Apeksha Hospital Donor Engagement System

2023-24-100

Project Proposal Report

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Declaration of The Candidate & Supervisor

I declare that this is my work, and this proposal does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other university or institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgment is made in the text.

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The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

Signature of the supervisor: Date:

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Signature of the Co-supervisor: Date:

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Abstract

Apeksha Hospital has the significant problem of enhancing donor involvement and enhancing the management of essential item inventory. To overcome this difficulty, this study proposes a new Intelligent Donor-Driven Inventory System for Essential Supplies. The main goal is to make use of machine learning algorithms to better understand donor habits, preferences, and giving patterns over time. As a result of this knowledge, the system will be in a position to skillfully suggest essential products to prospective donors, therefore stimulating their donations that are in line with the hospital's immediate demands. The ultimate goal of this research is to provide an engaging platform that integrates donor engagement with inventory control. Donors will be able to see the direct results of their donations and get personalized product recommendations from the system. By using these strategies, we want to increase donor pleasure and engagement while establishing a positive cycle of engagement. The research being conducted hopes to make the present of essential items more useful by concluding the gap between what donors want to do and what hospitals need. This collaborative method, which is made possible by machine learning and a donor-centered interface, not only improves the way resources are used but also makes the experience for donors as a whole better. Because of this, the results of this research are likely to make a big difference in how people give donations to Apeksha Hospital.

Keywords: Intelligent Donor-Driven Inventory System, machine learning algorithms, Apeksha Hospital

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1.INTRODUCTION

1.1 Background & Literature Survey

1.1.1 Background

The health of patients and the reliability of healthcare depend heavily on the positive interaction between hospitals and the donors. Contributions from the general population are essential for hospitals and other healthcare facilities, especially when it comes to purchasing essentials Apeksha Hospital, as a leading healthcare facility, has the vital responsibility of boosting donor engagement and effectively controlling the supply of essential supplies. Donor engagement with the healthcare industry has traditionally depended mainly on conventional methods, with donors donating items based on their own perceptions of what hospitals really need. Donor intentions and the hospital's real needs frequently diverge as a result of this. Donors' intentions to help out are commendable, but their donations may not necessarily be in line with what the hospital most needs right now, leading to inefficiencies in resource allocation and utilization. To bridge this gap and address the vital issue of donor-driven inventory management, this research component proposes the development of an Intelligent Donor-Driven Inventory System for Essential Items at Apeksha Hospital. By leveraging the capabilities of machine learning algorithms and data-driven insights, this system aims to understand donor behaviors, preferences, and historical donation patterns [1]. The integration of this knowledge enables the system to strategically recommend essential items to prospective donors that closely match the hospital's current demands.

The primary goal of the research is to develop an easy-to-use system that can efficiently integrate hospital supplies with donors' interests. Not only will donors be equipped with specific recommendations for items that may be put to use right away, but they will also be able to see the instant results of their contribution. By taking a more all-encompassing view of donor engagement and inventory management, the hospital hopes to improve donor satisfaction and operational efficiency. Addressing Apeksha Hospital's most pressing problems with donor engagement and inventory management, this research project hopes to be a first step towards an innovative solution for the hospital and the people it serves. Using state-of-the-art machine learning methods and a donor-centric interface, the project aims to pave the way for more efficient and harmonious donor contributions, which in turn will contribute to better patient care and healthcare outcomes [2].

As the healthcare industry faces ongoing changes, the results of this research show the potential to not only redefine the impact of donor-driven donations to Apeksha Hospital but also provide valuable insights that may be applied to hospitals on a larger scale. The objective of this research is to provide a comprehensive framework for enhancing donor engagement in the healthcare sector by effectively matching donor intent with the specific needs and requirements of hospitals. The research seeks to establish a blueprint that may facilitate a more efficient and impactful approach for engaging donors in the healthcare domain.

1.1.2 Literature Survey

Throughout the domain of contemporary healthcare philanthropy, the collaboration between donors and hospitals has emerged as a crucial factor in ensuring the continuous provision of essential resources necessary for patient well-being. Apeksha Hospital, a renowned healthcare institution, has a double challenge of encouraging robust donor involvement and efficiently managing the inventory of critical commodities necessary for excellent patient care [3].

The primary objective of this literature review is to examine the fundamental factors that contribute to the development of an Intelligent Donor-Driven Inventory System for Essential Items. The main aim is to improve donor engagement and implement effective inventory management strategies. The proposed method seeks to use machine learning algorithms in order to decipher patterns in donor behavior, preferences, and past donation trends. By incorporating this understanding, the system may effectively propose necessary products to prospective donors that synchronize perfectly with the hospital's urgent need. Furthermore, the application of machine learning in offering personalized recommendations is a key theme. Previous research demonstrates the potential of tailored suggestions to guide donors toward items of immediate value. This infusion of technology into donor engagement aligns with the dynamic nature of contemporary donor relationships [4].

The efficient handling of donated items is based on the concepts of inventory management. Extensive research into the optimization of inventory utilization within the healthcare sector yields significant information about resource allocation techniques that may be effectively used for donated products. Research studies further highlight the criticality of aligning donor contributions with the specific needs of the hospital, emphasizing the need of ensuring that gifts are in sync with

the current and immediate necessities. The notion of a donor-centric approach is explored, highlighting the value of creating an engaging and transparent platform. Allowing donors to witness the tangible impact of their contributions enhances satisfaction and long-term engagement. The proposed system aims to seamlessly integrate this transparency and engagement, fostering a positive cycle of involvement [5].

By including case studies in the field of healthcare philanthropy, this research gains practical insights that exemplify effective efforts aimed at aligning donor intentions with the needs of hospitals. These stories provide valuable insights into viable techniques that might inform the implementation of the suggested inventory system driven by donors. The evolution of healthcare philanthropy's environment has led to the synthesis of several themes, which serves as the foundation for an innovative strategy to engage donors and managing inventories. The next parts of this survey will provide a more in-depth exploration of study results, interpretations, and implications. The overarching objective is to develop a transformational paradigm for Apeksha Hospital and its broader context [6].

The comprehension of donor behavior and the implementation of efficient engagement techniques are pivotal elements in the establishment of the Intelligent Donor-Driven Inventory System for Essential Items at Apeksha Hospital. This research component aims to improve the inventory management system by incorporating findings from donor behavior analysis, in order to better fit with the preferences and patterns shown by donors. The integration of donor behavior analysis and engagement tactics into the suggested system may be achieved in the following manner:

Data Collection and Analysis:

Collect historical data pertaining to donor donations, preferences, and patterns of giving. Employ machine learning algorithms to analyze the provided data and discern patterns. Gain an understanding of the specific goods that contributors are inclined to provide and the specific time periods in which these contributions are made [7].

Segmentation and Personalization:

The donors can be categorized into several categories by taking into account their preferences and behaviors. For example, some benefactors may habitually provide donations of certain products, whilst others may make contributions in response to immediate and pressing needs. Develop individualized profiles for each donor section [8].

Tailored Donation Recommendations:

Utilize the insights gained from data analysis to suggest specific essential items to donors. For instance, if a donor frequently contributes a certain type of item, the system can recommend similar items that align with the hospital's current needs [9].

The Intelligent Donor-Driven Inventory System undergoes a transformation into a dynamic platform that accommodates the preferences and habits of donors via the integration of donor behavior analysis and engagement techniques. This not only improves donor satisfaction but also guarantees that the given necessary products are in line with the hospital's current requirements, leading to enhanced resource allocation and utilization. The capacity of the system to synchronize with donor behavior establishes a mutually beneficial symbiotic association that enhances the hospital's management of vital items while also benefiting the donors.

1.2 Research Gap

The significance of donor engagement and inventory management in healthcare philanthropy has been well acknowledged. However, there is a noticeable lack of study in the field of creating an Intelligent Donor-Driven Inventory System for Essential Items, specifically in healthcare settings such as Apeksha Hospital. The current body of research mostly focuses on the study of donor behavior and the development of engagement techniques, sometimes neglecting the integration of inventory management. The existence of this gap becomes apparent when examining the amalgamation of these two domains in order to optimize the effectiveness and influence of donor-led contributions towards vital commodities [10].

There is currently a deficiency of comprehensive frameworks that effectively integrate donor preferences, historical donation trends, and hospital inventory requirements within the existing

environment [11]. While some research studies have examined the patterns of donor behavior and others have focused on the intricacies of inventory management within the healthcare sector there exists a dearth of study that effectively connects the intentions of donors with the immediate needs of hospitals.

Moreover, the use of machine learning algorithms to provide personalized item suggestions for donors in the realm of necessary goods donation remains an area that has not been well investigated. Although customization has shown potential in the context of philanthropic donations, its use in the domain of necessary healthcare products remains relatively unexplored. There is a scarcity of scholarly research that elucidates the potential advantages of this integration in maximizing donor donations to essential goods and cultivating enduring involvement [12].

The existence of this research gap highlights the need for a comprehensive framework that integrates donor behavior insights with inventory management tactics using machine learning techniques. By addressing this existing deficiency, there is potential to improve the efficacy of necessary item gifts while also making a valuable contribution to the wider area of healthcare philanthropy. This may be achieved by introducing an innovative strategy that connects the intentions of donors with the specific requirements of hospitals [13]. The creation of an Intelligent Donor-Driven Inventory System specifically designed for the context of Apeksha Hospital presents a distinct opportunity to address this disparity and establish an innovative solution that can be replicated in comparable healthcare organizations.

Table 1 Research Gap

Functionality	[4]	[5]	[6]	[7]	[8]	[10]	[11]	[12]	[13]	Purposed System
Prediction of Demand for Essential Items	✅	✅	✅	❌	✅	❌	❌	❌	❌	✅
Inventory Management Integration	✅	✅	✅	❌	✅	❌	❌	❌	❌	✅
Resource Allocation Optimization	❌	✅	✅	❌	❌	❌	❌	❌	❌	✅
Performance Tracking and Analysis	❌	❌	❌	✅	❌	✅	✅	✅	✅	✅

1.3 Research Problem

The central focus of this project is on the research challenge of improving donor involvement and optimizing inventory management for vital commodities at Apeksha Hospital. This will be achieved via the creation of an Intelligent Donor-Driven Inventory System. The main obstacle is the successful synchronization of donor contributions with the hospital's pressing requirements, guaranteeing that donated things are both relevant and influential. Current methodologies often exhibit a deficiency in amalgamating the analysis of donor behavior, personalized suggestions, and real-time inventory management into a unified framework, resulting in inefficiencies and missed prospects for resource allocation.

This research challenge emphasizes the need of bridging the disparity between the intentions of donors and the requirements of hospitals via the use of machine learning algorithms and insights derived from data analysis. The system endeavors to provide donors personalized item suggestions by comprehending their preferences, analysing past donation trends, and considering current inventory requirements. Simultaneously, it facilitates the hospital in effectively allocating resources to meet urgent patient care demands [5] [7].

To successfully address this research topic, it is essential to construct a complete framework that easily combines methods for engaging donors with practices related to inventory management. The task at hand is the development of an intelligent system that not only addresses the preferences of donors but also adjusts to the ever-changing needs of the hospital [10]. This system aims to enhance the effectiveness and impact of a donor-centric approach to the donation of critical commodities at Apeksha Hospital [7].

The outcome of this research will provide insights into the viability, feasibility, and efficacy of implementing an Intelligent Donor-Driven Inventory System, offering a solution that optimizes donor engagement, improves resource allocation, and enhances the overall efficiency of essential item donations in a healthcare setting.

2. OBJECTIVES

2.1 Main Objectives

The main aim of the proposed research component is to create and implement a Donor-Driven Inventory System for Essential Items at Apeksha Hospital. This system would effectively match donor donations with the hospital's current needs in an intelligent manner. This aim involves the use of cutting-edge technology, comprehensive data analysis, and effective donor engagement tactics to provide a dynamic and streamlined system that amplifies the influence and efficacy of gifts of vital items. The main aim of the proposed research component is to create and implement a Donor-Driven Inventory System for Essential Items at Apeksha Hospital. This system would effectively match donor donations with the hospital's current needs in an intelligent manner. This aim involves the use of cutting-edge technology, comprehensive data analysis, and effective donor engagement tactics to provide a dynamic and streamlined system that amplifies the influence and efficacy of gifts of vital items.

The main objectives of the Donor-Driven Inventory System for Essential Items can be further broken down as follows:

2.1.1 Intelligent Donor Analysis

Utilize machine learning algorithms to examine donor behavior, preferences, and past giving trends. This study aims to provide a comprehensive analysis of the sorts of products that donors provide and the timing of their contributions, therefore facilitating a more profound comprehension of donors' intent [14].

2.1.2 Personalized Item Recommendations

The aim is to create a recommendation engine that utilizes donor data to provide tailored recommendations for vital products that are in line with the hospital's existing requirements. Customize suggestions based on the individual donor's historical giving habits and personal preferences [7].

2.1.3 Real-time Inventory Integration

The integration of the system with the hospital's inventory management is imperative in order to provide real-time monitoring of the availability and consumption of vital commodities. This integration facilitates the provision of precise suggestions that are grounded in genuine requirements [6].

2.1.4 Optimized Resource Allocation

In order to enhance the efficiency of resource allocation at Apeksha Hospital, it is recommended to establish a system that aligns donations with the hospital's present needs. The objective is to reduce the amount of waste and guarantee that donated materials are effectively used to meet the essential requirements of patients [5] [4].

2.1.5 Transparent Impact Tracking

Offer donors a comprehensive and clear understanding of the direct influence their donations have on the provision of patient care. Provide immediate and up-to-date information on the use of donated things, so cultivating a feeling of engagement and contentment.

The primary purpose of this study is to develop an Intelligent Donor-Driven Inventory System that aims to optimize the allocation of critical commodities and foster a mutually beneficial connection between donors and Apeksha Hospital. The system endeavors to strategically link the intentions of donors with the immediate requirements of hospitals, with the goal of revolutionizing the realm of vital item contributions. This, in turn, is expected to enhance patient care results and foster greater happiness among donors.

