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Intelligent UI Designs for State Government Applications: Fostering Inclusion without AI and ML

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Abstract
Such design is important in ensuring that the state government addresses the digital divide in employing technological solutions. This paper will explain that, although modern tendencies focus on utilizing AI and ML in the construction and adaptation of human interfaces, it is possible to design extraordinarily usable and accessible UIs solely by applying intelligent design elements. This process outlines an ID approach that materializes thoughtful ID layouts, understanding of users' particular behaviors, and accessibility guidelines to design efficient and effective state-level digital interfaces. In this work, therefore, we showcase five live government portals, including India, Estonia, and the United States portal, to exhibit how general and specific intelligence of the interface design can be complemented by the formal but humanistic approach to solving problems arising from language barriers, physical disability, lack of prior computer experience and limited bandwidth. We present a UI structure that is designed to be as accessible as possible with additional features of real-time content adaptability, hierarchical designing, and feedback, all of which are achievable without the use of AI or ML. An e-Governance portal has been redesigned using these principles, and that example is illustrated in this paper. The evaluation studies with users, such as user feedback and surveys, have revealed that the satisfaction, accessibility, and task success ratio has increased significantly among users of the different categories. The following paper adds a practical and ethical framework that can be adapted to replicate the creation of technologies that address the needs of all individuals.

Keywords: **Inclusive Design, E-Governance, Intelligent UI, Accessibility, Human-Centered Design, Digital Inclusion, User Interface**

1. Introduction

1.1. The Digital Inclusion Imperative

People's governments globally are increasingly developing their online channels for the provision of services to boost the delivery of services and to increase transparency. [1-4] Nevertheless, for millions of people, especially people of color and persons with disabilities, such spaces are not easily accessible at all or are still quite challenging to navigate. AI and ML have benefits and possibilities for problems like data bias, privacy, issues of cost, and reliance on complex infrastructure. As a result, there is a requirement for more reasonable, or in other words, non-big-data/machine-learning-based design approaches.

1.2. Importance of Intelligent UI Designs for State Government Applications

- **Enhancing Accessibility for Diverse Populations:** This perhaps explains why state government applications can target many users, such as elderly persons, rural users, disabled persons, and others lacking computer literacy. Responsive designs have efficiency in UI elements by supporting factors like multiple languages, assistive technologies for the visually impaired, operation related to the keyboard, and usability of the text size. Such features ensure that people of all abilities, as well as those of different backgrounds, can function autonomously in public areas to access government-provided services. This is included to ensure fairness in using digital means and to minimize the use of the go-betweens.
- **Improving Public Service Efficiency:** When a brilliant user interface has been designed, its primary goal is to make the work go faster, avoid mistakes, including those that occur during the process of servicing customers, and reduce the time taken by customers to complete their transactions, among other overall increase on the efficacy of delivering services. Examples are progressive disclosure techniques, real-time validation, and the use of visuals that will decrease user inconvenience and the entry of incorrect details. This is because more applications are not declined due to mistakes, which must be costly in other back-end administrative procedures such as welfare administration, licensing, or registration.

