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Banking Beyond Barriers -Voice Guided Slip Assistance

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Abstract: *The paper "Banking Beyond Barriers – Voice Guided Slip Assistance" is an innovative banking support system developed to assist illiterate, elderly, and visually impaired individuals in performing banking transactions independently. In existing banking systems, customers are required to manually fill deposit and withdrawal slips, which becomes difficult for users who cannot read, write, or clearly understand banking procedures. Due to this limitation, many people depend on bank staff or strangers for assistance, which may lead to errors, privacy issues, insecurity, and financial fraud. The proposed system aims to overcome these challenges by introducing a smart, secure, and voice-guided banking solution that simplifies the transaction process and improves user accessibility. The system integrates voice recognition, face authentication, embedded processing, and IoT-based communication techniques to provide a reliable and user-friendly banking experience.*

Keywords: Voice, Banking, Slip Assistance,

I. INTRODUCTION

In today's digital age, banking services have become increasingly technology-driven, yet a significant portion of society, particularly illiterate, elderly, and visually impaired individuals, continues to face challenges in performing basic banking transactions independently [1], [4], [15]. Filling out deposit and withdrawal slips remains a major barrier for such users, often forcing them to rely on others for assistance. This not only creates dependency but also exposes them to privacy risks, errors, and potential fraud. Recent advances in voice biometrics, speech processing, artificial intelligence, and embedded systems have enabled the development of secure and accessible banking platforms [2], [3], [5], [8], [12].

The project "Banking Beyond Barriers: Voice-Guided Slip Assistance for All" aims to address this gap by introducing an innovative voice-assisted banking system that empowers users to complete transaction slips using simple voice commands. The system recognizes the user, retrieves account details, guides them through each step of the process, and securely prints the completed slip for submission. With integrated thumbprint verification, the solution ensures both convenience and security. Similar embedded and IoT-based approaches have demonstrated effectiveness in healthcare monitoring, wireless communication systems, and intelligent assistive technologies [7], [10], [16], [19], [20], [21], [22], [23].

