International Scientific Journal of Engineering and Management (ISJEM) ISSN: 2583-6129
Volume: 04 Issue: 05 | May – 2025 DOI: 10.55041/ISJEM03935
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata

ORGANATE

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Abstract - Organate is a modern, integrated healthcare management platform designed to streamline the organ donation process, health data tracking, and electronic medical record management. It addresses key challenges in organ transplantation, including compatibility assessment, fragmented data systems, and inefficient communication. A core feature of the platform is its intelligent donor-recipient matching system, which calculates a match score based on blood group compatibility, urgency level, health data from wearable devices (such as Fitbands), and organ availability. Built with technologies like Next.js, React, TypeScript, and Firebase, Organate offers a secure, scalable, and user-friendly interface. Real-time analytics and encrypted health monitoring support informed clinical decision-making. Its modular, responsive architecture enhances accessibility across devices while ensuring privacy and performance. This paper explores the system's design, core functionalities, and future potential, positioning Organate as a promising digital solution for organ transplant management in evolving healthcare environments.

Key Words: Organ Donation, Healthcare Management System, Donor-Recipient Matching, Match Score Algorithm, Blood Group Compatibility, Health Data from Wearables, Organ Availability, Electronic Medical Records, Web-Based Healthcare Platform, Real-Time Health Monitoring

1.INTRODUCTION

The healthcare sector is rapidly evolving through digital transformation to improve patient care, data handling, and the efficiency of service delivery. Organ donation and transplantation remain among the most complex and underserved areas in this transformation due to outdated systems, poor interoperability, and inefficient coordination. Traditional processes often suffer from delays and mismatched data, leading to missed transplant opportunities. Organate is proposed as a comprehensive web-based healthcare management system aimed at modernizing the organ donation workflow. Its core innovation lies in a smart donor-recipient matching engine that computes a match score based on multiple weighted factors such as blood group compatibility, urgency level, real-time health metrics from wearable devices like Fitbands, and organ availability. This score-based approach ensures fair prioritization and medically suitable matching between donors and recipients..The platform also facilitates secure data entry, real-time health monitoring, and streamlined communication between all stakeholders involved in the transplantation process. By leveraging modern web technologies and integrating health data analytics, Organate provides a reliable foundation for improving match accuracy and decision-making in organ transplant management

2. Literature Survey

Fig-1: Literature Survey Table

Ref no	Title of the work, publication & year	Author	Summary of the work [Methodology]	Research gaps and motivation
1	**Smart Health Monitoring for Critical Patients Using IoT**, IEEE Conference, 2021	Dr. Rajeev Kumar, Pooja Sharma	This paper presents a real-time health monitoring system using IoT sensors to track critical parameters like SpO2, BP, and heart rate. Data is processed and stored in the cloud for remote analysis and alerts.	he study lacks integration with organ donation systems and does not address how this data can be used for matching recipients or prioritizing urgency..
2	**Organ Donation Management System Using Blockchain**, IJCSIT, 2022	Alok R. Deshmukh, Neha Ghosh	The system ensures data integrity and traceability using blockchain in donor-recipient records. Emphasis is on transparent and secure storage of donation history and consent	While security is addressed, no mechanism for intelligent donor-recipient matching or health data analytics is provided.
3	**IoT Based Health Tracking with Emergency Alert System**, IJARECE, 2023	Priya M., Karthik R.	Proposes a wearable-based alert system using microcontrollers and GSM modules to notify doctors/family during emergencies. Health data is displayed on a dashboard.	Focuses solely on emergency alerting, lacking integration with organ transplant decision support or predictive analysis for donation systems. Additionally, there is no match-scoring logic to help prioritize recipients based on urgency or organ availability, limiting its use in critical transplant scenarios.