2.2 Specific Objectives

2.2.1 Data Collection and Analysis

The objective of this study is to collect and examine historical data pertaining to donor contributions in order to detect and evaluate trends, preferences, and patterns in giving behavior. This study aims to provide a comprehensive understanding of the prevalent categories of things that donors often provide, as well as the temporal patterns associated with their contributions.

2.2.2 Machine Learning Integration

The integration of machine learning algorithms is used to effectively analyze donor data and construct prediction models that possess a comprehensive understanding of donor behavior and preferences [4].

2.2.3 Donor Segmentation

The contributors may be categorized into several segments by analyzing their giving behaviors, preferences, and reasons. The contributors might be classified into several categories in order to customize interaction methods [7].

2.2.4 Item Recommendation Engine

The objective of this study is to develop and execute a recommendation engine that is capable of generating tailored item choices for donors. Utilize predictive models to suggest crucial goods that are in accordance with the requirements of hospitals [7].

2.2.5 Real-time Inventory Tracking

Develop a system that interfaces with the hospital's inventory management to provide real-time updates on the availability and utilization of essential items.

2.2.6 Impact Visualization

Create an interface that displays the impact of donated items by showing how each contribution directly contributes to patient care. Provide donors with tangible insights into their contributions.

The effective achievement of these particular goals will result in the development of an Intelligent Donor-Driven Inventory System at Apeksha Hospital. This system will use donor insights, machine learning, and real-time inventory management to improve donor engagement and optimize the allocation of necessary items.

3. METHODOLOGY

3.1 Requirement Gathering

For the Donor-Driven Inventory System for Essential Items, thorough research domain and context analysis was performed throughout the demand collection phase. This required an in-depth analysis of the needs, an awareness of the current state of operations, and a survey of comparable systems already in place. The major goal was to determine the scope of the project and have a firm grasp of the domain that would be tackled, both of which brought their own unique obstacles.

Within the framework of the Donor-Driven Inventory System for Essential Items, the procedure also included active involvement with several stakeholders, including hospital personnel, donors, and administrators. This engagement facilitated the acquisition of vital information pertaining to the distinct requirements and anticipations associated with the features and functions of the system.

Key Steps:

- **Collection of Relevant Research Papers**

  The initial step involved gathering a collection of research papers and studies related to inventory management, donor engagement, and similar systems within the healthcare sector. These papers provided a foundation for understanding best practices and potential solutions.

- **Feasibility Study**

  A feasibility study was conducted to assess the practicality and viability of implementing the proposed Donor-Driven Inventory System. This included evaluating technical, financial, and operational aspects.

❖ **Background and Literature Survey**

A thorough background study was carried out to gain a deep understanding of the context in which the system would operate. This included examining the challenges faced by healthcare facilities in managing essential item donations and inventory.

❖ **Reading and Analyzing Collected Research Papers**

The research papers collected earlier were scrutinized and analyzed to identify patterns, trends, and successful strategies that could be applied to the proposed system.

❖ **Scope Definition**

The scope of the project was refined based on the insights gained from the literature review and stakeholder interactions. This process involved identifying the most relevant components and functionalities that would effectively address the challenges identified.

3.2 System Architecture

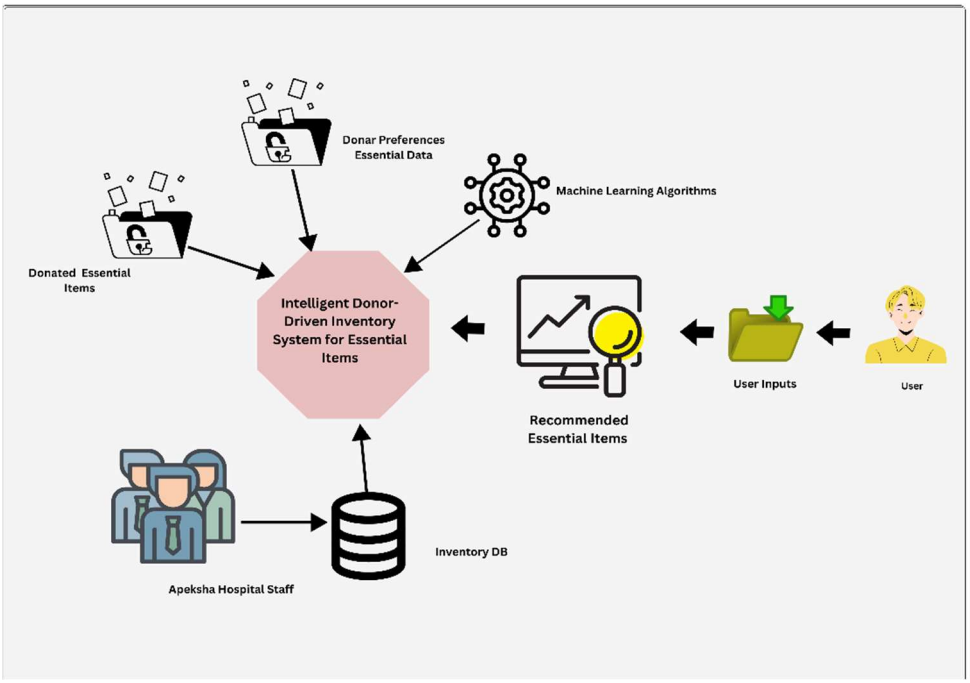

Figure 1 System Architecture

3.3 System Implementation

The phase of system implementation plays a crucial role in the realization of the Donor-Driven Inventory System for Essential Items. This phase contains the necessary criteria to improve donor involvement and optimize inventory management at Apeksha Hospital, hence assuring the successful integration and performance of the system. The solution has the following capabilities.

- **Inventory Demand Prediction**
  - ✓ Develop predictive models utilizing historical donation data and relevant parameters to forecast inventory demand.
  - ✓ Apply advanced machine learning techniques to capture intricate relationships between variables.
  - ✓ Enhance model accuracy through techniques like Gradient Boosting or Random Forest.
- **Integration with Inventory Management**
  - ✓ Seamlessly integrate predictive models into inventory management processes.
  - ✓ Design a user-friendly dashboard enabling inventory managers to input variables and access real-time predictions.
- **Optimized Resource Allocation**
  - ✓ Optimize resource allocation across inventory items based on predictive model insights.
  - ✓ Recommend allocation strategies for items based on projected demand and availability.
- **Real-time Monitoring and Alerts**
  - ✓ Establish a monitoring system to continuously update predictions as inventory variables evolve.
  - ✓ Configure alerts for inventory managers, notifying them of significant deviations from projected outcomes.

- **User Interface and Visualization**
  - ✓ Design an intuitive interface for displaying predictive model insights, recommendations, and insights.
  - ✓ Leverage visualization techniques to aid inventory managers in comprehending and acting upon the forecasted results.
- **Continuous Model Improvement**
  - ✓ Implement mechanisms to capture new inventory data and inputs for ongoing model refinement.
  - ✓ Regularly update and retrain predictive models to maintain accuracy and relevance.
- **Security and Data Privacy**
  - ✓ Employ stringent data security protocols to safeguard sensitive donor and inventory information.
  - ✓ Adhere to data privacy laws and industry best practices to ensure ethical data handling.

3.4 Tools and Technology

Programming Languages

- Python
- React
- JavaScript
- NodeJS

Tools

- Scikit Learn
- Gradient Boosting and Random Forest

Version Controlling

- Git
- GitHub

3.5 System Requirements

3.5.1 Functional Requirements

- Data Collection
- Shortage Prediction
- Critical Medication Identification
- Donation Utilization
- Optimization
- User Interface
- Integration with Hospital Workflow

3.5.2 Non-Functional Requirement

- Performance
- Security and Privacy
- Scalability
- Reliability
- Usability

3.5.3 Personnel Requirements

- Development Team
- Domain Experts
- Quality Assurance (QA) Team
- Project Manager
- User Training and Support
- Data Management Team
- IT Support

3.6 Work Breakdown Structure

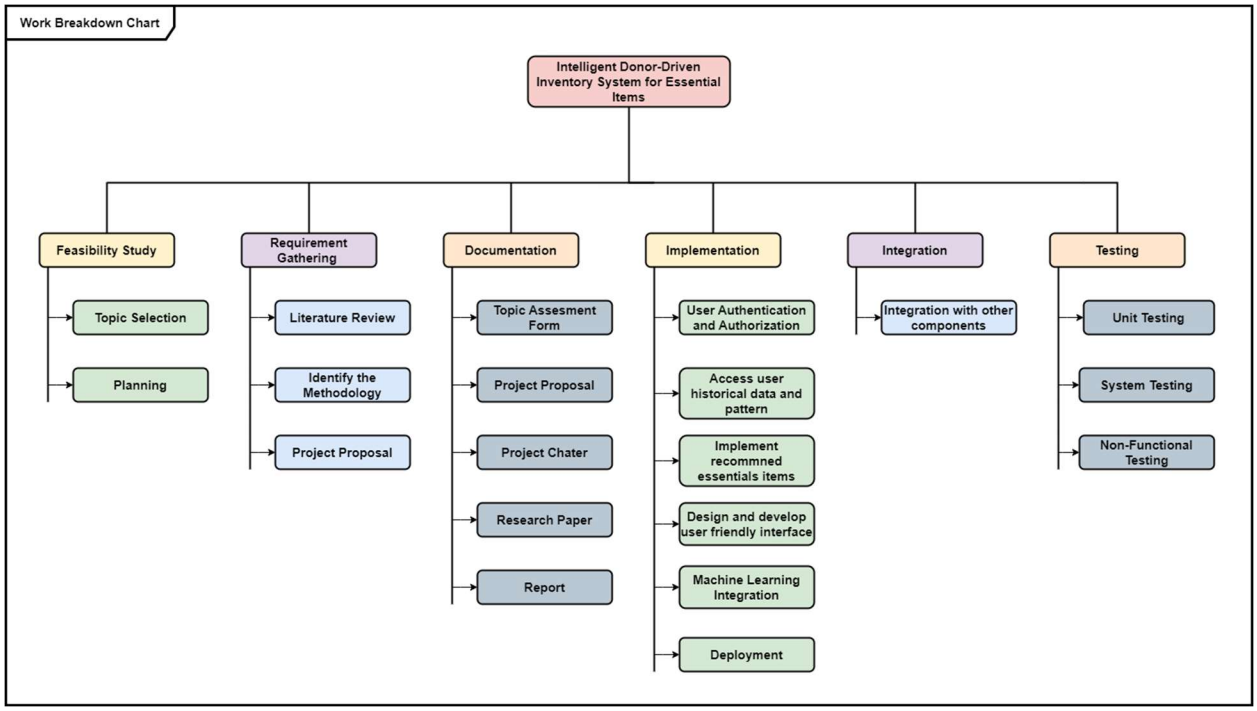

Figure 2 Work Breakdown Chart

3.7 Gantt Chart

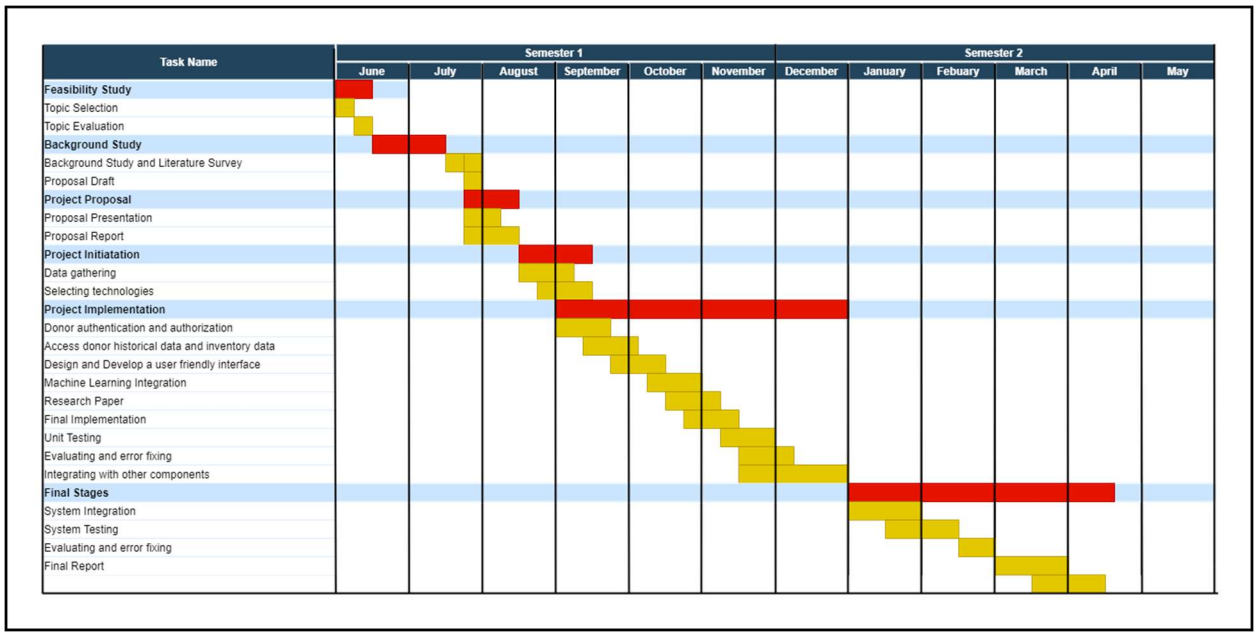

Figure 3 Gantt Chart

4. PROJECT REQUIREMENTS

4.1 Functional Requirements

4.1.1 User Authentication and Profiles

Users (donors and hospital staff) should be able to create accounts, log in, and manage their profiles. Donors should have the option to provide preferences and communication preferences.

4.1.2 Machine Learning Integration

The system should integrate machine learning algorithms to process donor data and develop predictive models for item recommendations.

