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Inclusive Interaction: Implementing Accessibility Guidelines in UI/UX Design - A Study in the Context of Uttarakhand

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Abstract

Uttarakhand, with a population of almost 2 lakh people with disabilities, is increasingly adopting the use of digital technologies in its government operations using e-governance portals and NIC-enabled portals. This research uses a qualitative case study approach to analyze various state portals using their accessibility statements, structural layout, navigation, color contrast, language capabilities, and keyboard accessibility, among other features in view of WCAG 2.2 and the POUR model. Based on the results, it is evident that there have been accessibility attempts made in some state portals like WCAG AA compliance levels and availability of assistive technology tools on the Public Works Department portal, though several state portals lack any accessibility audit or are only partially compliant regarding language capability and keyboard accessibility. It is proposed that there is a need for more inclusive and user-friendly interfaces and user experience in the State's e-Government portals.

Keywords — UI/UX accessibility, inclusive design, Uttarakhand e-governance, digital accessibility, assistive technology, POUR principles

I. INTRODUCTION

Uttarakhand, which was formed from Uttar Pradesh in November 2000, has 13 districts, difficult Himalayan topography, and an estimated population of 1.01 crores (Census 2011)[1]. More than 1,85,272 disabled people live in the state, with 29,107 being visually impaired, 37,681 hearing impaired, and 36,996 movement-disabled. Rapid urbanization in cities such as Dehradun, Haridwar, and Rishikesh has meant that online transactions are replacing face-to-face contact with the government.

The Uttarakhand Government has made substantial investments in building digital infrastructure, such as the Digital Uttarakhand Portal, which is a web portal launched by the Chief Minister of Uttarakhand in January 2025 [2]. The motto of the Department of Information Technology, Uttarakhand, is to deliver services that are "Accessible Anywhere, Anytime." NIC Uttarakhand began operations in 2001.[3]

However, even with these developments, the digital divide still exists, especially for people with disabilities, the elderly, and the residents of rural hill districts such as Pithoragarh, Chamoli, and Uttarkashi. While the Uttarakhand Right to Service Act, 2011 lays down the provision of time-bound delivery of governmental services, it fails to mention digital accessibility guidelines [4].

UI / UX design is central to addressing this gap. This paper explores WCAG driven accessibility principles, the relevance to the digital landscape of Uttarakhand, existing gaps, institutional capabilities with regards to UI / UX design offered by Dehradun-based universities, and the way forward.

II. DIGITAL LANDSCAPE OF UTTARAKHAND

A. E-Governance Initiatives

The ICT Policy of Uttarakhand, 2006 aimed to build a completely connected society to facilitate information availability to everyone [5]. Important portals are:

pwd.uk.gov.in (Public Works Department) – WCAG 2.0 AA compliance with screen reader compatibility and high contrast settings [6].

digital.uk.gov.in – Introduced on January 2025, offering various governmental facilities [7].

uk.nic.in – NIC Uttarakhand, which operates the state's e-infrastructure since 2001.

B. Disability Demographics

According to the 2011 disability census, the number of people suffering from visual disability constitutes about 1% of the entire state population, with an estimated figure of 1,25,668 people suffering when the unreported cases are considered too.

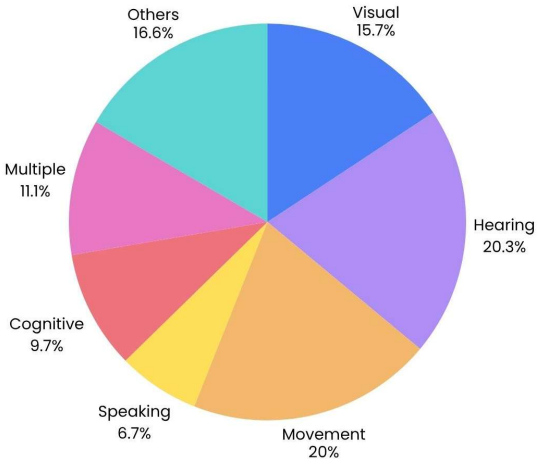

***Fig1**- Disability census of Uttarakhand, 2011*

***Source**- census2011.co.in/data/disability/state/5-uttarakhand.html*

C. UI/UX Education in Uttarakhand

In Uttarakhand, there are about 10+ private universities and one government university that provide UI/UX training programs. DBUU, Dehradun, provides M.Des. in Digital Product Design (UI/UX), which is a two-year postgraduate program specializing in interface design, usability, and user experience. Both Graphic Era University and Quantum University have UI/UX design programs.

