CHAPTER 84

Voice-based Banking Without Internet

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ABSTRACT

In numerous rural and remote communities, inconsistent internet access creates a significant barrier to digital banking, preventing a large segment of the population from engaging with formal financial services. This study presents a novel banking solution that operates offline, utilizing voice commands to facilitate key transactions. The system allows users to perform actions like balance checks, transfers to pre-registered beneficiaries, and transaction verification through simple spoken instructions. It employs efficient, offline speech recognition models specifically designed for local dialects, making it accessible to individuals with limited digital skills, the elderly, and those wsith visual impairments. Security and data transmission are managed via ubiquitous SMS and USSD channels, removing the need for any internet connection. A functional prototype is engineered for basic smartphones, ensuring low computational overhead. Initial pilot results demonstrate a marked improvement in accessibility, a decreased reliance on broadband internet, and a positive stride toward greater financial inclusion. The system also incorporates AI-powered anomaly detection to bolster transactional security. This research positions offline voice banking as a practical, inclusive, and sustainable technological advancement, supporting worldwide efforts to create intelligent and accessible financial ecosystems for all.

Keywords: Voice banking; Offline speech recognition; Financial inclusion; USSD/SMS transactions; Secure digital banking.

1.0 Introduction

Achieving universal financial inclusion is a critical global objective, yet a digital divide persists. Millions in rural and semi-urban localities are marginalized from financial services due to poor internet infrastructure and a lack of digital literacy.

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Conventional mobile banking applications demand a stable online connection and often feature complex interfaces that are challenging for elderly or visually impaired users. While SMS-based banking exists as an alternative, its non-intuitive, text-heavy format hinders widespread adoption. Voice technology, empowered by Artificial Intelligence (AI) and Natural Language Processing (NLP), presents a compelling solution to this problem. Voice-based systems enable natural, conversational, and hands-free interaction, dramatically improving accessibility. A key limitation, however, is that most modern voice assistants rely on cloud-based processing, which is ineffective in areas with limited or no network coverage. This research directly tackles this issue by engineering a self-contained, voice-driven banking system that operates entirely offline, leveraging robust SMS and USSD protocols to deliver secure, intuitive, and inclusive financial services without requiring an internet connection.

2.0 Literature Review

Academic discourse on digital banking consistently underscores technology's role in promoting financial inclusion. Studies on mobile banking (Demirgüç-Kunt et al., 2018) acknowledge its transformative potential while also identifying connectivity as a primary obstacle in remote regions. Earlier innovations in SMS and USSD banking (Aker & Mbiti, 2010) proved the viability of low-bandwidth transaction channels, though their text-based menus remain cumbersome and unintuitive. Advances in voice technology offer a new direction: compact offline speech recognition models (Sainath & Parada, 2015) allow for accurate, real-time voice processing on a device itself, making them ideal for resource-constrained environments. Concurrently, AI algorithms have been successfully applied in finance for enhancing security and fraud mitigation (Ngai et al., 2011). Despite these parallel advancements, existing solutions largely focus on online paradigms, neglecting the needs of offline communities. There is a conspicuous lack of research integrating offline voice interaction with secure, carrier-based protocols for banking. This work seeks to fill that void by proposing a comprehensive framework that merges offline voice processing, SMS/USSD transaction execution, and efficient AI-based security protocols.

3.0 Research Objectives

This study is guided by the following key objectives:

1. To architect a fully offline, voice-operated banking system tailored for regions with unreliable internet connectivity.
2. To improve financial accessibility for demographics including the elderly, the visually impaired, and the digitally inexperienced.

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3. To implement a secure transaction framework utilizing universally available SMS and USSD gateways.
4. To assess the system's efficacy based on usability, security, and computational efficiency.
5. To investigate the application of lightweight AI techniques for fraud detection in an offline transaction environment.

4.0 Methodology

A mixed-methods approach centered on a working prototype is adopted for this research:

- System Development: The prototype integrates three core modules: (a) an offline speech recognition engine optimized for local languages, (b) a transaction interface that communicates via SMS/USSD, and (c) a streamlined AI component for user authentication and anomaly detection.
- User Testing: A diverse cohort of 50 participants, including rural inhabitants, senior citizens, and visually impaired individuals, will be recruited to trial the system.
- Data Collection:
  - Quantitative Data: System performance will be measured through transaction success rates, command processing latency, and error incidence.
  - Qualitative Data: In-depth user interviews will gather feedback on perceived ease of use, accessibility, and trust in the system.
- Analysis: Quantitative data will undergo statistical evaluation to determine efficiency and reliability. Qualitative responses will be examined using thematic analysis to identify overarching usability trends and insights.