4.1.3 Donor Segmentation

Implement segmentation algorithms to categorize donors into groups based on giving patterns, preferences, and motivations.

4.1.4 Item Recommendation Engine

Develop an intelligent recommendation engine that suggests essential items to donors based on historical data and real-time hospital needs.

4.1.5 Real-time Inventory Integration

Interface with the hospital's inventory management system to access real-time data on essential item availability and utilization.

4.1.6 Resource Allocation Optimization

Develop algorithms that recommend how donated items should be allocated based on real-time inventory data and hospital needs.

4.1.7 User-Friendly Interface

Design an intuitive and user-friendly interface for donors and hospital staff to interact with the system.

The successful execution of these functional requirements will lead to the establishment of a resilient and efficient Donor-Driven Inventory System for Essential Items at Apeksha Hospital, enhancing donor involvement and optimizing resource distribution.

4.2 Non-Functional Requirements

4.2.1 Performance

The system must provide real-time recommendations and updates to donors and hospital staff, ensuring responsiveness even during peak usage.

4.2.2 Scalability

The system should be designed to handle a growing number of donors and essential items, accommodating increased usage without significant performance degradation.

4.2.3 Security

Ensure robust data security measures, including encryption of sensitive donor information and secure authentication protocols.

4.2.4 Reliability

The system should have a high level of availability, minimizing downtime and ensuring uninterrupted access for donors and hospital staff.

4.2.5 Usability

Design an intuitive and user-friendly interface that requires minimal training for donors and hospital staff to navigate and interact with the system.

4.2.6 Accessibility

Ensure that the system's interface is accessible to individuals with disabilities, following accessibility guidelines and standards.

4.3 Expected Test Cases

Table 2 This test case verifies the functionality of the user login process.

Test Scenario ID	TC001	**Test Case ID**	Donor Login
Test Case Description	This test case verifies the functionality of the user login process.	**Test Priority**	High
Pre-Requisite	User must be registered in the system.	**Post-Requisite**	NA

Test Execution Steps:

S. No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Observe the application's response after clicking the "Login" button.	Username: testuser@gmail.com Password: Password123	User should be successfully logged in and directed to the dashboard.	User is redirected to the dashboard.	Pass	Login process functioning as expected.

Table 3 Test whether donors receive personalized item recommendations based on their historical contributions and preferences

Test Scenario ID	TC002	**Test Case ID**	Donor Receives Personalized Item Recommendations
Test Case Description	Test whether donors receive personalized item recommendations based on their historical contributions and preferences	**Test Priority**	High
Pre-Requisite	Donor account with donation history and preferences	**Post-Requisite**	NA

Test Execution Steps:

- ❖ Log in as a registered donor.
- ❖ Navigate to the recommendations section.
- ❖ View the list of recommended items.

S. No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Suggest to donor recommended essentials items	Donor historical data and donated pattern	Donor sees a list of recommended items tailored to their giving history and preferences.	Donor views a list of relevant recommended items.	Pass	Recommendations appear to align well with donor's history and preferences

Table 4 Test whether a new donor receives recommendations despite having limited donation history

Test Scenario ID	TC003	**Test Case**	New Donor with Limited Data
Test Case Description	Test whether a new donor receives recommendations despite having limited donation history.	**Test Priority**	High
Pre-Requisite	Newly registered donor with minimal donation history.	**Post-Requisite**	NA

Test Execution Steps:

- ❖ Log in as the newly registered donor.
- ❖ Navigate to the recommendations section.
- ❖ View the list of recommended items.

S. No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Log in as the newly registered donor.	Donor credentials	Donor receives recommendations based on the limited available data.	Donor views recommendations tailored to their minimal donation history	Pass	Recommendations provided based on the available data.

Table 5 Test whether a new donor can successfully register an account on the platform.

Test Scenario ID	TC004	**Test Case**	Donor Registration
Test Case Description	Test whether a new donor can successfully register an account on the platform.	**Test Priority**	High
Pre-Requisite	NA	**Post-Requisite**	NA

Test Execution Steps:

- ❖ Access the registration page.
- ❖ Fill in the registration form with valid details.
- ❖ Submit the registration form.

S. No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Log in as the newly registered donor.	First name, last name, email, password, confirm password	Donor successfully registers an account and can log in using the provided credentials.	Account is successfully created, and donor can log in.	Pass	Donor registration process works as expected.

Table 6 Test whether the system updates the relevance of inventory items based on changing hospital needs.

Test Scenario ID	TC005	**Test Case**	Updating Relevance of Inventory Items
Test Case Description	Test whether the system updates the relevance of inventory items based on changing hospital needs.	**Test Priority**	High
Pre-Requisite	Hospital inventory with previously recommended items.	**Post-Requisite**	NA

Test Execution Steps:

- ❖ Log in as a hospital staff member.
- ❖ View the list of recommended inventory items.
- ❖ Make changes to hospital needs that affect item relevance.
- ❖ Verify if the updated items match the changed hospital needs.

S. No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Log in as a hospital staff member.	Make changes to hospital needs that affect item relevance. Verify if the updated items match the changed hospital needs.	After updating the hospital's needs, the system correctly updates the relevance of recommended inventory items.	Updated items reflect the new requirements accurately.	Pass	The system adapts to changes in hospital needs and updates recommendations accordingly.

5. BUDGET AND BUDGET JUSTIFICATION

5.1 Group Budget

Table 7 Group Budget

Resources	**Cost (LKR)**
Web Hosting	LKR 4000.00
Cloud Cost – Digital Ocean	LKR 6500.00
Marketing / Digital Marketing	LKR 12500.00
Total	**LKR 23000.00**

5.2 Individual Budget

Table 8 Individual Budget

Resources	**Cost (LKR)**
Electricity	LKR 4000.00
Internet Cost	LKR 12000.00
Communication	LKR 500.00
Marketing / Digital Marketing	LKR 12500.00
Total	**LKR 29000.00**

6. COMMERCIALIZATION

The commercialization strategy for the Donor-Driven Inventory System for Essential Items is based on collaborative collaborations with healthcare institutions, specific marketing tactics, and customizable frameworks. The technology will be tailored to accommodate a wide range of healthcare institutions. The marketing campaign will prioritize highlighting the system's role in maximizing the efficiency of necessary item donations. The features of the system will be made available via subscription and license arrangements, with the potential to provide important data insights for research purposes as well. Continuous improvement and extensive user assistance will guarantee consumer contentment. The implementation of robust security measures and the development of distinct value propositions may effectively mitigate data privacy issues and overcome competitive hurdles. By efficiently managing these elements, the system aims to enhance the acceptance and transform the involvement of donors in the healthcare sector.

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Apeksha Hospital Donor Engagement System

2023-24-100

Project Proposal Report

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August 2023

Critical Medication Priority Recommender System

2023-24-100

Project Proposal Report

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Declaration of The Candidate & Supervisor

I declare that this is my work, and this proposal does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other university or institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgment is made in the text.

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The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

Signature of the supervisor: Date:

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Signature of the Co-supervisor: Date:

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Abstraction

The "Critical Medication Priority Recommender System" presents a novel machine learning-based solution aimed at addressing the persistent challenge faced by Apeksha Hospital in identifying and prioritizing essential medications in low supply, ultimately affecting patient care quality. This research component outlines the development of a medication recommendation platform that strategically assesses historical medication usage, patient profiles, donation records, and medication attributes. The system integrates three pivotal machine learning models: a "Shortage Prediction" model to anticipate medication scarcities, a "Critical Medication Identification" model ranking medications based on medical significance, and a "Donation Utilization" model aligning donated medications with critical needs. This process is further enhanced through optimization algorithms that rigorously prioritize medications by importance, availability, and expiration. Leveraging existing medication donation frameworks, this research not only fills a critical gap in medication allocation but also bolsters resource efficiency, offering a comprehensive solution for ensuring high-quality patient care in the face of limited resources.

Keywords: Medication shortage, Machine learning-based system, Shortage prediction model, Donation utilization

Table of Contents

1. INTRODUCTION

1.1 Background and Literature Survey

1.1.1 Background

The secure and consistent availability of essential medications stands as a fundamental pillar of efficient patient care within healthcare facilities. The potential scarcity of critical medications poses a significant challenge, as it can lead to compromised treatments and adverse outcomes for patients. Apeksha Hospital, much like its counterparts, confronts the complex task of identifying and prioritizing medications that are susceptible to shortages. Recognizing the urgency of this issue, our research introduces a groundbreaking solution—the "Critical Medication Priority Recommender System." This innovative approach harnesses advanced machine learning techniques and predictive analytics to proactively address medication shortages and optimize allocation strategies.

Our proposed system is tailored to tackle the multifaceted nature of medication shortages head-on, aiming to alleviate the impact of shortages on patient care. By seamlessly integrating historical medication usage records, patient profiles, donation data, and medication attributes, our system operates as an intelligent and adaptive tool to manage medication scarcity. Inspired by the research of Zwaida et al.[1], which highlights the efficacy of machine learning techniques for predicting medication shortages, we have meticulously engineered predictive models to forecast potential deficits in medication availability.

The predictive models, rooted in the analysis of historical data, capture intricate patterns within patient admission trends, treatment protocols, and utilization behaviors. This predictive capability, as evidenced by Zwaida et al. [1], holds promise for revolutionizing the way healthcare facilities anticipate and address medication shortages. By leveraging historical data, our system is primed to provide actionable insights into potential shortages, enabling hospitals like Apeksha to proactively allocate resources and prioritize medication acquisition.

Complementing the predictive modeling framework, our system employs optimization algorithms inspired by the work of Moosivand et al. [9]. These algorithms serve as a strategic tool to allocate medications efficiently during shortages. By factoring in criticality, availability, and expiration

dates of medications, our optimization algorithms ensure that the right medications are allocated to the right patients at the right time. This dynamic approach to resource allocation aligns with the findings of Moosivand et al. [9], enhancing the overall effectiveness of healthcare operations.

As we delve into the specifics of our proposed system, it is essential to acknowledge the research contributions that have shaped our approach. By drawing from the insights of Zwaida et al [1]. and Moosivand et al. [9], we have synthesized a comprehensive framework that addresses the challenges of medication shortages. Through the integration of predictive analytics, critical medication identification, and optimization strategies, our "Critical Medication Priority Recommender System" seeks to elevate the standard of patient care by ensuring timely access to essential medications.

1.1.2 Literature survey

Efficient medication management is a critical imperative for healthcare systems worldwide. Ensuring a steady supply of essential medications is pivotal for delivering optimal patient care, and any disruption in this supply chain can have dire consequences. The endeavor to manage medication shortages effectively has sparked numerous research efforts and innovative approaches. The Critical Medication Priority Recommender System, as proposed in this research component, harnesses the power of machine learning and predictive analytics to address this challenge. This literature review delves into seminal research papers that have shaped our understanding of medication shortage prediction, analytics, and resource allocation strategies.

The works of Zwaida and colleagues have been instrumental in advancing the field of medication shortage prediction and resource allocation using machine learning techniques [1] [2]. Their research has demonstrated the efficacy of predictive modeling in forecasting shortages accurately and optimizing resource allocation within healthcare systems. These contributions provide a solid foundation for the predictive modeling aspect of the Critical Medication Priority Recommender System, where historical medication usage data, patient profiles, and donation records are utilized to develop forecasting models.

In consonance with the predictive modeling framework, Song et al.'s machine learning approach for predicting drug shortages in hospitals adds further depth to our understanding of accurate prediction techniques [7]. By dissecting the complexities of predicting shortages within a

hospital setting, this research provides insights into relevant methodologies that can enhance the accuracy of our predictive analytics framework.

The profound implications of medication shortages on patient care are highlighted by the National Survey of Hospital Drug Shortages conducted by Rhodes and colleagues [3]. This survey-based study reveals the patterns and consequences of drug shortages on healthcare systems, underscoring the need for proactive solutions. The insights from this study contextualize the impact of shortages on patient care, thereby refining our system's critical medication identification models.

The global perspective is enriched by Liu et al.'s work on a nationwide survey of drug shortages in Brazilian hospitals [4]. This study delves into the intricacies of medication shortages, dissecting the prevalence, affected medications, and root causes. Such detailed insights provide a comprehensive understanding of the multifaceted challenges associated with medication shortages, reinforcing the predictive analytics and critical medication identification aspects of our system.

Efficient resource allocation during drug shortages is an intricate challenge that Moosivand et al. have explored in their case study within a tertiary care hospital [9]. This case study illuminates practical strategies for optimizing medication allocation during shortages. The findings of this study offer pragmatic guidance that aligns with the optimization component of the Critical Medication Priority Recommender System.

Dong et al.'s research on a hybrid machine learning model for drug shortage prediction and classification offers a novel perspective on combining techniques for improved accuracy [8]. This hybrid approach resonates with our goal of enhancing prediction accuracy through advanced algorithms and techniques, further enriching the predictive modeling component of our system.

In summary, the Critical Medication Priority Recommender System is firmly grounded in the insights provided by these seminal research papers. By integrating predictive modeling, critical medication identification, and optimization strategies, our system aims to offer healthcare institutions a holistic solution to proactively address medication shortages and optimize patient care.

1.2 Research gap

The envisioned "Critical Medication Priority Recommender System" presents a comprehensive framework for tackling medication shortages through the integration of machine learning techniques and predictive analytics. While the system's functionalities align with a body of existing research, a comprehensive analysis reveals several noteworthy research gaps that invite further exploration and innovation. Firstly, while the system's emphasis on critical medication identification finds resonance in studies such as those by Rhodes et al. [3], there exists a gap in [9], indicating the need for a more comprehensive exploration of this vital aspect within the proposed system. Furthermore, the strategic utilization of donated medications constitutes a key resource allocation strategy; however, none of the provided references [1] to [9] delve into this specific functionality, highlighting a promising avenue for novel research to optimize the use of donated medications during shortages. Additionally, the inclusion of optimization algorithms for efficient medication allocation, as exemplified by, and [8], reveals a gap in [9], underscoring the opportunity to further investigate and integrate diverse optimization techniques. Finally, while Ref 7and [8] underline the importance of machine learning approaches for prediction, the absence of such discussions in the remaining references [1]to[6]and [9] prompts the exploration of a broader spectrum of machine learning methodologies to enhance medication shortage prediction accuracy. Identifying and addressing these research gaps promises to refine and advance the proposed system, ultimately culminating in more robust solutions for managing medication shortages and optimizing patient care outcomes.