III. WCAG POUR PRINCIPLES AND UTTARAKHAND CONTEXT

WCAG 2.2 is currently the international standard that categorizes all accessibility criteria under four POUR guidelines.

A. Perceivable

Interface information must be perceivable by all the people. Alternative text must be provided for all the graphics, including maps of hills, and captions added to government videos that are broadcast on portal websites, there must be at least a contrast ratio of 4.5:1 for Hindi as well as English texts, and there must be provision for documents in HTML format as well as PDF (W3C WAI, 2026)[8].

B. Operable

Needs of the motor impaired population in Uttarakhand, which includes at least 36,996 registered people, should be catered to by designing an interface with accessibility considerations. It will entail offering full keyboard navigation in menu options and forms, use of skip links in repetitive headers and footers often used in the template of NIC website, no timeouts in service request application forms since internet connectivity is poor in hilly areas, and focus visibility in accordance with WCAG 2.2 Success Criterion 2.4.11 (W3C WAI, 2026) [9] .

C. Understandable

However, most users in Uttarakhand who use government portals are new digital users and belong to rural settings, so it is imperative that the content is made understandable. Therefore, it is required that content on portals run by the government be in Hindi with lang="hi" HTML tag and in a simple language devoid of bureaucratic jargon, and with proper feedback to the user when completing online processes like linking Aadhaar card (W3C WAI, 2026).

D. Robust

The official websites of Uttarakhand Government must be accessible through basic Android phones that are generally available in rural areas. For this purpose, there will be a need to use semantic HTML along with proper ARIA roles for custom UI controls, support for NVDA free-of-cost screen reader software in Hindi language version, and testing of website content through TalkBack on Android phone (W3C WAI, 2026) [9], [10].

IV. BEST PRACTICES FOR ACCESSIBLE PORTAL DESIGN

A. Visual and Typographic Design

Keep minimum 4.5:1 ratio for all text content in Hindi and English languages. Ensure font size scalability to 200%, especially significant for senior citizens residing in rural Uttarakhand. Utilize system Hindi fonts that display properly on low-end systems.

B. Navigation Architecture

Breadcrumb navigation for multi-steps forms of government services. Site map and search available through keyboard access. Skip links are required in all NIC-provided templates.

C. Multilingual Accessibility

Screen readers need to appropriately read the Devanagari script using Unicode encoding and lang attribute testing with Hindi speech engine. Switching government websites from Hindi to English or vice versa should indicate this change through lang attributes.

D. Form Accessibility

Online forms for services such as land records (Bhulekh), ration card applications, and pension form submission will have an association between label and input elements. The error messages should state what is wrong and provide suggestions.

TABLE I — Accessibility Audit: Key Uttarakhand Portals (Indicative)

Portal	Screen Reader	Keyboard Nav	Contrast	Hindi Lang Tag
pwd.uk.gov.in	Partial	Partial	AA	Not verified
digital.uk.gov.in	Not audited	Not audited	Visual only	Not verified
uk.nic.in	Basic	Basic	Partial	Not verified

V. CHALLENGES SPECIFIC TO UTTARAKHAND

A. Connectivity and Device Constraints

There is a large proportion of Uttarakhand's population in districts like Chamoli, Rudraprayag, and Uttarkashi, where broadband internet connectivity is poor and only 2G/3G connectivity is available [10]. The accessible design should be able to accommodate slow internet speeds that make it difficult for screen readers to parse heavy JS frameworks.

B. Digital Literacy

Digital novices, especially those who live in hill villages, find it challenging to navigate through complicated UI designs. Cognitive accessibility is critical when designing government portals.

C. Hindi Screen Reader Ecosystem

Screen reader support in Hindi is less developed than in English. The NVDA screen reader with the Hindi language setting and the JAWS Hindi profile are available, though their performance is sporadic. Government websites should be tested using such applications, and not just the English version of AT.

D. Workforce Readiness

Though there have been more UI/UX courses offered by DBUU, Graphic Era University, and Quantum University in Uttarakhand, accessibility education is still not part of the mandatory syllabus. Majority of students complete their studies lacking knowledge about WCAG [10], [11].

