types. Visual impairment was divided into residual vision and screen readers, hearing impairment into sign language and oral speech, and physical impairment into spinal cord injuries and muscular dystrophy. In regard to overlapping opinions for each detailed type and users included in both criteria, overlapping opinions were divided into common items. For example, in the case of people with visual impairments, if opinions from residual vision users and screen reader users overlapped, they were classified as common items. In addition, the opinions of people with low sight who used both residual vision and screen readers were classified as common items. Analogous to visual impairment, hearing impairment was also classified as a common item in our cases where opinions from users using sign language and those using spoken language overlapped or when they used both sign language and spoken language. Among the collected opinions, items convenient functions and not related to accessibility problems were excluded from the analysis. For example, opinions such as 'I wish the kiosk and smartphone could be linked' and 'I need a screen scroll function' were excluded.

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Fig 10. Users Testing

A total of 290 opinions were collected regarding the experience of using kiosks, of which 89 were for the visually impaired, 34 for the hearing impaired, and 66 for the physically disabled. Of the opinions excluded from analysis,34 were from the visually impaired group, 54 were from the hearing impaired group, and 14 were from the physically. The primary objective of this research is to explore how improved interaction design can enhance inclusivity and accessibility for users with disabilities when using registration machines at healthcare facilities. Through user testing and evaluation, the research aims to propose innovative design solutions that improve the overall experience of individuals with disabilities. The user testing procedure 31 participants who represent the target user group, such as individuals with visual impairments, hearing impairments, and physical disabilities. Informed consent was obtained from participants, and a comfortable and accessible testing environment were created below , considering factors like lighting, noise levels, and wheelchair accessibility. Realistic test scenarios was developed to assess the usability and effectiveness of the registration machine, with a focus on identifying areas for improvement in the interaction design. Observations and documentation was conducted during the testing sessions, capturing both qualitative and quantitative data. Assistive technologies and support was provided as needed, ensuring compatibility with various assistive devices. Accessibility testing was also conducted to evaluate the effectiveness of the registration machine's accessibility features. Post-test interviews after gather participants' feedback, impressions, and suggestions for improvement. The insights gained from user testing helped inform iterative improvements to the registration machine's design, aiming to create a more inclusive and user-friendly experience for individuals with disabilities.

L. Qualitative Analysis

The ratio of accessibility opinions collected in FGIs by disability type is as follows (Figure. 5). The opinion son accessibility issues for the visually impaired were complementation and replacement of vision (C): 37(41.6%), hardware size and space (A): 21 (23.6%),complementation and replacement of input method (B): 16(18.0%), complementation and replacement of cognition(D): 12 (13.5%), and the complementation and replacement of hearing (E): 3 (3.4%). Of the 123 opinions, 89 were classified as accessibility problem opinions: the highest among all the types of disabilities. This means users with visual impairments face significant difficulty using kiosks. Owing to the kiosk using touch screen technology, most of the information is transmitted visually; thus, the degree of difficulty of the visually impaired was found to be greater than that of other types of disabilities.

VI. CONCLUSION

Kiosks are widely used in many fields due to advantages such as 24-h availability, cost reduction, and fast service. But users with disabilities have reported difficulties in their use. These difficulties also have different characteristics from the previously our studied areas of web and mobile accessibility; and thus, there are gaps between previously developed accessibility guidelines and those that consider the characteristics of kiosks. In this study, various global accessibility methods/standards related to kiosks were analyzed, and detailed guidelines for accessibility methods/standards were derived. FGIs were conducted with China users with visual, auditory, and physical disabilities to collect accessibility problems experienced by them when using kiosk devices and identify accessibility functions that should be considered first. Thus, China perspectives on accessibility kiosks were provided. This study makes several contributions. First, various global accessibility methods/standards related to kiosks were systematically analyzed and grouped and the results of this study are expected to serve as an important reference for the development of a common standard kiosk in the future. Several studies [18, 21, 40] relating to kiosk accessibility have also emphasized the need to develop a single common standard for kiosk accessibility. Second, from the FGIs, the main accessibility problems of users with disabilities were identified and guidelines for accessibility to kiosks were derived. The kiosk accessibility guidelines proposed in this study can be applied to forthcoming kiosk designs. Third, it was confirmed that certain accessibility functions for the different types of disabilities opposed one another; thus, when designing kiosks in future studies, these conflicting functions should be considered. Unlike individual devices, there were many conflicting accessibility functions for each

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type of disability because of the characteristics of public devices being used by many people. As it is difficult to provide accessibility functions tailored to individual characteristics, continuous research on how various types of users can use kiosks without any inconvenience is necessary.

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