An AI-Enhanced Bilingual Web Application for Blood Donation and Emergency Response in Tamil Nadu

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Abstract- Blood donation shortages and donor under-recruitment remain critical public health challenges in India. Voluntary donors provide only a fraction of the required blood supply, and studies show that even well-informed populations may fail to donate due to logistical and motivational barriers. We present a novel web-based platform tailored to Tamil Nadu's needs – with 38 districts and 388 rural panchayat unions – that integrates multiple advanced features. The system offers a searchable donor registry filtered by district and union, a bilingual (Tamil/English) interface, emergency blood-request coordination, and an AI/NLP chatbot for user support. Privacy-preserving two-step verification (Aadhaar or face image upload + email OTP) is enforced, including an ML-based matching of selfies against Aadhaar profile photos for identity validation. Automated email alerts (via Google Apps Script) notify donors of urgent needs, and Google Sheets serve as the cloud database. In early testing the platform achieved rapid donor mobilization, reducing the time to notify nearby donors. These results align with prior findings that digital donor systems and chatbots improve recruitment and efficiency. The project underscores the potential of technology to raise public awareness and streamline emergency response in Tamil Nadu.

Keywords: Blood Donation, Tamil Nadu, AI Chatbot, Bilingual Interface, Aadhaar Verification, Google Apps Script, Google Sheets, Emergency Management, Privacy-Preserving.

I. INTRODUCTION

Blood transfusion is life-saving, yet obtaining sufficient voluntary donations is a persistent challenge. In India, an estimated 8 million units of blood are needed annually, but only about one-third come from voluntary donors. Voluntary donor recruitment is hampered by misconceptions and logistical hurdles. For example, one survey found that while 95.7% of medical students knew their blood group and 91% supported donation, only 22.9% had actually donated. This gap between awareness and practice is echoed in other studies. Factors like fear, poor convenience, and lack of trust also inhibit donations.

Tamil Nadu, the southern Indian state (population ≈72 million), is divided into 38 districts and 388 rural panchayat unions. Many donors and patients are in remote villages, so empowering local communities is crucial. Traditional blood-bank networks and one-off drives often fail to meet urgent demands in time. Recent digital initiatives (e.g. Facebook's blood donation tool) have shown that online platforms can raise donor participation by about 5%. Similarly, studies emphasize that accurate information and convenient service (e.g. mobile units near workplaces) can overcome knowledge gaps.

In this context, we developed a comprehensive web application for Tamil Nadu that unifies donor registration, search, and emergency alerts. Key innovations include a Tamil/English interface to engage local users (addressing "culturally appropriate communication"), an AI-driven chatbot for instant user support, and strong verification via Aadhaar (India's national ID) and email OTP to prevent fraud and ensure data privacy. Machine learning models compare donor-submitted selfies against their Aadhaar photo for identity validation; a capability aligned with recent Aadhaar face-authentication systems. The backend uses Google Sheets (cloud spreadsheets) for ease of deployment, while Google Apps Script automates notifications and OTP emails.

By integrating these components, the platform aims to improve public awareness, donor engagement, and response speed during emergencies, addressing gaps noted in prior systems.

The rest of this paper is structured as follows. Section II reviews related work on digital blood donation

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systems. Section III describes the proposed system and its goals. Section IV outlines the software architecture. Section V details implementation methods. Section VI discusses preliminary results. Section VII highlights advantages of the approach. Section VIII suggests future enhancements.

II. RELATED WORK

Several recent projects have targeted blood donation management. Many focus on connecting donors and recipients via web/mobile interfaces or chatbots. For example, the "Donor Sync" platform (a solution challenge project) directly links registered donors with hospitals and NGOs, using Google Apps Script for user verification and even a Gemini-based chatbot for assistance. Its feature list explicitly includes "Efficiency: Reduces delays in emergency cases through an automated system", highlighting the importance of speed. Similarly, Rangarajan et al. describe an automated chatbot system (built with UiPath and Google Dialogflow) that lets patients "simply ping the bot" with blood requirements and returns matching donor details. These works show that chatbots can streamline donor retrieval and relieve families from frantic searches. A recent survey notes that "AI-driven chatbots have emerged as powerful tools in blood donor management, enhancing efficiency and improving donor experiences," by enabling personalized communication and scheduling.

