

# Exploring Global Research Trends on AI-Driven Assistive Technologies for the Visually Impaired: A Bibliometric and Network Visualization Study

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## Abstract

Artificial intelligence (AI) is increasingly transforming assistive technologies for visually impaired individuals, offering new possibilities for navigation, scene understanding, and daily mobility. This study maps global research trends in this growing field using a bibliometric and network visualization approach. A comprehensive Scopus search covering 2015–2025 was conducted, yielding 403 records. Following PRISMA 2020 screening procedures, 328 publications were included for analysis. Descriptive bibliometric techniques were used to examine publication growth, subject areas, document types, and leading countries and institutions. Network analysis using VOSviewer identified major themes and keyword co-occurrence patterns. The findings reveal a strong rise in publications from 2020 onward, aligned with advances in deep learning, object detection, and lightweight embedded systems. Research activity is dominated by Computer Science and Engineering, with India and the United States emerging as the most productive contributors. Keyword clustering highlights core themes such as assistive technology, AI, object detection, and navigation, alongside increasing attention to user experience and ethical issues. Overall, the study provides a clear overview of how AI-driven assistive technologies for visually impaired users have evolved and identifies important gaps to guide future research.

**Keywords:** AI-Driven Assistive Technologies, Artificial Intelligence (AI), Visually Impaired, Bibliometric, PRISMA

## Introduction

The rapid advancement of artificial intelligence (AI) has transformed many aspects of daily life, including how individuals with visual impairments navigate, communicate, and participate in society. Traditional assistive tools—such as white canes, Braille displays, and screen readers—have offered support for decades, but they often struggle to meet the

demands of today's complex and information-rich environments. The emergence of AI-driven assistive technologies represents a major shift, allowing systems to "understand" surroundings, interpret visual scenes, and deliver real-time, personalized support in ways that were previously unimaginable. Modern solutions now integrate computer vision, natural language processing (NLP), and machine learning (ML) to provide navigation assistance, object recognition, reading support, and even social interaction tools for visually impaired users (Aduri & Naganjaneyulu, 2024; Ganesan et al., 2022).

These advancements have been fueled by breakthroughs in deep learning. Real-time object detection models such as YOLOv8, YOLOv10, and DETR have significantly enhanced accuracy, speed, and reliability across mobile and wearable devices (Algaraady et al., 2025; Ikram et al., 2025). Transformer-based approaches now support complex visual-to-text translation, enabling more natural scene descriptions and improved environmental awareness for visually impaired users. At the same time, lightweight architectures and edge-computing platforms such as Raspberry Pi and NVIDIA Jetson have made it feasible to run sophisticated AI models on low-power wearable devices, bringing these innovations closer to real-world use (Qiao et al., 2022; Satheesh Kumar et al., 2025).

Beyond technical performance, researchers have increasingly emphasized user experience, accessibility, and the practical challenges faced by visually impaired individuals when interacting with AI-enabled tools. Persistent issues include gesture ambiguity on touchscreens, speech recognition errors, inaccessible digital interfaces, and inconsistent or unclear audio and haptic feedback (Choi et al., 2024; Hamideh Kerdar et al., 2024). These challenges often lead to frustration, device abandonment, and reduced trust in AI systems. Studies highlight the need for multimodal feedback, simplified interface designs, structured training, and personalization strategies to improve adoption and long-term usability (Oh et al., 2013; Palani & Giudice, 2017).

Ethical and privacy considerations also play a major role in shaping the development and acceptance of AI-driven assistive technologies. Camera-based tools—especially those involving facial recognition or environmental capture—raise concerns about misrepresentation, consent, and data protection for both users and bystanders (Akter et al., 2020; Sasu et al., 2025).

Researchers increasingly advocate for participatory governance, user-centered design, and responsible AI frameworks to ensure transparency, accountability, and respect for user autonomy (Yu et al., 2025). Despite impressive advancements, significant research gaps remain. For example, much of the existing technology focuses on ocular visual impairments, while Cerebral Visual Impairment (CVI)—one of the most underrepresented conditions—receives far less attention, despite its growing prevalence (Gamage et al., 2024; Lehman et al., 2024).

Other challenges relate to algorithm robustness in real-world environments, inclusive design, speech error management, and evaluating long-term impact outside laboratory conditions (Kuriakose et al., 2024). These gaps underscore the need for interdisciplinary, human-centered, and ethically grounded research moving forward. Given the rapid growth of this field, a comprehensive examination of global research trends is essential. This study provides

a bibliometric and network visualization analysis of 328 publications related to AI-driven assistive technologies for visually impaired individuals. Through examining publication trends, dominant research domains, methodological patterns, technological themes, and emerging areas, the study offers valuable insight into how this field is evolving and where future research should be directed. Ultimately, understanding these trends helps researchers, developers, policymakers, and educators design more equitable, accessible, and effective AI-assisted solutions that support independence, mobility, and social inclusion for individuals with visual impairments. Thus, these research questions were developed as follow:

### *Research Questions*

1. What is the trend of publications on AI-driven assistive technologies for the visually impaired from 2015 to 2025?
2. How are these publications distributed across different subject areas (e.g., computer science, social sciences, arts and humanities)?
3. What are the most common document types published in this field (e.g., journal articles, conference papers, book chapters, reviews)?
4. Which countries or territories contribute most to the research on AI-driven assistive technologies for the visually impaired?
5. Which institutions are the most productive in publishing research on AI-driven assistive technologies for the visually impaired?
6. What are the main research themes and emerging topics in AI-driven assistive technologies for the visually impaired, based on keyword co-occurrence and trends?

