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Offline-First, Voice-Enabled Mobile ERP for Rural and Semi-Urban MSMEs: A Survey of Literature, Trends, and Research Gaps

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ABSTRACT—

Rural and semi-urban micro, small and medium enterprises (MSMEs) in India often keep inventory, billing and credit records on paper registers or messaging apps, while mainstream ERP and accounting software is commonly designed around stable internet, English-language menus and moderate digital literacy. This narrative literature survey reviews 38 journal and review papers in seven themes: MSME digitalisation, ERP adoption in small firms, mobile inventory and billing systems, offline-first design and synchronisation, cross-platform and on-device security, voice and low-literacy interfaces, and payments, credit and forecasting. The reviewed literature supports the need for lightweight, offline-capable tools and indicates that synchronisation, text-free interface and security building blocks exist, while Indian-language speech recognition remains uneven. None of the reviewed studies combines ERP-lite scope, offline-first operation, regional-language voice entry and a rural Indian MSME focus. Six research gaps are identified and used to outline GRAMIK, a proposed offline-first, voice-enabled mobile ERP that has not been implemented or evaluated. Sources were assessed from abstracts and record pages, so the findings are indicative.

Index Terms—ERP, MSME, offline-first, data synchronisation, voice user interface, Indian languages, mobile applications, literature survey.

I. INTRODUCTION

Digital technology is widely treated as a route to competitiveness for Indian micro, small and medium enterprises (MSMEs), yet digital readiness varies widely [1], [2]. Rural and semi-urban micro-enterprises such as kirana stores and small hardware shops often record sales, stock and customer credit (*khata*) on paper or in messaging apps, leaving little structured transaction history for decisions, credit disputes or access to MSME schemes and loans.

ERP and accounting apps could address this gap, but many are designed for firms with reliable connectivity, trained staff and English-language interfaces. Studies report unreliable internet, limited knowledge and data-security concerns as barriers to small-firm ERP adoption [3], and infrastructure and staffing difficulties among Indian entrepreneurs [4].

Preliminary informal interviews with about ten shop owners in Tier-3 towns and villages indicated a similar pattern: about eight used paper registers or WhatsApp for sales and stock, about seven reported unreliable connectivity during business hours, and about six were uncomfortable with complex or English-only interfaces (roughly 80%, 70% and 60%). With so few respondents, these counts are indicative only.

This survey addresses four research questions:

RQ1. What adoption barriers does the literature report for MSMEs and small-firm ERP, and how do they apply to rural micro-enterprises?

RQ2. Which offline-first and synchronisation techniques are established, and how well do they suit transactional business records?

RQ3. What evidence supports voice and low-literacy interface design, and how mature is Indian-language speech recognition for this use?

RQ4. What do existing academic and commercial systems cover, and what remains unaddressed?

The contributions are a thematic review of 38 papers, a comparison with academic and commercial systems, six research gaps, and the design implications for GRAMIK, a proposed system. Section II describes the method, Sections III–V present findings, comparison and trends, Section VI states the gaps, Section VII outlines GRAMIK, and Section VIII concludes.

II. REVIEW METHODOLOGY

A. Sources and Search Procedure

Candidate papers were identified through Google Scholar, which also served as the main source for confirming that each record exists. Publisher, DOI, repository and indexing pages (for example IEEE, ACM, Springer, DOAJ and RePEc) were then opened to cross-check bibliographic metadata wherever possible. Only journal and review papers entered the corpus. Searches were organised by theme and covered MSME digitalisation, ERP and cloud-ERP adoption, mobile inventory and billing apps, offline synchronisation, cross-platform frameworks, Android data security, Indian-language speech recognition, low-literacy interfaces, digital payments, credit and forecasting. The survey is narrative and does not follow PRISMA; the exact query strings and search dates were not documented.

B. Inclusion and Exclusion Criteria

A study was included if it (a) was a journal article or review paper, (b) addressed at least one of the seven themes, and (c) had a bibliographic record that could be confirmed. Papers from 2023–2026 were preferred, and earlier foundational papers were retained when no recent equivalent was found. Studies were excluded if they were conference papers, theses, preprints, working papers, industry reports or news items, or if their records could not be confirmed.