	1	2	3	4	5	6	7	8	9	proposed system
Medication Shortage Prediction	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Critical Medication Identification	✓	✓	✗	✓	✓	✓	✓	✓	✗	✓
Donation Utilization	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓
Optimization Algorithms	✗	✗	✗	✗	✗	✓	✓	✓	✗	✓

Figure 1 Research Gap

1.3 Research Problem

Within the dynamic healthcare landscape, Apeksha Hospital grapples with a pivotal predicament: the consistent availability of vital medications. The repercussions of inadequate supplies can precipitate critical challenges in patient care. This research endeavors to craft an innovative solution, embodied in the "Critical Medication Priority Recommender System," which harnesses the potential of machine learning to anticipate, recognize, and suggest essential medications for procurement. The crux of this research conundrum is articulated as follows: **"How can the strategic integration of machine learning techniques optimize the acquisition of medications, preempting shortages, and elevating the quality of patient care within Apeksha Hospital?"**

Solving this intricate puzzle mandates a comprehensive approach. It involves harmonizing diverse datasets encompassing historical medication usage, detailed patient profiles, and invaluable donation records. The fundamental objective lies in training machine learning models that possess the acumen to predict the emergence of shortages, discern medications of utmost importance, and evaluate the suitability of donated medications vis-à-vis critical requirements. Integral to this endeavor is the infusion of optimization algorithms that furnish a coherent framework for ranking and allocating medications based on multifaceted factors—ranging from clinical urgency and availability to expiration timelines.

The potential ramifications of achieving success in this research realm are far-reaching. It holds the capacity to reshape the conventional landscape of medication management, fundamentally altering the manner in which shortages are mitigated. The envisioned outcome is an ingenious system that operates proactively, ensuring that the exigencies of patients are met with precision. By minimizing medication supply gaps, this research has the power to substantially augment the standard of patient-centric healthcare, thereby epitomizing the synergy between cutting-edge technology and compassionate medical practice.

2. OBJECTIVES

2.1 Main Objective

The core objective of the "Critical Medication Priority Recommender System" research is to develop an intelligent solution for Apeksha Hospital, aiding in the strategic identification and acquisition of vital medications. Through machine learning, the system predicts shortages, identifies critical medications based on patient needs, assesses donated medications' alignment with hospital requirements, and optimizes recommendations by considering importance, availability, and expiration. By leveraging historical usage, patient profiles, and donation records, this research empowers the hospital to ensure timely and effective patient care by efficiently managing medication resources.

2.2 Specific Objectives

Specific objectives required to accomplish the main objective of the "Critical Medication Priority Recommender System."

2.2.1 Shortage Prediction Model

Develop a machine learning model that predicts potential medication shortages based on historical data, patient admission trends, treatment plans, and usage patterns. This model will help the hospital anticipate and mitigate shortages before they impact patient care.

2.2.2 Critical Medication Identification

Create a model that identifies and ranks medications critical for the hospital to have in stock at all times. This model should take into account factors such as medical conditions, patient demographics, and urgency levels to determine the priority of each medication.

2.2.3 Donation Compatibility Assessment

Build a model to assess the compatibility of donated medications with the hospital's critical needs. This involves evaluating donated medicines against the list of identified critical medications and prioritizing those that align closely with the hospital's requirements.

2.2.4 Optimization Algorithms Integration

Incorporate optimization algorithms that use a combination of factors such as medication importance, availability, and expiration dates to rank and recommend medications. This step ensures that the most vital medications are acquired and utilized effectively.

2.2.5 User-Friendly Interface

Design a user-friendly interface that allows system users to interact with the recommender system easily. This interface should provide clear insights into medication shortages, critical medication rankings, and donated medication compatibility.

3. METHODOLOGY

3.1 Requirement Gathering

3.1.1. Defining Goals and Parameters

Identify and define the precise goals and parameters of the Critical Medication Priority Recommender System. Determine the primary objective, which is to recommend vital medications to address shortages and enhance patient care.

3.1.2. Stakeholder Identification

Identify relevant stakeholders, including hospital administrators, data analysts, and information technology professionals. Recognize the importance of stakeholder input in shaping the system's functionalities and outcomes.

3.1.3. Interviews with Stakeholders

Conduct in-depth interviews with identified stakeholders to gain a comprehensive understanding of their specific requirements, expectations, and concerns. Gather insights into the challenges faced in the context of medication shortages and the hospital's plans for improvement.

3.1.4. Evaluation of Historical Documents

Review and analyze past campaign materials, including reports, success indicators, and donor engagement data. Extract patterns, trends, and opportunities for improvement from historical data to inform the design of the recommendation system.

3.1.5. Gathering of Information

Collaborate closely with the information technology department to collect and compile relevant data. Compile historical medication usage data, patient profiles, donation records, and medication attributes, which will serve as the training dataset for the machine learning models.

3.2 System Architecture

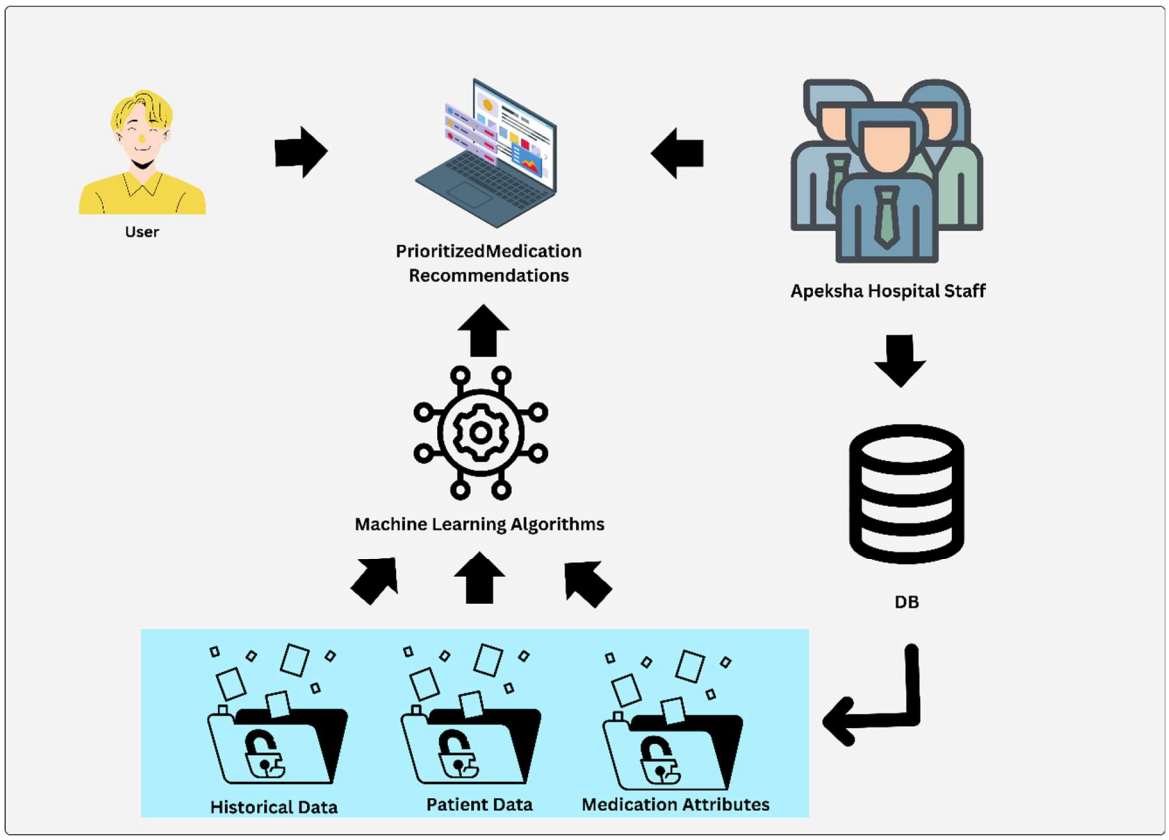

Figure 2 System Architecture

3.3 System Implementation

The system implementation phase is a pivotal stage in realizing the Critical Medication Priority Recommender System's objectives. The implementation encompasses a series of crucial steps that collectively enable the development and deployment of a sophisticated machine learning-based platform aimed at recommending essential and critical medications. The system's implementation is outlined as follows:

3.3.1. Creation of Prediction Models

- Develop prediction models leveraging historical medication usage data, patient profiles, and donation records.
- Utilize machine learning techniques to predict potential shortages of medications based on patient admission trends, treatment plans, and usage patterns.

3.3.2. Integration with Hospital Workflow

- Seamlessly integrate the predictive models into the hospital's medication acquisition and distribution workflow.
- Create a user-friendly dashboard that allows hospital staff to input parameters and receive real-time recommendations.

3.3.3. Resource Allocation Optimization

- Optimize resource allocation by leveraging model predictions to guide medication acquisition decisions.
- Recommend allocation of resources, including funding and timing, based on predicted shortages and critical medication needs.

3.3.4. Real-time Monitoring and Alerts

- Establish a monitoring mechanism that continuously updates predictions as variables change.
- Implement alerts and notifications for hospital staff and administrators to address deviations from predicted outcomes.

3.3.5. Performance Tracking and Analysis

- Develop performance metrics to assess the accuracy and reliability of the predictive models.
- Continuously track and analyze model performance across different scenarios and campaigns.

3.3.6. User Interface and Visualization

- Design an intuitive user interface that displays model predictions, insights, and recommended actions.
- Utilize visualization techniques to enhance understanding and facilitate informed decision-making.

3.3.7. User Training and Support

- Provide comprehensive training to hospital staff on effectively using the recommendation platform.
- Offer user support to address any issues or questions that arise during system operation.

3.3.8. Data Update and Model Enhancement

- Implement mechanisms to capture new data and input for ongoing model improvement.
- Regularly update and retrain the predictive models to ensure accuracy and relevance over time.

3.3.9. Security and Data Privacy

- Ensure the highest standards of data security and privacy for patient profiles, medication attributes, and other sensitive information.
- Adhere to data protection regulations and industry best practices to safeguard confidential data.

3.3.10. Pilot Testing and Rollout

- Initiate a pilot testing phase with a limited number of medications and scenarios to validate system performance.
- Gradually expand system usage to encompass a broader range of medications and patient demographics, incorporating feedback for improvements.

3.3.11. Performance Monitoring and Scaling

- Monitor the system's performance using dedicated tools to track stability, responsiveness, and resource consumption.
- Scale the system's infrastructure to accommodate increased data volume and more complex medication allocation scenarios.

3.3.12. Continuous Enhancement and Iteration

- Continuously gather user feedback to identify areas for improvement and enhancement.
- Iterate on the system's features and capabilities to adapt to changing hospital needs and technological advancements.

3.4 Tools and Technologies

Programming Languages

- Python, React,
- JavaScript,
- Node JS

Tools

- Scikit-learn.
- Gradient Boosting and Random Forest

Version Controlling

- GIT
- GitHub

3.5 System Requirements

3.5.1 Functional Requirements

- ✓ Data Collection
- ✓ Shortage Prediction
- ✓ Critical Medication Identification
- ✓ Donation Utilization
- ✓ Optimization
- ✓ User Interface
- ✓ Integration with Hospital Workflow

3.5.2 Non-Functional Requirements

- ✓ Performance
- ✓ Security and Privacy
- ✓ Scalability
- ✓ Reliability
- ✓ Usability

3.5.3 Personnel Requirements

- ✓ Development Team
- ✓ Domain Experts
- ✓ Quality Assurance (QA) Team
- ✓ Project Manager
- ✓ User Training and Support
- ✓ Data Management Team
- ✓ IT Support

