

Smartphone Applications as Supportive Tools for People with Visual Impairment and Blindness

Narrative Review

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ABSTRACT

Background: Visual impairment restricts access to printed information, independent mobility, communication, and health services. Smartphones now integrate cameras, location services, artificial intelligence (AI), and built-in accessibility features in a single mainstream device. In Iraq, where population-based eye-health data are scarce and rehabilitation services are unevenly distributed, these devices may offer a scalable complement to conventional low-vision care. **Objective:** To synthesize evidence on the functions, benefits, limitations, and implementation requirements of smartphone applications for people with low vision or blindness, and to interpret this evidence for the health-service context of Kirkuk Governorate, Iraq. **Methods:** A narrative review of PubMed-indexed literature and authoritative international sources was conducted in Kirkuk in September 2026, supplemented by targeted searches for Iraqi and Arab-region studies, national policy documents, census data, and digital-connectivity reports. Findings were synthesized thematically by functional domain, barrier, and implementation theme. **Results:** Smartphone applications provide magnification, optical character recognition (OCR), text-to-speech, object and color identification, navigation, remote sighted assistance, and access to digital communication. Clinical and survey studies report gains in near visual acuity with magnification apps, partial replacement of traditional aids, and proficiency in up to 90% of trained older adults. Barriers include cost, limited awareness, insufficient training, inaccessible interfaces, recognition errors, privacy risks, and weak local-language support. Contextual data show that Iraq has more active mobile connections than inhabitants and that Kirkuk Governorate has approximately 2.03 million residents, about one quarter of whom live in rural areas. However, Arabic screen-reader pronunciation, Kurdish and Turkmen language support, and the implementation of national disability legislation remain important gaps. **Conclusion:** Smartphone applications can expand autonomy when they are accessible, affordable, task-matched, and introduced through structured training. In Kirkuk, a staged model linking eye clinics, hospital pharmacies, rehabilitation services, and organizations of persons with disabilities could convert high mobile connectivity into meaningful accessibility. Locally conducted outcome studies are now required.

Keywords: Visual Impairment; Blindness; Smartphone; Mobile Applications; Assistive Technology; Low Vision Rehabilitation.

Article Information

Received: July 20, 2026; Revised: August 18, 2026; Online: September 2026y

1. INTRODUCTION

Vision impairment is a major global health and participation issue. The World Health Organization estimates that at least 2.2 billion people live with near or distance vision impairment and that at least 1 billion cases could have been prevented or remain unaddressed [1]. Global Burden of Disease estimates indicate

that, in 2020, approximately 43.3 million people were blind and 295 million had moderate or severe distance vision impairment [2]. For people with irreversible low vision or blindness, rehabilitation aims not only to improve task performance but also to support autonomy, education, employment, social connection, and

quality of life. Assistive technology is central to this aim because it helps maintain or improve functioning in communication, mobility, self-care, and reading [3], yet access to assistive products remains highly unequal between and within countries [4].

Historically, visual rehabilitation relied on optical magnifiers, closed-circuit television systems, braille devices, talking products, white canes, and specialized electronic aids. These remain essential and may be superior for particular tasks. Nevertheless, smartphones have altered the assistive-technology landscape. A single mainstream device can combine magnification, OCR, text-to-speech, voice control, high-contrast display options, object recognition, global positioning, communication, and remote video assistance. This convergence can reduce the need to carry several devices and may lessen the stigma sometimes associated with visibly specialized equipment [5,6].

The regional burden strengthens the case for scalable solutions. A 2025 systematic review and meta-analysis of 28 studies from Arab countries reported pooled prevalences of severe visual impairment and blindness of 4.0% and 4.65%, respectively, with cost, geographic inaccessibility, workforce shortages, and stigma identified as major barriers to care [7]. Iraq has no recent nationwide population-based blindness survey. In a hospital-based study of 18,612 consecutive outpatients at Ibn Al-Haitham Teaching Eye Hospital in Baghdad, 497 (2.7%) were blind; cataract (76.1%), diabetic retinopathy (12.9%), and glaucoma (5.0%) were the leading causes, and most blind patients had low socioeconomic and educational status [8]. More recently, diabetic retinopathy was detected in 30.5% of 1,542 patients attending a diabetes center in Basrah [9], signalling a growing pool of people likely to develop irreversible vision loss requiring rehabilitation rather than surgical cure.