The literature-survey explores various approaches in healthcare technology, underscoring the growing demand for intelligent, interoperable systems that support organ donation and transplantation. Current methods range from manual data entry to mobile/web applications focused on health monitoring and patient-specific data collection

[1][2][3]. Several studies emphasize the importance of real-time health status tracking and decision-support tools to improve the organ allocation process. Despite technological progress, challenges remain in developing systems that are accurate, scalable, and easy to use—especially those that can match donors and recipients based on medical compatibility. This gap highlights the need for integrated platforms like Organate, which aims to automate and streamline organ matching by calculating match scores based on blood compatibility, urgency level, wearable health data, and organ availability. Organate's objective is to create a more responsive and fair system that reduces delay in life-saving procedures while maintaining ease of use and accessibility for patients and healthcare providers.

3.Objectives

The Organate system was conceptualized with the following core objectives: To develop a secure and interoperable platform that manages the entire organ donation lifecycle—from donor and recipient registration to real-time match identification and post-transplant tracking; to enable continuous health monitoring using data from wearable devices, supporting timely and accurate clinical decisions; to provide a user-friendly interface that is accessible to both medical professionals and patients; to implement an intelligent matching algorithm that calculates match scores based on blood group compatibility, urgency level, organ availability, and health trends; and to facilitate smooth, reliable communication among all stakeholders involved in the transplant process, including hospitals, donors, recipients, and coordinating authorities.

4.Methodology

The development of Organate followed a structured, iterative methodology rooted in agile development principles.

4.1 Requirements Analysis

This phase involved a comprehensive review of existing literature, healthcare workflows, and available organ donation systems to identify common challenges and necessary functionalities. Emphasis was placed on understanding security, scalability, and regulatory compliance requirements to guide the platform design.

4.2 Design Phase

The system architecture was laid out using a microservices-based approach to support scalability and maintainability. The database schema was designed to allow rapid querying of health metrics and donor-recipient matching criteria. Wireframes and high-fidelity prototypes were developed using Figma, and regular feedback was incorporated to enhance usability and accessibility. Particular attention was paid to designing secure user flows and ensuring modularity across frontend and backend services.

4.3 Development Phase

The development stack included Next.js for server-side rendering and route optimization, React 19 with TypeScript for dynamic UI development, and Firebase for backend services including authentication and real-time data management. React Hook Form and Zod were used for efficient form management and data validation. Performance testing, automated unit testing, and manual integration tests were performed to ensure code robustness and cross-platform compatibility.

4.4 Matching Function Implementation

The core matching system is built around two main interfaces: **MatchCriteria** and **MatchResult**. *MatchCriteria* defines the essential matching parameters, including blood group, urgency level, health status, and required organs. *MatchResult* encapsulates the outcome of the matching process, containing detailed match scores alongside health information.

The match score is calculated using a weighted scoring system that balances multiple critical factors:

- **Blood Group Compatibility (40% weight):** Employs a predefined compatibility matrix where O- is treated as the universal donor compatible with all blood types, and AB+ as the universal recipient. Other blood groups follow specific compatibility rules to ensure medically appropriate matches.
- **Health Stability (30% weight):** Assessed by analyzing health trends over the previous seven days. Stability is quantified based on counts of normal, warning, and critical status indicators, with higher weight given to stable health conditions to prioritize recipients and donors less likely to experience sudden deterioration.
- **Urgency Level (20% weight):** Points are allocated according to clinical urgency, with 'Critical' cases receiving 20 points, 'High' 15 points, 'Medium' 10 points, and 'Normal' 5 points, thereby ensuring priority is given to the most urgent needs.
- **Organ Compatibility (10% weight):** Confirms whether the donor's available organs correspond to the recipient's required organs, adding 10 points when a direct match exists.

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The system includes two primary matching functions:

- **findRecipientMatches:** Accepts a donor ID as input, retrieves donor health data and trends, identifies all recipients currently on the waiting list, computes match scores for each recipient, and returns a sorted list of potential matches ranked by score.
- **findDonorMatches:** Takes a recipient ID as input, fetches recipient data, finds all active donors, calculates match scores for each donor, and returns a sorted list of donors ranked by suitability.

