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Designing inclusive tactile ecosystems: braille stickers as tools for enhancing accessibility for the visually impaired

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Abstract
Accessibility remains a significant challenge for individuals with visual impairments, particularly concerning everyday consumer products and pharmaceutical packaging. Standard packaging often lacks features interpretable through non-visual means, hindering independence and potentially compromising safety. This paper details a design research project to develop low-cost, universally applicable Braille and tactile stickers to enhance the accessibility of retail and pharmaceutical products. The study outlines the needs assessment process, explores existing assistive technologies and accessibility guidelines, and presents the design methodology for developing these stickers. Key design considerations include material selection, tactile element design (incorporating Braille and distinct shapes/ textures), information hierarchy, and adhesive properties suitable for diverse surfaces. The methodology encompasses user-centred design principles and system thinking, involving iterative prototyping based on literature review and expert consultation. A framework for primary user evaluation with visually impaired participants is proposed to assess the usability, effectiveness, and user acceptance of the prototype stickers. The potential benefits of such a system include increased autonomy, improved safety (e.g., identifying, medication, expiry dates, allergens), and greater social inclusion for visually impaired individuals. The anticipated outcome is a validated sticker design that enhances the universal accessibility of consumer products, promoting greater autonomy and informed decision-making for the visually challenged community.

Keywords: Visual impairment, accessibility, universal design, braille, packaging, assistive technology, system thinking, regenerative design

Introduction
Globally, millions of individuals live with visual impairments ranging from low vision to total blindness (WHO, 2022) [22]. This sensory disability significantly impacts daily life, creating barriers to accessing information, navigating environments, and interacting with everyday objects independently and safely (McDonnall *et al*., 2024; Nuzzi *et al*., 2024) [9, 12]. The physical world of consumer products and essential packaging, such as pharmaceuticals, often remains inaccessible (Velázquez, 2010) [19]. Standard print labels, complex shapes, and uniform textures make it difficult or impossible for visually impaired individuals to identify products, understand usage instructions, check expiry dates, or be aware of warnings (e.g., allergens, dosage) without assistance.

This lack of accessibility compromises user autonomy, increases reliance on others, and poses significant safety risks, particularly concerning medication identification and food products (Sahithi, 2022; Mandal *et al*., 2020) [14, 8]. Universal Design principles advocate for creating products and environments usable by all people, to the greatest extent possible, without the need for dedicated assistive devices can be expensive and are not universally available. Braille on packaging is mandated in some regions (e.g., pharmaceuticals in the EU) but is not widespread across all product types, and not all visually impaired individuals read Braille (McDonnall *et al*., 2024; Ryles, 1996) [9, 13]. Tactile markings are even less standardized.

This research addresses the gap by proposing the standardized, low-cost, universally applicable Braille and tactile stickers. These stickers are designed to be applied post-purchase or potentially integrated by manufacturers/retailers onto a wide range of product surfaces, conveying essential information through touch.

Fig 1: Visually Impaired Adult at NIEPVD, Dehradun

Aim

To design, develop, and evaluate Braille and tactile stickers to improve the universal accessibility of retail and pharmaceutical products for visually impaired individuals.

Objectives

- To identify the essential information needs of visually impaired individuals regarding product identification and usage.
- To review existing accessibility solutions and tactile communication standards.
- To design and prototype a set of Braille and tactile stickers suitable for various product types and surfaces. To establish a methodology for evaluating the usability and effectiveness of the sticker with visually impaired users.

Literature Review

Accessibility Challenges and Needs of the Visually Impaired

Visual impairment significantly impacts daily activities, including shopping, cooking, and medication management (Sahithi, 2022; IJFMR, 2023) [14, 5]. Identifying packaged goods relies heavily on visual cues (branding, colour, text). Visually impaired individuals often develop compensatory strategies, such as relying on shape, size, location, or assistance from others, but these methods are not always reliable or sufficient (Fletcher *et al*., 1995) [4]. Studies highlight difficulties in distinguishing between similar containers, reading instructions, identifying expiry dates, and recognizing potential hazards (Mandal *et al*., 2020; Zahoormal, 2019) [8, 24].