C. Verification and Selection

Each retained paper was located through Google Scholar, and its title, authors or venue were matched to the record, with publisher or DOI pages used for cross-checking where available. Screening relied on titles and abstracts; full texts were not analysed, so statements about each paper are limited to what its abstract or record reports. During selection, one conference paper was excluded and seventeen candidates from an earlier project bibliography were dropped because their records could not be confirmed. A final audit removed eleven further sources whose records lacked author names or a publication year, or showed inconsistent publication details, reducing the corpus from 49 to 38 papers.

The final corpus of 38 papers spans 2007 to 2025, of which fifteen date from 2023–2026, and covers the seven themes (Table I, Fig. 1). Thirty-three come from established or indexed journals and five from regional or less widely indexed journals [4]–[8]; conclusions resting only on the latter are weaker.

TABLE I

CORPUS BY THEME

Theme	n	References	2023-26
A. MSME digitalisation	10	[1], [2], [4], [5], [10]–[14], [38]	6
B. ERP / cloud ERP	4	[3], [6], [15], [16]	2
C. Mobile inventory, billing	1	[7]	1
D. Offline-first, sync	6	[17]–[22]	1
E. Frameworks, security	4	[8], [23]–[25]	0
F. Voice, low literacy	7	[26]–[32]	3
G. Payments, credit, forecasting	6	[9], [33]–[37]	2
Total	38	[1]–[38]	15

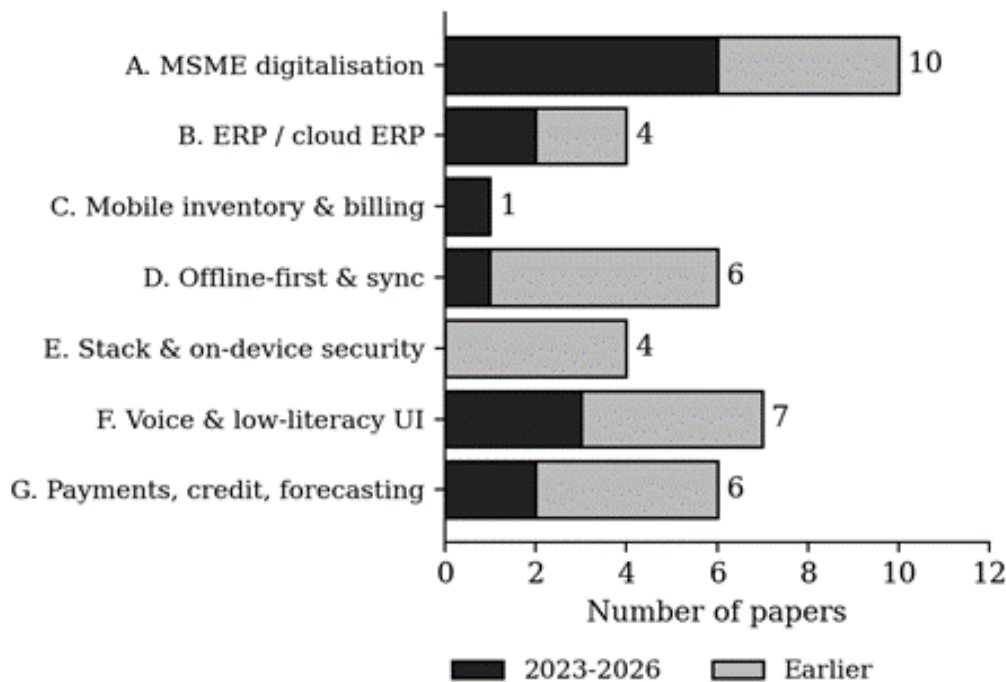


Fig. 1. Papers per theme, split by publication period.

D. Limitations of the Review

- Summaries rest on abstracts and record pages; full texts were not reviewed, so reported figures should be checked against the full text before quotation.
- The search was limited and its exact queries and dates were not documented, so it cannot be reproduced exactly, and statements that no study combines certain features apply to this corpus only. “Not reported” means that the abstract or record does not mention a feature.
- Excluding conference papers omits much speech, human-computer interaction and systems work and favours journals, including regional ones.
- Some records are incomplete (for example, missing volume or pages) or rest on repository links, and [9] was summarised from its title and record only.
- The mobile inventory theme rests on a single source, so its conclusions are tentative.
- The preliminary interviews are informal and small, and the competitor review was not independently re-checked.

