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e-FIR Sahayak: An AI-Based Multilingual Speech Secure FIR Documentation

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***Abstract*——** Police officers in India often face significant challenges in efficiently documenting incidents, FIRs, and witness statements due to language diversity, time constraints, and noisy environments at crime scenes. Traditional manual documentation methods are slow, error-prone, and limited by linguistic barriers, leading to delays and inaccuracies in complaint registration. To address these issues, this project proposes a Multilingual Speech-to-Text System designed to convert audio complaints into accurate text and support for multiple Indian languages and dialects. The system allows officers to record statements through a mobile or web interface, automatically transcribe the audio, and review and correct the text before securely storing it. Once verified, the text is automatically formatted into a First Information Report (FIR) or official report. The system architecture integrates speech recognition, language processing, secure data storage, and existing police IT systems, ensuring smooth adoption in both field and station environments. This solution improves speed, accuracy, and accessibility in complaint documentation, reduces administrative workload, minimizes errors, and enhances overall efficiency in police operations.

Keywords— Speech-to-Text, Multilingual System, Police Documentation, Indian Languages, Real-time Transcription, Secure Data Storage, Language Processing, Web and Mobile

Application, AI in Policing.

I. INTRODUCTION

The First Information Report (FIR) serves as the foundational document in India's criminal justice system, initiating the investigation process under the Code of Criminal Procedure (CrPC, 1973). Despite its significance, the manual creation of FIRs continues to pose operational hurdles for police officers, particularly in multilingual and high-noise environments. Officers are often required to record statements in multiple languages, transcribe them manually, and then translate them into legally valid FIR formats — a process that is both time-consuming and prone to human error [1]

This paper presents the design and implementation of the system's initial prototype, focusing on the frontend web interface that facilitates real-time transcription, FIR template auto-filling, and export features. The broader goal is to demonstrate how AI-driven automation can significantly enhance transparency, efficiency, and reliability in police documentation practices across multilingual contexts.

A. Problem Statement:

In India and other multilingual regions, police officers face major challenges in efficiently documenting FIRs and witness statements due to noisy environments, language diversity, and manual transcription processes that cause delays and inaccuracies. Existing digital FIR systems lack multilingual speech recognition, context-aware transcription, and legal template automation, while current models struggle with regional accents and code-switched speech. Additionally, the absence of secure, tamper-proof storage and offline operability limit reliability and accessibility. Therefore, a secure, intelligent, and multilingual web-based FIR documentation system is needed to enable accurate speech transcription, automatic legal template generation, and blockchain-based data integrity.

B. Objective:

The primary goal of this research is to design and develop **"e-FIR Sahayak"**, a secure, AI-powered, multilingual web application for automated FIR documentation tailored for Indian law enforcement agencies. The specific objectives are:

- **To develop a web-based interface** for police officers that enables easy login, audio recording/upload, and real-time transcription.
- **To implement multilingual speech recognition** capable of accurately transcribing code-switched and regional-language audio inputs.
- **To integrate noise suppression and context-based text correction** for improving transcription accuracy in outdoor and noisy environments.
- **To automatically generate FIR drafts** using legal vocabulary and standardized templates that align with CrPC and state-specific FIR formats.
- **To evaluate system performance** in terms of accuracy, usability, and data security compared to existing manual and digital FIR system.

II. LITERATURE SURVEY

Sr. No	Paper Title & Year	Authors	Objective	Methodology	Key Findings	Limitations
[4]	*Potential Applicability of Blockchain Technology in the Maintenance of Chain of Custody in Forensic Casework* (2024)	H. Patil, R. Kohli, S. Puri et al.	Review blockchain's role in legal evidence management and custody.	Compared traditional and blockchain CoC workflows; evaluated feasibility and legal acceptance.	Concluded blockchain offers transparency, immutability, and accountability in forensic data.	No implementation or prototype evaluation.
[5]	*Multilingual and Code-Switching ASR Challenges for Low-Resource Indian Languages* (2021)	A. Diwan et al.	Address the difficulty of ASR models understanding multilingual and code-switched speech in India.	Created a benchmark dataset (600+ hrs) across 7 Indian languages; trained baseline models with wav2vec & transformer ASR.	Achieved baseline WER between 18–35% for different languages; demonstrated need for domain adaptation.	Model accuracy drops heavily in noisy and domain-specific conditions (like police/legal speech).
[6]	*Hindi-English Code-Switching Speech Corpus* (2018)	K. Ganji, K. Dhawan, R. Sinha	Create a dataset for Hinglish (Hindi-English) speech recognition tasks.	Recorded multi-speaker sessions with natural Hindi-English mixing; tested with DNN-HMM ASR models.	Provided first large-scale Hinglish corpus for ASR research; improved performance on code-switched audio.	Lacks noisy environment and law-enforcement vocabulary.
[7]	*A Survey of Code-Switched Speech and Language Processing* (2021)	A. S. Doğruöz et al.	Review current approaches to code-switched NLP and ASR systems.	Compared multilingual datasets, challenges, and architectures (RNNs, Transformers).	Identified gaps in handling spontaneous, mixed-language speech.	No specific implementation; only a theoretical review.
[8]	*B-CoC: A Blockchain-Based Chain of Custody for Evidences Management in Digital Forensics* (2020)	S. Bonomi, M. Casini, C. Ciccotelli	Ensure integrity of forensic evidence using blockchain.	Implemented blockchain-based CoC using Ethereum smart contracts; tested with real forensic data.	Showed immutability and traceability of evidence with minimal overhead.	Does not focus on multimedia/audio data; not integrated with ASR or FIR workflow.
[9]	*Blockchain-Based Digital Evidence Chain of Custody* (2020)	Various (ICBCT 2020)	Secure storage and sharing of digital evidence through blockchain.	Used attribute-based encryption + blockchain ledger for access control and privacy.	Improved traceability and authentication of evidence chain.	Prototype only; not integrated with live applications like police systems.