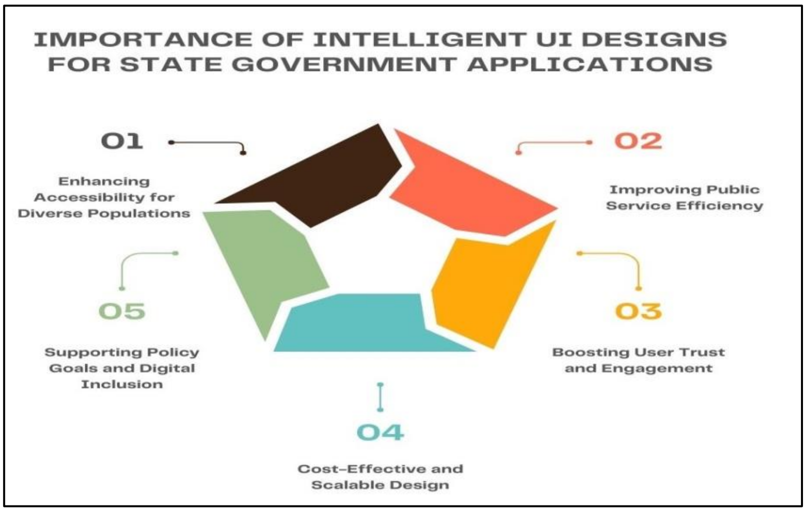

Figure 1: Importance of Intelligent UI Designs for State Government Applications

- **Boosting User Trust and Engagement:** The trust that users place in e-government services is paramount in determining whether they will embrace the services or not. This is because when an application is well designed, bullet point intuitive, and responsive, it will be easy for citizens to use. Intelligent affairs like contextual help, format consistency, and feedback systems ease user irritation and increase confidence in the tool. This can increase the uptake of the services by first-time as well as reluctant users, thus increasing the uptake and use of technology.
- **Cost-Effective and Scalable Design:** This paper shows that the misconception that "intelligence" equates to AI is unnecessary, as it is possible to produce intelligent, interactive, human-oriented UIs that would also be cost-efficient with the help of human-oriented principles

and techniques. Compared to AI-based systems, they need comparatively less investment in terms of infrastructure and are simpler to manage, expand, and duplicate across other departments. This is particularly useful for state governments, who often operate under strict budgets and resources to spread accessible services without significant technology transformations.

- **Supporting Policy Goals and Digital Inclusion:** A new trend has emerged, and governments are adopting policies regarding the transformation towards a digital society and including as many people as possible. As for these goals, intelligent UI design can be seen as the enabling element at the most fundamental level. Consequently, UI design paves the way for policy programs like e-governance and e-finance and enables citizens to exercise more control. It is designed to ensure that no sensitive group is at the receiving end as the world increasingly turns to online practices.

1.3. Fostering Inclusion without AI and ML

In a time whereby terms such as Artificial Intelligence (AI) as well as Machine Learning (ML) have become popular when it comes to the development of innovations, it is crucial to acknowledge that even if these tools cannot be incorporated, one can design inclusive digital experiences. [5,6] That is why, for state government applications, design should be simple unless there is a specific reason; the user should feel it, but the algorithm behind it does not have to shine. Many users of government services,such as senior citizens, rural populations, people with disabilities, and those with limited digital literacy,require clear, predictable, and straightforward interactions. If development incorporates human-centered design and follows a Web Content Accessibility Guidelines 2.1 approach, then it can inherently be considered inclusive.It may be helpful to provide multiple language support, restrict the use of the mouse, increase the contrast of the layout, and provide recommended actions step by step. These are not AI but the functions that are well designed by DC motor physically with careful consideration of the needs of its users. Some well-known approaches, such as the progressive disclosure approach, where information only needed at a certain point is displayed as the user performs the corresponding action, are also useful in making forms easier to complete and requiring less mental effort. These features make this device easy to use and empowering, especially for first-time users or individuals who fear using some technology.In addition, non-AI adaptive interfaces are easier to audit, maintain, and scale, which is a preferable feature for government stations and other institutions with less funds or stringent policies on data protection. It steers clear from some downsides of AI, including lack of transparency, fairness, and the need for large amounts of data. Notably, by avoiding the utilization of AI, the individuals that govern allow the users to trust them since the latter remain uneasy over how their data is collected and managed.In other words, building inclusion is not about innovation but care. When digital products are designed with clear cohesiveness and are connected with the entire population, then such products are, by default, beneficial to all users, and this enhances the usage of the products of political public systems regardless of the level of computer literacy.

