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User-Centered Design for Diversity: Human-Computer Interaction(HCI) Approaches to Serve Vulnerable Communities

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Abstract: User-centered design is important in serving vulnerable groups, which means that we consider this perspective when researching and developing new technologies and systems, and add humanistic background and diversity considerations. Human-computer interaction (HCI) methods should not only focus on the functionality of technology, but also pay attention to the emotional and psychological needs of users, and effectively improve the usability and friendliness of technology. Vulnerable groups face many challenges in accessing and using technology, including technical barriers, cultural differences, and economic constraints. This article will explore the application of HCI methods in designing inclusive technology, and elaborate on how to design a basic system in the LGBTQ+ community and specific methods to improve the UI/UX part of HCI.

Keywords: User-Centered Design, Human-Computer interaction (HCI), Diversity in Design, inclusive Technology, Vulnerable Communities, UI/UX For Marginalized Groups, Accessible interface Design, Digital inclusion, HCI Approaches, Cultural Sensitivity in Design.

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1 LITERATURE REVIEW

1.1 HISTORY AND MULTIDISCIPLINARY DEVELOPMENT OF HUMAN-COMPUTER INTERACTION

Human-computer interaction (HCI) is a research field involving multiple interdisciplinary disciplines. It not only includes multiple computer science directions such as interface design, system design, user experience research, computer programming, etc., but also covers other disciplines in the humanities such as psychology and sociology [1]. The interaction here includes two main elements, one is the user, that is, the person who uses the system and outputs instructions, and the other is the system, that is, the computer device that receives instructions and outputs results.

The purpose of the continuous development and evolution of HCI is to study how to design, evaluate, and develop better computer systems that align more closely with human needs. This helps improve the interactive experience between users and technology, shortening the distance between computers and humans. HCI covers the interaction between people and computer systems, not limited to robots but including various computing devices and applications [2]. In short, humans interact with mobile or electronic devices all the time, and most seemingly inconspicuous actions involve human-computer interaction principles. For example, people raise their mobile phones to make calls anytime and anywhere. Therefore, any situation involving interaction between humans and computing devices can be classified as HCI. As we enter the 21st century, our interactions with mobile devices are becoming more frequent, and we may interact and communicate with systems organized by interfaces and codes anytime and anywhere.

The core of the HCI research field is to help improve human life by studying optimized interface design and interaction methods. This can enhance the overall user experience and the usability of system technology. In this process, UI/UX design occupies a core position because it directly affects how users interact with the system. A human-computer interface with good user experience can fundamentally save users' time. It can help users get the information they need in a moment instead of an hour, and operate the device simply and quickly in a shorter time.

In HCI research, keywords include barrier-free design, user-participatory design (PD), user-centered design, overall usability, interaction research, task analysis, interface design, interdisciplinary cooperation, culture, and society. These principles have been widely applied in UI/UX design. For

example, barrier-free design ensures that visually impaired users can use the software smoothly by adjusting interface elements. User participation design ensures that the final product meets user needs by involving users in the design process [3]. Through these methods, HCI research can better understand and meet diverse user needs and achieve inclusiveness and accuracy of technology.

Author Kyriakoullis and Zaphiris believes that the development of HCI should not only focus on technological progress, but also pay attention to the influence of social and cultural background [4]. Author Schelenz agrees with Author A and believes that the diversified design of HCI plays an important role in solving social inequality problems [5]. However, Author Liang, Munson and Kientz points out that although HCI has made certain progress in technology and society [6], there are still some shortcomings in practical applications, especially in responding to the needs of vulnerable groups [6].

Therefore, the author recommends further strengthening user participation and barrier-free design in HCI design to ensure the inclusiveness and inclusiveness of technology. In the process of current HCI evolution, the cultural and social background behind HCI has gradually weakened, and diversified design is lacking. However, in fact, HCI itself should be developed to provide the same services to everyone in a unified manner.

1.2 Barriers Faced by Vulnerable Groups in Technology Use and Inclusive Design

From a sociocultural perspective, most companies have neglected this important need in terms of technology development and user research. This need has been neglected by society and technology. However, we use the same technology development to design and develop new systems, support, care for, and enhance the lives of various people and vulnerable groups, research their user needs, and develop acceptable online internet technology applications. From another perspective, it helps us and secures our lives [7]. Because people's views, duties, and positions change constantly. As everyone gets sick and old, HCI interface design research for the elderly becomes more significant. Understanding how needs vary with age is crucial. Because popular applications may become increasingly difficult with time, such system functions cannot aid the elderly but constitute a technological burden. Alzheimer's disease is also rising and becoming more common. It is crucial to build HCI lightweight brain-training applications to avoid this disease or delay and relieve its symptoms in senior patients [8]. These data can also improve modern medicine's advances and flaws. Everyone experiences unexpected incidents.Most modern cultures are based on the law, thus you may face lawsuits and unknown legal hazards anytime, anywhere. The percentage of people with legal needs is small, maybe 5%, but it changes every year. This indicates that everyone might become legally vulnerable and need professional advice at any time. Currently, an HCI internet solution that connects to a competent lawyer team at a reasonable fee can answer customer pain points quickly. Due to the lack of professional system design and user research assistance, the current threshold for the use of these systems and platforms is still too high for ordinary people and difficult to popularize, not to mention the lack of this in most developing countries and other countries, which has caused many people to be unable to use them [9].

