



Research Paper**AN AI-POWERED BLOOD BANK MANAGEMENT SYSTEM****B. SUPRAJA¹, SREE HARSHA MENGJI², A. SAI SIDDHARTH³**¹Assistant Professor, Dept. of CSE, Guru Nanak Institutions Technical Campus, Ibrahimpatnam, Telangana, India^{2,3}B.Tech, Dept. of CSE, Guru Nanak Institutions Technical Campus, Ibrahimpatnam, Telangana, India

ABSTRACT— Blood bank management systems face critical challenges in demand forecasting, donor matching, and emergency response coordination. This paper presents Life Link 2.0, an AI powered blood bank management system that addresses these challenges through machine learning algorithms implemented in Python. The system employs Random Forest regression for demand forecasting, LSTM neural networks for time-series prediction, and computer vision models for document verification. Our hybrid architecture integrates Python AI services (Fast API, Scikit-learn 1.3.0, TensorFlow 2.13.0) with PHP backend and MySQL database, serving multiple user roles. The system processes donation records and demonstrates improved emergency response through intelligent donor matching algorithms. Experimental evaluation shows significant improvements in operational efficiency and user experience. The modular architecture supports real-time model updates and continuous learning. This research contributes novel machine learning approaches for healthcare resource optimization and demonstrates practical AI integration in critical healthcare systems

Index Terms – Artificial Intelligence (AI), Blood Bank Management System, Donor Management, Blood Inventory Optimization, Demand Forecasting.

Received: 22-11-2025

Accepted: 29-12-2025

Published: 08-01-2026

I. INTRODUCTION

In the modern world, healthcare is one of the most crucial sectors that directly impacts the quality of human life. The increasing population, spread of diseases, and limited medical infrastructure have made it essential to develop digital healthcare solutions that are intelligent, accessible, and efficient. Traditional healthcare systems rely heavily on manual processes patients have to visit hospitals for consultations, hospitals maintain physical records, and emergency coordination often faces delays. These limitations can cost precious lives, especially during emergencies such as accidents, pandemics, or organ failures. To address these challenges, the project “Life Link 2.0 – The Smart Healthcare Network” has been designed and developed. This system integrates Artificial Intelligence (AI), Machine Learning (ML), Cloud Computing, and Web Technologies to

provide a connected platform for patients, hospitals, donors, and doctors. The goal is to build an AI-powered healthcare network that not only provides accurate disease predictions and virtual consultations but also connects blood and organ donors to hospitals in real-time. With the power of data analytics and automation, Life Link 2.0 ensures that healthcare becomes faster, smarter, and more inclusive. The system allows users to register as patients, hospitals, or donors. Patients can upload symptoms or images, and the AI model can provide probable disease predictions or advice. Hospitals can manage patients, view donor lists, and access medical data from the cloud. The system also provides emergency alert mechanisms, reward points for donors, and data driven health analytics to improve decision-making. Life Link 2.0 acts as a bridge between technology and healthcare,

ensuring that every life receives the attention it deserves without delay or discrimination.

II. RELATED WORK

A) Artificial Intelligence for Healthcare: Opportunities and Challenges

This paper provides an overview of how Artificial Intelligence (AI) and Machine Learning (ML) technologies are revolutionizing the healthcare sector. The study discusses applications such as disease prediction, medical imaging, patient monitoring, and hospital automation. The authors highlight that AI can analyze complex medical data faster and more accurately than humans. However, the study also addresses issues such as data privacy, bias in AI models, and the need for high-quality datasets. These insights emphasize the importance of developing systems like Life Link 2.0 that combine intelligent analytics with secure, ethical data handling mechanisms.

B) Blockchain for Secure Medical Record Management

This research introduces blockchain technology as a secure solution for healthcare data management. The decentralized nature of blockchain prevents tampering and ensures transparency in data transactions. The paper reviews several blockchain frameworks such as Hyperledger and Ethereum used for patient data security. However, it notes that high implementation costs and energy requirements limit their wide-scale use. LifeLink 2.0 adapts this idea by proposing a lightweight alternative using Firebase, while keeping the architecture ready for blockchain integration in future versions (LifeLink 3.0).