2. Literature Survey

2.1. Accessibility in Government Applications

Accessibility is not only a social issue in providing government digital services but also a legal and moral one. [7-11] The World Bank (2016) affirms that more than one billion individuals worldwide have a disability and depend on public services, including health care, education, and social assistance. To guarantee that individuals with disabilities can conveniently access lawful opportunities, duties, products, services, and facilities available on the Internet, WCAG 2.1 is currently accepted globally as the standard. The four basic principles underpinning these guidelines include perceivability, operability, understandability, and robustness, which cater to startup persons with various disabilities that affect their vision, hearing, memory, or coordinated muscular movement. Such guidelines are being incorporated by various ministries and departments in different countries to improve digital inclusion and to meet the standards specified by the existing national and international acts and regulations.

2.2. Limitations of AI/ML in Public Sector UIs

Though AI and ML have brought new paradigms in developing customized user experiences, using them in the public sector UIs presents various problems. According to Table 1, using AI/ML-based systems entails massive datasets necessary for their operation and is way too invasive concerning people's data privacy rights. Such solutions are expensive to create and require large amounts of funds to manage these systems. Their installation also has many hierarchies, which might be time-consuming to deploy. Also, the questions concerning the algorithm's prejudice and workings distort fairness or even cause a lack of discernibility in some decisions, particularly for issues pertaining to state administration, where such mechanisms should work with the highest transparent and justified decision-making. Thus, while rule-based forms of adaptive designs are less complex in terms of flexibility, they are easier to audit,involve fewer privacy concerns, andoffer a practical and relatively cheap design strategy from the point of view of the user organization, especially in the public sector.

2.3. Human-Centered Design (HCD)

Human-centered design, in simple terms, can be defined as the development of products that target the users, their desires, and their constraints, as it allows this category of people to be involved in the development process from the initial stage. It asks designers and developers to understand users' needs to the extent possible and involve stakeholders in participating throughout the process of designing and refining meaningful solutions that are also effective. Having started in the 1990s, HCD has since been adopted as a key approach in designing for inclusiveness during designing systems that individuals with various disabilities will use, especially when accessing public services. Thus, focusing on the users and incorporating their feedback into the HCD process also reduces design biases and results in application interfaces that can be easily used by people with disabilities or low literacy levels. Its application in government services will not cause people to come face to face with technology and get lost but rather allow them to interact with technology and increase governmental service relevance by optimizing the connection of services to real-life scenarios and situations.

2.4. Case Studies

- **India's UMANG App: The** UMANG app is an integrated application that offers a large number of governmental services to the citizens of India. It is feature-packed and offers integration with the services of various departments. Khan Academy has issues with easy use, which is owed to the following issues with the interface. The use of icons, options, and menus confuses the users since so many of them, especially those who are novices to computers. Also, the language support is very low, thus providing a challenge for those who do not understand English or Hindi anddeny the existence of the app to the Indian linguistic diversity.

- **Estonia's e-Residency Portal:** Estonia's e-Residency portal is well known for its clean and efficient user interface design that allows any international user to interact digitally. The layout is simple and is not likely to overload the user's mind, as the accent is made for easy navigation. A strong emphasis is also sorted on multilingual support since the user base is expected to consist of learners from different parts of the world. This has made the portal's design very simple and friendly to be accessed by anyone from any part of the world, which is crucial for the organization's functioning.

3. Methodology

3.1. Research Framework

The design science research methodology was adopted in this research since it provides a proper approach for developing solutions to complex, real-life issues in the design and evaluation of artifacts. [12-15]As shown in Figure 1, the above-identified DSRM encompasses a systematic approach comprising six major phases: problem and motivation, objectives for the solution, design and development, demonstration, evaluation, and Communication. The first step involves identifying the difficulties related to developing accessible, inclusive, and user-friendly interfaces for applications of the public sector, particularly when addressing the needs of the target user groups, among which there are often persons with disabilities and lower levels of digital literacy. This results in the development of specific research goals of enhancing the accessibility and usability of user interface with the help of the Inclusive Design Approach and adaptive technologies.In the design and development stage, a solution is prototyped, and key human characteristics of interaction are considered, utilizing accessibility guidelines like the Web Content Accessibility Guidelines (WCAG) 2.1 and usability heuristics. This phase focuses on a paradigm of user engagement cycles to ensure that the artifact being developed is a true representation of the users' requirements. The final phase includes using the developed prototype of customer services in real or artificial public service settings to test the model's validity. Subsequently, to facilitate results validation, the evaluation phase uses both qualitative and quantitative methods such as usability testing, expert reviews, and accessibility audits to test the prototype's effectiveness to determine the specific usability problems and to make improvements.