Health trend analysis integrates various critical metrics such as SpO2 (oxygen saturation), blood pressure (both systolic and diastolic), heart rate, and thyroid-stimulating hormone (TSH) levels. Each metric is classified into normal, warning, or critical categories, which contribute to an overall health stability score critical for the matching process.

Match status management functionality allows real-time updating of match statuses—such as pending, accepted, or rejected—with timestamps for accurate tracking and auditability.

This comprehensive matching framework is designed to be both fair and efficient, balancing medical compatibility with urgency, thus optimizing the allocation of organs to maximize patient outcomes.

5. Workflow

The operational workflow of Organate spans multiple functional layers, integrating secure data management with an advanced matching algorithm to optimize organ allocation.

The process begins with secure user registration, followed by comprehensive health data input and document verification. Health information such as blood group, organ health, allergies, and medical history is captured manually or imported via wearable device integrations.

Once a donor or recipient is registered, the system initiates the matching process based on the defined matching criteria. This involves evaluating blood group compatibility using a medical compatibility matrix, assessing health stability by analyzing trends over the past seven days, prioritizing urgency levels, and verifying specific organ requirements. The core matching algorithm calculates a weighted match score that incorporates these parameters.

It is important to note that these factors—health condition, urgency level, blood compatibility, and organ availability—serve as preliminary aids to streamline the matching process. They help shortlist the most suitable candidates for transplantation but are not the final determinant. Upon identifying a high-scoring match, the system facilitates the scheduling of a medical appointment for both the donor and recipient. At this stage, medical professionals conduct detailed clinical evaluations, including crossmatching and organ-specific viability testing. The final transplant decision rests solely with healthcare personnel based on these comprehensive medical assessments.

Matched parties are notified instantly through secure communication channels, ensuring timely coordination. The system continuously monitors health status updates to dynamically adjust match rankings and statuses. All communication is encrypted to maintain confidentiality.

A real-time dashboard provides healthcare administrators and medical personnel with comprehensive status updates, detailed match results, system performance indicators, and analytical insights to support proactive decision-making and improve patient outcomes.

Fig-2: Match Function

Here Jay, the donor, has blood group O+. The system has matched Jay with two recipients: Rav and Sudarsana. Rav has blood group A+ and a critical urgency level, with a match score of 70%. Sudarsana has blood group AB+ and a high urgency level, with a match score of 65%.

6. Technology Stack

Organate leverages a robust tech stack tailored for high performance and flexibility:

- Frontend: Next.js 15.2.4 and React 19 for reactive user interfaces
- UI Components: Radix UI and Tailwind CSS for seamless design

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- Backend: Firebase Authentication and Realtime Database for secure and scalable backend support
- State Management: Zustand for predictable state transitions
- Data Validation: Zod and React Hook Form
- Visualization Tools: Chart.js and Recharts for analytical dashboards

This combination ensures real-time performance, modularity, and a consistent user experience across devices.

7. Limitations and Assumptions

7.1 Limitations

Despite its comprehensive design, Organate has certain limitations. The platform is dependent on stable internet connectivity for real-time functionalities, which can hinder performance in low-network regions. While the web application is optimized for modern browsers, compatibility with older or legacy systems remains limited. The mobile interface, though operational, may require further optimization for seamless user experience on smaller screens or low-end devices. Organate currently utilizes Firebase, which can pose constraints during high-traffic scenarios due to usage quotas. Additionally, third-party APIs used for wearable health data or external validations may experience latency or downtime, affecting the accuracy of real-time analytics. Finally, while the matching system provides intelligent recommendations, final medical evaluation is still mandatory to confirm transplant suitability. Moreover, the system currently does not support offline access or local storage, limiting its use in emergency scenarios without connectivity. The accuracy of health data analytics is also directly dependent on the quality of data received from external sources. Interoperability with hospital systems may face technical or bureaucratic barriers depending on the region. Data visualization dashboards, while functional, may require enhancements for more intuitive use by non-technical users. Lastly, multilingual support is limited, which may pose accessibility issues for users in non-English speaking regions..