Humanistically, we have more social software and platforms in today's heavy work pressure environment, and people are getting to know, understand, and communicate on the Internet of Things, so this area also needs attention. LGBT is still considered "diseases" and "innate defects" in numerous countries and cultures, so LGBTQ+ people face social pressure, psychological pressure, and unfriendly living conditions [10]. We may progressively affect and develop such an environment by providing a good system or a somewhat complete user research platform so people from all countries can access and grasp some basic relevant knowledge and information.

In light of these goals, the author believes HCI and UI/UX design should address these historical and societal challenges. Modern HCI and UI/UX design can address equality and social issues through inclusive design, at least online, by providing reasonably inclusive, open, and diversified technological application solutions for different groups. Diversity and fairness are prioritized in inclusive design to give people of varied backgrounds and abilities a positive experience [11]. We can help disadvantaged groups and the needy overcome historical hurdles and enjoy equal technological opportunities by building more inclusive and welcoming interfaces. Thus, this essay will expand on LGBTQ+ Internet application design and HCI UI&UX improvement.

2 METHODOLOGY & APPROACH

I will demonstrate how to create an LGBTQ+-friendly website. Public websites may distribute health information, motivate others to accept a concept, and provide a communication channel for confused individuals to assist them. Accessible on different devices, this website makes HCI flexible. I interleaved quantitative and qualitative analysis, user participative design, etc. To enhance website accessibility and usability [12].

2.1 Web Design Process

I used Wix for fast prototyping and Illustrator CC for major picture design. Visual design and user experience were my priorities to keep the website layout simple.

Homepage: The logo, tagline, and banner visuals address genuine issues and attract LGBTQ+ users.

The Forum Information Page: Display regional and

group themes and regulations and enables anonymous posting and registration.

Health Page: Ask psychologists and professionals about health.

Contact Page: Have a feedback form with just required information for user privacy.

User research helped me make the website more accessible. I included users in the design process to ensure the website met their needs and was usable. A simple, distinctive gender-harmony brand logo was also created. The homepage banner shows two anonymous runners with an LGBTQ+ rainbow flag, symbolizing diversity. The website will not be released until personal protection laws are reviewed. After launch, the website will help LGBTQ+ people. I like how this page's comment section lets folks provide and ask for guidance confidentially. Delivering the feedback form to me protects user and my privacy. To retain consumers' patience, the form will have less text fields with important information without a phone call and be less written. I designed this form on my employment website to be consistent and leverage my skills.

2.2 Website Design and Research

I examined the Leicester LGBT Centre website and other comparable websites before designing the LGBTQ+ website. Helping local LGBTQ+ persons accept and seek support makes it successful. Colors and logo are evident. I replicated an anti-bullying website's design and made it more culturally accessible. Leicester Lesbian, Gay, Bisexual, and Transgender Centre is a volunteer organization that serves LGBT persons in Leicester, Leicestershire, and Rutland. Adam designed it to help local LGBT individuals accept themselves and acquire assistance from the website. Its bright, bold colors and clear logo make it successful. Look at MaheHay, an anti-bullying website, and Bill Cole (2016) [13]. It was designed for a public website, however the LGBT website has a friendlier interface. I compared announcement websites and created research questions based on their qualities. I collect quantitative and qualitative data from LGBTQ+ technology users via research and in-depth interviews. The questionnaire offers fundamental user information, use patterns, requirements, and pain spots, while in-depth interviews give specific experiences and specialized demands.

2.3 Quantitative and Qualitative Analysis

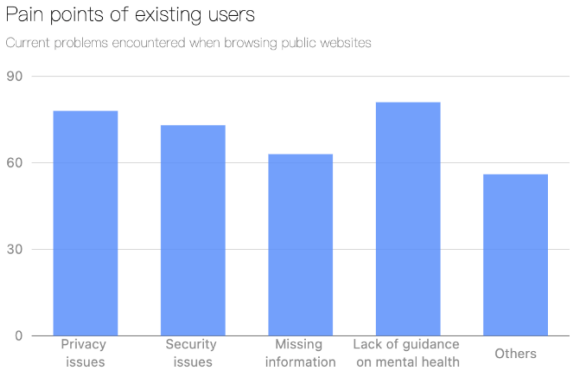

Figure 1. Pain points of existing users

Data analysis shows that more than 70% of respondents believe that current Internet platforms cannot ensure privacy, and 60% want more educational and psychological help. Qualitative analysis examines needs through user feedback and personal experience.