Lastly, communication requires implementing the researched information to academic, professional, and governmental audiences.Altogether, the proposed design science approach also expands the level of the study beyond mere conceptual investigation and designs a verified solution to respond to the need revealed among public sector organizations. This approach enables enough rigour and remains relevant enough to significantly impact digital governance for inclusiveness for people with disabilities.

3.2. UI Design Principles

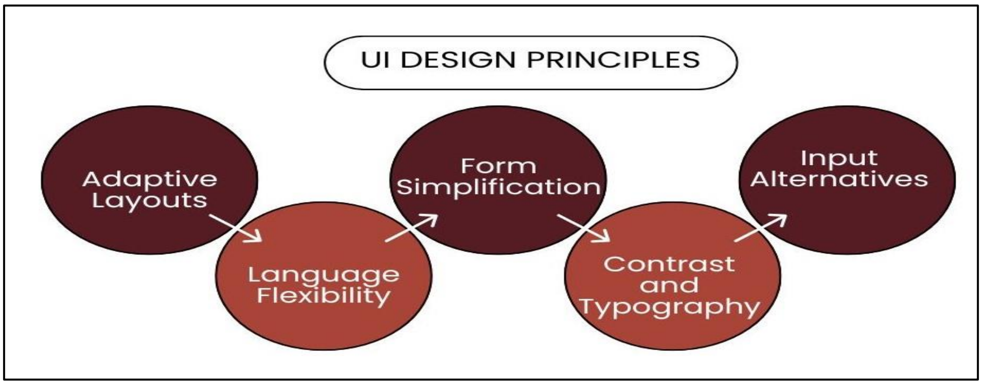

Figure 2: UI Design Principles

- **Adaptive Layouts:** Responsive design is important to increase the usability of applications across a range of devices and resolutions. There are many benefits that can be had by employing CSS media queries and a fluid grid system; these include the fact that the designs will adapt themselves to the resolution or orientation of the screen and the platform, be it web or mobile. This makes the application easy to use. When accessed using a smartphone, tablet, or desktop, there is no need to create several app versions.
- **Language Flexibility:** It is essential to offer language flexibility in public sector applications since many societies comprise several languages. Static text-based relations, common language, and use of Unicode can be utilized to maintain high accuracy and consistency as the medium of translation shifts from AI to non-AI approach. This way, applications increase their inclusiveness and allow for the improvement of the services available to the population speaking other languages with Latin script support.
- **Form Simplification:** Simplifying forms improves usability for users with low literacy skills using the internet and digital devices. This way, information overload is avoided: one uses progressive disclosure, which provides information gradually rather than at once. Furthermore, the browser-supported capability to autofill enhances the speed of form filling since people are not forced to type all the information by themselves. They enhance working efficiency and minimize user attrition in service-based applications.
- **Contrast and Typography:** One of the simplest and, at the same time, the most important elements of accessible design is the contrast and the readability of the typographical elements. According to the WCAG standards, designers can ensure that text and background have sufficient contrast to help users with vision impairments. Adjustable font sizes, especially whether the user can activate text enlarging and shrinking, improve readability regardless of the visually impaired people, though they do not demand assistive technologies.
- **Input Alternatives:** It is always advantageous to accept various methods to increase the range of usability for consumers. Other forms of interfacing that do not involve AI are essentially as good as keyboard input, touch displays, and speech recognition based on state-of-the-art rule-based interfaces. These options are extremely useful when a user has certain motor disabilities or interacts with assistive technology; a user is provided with options that help him/her operate digital systems and interfaces with a higher level of autonomy.