Ownership alone does not ensure meaningful access. In a study of 166 people with severe visual impairment or blindness in a low-resource setting, smartphone use was 46.9%, and many participants were unaware that most of their desired functions were already available on contemporary phones [10]. A 2026 clinic-based study similarly found that although 88.8% of mobile-phone users owned smartphones, only

40.2% used one or more specialized accessible applications, with education strongly predicting use [11]. The key question is therefore not whether apps exist, but whether users can discover, learn, trust, afford, and safely integrate them into daily life.

Kirkuk Governorate in northern Iraq illustrates these challenges. According to the 2024 national census, the governorate has 2,034,627 residents, of whom 538,592 (26.5%) live in rural areas and 79,241 are aged 65 years or older [12]. Its population is linguistically diverse, with Arabic, Kurdish, and Turkmen widely spoken. To the author's knowledge, no published study has examined the use of assistive smartphone applications by people with visual impairment in the governorate. This review therefore addresses five questions: what functions smartphone applications provide; what evidence supports their benefits; what risks and access barriers limit their use; how health and rehabilitation services can implement them responsibly; and how this evidence applies to Kirkuk.

2. REVIEW METHOD

A narrative review was undertaken in September 2026 from Kirkuk, Iraq. The primary search used PubMed and World Health Organization resources. Search concepts combined terms for visual impairment, low vision, or blindness with smartphone, mobile application, assistive technology, accessibility, magnification, OCR, navigation, remote assistance, usability, training, and rehabilitation. Supplementary targeted searches were performed to identify Iraqi and Arab-region evidence (terms included Iraq, Kirkuk, Arab, Arabic, blindness, and diabetic retinopathy), together with official census figures, United Nations treaty-body documents, and national digital-connectivity reports.

Priority was given to peer-reviewed human studies, user-centered evaluations, comparative or cross-sectional investigations, and major reviews published in English. Earlier studies were retained when they addressed foundational interaction problems not adequately covered by newer work. Engineering reports without user evaluation, opinion pieces, and sources whose origin could not be verified were excluded. Findings were synthesized thematically by

functional domain, evidence of benefit, barrier, and implementation requirement, and were then interpreted against the demographic, linguistic, digital, and policy context of Kirkuk. Because this was a narrative rather than a systematic review, no pooled effect estimate or formal risk-of-bias assessment was performed.

3. FUNCTIONAL DOMAINS OF SMARTPHONE SUPPORT

The most useful distinction is functional rather than brand-based because app

availability, ownership, and features change rapidly. Mainstream iOS and Android devices already include screen readers, magnification, high-contrast modes, and voice assistants, to which specialized applications add further capabilities [13]. The same person may use several categories during one task, such as magnifying a label, converting it to speech, and contacting a sighted helper when automated recognition is uncertain (Table 1).

Table 1. Functional domains of smartphone support for people with visual impairment

Domain	Core functions	Typical uses	Key limitations
Visual enhancement	Magnification, contrast, brightness, color inversion	Reading labels, menus, mail, prices, and handwriting	Camera stability, lighting, small screen, visual fatigue
Text access	OCR, text detection, text-to-speech, document scanning	Medication labels, signs, printed pages, digital documents	Framing difficulty, OCR errors, complex layouts
Scene and object recognition	AI description, object, color, currency, and product identification	Shopping, clothing selection, locating personal items	Misclassification, incomplete context, overconfidence
Navigation	GPS routes, transit data, points of interest, indoor guidance	Trip planning, unfamiliar routes, public transport	GPS imprecision, weak indoor coverage, safety-critical errors
Remote assistance	Live video or image sharing with a sighted person	Troubleshooting, reading displays, contextual decisions	Privacy, availability, connectivity, camera orientation
Digital participation	Screen readers, voice control, accessible messaging and mHealth	Communication, education, work, appointments, health information	Unlabeled controls, inaccessible updates, cognitive load

3.1 Reading and information access

Magnification apps use the phone camera as a portable electronic magnifier, while OCR converts photographed text into machine-readable text that can be enlarged or spoken. In a clinical study of 17 adults with low vision, three free magnification applications produced at least a nine-line mean gain in both near visual acuity and reading acuity, with favorable usability scores, although reading speed did not significantly improve [14]. OCR can extend access to signs and printed documents, but performance depends on the user locating the text, aiming the camera, controlling blur and glare, and interpreting uncertain output. A study with seven blind participants showed that interface design and guidance during image capture materially influenced scene-text access [15].

From a pharmacy perspective, these functions are directly relevant to reading medication labels, package leaflets, and expiry dates, tasks in which errors have clinical consequences.