### **Literature Review**

Artificial intelligence (AI) has rapidly reshaped the landscape of assistive technologies for individuals with visual impairments. Early assistive solutions primarily focused on tactile and auditory tools, offering limited support in environments that demand quick interpretation and complex decision-making. Recent developments, however, show a clear shift toward AI-driven systems capable of recognizing objects, understanding scenes, processing speech, and providing personalized navigation support. This section synthesizes existing literature to highlight technological trends, user experience considerations, ethical issues, and persistent research gaps that inform the current study.

#### *Evolution of AI-Driven Assistive Technologies*

The integration of computer vision, machine learning, and natural language processing has significantly expanded what assistive technologies can achieve. Modern systems can now analyze visual input, detect objects, read text, and offer contextual feedback in real time. For example, recent research demonstrates how deep learning models—particularly those based on YOLO architectures and DETR—enhance object detection accuracy and responsiveness in mobile and wearable devices (Algaraady et al., 2025; Ikram et al., 2025). These models allow visually impaired users to receive clearer, faster, and more reliable information about their surroundings.

Complementing these advances, transformer-based models have improved visual-to-text translation, enabling more natural scene descriptions. At the hardware level, low-power platforms such as Raspberry Pi and NVIDIA Jetson have made it feasible to deploy advanced algorithms on lightweight assistive devices (Qiao et al., 2022; Satheesh Kumar et al., 2025).

Together, these developments mark a transition from basic support tools to intelligent assistive systems capable of understanding environments and anticipating user needs.

#### *Navigation, Object Recognition, and Environmental Awareness*

Navigation remains one of the most challenging aspects of living with visual impairment. Several studies have explored AI-powered navigation assistants that combine camera-based perception with real-time feedback. Deep learning readers (Ganesan et al., 2022) and enhanced obstacle detection systems (Satheesh Kumar et al., 2025) show promising outcomes by helping users interpret paths, identify hazards, and maintain orientation in unfamiliar spaces.

Other research introduces multimodal approaches that merge visual, auditory, and haptic cues. These systems aim to reduce cognitive load and enhance safety by presenting information through intuitive channels (Aduri & Naganjaneyulu, 2024; Palani & Giudice, 2017). As object detection models become more accurate and efficient, users gain access to richer environmental details, making navigation more seamless and autonomous.

#### *User Experience, Human–Technology Interaction, and Accessibility*

Even with advanced algorithms, the success of assistive technologies largely depends on the user experience. Studies point to recurring challenges that hinder adoption, including gesture ambiguity on touchscreens, speech recognition errors, inconsistent feedback, and inaccessible interface designs (Choi et al., 2024; Hamideh Kerdar et al., 2024). These usability barriers often lead to frustration, device abandonment, or reduced trust in technology.

Research consistently emphasizes the need for simplified interfaces, structured training, and personalization strategies that adapt to the user's skill level and preferences (Oh et al., 2013; Palani & Giudice, 2017). For many users, multimodal feedback systems that combine haptics, audio, and visual cues offer a more intuitive and supportive experience—especially in complex or noisy settings. Kuriakose et al. (2024) further highlight the importance of evaluating cognitive workload to ensure systems do not overwhelm users. Their findings show that even high-performing algorithms must be paired with thoughtful interaction design to achieve true usability.

#### *Ethical, Privacy, and Governance Considerations*

The rapid adoption of camera-based assistive tools raises significant ethical and privacy concerns. Users may face risks related to misrepresentation, consent, data misuse, and the visibility of bystanders captured in camera feeds (Akter et al., 2020). These issues become even more prominent when tools incorporate facial recognition or continuous environmental scanning.

Recent scholarship underscores the importance of responsible AI frameworks, transparent design processes, and legal protections that safeguard user autonomy (Sasu et al., 2025; Yu et al., 2025). Disability-oriented data protection policies, in particular, are essential for ensuring that assistive AI respects the privacy and dignity of users while maintaining accountability and fairness.

### *Emerging Gaps and Underexplored Areas*

Despite meaningful advancements, several gaps remain in current research. One major limitation is the underrepresentation of Cerebral Visual Impairment (CVI) in assistive technology development, even though CVI is increasingly recognized as one of the most prevalent causes of childhood visual impairment (Gamage et al., 2024; Lehman et al., 2024). Technologies often focus on ocular impairments, leaving individuals with neurological visual processing difficulties underserved.