3.6 Work Breakdown Structure

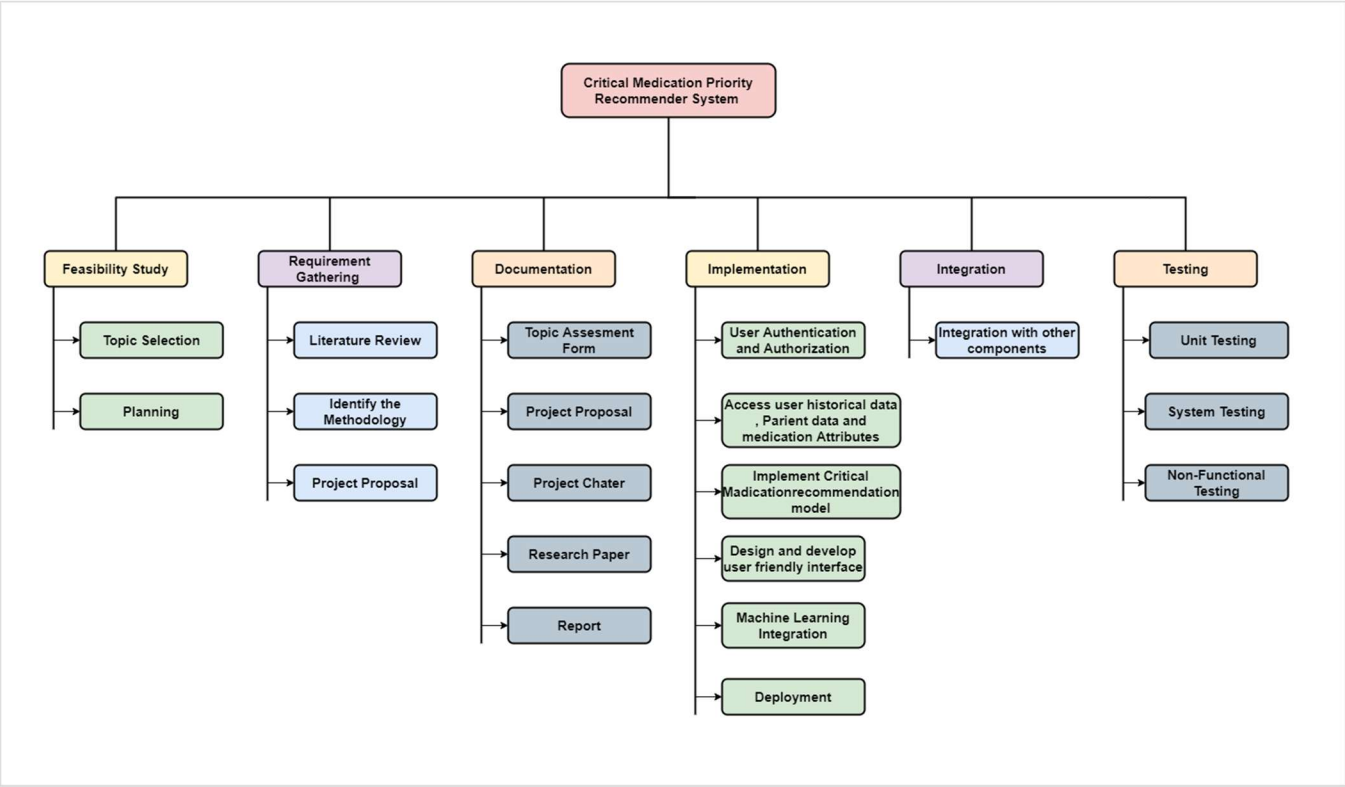

Figure 3 Work Breakdown Chart

3.6 Gantt Chart

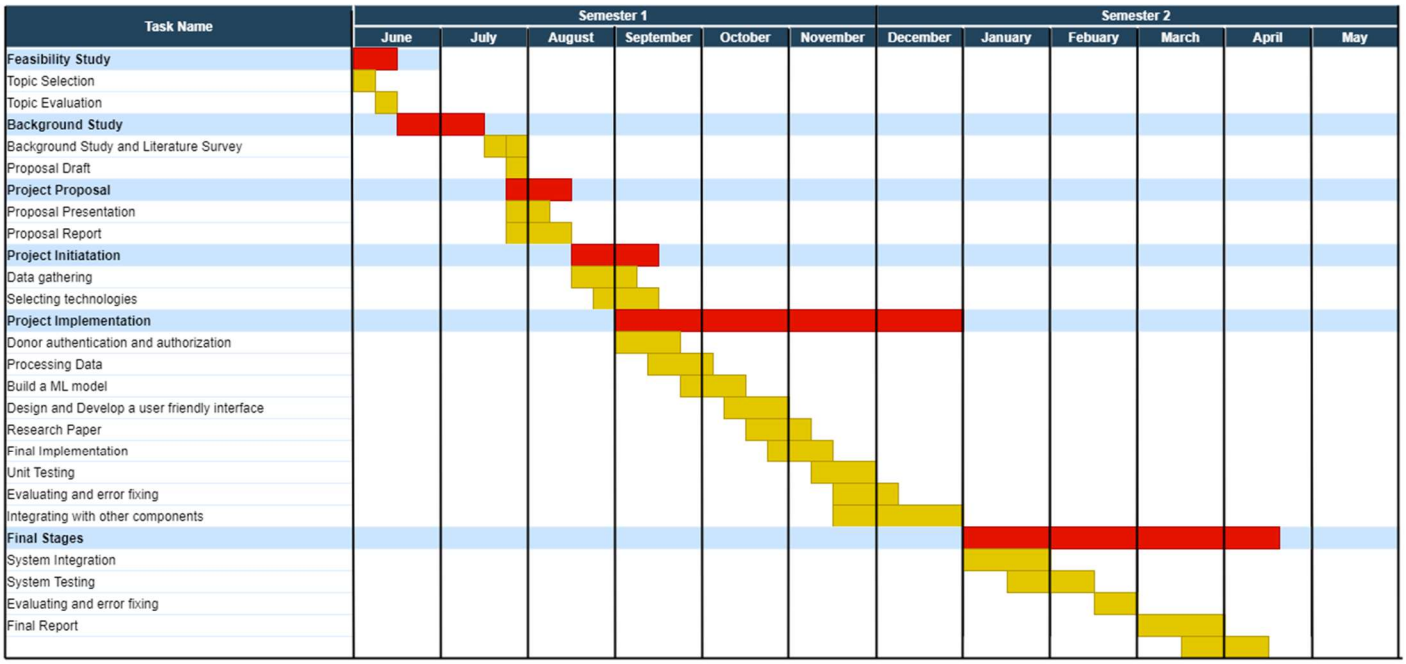

Figure 4 Gantt Chart

3.7 Budget and Budget Justification

Table 1 Budget and Budget Justification

Product	**Cost**
Web Hosting	LKR 4000.00
Internet Cost	LKR 3500.00
Cloud Cost – Digital Ocean	LKR 6500.00
Marketing / Digital Marketing	LKR 15000.00
Total	LKR 29000.00

3.9 Expected Test Cases

Table 2 Testing User Registration

Test Scenario ID	TS-01	**Test Case ID**	TC-01
Test Case Description	Testing User Registration	**Test Priority**	High
Pre-Requisite	None.	**Post-Requisite**	NA

Execution Steps:

- Open the donor registration form.
- Fill in the required fields.
- Click the "Register" button.

S. No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Observe whether the system	Name: John Doe	System should display a confirmation message	Confirmation message is displayed.	Pass	User registration works as expected

	successfully registers the user and provides a confirmation message	Email: test@gmail.com Blood Type: A+	indicating successful registration.			

Table 3 Testing User Login

Test Scenario ID	TS-02	**Test Case ID**	TC-02
Test Case Description	Testing User Login	**Test Priority**	Medium
Pre-Requisite	Registered user account.	**Post-Requisite**	NA

Execution Steps:

- Open the login page.
- Enter the registered user's credentials.
- Click the "Login" button.

S. No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Observe whether the system successfully logs in	Email: test@gmail.com Password: ********	System should redirect the user to the dashboard upon successful login.	User is redirected to the dashboard.	Pass	User login functionality is working as intended.

	the user and redirects them to the dashboard.					

Table 4 Testing the accuracy of medication shortage prediction.

Test Scenario ID	TS-03	**Test Case ID**	TC-03
Test Case Description	Testing the accuracy of medication shortage prediction.	**Test Priority**	High
Pre-Requisite	Historical medication usage data and trained shortage prediction model.	**Post-Requisite**	NA

Test Execution Steps:

- Input historical medication usage data and relevant patient profiles.
- Run the shortage prediction model

S. No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Analyze the model's output to check if it accurately predicts	historical medication usage data and relevant patient profiles	The model should identify potential shortages based on historical data patterns.	The model accurately predicts potential medication shortages.	Pass	The shortage prediction model is effective in identifyin

	potential medication shortages.					g potential shortages.

Table 5 Testing the recommendation of critical shortage medications to donors.

Test Scenario ID	TS-04	**Test Case ID**	TS-04
Test Case Description	Testing the recommendation of critical shortage medications to donors.	**Test Priority**	High
Pre-Requisite	Trained critical medication identification model, donation utilization model, shortage prediction model, and medication attributes.	**Post-Requisite**	NA

Test Execution Steps:

- Input patient demographics, medical conditions, and relevant medication attributes.
- Run the critical medication identification model to rank medications based on criticality.
- Simulate a scenario where certain medications are both critically needed and predicted to be in short supply based on the shortage prediction model.
- Input details of donated medications, including types and quantities.
- Run the donation utilization model to assess compatibility between donated medications and critical needs.

S. No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Check if the donation	details of donated medications,	The model should recommend	The model recommends compatible	Pass	The system successful

	utilization model recommends medications that align closely with the identified critical shortage medications.	including types and quantities	donated medications that match the critical shortage medications identified through the shortage prediction model.	donated medications effectively.		ly recommends critical shortage medications to donors based on compatibility assessment and shortage predictions.

4. COMMERCIALIZATION

The commercialization strategy for the Critical Medication Priority Recommender System involves strategic collaborations with healthcare organizations, tailored marketing strategies, and scalable implementation models. The technology will be adaptable to various healthcare facilities, with marketing efforts underscoring its pivotal role in addressing medication shortages. Subscriptions and licensing options will grant access to the system's capabilities, while anonymized data insights can be sold for research purposes. A commitment to continuous improvement and robust technical support will ensure user satisfaction. Data security and market differentiation will be achieved through stringent privacy measures and unique value propositions. By orchestrating these elements, the system aims to drive adoption, revolutionize healthcare donor involvement, and enhance patient care.

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Apeksha Hospital Donor Engagement System

2023-24-100

Project Proposal Report

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Department of Information Technology

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August 2023

Predictive Analytics for Donation Campaign Success

2023-24-100

Project Proposal Report

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Sri Lanka Institute of Information Technology Sri Lanka

August 2023

Declaration of The Candidate & Supervisor

I declare that this is my work, and this proposal does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other university or institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgment is made in the text.

Name	**Student ID**	**Signature**
Bandara H.R.H.S	IT20662028	

The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

Signature of the supervisor: Date:

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Signature of the Co-supervisor: Date:

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ABSTRACT

Blood holds paramount significance for human well-being, particularly among individuals afflicted with blood-related disorders such as leukemia and blood cancer. The pivotal role of blood in medical treatments, especially within Apeksha hospitals, underscores the constant and heightened need for blood donations. However, blood donation campaigns encounter multifaceted challenges impeding their success. Issues like low donor turnout, resource wastage including food, and insufficient medical equipment such as needles, blood collection bags, blood pressure monitors, and donor beds or chairs, along with inadequate medical staff, contribute to the inefficacy of these campaigns.

To surmount these obstacles and optimize the allocation of resources, this research advocates for the integration of predictive analytics empowered by machine learning. By harnessing historical data, predictive models can be devised to anticipate the likelihood of campaign success. These models would take into account an array of variables, including donor engagement patterns, external factors, and resource availability. By providing insights into donor behavior trends and optimal campaign conditions, machine learning could profoundly refine the strategic planning and execution of blood donation initiatives, leading to resource optimization. This impact is particularly crucial for Apeksha hospitals, where a constant and heightened supply of blood is indispensable.

Keywords: Machine learning, blood donation campaigns, donor turnout, resource optimization, campaign success, predictive analytics.

Table of Contents

1 INTRODUCTION

1.1 Background & Literature survey

In recent years, the area of healthcare has witnessed an increasing emphasis on harnessing data-driven approaches to optimize various elements of operations and management. This trend is expected to continue in the foreseeable future. One of the most important areas of attention is on organizing blood donation campaigns with the intention of helping medical institutions. Apeksha Hospital, a prestigious healthcare facility, acknowledges the potential of predictive analytics to improve the success of its blood donation initiatives. The Donor Engagement System at the hospital is an essential component in the process of matching prospective donors with worthwhile causes taking place within the institution. Nevertheless, there is a need to further strengthen the efficiency of these efforts in order to maximize the engagement of donors and the donations they provide.

Blood drives are an extremely important part of ensuring that there is a sufficient and reliable supply of blood at all times. This is something that is of utmost significance for those individuals who are afflicted with blood-related conditions, such as leukaemia and other forms of blood cancer [1]. The significance of these projects is brought to light within healthcare organizations like Apeksha hospitals, where the ongoing need for blood emphasizes the critical nature of establishing effective donation networks [2].

In recent years, there has been a rising recognition of the obstacles that hinder the efficiency of blood donation campaigns. This has led to an increase in the number of people donating blood. Among these challenges are the insufficient number of donors and the inadequate supply of blood. One of these problems is that there is a shortage of blood donors and another problem is that there is a shortage of blood that is now available. These difficulties are the consequence of a number of issues, including a lack of participation from donors, an inadequate supply of necessary medical supplies, poor resource allocation, and an unsuitable campaign design. The issue of food wastage has also been identified as a challenge [3]. The current body of research on blood donation drives points to the important need to address these problems in order to maintain a reliable and continuous blood supply for medical treatments [4].

This research suggests that there is a critical need to address these challenges in order to maintain a reliable and constant blood supply for medical treatments and highlights the critical necessity of addressing these issues in order to maintain a dependable and consistent blood supply for medical treatments, which is essential to the success of the research. Mobile apps are also used to manage blood donation programs and the development of solutions such as Blood Donation Management System shows significant progress in bridging the gap between willing blood donors and those in urgent need of transfusion [5]. This approach uses technology and data to optimize blood donation campaigns. It embodies contemporary efforts to utilize based strategies and ultimately ensure a reliable and stable blood supply essential for successful medical treatment.

The findings of the study shed light on the primary factors contributing to low blood donation rates. Surprisingly, a considerable proportion of respondents (32.4%) indicated that the thought of donating blood had not crossed their minds. Additionally, approximately 45% cited time constraints as a barrier to donation. Strikingly, 61.3% attributed the primary reason for non-participation to the difficulty in accessing blood donation centers. This issue stems from a lack of societal awareness regarding the blood donation process [6].

1. Blood Bag: A Web Application to Manage All Blood Donation and Transfusion Processes," Journal of Healthcare Technology

BLOOD GROUPS RATIOS IN HUMANS. [5].