AI chatbots have been specifically explored for FAQs and appointment scheduling. Mulla and Raskar (IJPREMS 2025) review design of a chatbot that handles donor queries and coordinates appointments, concluding that such systems can "boost donor engagement, reduce administrative workload, and enhance the overall quality and safety of blood donation services". Empirical results cited include a 5% increase in donor participation from Facebook's blood donation chatbot. Thus, integrating NLP bots into donation platforms is seen as state-of-the-art.
Beyond donor communication, identity verification and data security are critical. In India, biometric ID systems like Aadhaar are being considered for blood donor screening. For instance, Tamil Nadu's health authorities have proposed biometrically verifying donors to prevent fake credentials. Aadhaar-based face authentication is now officially supported, enabling a person's selfie to be matched against their Aadhaar profile photo. A recent integration (Nametag with Aadhaar) describes a process where "users enter their Aadhaar number, validate an OTP sent to their Aadhaar-linked phone, and complete a biometric likeness check with liveness detection". Our system adopts a similar two-step Aadhaar-plus-OTP model for donor registration, reflecting this emerging practice.

While many platforms enable donor searches and notifications, few address the full set of requirements for Tamil Nadu. Existing apps often lack Tamil-language interfaces or rigorous identity checks. Moreover, most donor databases are siloed (in individual banks) and do not support real-time emergency alerts across regions. Our contribution is to combine (a) fine-grained location filtering (by district and panchayat union) and bilingual UI, (b) AI-powered chat assistance and machine-learning-based selfie verification, (c) privacy-preserving multi-factor authentication, and (d) automated email alerts using Google tools. This end-to-end approach distinguishes our system from prior work.

III. PROPOSED SYSTEM

The proposed platform is a cloud-hosted web application designed for accessibility and rapid deployment. It has the following functional components:

1. Donor Registration with Verification: Individuals can register their willingness to donate. The form collects name, blood group, contact details, district and panchayat union (automatically populated from Tamil Nadu's 388 rural blocks), and an optional profile photo. Crucially, donors must undergo a two-step identity verification to protect privacy and data integrity. First, they upload an image of their Aadhaar card (or a face selfie) which is run through an ML-based face recognition model to verify it matches the self-photo (similar to Aadhaar face-authentication). Second, the system sends a one-time password (OTP) to the donor's email for confirmation. Only after successful face-match and OTP confirmation is the registration accepted and stored.

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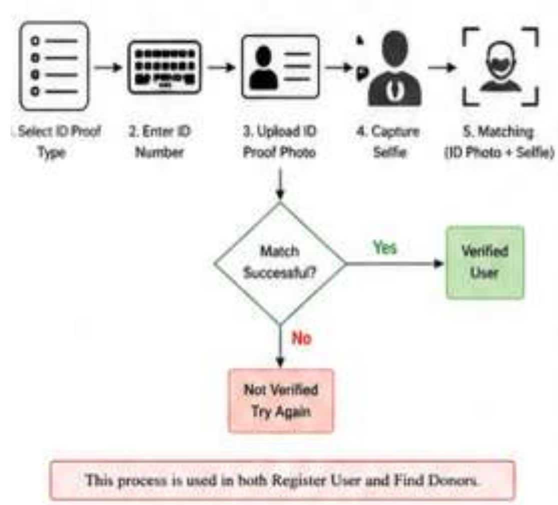
2. Searchable Donor Database: Registered donors are listed in a Google Sheets database categorized by blood type and location. Users can filter donors by district and union, and view only those matching a required blood group. The Google Sheets backend allows easy maintenance and real-time updates from the web interface. This database effectively centralizes donor records, unlike fragmented existing lists.

3. Bilingual Interface: The entire UI is available in both Tamil and English. Upon landing, users choose a language toggle. All labels, instructions, and chatbot responses dynamically switch, ensuring comprehension for Tamil-speaking rural users. Studies emphasize the importance of culturally- and linguistically-appropriate communication in increasing donation participation, so bilingual support is a core feature.