III. REVIEW FINDINGS

A. MSME Digitalisation and Technology Adoption

Indian studies describe uneven digital readiness and call for an enabling ecosystem [1], link technology adoption to competitiveness [2], report IT adoption hurdles [10] and policy and technology determinants of success [11], and examine mobile CRM adoption in MSMEs [5]. Studies closer to micro-enterprises stress cost, risk and ease of use: perceived cost and risk rank highest among enablers of mobile-wallet use in rural MSMEs [12], and usefulness, ease of use and risk shape adoption in urban micro units, where digital finance is associated with financial inclusion [13]. A survey of rural micro-entrepreneurs in the Democratic Republic of Congo urges training and motivation [14], and a Haryana study groups difficulties into staffing and infrastructure [4].

Together, the reviewed studies suggest three classes of barrier: **infrastructure** [3], [4], **skills** [3], [14] and **cost and risk** [12], [13]. These map onto offline operation, voice and simple interfaces, and low cost. The grouping is an interpretation, and the sources differ in country, sector and firm size.

B. ERP and Cloud-ERP Adoption in Small Firms

ERP studies come mostly from formal SMEs in other countries. Unreliable internet, lack of knowledge, compatibility and security concerns are linked to reluctance to adopt SaaS ERP in Namibian SMEs, while low cost is a positive factor [3]. Further studies give factor lists for cloud ERP adoption [15], [16], and a review points to modular, subscription-style delivery [6]. Connectivity is thus a named barrier to cloud delivery, yet, as far as the abstracts show, none of these studies evaluates an offline-capable alternative.

C. Mobile Inventory, Billing and Offline-First Business Apps

One journal-published mobile business system remained after the audit: an Indian retail app with invoices, inventory, barcode scanning, stock alerts and UPI integration [7]. Its abstract reports neither offline operation nor regional-language voice, and it appears in a regional journal, so conclusions for this theme are tentative.

D. Offline-First Design and Synchronisation

A conflict-free replicated JSON datatype lets concurrent edits merge on the client without lost updates [17]. Sync-efficiency work shows that aggregating updates reduces traffic [18], [19] and that naive incremental sync can waste bandwidth [20]. Applied studies report usable sync-then-use models in constrained settings [21] and offline update strategies for unstable networks [22]. These studies concern file storage, learning content and translation, not transactional ERP records.

E. Cross-Platform Frameworks and On-Device Security

A survey of cross-platform development warns that many framework claims lack empirical verification [23], and one 2020 comparison favoured Flutter and React Native [8]. An Android storage review covering 2013 to 2018 notes that on-device encryption keys remain vulnerable to physical threats [24], and a secure-database architecture stores data encrypted and bound to its owner app [25]. Local encryption therefore requires a key-management aaaaaaaaaaaaaaaaaaaaaa

Low-literacy interface studies favour text-free design: graphics, voice feedback and help were strongly preferred by illiterate workers in Bangalore [26], and in a study of 90 low-literacy users text was unusable for first-time users, graphical interfaces gave the best task completion and spoken dialog was faster for some [27]. Systematic reviews provide design guidelines [28] and a usability classification for voice interfaces [29]. These studies involve low-literacy users, and shop owners are not necessarily in that group.

Indian-language speech recognition is less mature. Surveys note that languages other than Hindi were less developed [30] and stress low-resource and mutually influencing languages [31], and a Hindi-Marathi study reports difficulty with code-switched speech [32]. If shop owners mix Hindi, Marathi and English, voice entry requires field testing.

G. Payments, Credit and Forecasting

These papers bear on Phase 2 features. A study of small retailers in Bangalore reports that habit, pervasiveness and operating costs affect digital payment adoption [33]. Digital-footprint variables matched credit-bureau information for consumers [34], but this does not show that MSME records would support rural lending. Forecasting reviews report that causal models beat simple benchmarks while machine-learning evidence was limited [35], with further reviews of deep and machine learning [36], [37]. Very small shops may lack the data these methods need.

