

AI FOR WELFARE ACCESS: A SYSTEMATIC REVIEW OF FRAMEWORKS FOR ENHANCING ACCESSIBILITY AND REACHABILITY OF GOVERNMENT SCHEMES

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Abstract: Government welfare delivery in India increasingly relies on digital portals and online systems; however, effective access to schemes remains uneven due to digital divides, fragmented information, and limited accessibility. Many citizens, particularly from rural and marginalized communities, struggle to identify relevant schemes, understand eligibility conditions, and complete application processes. Recent policy initiatives highlight the potential of artificial intelligence (AI) to enhance public-service delivery, yet existing AI-based welfare systems remain portal-centric, weakly explainable, and insufficiently inclusive.

This paper proposes a design-science-oriented, AI-enabled conceptual framework to improve the accessibility and reachability of government welfare schemes. The framework integrates rule-based eligibility assessment with learning-based prioritization, multimodal and multilingual conversational interfaces, explainable AI mechanisms, and human-in-the-loop participation by frontline workers. A prototype-level feasibility demonstration using a simulated use-case scenario is presented to illustrate operational viability. The proposed framework provides a structured foundation for future pilot implementations and empirical evaluation and contributes toward the development of inclusive, transparent, and citizen-centric AI systems aligned with Digital India and the AIforAll strategy...

Keywords: Artificial Intelligence, E-Governance, Welfare Schemes, Accessibility, Explainable AI, Human-in-the-Loop.

1. INTRODUCTION

This study proposes a design-science-oriented, AI-enabled conceptual framework for accessible and explainable welfare scheme discovery. The framework integrates rule-based eligibility assessment, learning-based prioritization, multimodal conversational interfaces, and frontline human participation to support inclusive, transparent, and trustworthy access to welfare schemes.

India operates a large and diverse ecosystem of government welfare schemes across sectors such as health, nutrition, social protection, livelihood, and education [1]. Digital governance initiatives, particularly the Digital India programme, aim to improve the efficiency and transparency of welfare delivery through online platforms [2]. In parallel, India's National Strategy for Artificial Intelligence (AI for All) identifies public welfare as a priority domain for inclusive, AI-enabled service delivery [3].

Despite these initiatives, digitization has not resulted in uniform or effective access to welfare services. Scheme-related information remains fragmented across departmental portals and documents, often presented in technical language and requiring digital literacy and familiarity with online systems. These challenges disproportionately affect rural households, low-income groups, women, persons with disabilities (PwDs), and other marginalized communities, leading to persistent gaps between formal digital coverage and actual welfare access.

Table 1 summarizes major categories of government welfare schemes in India, their target beneficiaries, and the key access challenges that motivate the need for an AI-enabled accessibility framework

TABLE 1. CLASSIFICATION OF GOVERNMENT WELFARE SCHEMES AND ACCESS CHALLENGES

Sector	Example Schemes	Target Beneficiaries	Key Eligibility Parameters	Major Access Challenges
Health	Ayushman Bharat (PM-JAY), Janani Suraksha Yojana	Low-income families, pregnant women	Income category, family size	Low awareness, portal navigation
Nutrition	POSHAN Abhiyaan, ICDS	Children (0–6 yrs), mothers	Age, maternal status	Limited outreach, language barriers
Agriculture	PM-Kisan, PMFBY (Crop Insurance)	Small & marginal farmers	Landholding, crop type	Digital literacy, registration issues
Social Security	Indira Gandhi National Pension Scheme	Elderly, widows, PwDs	Age, disability, income	Documentation, verification delays
Employment	MGNREGA, PM-SVANidhi	Rural workers, street vendors	Job card, occupation	Procedural complexity
Education	Pre-Matric & Post-Matric Scholarships	Students from weaker sections	Income, caste, merit	Information fragmentation
Housing	PMAY (Urban/Rural)	Economically weaker sections	Income, housing status	Eligibility confusion
Financial Inclusion	Jan Dhan Yojana, DBT	Unbanked citizens	Identity, residence	Account linkage issues
Women Empowerment	Beti Bachao Beti Padhao, Ujjwala Yojana	Women & girl children	Gender, household status	Awareness, application guidance
Disability Welfare	ADIP Scheme, Divyang Pension	Persons with disabilities	Disability certification	Accessibility of portals

Problem statement

Although multiple digital platforms list government welfare schemes, many citizens remain unable to identify relevant schemes, understand eligibility conditions, or navigate application procedures. Fragmented information, technical presentation, and limited accessibility support result in low effective access despite widespread digital infrastructure.