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II. FLOWCHART

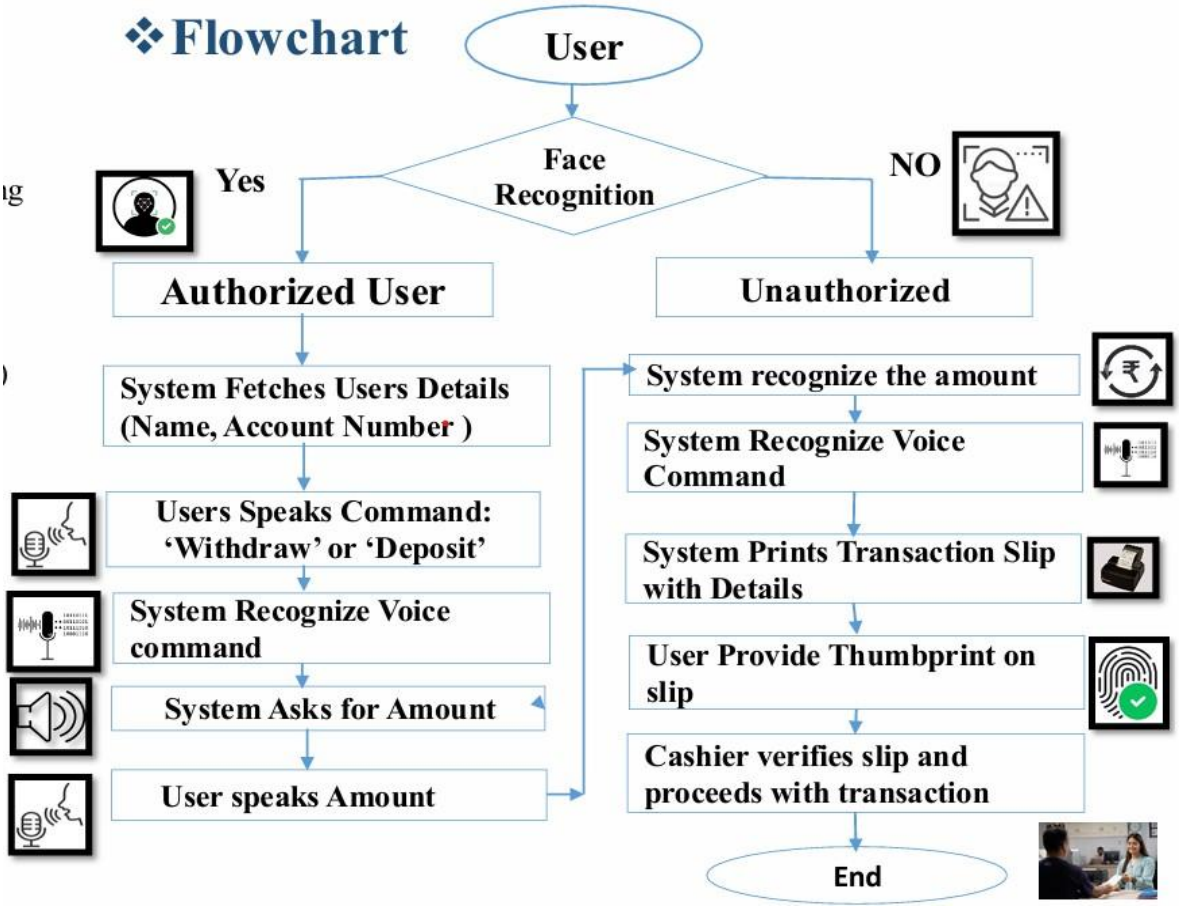

Figure : Flow Chart

The proposed Voice-Based Banking System is designed to provide secure and user-friendly banking transactions using face recognition and voice commands. The architecture combines biometric authentication, speech recognition, transaction processing, and embedded communication technologies [4], [6], [8], [13], [14], [19].

The process begins with user authentication through facial recognition. If the user is successfully identified, account information is retrieved from the database and voice interaction is initiated. Face recognition techniques and data fusion methods have demonstrated high reliability in secure user authentication systems [4], [14].

The user then selects a transaction type such as withdrawal or deposit through voice commands. Advanced speech processing and voice biometric technologies enable accurate command recognition and secure interaction [2], [3], [5], [12], [13].

After receiving the transaction amount through speech input, the system processes the request and generates a transaction slip. The use of embedded communication protocols and intelligent processing improves system reliability and performance [16], [17], [18], [19], [22], [23].

Thumbprint verification is incorporated as an additional security layer before transaction approval. Multi-factor authentication significantly enhances transaction security and minimizes fraudulent activities [3], [5], [8][21-186].

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1. User Authentication

- The process begins when a user approaches the system.
- The system performs Face Recognition to verify the identity of the user.

2. Authorized User Verification

- If the face is successfully recognized, the user is considered an Authorized User.
- The system retrieves the user's account information, such as Name and Account Number.

3. Transaction Selection

- The user gives a voice command such as “Withdraw” or “Deposit.”
- The system recognizes and processes the voice command.

4. Amount Entry

- The system asks the user to specify the transaction amount.
- The user speaks the required amount.
- The system converts the spoken amount into digital data and confirms the transaction details.

5. Transaction Processing

- The system recognizes the transaction amount and command.
- A transaction slip containing the transaction details is generated and printed.

6. Thumbprint Verification

- The user provides a thumbprint on the transaction slip as an additional security measure.

7. Cashier Verification

- The cashier verifies the transaction slip and thumbprint.
- After successful verification, the cashier completes the withdrawal or deposit transaction.

8. Unauthorized User

- If face recognition fails, the user is marked as Unauthorized, and access to banking services is denied.

9. End of Process

- After successful verification and transaction completion, the process ends.