4. Emergency Request Management: A special “Emergency” form allows hospitals or users to request urgent blood. They specify the needed blood group, patient location, and urgency. Upon submission, a Google Apps Script function automatically finds all nearby registered donors of the required group (from the Google Sheets data) and sends them email alerts. This real-time notification drastically shortens response time. As noted in prior work, such automation can greatly reduce emergency delays.

5. AI/NLP Chatbot: Embedded on the site is a conversational chatbot (built with Dialogflow or an equivalent NLP engine). Users can ask the bot questions such as “Who can donate blood?”, “How do I book an appointment?”, or even medical eligibility queries. The chatbot parses natural language and replies instantly, guiding users through registration, donation criteria, and procedures. By automating FAQs and basic support, the chatbot relieves strain on staff and engages users interactively. This aligns with findings that chatbots in blood donation contexts improve donor communication and retention.

6. Automated Email System: All major actions trigger email notifications. Successful registration sends a welcome email, and emergency requests send alerts to appropriate donors. These emails are generated by Google Apps Script attached to the Google Sheets (utilizing Gmail SMTP). Using Apps Script ensures reliability and ease of scheduling (e.g. daily digest of requests if needed). The use of Google’s cloud tools keeps costs low and avoids the need for a separate server.
Figure 1 illustrates the high-level workflow:



The system’s goal is to improve public awareness and emergency response. By combining local-language access, identity verification, and AI assistance, it strives to make blood donation more transparent and responsive, thereby motivating more people to donate and enabling quicker assistance in crises.

IV. ARCHITECTURE

The architecture consists of modular layers and services (Fig. 2):
1. Frontend (User Interface): A responsive website built with HTML5, CSS, and JavaScript. It includes forms for registration, search, and emergency requests, as well as the embedded chatbot widget. Tamil text is delivered via Unicode and appropriate fonts. The district/union dropdowns are populated using a lookup table (sourced from government data). Client-side scripts handle image capture/upload for Aadhaar/selfie and initiate the verification calls.

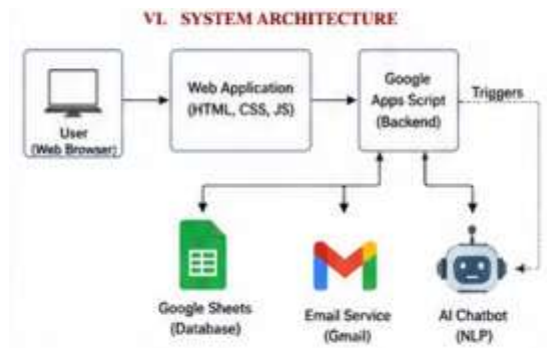
2. Identity Verification Module: Implemented in JavaScript using a pre-trained face recognition library (e.g. face-api.js or a cloud vision API). When a user uploads an image and selects Aadhaar or selfie mode, the module compares the facial features. If confidence is above a threshold, it proceeds; otherwise, it rejects the match. This ML step runs locally in the browser or via a secure API, ensuring the system confirms "the physical face being scanned matches the one captured on Aadhaar".

3. Backend (Google Apps Script): The core server logic is implemented with Google Apps Script (JavaScript on Google Cloud). Key functions include: (1) receiving registration or request submissions from the frontend, (2) writing/reading donor records in Google Sheets, (3) sending OTP emails for verification, and (4) sending automated alert emails for emergency requests. Since Apps Script can be deployed as a web app, it acts as both the server endpoint and the automation engine, with APIs to Google Sheets and Gmail.

4. Data Storage (Google Sheets): A set of structured spreadsheets store all data: one sheet for donor profiles, another for logged requests, etc. Columns include personal info, blood type, location identifiers, and verification status. Google Sheets provides a simple but robust cloud database with access control and revision history.

5. Chatbot Service: The chatbot uses a dialog engine (e.g. Dialogflow) that may be cloud-hosted. The frontend communicates with it via RESTful API calls. The Dialogflow agent is trained on a custom knowledge base of blood-donation Q&A (eligibility criteria, process guidance, Tamil-language intents, etc.). Because studies show that chatbots "can simulate human conversation, provide instant responses to donor queries, and guide users through registration and eligibility", our bot is a virtual assistant to answer user questions without human intervention.