2.4 User Design Involvement

I asked anonymous LGBTQ+ users to participate all through the design process so that the design would remain inclusive and productive. From first idea creation to prototype testing and final evaluation, they offered comments and input at every level. This strategy guaranteed the website stayed user-centered and encouraged active user involvement [14].

2.5 Methodological Approach Execution

Questionnaire: A detailed questionnaire was designed, including multiple choice questions and open questions, to fully understand the needs and pain points of users.

In-depth interviews: In-depth interviews were conducted with some users to understand their personal experiences and specific needs. Help to dig out deep-seated problems that quantitative data cannot reflect.

Focus group discussions: Several online focus group discussions were organized to allow users to share their views on the website's functions and interfaces. Enhance user participation and sense of identity.

Prototype testing: Invite users to try it out. By collecting feedback from these users, continuously improve and optimize the design to ensure that the final version truly meets user needs.

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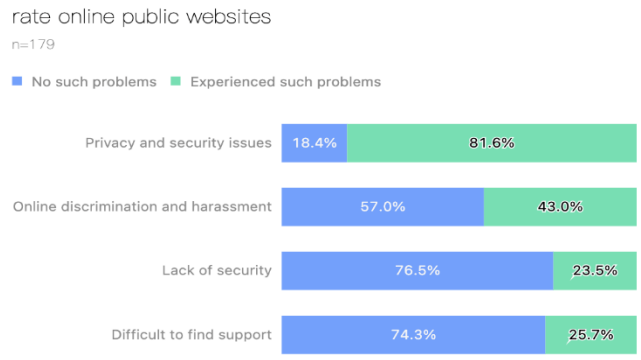

FIGURE 2. RATE ONLINE PUBLIC WEBSITES

Data analysis suggests that over 80% of LGBTQ+ users worry about privacy and security, 50% have experienced online harassment and verbal abuse, and 20% feel unsafe accessing public websites. People struggle to find support and belonging. To fulfill these user needs, I decided the following solutions:

A. Prevent data breaches by improving user identity and privacy settings. Created a multi-level privacy protection system, including anonymous login, encrypted communication, etc., to reassure website users.

B. To welcome LGBTQ+ individuals online to help them feel included. I built a secure forum and chat room for experience sharing.

C. Educational and psychological aid: Provide complete educational and psychological assistance to help users overcome life's challenges. To prevent prejudice and misconceptions, improved this website's LGBTQ+ health education section. Problematic users could received psychological therapy and assistance.

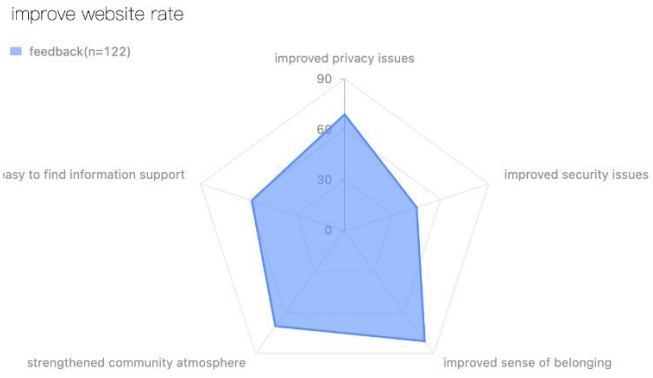

FIGURE 3. IMPROVE WEBSITE RATE

These changes improved privacy and security, reducing personal data breaches by 60–65%, according to user feedback. Up to 75% of users said the new forum and community environment improved trust, friendliness, support, and belonging. Most consumers found the psychological and educational support resources helpful, emphasizing the relevance of practical health products.

2.6 METHODICAL APPROACH IMPLEMENTATION

My research and comparative design improved the website's user interface (UI) design while making it appealing and simple to read. I chose gentle blue and yellow to convey warmth and tolerance. These hues may calm and educate consumers. While adding high-contrast color combinations to the page layout, contrast tests were done to guarantee appropriate contrast between the text and the backdrop to boost readability. I used sans-serif typefaces like Helvetica, harmonized the website's fonts, and changed line spacing and tracking to read text on various screen sizes. The simple navigation bar style makes content easy to find, and breadcrumb navigation lets visitors return to the previous page.

The button has rounded edges and shadow effects, the form is basic, and essential interaction places have hover and click effects for immediate response. Optimize image and multimedia loading using lazy loading for responsiveness and speed. A/B testing establishes the optimum color scheme and button style, user interviews indicate user pain areas and wants, and frequent user testing and modifications enhance the UI design. The website will be more user-friendly, intuitive, and efficient after these adjustments.