### *Other Gaps Involve*

- Lack of robustness testing in real-world environments
- Limited long-term evaluation of user outcomes
- Insufficient consideration of diverse user needs and abilities
- Ongoing challenges in speech error management and sensor reliability
- Addressing these gaps requires interdisciplinary collaboration across AI, vision science, rehabilitation, human–computer interaction, and ethics.

### *Summary*

The literature demonstrates rapid progress in AI-driven assistive technologies, with deep learning models significantly improving navigation, object detection, and environmental interpretation. However, user experience, ethical considerations, and inclusivity remain critical challenges. Existing studies call for a more holistic approach that integrates technical innovation with user-centered design, accessibility, and responsible governance. These insights guide the present study's bibliometric analysis, which aims to map global research trends and identify future directions for developing effective and equitable AI-based solutions for visually impaired individuals.

### **Methods**

This study adopted a bibliometric and network visualization approach to explore global research trends on AI-driven assistive technologies for visually impaired individuals. The methodological process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines to ensure transparency, reproducibility, and systematic reporting (Page et al., 2020). Although bibliometric studies do not require full systematic review procedures, the PRISMA flow principles were used to structure the identification, screening, eligibility, and inclusion steps.

### *Data Source and Search Strategy*

All data were retrieved from Scopus, one of the world's largest and most reputable abstract and citation databases for peer-reviewed literature. The search was conducted using a carefully constructed query targeting publications related to artificial intelligence technologies and visual impairment. The search string was applied to the Title, Abstract, and Keywords (TITLE-ABS-KEY) fields to maximize relevance and coverage:

TITLE-ABS-KEY (AI Technologies AND Visually Impaired) AND PUBYEAR > 2014 AND PUBYEAR < 2026 AND (LIMIT-TO(SUBJAREA, "COMP") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "ARTS")) AND (LIMIT-TO(DOCTYPE, "ch") OR LIMIT-TO(DOCTYPE, "cr") OR LIMIT-TO(DOCTYPE, "ar") OR LIMIT-TO(DOCTYPE, "cp")) AND (LIMIT-TO(LANGUAGE, "English"))

The search covered the period 2015–2025, capturing a full decade of research activity. The search was conducted in English and included journal articles, conference papers, book chapters, and conference reviews. The initial search yielded 403 documents. After applying additional inclusion and exclusion criteria, 328 documents were retained for analysis.

#### *Screening and Selection Process (PRISMA 2020)*

The study followed the four PRISMA stages—Identification, Screening, Eligibility, and Inclusion to ensure a transparent and systematic selection process.

- Identification

The 403 records returned from Scopus were exported in RIS and CSV formats. All records were consolidated and checked for technical errors (e.g., corrupted entries, incomplete metadata).

- Screening

Duplicate entries were removed automatically based on title, DOI, and author metadata. Titles and abstracts were screened to exclude works unrelated to AI, accessibility technology, or visual impairment.

- Eligibility

Full metadata (author information, keywords, document type, subject area, and abstract) was reviewed to ensure that each study aligned with the research scope. Publications that did not explicitly discuss AI-driven solutions, visual impairment, or assistive innovation were excluded.

- Inclusion

A total of 328 publications met all criteria and were included in the bibliometric and network visualization analysis. The PRISMA flow process is illustrated below:

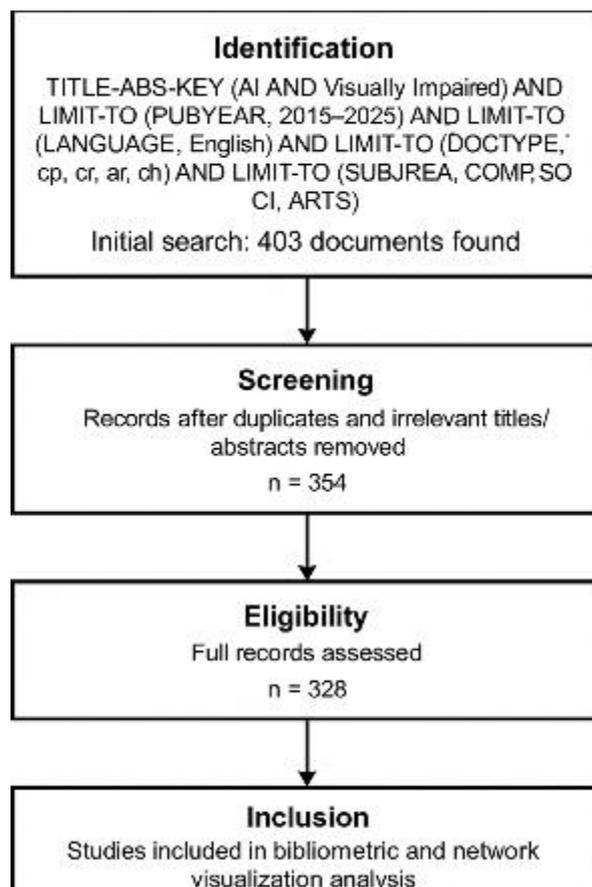


Figure 1: PRISMA flow process

*Inclusion and Exclusion Criteria*

The following criteria guided the selection process:

Table 1

*Inclusion and Exclusion Criteria*

Criteria Type	Inclusion Criteria	Exclusion Criteria
<b>Topic relevance</b>	Studies focusing on AI-driven technologies supporting visually impaired individuals (navigation, object detection, scene description, accessibility, HCI, etc.)	Studies unrelated to visual impairment, accessibility, or AI-based support systems
<b>Technology focus</b>	AI, machine learning, computer vision, NLP, wearable systems, embedded platforms	Non-AI assistive tools (e.g., traditional aids without digital/AI components)
<b>Document type</b>	Journal articles, conference papers, conference reviews, book chapters	Editorials, letters, short surveys, non-scholarly reports
<b>Language</b>	English	Non-English publications
<b>Timeframe</b>	2015–2025	Publications before 2015
<b>Subject areas</b>	Computer Science, Social Sciences, Arts & Humanities	Medical-only research without AI content; unrelated engineering fields
<b>Population</b>	Studies addressing visually impaired or blind individuals (including CVI)	Studies on general disability populations without specific focus on visual impairment

### *Data Extraction and Preparation*

Metadata for all 328 included documents were extracted, including:

- Title
- Authors and affiliations
- Publication year
- Document type
- Source title
- Subject area
- Country of origin
- Author keywords
- Abstract text
- Citation count

Data were cleaned to ensure consistency in author names, institution names, and keyword spelling variants (e.g., "assistive tech" vs. "assistive technology").

### *Bibliometric Analysis Techniques*

The bibliometric analysis aimed to uncover publication trends, subject-area classifications, document types, geographic contributions, and institutional productivity. Descriptive statistics were used to:

- Examine annual publication growth
- Identify dominant subject areas
- Categorize document types
- Map international research contributions
- Analyze institutional output
- Microsoft Excel was used for frequency counts and data visualization.

### *Network Visualization Analysis*

Network analysis was conducted using VOSviewer, a widely used tool for science mapping and co-occurrence visualization. The software generated:

- Keyword co-occurrence maps
- Thematic clusters
- Trend visualizations using color-coded temporal overlays
- This process identified conceptual themes, emerging trends, and contextual relationships between AI technologies and visually impaired communities.

### **Ethical Considerations**

This study did not involve human participants. All data were obtained from publicly available bibliographic sources. Ethical procedures were followed regarding proper citation, transparent reporting, and methodological integrity.

### **Results**

This section presents the main findings of the bibliometric analysis conducted on 328 publications related to AI-driven assistive technologies for visually impaired individuals. The results highlight publication trends, subject-area distribution, document types, contributing countries, institutional productivity, and emerging research themes. Together, these patterns

provide a clear overview of how this field has evolved over time and where scholarly attention is currently concentrated.

### *Publication Trends Over Time*

Figure 2 illustrates the annual growth of publications on AI-driven assistive technologies for visually impaired users from 2017 to 2025. The trend provides insight into how scholarly interest in this field has shifted over time and reflects the broader global momentum surrounding AI applications in accessibility research.

Documents by year

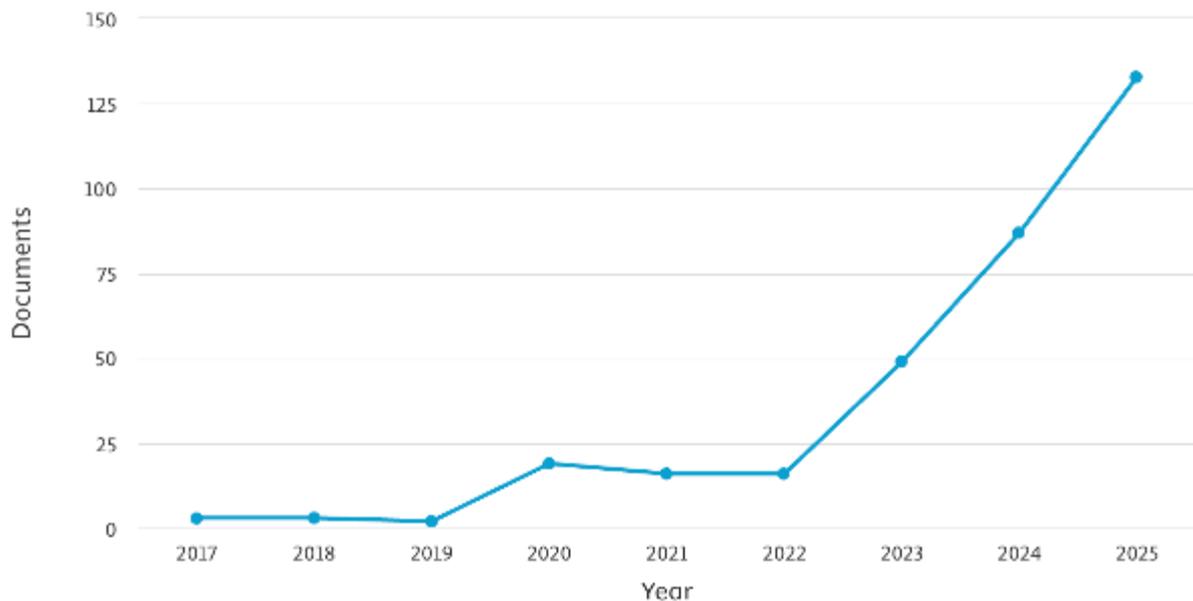


Figure 2: Publications on AI-Driven Assistive Technologies for the Visually Impaired by years