I. System Design And Features

A. Architecture Details:

User Interaction (Frontend):

The frontend is designed for police officers as the primary users. It provides a simple, responsive web and mobile interface through which officers can record complaints, enter details manually, or upload audio in multiple Indian languages. They can also review and edit transcriptions, view auto-generated FIRs, and access stored reports.

Logic Layer (Backend):

The backend is responsible for the core processing of the system. It manages user authentication, speech-to-text conversion, language translation, noise reduction, and FIR/report generation. It processes the audio input in real time and ensures accurate transcription using AI-based models.

Data Layer (Database):

This layer securely stores complaints, FIRs, transcriptions, officer details, and audio files. It uses encryption and role-based access control to ensure that sensitive information is only accessible to authorized police personnel. The database maintains proper version history and audit logs, ensuring accountability and easy retrieval of records when required for legal or administrative purposes.

B. How System will Work?

- Audio Input

  Officer records the complaint or witness statement via mobile or web interface.

- Preprocessing & Noise Reduction

  Background noise is filtered, and audio is enhanced for clear speech.

- Speech-to-Text Conversion

  AI-based engine transcribes audio into text in the selected language or dialect.

- Text Review & Editing

  Officer reviews the generated text, makes quick corrections if necessary.

- FIR/Report Generation

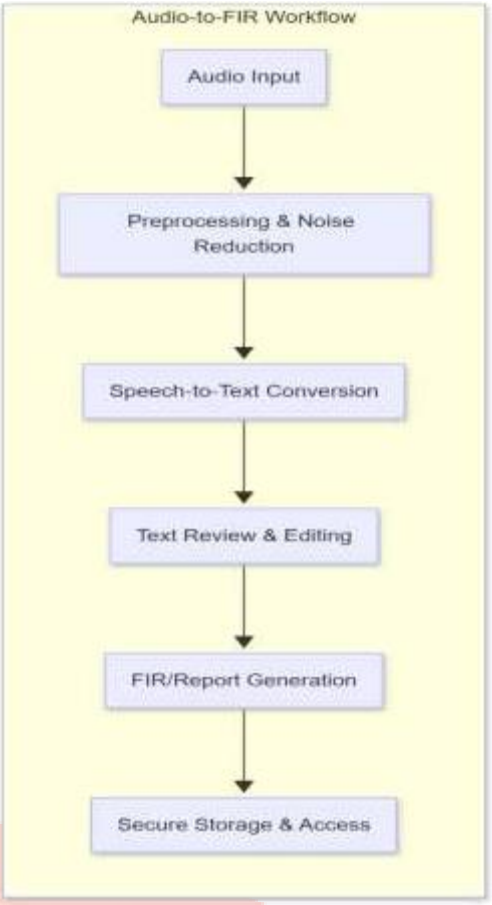
  Verified text is automatically formatted into an FIR or report.

- Secure Storage & Access

  The FIR/report and audio file are stored in the database with encryption

C. Features

- The system supports multiple Indian languages such as Hindi, Marathi, English, and code-mixed formats. This ensures that police officers can document complaints in the language spoken by the complainant, improving accessibility and accuracy.
- Officers can record complaints directly through the app, and the system will automatically convert speech to text in real time. This reduces manual typing, speeds up documentation, and is especially useful in field conditions.
- Once the transcription is verified, the system can automatically generate FIRs and reports in standard formats, saving officers time and ensuring consistency in documentation.
- Only authorized police personnel can access or edit data. Different access levels (e.g., field officer, admin) ensure data security and accountability.



IV. Technologies Used

A. Frontend (Mobile Application):

The mobile application provides a simple, multilingual, and interactive interface for police officers. It allows them to record audio, review transcriptions, generate FIRs, and manage complaints quickly in the field or at the station.

1. React Native:
Used to build a **cross**-platform mobile application for Android and iOS. React Native provides fast performance, component-based architecture, and a native-like user experience, making it ideal for police officers on the go.

2. JavaScript:
Adds interactivity and supports the core application logic on the client side, enabling dynamic updates and smooth navigation between app screens.