Existing Assistive Technologies and Solutions

Various technologies aim to assist visually impaired individuals. Screen readers (e.g., JAWS, VoiceOver) provide access to digital information (Watanabe *et al*., 2019; WebAIM, 2017) [20, 21]. Smartphone apps offer OCR (Optical Character Recognition) and object recognition capabilities, although performance can vary based on conditions (Sivan C Darsan, 2016) [15].

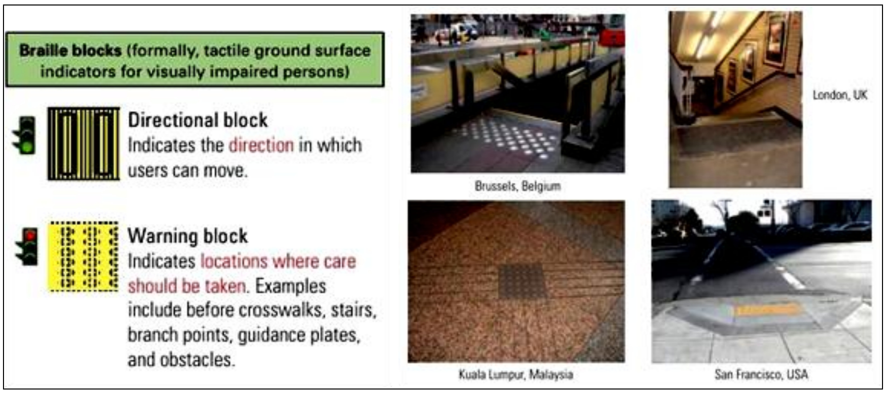

Fig 2: The first image is about Directional Block and Warning Block, the second image is about different Braille Blocks from all over the world

Braille remains a fundamental literacy tool for many blind individuals (McDonnall *et al*., 2024; Wormsley, 1997) [9, 23]. While its use on packaging exists (e.g., EU pharmaceutical mandate), it's not universal, and proficiency varies among users (Ryles, 1996) [13]. Tactile Ground Surface Indicators (TGSIs) demonstrate the utility of tactile information for navigation (Tokuda C Yamauchi, 2003; NRCD, 2003) [17, 11], but standardized tactile markings on products are rare (See Figure 2 to know about the tactile ground surface). Existing research on tactile graphics provides guidelines for creating understandable non-visual representations, emphasizing simplicity, clear distinction, and appropriate use of textures and elevations (Kaneko C Oouchi, 2010; Edman, 1992) [6, 3], (Figure 3).

a. Dot Types of Braille Textbooks (Junior High School level Science (Category 1 textbooks)

Dot type*	Dot size Dot base diameter (mm)
Very large	2.7
Large	1.8
Medium	1.5
Medium-small	1.2
Small	0.8

*Unauthorized names applied for convenience by the authors

b. Dot Types for Braille Printer, *ESA721 Ver. '95*

Dot type*	Dot size Dot base diameter (mm)
Large	1.7
Medium	1.5
Small	0.7

*Unauthorized names applied for convenience by the authors

Fig 3: Dot sizes of braille textbooks and braille printers from research paper on tactile graphics in braille textbooks by Kaneko Takeshi and Oouchi Susumu (2010) [6]

Universal Design in Packaging

Universal Design aims to create products usable by the broadest range of people (Stephanidis, 2001) [16]. Applying this to packaging involves considering sensory limitations. While some progress has been made (e.g., tactile warnings on certain hazardous products, easy-open features), systemic integration of accessibility features for the visually impaired, such as tactile or Braille information, is lacking across the consumer goods industry (Lazar *et al*., 2004) [7].

Research Gap

Despite existing technologies and the recognized need, there is a lack of a simple, low-cost, standardized, and universally applicable method for rendering essential information on diverse product packaging tactilely accessible. This research project aims to fill this gap by developing and evaluating a Braille and tactile sticker.

Methodology

This study employs a design research methodology, focusing on developing a practical solution to the identified accessibility problem through an iterative process involving user needs assessment, design, prototyping, and evaluation. A mixed-methods approach is planned, combining qualitative data from user consultations and feedback with quantitative data from usability testing.