The publication trend displayed in Figure 2 shows a steady but modest level of scholarly activity between 2017 and 2019, followed by a noticeable rise beginning in 2020. This early increase aligns with the growing maturity of deep learning models and their integration into assistive technologies. After a brief stabilization between 2021 and 2022, the field experienced a sharp acceleration from 2023 onward. Publications more than doubled between 2023 and 2024, and the surge continues dramatically into 2025, reaching the highest output recorded in the dataset. This strong upward trajectory suggests that AI-driven assistive technologies for visually impaired individuals have become a rapidly expanding area of global research. The significant growth in recent years likely reflects both technological advancements—such as improved object detection models, lightweight embedded systems, and transformer-based architectures—and increasing societal emphasis on accessibility, inclusion, and human-centered AI solutions. Overall, the trend indicates that this research domain is moving toward greater maturity and relevance, attracting multidisciplinary contributions from engineering, health sciences, human-computer interaction, and ethics.

### Subject Area Distribution

Figure 3 presents the distribution of publications across major subject areas, showing which academic fields contribute most to research on AI-driven assistive technologies for visually impaired individuals.

#### Documents by subject area

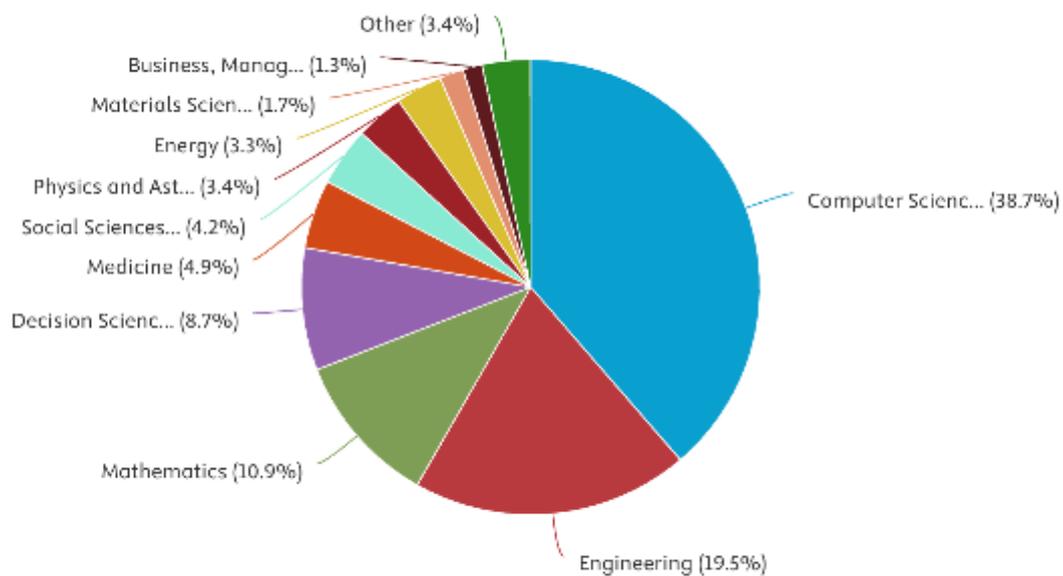


Figure 3: Publications on AI-Driven Assistive Technologies for the Visually Impaired by Subject area

The results in Figure 3 show that this research area is predominantly shaped by technical disciplines. *Computer Science* leads with 38.7% of the total publications, emphasizing its central role in developing algorithms, deep learning models, and intelligent systems that power modern assistive tools. *Engineering* follows at 19.5%, reflecting strong involvement in device design, sensor integration, robotics, and hardware solutions that support mobility and environmental awareness. *Mathematics* accounts for 10.9%, highlighting the importance of computational modeling, optimization, and machine learning foundations.

Beyond these core fields, contributions from *Decision Sciences*, *Medicine*, *Social Sciences*, and *Physics* indicate a growing interdisciplinary approach. These areas address topics such as usability, user behavior, accessibility challenges, clinical needs, and human–technology interaction. Smaller contributions from *Business*, *Energy*, and *Materials Science* suggest niche but emerging intersections. Overall, the diversity of subject areas reflects a multidisciplinary landscape where technological innovation, human factors, and societal perspectives work together to advance AI-based assistive solutions.

### Document Type Distribution

Figure 5 shows the distribution of publications by document type, offering insight into how researchers disseminate work related to AI-driven assistive technologies for visually impaired individuals.