TABLE II

SUMMARY OF THE 38 REVIEWED STUDIES

Ref.	Study	Focus and key finding	Relevance to offline voice ERP
A. MSME digitalisation and technology adoption			
[1]	Buteau, 2021	Digital technology for India's MSMEs; uneven readiness, enabling ecosystem needed.	Policy context.
[2]	Mittal et al., 2025	T-O-E study of IT adoption and competitiveness in Indian MSMEs.	Need case; no offline or voice tool.
[10]	Singh et al., 2013	Survey of 84 Indian MSMEs on IT adoption and hurdles.	Early baseline; not rural.
[38]	Todd & Javalgi, 2007	Technology and entrepreneurship in Indian SMEs; internationalization focus.	Background only.
[11]	Kumar & Nanda, 2023	MSME success determinants: policy and technology.	Technology alongside policy.
[12]	Agrawal & Yadav, 2024	Mobile-wallet enablers for rural MSMEs; risk and cost rank highest.	Cost and trust drive uptake.
[13]	Verma & Shome, 2025	Micro units (Mumbai, Ahmedabad): usefulness, ease of use, risk; digital finance aids inclusion.	Simplicity and trust; urban sample.
[14]	Perez-Estebanez et al., 2018	Rural micro-entrepreneurs (DRC): ICT, mobile use, accounting systems.	Closest segment; African setting.

Ref.	Study	Focus and key finding	Relevance to offline voice ERP
[5]	Hatvalne & Dahivale, 2024	Drivers and barriers of m-CRM adoption in Indian MSMEs.	Mobile adoption; CRM focus.
[4]	Hooda & Santpal, 2025	Haryana entrepreneurs (384): infrastructure and staffing difficulties.	Infrastructure barrier.
B. ERP and cloud-ERP adoption in small firms			
[3]	Hasheela et al., 2016	SaaS ERP reluctance in Namibian SMEs: knowledge, internet, security; low cost helps.	Connectivity as cloud-ERP barrier.
[15]	Al-Shboul, 2019	Determinants of cloud ERP adoption in developing-economy SMEs.	Adoption factors.
[16]	Barbieri et al., 2024	PRISMA-P review of cloud ERP success factors (T-O-E).	Factors to measure in a pilot.
[6]	Jannah, 2025	Review of ERP adoption in developing-country SMEs; modular, subscription delivery.	Modular, low-cost delivery.
C. Mobile inventory, billing and offline-first business apps			
[7]	Reddy & Krishna, 2025	Indian retail app: invoices, inventory, barcode, alerts, UPI.	Closest Indian overlap; no offline or voice.
D. Offline-first design and synchronisation			
[17]	Kleppmann & Beresford, 2017	Conflict-free replicated JSON datatype; offline edits converge.	Basis for conflict handling.
[18]	Lee et al., 2017	Delta synchronisation aggregating updates to cut traffic.	Batching offline changes.
[19]	Lee et al., 2019	Fog-assisted aggregated synchronisation.	Context; fog unlikely.
[20]	Cui et al., 2017	Measurement of sync services; naive sync wastes bandwidth.	Sync traffic matters.
[21]	Pugoy et al., 2016	Hybrid sync-then-use apps rated usable (139 respondents).	Usable offline model; educational content.
[22]	Wang & Wang, 2024	Offline storage and update strategies for unstable networks.	General sync strategy.
E. Cross-platform frameworks and on-device security			
[23]	Biørn-Hansen et al., 2018	Taxonomy of cross-platform development; claims lack verification.	Framework claims need testing.
[8]	Isitan & Koklu, 2020	Cross-platform tools compared; Flutter and React Native best.	Consistent with Flutter choice.
[24]	Altuwaijri & Ghouzali, 2020	Android storage security; on-device keys vulnerable.	Key management matters.
[25]	Park et al., 2018	Secure Android database, encrypted and bound to owner app.	Local store design.
F. Voice, local language and low-literacy interfaces			
[26]	Medhi et al., 2007	Text-free UIs for illiterate workers; graphics, voice, help preferred.	Icon-first design.
[27]	Medhi Thies et al., 2013	90 low-literacy users, four countries; text unusable, graphical best, spoken faster for some.	Graphics plus voice for money tasks.