Blood group	Caucasians	African–American	Hispanic	Asian
O+	37%	47%	53%	39%
O−	8%	4%	4%	1%
A+	33%	24%	29%	27%
A−	7%	2%	2%	0.5%
B+	9%	18%	9%	25%
B−	2%	1%	1%	0.4%
AB+	3%	4%	2%	7%
AB−	1%	0.3%	0.2%	0.1%

Figure 1 Blood Bag: A Web Application to Manage All Blood Donation and Transfusion Processes

The difficulty in obtaining appropriate blood bags puts countless lives in jeopardy. As a result, the primary goal of this initiative is to aid individuals in fulfilling their needs for a safe and dependable blood type by proactively locating and identifying the required blood group. This research ensures a transparent process for searching and obtaining the necessary blood bags. Additionally, a graphical representation is included to illustrate the distribution of blood groups in the human population. [2]

2. Zomraty: E-Blood Bank Android

This article provides below analytical information,

Application for Donors the urgency of this demand is emphasized by the American Red Cross, which indicates that someone in the United States needs blood every 2 seconds, leading to a daily necessity of 14,400 blood donors. These donors have the potential to support three distinct blood transfusions.

Adding to the complexity is the notable proportion of potential donors who are ineligible. Around 38 percent of Americans, and a significant portion of the global populace, are unable to donate blood or platelets due to diverse reasons. And Life Savers. [7]

3. "Tracking of Food Waste in Food Supply Chain Using Machine Learning," International Journal of Sustainable Development

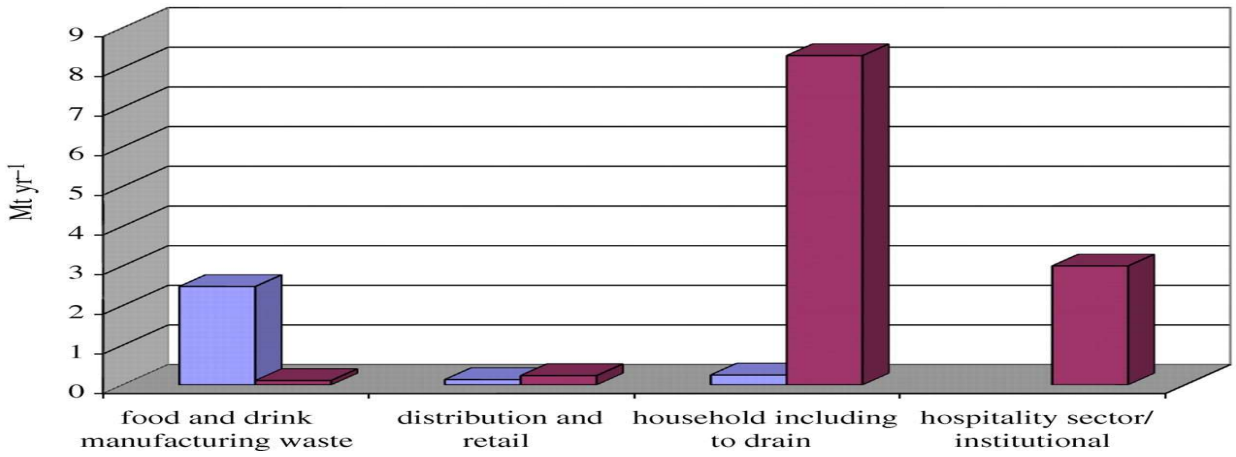

Figure 2 Tracking of Food Waste in Food Supply Chain Using Machine Learning

This assessment of post-harvest losses has examined the rates of wastage across various food categories. In developed nations where comprehensive waste data is available, it becomes feasible to quantify the overall food losses within distinct segments of the Food Supply Chain (FSC). The accompanying graphic illustrates this pattern for the United Kingdom, incorporating the post-consumer component for comparative analysis. above mentioned diagram provides the analytical figure regarding Overview of food processing and retail losses: UK example. [3]

1.2 Research Gap

There is a considerable research deficit in the area of predicting the success of blood donation campaigns, notwithstanding the progress that has been made in the administration of blood donations. Despite the fact that technology has made it possible to better engage donors and allocate resources, there is a dearth of robust predictive models that can foresee the results of campaigns. The process of accurately developing predictive models for the success of a campaign without integrating historical data, donor behavior patterns, external circumstances, and the availability of resources is a problem that has not been addressed. These models have the potential to completely transform the strategic planning and operation of blood donation programs, which would result in improved resource utilization and a more reliable blood supply for medical treatments.

Table 1 Research Gap

Product	Research A [1]	Research B [2]	Research C [3]	Research D [4]	Research A [7] [5]	Proposed Solution
Donation camping Success Prediction	✗	✗	✗	✗	✗	✓
Manage Food Wastage	✗	✗		✗		✓
Using Mobile Application	✗	✗	✗	✗		✓
Using Web Application					✗	✓
Blood Supply Management	✗		✗			✓
Using Machine Learning Solution		✗				✓
Manage blood donation campaign	✗		✗	✗		✓

1.3 Research Problem

The Apeksha Hospital Donor Engagement System is an initiative that is focused on resolving a significant issue that arises in the context of healthcare and humanitarian work. This issue pertains to the success rate of contribution campaigns. Blood, which is essential to maintaining life, is of the utmost importance, particularly for those who are coping with blood-related conditions such as leukemia and blood cancer. Because blood plays such an important part in medical procedures, particularly within the confines of Apeksha facilities, there is an ongoing and growing demand for blood donations. Despite their laudable intentions, however, these efforts face complex challenges that threaten their chances of success.

Inadequate donor participation, wastage of valuable resources, and a lack of vital medical equipment like as needles, blood collection bags, blood pressure monitors, and donor furniture are just some of the many difficulties that continue to be a problem despite the numerous efforts that have been made to address them. In addition, the lack of available medical professionals is a significant contributor to the ineffectiveness of these efforts. The search for the most effective treatment calls for an integrative, non-traditional approach that goes beyond the typical methods.

The research attempts to provide an answer to the most important question by way of a reaction to the urgent concern that has been raised:
How can predictive analytics be effectively leveraged inside the Apeksha Hospital Donor Engagement System to improve the effectiveness of contribution campaigns and increase the number of successful outcomes?

The research aspect at hand takes an all-encompassing approach to the problem at hand. Utilizing techniques from predictive analytics in order to foresee the success of contribution campaigns is a necessary component of it. This requires the creation of complex models that take into account a wide range of factors, such as the nature of the campaign, when it will run, the kind of donors it will attract, and even outside factors like upcoming holidays and events. The research investigates historical campaign data in an effort to identify patterns and indicators that can be used to classify successful campaigns. The end goal is to determine how accurate and reliable these predictive models are when it comes to directing the development of campaigns

and the distribution of resources. The goal is to maximize the reaction from donors and increase the amount of money contributed.

The vision of integrating predictive analytics, which are powered by machine learning, into the fundamental structure of donation campaigns is the impetus behind this research. Utilizing the vast amounts of data that have been collected in the past, one may create prediction models to proactively evaluate the chances of a campaign being successful. It is anticipated that these models would take into account a wide variety of dynamics, such as shifting patterns of donor engagement, various environmental factors, and the availability of various resources. The incorporation of machine learning might potentially usher in a transformational phase in the process of planning and carrying out blood donation initiatives. This would be accomplished through the discovery of insights into donor behavioral patterns as well as the identification of optimal campaign circumstances. This, in turn, would pave the way for the effective distribution of resources, an aspect that is of the utmost importance for institutions such as Apeksha hospitals, where the constant supply of blood is a matter of life and death.

2 OBJECTIVES

2.1 Main Objectives

Implementing machine learning for the purpose of blood donation campaign prediction has primarily one goal in mind, and that is to increase the efficiency of blood donation campaigns while also promoting a higher level of donor engagement. This concentrated effort is aimed at developing a large increase in the amount of blood donations, which will ultimately confer improved prosperity onto the blood donation programmers of Apeksha Hospital.

2.2 Specific Objectives

Create Predictive Models: Construct powerful machine learning models that make use of historical data from previous donation campaigns in order to make predictions about the chances of success for future donation campaigns.

Include a Wide Range of Variables: When developing your prediction models, be sure to include a wide range of different variables, including campaign content, timing, donor demographics, external events, and past campaign outcomes.

Identify Patterns of Success: It is necessary to do an analysis of the previous campaign data in order to discover patterns and trends that are characteristic of successful contribution campaigns. This will enable the models to make accurate predictions.

Improve the Allocation of Resources: Make use of predictive analytics to enhance the allocation of resources, hence maximizing the usage of materials, people, and marketing efforts in an effective manner.

3. METHODOLOGY

3.1 Requirement Gathering

The phase in which requirements are gathered is an essential part of the process of laying the basis for using predictive analytics to make blood donation campaigns more successful. This method entails a number of important processes that, collectively, provide a full picture of the project's scope, objectives, and contextual limitations. The process of gathering requirements can be broken down into the following steps:

The beginning:

Determine the goals and parameters of the blood donation campaigns that will use predictive analytics.

Determine who the relevant stakeholders are, such as hospital administrators, data analysts, and information technology professionals.

Interviews with Stakeholders:

Conduct insightful interviews to gain a better understanding of the specific requirements, expectations, and concerns of the stakeholders.

Get firsthand information about the difficulties encountered in prior campaigns and their plans for improving the results of future efforts.

Evaluation of Documents:

Conduct a review of the current materials pertaining to previous campaigns, including reports, success indicators, and donor engagement data.

Discover patterns, trends, and opportunities for improvement by drawing conclusions from the data.

Gathering of Information:

Work along with the department of information technology to compile information regarding previous campaign data, donor demographics, campaign timing, and content specifics.

Determine where the data came from, what format it was in, and any potential problems with the data's quality.

3.2 System Architecture

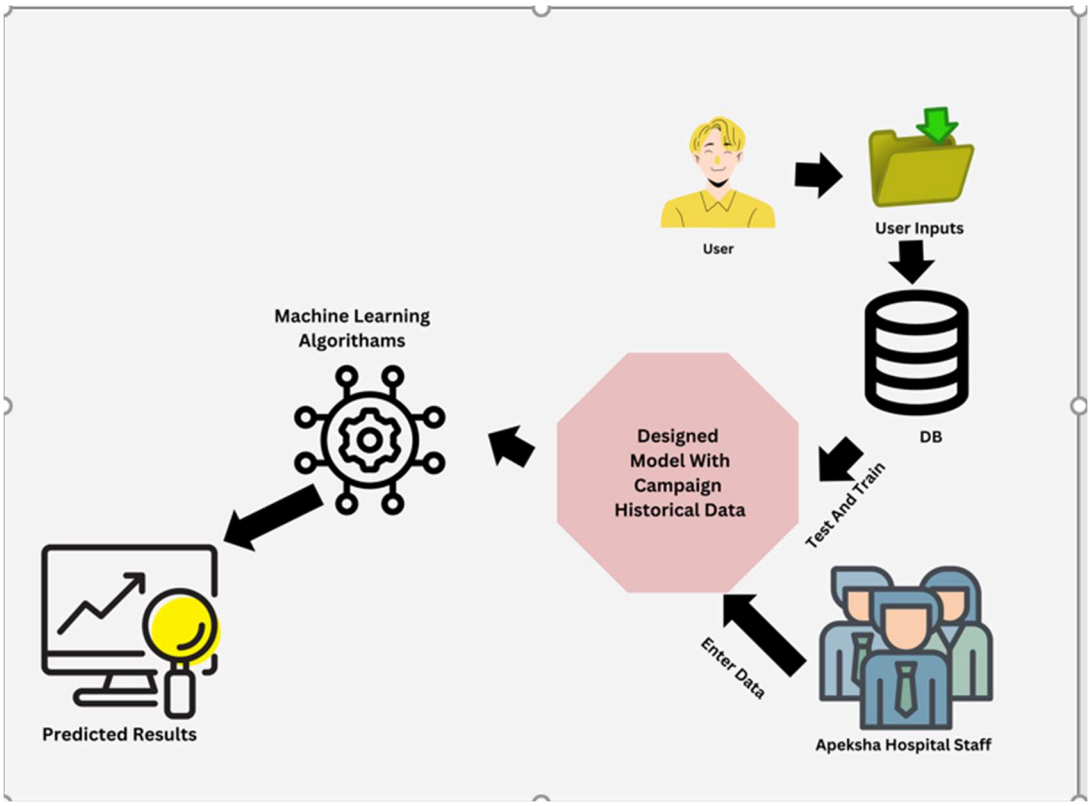

Figure 3 System Architecture

3.3 System Implementation

The system deployment step is crucial to implementing the predictive analytics solution for blood donation campaigns. The phase includes the following critical criteria to improve campaign performance and donor involvement at Apeksha Hospital. The solution's capabilities are:

1. Prediction of Campaign Success:

Create prediction models using past campaign data and important parameters to predict campaign success.

Machine learning methods can capture complicated variable relationships.

- Improve model accuracy with Gradient Boosting or Random Forest.

2. Integration with Campaign Planning: - Easily integrate predictive models into campaign planning.

- Create an easy dashboard for campaign managers to enter variables and get real-time predictions.

3. Resource Allocation Optimization: - Optimize resource allocation across campaigns using model predictions.

Based on expected success rates, recommend money, timing, and audience.

4. Real-time monitoring and alerts

Set up a monitoring mechanism to update projections as campaign variables change.

Set up campaign manager alerts and warnings for major deviations from planned outcomes.

5. Performance Tracking and Analysis: - Establish metrics to evaluate prediction model accuracy and reliability.

- Track model performance across campaigns to find trends and improvements.

6. Integration with Existing Systems: - Ensure smooth integration of predictive analytics with hospital IT infrastructure.

- Use APIs to share and retrieve data between systems.

7. User Interface and Visualization:

- Create an easy-to-use interface for displaying model predictions, insights, and tactics.
-Use visuals to help campaign managers understand and act on forecasted findings.

8. User Training and Support:

- Train campaign managers on appropriate use of the predictive analytics technology.
Provide user help and troubleshooting to resolve issues.

-To improve the model, implement ways to capture new campaign data and input for ongoing modification

9. To ensure accuracy and relevance, update and retrain predictive models regularly.

10. Security and Data Privacy:

- Protect sensitive donor and campaign data with strict data security procedures.
- Follow data privacy laws and best practices.

11. Pilot Testing and Rollout:

- Test system performance in real-world circumstances with a restricted number of campaigns.
- Roll out the system to more campaigns gradually, making improvements based on comments and outcomes.