#### Documents by type

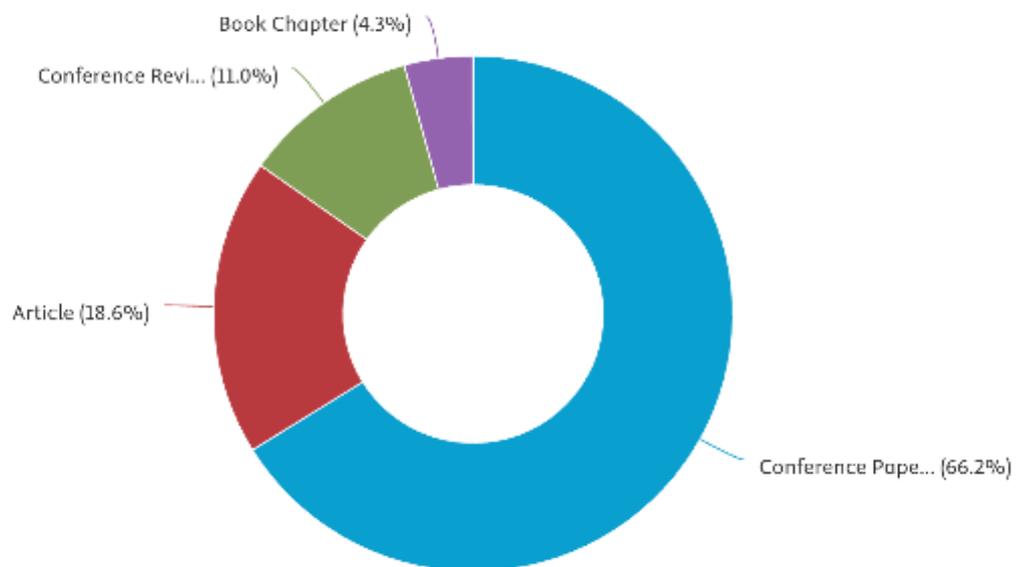


Figure 5: Publications on AI-Driven Assistive Technologies for the Visually Impaired by document type.

As shown in Figure 5, conference papers dominate the research output, representing 66.2% of all publications in this field. This strong presence reflects the fast-evolving nature of AI research, where conferences often serve as the primary venue for sharing cutting-edge models, prototypes, and early-stage innovations. Conferences also allow rapid dissemination and immediate community feedback, which is especially important for emerging technologies such as computer vision-based navigation aids, deep-learning object detection systems, and wearable assistive devices. Journal articles account for 18.6%, indicating more mature studies that typically involve rigorous methodological evaluation, user studies, or comprehensive system assessments. Conference reviews contribute 11.0%, reflecting synthesized insights and curated discussions surrounding trends, challenges, and ongoing developments. Book chapters represent 4.3%, demonstrating slower-paced contributions that often provide broader overviews, conceptual frameworks, or theoretical discussions.

Overall, the distribution highlights a research landscape that is dynamic and technology-driven, with a strong emphasis on rapid innovation, experimentation, and the early sharing of breakthroughs that push the field forward.

### Geographic Distribution of Research Output

Figure 6 highlights the countries and territories contributing most to the research on AI-driven assistive technologies for visually impaired individuals, showing clear differences in global research productivity.

#### Documents by country or territory

Compare the document counts for up to 15 countries/territories.

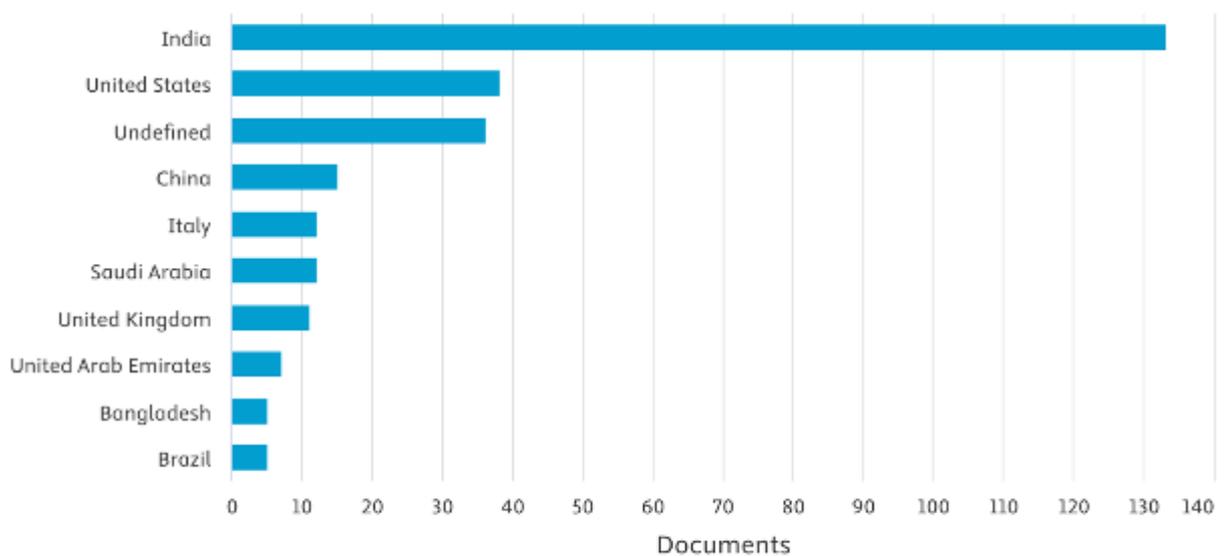


Figure 6: Publications on AI-Driven Assistive Technologies for the Visually Impaired by Country or territory.