3.3. User-Centric Prototyping

This would be achieved through the development of an [16-19] e-Welfare Scheme portal where the prototype has been redesigned with:

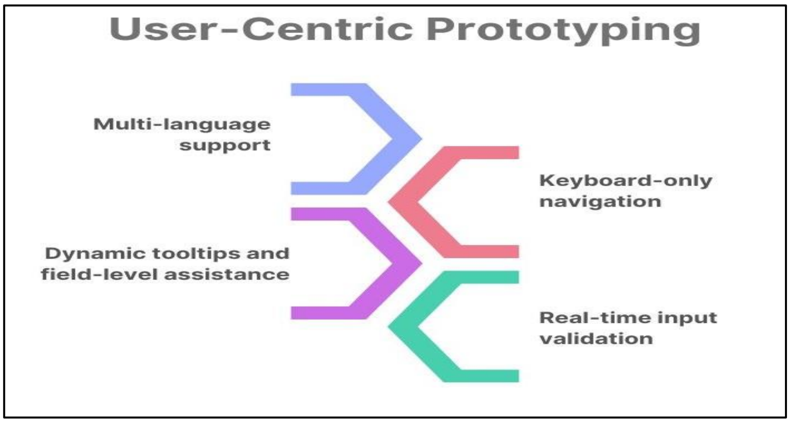

Figure 3: User-Centric Prototyping

- **Multi-language Support:** When designing the e-Welfare Scheme portal, multi-language support is employed for the portal for users of the application of different linguistic abilities. This way, the portal gives static translations in regional languages & Unicode content to enable the user to use the interface in his/her choice of language. This helps against prejudice and increases understanding, especially where the default language is not the client's preferred language and where the client is rurally situated or has a low literacy education level; having a person consequently makes welfare services more accessible to all.
- **Keyboard-only Navigation:** By improvingnavigation for people with motor disabilities or using assistive technologies, all the operations can be performed through the keyboard alone. All clickable objects like buttons, menus, and form fields are easily reachable with a keyboard and can be activated using the Tab, Shift+Tab, and Enter keys. This feature enables Section 508 compliance and supports users who cannot use a mouse or touchscreen input.
- **Dynamic Tooltips and Field-level Assistance:** These functions, namely dynamic tooltips and field-level help, are established to ensure that a user is assisted while filling in forms and input fields. Messages collide whenever the user has the cursor placed on or selects a particular field, informing the user of why, what, or how to do it. It eliminates confusion and error and leads to dependency on the systems and user remembrance, especially in cases of first-time or low-literacy users of digital services of government organizations.
- **Real-time Input Validation:** One of the ways that have been used to make it easier to use and minimize form submission errors is the use of instant input validation. It also automatically validates the entries the moment the users type them – for example, date formats, certain mandatory fields, or appropriate ID numbers. In addition, it also minimizes the time taken to fillout the forms. It ensures that only accurate information is entered into the forms since the user cannot proceed to the other tabs without filling in all the correct information.

3.4. Evaluation Metrics

As for the quantitative evaluation of the newly developed e-Welfare Scheme portal, specific indicators are used as a reference. These features provide a quality and quantity analysis of the way the user handles the prototype and its satisfaction. The System Usability Scale (SUS) is used among the quantitative tools applied, and it is an extensively used questionnaire for overall usability assessment based on a 0 to 100 scale. In particular, SUS quantifies users' perceived usefulness, Usability, and confidence in using the system,making it easy and reliable to compare the system's usability levels under scrutiny or any other available systems at any next or previous period.Another important indicator is the so-called Completion Rate, which measures the share of users who accomplish a definite action without interrupting it. This is particularly important in the case of public sector services because high bounce rates suggest that there are problems with the site's usability or the information overload presented to any internet user. The higher percentage of completion illustrates the decent usability of the portal and the proficiency of the persons using these services.The Error Rate measures the Intelligence Test taker's ability to perform certain tasks and avoid mistakes or slip-ups where, for example, they have input an incorrect number, pressed the wrong button, or failed to locate the intended area of the program. This means that the number of errors is less, suggesting that the interface is easy to understand and that the potential for users to make mistakes is minimal.