Research Design Phases

- **Phase 1: Needs assessment and requirement gathering:** This phase involved a literature review and is planned to include qualitative data collection through semi-structured interviews and focus groups with visually impaired individuals (varying degrees of vision loss and Braille literacy), orientation and mobility specialists, and rehabilitation professionals.
- **Phase 2: Sticker Design and Prototyping:** Based on Phase 1 findings and existing standards (e.g., Braille codes, tactile graphic guidelines), conceptual designs for the stickers were developed. This involved selecting potential materials (considering durability, flexibility, tactility, cost, adhesive properties).
- **Phase 3: Primary research-user testing and evaluation:** This phase focuses on evaluating the prototypes with the target user group. A usability testing protocol involving specific tasks (e.g., identifying products, locating specific information on the sticker) will be employed. (Data collectionv: Observation, think-aloud protocol, questionnaires, interviews).
- **Phase 4: Data Analysis:** Qualitative data from interviews and usability testing (think-aloud protocols, feedback) will be analyzed using thematic analysis to identify patterns, usability issues, and user preferences. Quantitative data from questionnaires and task performance (completion rates, time, error rates) will be analyzed using descriptive statistics.

Sampling

For qualitative needs assessment and usability testing, purposive sampling will be used to recruit 15-30 visually impaired participants representing a range of ages, vision levels (low vision, legally blind, totally blind), Braille literacy (non-readers, basic, proficient), and experience with assistive technology.

Design and Development of Tactile/Braille Stickers Conceptualization and Information Hierarchy

Based on the initial literature review and planned needs assessment, essential information categories for the stickers include:

- Product Identification (Name/Type, Brand)
- Critical Dates (Expiry)
- Usage Instructions (Dosage for pharma)
- Warnings (Allergens, Hazards)

Standardization of symbols and Braille contractions (UEB-Unified English Braille) is crucial for universal understanding

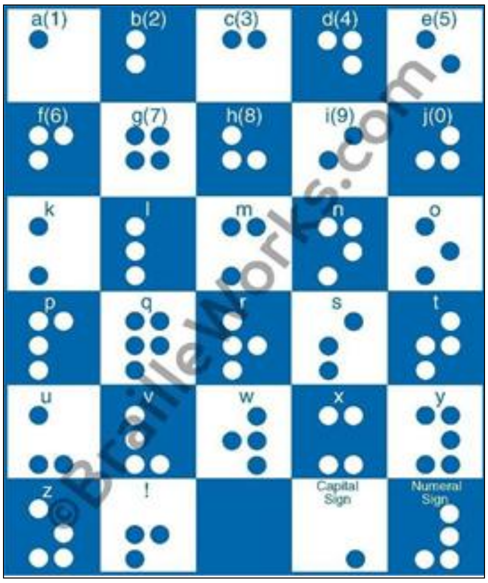

Fig 4 (Image 1): English Grade 1 braille consists of the 2C letters of the alphabet and punctuation. (Image credit to Braille works)

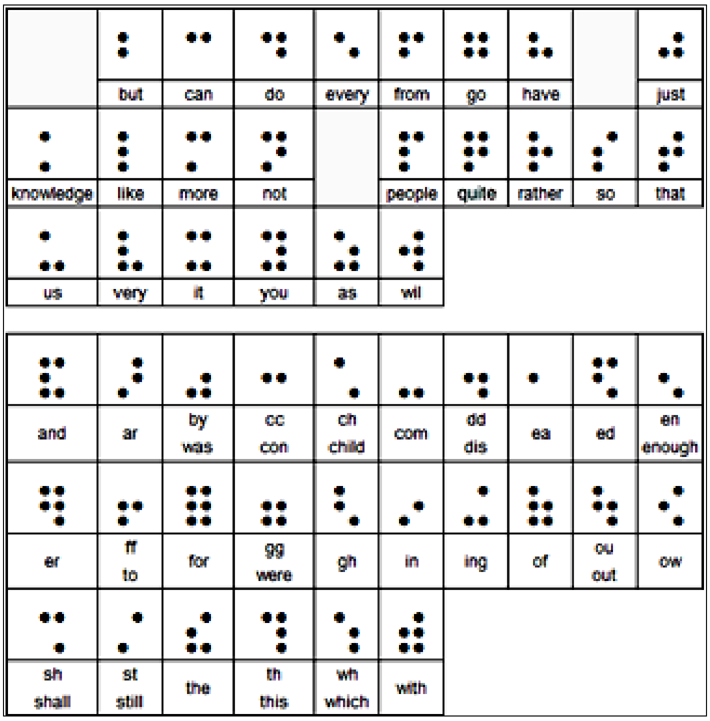

Fig 4 (Image 2): Grade 2 braille is the most commonly used form of braille code and is found in books, and public signage. It consists of the 2C letters of the alphabet, punctuation and contractions. (Image credit to Braille works)

Prototyping

Initial prototypes were digitally designed and fabricated using embossing techniques. Iterations focused on refining tactile legibility, testing different material/adhesive combinations, and optimizing the layout based on ergonomic principles and anticipated user feedback.