Aim and Objectives

The aim of this study is to conceptualize an AI-enabled framework that improves the accessibility and reachability of government welfare schemes, particularly for rural and marginalized populations.

The objectives are:

To review literature on e-governance, digital divide, AI in public services, welfare scheme recommendation systems, and explainable AI.

To identify gaps affecting accessibility, reachability, and trust in AI-enabled welfare access.

To propose a human-centric AI framework integrating rule-based eligibility assessment with learning-based prioritization and multimodal, multilingual interfaces.

To outline a methodological roadmap for framework design, prototyping, and evaluation.

Contribution

This paper contributes a design-science conceptual framework that integrates accessibility-first interaction, proactive scheme reachability, explainable eligibility reasoning, and human-in-the-loop participation for AI-enabled welfare delivery.

2. LITERATURE REVIEW

Digital governance initiatives such as the Digital India programme aim to improve the efficiency, transparency, and scalability of welfare service delivery through online platforms and Common Service Centres (CSCs) [4],[5]. Prior evaluations indicate that although e-governance portals have streamlined administrative processes, effective access remains uneven across regions and socio-economic groups due to fragmented, department-specific systems and limited user-centric integration [7].

The digital divide in India extends beyond connectivity to include disparities in device access, digital literacy, language proficiency, disability status, and socio-economic positioning [6], [7]. Empirical studies show that marginalized populations—including rural households, women, persons with disabilities (PwDs), and tribal communities—face persistent barriers in discovering welfare schemes, understanding eligibility conditions, and navigating application workflows [8], [9],[10]. Accessibility audits further

reveal limited compliance with usability and accessibility standards in government portals, while field-based studies highlight user preference for assisted, voice-based, and local-language interactions [11], [12].

Artificial intelligence is increasingly explored to enhance public-service delivery through personalization and decision support [13], [14]. In India, AI adoption is observed in initiatives such as Mission Karmayogi and sector-specific applications across health, agriculture, and grievance redressal [3]. AI-powered chatbots deployed on platforms such as WhatsApp demonstrate the potential of conversational interfaces to extend service reach through familiar channels and regional languages [15], [16]. However, most deployments remain department-specific and do not adequately support cross-scheme discovery or accessibility at scale [7]. A growing body of work explores AI-based recommendation systems for welfare schemes using rule-based eligibility filtering, machine learning, and citizen profiling [17],[21]. While these systems demonstrate technical feasibility, they typically rely on text-centric interfaces, provide limited explanation of recommendation outcomes, and show minimal integration with frontline human actors. Explainable AI and human-in-the-loop approaches are therefore emphasized as essential for trust, transparency, and accountability in welfare decision support [5], [22]. The literature reveals a clear gap in integrated frameworks that jointly address accessibility, proactive reachability, explainability, and human participation in welfare scheme discovery.

3. METHODOLOGY

A design-science and mixed-methods research approach is adopted to guide the development and analysis of the proposed AI-enabled framework [22]. The methodology is structured into four interrelated phases: (i) problem exploration and requirements analysis, (ii) framework design, (iii) prototype development, and (iv) evaluation.

Phase I involves document analysis of central and state welfare schemes to identify target beneficiaries, eligibility conditions, and application workflows, complemented by stakeholder interactions with rural citizens, persons with disabilities (PwDs), women’s self-help groups, ASHA and Anganwadi workers, Common Service Centre (CSC) operators, and local officials to..

capture real-world access challenges [21]. An accessibility needs assessment is also conducted to understand literacy levels, language preferences, device availability, and connectivity constraints [11].

Phase II focuses on conceptual framework design using design-science principles, refined iteratively through expert feedback and aligned with national initiatives such as Digital India and India’s AI strategy [2], [22].

Phase III involves developing a prototype-level implementation comprising a scheme knowledge base, a hybrid eligibility and recommendation engine, a multilingual conversational interface (e.g., WhatsApp or web chat), and a dashboard to support frontline workers, drawing on prior work on conversational AI and public-sector NLP applications [23].