III. CIRCUIT DIAGRAM

The hardware implementation of the Voice-Based Banking System consists of four major modules interfaced with the ESP32 microcontroller: a microphone module, speaker module, camera module, and thermal printer. The design follows IoT-enabled embedded system architecture principles similar to those adopted in healthcare monitoring and intelligent automation systems [7], [10], [16], [22].

The I2S Microphone Module (INMP441) captures voice commands and transfers digital audio data to the ESP32 for processing. Speech acquisition and processing techniques are widely used in intelligent voice-controlled systems [2], [12], [13].

The MAX98357A I2S Amplifier Module and speaker provide audio feedback to users, ensuring accessibility for visually impaired individuals. Such assistive voice-based interfaces improve usability and system interaction [1], [4], [20].

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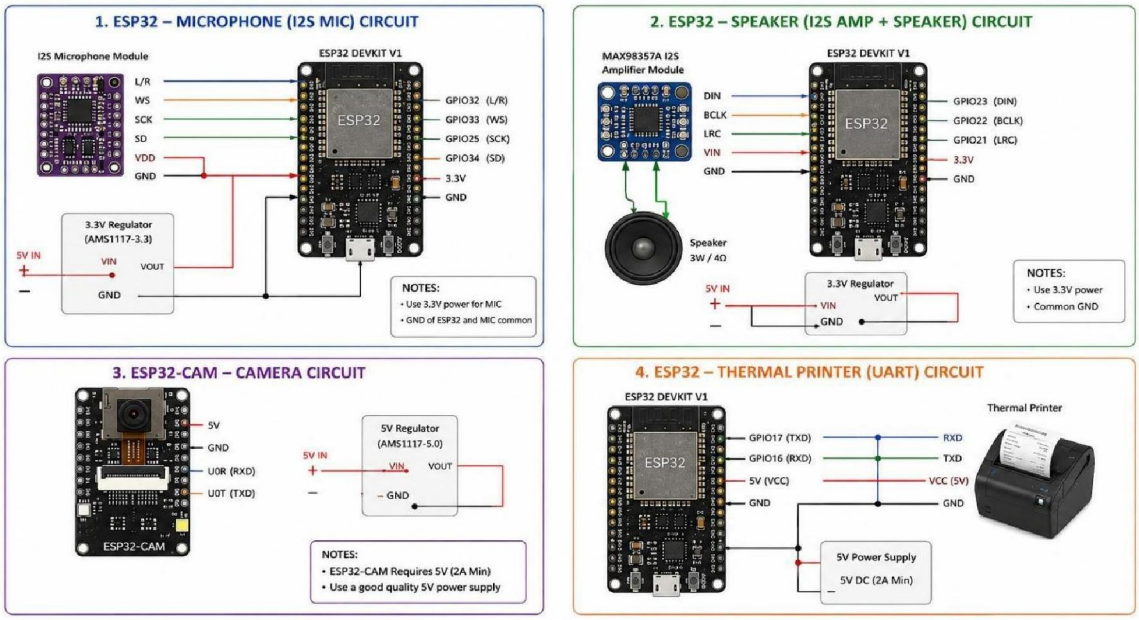

Figure: Circuit Diagram

The ESP32-CAM module performs facial recognition and user authentication. Face recognition algorithms combined with embedded processing platforms provide reliable identification and security in automated systems [4], [14], [19].

A thermal printer is interfaced with the ESP32 through UART communication for receipt generation. Efficient communication protocols and embedded system design methodologies contribute to reliable transaction processing [17], [18], [22], [23].

The ESP32 acts as the central controller, coordinating facial recognition, voice command processing, audio feedback generation, and receipt printing. The integration of IoT, wireless communication, and intelligent processing technologies enables a secure and accessible banking platform suitable for elderly, illiterate, and visually impaired users [7], [10], [16], [19], [22], [23],[25], [26].