As illustrated in Figure 6, India emerges as the most active contributor, producing the highest number of publications in this field. This strong presence likely reflects India's rapidly growing AI research ecosystem, expanding engineering institutions, and ongoing national initiatives that promote affordable assistive technologies. The United States follows, supported by its extensive research infrastructure, well-established computer science programs, and strong collaboration between academia, industry, and accessibility-focused organizations. A notable portion of documents is categorized under "Undefined," which typically represents publications with missing or unclassified affiliation data common in conference proceedings or multi-author works with incomplete metadata. China, Italy, and Saudi Arabia contribute a moderate volume of research, reflecting rising interest in AI applications, wearable assistive devices, and human-technology interaction within these regions.

The contributions from the United Kingdom, United Arab Emirates, Bangladesh, and Brazil, although smaller, indicate growing international engagement. These countries are increasingly exploring AI solutions to enhance mobility, independence, and daily functioning for visually impaired individuals—often through interdisciplinary projects involving engineering, healthcare, and social sciences. Overall, the geographic spread shows that research on AI-assisted technologies for the visually impaired is globally expanding, with strong leadership from Asia and North America. The diversity of contributing regions also

suggests increasing recognition of accessibility challenges as a shared global priority rather than a localized concern.

### Institutional Contributions

Table 2 presents the top ten institutions contributing to research on AI-driven assistive technologies for visually impaired individuals, offering insights into the academic centers leading innovation in this field.

Table 2

#### *Top 10 affiliation on AI-Driven Assistive Technologies for the Visually Impaired*

#	Affiliation	TP*	Country
1	SRM Institute of Science and Technology	7	India
2	Indiana University Bloomington	4	USA
3	Symbiosis International Deemed University	4	India
4	Sri Sairam Engineering College, Chennai	4	India
5	Chennai Institute of Technology	4	India
6	Indian Institute of Science	3	India
7	Microsoft Research	3	USA
8	New York University	3	USA
9	Politecnico di Milano	3	Italy
10	Sathyabama Institute of Science and Technology	3	India

TP\*= Total Publications

As shown in Table 2, the research landscape is strongly influenced by institutions based in India, which occupy six out of the ten top positions. The SRM Institute of Science and Technology leads with seven publications, reflecting India's rapidly expanding commitment to AI research and affordable assistive solutions. Other Indian institutions—including Symbiosis International Deemed University, Sri Sairam Engineering College, Chennai Institute of Technology, and the Sathyabama Institute of Science and Technology—each demonstrate consistent output, highlighting a well-established academic ecosystem focused on engineering, computer science, and applied AI. The presence of prominent U.S. institutions such as Indiana University Bloomington, Microsoft Research, and New York University underscores the significant role of North American research in advancing deep learning models, human-computer interaction, and ethical considerations within assistive technology development. Meanwhile, Politecnico di Milano represents Europe's growing involvement, contributing research grounded in engineering, robotics, and inclusive design. Overall, the distribution suggests that the field benefits from a blend of expertise across regions, India's strength in practical engineering solutions, the United States' leadership in AI and accessibility research, and Italy's contribution to human-centered design. This diverse institutional participation supports the steady global advancement of AI-driven tools aimed at improving mobility, independence, and quality of life for visually impaired individuals.

#### *Keyword Co-Occurrence and Emerging Research Trends*

Figure 7 visualizes the co-occurrence of keywords within the dataset, highlighting dominant research themes, interconnected concepts, and emerging directions in AI-driven assistive technologies for visually impaired individuals.



keywords over time suggests that future research will continue moving toward more intelligent, personalized, and ethically grounded assistive solutions.

### **Discussion**

The findings of this study reveal a rapidly expanding research landscape focused on AI-driven assistive technologies for visually impaired individuals. When compared with the existing literature, several meaningful patterns emerge that highlight both the progress made and the gaps that remain in the field.

First, the sharp growth in publications from 2020 onward aligns closely with technological advancements reported in previous studies. The literature consistently shows that the introduction of high-performing deep learning models—such as YOLO variants and DETR—has significantly improved object detection, navigation support, and scene interpretation (Algaraady et al., 2025; Ikram et al., 2025). Our results confirm that this technological shift has fueled increased scholarly interest, as evidenced by the steep rise in publications seen in Figure 2. The transition toward lightweight, edge-based systems noted in earlier work (Qiao et al., 2022; Satheesh Kumar et al., 2025) further explains the surge, as such innovations make AI-based assistance more feasible for real-world use.