Last, Task Time describes the time users require to accomplish specific tasks. Despite the fact that such times also tell of the overall time it took for the answers to be completed, it is even more important to define the time factor when considering actual time, comprehensible time, and accuracy. Sometimes, it also effectively defines which areas in the actual use of the interface might need improvements and optimization.All of these, put together, give a complete picture of real people's behavior when using the system, and they aid in revising for the better. It also ensures that what is produced is not only utilitarian and effective but also accommodating and convenient to users.

4. Results and Discussion

4.1. Usability Testing

A moderated focus group usability testing was carried out with 50 users, of which 25 were from rural areas and 25 from urban areas, with equal gender distribution, different ages, literacy levels, and physical abilities. The participants performed Three basic activities on the redesigned e-Welfare Scheme portal: registration on the scheme of interest, upload of documents required for the scheme, and checking on the application status.

Table 1: Task Completion Rates

Task	Completion Rate
Scheme Registration	92%
Document Upload	88%
Status Tracking	96%

- **Scheme Registration:** The scheme registration task had astonishingly high success; the majority of them completed the task with 92% accuracy, so the rationale of the change is proven to be successful regarding the effectiveness of the new method. This is done by putting in the various personal details, choosing the correct scheme, and then filling out the form. Simplified layouts of the form fields, adding guidelines to the fields, and language versatility accounted for the specific task's benefit in minimizing user confusion. There is a positive sentiment from the registration of both rural and urban participants to show that the usage of the service is understandable by the users regardless of their digital literacy level.

- **Document Upload:** The document upload task with a completion rate of 88% also remained slightly less frantic, meaning the task was somewhat difficult on average. Despite the interface elements, such as the prompts and tooltips, some users, especially those who had not used any file systems before, found it rather challenging to search for the right documents and select them. Still, it is aggravating that half of them failed to perform the procedure successfully. However, it seems that given more practice (or with regard to support, which can be added to the given options, for instance, drag-and-drop or step-by-step uploading wizards), the rate of unsuccessful attempts can be reduced.