Ref.	Study	Focus and key finding	Relevance to offline voice ERP
[28]	Islam et al., 2023	Systematic review: 16 design guidelines in five groups.	UI test checklist.
[29]	Deshmukh & Chalmeta, 2024	Systematic review of voice UI usability.	Voice UX evaluation.
[30]	Singh et al., 2020	Indian-language ASR survey (2000–2018); non-Hindi less developed.	Marathi support may be weaker.
[31]	Dey et al., 2022	Review of Indian spoken language recognition.	Mixed-language detection.
[32]	Palivela et al., 2025	Hindi-Marathi code-switching ASR; systems struggle.	Mixed-language speech.
G. Payments, credit and forecasting (Phase 2 features)			
[33]	Ravikumar & Prakash, 2022	Bangalore retailers: habit, pervasiveness, cost affect payment adoption.	Effortless payment tracking.
[9]	Kumar et al., 2025	UPI adoption by Indian micro-enterprises (title and record only).	Topic relevant; findings not assessed.
[34]	Berg et al., 2020	Digital footprints match bureau information for consumer defaults.	Alternative data; not MSMEs.
[35]	Fildes et al., 2022	Retail forecasting review; causal models beat simple benchmarks.	Modest forecasting claims.
[36]	Eglite & Birzniece, 2022	Systematic review of deep learning for retail forecasting.	Deep models need more data.
[37]	Douaioui et al., 2024	Review of ML and DL demand forecasting.	Method choice.

Findings are as reported in abstracts and record pages; [9] is summarised from its title and record only. Relevance statements are interpretations derived from the analysis, not findings of the cited papers.

IV. COMPARISON WITH EXISTING SYSTEMS

A. Academic Prototypes

Table III compares the nearest journal-published systems with the planned GRAMIK design. No reviewed academic system reports offline operation, regional-language voice and ERP-lite scope together.

B. Commercial Tools

Table IV summarises a competitor review of commercial tools as of August 2026, based on public information. Khatabook and OkCredit focus on khata tracking with minimal inventory. Vyapar is marketed as offline-first and is the closest analogue to GRAMIK, but showed no voice-first entry. myBillBook is cloud-first, and full ERP suites target a different buyer.

TABLE III

CLOSEST ACADEMIC SYSTEMS VERSUS GRAMIK (PLANNED)

System	Platform	Offline	Voice	Context	Scope
Reddy & Krishna [7]	Mobile app	Not reported	Not reported	India, small retail	Billing, invoices, inventory, barcode, UPI
Pugoy et al. [21]	Android app	Yes: sync then use	Not reported	Philippines, learners	Educational content, not business data
GRAMIK (planned)	Android; Flutter, SQLite	Planned: local DB and sync queue	Planned: Hindi, Marathi, English	Rural, semi-urban India	Inventory, billing, sales, expenses, khata, reports

“Not reported” means the abstract or record does not mention the feature. GRAMIK entries describe planned features, not measured results.

TABLE IV

COMMERCIAL TOOLS VERSUS GRAMIK (PLANNED)

Product	Offline-first (local source of truth)	Voice / regional language	Inventory depth	Entry-tier cost
Khatabook	No (cloud ledger)	Multi-language, text-based	Minimal	Free entry tier
OkCredit	No (cloud ledger)	Multi-language, text-based	Minimal or none	Free entry tier
Vyapar	Yes (marketed offline-first)	No voice; regional text UI	Strong (multi-godown, barcode)	Paid plans
myBillBook	No (cloud-first)	No voice	Strong (batch, barcode)	Paid plans
Tally	Partial (desktop-bound)	No	Strong (accounting grade)	Licensed
ERPNext	No (web-based)	No	Very strong (full ERP)	Free self-hosting; paid hosting
Odoo	No (web-based)	No	Very strong (full ERP)	Free single app; paid plans
SAP Business One	No	No	Very strong (enterprise)	Licensed
GRAMIK (planned)	Yes (local-first, SQLite)	Yes: primary input, Hindi, Marathi, English	Focused, single-shop scale	Low cost (target)

Source: project competitor review, based on public information as of August 2026. Features and plans change often and were not independently re-checked; specific prices are therefore omitted.

V. CURRENT TRENDS IN DEVELOPING ERP FOR SMALL FIRMS

Six trends emerge from the corpus; evidence is noted as weak or moderate for each. (1) *Lightweight, modular, mobile delivery* [6], [7]: weak evidence from abstracts and regional journals. (2) *Offline-first operation*, supported by conflict-free merging, traffic-aware sync and sync-then-use models [17], [18], [20], [21]: moderate technically, but not shown on ERP records. (3) *Voice and vernacular interaction*, supported for low-literacy users [26]–[28] but limited by uneven Indian-language recognition [30], [32]. (4) *On-device data security*, where key protection is the weak point [24], [25]. (5) *Digital records as a bridge to finance* [13], [34]: plausible but unproven for rural lending. (6) *Modest, data-aware AI*, where simple methods remain competitive [35]–[37].