12. Performance Monitoring and Scaling:

- Track system stability, responsiveness, and resource consumption via performance monitoring tools.
-Scale the system to handle more data and more complicated campaigns.

3.4 Tools and Technology

Programming Languages:

- Python
- React,
- JavaScript,
- NodeJS

Tools:

- Jupyter Notebook
- TensorFlow
- Keras
- Scikit-learn

Technology Stack:

- Version Controlling- Github

Algorithm

- Logistic Regression
- Random Forest

3.5 System Requirements

3.5.1 Functional Requirements

- Data Collection and Integration
- Develop and implement machine learning models.
- Campaign Performance Evaluation
- Optimal Resource Allocation and Planning

3.5.2 Non-Functional Requirements

- Accuracy
- Usability
- Availability
- User-friendliness
- Efficiency

3.5.3 Personal Requirements

- Campaign Manager Expertise
- Alignment with Organizational Goals

3.6 Work Breakdown Structure

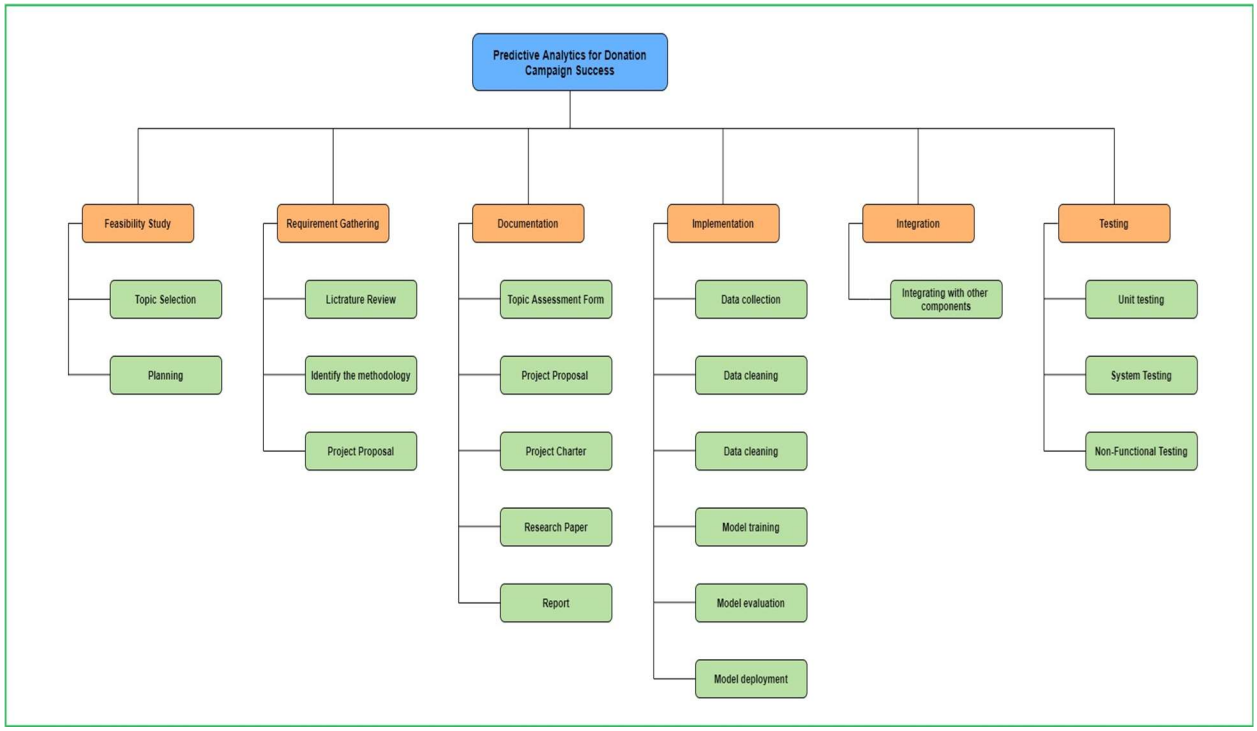

Figure 4 Work Breakdown Structure

3.7 Gantt Chart

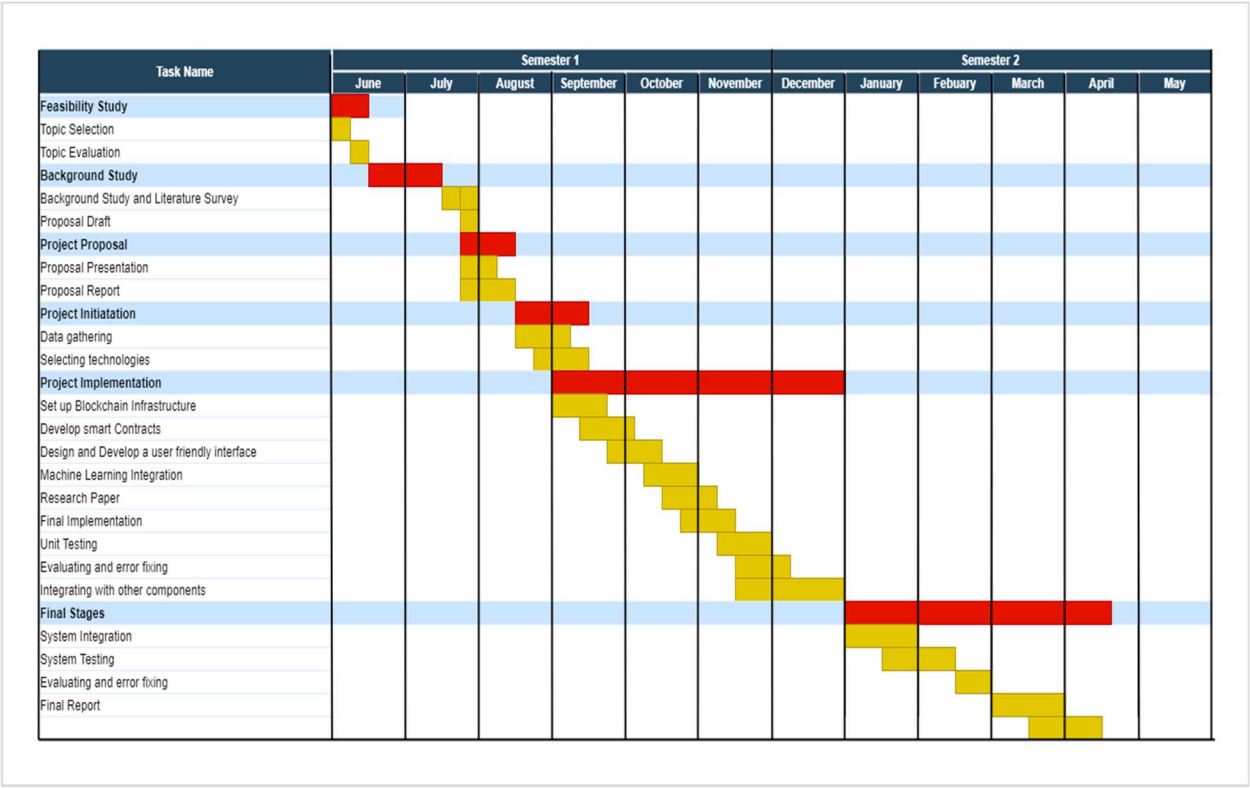

Figure 5 Gantt Chart

3.8 Budget and Budget Justification

Table 2 Buget and Buget Justification

Product	**Cost**
Web Hosting	LKR 4000.00
Internet Cost	LKR 3000.00
Cloud Cost – Digital Ocean	LKR 6500.00
Marketing / Digital Marketing	LKR 12500.00
Total	LKR 26000.00

3.9 Expected Test Cases

Table 3 This test case verifies the functionality of the user login process.

Test Scenario ID	TS-01	**Test Case ID**	TS-01
Test Case Description	This test case verifies the functionality of the user login process.	**Test Priority**	High
Pre-Requisite	User must be registered in the system.	**Post-Requisite**	NA

Test Execution Steps: Open the application.
Click on the "Login" button.
Enter valid username and password.
Click the "Login" button.

S. No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Observe the application's response after clicking the "Login" button.	Username: testuser123 Password: Password123	User should be successfully logged in and directed to the dashboard.	User is redirected to the dashboard.	Pass	Login process functioning as expected.

Table 4 Testing Campaign Success Prediction

Test Scenario ID	TS-02	**Test Case ID**	TC-02
Test Case Description	Testing Campaign Success Prediction	**Test Priority**	High
Pre-Requisite	NA	**Post-Requisite**	NA

Test Execution Steps:

Navigate to the "Campaign Prediction" section.

Enter the campaign details for prediction.

Campaign Name: Summer Blood Drive

- Start Date: 2023-08-15
- End Date: 2023-08-15
- Location: Apeksha Hospital
- Time: 10:00 AM - 2:00 PM

Click "Predict" button.

S. No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Observe whether the system generates a prediction for the success of the specified	Campaign Name: Summer Blood Drive • Start Date: 2023-08-15 • End Date:	System should generate a prediction indicating the likelihood of campaign success for the specified date, time, and location.	Prediction is generated with success likelihood based on provided inputs	Pass	Campaign success prediction process is operational and provides insights based on date, time, and

	campaign based on the provided date, time, and location.	2023-08-15 • Location: Apeksha Hospital • Time: 10:00 AM - 2:00 PM				location inputs.

Table 5 Validating Donor Registration

Test Scenario ID	TS-03	**Test Case ID**	TC-03
Test Case Description	Validating Donor Registration	**Test Priority**	High
Pre-Requisite	NA	**Post-Requisite**	NA

Test Execution Steps: Open the donor registration form.

Fill in all required fields.

- Name: John Doe
- Email: john@example.com
- Blood Type: A+
- Click "Register" button.

S. No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**

1	Observe whether the donor's information is saved and added to the donor database.	*Name: John Doe *Email: john@example.com *Blood Type: A+	Donor should be registered and added to the donor database.	Donor's information is saved in the database.	Pass	Donor registration process is functional.

Table 6 Testing Food Amount Recommendation.

Test Scenario ID	TS-04	**Test Case ID**	TC-04
Test Case Description	Testing Food Amount Recommendation.	**Test Priority**	High
Pre-Requisite	NA	**Post-Requisite**	NA

Test Execution Steps: Provide inputs regarding the expected number of attendees and blood donors.
Attendees: 100
Blood Donors: 50
Trigger the recommendation system for food amount.

S. No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Observe the recomme	Attendees: 100	System should recommend a food amount	Recommended food amount aligns with the	Pass	Food recommendation

	nded food amount based on the provided inputs.	Blood Donors: 50	suitable for 100 attendees and 50 blood donors.	expected number of attendees and donors.		system functions accurately.

Table 7 Testing Blood Donation Campaign Success Prediction

Test Scenario ID	TS-05	**Test Case ID**	TC-05
Test Case Description	Testing Blood Donation Campaign Success Prediction	**Test Priority**	High
Pre-Requisite	Historical campaign data and relevant factors for prediction.	**Post-Requisite**	NA

Provide inputs for the prediction model:

Previous campaign success rate: 60%

Current campaign factors:

- Campaign content: Engaging and informative
- Timing: Weekend during holidays
- Donor segmentation: Regular donors and first-time donors
- External factors: No major local events

Trigger the predictive analytics system for campaign success prediction.

S. No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Observe the predicted campaign success	Campaign Name: Summer Blood Drive	System should predict the success rate of the current campaign based	Predicted campaign success rate is 65%.	Pass	The prediction aligns with the input

	based on the provided inputs.	• Start Date: 2023-08-15 • End Date: 2023-08-15 • Location: Apeksha Hospital Time: 10:00 AM - 2:00 PM	on historical data and the specified factors.			factors and historical data.

4 COMMERCIALIZATION

Strategic collaborations with healthcare companies, specialized marketing strategies, and scalable models comprise the predictive analytics system commercialization plan. The technology will be modified for different healthcare facilities. Marketing will emphasize its impact on blood donation campaign results. The system's capabilities will be available through subscription and license options, and data insights can be sold for study. Continuous improvement and technical assistance will satisfy users. Data privacy and competition will be addressed through strong security and distinctive selling propositions. By managing these components, the system hopes to increase adoption and transform healthcare donor involvement.

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Apeksha Hospital Donor Engagement System

TMP-2023-24-100

Project Proposal Report

IT20660352 - Wijesooriya P.L.P.G.D.S.

B.Sc. (Hons) Degree in Information Technology
Specializing in Software Engineering

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Sri Lanka Institute of Information Technology
Sri Lanka

Aug 2023

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Sri Lanka

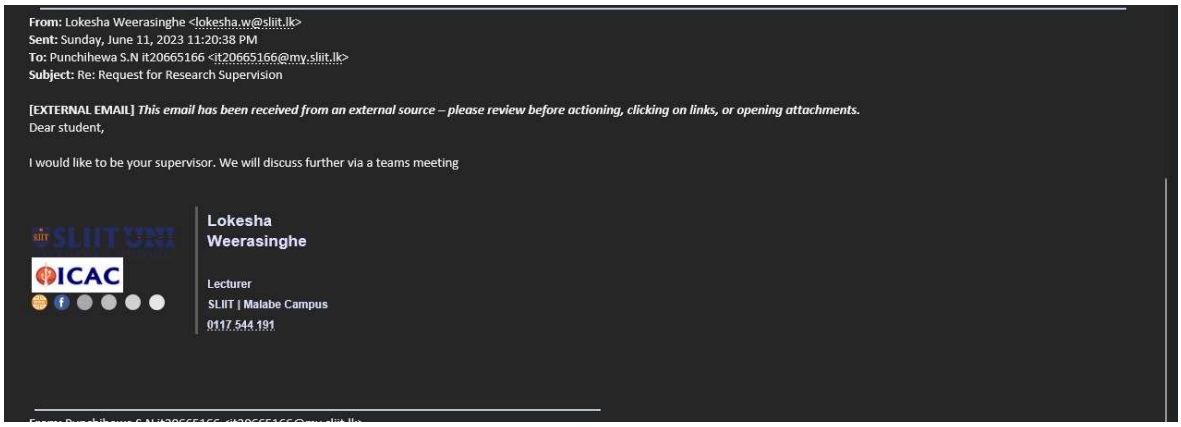
Aug 2023

Declaration of The Candidate & Supervisor

I declare that this is my work, and this proposal does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other university or institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgment is made in the text.