Phase IV adopts a mixed-methods evaluation strategy, combining usability and accessibility assessment, recommendation quality comparison with expert mappings, and qualitative analysis of trust and explainability perceptions [15], [24]. Ethical approval, informed consent, data minimization, and secure data handling are incorporated throughout in accordance with responsible AI guidelines [3]. To demonstrate feasibility, a prototype-level validation is conducted using a simulated use-case scenario. The scenario considers a representative rural citizen profile and a limited set of widely implemented welfare schemes, illustrating how structured eligibility rules are applied to identify qualifying schemes, followed by learning-based ranking to prioritize recommendations. Algorithm 1 summarizes the hybrid eligibility and recommendation logic used in the framework.

Algorithm 1: Hybrid Eligibility and Recommendation Engine

Input: Citizen Profile (CP), Scheme Knowledge Base (SKB)

Output: Ranked List of Recommended Schemes

Initialize an empty list of eligible schemes

For each scheme *S* in the scheme knowledge base:

Evaluate whether *CP* satisfies the rule- based eligibility conditions of *S*

If satisfied, add *S* to the list of eligible schemes

Rank the eligible schemes using a learning- based relevance scoring mechanism

Generate explanations based on satisfied eligibility rules

Return the ranked list of schemes with explanations

Evaluation feasibility is illustrated through a set of proposed metrics, summarized in **Table 2**, including eligibility accuracy, scheme coverage, explainability quality, and interaction effort.

TABLE 2. PROPOSED EVALUATION METRICS FOR PROTOTYPE-LEVEL VALIDATION

Metric	Description
Eligibility Accuracy	Agreement between AI-identified eligibility outcomes and expert or manual scheme mapping

Scheme Coverage	Number of relevant welfare schemes identified for a given citizen profile
Explainability Quality	Clarity and understandability of eligibility and ranking explanations provided to users
Interaction Effort	Number of interaction steps required to obtain scheme recommendations

These metrics support future quantitative benchmarking against baseline approaches such as manual portal-based scheme discovery and are aligned with established guidelines for assessing AI-enabled public services and explainable decision-support systems [12], [24].

Explainability is operationalized through rule-trace-based eligibility explanations and feature contribution-based ranking explanations, while scalability is addressed through modular rule management and centralized knowledge representation. Data privacy, consent, and interoperability are supported through role-based access control, audit logging, and standards-based

API integration with existing government systems, ensuring compatibility with public-sector data governance and digital governance strategies [2], [3].

3.5.3 Simulated Evaluation Metrics

Although large-scale empirical evaluation is beyond the scope of the present study, a set of evaluation metrics is defined to illustrate how the proposed framework can be quantitatively assessed during future pilot deployments. These metrics are conceptually applied to the simulated use-case scenario to demonstrate the evaluability of the framework.

The proposed metrics enable quantitative evaluation of the framework during pilot deployments. Eligibility accuracy measures alignment between automated eligibility and expert assessments, coverage reflects the number of relevant schemes identified, explainability quality assesses the clarity of rule-based explanations, and interaction effort captures the user effort required to obtain recommendations.

For benchmarking, the framework can be compared with baseline approaches such as manual portal-based discovery or keyword search by analyzing relative improvements in eligibility accuracy, scheme coverage, and interaction effort. These metrics are consistent with established guidelines for evaluating AI-enabled public services and explainable decision-support systems [12], [24].

PROPOSED AI FRAMEWORK FOR ACCESSIBILITY AND REACHABILITY

The proposed framework is structured into five interconnected layers: (1) Data & Knowledge, (2) Intelligence, (3) Interaction & Accessibility, (4) Human-in-the-loop & Governance, and (5) Infrastructure & Security. The overall architecture of the proposed system is illustrated in Fig. 1.