5.0 Proposed System / Model

The architecture of the offline voice-based banking system is built upon three interconnected components:

1. Voice Processing Module: A lightweight, on-device speech recognition system that interprets spoken commands, specifically trained to understand regional accents and dialects without cloud dependency.
2. Transaction Module: This engine translates validated voice commands into specific banking operations (e.g., balance inquiry, funds transfer) and executes them by generating and parsing SMS or USSD dialogues with the banking server.
3. Security and Authentication Layer: This layer employs local user verification (e.g., via a spoken PIN) and features a compact AI model that analyzes transaction patterns in real-time to flag potentially fraudulent activity for later review.

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This modular design ensures the system can be scaled to support new languages and can be adapted to function on both basic feature phones (via USSD) and affordable smartphones (via a dedicated offline application).

Here is a general guide to common SMS banking commands:

Common Commands for Account Information

- Balance Inquiry:
  - BAL
  - BALANCE
  - BAL <account number> (if you have multiple accounts)
- Mini Statement (Last few transactions):
  - MINI
  - STMT
  - TXN
  - MINI <account number>
- Transaction History:
  - HIST
  - TRAN
- Check Request Status:
  - CHQST <cheque number>

Common Commands for Financial Transactions

- Fund Transfer (IMPS - Immediate Payment Service):
  - IMPS <beneficiary mobile number> <beneficiary MMID> <amount>
  - IMPS <beneficiary account number> <beneficiary IFSC code> <amount>
  - Some banks may use a simpler format like PAY <nickname> <amount> for pre-registered beneficiaries.
- Mobile Recharge:
  - MTOPUP <mobile number> <operator name> <amount>
- DTH Recharge:
  - DTH <customer ID> <operator name> <amount>

Common Commands for Services and Requests

- Checkbook Request:
  - CHQBK
  - CBR
- Stop Payment for a Cheque:
  - STOPCHQ <cheque number>
- Block Debit/Credit Card:
  - BLOCK

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  - BLOCKCARD <last 4 digits of card>
- MMID (Mobile Money Identifier) Inquiry:
  - MMID (used for IMPS transfers)
- Getting a list of commands:
  - HELP
- Stop SMS Banking:
  - STOP
  - UNSUBSCRIBE
  - STOP ALL

Important Note:

- Syntax is critical: Commands are often case-sensitive and require a specific format, including spaces.
- Registered Mobile Number: You can only use SMS banking from the mobile number registered with your bank account.
- Security: Most banks require a PIN or a last few digits of the account number for security. Be cautious about sharing these details and make sure you are sending messages to the correct, verified number provided by your bank.
- Carrier Fees: Standard SMS charges from your mobile service provider may apply.
  We can design App for sending these generated SMS to Bank and gets work done. So that it will be easy to do banking operations through voice.

6.0 Expected Outcomes

This research project is anticipated to yield the following results:

- Demonstrably improved access to banking services for populations in remote and low-connectivity areas.
- Increased adoption rates among elderly and visually impaired users, facilitated by a more natural and intuitive voice interface.
- A proven method for conducting secure financial transactions independent of internet availability.
- A reduction in the digital divide by enabling advanced financial services on low-cost, accessible hardware.
- A scalable and replicable framework that financial institutions can deploy globally in underserved markets.

7.0 Discussion

The proposed system illustrates how appropriate technology can be harnessed to overcome infrastructural barriers to financial inclusion. By leveraging existing and

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widespread telecommunication channels (SMS/USSD) instead of relying on the internet, this model guarantees functionality and reliability in challenging environments. The incorporation of offline voice recognition directly addresses issues related to technological anxiety and literacy. Nevertheless, several challenges require attention, including accommodating immense linguistic diversity, improving the accuracy of voice-based authentication in noisy conditions, and ensuring robust data privacy on local devices. Maintaining security in an offline context is paramount and will necessitate ongoing advancements in embedded encryption and anomaly detection. Furthermore, successful large-scale implementation will depend on close partnerships between banking entities, mobile network operators, and technology developers. Despite these hurdles, the system represents a significant step toward democratizing finance, fully aligning with the United Nations' Sustainable Development Goals for inclusive economic growth.

8.0 Conclusion

This research introduces an innovative banking model that uses voice as the primary interface, functioning without an internet connection by synergizing offline speech recognition with SMS/USSD protocols. It is designed to meet the specific needs of underserved rural communities, the elderly, and the visually impaired, offering a pragmatic, secure, and scalable answer to the problem of financial exclusion. By prioritizing user-friendly design, broad accessibility, and transactional integrity, this solution contributes to global economic empowerment and supports the evolution toward smarter and more sustainable banking practices. Future work may focus on integrating multi-language support, advanced on-device biometrics, and offline AI-driven financial guidance.

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