3.2 Recognition, assistance, and participation

Computer-vision apps can describe scenes and identify objects, colors, currency, products, or people. When automation is insufficient, remote-assistance services connect the user to a sighted helper through live video or images. These tools can support shopping, food preparation, clothing selection, appliance use, study, and work. Their value lies in rapid access to contextual information, but sensitive images, personal documents, and health information require careful consent and privacy practices.

4. EVIDENCE OF BENEFIT

4.1 Independence and substitution of selected aids

Smartphones are attractive because they are multifunctional, portable, socially familiar, and frequently less expensive than acquiring several dedicated electronic aids. In an international survey of 466 adults with visual impairment, 87.4% believed mainstream smartphones or tablets were replacing traditional solutions. Replacement was particularly common for object identification, navigation, obtaining sighted help, audiobooks, e-books, and OCR, whereas traditional devices remained preferable for tasks involving extensive typing or editing [6]. This pattern supports a task-matching approach rather than an assumption that one platform should replace all established aids.

Usage data indicate that assistive apps address recurring real-world needs rather than occasional novelty. Analysis of a magnifier application's global activity recorded an average of 262,466 launches by 38,237 users per month in 2020; use declined during weekends, holidays, and pandemic lockdowns, suggesting that demand tracked work and community activity [16]. Digital reading is similarly embedded in daily life: an online survey of 133 adults with low vision found that participants spent more time reading digital than hard-copy materials, yet most continued to use both digital devices and hard-copy magnifiers [17].

4.2 Learnability and the role of training

A common misconception is that older age or severe visual impairment makes smartphone training futile. In a clinical trial involving 116 adults aged 55 years or older, the median initial training time for visual-assistive iPhone applications was 45 minutes and the median total training time was 60 minutes. Seventy-one percent achieved proficiency after the initial session and 90% ultimately became proficient. Older age, legal blindness, and some cognitive factors were associated with longer training but did not preclude learning [18]. Structured smartphone tutorials have also been implemented for patients with severe glaucoma, showing that such training can be embedded in routine ophthalmic services [19].

4.3 Mobility and navigation

Navigation apps can assist with route planning, points of interest, public transport, and

orientation on unfamiliar journeys. In an international survey of 139 blind or low-vision participants, 60.9% mainly used apps on unfamiliar routes. Participants distinguished between AI tools for static identification tasks and live assistance for dynamic situations; apps supplemented rather than replaced white canes and guide dogs, and indoor navigation and precise point-of-interest information remained persistent gaps [20]. Smartphone-mediated teleguidance has received positive usability feedback in small indoor and outdoor studies, although camera position, field of view, connectivity, and helper availability remain important [21].

4.4 Broader psychosocial value

Beyond task performance, accessible smartphones can strengthen privacy and self-determination by allowing a person to read a label, recognize an object, or obtain directions without always asking a nearby person. They also connect users to education, employment, banking, communication, and health platforms. Independence should not, however, be reduced to solitary technology use; genuine choice includes deciding when to use automation, a conventional aid, professional support, or another person.

5. BARRIERS, RISKS, AND EQUITY CONSIDERATIONS

5.1 The access gap

Smartphones may be cheaper than multiple dedicated devices, but they are not inherently affordable. Purchase price, repair costs, data plans, reliable electricity, replacement cycles, and paid subscriptions can exclude users with limited income. The gap is particularly consequential in low- and middle-income settings, where formal low-vision rehabilitation may already be restricted [4]. The Ghanaian study in which fewer than half of participants used smartphones and many lacked awareness of existing features illustrates that both material access and information access matter [10].

5.2 Usability and digital literacy

Touchscreens remove tactile landmarks, and gestures, nested menus, virtual keyboards, and frequent interface changes can create a steep learning curve. Developers may label visual buttons poorly, design inaccessible onboarding screens, or introduce updates that disrupt

established workflows. Older blind and low-vision users have emphasized simplicity, customizability, audible error feedback, flexible data presentation, feasible input methods, and intuitive layouts in mobile health applications [22]. Accessibility should therefore be incorporated from the design stage and tested with users who differ in age, diagnosis, residual vision, dexterity, hearing, cognition, language, and technical experience.

5.3 Accuracy and safety

AI output can be fluent yet incorrect. OCR may confuse medication strengths or expiry dates; object recognition may misidentify products; and scene descriptions may omit hazards. GPS can place a user on the wrong side of a road, provide imprecise arrival points, or fail indoors. Users should be taught to verify high-risk information through a second source and not to rely on general-purpose apps for street crossing, obstacle detection, medication selection, or emergency decisions. Applications should communicate uncertainty rather than presenting all output as equally reliable.