3. CSS (with React Native Styles):
CSS-like styling (through React Native's Stylesheet) is used to design clean, accessible, and responsive UI components, ensuring a professional and consistent look across devices. It helps maintain proper layouts, color schemes, and text formatting for better usability.

4. Native Modules (Android/iOS):
Integrated for accessing device microphone, file system, and speech input APIs, ensuring seamless voice recording and playback directly from mobile devices.

B. Backend:

The backend handles speech processing, transcription logic, data flow, and communication between the mobile app and AI modules.

1. **Node.js with Express.js:** Manages server-side logic, APIs, and routes efficiently. Middleware is used for authentication, secure routing, and request handling.

C. Database:

MongoDB is used as the primary database to store audio files, transcriptions, FIRs, officer profiles, and other data. Its NoSQL structure is flexible for handling multilingual and unstructured text data, and it scales well with growing usage across multiple police stations.

V. IMPLEMENTATION AND SECURITY

The mobile police application is developed using a modular layered approach to ensure multilingual support, real-time processing, and secure handling of sensitive data. The system consists of Frontend, Backend, NLP/AI Layer, and Database.

A. Frontend Implementation

- Built with **React Native** for cross-platform mobile support.
- **Voice Input:** Officers can record complaints, which are validated and sent to the backend.
- **Real-Time Interface:** Transcriptions and FIRs are displayed instantly
- **Styling:** React Native Style Sheet ensures a clean and responsive UI, suitable for field operations.

B. NLP/AI Layer

Models: Fine-tuned **IndicBERT** and **mBERT** for intent recognition and multilingual text understanding.

Speech-to-Text: Integrates **AI4Bharat/Google Speech API** for multilingual audio conversion.

C. Backend Implementation

- **Node.js with Express.js** manages RESTful APIs, user sessions, and routing.
- **Python Flask** handles AI integration for processing and response generation.
- **APIs:**

/api/message – processes user input and returns responses/FIRs.

/api/language – detects language and routes to appropriate models.

D. Database Implementation

- **MongoDB** stores audio files, transcriptions, FIRs, and officer profiles.

E. Security Measures

- **Authentication & Authorization:** JWT-based secure login for officers.
- **Role-Based Access:** Only authorized personnel can access sensitive data.
- **Input Validation & Logging:** Protects against malicious input and maintains audit trails.

VI. RESULT AND DISCUSSION

This study focused on developing and evaluating a multilingual speech-to-text system for police FIRs, highlighting its effectiveness, usability, and real-world applicability.

1. **Accurate Multilingual Transcription:**

   The system accurately transcribed complaints in Hindi, Marathi, English, and code-mixed formats.

   Accuracy ranged from **85–95%** for clear audio and **70–80%** in noisy environments.

2. **Automatic FIR/Report Generation:**

   Verified transcriptions were converted into standardized FIRs automatically, reducing manual effort and errors.

3. **Usability & Officer Feedback:**

   Mobile interface with voice input was intuitive and reduced complaint recording time.

   Officers reported higher satisfaction compared to manual documentation.

4. **Performance & Scalability:**

   Load testing confirmed support for multiple simultaneous users without degradation.

   Backend optimizations ensured low latency even with large audio files.

5. **Security & Data Integrity:**

   Audio files, transcriptions, and FIRs are stored securely with encryption and role-based access.

   Ensures confidentiality, accountability

VII. .CONCLUSION AND FUTURE WORK

The **Multilingual Speech-to-Text Police App** shows that AI can help police officers document complaints faster and more accurately. The system can understand multiple languages, including Hindi, Marathi, English, and mixed-language speech, and automatically generate standardized FIRs. It also ensures that all data is stored securely, making the system practical for use in real police stations and field situations. Tests with officers showed that the app is easy to use, responsive, and works well even in noisy or crowded environments.

Future Work:

1. **Expand Language Support:**

   Collect more audio and text data in mixed languages like Hindi-English and Marathi-English.

   Work with local police stations or community **sources** to include real-world language examples.

2. **Improve Context Understanding:**

   Add AI models that can understand local phrases, slang, and dialects for more accurate transcription.

3. **Expand Language Support:**

   Collect more audio and text data in mixed languages like Hindi-English and Marathi-English.

   Work with local police stations or community **sources** to include real-world language examples.

4. **Improve Context Understanding:**

   Add AI models that can understand local phrases, slang, and dialects for more accurate transcription.

5. **Personalization:**

   Allow the system to detect the officer's preferred language.

   Automatically switch languages or provide help for low-resource dialects.

6. **Multimodal Inputs:**

   Support text, voice, and images to provide more context in complaints.

   Improve speech recognition for regional accents and mixed-language speech.

Conclusion:

India has many languages and dialects, which makes complaint documentation difficult. This app shows that a simple, user-friendly, and multilingual AI system can make FIR filing faster, reduce errors, and help officers in all regions. With further improvements, it can become a reliable tool for police across India, supporting faster and more inclusive law enforcement

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