TABLE V

COVERAGE OF KEY CAPABILITIES BY LITERATURE STREAM

Literature stream	Refs	Offline operation	Sync design	Regional voice	ERP-lite scope	Rural MSME	India
A. MSME digitalisation	[1], [2], [4], [5], [10]–[14], [38]	Not reported	Not reported	Not reported	Not reported	Partial	
B. ERP / cloud ERP	[3], [6], [15], [16]	Not reported	Not reported	Not reported	Partial	Not reported	
C. Mobile inventory, billing	[7]	Not reported	Not reported	Not reported	Partial	Partial	
D. Offline-first, sync	[17]–[22]	Yes	Yes	Not reported	Not reported	Not reported	
E. Frameworks, security	[8], [23]–[25]	Not reported	Not reported	Not reported	Not reported	Not reported	
F. Voice, low literacy	[26]–[32]	Not reported	Not reported	Yes	Not reported	Partial	

Literature stream	Refs	Offline operation	Sync design	Regional voice	ERP-lite scope	Rural India MSME
G. Payments, credit, forecasting	[9], [33]–[37]	Not reported	Not reported	Not reported	Partial	Partial
GRAMIK (planned)	—	Planned	Planned	Planned	Planned	Planned

“Partial” means the stream touches the capability in some papers or settings but not as a combined solution. “Not reported” means the abstracts and records reviewed do not mention it. GRAMIK entries describe planned features.

VI. RESEARCH GAPS AND OPEN CHALLENGES

Table V shows that the capabilities GRAMIK targets are covered by separate streams, not jointly. Six gaps are identified, each bounded by the corpus reviewed.

RG1: No combined solution found. None of the reviewed papers combines ERP-lite scope, offline-first operation, regional-language voice entry and a rural Indian MSME focus; the nearest are [7], which reports no offline or voice features, and [21], which does not concern business data. This reflects a limited search, not proof that no such system exists.

RG2: Synchronisation not validated on transactional records. Synchronisation studies address files, learning content and generic apps [18], [20]–[22]. Conflict policies for stock and credit balances, for example mergeable deltas [17], were not found specified or tested in a small-business ERP.

RG3: Offline Hindi-Marathi voice entry untested. Recognition for languages other than Hindi is less developed [30] and code-switching is difficult [32]. No reviewed paper tests on-device speech on budget phones for product names, quantities and units.

RG4: Thin evidence for rural Indian micro-enterprises. ERP evidence mostly concerns formal SMEs outside India [3], and micro-enterprise studies come from cities [13] or other countries [14].

RG5: Offline security and sign-in. Local encryption needs key protection [24], [25]. Phone-number OTP sign-in needs connectivity at first login (a design observation), so a cached session is required for continued offline use.

RG6: Downstream value unproven. No reviewed paper shows that MSME transaction logs improve rural lending [34], and small-shop forecasting is limited by data volume [35], [36].

VII. PROPOSED DIRECTION: GRAMIK

GRAMIK is a proposed lightweight Android ERP for single-owner rural and semi-urban businesses, covering inventory, billing, sales, purchases, expenses and customer credit. It is not proposed as necessary for every rural business. The planned stack is Flutter with SQLite on the device and a Node.js/Express REST API with Firebase in the cloud, with a MySQL migration path; the device is the intended source of truth, with opportunistic synchronisation (Fig. 2). Generative AI is excluded from the MVP because cloud-hosted models require connectivity, which would conflict with offline-first operation. No component has been implemented or tested; prototyping is future work. Table VI checks the design claims against the evidence, and Table VII gives component status.