7.2 Assumptions

Organate operates under several assumptions for smooth functionality. It assumes that users will access the platform via updated web browsers and stable internet connections. The system presumes that all submitted medical data is accurate, updated, and verified by trusted sources or medical personnel. It also assumes that wearable device integrations function reliably and transmit valid health metrics. The platform’s role-based access control model depends on stakeholders following their designated roles and responsibilities responsibly. Furthermore, it is assumed that future integration with hospital and insurance systems will adhere to standardized protocols and maintain data security and consistency across sources.
Another key assumption is that healthcare personnel have the required technical literacy to operate the system effectively. It also assumes that legal and regulatory frameworks in the deployment regions permit electronic health data transmission and storage. Patient consent and data sharing are assumed to be granted as per ethical guidelines. The system presumes that donors and recipients actively participate in the platform, updating their health profiles regularly. It is also assumed that administrators will periodically review system logs and alerts to ensure continued compliance and performance optimization.

8. Results and Performance Evaluation

8.1 Performance Metrics

While formal benchmarking and testing are planned for future development stages, the platform has been designed with performance optimization in mind. Anticipated targets include page load times under 2 seconds, API response times below 500 milliseconds, and efficient database query execution. The system architecture aims to ensure high availability and reliability to support continuous operation.

8.2 Error Handling

Error logging was implemented using a centralized logging service, with real-time alerts for system anomalies. Users received clear and actionable error messages, while system crashes were prevented through fallback handling and retry logic.

8.3 Speed and Efficiency

The platform integrates SSR (Server-Side Rendering) for performance enhancement. Code splitting, image optimization, lazy loading, and caching mechanisms significantly reduced data payloads, improving load speed and responsiveness.

8.4 Future Scope

Future enhancements to Organate aim to further improve the precision, accessibility, and security of the organ donation and transplant process. Planned developments include the integration of AI-powered compatibility algorithms to enhance the accuracy and personalization of donor-recipient matching. Native Android and iOS mobile applications will be developed to broaden access and usability across devices. The system will incorporate predictive health analytics to identify potential risks and deterioration in patient conditions at an early stage. Additionally, telemedicine support will be introduced to enable remote consultations and follow-ups between donors, recipients, and medical professionals. The platform also envisions exploring blockchain technology for creating immutable and secure health records, ensuring transparency and trust throughout the organ donation lifecycle.

Future iterations may also introduce dynamic weight adjustment capabilities, allowing medical professionals to fine-tune the importance of various match criteria in real time based on clinical judgment. Expansion to include cross-border donor-recipient matching through compliance with international medical standards is also under consideration. Integration with hospital ERP systems can further streamline administrative workflows and data synchronization. Moreover, incorporating genomic compatibility data and machine learning-based anomaly detection will significantly raise the system's ability to detect rare conditions or mismatches early. These future directions will ensure Organate evolves into a fully intelligent, adaptive, and globally scalable healthcare platform

9. Conclusion

Organate marks a significant leap forward in healthcare management systems, especially within the organ donation and transplant domain. Its strategic use of web technologies, secure data practices, and intelligent design collectively result in a platform that is not only effective but also scalable and future-proof. By addressing key challenges in organ donor coordination and medical record handling, Organate has the potential to save lives, optimize healthcare delivery, and inspire a new generation of medical technology solutions. The platform's integration of real-time data monitoring and dynamic matching algorithms enhances decision accuracy, reducing organ wastage and wait times. Secure communication channels and encrypted data transfers ensure patient confidentiality and regulatory compliance. Moreover, the customizable dashboard empowers healthcare professionals with actionable insights, facilitating faster and more informed transplant decisions. As Organate continues to evolve, its adaptability to emerging medical devices and data sources positions it as a vital tool in modern healthcare ecosystems worldwide.

Acknowledgements

Our heartfelt thanks to the Presidency University for having us take part in this academic team project as a part of our curriculum. Special thanks to our project guide, Dr. Renuka Devi, Professor – PSIS, Presidency University. Our sincere thanks to the School of Information Science for providing a platform for us to express our ideas.

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