Primary Research: User Understanding (Foundation for Evaluation)

While the presentation doesn't detail a specific *product evaluation* phase with users testing the final Braille stickers, it extensively documents the *user research* conducted to understand the target audience, their needs, and context. This foundational research is crucial for evaluating whether the final product meets user requirements.

Participants

The research focused on individuals with visual impairments and stakeholders within their support ecosystem.

Specific user groups were identified and profiled through detailed personas

- **Rajesh:** An older (Age 49), Veteran Manufacturing Worker at NIEPVD, representing working adults dealing with accessibility in professional and daily life, seeking efficiency and independence.
- **Anil Sharma:** A Senior Rehabilitation Instructor at NIEPVD (Age 50), representing professionals who train and support visually impaired individuals, focused on effective rehabilitation techniques, modern tools, and client well-being.
- **Ananya:** A young (Age 12) student, representing youth navigating educational environments, social interactions, and daily living skills with visual impairment, needing tools for learning and independence.

Participants likely sourced from or associated with NIEPVD (National Institute for the Empowerment of Persons with Visual Disabilities), Dehradun.

Procedure

- The primary method appears to be qualitative user research, likely involving interviews and observation (suggested by the depth of persona details like "Says, Thinks, Does, Feels").
- **Persona Development:** Synthesizing research findings into representative user archetypes.
- **Scenario Mapping:** Outlining specific situations users face (e.g., navigating school, classroom participation, daily living) to understand contextual challenges.
- **Customer Journey Mapping:** Charting user experiences across broader stages (e.g., enrollment, adaptation, integration, skill development) to identify pain points and needs over time.

Data Collection

Data was collected on user demographics, roles, goals, needs, and pain points.

Specific information gathered included

- Daily struggles and frustrations (e.g., accessing information, using unlabeled products, navigating environments).
- Existing coping mechanisms and reliance on assistive tools (Braille, screen readers, mobility aids).
-
- Aspirations for independence, efficiency, and social inclusion.
- Emotional aspects related to their visual impairment and societal barriers.
Needs related to education, employment, rehabilitation, and technology access.

Results (User Needs Identification)

- The research clearly identified a significant gap and need for accessible labeling on everyday products (pharmaceuticals, retail, electronics) to provide essential information (name, usage, expiry).
- Users require solutions that promote independence, reduce reliance on others, and enhance safety
- Different user segments (age, occupation, context) have distinct but overlapping needs regarding accessibility tools and information.
- The need for durable, reliable, and easy-to-use assistive solutions was highlighted.
- These findings directly informed the development of the "Nirdesh" embossed Braille sticker concept as a targeted solution. The final product's features (durable, waterproof, high-contrast, Braille) aim to address the specific pain points and needs uncovered during this research.

Fig 5: Braille Stickers designed by our team

Conclusion and Future Work

This paper presents the rationale, design methodology, and development framework for a Braille and tactile sticker aimed at improving product accessibility for visually impaired individuals. This stickers has the potential to significantly enhance user independence, safety, and inclusion in everyday consumer activities. The design research approach, focuses on user needs and iterative prototyping, lays the foundation for building a practical and effective assistive tool.

Future work will focus on

- Completing user evaluations to refine design through data-driven insights.
- Material research to enhance sticker durability, flexibility, tactility, and adhesion.
- Product testing to improve information hierarchy.
- Integration with QR codes or NFC for added audio accessibility.
- Working on standardization and scalability.
- Conducting longitudinal research to measure impact on user independence and quality of life.

By addressing the identified challenges and pursuing these future directions, the Braille and tactile sticker can evolve into a valuable tool contributing meaningfully to universal product accessibility.