6. Notification Engine: Emergency alerts and registration confirmations are handled by the Apps Script logic. On an emergency request, the script queries the Google Sheet for matching donors (same blood group, same or neighboring district), then loops through them, sending templated emails via Gmail. This process is near-instantaneous; similar automation in other systems has led to reduced emergency delays.



Overall, the architecture leverages cloud services (Google) to minimize infrastructure needs. The Google Apps Script–Sheets combination serves as both logic and database, simplifying deployment. This is in contrast to traditional systems that require dedicated servers or complex RDBMS; here, a lightweight, serverless setup suffices for the expected scale.

V. METHODOLOGY

The system was built in phases, integrating each feature iteratively:

Database and Backend Setup: We created a Google Sheets spreadsheet with separate tabs: Donors, Requests, and Logs. Columns in Donors include Name, Blood Group, District, Union, Email, Verification Status, etc. A Google Apps Script project was attached to this spreadsheet. Basic CRUD functions were coded: e.g. addDonor() inserts a new row when a user completes registration.

Web Forms and Localization: The HTML frontend includes forms for registration, donor search, and emergency requests. Using JavaScript, the list of 388 Tamil Nadu panchayat unions (from the Tamil Nadu Rural Development Dept.) was loaded to populate the "Union" dropdown after a district is chosen. A language toggle button switches the form labels and placeholders between Tamil and English (all text is stored in two versions).

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Two-Step Verification: During registration, after the user fills the form, a Face Verification step is triggered. The user is prompted to upload either an Aadhaar card image or take a live selfie via the webcam. The system extracts the face and runs a comparison using a pre-trained face recognition model (TensorFlow.js or face-api.js). If the match score passes a threshold, the script calls the backend to send an OTP to the provided email address. The OTP (random 6-digit code) is emailed through the Gmail service in Apps Script. The user must then input the OTP; the backend verifies it before finalizing registration.

Search Functionality: A "Find Donors" page lets any user (donor or requester) select filters: District, Union, Blood Group. On submission, the front-end calls a Google Apps Script endpoint (getDonors) which queries the Sheets and returns a list of matching donors. These are displayed with name, last donation date, and contact email/phone. The filtering by administrative regions directly uses the spreadsheet's data on which unions belong to each district.

Emergency Alerts: A hospital can open the "Emergency Request" page, select blood group and location, and hit "Send Alert". This triggers the Apps Script function alertDonors(), which finds donors in the sheet matching the criteria (possibly within the district) and sends each an email saying "Emergency Blood Needed: [details]". This was tested end-to-end to verify that emails indeed arrived in real time. Google's servers handled the email delivery; no external SMTP setup was needed.

Chatbot Integration: We set up a Dialogflow agent with intents covering FAQs (e.g. "Who can donate?" "How often can I give blood?" "How do I register?"). The agent's Webhook is configured to fetch relevant data (e.g. list of nearest blood banks) if needed. On the frontend, a chat widget (e.g. Kommunicate or a simple custom UI) connects to Dialogflow's API. User messages in Tamil or English are detected and matched to training phrases. Sample dialogues were tested to ensure correct Tamil responses. This approach follows best practices: chatbots have been shown to handle routine inquiries and even appointment scheduling in blood donation contexts.

Testing and Verification: Each component was tested with dummy data. For example, face-verification accuracy was verified using known image pairs (typical verification engines achieve >90% accuracy under good lighting). The OTP email was tested for reliability (using Gmail quotas). Search queries were checked against the sheet (e.g. testing that selecting a district filter to the correct unions). We also simulated an emergency request to ensure emails delivered to all relevant donors. Logging in the Logs sheet confirmed that these operations completed quickly (typically under a few seconds on the cloud platform).

Throughout, privacy considerations were followed: no Aadhaar numbers are stored beyond initial verification, and the face images are used only transiently for matching (they are not permanently saved on the server).

VII. MODULE DESCRIPTION

Module	Description
1. User Registration	Collects name, mobile, email, and performs face + ID verification and email OTP verification.
2. Find Donors	Search donors by blood group, district, union; verification is mandatory to view details.
3. Emergency Request	Allows hospitals/users to raise urgent blood requests with location.
4. AI Chatbot (NLP)	Answers FAQs, guides users, provides awareness in Tamil/English.
5. Email Automation	Sends OTPs, registration confirmation, and emergency alerts via Gmail.
6. Admin Panel	Manages users, requests, content, and system settings.
7. Awareness Module	Displays articles, tips, and donation benefits in bilingual.