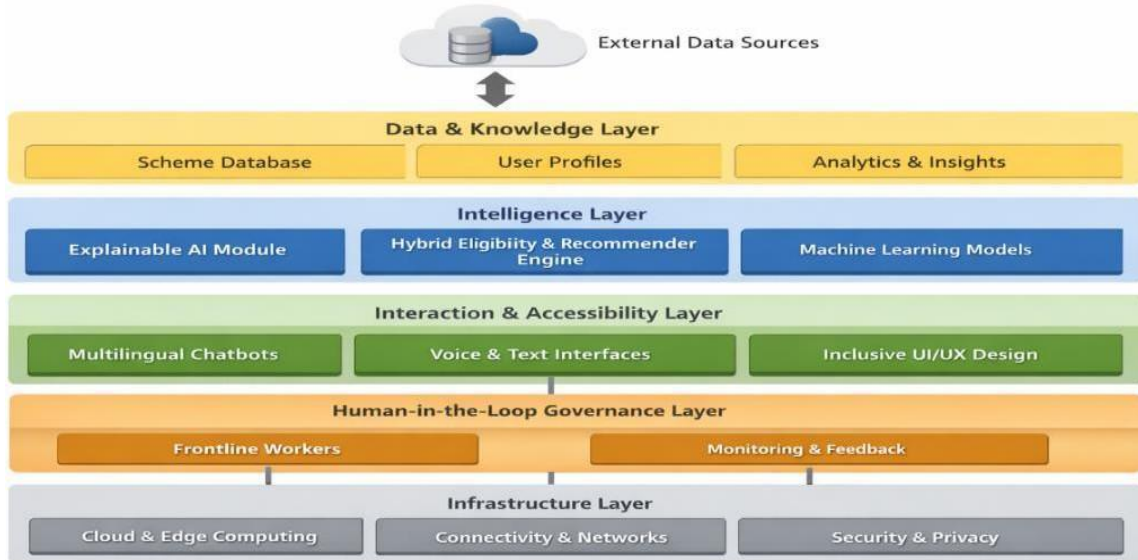


Fig. 1. Conceptual AI Framework Architecture

DATA & KNOWLEDGE LAYER

Scheme knowledge base

A centralized, machine-readable scheme knowledge base stores structured information on welfare schemes, including objectives, benefits, target beneficiaries, eligibility conditions (e.g., age, gender, income, occupation, disability, and location), and required documents or application channels. Eligibility is encoded using transparent rule-based representations, enabling direct use by AI components while supporting clear, human-readable explanations for citizens and frontline workers [16], [19].

Citizen profile data

Citizen profiles include only essential attributes for eligibility assessment and scheme recommendation, such as age, gender, location, income band, occupation, household composition, and disability status. Profile data may be collected through self- entry via conversational interfaces, assisted input by frontline workers, or selective linkage with government registries where legally permitted, ensuring inclusive participation while adhering to privacy and data governance requirements [3].

Intelligence Layer

Hybrid eligibility & recommendation engine

The intelligence layer employs a hybrid eligibility and recommendation engine that integrates deterministic rule-based filtering with learning- based prioritization. The rule-based component

applies legally defined eligibility conditions to ensure transparent, auditable, and guideline- compliant scheme filtering, consistent with

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A complementary machine-learning component is applied only to the set of eligible schemes to learn relevance patterns from contextual or historical data, such as common co-availment trends or underutilized schemes among specific beneficiary groups. Techniques such as gradient boosting or neural models may be used to prioritize schemes and surface additional relevant options beyond rule-based matches [15]. This staged separation of eligibility filtering and ranking preserves explainability while enabling adaptive, data-informed prioritization.

Explainable AI (XAI) module

For each recommended scheme, the explainable AI (XAI) module generates concise, user-facing explanations derived from rule-based reasoning and interpretable model outputs. Explanations indicate eligibility or ineligibility based on key attributes such as age, gender, location, and income category, and highlight satisfied or unmet conditions affecting access. The module also provides guidance on required documents and next steps for application, supporting transparent and trustworthy decision support in line with established public-sector XAI principles [24].

Interaction & Accessibility Layer

To improve accessibility and reachability, the framework includes a dedicated interaction layer that supports multimodal, multilingual, and low-friction user engagement.

Conversational Interfaces

Conversational access is provided through chatbots deployed on platforms such as WhatsApp, web widgets, and mobile applications, supporting English, Hindi, and relevant regional languages. Both text and voice interactions are enabled using speech-to-text and text-to-speech technologies, facilitating inclusive access for low-literacy users and persons with disabilities. This design is informed by prior public-sector deployments of regional-language, voice-enabled conversational systems for welfare access.

Kiosk and Common Service Centre (CSC) Integration

The framework supports deployment within Common Service Centres and kiosk-based environments, where trained operators assist citizens in accessing welfare schemes, particularly in rural or low-connectivity settings [25]. Basic functionality is maintained during intermittent connectivity through offline caching of scheme data and conversational workflows.