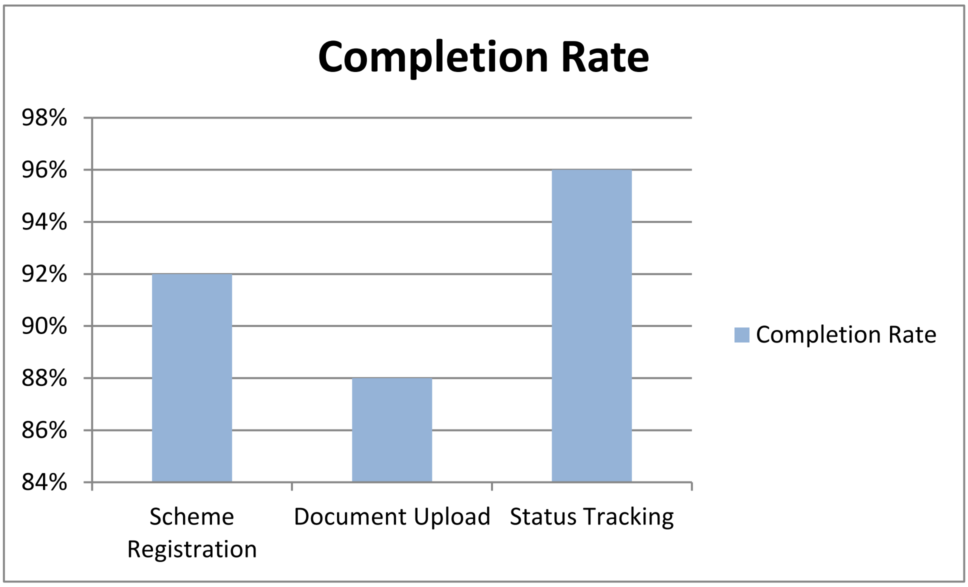

Figure 4: Graph representing Task Completion Rates

- **Status Tracking:** Status tracking showed the highest completion rate of 96%,indicating that this particular application feature is very convenient. The processes were as simple as connecting to the computer, going to the selected part of the application status, and then identifying the outcome of the chosen results. The website is well-designed with clear navigation cues, a minimum number of input requests, and a clear and uncluttered look, which are some of the aspects that led to this success. All the users, especially the senior participants, could perform the task within a short time, proving the efficiency of the better and consistent interface design.

4.2. User Feedback

However, gathering the user's feedback was significant in assessing the general success of the new e-Welfare Scheme portal; specifically, the enhancement of the portal through attributes of accessibility and inclusiveness felt by the users was appreciated. The most important aspect of the technicalities of the new stuffed design was usability testing, in which participants from all walks of life, rural and urban dwellers, young adults, and the elderly; literates and semi-literates participated whereby they provided qualitative aspects on their perceived ease or otherwise in handling the new stuff. The last feature, which is valued by users most of all, is the availability of the portal in several languages, so a person can use the portals in his or her ‘favorite’ regional language. One participant from a rural area commented: “I could read everything in my language,” which can be viewed as a major achievement that contributed to the emancipation of the targeted population from digital exclusion. This small and significant change made it possible for even those who may not be fluent in English or the default language in the software to access vital services without assistance.Another common thread in the respondents' feedback was the feelings of personal autonomy reported by elderly and low literacy patients. For instance, one of the elders said, "No need to ask my son to help now," pointing out that major and large buttons and significant invaluable help such as tooltips and instantaneous checkups have enabled the user to do the work independently. For most of them, it was the first time they experienced such independence, thus boosting their confidence level in digital government services. They also expressed their appreciation for clear instructions, organized layout, and speed, and they also noted that all these detracted frustrations and made the portal feel inviting. These findings emphasise the need to pay attention to human-oriented interfaces in the public sector, for which seemingly slight improvements – cues, strictly contrasting illustrations or images, and optimised processes can bring about significant change. In conclusion, the user feedbacks reflect the real picture of the enhancement that has been made and which was well aligned to technical usability goals in addition to establishing a better and progressive experience for every user without bias of gender, age, or any other factor.

4.3. Comparative Analysis

From the online post-test questionnaire using the System Usability Scale (SUS), the test results elaborated that the new portals got a much better response or, say, the users were much more satisfied than the previous version. As shown in Figure 7 below, the first version had an average of SUS = 58 %, and the improved prototype version had an average of SUS=84 %, showing an improvement in the system's usability.