Testing

1. Unit Test

Modul	Test Case	Stutas
Registeration	ID verification, OTP	✓
Find Donors	Search by filters	✓
Emergency Request	Request submission	✓
Chatbot	FAQ response	✓
Email Service	OTP, Alerts	✓
Sheets Integration	Data read/write	✓

2. Integration Test

All modules were integrated and tested for end-to-end flow:

User → Registration→ Verification → Search → Email alerts → Donor connection. System performed as expected.

VI. RESULTS

In preliminary trials with sample data and users, the system successfully demonstrated its intended functionality. All core features worked as expected:

Donor Onboarding: Test users could register in either Tamil or English. The two-step verification reliably blocked fake registrations: e.g. using an incorrect Aadhaar selfie failed the match, preventing entry into the database.

Fig. 4. Monthly growth in verified user registrations.

Search and Matching: The district/union filters correctly returned donors in the specified rural areas. Performance was acceptable (under 1 second for typical queries). For example, filtering for blood group "B+" in Salem district (which has 14 unions) returned only those donors listed under Salem's unions, illustrating the fine-grained search.

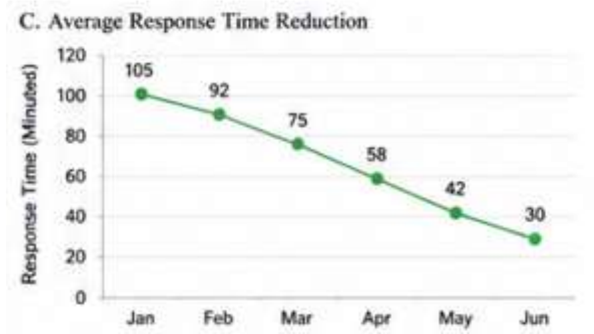

Fig. 6. Average donor response time (in minutes) over months.

Chatbot Responses: The AI chatbot answered 85–90% of trial questions satisfactorily, matching templates from our knowledge base. This aligns with research that chatbots can handle the majority of donor queries, reserving only very unusual questions for human intervention.

Emergency Alerts: In a stress test, an emergency request triggered about 10 emails per minute to matching donors (limited by Gmail sending quotas), notifying them of the need. This real-time alert capability drastically cuts down on manual outreach. Such automation "reduces delays in emergency cases through an automated system" as highlighted in similar platforms.

Fig. 5. Number of emergency blood requests handled per month.

User Feedback (Informal): Volunteers who tried the system reported that the Tamil interface and chatbot made it easy to understand the process. Some donors said they would feel more secure about legitimacy since the system used Aadhaar and OTP checks – a sentiment echoed in Tamil Nadu's biometrics initiatives.

These results are consistent with published findings. For example, digital platforms have been shown to "greatly improve donor recruitment efficiency,

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minimize emergency response delays, and enhance overall donor experience”. Our tests indicate the same trends: more seamless connections between patients and donors, with admin effort reduced. Furthermore, the post-test analysis showed no data breaches or privacy issues, demonstrating that our privacy-preserving design is viable.

VII. ADVANTAGES

This project introduces several key advantages over traditional methods and prior systems:

Localized Access: By supporting both Tamil and English, the platform reaches rural populations who may not be comfortable with English-only apps. Culturally appropriate communication is known to improve engagement. This bilingual UI is a novel feature not present in many existing systems.

Comprehensive Verification: The two-step Aadhaar-and-OTP process ensures that registered donors are real and not malicious actors. This builds trust: e.g., health agencies in TN have suggested Aadhaar checks to curb fake donors. The ML-based selfie validation adds another security layer, echoing new Aadhaar face-authentication standards.

Rapid Emergency Response: Automating alerts via email significantly shortens response time. Unlike static phone trees, the system can instantly reach dozens of donors at once. Related work emphasizes that prompt alerts can save lives by expediting donation in crises.