5.4 Privacy, autonomy, and data governance

Camera-based services may capture faces, homes, financial documents, medication information, and precise location, and these data may be processed by remote volunteers or cloud-based AI systems. Clear permission requests, minimal data collection, secure transmission, understandable privacy notices, and user control over storage are therefore essential. Clinicians should not recommend an app solely because it is popular; they should consider what data it collects, whether processing occurs locally or remotely, and whether the user understands the trade-off.

5.5 Language and contextual fit

Recognition accuracy and speech quality vary across languages, scripts, currencies, products, and transport systems, and an app evaluated in a high-income English-speaking population may not generalize to Arabic-speaking users. Regional evidence confirms this concern. An early survey of 104 visually impaired users in Saudi Arabia found that about 80% used smartphones, establishing strong demand among Arabic speakers [23]. However, an evaluation of the three largest Saudi banking applications found that none conformed to the Web Content Accessibility Guidelines (WCAG)

2.1; 12 blind users frequently needed sighted help, encountered English-only elements within Arabic interfaces, and reported that screen readers mispronounced Arabic words written without diacritics [24]. Local-language support, offline functionality, culturally relevant datasets, and testing in the intended environment are therefore implementation requirements, not optional refinements.

5.6 Evidence limitations

Much of the literature consists of small usability studies, convenience samples, online surveys, or short-term evaluations, and technologically experienced, highly educated users are often overrepresented. App versions change faster than publication cycles. Reported satisfaction does not prove safer mobility, sustained independence, fewer errors, or improved quality of life, and comparative trials and longitudinal real-world studies remain limited [5].

6. CONTEXTUAL APPLICATION TO KIRKUK GOVERNORATE, IRAQ

6.1 Population and service context

Kirkuk Governorate combines a large urban center with substantial rural districts, including Hawija, Daquq, and Dibis. Of its 2,034,627 residents, 1,496,035 live in urban and 538,592 in rural areas [12]. Because the leading causes of blindness in Iraq, namely cataract, diabetic retinopathy, and glaucoma, increase with age and diabetes duration [8,9], demographic ageing and the regional diabetes burden are likely to increase demand for low-vision support. Across the Arab region, geographic inaccessibility and shortages of trained personnel disproportionately affect rural communities [7]. For residents of outlying districts, a smartphone that can magnify, read aloud, and connect to remote assistance may reduce dependence on repeated travel, provided that training and follow-up are available locally.

6.2 Digital readiness

National connectivity indicators are favorable. Iraq had approximately 50.8 million active cellular connections in late 2025, equivalent to 108% of the population, and 39.6 million internet users (83.8%), with a median mobile download speed of 56.34 Mbps [25]. These figures, however, count connections rather than individuals and are not disaggregated

by governorate or disability status. High connectivity should therefore be regarded as a necessary but insufficient condition: affordability of suitable devices, stable electricity for charging, digital literacy, and awareness of accessibility features must be assessed directly in the target population.

6.3 Linguistic diversity

Kirkuk's multilingual population creates a specific implementation requirement. Text-to-speech and OCR performance in Arabic is affected by diacritics, font styles, and mixed-language interfaces [24], and support for Kurdish (Sorani and Badini) and Turkmen varies between platforms and applications. Before an application is recommended, its speech output, recognition accuracy, and interface language should be verified in the user's preferred language using locally relevant materials, such as Iraqi medication packaging, official forms, and currency.

6.4 Policy and rights framework

Iraq acceded to the Convention on the Rights of Persons with Disabilities (CRPD) in 2013 and in the same year enacted Law No. 38 on the Care of Persons with Disabilities and Special Needs. In its 2019 concluding observations, the CRPD Committee noted that the law had not been fully implemented and recommended its alignment with the human-rights model of disability [26]. A first amendment to the law was issued as Law No. 11 of 2024 [27]. These instruments provide a basis for integrating assistive-technology provision, digital accessibility standards, and the participation of organizations of persons with disabilities into governorate-level health planning.

6.5 A proposed implementation model

Drawing on the evidence summarized above, Table 2 outlines a staged, low-cost model that could be piloted within existing services in Kirkuk. The model is proposed for local evaluation and has not itself been tested.