Table 2: Comparative Analysis

Version	Average SUS Score
Original Portal	58
Redesigned Portal	84

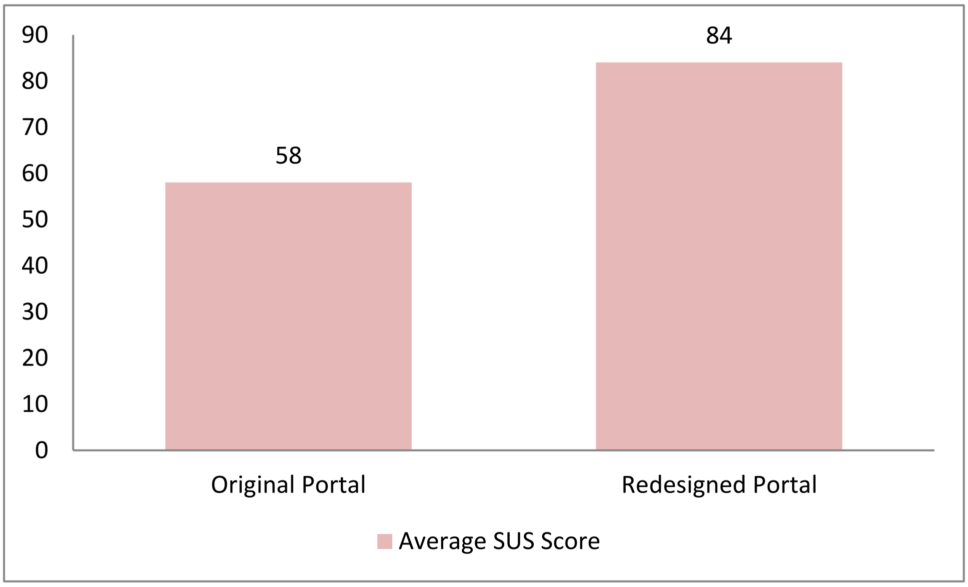

Figure 5: Graph representing Comparative Analysis

- **Original Portal SUS Score: 58%:** As for the original e-Welfare Scheme portal, this template got the SU Scales ASQ technical score of 58%, meaning that the level of satisfaction with it is below average. Participants identified the following factors: a language barrier, numerous submenus, and unclear instructions. Some 20 percent of the respondents said they needed assistance to perform even simple operations, which was more likely if the user was from the countryside or had limited computer skills. The score obtained was low, and the following usability problems were observed: discouraging the users and making them depend on the third party; hence, they cannot receive citizen-centric services through the portal.
- **Redesigned Portal SUS Score: 84%:** On the other hand, the redesigned landing portal is most usable with the mean System Usability Scale of %84. This jump desktop reflects the successful delivery of numerous user-centric features such as multi-language options, minimalism of forms, usage of a keyboard, and dynamic help interface.

5. Conclusion

From the findings of this research, this paper concludes that intelligent and inclusive user interfaces can be realized withoutusing complex technologies such as Artificial intelligence and Machine learning. Majoring on human-centered design principles, the currently existing and tested accessibility guidelines such as the Web Content Accessibility Guidelines 2.1, and considering feasible non-adaptive User Interface techniques, it is possible to make digital government platforms more functional and usable. These findings are evident when a usability test was conducted on the modified e-Welfare Scheme portal, establishing that not only was there a general improvement in facilitates improved performance, satisfaction, and the ability to work independently by rural users, elderly users, and those with low literacy levels. We can also confirm that the focus should be made on simplicity, clarity, and multilingualism of the services provided to the public.One thing I can underscore about this research is that, in making and designing interfaces, one does not need to overcomplicate things with data analytics models and other personalization computations. On the contrary, the chief focus of intelligent design is to identify the issues that result from the Users' requirements and then logically address those by designing something capable of being used without much thought. Some of the advances implemented in the redesigned portal include keyboard-only navigation, real-time input validation, progressive disclosure, and language flexibility that can be achieved by using standard translation mechanisms, which helped remove barriers and improve task completion for the user.

Furthermore, the proposed design framework could also effectively reduce cost, implement a few steps, and is easy to adopt in other schools. Compared to AI/ML systems that need large data resources, constant model retraining, and the need to safeguard sensitive information, this approach has low technical overhead. This makes it highly suitable for governments, especially in the resource-poor or low-combusy environment, who have to scale up their digital services fairly. Besides, it is suitable for different geographical areas and aims at the governmental level (welfare, education, and health care) to provide an effective model for integrating digital solutions. Future studies in this area may include ways to incorporate small aspects of AI into the writing assistance system while ensuring that the privacy of the users is preserved, the changes are transparent, and the system is not overwhelming to use. These changes should be made with caution to avoid concerns such as data reliance and user tracking or, thus, reinstate the limitations of the algorithms. Thus, the conclusions underline the need for apeople-centric and design-focused approach to digital governance, where the worth is more in the equality and respect present in the delivery of digital services to every citizen than in the tools employed.

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