IV. RESULT AND DISCUSSION

- The proposed Voice-Guided Banking Slip Assistance System is developed using a combination of hardware and software modules that work together to provide an accessible, secure, and intelligent banking experience for users. The architecture consists of the following key components:
- Voice Input Module: A high-quality microphone with noise and echo cancellation is used to capture clear voice commands from the user. Additional accessibility buttons, such as Help and Repeat, may be provided to assist elderly and visually impaired users. Voice-enabled assistive systems have been successfully implemented in intelligent human-computer interaction applications [2], [3], [13], [26].
- Speech Recognition and Natural Language Processing (NLP): Advanced speech processing technologies, such as OpenAI Whisper, Google Speech-to-Text, or the Bhashini platform, convert the user's spoken instructions into text. NLP algorithms analyze speech and identify the intended banking operation and transaction details [2], [3], [12], [13].
- Banking Middleware and Database Interface: A secure middleware layer communicates with the bank's Core Banking System (CBS) through APIs. This layer verifies account information, processes transaction requests, and ensures secure data exchange between the user interface and banking database. Secure communication

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architectures and protocol design approaches have been widely adopted in embedded and networked systems [17], [18], [22], [23].

- Text-to-Speech (TTS) Module: The system provides audio guidance using Text-to-Speech technology. Instructions, confirmations, warnings, and transaction details are converted into natural-sounding speech and delivered through a speaker or headphones, improving accessibility for visually impaired users [1], [4], [20].
- Transaction Database and Record Management: All transaction details and generated slip information are stored in a centralized database for efficient transaction management and retrieval. IoT-enabled data acquisition and monitoring systems demonstrate the effectiveness of centralized data management in real-time applications [10], [19], [22], [26].

Working Methodology

The Voice-Guided Banking Slip Assistance System operates through a user-friendly interactive process designed to simplify banking transactions for individuals with limited literacy or visual impairments.

1. System Initialization:

The user accesses the banking kiosk or voice-enabled banking terminal available at the bank branch.

2. Language Selection:

The system prompts the user to select a preferred language, such as English, Hindi, Marathi, or another regional language, using simple voice commands.

3. User Authentication:

The user is authenticated through facial recognition, voice biometrics, or account verification details. This ensures secure access to banking services.

4. Voice-Guided Slip Completion:

The system interactively asks questions required for transaction processing, such as:

- Transaction type (Deposit or Withdrawal)
- Account number
- Customer name
- Transaction amount

The user responds verbally, and the speech recognition engine converts the spoken information into digital text. The extracted information is automatically entered into the corresponding fields of the transaction slip.

5. Verification and Confirmation:

After collecting all required details, the system reads back the entered information through the speaker. The user verifies the information and confirms its correctness using a voice command.

6. Slip Generation and Printing:

Upon confirmation, the system generates the completed transaction slip and prints it using a thermal printer. The printed slip can then be submitted to the cashier for transaction processing.

7. Transaction Completion:

The cashier verifies the printed slip and customer authentication details. Once verified, the banking transaction is completed successfully.

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This architecture enables a secure, efficient, and user-friendly banking environment, reducing dependency on others and promoting financial inclusion for elderly, illiterate, and visually impaired individuals.

IV. CONCLUSION

The project "Banking Beyond Barriers – Voice Guided Slip Assistance" was developed with the aim of making banking services more accessible, secure, and user-friendly for illiterate, elderly, and visually impaired individuals. Traditional banking systems often require manual form filling and external assistance, creating challenges related to dependency, privacy, and transaction errors. The proposed system successfully addresses these issues by integrating voice guidance, speech recognition, biometric authentication, and automated slip generation into a single banking assistance platform.

The developed system enables users to perform deposit and withdrawal slip filling independently through simple voice commands while ensuring security through fingerprint verification. By automatically processing user input and generating accurate transaction slips, the system reduces human errors, saves time, and enhances overall banking efficiency. The project also promotes financial inclusion by empowering users who face difficulties with conventional banking procedures.

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