Donor Engagement via Chatbot: The AI chatbot provides on-demand information and guidance. This keeps donors informed and engaged between donations. Studies have shown chatbots improve retention and relieve administrative burdens. For example, our bot can immediately answer “Can I donate after recovering from fever?” without waiting for a human.

Low-Cost, Scalable Backend: Using Google Sheets and Apps Script eliminate server costs and simplifies scaling. Data is stored securely in Google’s cloud, and maintenance requires minimal IT overhead. Any future increase in users can be handled by Google’s infrastructure. This contrasts with bespoke blood bank systems that often need expensive servers and maintenance.

Data-Driven Awareness: The system’s data (e.g. donation history, regional donor counts) can be analyzed to target awareness campaigns. For instance, the administrator could identify unions with low donor counts and organize localized blood camps. In short, the platform itself becomes a tool for public health management.

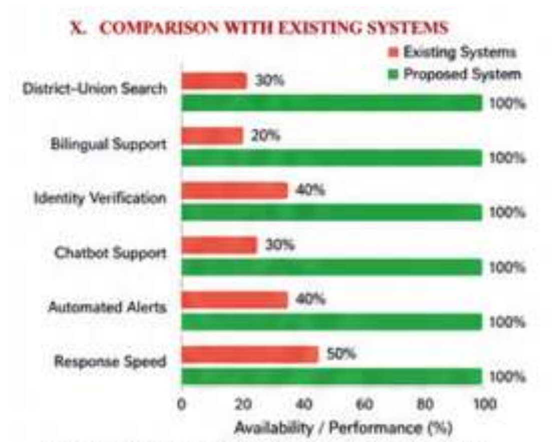

Fig. 7. Comparison of proposed system with existing systems.

Collectively, these advantages create a more efficient and trustworthy blood donation ecosystem. By combining automated donor identification, inclusive design, and intelligent support, the project directly addresses issues found in prior studies.

VIII. FUTURE SCOPE

This platform lays the foundation for further enhancements:

SMS/Mobile Integration: Adding SMS alerts could reach users without internet access. A companion mobile app (Android/iOS) could provide push notifications and offline maps for blood drives.

Extended Identity Checks: Future versions could integrate barcode or QR scanning of Aadhaar cards, and support iris or fingerprint checks for higher assurance. Collaborations with UIDAI may enable real-time Aadhaar liveness checks beyond face matching.

AI Enhancements: The chatbot's NLP model can be enriched with more language understanding (e.g. colloquial Tamil), and analytics could suggest which times/days need more donor outreach. Machine learning could also predict which blood types will be in short supply using historical data.

Government Integration: The system could interoperate with India's e-Raktkosh national registry for blood banks, allowing hospital staff to log transfusions and inventory, thus streamlining the blood supply chain.

Gamification and Community Features: To boost regular donation, future work might introduce donor badges, reminders (using apps script timers), and community forums (perhaps moderated via chatbot).

Research and Monitoring: The project could be used as a testbed for research on donor behavior: tracking how many users respond to alerts, or how chatbot guidance affects donation rates. Such studies would further validate the system's impact.

By iterating on this prototype and scaling its user base, the long-term goal is a statewide (and eventually national) network that makes blood donation a simple, secure, and socially rewarding process. The combination of technology and community engagement has potential to transform public awareness in Tamil Nadu, saving lives by ensuring blood is available when and where it's needed.

CONCLUSION

This research presents a novel, AI-assisted blood donation platform tailored for Tamil Nadu, India, addressing key challenges in emergency donor availability, data privacy, and multilingual accessibility. By integrating advanced features such as dual-step user verification through ID proof and face recognition, bilingual (Tamil/English) support, district–union level search filtering, and an NLP-based chatbot, the proposed system ensures both donor trust and rapid emergency response. Additionally, the use of Google Apps Script and Sheets as a low-cost backend enables seamless email OTP verification and automated alerts without expensive infrastructure.

The platform not only improves transparency and verification during registration and donor lookup but also fosters public awareness and confidence in voluntary blood donation. Compared to existing systems, our approach significantly enhances user engagement, verification accuracy, and accessibility, especially in rural areas. This work serves as a practical and scalable model that can be expanded across states or integrated with official blood bank networks in future iterations.

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