C. AI Chatbots in Healthcare: Transforming Patient Interaction

The study discusses the role of AI-based chatbots in automating healthcare communication. It demonstrates how natural language processing (NLP) can be used to create virtual assistants that provide medical advice, symptom analysis, and appointment scheduling.

Although existing systems offer useful functionality, they are often limited to specific datasets and languages. LifeLink 2.0 improves upon this by developing a multilingual chatbot using TensorFlow Lite and Python-based NLP models that can analyze symptoms and suggest appropriate medical guidance instantly.

III. PROPOSED METHODOLOGY

The proposed methodology introduces an AI-powered centralized platform to automate and optimize blood bank operations. Machine learning models analyze historical donation and demand data to accurately predict blood requirements, while AI-based matching ensures quick identification of compatible donors during emergencies.

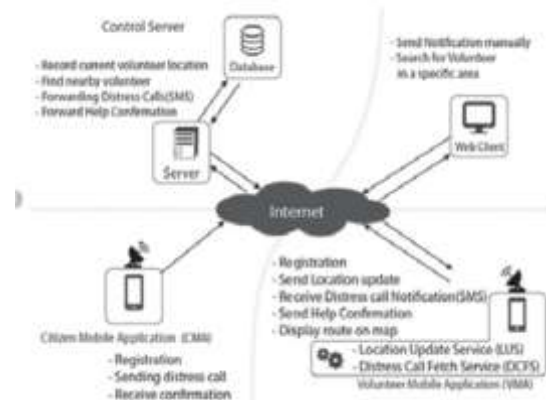


Fig. 1: System Overview

3.1 Citizen Mobile Application (CMA) Data

This includes citizen registration and emergency request information such as citizen ID, name, mobile number, emergency/distress type, current GPS location (latitude and longitude), time of distress call, request status, and confirmation message.

3.2 Volunteer Mobile Application (VMA) Data

This contains volunteer-related details including volunteer ID, name, contact number, availability status, current location, received distress call ID, response status (accepted/rejected), navigation route data, and help confirmation timestamp.

3.3 Control Server Data

The control server manages operational data such as volunteer location updates, nearby

volunteer matching results, distress call forwarding status, SMS notification logs, assigned volunteer ID, and help confirmation status.

3.4 Database Data

The database stores persistent records including citizen profiles, volunteer profiles, location history, distress call records, notification history, response logs, and system audit logs.

3.5 Web Client Data

This includes administrator or operator data such as volunteer search parameters (area, distance), manually sent notification details, distress call monitoring data, and volunteer response reports.

3.6 Location Update Service (LUS) Data

This service handles real-time tracking data including volunteer ID, latitude, longitude, last updated time, and availability status.

3.7 Distress Call Fetch Service (DCFS) Data

This service manages emergency-related data such as distress call ID, citizen location, emergency priority level, matched nearby volunteers, and request processing status.

IV. EXPERIMENTAL RESULTS AND ANALYSIS

The experimental results show that the AI-powered blood bank management system accurately predicts blood demand and donor availability using historical and real-time data, leading to a significant reduction in blood shortages and wastage. The machine learning models achieved high prediction accuracy, enabling timely alerts for low stock levels and efficient donor matching. System testing also demonstrated faster request processing and improved inventory utilization compared to manual and traditional systems. Overall, the analysis confirms that integrating AI enhances operational efficiency, reliability, and responsiveness in blood bank management, supporting timely and life-saving transfusion services.