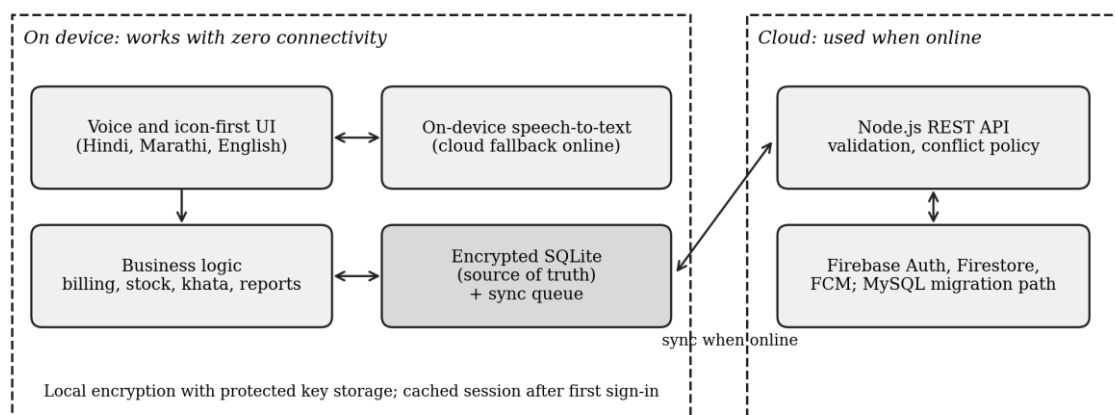


Fig. 2. Proposed offline-first architecture of GRAMIK. The on-device tier of the proposed design is intended to work without a network; the cloud tier is used for backup, multi-device access and sync. The architecture is a design and has not been implemented as a tested system.

TABLE VI

DESIGN CLAIMS CHECKED AGAINST THE LITERATURE

Design claim	What the evidence shows	Status
SQLite is fast on low-end devices	No reviewed paper tests this; suitability is a design judgement to benchmark on target devices.	Unverified
Flutter eases offline support	Flutter and React Native performed well in one comparison [8], but framework claims often lack verification [23]; offline support depends on the local database and sync design.	Partly supported; drop the offline claim
Phone OTP sign-in	OTP needs connectivity at first login (design observation); a cached session is needed offline.	Design risk
Local encryption	On-device keys remain vulnerable [24]; encrypted, separated storage is proposed [25]; key management required.	Needs key management
Voice via cloud speech services	Cloud services conflict with offline use (design observation); recognition is uneven [30] and code-switching is hard [32]. On-device recognition with cloud fallback needs testing.	Not yet offline-capable
Queue-based sync with conflict handling	Conflict-free merging [17] and traffic-aware batching [18], [20] support the approach; stock changes as mergeable deltas with a written conflict policy.	Supported
Loan-eligibility reports	Alternative data can rival bureau scores for consumers [34]; no reviewed paper shows MSME logs improve rural lending.	Plausible, unproven
AI sales-trend forecasting	Machine-learning retail forecasting evidence is limited [35]; tiny shops may lack history.	Phase 2, modest claims

TABLE VII

IMPLEMENTATION STATUS OF GRAMIK COMPONENTS

Component	Description	Status
Local store and sync queue	SQLite source of truth with a queue for offline changes.	Proposed
Business modules	Inventory, billing, sales, purchases, expenses, khata and reports.	Proposed
Voice and icon-first interface	Hindi, Marathi and English; on-device speech-to-text with cloud fallback.	Proposed
Cloud services	Node.js/Express API, Firebase services, MySQL migration path.	Proposed
Security	Local encryption, protected key storage, cached session.	Proposed
Loan-eligibility reports, forecasting	Later-phase features.	Phase 2 (future work)
Generative AI	Cloud-hosted LLM features.	Out of MVP scope
Prototype, benchmarks, voice tests, pilot	Evaluation steps (Section VII).	Future work

Evaluation should follow the gaps: synchronisation correctness and data integrity (RG2); Hindi-Marathi voice accuracy, including numbers and units, on budget phones (RG3); task completion with intended users using the guidelines in [28]; and a field pilot recording weekly active users, offline records, sync success and stock accuracy, complemented by a structured survey of owners (RG4).

VIII. CONCLUSION AND FUTURE WORK

The survey of 38 papers indicates, for RQ1, that barriers group into infrastructure, skills and cost or risk [3], [4], [12]; for RQ2, that offline-first and synchronisation techniques are well founded [17], [18], [20] but unvalidated on transactional records; for RQ3, that text-free and voice-plus-graphics interfaces are supported for low-literacy users [26], [27] while Hindi-Marathi recognition needs field testing [30], [32]; and for RQ4, that existing academic and commercial systems cover parts of the need, but none, within the limits of this search, combines all of it. The conclusions rest mainly on abstract-level reading, and GRAMIK remains a design that has not been implemented or evaluated. Future work comprises a GRAMIK prototype, device benchmarks, field voice tests and a pilot (Section VII), together with full-text re-reading of the key papers.

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