The subject area distribution reinforces the technologically driven nature of the field. Consistent with the literature, our analysis shows that most research originates from Computer Science and Engineering, with Mathematics contributing foundational modeling and algorithmic advancements. This aligns closely with the emphasis in past studies on computer vision, machine learning, and hardware integration as core components of assistive systems for visually impaired users (Aduri & Naganjaneyulu, 2024; Ganesan et al., 2022). At the same time, smaller contributions from Medicine, Social Sciences, and Human Factors reflect growing but still limited attention to user experience, clinical needs, and everyday usability challenges—topics highlighted as essential but under-addressed in the literature (Choi et al., 2024; Hamideh Kerdar et al., 2024).

The dominance of conference papers in Figure 5 mirrors the rapid pace of AI innovation documented in prior studies. Research on deep learning, wearable devices, and navigation support often reaches conference platforms first, allowing early dissemination and iterative development. This aligns with the pattern seen in the literature, where many breakthroughs—such as sonification feedback (Oh et al., 2013), haptic interaction techniques (Palani & Giudice, 2017), and multimodal navigation tools—originated in conference proceedings before maturing into journal outputs.

Geographically, India's leadership in publication volume reflects the country's strong engineering and computer science research ecosystem. This finding is consistent with the literature, where several impactful AI-driven assistive solutions originate from Indian institutions with emphasis on low-cost innovation and applied research. Similarly, the United States continues to play a significant role, especially in user-centered design, accessibility standards, and ethical considerations—topics that feature prominently in recent work (Akter et al., 2020; Sasu et al., 2025; Yu et al., 2025). Emerging contributions from Europe, the Middle East, and Asia underscore the increasing global recognition of accessibility as a shared research priority.

The keyword analysis (Figure 7) reveals strong alignment with the themes identified in the literature. The prominence of terms such as object detection, navigation, and assistive technology reflects ongoing efforts to enhance environmental understanding and user mobility—challenges repeatedly emphasized in empirical studies. The presence of artificial intelligence, machine learning, and deep learning as central nodes mirrors the literature's focus on algorithmic innovation. Notably, emerging keywords connected to user experience, multimodal feedback, and ethics correspond closely with concerns raised in past research about usability barriers, training needs, privacy risks, and user autonomy (Choi et al., 2024; Hamideh Kerdar et al., 2024; Akter et al., 2020). The relatively limited visibility of terms associated with Cerebral Visual Impairment (CVI) confirms what the literature identifies as a major gap—CVI remains significantly underrepresented despite increasing clinical attention (Gamage et al., 2024; Lehman et al., 2024).

Taken together, the results show a clear convergence between current research trends and the literature: technological advancement is outpacing human-centered and ethical considerations. While the field has made significant strides in deep-learning-based recognition, navigation, and environmental awareness, user experience challenges, long-term adoption, cognitive load, and accessibility remain underexplored (Kuriakose et al., 2024). The findings also reinforce calls from the literature for broader interdisciplinary collaboration and more inclusive research that addresses diverse visual conditions, including underrepresented groups such as individuals with CVI.

Overall, this discussion highlights the complementary relationship between existing knowledge and emerging trends. The field is advancing rapidly in technical capability while still striving to address persistent gaps in usability, inclusivity, and ethical governance. These findings underscore the importance of future research that balances innovation with accessibility and human-centered design.

### **Conclusion**

This study provides a comprehensive overview of global research trends on AI-driven assistive technologies for visually impaired individuals, drawing on 328 publications and a range of bibliometric indicators. The findings demonstrate a rapidly expanding field driven primarily by advancements in deep learning, computer vision, and embedded AI systems. The sharp increase in publications since 2020 corresponds with breakthroughs in real-time object detection, scene understanding, and lightweight hardware platforms all of which have significantly influenced how assistive technologies are developed and deployed.

The results further show that research activity is concentrated within Computer Science, Engineering, and Mathematics, reflecting the field's strong technological foundation. At the same time, emerging contributions from Medicine, Social Sciences, and Human Factors signal a growing recognition of the importance of usability, accessibility, and user-centered design—areas emphasized throughout the existing literature. The dominance of conference publications highlights the fast-moving nature of AI innovation, while the geographic distribution underscores strong leadership from India and the United States, alongside growing participation from Europe, the Middle East, and Asia.

The keyword analysis reinforces these patterns, revealing dense clusters around deep learning, navigation support, object detection, and multimodal feedback systems. However, the limited presence of terms related to Cerebral Visual Impairment (CVI) and user experience challenges confirms persistent gaps highlighted in prior research. Despite significant technological progress, issues such as gesture ambiguity, cognitive load, privacy concerns, and long-term usability continue to influence user adoption and acceptance.

Overall, the study shows that while AI-driven assistive technologies are becoming increasingly powerful and sophisticated, future progress depends on balancing innovation with human-centered, ethical, and inclusive design practices. Addressing underexplored areas—such as CVI, real-world performance evaluation, and accessibility governance—will be essential for ensuring that technological advancements translate into meaningful support for visually impaired individuals. By mapping current research trajectories, this study provides a foundation for guiding future work toward more equitable, effective, and user-aligned AI-assisted solutions.

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