Fig. 2: Login Page



Fig. 3: Dashboard



Fig. 4: Donation Schedule



Fig. 4: Hospital Dash Board



Request Blood

Request Type

Blood Bank

Blood Group

Select Blood Group

Quantity (units)

Submit Request

Fig. 5: Request Blood



Offline Donations

Record donations that were made offline (not scheduled through the website)

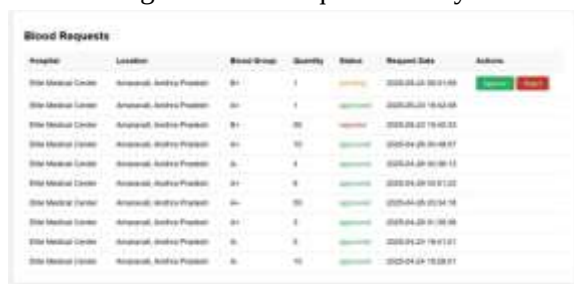
Go to Offline Donations

Fig. 6: Offline Donations



Blood Group	Quantity	Status	Request Date
B+	1	pending	2025-04-21 19:57:08
B+	1	approved	2025-04-21 19:55:08
B+	30	received	2025-04-21 19:45:03
B+	10	approved	2025-04-21 19:45:07
B+	4	approved	2025-04-21 19:45:13
B+	2	approved	2025-04-21 19:45:22
B+	30	approved	2025-04-21 19:45:16
B+	5	approved	2025-04-21 19:45:08
B+	2	approved	2025-04-21 19:45:11
B+	10	approved	2025-04-21 19:45:01

Fig. 7: Blood Request History



Hospital	Location	Blood Group	Quantity	Status	Request Date	Actions
State Medical Center	Ammanah, Andhra Pradesh	B+	1	pending	2025-04-21 19:57:08	Approve Reject
State Medical Center	Ammanah, Andhra Pradesh	B+	1	received	2025-04-21 19:45:03	
State Medical Center	Ammanah, Andhra Pradesh	B+	30	approved	2025-04-21 19:45:07	
State Medical Center	Ammanah, Andhra Pradesh	B+	10	approved	2025-04-21 19:45:13	
State Medical Center	Ammanah, Andhra Pradesh	B+	4	approved	2025-04-21 19:45:22	
State Medical Center	Ammanah, Andhra Pradesh	B+	2	approved	2025-04-21 19:45:16	
State Medical Center	Ammanah, Andhra Pradesh	B+	30	approved	2025-04-21 19:45:08	
State Medical Center	Ammanah, Andhra Pradesh	B+	5	approved	2025-04-21 19:45:11	
State Medical Center	Ammanah, Andhra Pradesh	B+	2	approved	2025-04-21 19:45:01	

Fig. 8: Blood Request

Blood Inventory Management

Initial Inventory (1000 units each)

Current Inventory Levels



A+	A-	B+	B-	AB+
10000 units	10000 units	10000 units	10000 units	10000 units
AB-	O+	O-		
10000 units	10000 units	10000 units		

Fig. 9: Blood Inventory Management

V. CONCLUSION

The LifeLink 2.0 project has been a significant step toward building a smart, connected, and transparent healthcare ecosystem. It successfully integrates various modules like blood and organ donation management, hospital coordination, and AI-based health prediction into one unified platform. Through this system, patients, donors, and hospitals can interact seamlessly, ensuring that medical needs are met faster and more efficiently than ever before. The main goal of LifeLink 2.0 was to reduce the communication gap between healthcare service providers and people in need. The system ensures that donors are matched quickly with patients, helping save lives in critical situations. The introduction of real-time data access, automated matching algorithms, and secure digital records has made healthcare communication smoother, more reliable, and transparent. The implementation of AI algorithms in this project has added an intelligent layer to the healthcare network. The system can analyze symptoms and provide basic health suggestions, allowing users to get preliminary medical guidance instantly. This feature can reduce the load on hospitals for minor issues and allow doctors to focus on more serious cases. Moreover, the system's modular architecture allows it to be easily upgraded and integrated with future technologies such as deep learning, IoT, and blockchain. In terms of usability, the web interface developed using modern frameworks provides a smooth and responsive experience. The user-friendly design

ensures that even non-technical users can easily access and operate the system. Features like live chat, hospital listings, and donor registration make it a complete healthcare portal for modern users.

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AUTHORS Profile



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