E. Procurement and Policy Gaps

The Uttarakhand Right to Service Act, 2011, ensures efficient delivery of services but doesn't make any provisions concerning digital accessibility standards. Tenders for website development by the government do not indicate specific compliance with WCAG [12].

VI. CASE STUDIES

A. PWD Uttarakhand Portal — Partial Compliance

Public Works Department portal (pwd.uk.gov.in) clearly states that their commitment is to WCAG 2.0 AA compliance. They provide screen reader guidance and high-contrast features.[13] It is a positive point, yet heavy use of PDF files as a way of disseminating tenders and circulars poses problems for screen readers without support of tagged PDFs.

B. Digital Uttarakhand Portal — 2025 Launch

Chief Minister launched digital.uk.gov.in in January 2025, aiming at providing a single window platform for government services. The project demonstrates impressive efforts toward e-governance, but no accessibility audits

were found online. In order to ensure full accessibility of the portal, it is recommended to conduct WCAG AA testing proactively.

C. NIC Uttarakhand — E-Governance Backbone

NIC Uttarakhand (uk.nic.in) operates in the state since 2001 and built many solutions such as DEO Portals, PMGSY Tender. [14] It has been operating as a portal developer for state government departments. Being the provider of technology solutions, it is well-placed for ensuring accessibility at the template level.

D. Home Depot (National/Global Reference)

The approach that Home Depot has taken toward WCAG upskilling of 200+ UX professionals can be followed by the IT department of Uttarakhand through WCAG training, audit in sprints, and AA compliance at 90%. The same approach can be adapted by the NIC Uttarakhand IT Department team [15].

VII. TOOLS FOR ACCESSIBLE DESIGN AND AUDIT

TABLE II — Recommended Tools for Uttarakhand Portal Audits

Tool	Purpose	Cost	Relevance
WAVE	Automated scan	Free	All portals
Google Lighthouse	AA audit + perf	Free	Low-bandwidth test
axe Core	Dev integration	Free	NIC dev pipelines
Stark	Contrast check	Freemium	Design phase
NVDA + Hindi TTS	Screen reader test	Free	Hindi portals
TalkBack (Android)	Mobile AT test	Free	Rural Android users

Automated tools can identify around 30-40% of problems; manual testing with screen readers in Hindi language and end-users with disabilities is crucial [16].

VIII. IMPLEMENTATION PLAN FOR ACCESSIBLE UTTARAKHAND

1. **Policy**: Modify guidelines for purchasing information technology to include WCAG 2.1 AA accessibility for all state portal projects.
2. **Training**: Collaborate with DBUU, Graphic Era, and Quantum University to incorporate WCAG courses in their UI/UX design programs [11-13].
3. **Audit:** Conduct a statewide audit for accessibility of all portals managed by NIC using axe Core and Wave.
4. **Hindi Language Screen Reader Testing:** Create a testing facility with NVDA Hindi and TalkBack for testing government portals.
5. **Citizen Engagement**: Create an accessibility feedback portal on digital.uk.gov.in for people with disabilities.
6. **Component Design:** Develop an accessible component library based on WCAG AA guidelines for NIC Uttarakhand

IX. FUTURE TRENDS

AI and Automation: Alt-text generated by AI and Hindi captions will help boost accessibility in Hindi-dominated portals in Uttarakhand. [14-15] The outcome-based approach of WCAG 3.0 will work better in testing Hindi and Devanagari-based content [16].

Mobile-First Accessibility: Since most of rural Uttarakhand uses Android-powered smartphones to access the Internet, accessibility through these devices needs to be considered first and not as an afterthought [17-18].

Offline Accessibility: Due to network-related issues in the Himalayan districts of Uttarakhand, PWAs along with accessible forms that work offline are a good option to consider.

X. CONCLUSIONS

The vision for digital inclusivity in Uttarakhand – Digital Uttarakhand portal, e-governance with the help of NIC, and the Right to Service act – forms a solid basis for achieving this objective. However, around 1.85 lakh disabled people in the state are still vulnerable to digital exclusion in the absence of universal accessibility being systematically built into UI/UX design.

Implementation of WCAG guidelines based on the POUR principles – customized for Hindi language support, low bandwidth and Android mobile users in rural areas – is a realistic proposition for technical and economic reasons. The availability of IT educational infrastructure in Dehradun (DBUU, Graphic Era, Quantum) and the potential for harnessing the development capability of NIC make this an achievable goal for Uttarakhand.

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