References

1. Braun V, Clarke V. Using thematic analysis in psychology. Qual Res Psychol. 2006;3(2):77-101.
2. McDonnall CM. The need for health promotion for adults who are visually impaired. J Visual Impairm Blind. 2007;101(3):133-45.
3. Edman PK. Tactile graphics. New York: American Foundation for the Blind; 1992.
4. Fletcher DC, Schuchard RA. Preferred methods of identifying medications by visually impaired patients. J Visual Impairm Blind. 1995;89(3):262-267.
5. International Journal for Multidisciplinary Research (IJFMR). The quality of life for persons with visual impairment in the society. Int J Multidiscip Res. 2023;5(4).
6. Kaneko T, Oouchi S. Tactile graphics in braille textbooks: the development of a tactile graphics creation manual. NISE Bull. 2010;10:13-28.
7. Lazar J, Dudley-Sponaugle A, Greenidge KD. Improving web accessibility: a study of webmaster perceptions. Comput Human Behav. 2004;20(2):269-288.
8. Mandal S, Dasgupta A, Bandyopadhyay L. Introspection of visually impaired children: A qualitative study in a blind school of Kolkata, West Bengal. J Compr Health. 2020;8(1):22-6.
9. McDonnall MC, Trinkowsky SR, Steverson A. Use of braille in the workplace by people who are blind. In: Proceedings of the Journal on Technology and Persons with Disabilities Conference; 2024.
10. Nakajima S, Okochi N, Iizumi N, Tsuru M, Mitobe K, Yamagami T. The possibility and challenges for deaf-blind individuals to enjoy films in theater. J Adv Comput Intell Intell Inform. 2017;21(2):350-357.
11. National Rehabilitation Center for the Disabled (NRCD). Tactile ground surface indicators for blind persons. Japan: NRCD; 2003. Rehabilitation Manual 13.
12. Nuzzi A, Becco A, Boschiroli A, Coletto A, Nuzzi R. Blindness and visual impairment: quality of life and accessibility in the city of Turin. Front Med. 2024;11:1382438.
13. Ryles R. The impact of braille reading skills on employment, income, education, and reading habits. J Visual Impairm Blind. 1996;90(3):219-226.
14. Sahithi G. Facilities for visually impaired students that are available in University of Hyderabad campus. Acta Sci Ophthalmol. 2022;5(7):37-45.
15. Sivan S, Darsan G. Computer vision based assistive technology for blind and visually impaired people. In: Proceedings of the International Conference on Computation System and Information Technology for Sustainable Solutions (ICCSNT); 2016.
16. Stephanidis C, editor. User interfaces for all: concepts, methods, and tools. Boca Raton: CRC Press; 2001.
17. Tokuda K, Yamauchi S. Creating installation guidelines for tactile ground surface indicators (braille blocks) for the visually impaired. IATSS Res. 2003;27(2):88-90.
18. van den Akker J, Gravemeijer K, McKenney S, Nieveen N, editors. Educational design research. London: Routledge; 2006.

19. Velázquez R. Wearable assistive devices for the blind. In: Lay-Ekuakille A, Mukhopadhyay SC, editors. Wearable and autonomous biomedical devices and systems for smart environment: issues and characterization. Berlin, Heidelberg: Springer; 2010, p. 331-49. (Lecture Notes in Electrical Engineering; vol. 75).
20. Watanabe T, Kaga H, Kobayashi M, Minatani K. Touchscreen text entry methods used by blind and low vision users: analysis of ICT user survey 2017. ITE Trans Media Technol Appl. 2019;7(3):134-141.
21. WebAIM. Screen reader user survey #7 results [Internet]. 2017 [cited 2026 Jan 21]. Available from: https://webaim.org/projects/screenreadersurvey7/
22. World Health Organization (WHO). Blindness and vision impairment [Internet]. 2022 [cited 2026 Jan 21]. Available from: https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment
23. Wormsley DP. Braille as the primary literacy medium: general guidelines and strategies. In: Wormsley DP, D'Andrea FM, editors. Instructional strategies for braille literacy. New York: AFB Press; 1997, p. 1-16.
24. Zahoormal Z. Experiences of a visually-challenged student: A qualitative study. Int J Indian Psychol. 2019;7(4).