Accessibility Features

Accessibility is enhanced through interface-level design choices such as simple, icon-rich screens, optional simplified language modes, compatibility with screen readers and keyboard navigation, and appropriate colour contrast, font size, and layout. These features align with established accessibility standards for digital public services [10].

Human-in-the-loop & Governance Layer

The role of frontline workers in validating and contextualizing AI outputs is depicted in Fig. 2.

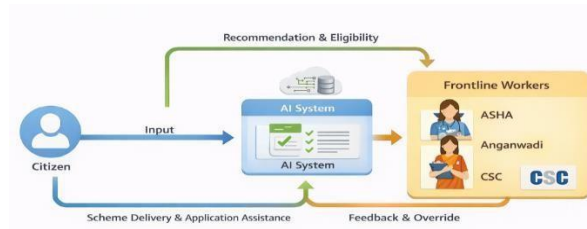


Fig. 2: Human-in-the-Loop Welfare Delivery Model

Frontline worker dashboards

Frontline actors such as ASHA workers, Anganwadi workers, Panchayat staff, CSC operators, and NGO facilitators are provided with a dedicated dashboard to support assisted welfare access. Through this interface, workers can create or update citizen profiles, review scheme recommendations, annotate or override suggestions in special cases, and generate digital or printed summaries for citizens. Integrating frontline workers as intermediaries enhances contextual interpretation, transparency, and trust in AI-assisted recommendations [21].

Feedback and learning mechanisms

Feedback mechanisms allow citizens and frontline workers to rate recommendation usefulness, flag incorrect or missing schemes, and suggest improvements to explanations. Logged feedback is used to iteratively refine eligibility rules and improve learning-based models, supporting continuous system adaptation.

Ethical governance

Ethical governance is operationalized through explicit consent workflows, role-based access controls, and audit logs that record recommendation logic and system actions. Periodic reviews by a multi-stakeholder oversight group are envisaged to monitor bias, errors, and complaints, in line with responsible AI and public-sector governance guidelines [3].

Infrastructure & Security Layer

The framework is designed to be deployable within a secure, government-approved cloud environment. Security measures include encryption of personal data in transit and at rest, and integration with national digital services (e.g., DigiLocker) only where legally permitted and operationally necessary. The deployment architecture aligns with national digital governance and data protection initiatives to ensure privacy, security, and regulatory compliance throughout the system lifecycle [2], [3].

4. DISCUSSION

The proposed framework addresses key limitations of existing digital welfare systems by prioritizing accessibility, proactive reachability, explainability, and human oversight.

Accessibility and Reachability

Multimodal and multilingual interaction, assisted access through frontline workers, and delivery via familiar channels such as WhatsApp or SMS help reduce barriers related to literacy, language, and digital skills. Proactive profile-based matching aligns with emerging AI-driven scheme navigators and hybrid recommender systems piloted in India and comparable contexts, improving reach where lack of awareness remains a major constraint [15], [19].

Trust through Explainability and Human Oversight

Explainable eligibility reasoning enables citizens and frontline workers to understand why schemes are recommended, consistent with principles of trustworthy public-sector AI [3], [24]. Human oversight through frontline intermediaries mitigates over-reliance on algorithmic outputs and supports contextual judgment in complex or ambiguous cases.

Implementation and Research Challenges

Key challenges include translating evolving scheme guidelines into machine-readable rules, scaling from pilots to large numbers of schemes, and achieving coordination across departments. Longitudinal field evaluations will be

required to assess impacts on awareness, uptake, equity, and citizen satisfaction, suggesting the need for phased, participatory deployments with iterative refinement.

5. CONCLUSION

This study brings together existing work on e- governance, the digital divide, artificial intelligence in public services, welfare scheme recommendation systems, and explainable, human-centric AI to propose a conceptual framework aimed at improving access to government welfare schemes. The framework combines multimodal interaction, proactive profile-based recommendations, explainable eligibility reasoning, and human-in-the-loop participation to respond to ongoing challenges related to accessibility, reachability, and trust in digital welfare systems.

As a design-science contribution, the framework offers a practical foundation for pilot deployments and future empirical evaluation. Further research can focus on implementing the framework within specific regions or welfare sectors and conducting field-based studies to examine its impact on scheme

awareness, uptake, equity, and citizen trust, in alignment with national initiatives such as Digital India and the AIforAll strategy.

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