3 RESULTS AND DISCUSSION

LGBTQ+ group worry about privacy and security due to social media and job pressure. HCI research shows that identity protection and privacy settings make LGBTQ+ users feel safer and more trustworthy. UI/UX design may benefit LGBTQ+ users by creating a welcome online community. Beacuse inclusive HCI and UI/UX design may address historical and social challenges and develop open, diverse technological applications. In-depth historical and sociological background study can help us understand how HCI UI/UX design handles societal problems and lead future research.

I divided the website into homepage, forum, health, and contact pages. Each page has distinct features and material to satisfy users. LGBTQ+ persons use technology with privacy and security issues. HCI research demonstrates that updating identity protection and privacy settings might enhance LGBTQ+ users' security and trust. UI/UX design may benefit LGBTQ+ users by creating a welcome online community. These design elements improve LGBTQ+ acceptance and user experience. HCI and UI/UX design may promote LGBTQ+ acceptance via education and support. Several websites offer LGBTQ+ education programs to dispel myths. These networks help LGBTQ+ people with life challenges with psychotherapy. Designing for LGBTQ+ customers ensures inclusiveness and efficacy. Better design may alleviate disadvantaged people' technology challenges of information access and privacy protection, according to studies.

These studies provide theoretical and practical support

for this paper. Analyzing the historical and social context can help us understand how HCI UI/UX design handles social problems and guide future research.

Building and running LGBTQ+ websites internationally, I valued cultural variety and personalized design. Our extensive cultural research and user input in design guarantee that the website matches the needs of users in diverse countries and regions and delivers a comfortable user experience. This website has this issue often. To satisfy multiple cultures, design must be updated and adjusted. To develop a secure, inclusive, and supportive LGBTQ+ platform, user privacy and security must be addressed globally using professional technology in the next.

4 CRITICISM AND RESPONSE.

Diverse user-centered design enhances inclusion and usability, but it has drawbacks, most notably cost and time limits. Early adoption of these design ideas may necessitate more money and effort. Furthermore, varied user-centered design enhances inclusion and usability, but it also has drawbacks, most notably cost and time limits, thus early application of these design ideas may necessitate additional resources and effort. Taken together, these challenges may be used to try to balance these constraints and achieve design inclusion through careful planning and budget allocation. Long-term social and economic benefits may outweigh the original investment, and investment in inclusive technology can provide long-term social and economic gains [15]. In addition, inclusive technology may reduce social exclusion and inequality caused by technical hurdles while promoting social harmony and progress. Improving diversity coverage in technology may boost corporate potential, broaden the user base, and promote social equality and inclusion. This will broaden market coverage, give social advantages, and improve the company's social responsibility image, all while assisting the company's growth and long-term profitability. Historical and cultural influences have influenced society's attitudes toward LGBTQ+ persons. The medieval church saw homosexuality as a "disease" or "congenital defect" that required punishment and seclusion. Many outstanding people have been inspired by this mentality. Alan Turing, a prominent British computer scientist, committed himself after refusing hormone therapy [16]. Maugham hid his spouse throughout his life to avoid similar calamities [17]. These instances highlight society's ignorance and isolation of the LGBTQ+. Technology should reflect modern society's increasing acceptance and protection of LGBT rights. According to HCI study, LGBTQ+ users feel safer and more trusted when identity protection and privacy settings are improved. By creating a friendly online community, UI/UX design may make LGBTQ+ people feel supported and included. This improves the user experience and promotes LGBTQ+ acceptance. With these historical and cultural backgrounds, I see how HCI and UI/UX design may help solve societal problems. These findings provide a wealth of theoretical and practical support for this paper's focus on strengthening participatory design.

5 SUMMARY

This article first discusses the environment that disadvantaged groups face in modern technology, as well as the coverage of user groups. It then investigates the application of HCI methods in designing inclusive technologies and demonstrates how to adopt a user-centered approach through actual cases of LGBTQ+ website design. Then it outlines the critical role of HCI and UI/UX design in fostering social equity and inclusive growth, emphasizing that in the future, we must continue to pay attention to the demands of marginalized groups and encourage HCI progress in society. Finally, it discusses the issues that these technological advancements may encounter in real-world application environments, as well as how to avoid and solve them in order to ensure that this type of initial investment is repaid through long-term social and economic benefits, which are beneficial to the company's long-term growth. As a result, it is necessary to ensure that all users, regardless of background or aptitude, have equal access to the conveniences and benefits provided by technology, as well as to assist disadvantaged groups in breaking down historical barriers and enjoying equal technical opportunities. This essay encourages the academic community and industry to pay greater attention to this field and promote inclusive technological development in order to ensure the fairness and applicability of HCI development to disadvantaged groups.

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At the suggestion of the instructor, the website will now be made public when it is safe to obtain authorization in the future.

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CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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