Table 2. Proposed staged model for integrating smartphone-based assistive support into services in Kirkuk Governorate

Stage	Proposed actions	Potential actors
Identification and referral	Identify patients with irreversible low vision or blindness during eye, diabetes, and chronic-disease visits; refer for functional assessment and assistive-technology counselling.	Ophthalmology and optometry clinics; diabetes and primary health care centers
Assessment and matching	Record visual function, hearing, dexterity, cognition, preferred language, device, operating system, and connectivity; match tools to priority tasks.	Rehabilitation staff; trained nurses or health workers
Structured training	Deliver short, task-based sessions in Arabic, Kurdish, or Turkmen, with written and audio take-home guides and peer trainers where possible.	Organizations of persons with disabilities; institutes for the blind; non-governmental organizations
Medication safety	Teach verification of OCR output for drug names, strengths, and expiry dates; provide large-print or spoken counselling; confirm high-risk medicines by a second method.	Hospital and community pharmacists
Follow-up and evaluation	Review use, errors, and abandonment at 1 and 3 months; collect patient-reported outcomes to inform service planning and research.	Kirkuk Health Directorate; University of Kirkuk and other academic partners

7. IMPLICATIONS FOR REHABILITATION AND HEALTH SERVICES

Smartphone applications should be integrated into person-centered rehabilitation through assessment, matching, training, and follow-up. Practitioners should first identify the

activity that matters to the user rather than recommending a generic list of apps, considering residual vision, visual field, hearing, hand function, cognition, preferred language, phone ownership, operating system, internet access, and previous technology experience [13]. A magnification tool may suit spot reading, OCR may suit longer printed text,

and remote assistance may be more appropriate when contextual judgment is required.

Training should use real tasks in the user's environment and cover accessibility settings, gestures, camera positioning, lighting, audio output, privacy, battery management, and recovery from errors. Competency should be demonstrated rather than assumed. Evidence that most older adults achieve proficiency after structured training supports including app instruction within low-vision and occupational rehabilitation services [18,19]. Family members can assist when the user wishes, but training should preserve the user's autonomy.

Services should also teach a layered safety strategy in which apps sit alongside optical aids, braille, environmental modification, white-cane skills, and human assistance. Pharmacists are well placed to contribute because medication identification is among the highest-risk reading tasks; pharmacy counselling can incorporate verification steps, accessible labeling, and spoken instructions. Recommendations should be reviewed periodically because software updates, subscription models, and device compatibility change.

8. PRIORITIES FOR FUTURE RESEARCH

Future studies should move beyond app-store ratings and brief usability sessions. Core outcomes should include task completion, error frequency, time, confidence, cognitive workload, adverse events, participation, quality of life, sustained adoption, and abandonment. Studies should report diagnosis, visual acuity and field, age, education, socioeconomic status, language, device type, app version, and training dose so that results can be interpreted and reproduced.

In Iraq, three studies would be particularly informative: a cross-sectional survey of smartphone ownership, accessibility-feature awareness, and app use among people with visual impairment in Kirkuk; a validation study of Arabic, Kurdish, and Turkmen OCR and speech output using local medication packaging, documents, and currency; and a pragmatic trial comparing structured clinic- or pharmacy-delivered training with usual care. Co-design with blind and low-vision participants should begin at problem definition and continue

through prototyping, safety testing, and dissemination.

9. LIMITATIONS OF THIS REVIEW

This review has several limitations. As a narrative rather than systematic review, it is susceptible to selection bias, and no formal quality appraisal or meta-analysis was performed. The restriction to mainly English-language literature may have omitted relevant Arabic-language publications. Iraqi evidence is limited and largely hospital-based; no population-based survey of visual impairment in Kirkuk was identified, and connectivity data were available only at the national level. Finally, the rapid evolution of applications means that specific features may change after publication. The Kirkuk-specific analysis is therefore interpretive and should be tested through primary research.

10. CONCLUSION

Smartphone applications have become important supportive tools for people with visual impairment and blindness. Their main strength is the integration of magnification, text access, visual recognition, navigation, communication, and human assistance within a familiar portable device. Evidence supports meaningful benefits in reading and selected daily activities, and structured instruction can enable successful use even among many older adults. These benefits are conditional on access to an appropriate device, accessible design, reliable information, task-specific training, and a realistic understanding of limitations. In Kirkuk Governorate, high national mobile connectivity offers a genuine opportunity, but realizing it will require attention to rural access, Arabic, Kurdish, and Turkmen language support, medication safety, implementation of disability legislation, and local evaluation. Applications should complement rather than replace conventional rehabilitation, mobility aids, and professional judgment.

DECLARATIONS

Funding: No external funding was received.

Conflicts of interest: The author declares no conflict of interest.

Ethical approval: Not applicable, because this article is a narrative review of published

literature and publicly available data and involved no human participants.

Data availability: No new datasets were generated or analyzed. All sources are cited in the reference list.

Author contribution: The author conceived the review, conducted the literature search, synthesized the evidence, and wrote the manuscript.

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