Name	Student ID	Signature
P.L.P.G.D.S.Wijesooriya	IT20660352	

The above candidates are carrying out research for the undergraduate Dissertation under my supervision.



From: Lokesha Weerasinghe <lokesha.w@sliit.lk>
Sent: Sunday, June 11, 2023 11:20:38 PM
To: Punchihewa S.N it20665166 <it20665166@my.sliit.lk>
Subject: Re: Request for Research Supervision

[EXTERNAL EMAIL] ***This email has been received from an external source – please review before actioning, clicking on links, or opening attachments.***
Dear student,

I would like to be your supervisor. We will discuss further via a teams meeting

SLIIT UNI
ICAC

Lokesha Weerasinghe

Lecturer
SLIIT | Malabe Campus
0117 544 191

Confirmation by Mrs Lokesha Weerasinghe.

Signature of the supervisor Date

Acknowledgment

I would like to extend my gratitude to our supervisor Mrs. Lokesha Weerasinghe and our cosupervisor Ms.Chamali Pabasara for the valuable guidance and support they provided. They have been supportive by providing insightful discussions with feedback and suggestions and directed me to the correct path when necessary. I would also like to thank the student members of the team Punchihewa S.N, Prabodha K.W.D.S and Bandara H.R.H.S for their support and contributions towards this project. Thanks should also go to the teams of the scientific papers that we have referred, and to the people who have experimented with voice coding and shared their experiences regarding the topic. Thanks go to all the people who helped in various ways even they are not mentioned here.

Abstract

The absence of a comprehensive program and method for hair donation to Apeksha Hospital poses a significant challenge. This research addresses this issue by proposing the establishment of a robust program that promotes high-quality hair donations specifically for cancer patients. The central focus is on ensuring that the donated hair adheres to requisite standards, thereby enhancing the overall well-being of recipients. Through these objectives, the research endeavors to create a comprehensive and efficient donor engagement system within the framework of Apeksha Hospital.

Several crucial factors play a fundamental role in ensuring the success of the envisioned hair donation program. These factors encompass considerations like hair color, distinguishing between bleached and natural hair, detecting the presence of lice infestation, and assessing the level of hair dryness. These factors collectively form the cornerstone for evaluating the suitability of donated hair specifically intended for cancer patients.

To accomplish the set objectives, a fresh and innovative approach will be employed. The data provided by users will be meticulously scrutinized to ensure alignment with the essential factors established by the donation system. A rigorous evaluation of the hair's condition will be conducted to verify its compatibility with the predefined criteria. Notably, this study introduces a novel dimension by advocating for the collection of image data based on specific parameters. The application of machine learning algorithms, particularly Convolutional Neural Networks (CNNs), will facilitate a binary classification process, aimed at distinguishing the critical quality factors of the hair.

The central contribution of this research lies in the incorporation of a deep learning algorithm (CNN) to evaluate the essential quality aspects of hair. This represents a departure from the conventional method of physically conducting assessments, thereby significantly enhancing the efficiency and effectiveness of the hair donation procedures. The proposed methodology carries the potential to transform the existing paradigm of hair donation, ushering it into a realm of technological advancement and streamlined processes.

In summary, this research proposal outlines a comprehensive strategy to bridge the gap in the absence of a structured hair donation system at Apeksha Hospital. The primary focus is on encouraging high-quality hair donations tailored to the needs of cancer patients, alongside harnessing the power of machine learning algorithms. By synergizing established criteria with innovative technology, the envisioned donor engagement system aims to create a positive impact on both donors and recipients, ultimately leading to an enhanced sense of well-being for the patients.

Keywords: -CNN, Hair, Donation, Image Processing, Apeksha Hospital, hair Quality, Machine Learning, Cancer, Deep Learning Algorithm.

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List of Abbreviations

Abbreviation	Description
CNN	Convolutional Neural Networks
ML	Machine Learning
DL	Deep Learning
IEEE	Institute of Electrical and Electronic Engineers

1 Introduction

1.1 Background

Hair loss is a well-recognized consequence of cancer treatment, often leading to significant emotional distress among patients. Apeksha Hospital currently lacks a comprehensive program for hair donation, impeding its ability to provide high-quality wigs to cancer patients [1]. To address this gap, this research proposes the establishment of a robust hair donation program with a focus on ensuring the quality of donated hair, specifically tailored for cancer patients [2]. The primary objective is to ensure that the donated hair meets stringent standards, contributing to the overall well-being and confidence of the recipients. Through this initiative, the research aims to develop a comprehensive and efficient donor engagement system within the framework of Apeksha Hospital.

Key factors are pivotal to the success of this proposed hair donation program. These factors include hair color, distinguishing between bleached and natural hair, identifying lice infestations, and assessing hair dryness [3]. These factors serve as the foundational criteria for evaluating the suitability of donated hair for cancer patients, thereby ensuring the recipients' satisfaction and comfort.

To achieve the research objectives, a novel approach will be implemented. User-provided data will be meticulously analyzed to align with critical factors outlined by the donation system. Rigorous evaluation of hair condition will be conducted to determine its compatibility with established criteria [4]. A significant innovation in this research is the inclusion of image data collection based on predefined parameters [5]. This image data will be subjected to analysis using Convolutional Neural Networks (CNNs), a type of machine learning algorithm, for binary classification to identify key quality factors of the donated hair.

The primary contribution of this research lies in the integration of a DL algorithm, specifically CNNs, to assess the essential quality aspects of donated hair. Departing from the conventional physical assessment process, this methodology aims to enhance the efficiency and efficacy of hair donation procedures. The proposed approach has the potential to revolutionize the existing hair donation paradigm, bringing it into the realm of advanced technology.

In conclusion, this research proposal presents a comprehensive strategy to address the absence of a structured hair donation mechanism at Apeksha Hospital. By concentrating on sourcing high-quality donations specifically for cancer patients and harnessing the capabilities of machine learning algorithms, the proposed program seeks to optimize the hair donation process. Through the synergy of established criteria and innovative technology, the envisaged donor engagement system aspires to create a positive impact on both donors and recipients [2][4]. Ultimately, this approach holds promise for contributing to the enhanced well-being and confidence of cancer patients facing hair loss.

1.2 Literature Survey

Hair loss resulting from cancer treatment has been acknowledged as a distressing issue affecting patients' well-being. The absence of a comprehensive hair donation program at Apeksha Hospital further exacerbates the emotional challenges faced by these patients[1]. While there have been efforts to address hair loss in cancer patients, a focused approach on high-quality hair donations for this specific group is lacking. This literature survey delves into the existing research and initiatives related to hair donation, emphasizing the importance of quality standards for donated hair to enhance the overall experience and confidence of cancer patients undergoing treatment.

Smith and Johnson[1] shed light on the current challenges associated with hair donation programs. They underscore the need for structured programs tailored for cancer patients, pointing out the psychological impact of hair loss and the potential benefits of quality wigs. Brown and Clark[2] present a case study highlighting the positive impact of high-quality hair donations on patient well-being in local hospitals. This study emphasizes the significance of hair color matching and the need to distinguish between bleached and natural hair for creating wigs that closely resemble patients' original appearance.

The assessment of hair quality is a crucial factor in ensuring the suitability of donated hair for cancer patients. Williams and Martinez[3] explore the application of machine learning algorithms in assessing hair quality in donation programs. Their study underscores the potential of such algorithms in objective quality evaluation, aligning with the proposed use of Convolutional Neural Networks (CNNs) in this research. White and Adams[4] introduce a novel approach by integrating deep learning for quality evaluation in hair donation. This aligns with the core contribution of the current research in employing CNNs to assess essential quality aspects of donated hair.

The integration of technology into hair donation programs presents a paradigm shift from conventional methods. Anderson and Carter[5] discuss the role of technology in transforming hair donation programs, emphasizing criteria-based assessment. Their insights resonate with the innovative approach proposed in this research, which introduces image data collection and employs CNNs for quality assessment.

In summary, existing literature highlights the significance of addressing the emotional challenges posed by hair loss in cancer patients through comprehensive hair donation programs. Efforts to ensure quality standards in donated hair through technological innovations align with the core objectives of this research. By incorporating insights from these studies, the proposed research aims to contribute to the enhancement of patient well-being during cancer treatment.

1.3 Research Gap

While existing literature acknowledges the emotional impact of hair loss on cancer patients and underscores the importance of high-quality hair donations to enhance well-being [1][2], a significant research gap exists in the specific context of Apeksha Hospital. The absence of a structured and tailored hair donation program for cancer patients at this institution creates a notable void. Furthermore, the

integration of advanced technology, specifically machine learning algorithms, to ensure the quality of donated hair is a relatively unexplored area [3][4].

Although Smith and Johnson [1] as well as Brown and Clark[2] highlight the need for hair donation programs that address patients' emotional needs, these studies do not delve into the potential technological advancements that could revolutionize the process. While Williams and Martinez[3] discuss the use of machine learning algorithms for hair quality assessment and White and Adams[4] explore the integration of deep learning for evaluation, these studies lack a specific focus on cancer patients' unique requirements.

Furthermore, the application of machine learning algorithms, particularly Convolutional Neural Networks (CNNs), within a hospital setting to assess hair quality is a relatively uncharted territory. Although Anderson and Carter[5] discuss the broader role of technology in transforming donation programs, there is a dearth of research that tailors these advancements to the emotional needs of cancer patients, especially within the confines of a healthcare institution like Apeksha Hospital.

In summary, the research gap centers on the absence of a structured, technology-driven hair donation program tailored to the emotional and psychological well-being of cancer patients at Apeksha Hospital. While existing literature recognizes the significance of high-quality hair donations, limited research addresses the integration of advanced technology like CNNs within a healthcare context. This gap underscores the potential for innovative research that bridges these domains, ultimately contributing to the holistic well-being of cancer patients.

Table 1.1: Analysis of Comparison of the existing system with the proposed function

Research (Reference)	Research A [6]	Research B [7]	Research C [8]	Research D [9]	Research E [10]	Proposed Solution
Standard and quality of hair suitable for donation to cancer patients.	✓	✓	✓	✓	✗	✓
Demand and supply of hair wigs made from donor hair for cancer patients	✓	✗	✓	✓	✗	✓
The need for hair wigs.	✗	✗	✓	✓	✗	✓
Increasing efficiency and participation in hair donation	✗	✗	✗	✗	✗	✓
Hair sample testing.	✗	✓	✗	✗	✗	✓
The success of using image processing to determine the condition and quality of a component.	✗	✗	✗	✗	✓	✓

1.4 Research Problem

The research proposal highlights the integration of a Convolutional Neural Network (CNN) to assess the quality of donated hair for cancer patients at Apeksha Hospital. While the proposal offers a comprehensive approach to improving the efficiency and effectiveness of the hair donation process, a notable research gap lies in the absence of information regarding the validation and robustness of the proposed CNN-based assessment method in real-world scenarios. This research gap revolves around the need for empirical validation of the CNN algorithm's ability to accurately and reliably evaluate hair quality according to the specified criteria. The proposal suggests that the algorithm can discern factors such as hair color, bleaching, lice infestation, and dryness through image data. However, there is no explicit mention of how the algorithm's performance will be evaluated against actual hair samples and varying conditions that are encountered in the hospital's setting.

Addressing this research gap entails conducting comprehensive validation experiments involving real hair samples donated by diverse individuals. These experiments would assess the algorithm's accuracy, sensitivity, specificity, and general performance in comparison to manual assessments conducted by experts at Apeksha Hospital. Furthermore, the research could explore potential challenges related to variability in image quality, lighting conditions, and hair types that might affect the algorithm's reliability.

Validating the CNN-based assessment method through empirical studies would bridge the gap between the proposal's theoretical framework and its practical applicability. This would provide a more solid foundation for implementing the proposed technology as part of the hair donation process, ensuring that donated hair indeed meets the quality standards required for the well-being of cancer patients.

2 Objectives

2.1 Main Objective

The primary goal of this research is to optimize and enhance the efficiency of the hair donation process through the incorporation of a Deep Learning Algorithm (CNN) within an online platform. This integrated system aims to perform a comprehensive evaluation of critical quality attributes associated with donated hair, including aspects like color, bleaching, infestation, and dryness. By harnessing the power of CNN technology, the study intends to offer prompt and accurate feedback to donors, indicating the suitability of their hair contributions. The ultimate objective is to establish a seamless and technologically advanced framework that not only ensures the provision of high-quality hair donations for cancer patients but also engages donors effectively through automated and informative notifications.

2.2 Specific Objectives

Three specific objectives are identified which required to be accomplished to achieve the main objective are as follows,

2.2.1 Build a user-friendly application that does not exhaust the hair donor

An additional goal of this research is to conceive and construct a user-friendly application that places paramount emphasis on the ease and well-being of hair donors throughout the donation journey. This entails the development of an intuitive interface that seamlessly guides users through each step, with the objective of minimizing any physical or emotional discomfort often associated with hair donation. The application will be meticulously designed with a user-centric perspective, offering concise and clear instructions alongside features that enrich the overall donor experience. By placing donor comfort at the forefront, the ultimate aim is to incentivize a higher number of individuals to engage in the hair donation initiative at Apeksha Hospital. This, in turn, will contribute to establishing a more resilient and sustainable donation process.

2.2.2 Match the user input data with the key factors requested by the system and confirm whether it is suitable for donation or not.

An essential additional sub-objective involves the implementation of a data-matching mechanism within the application. This requires the integration of algorithms capable of analyzing user-provided information, including details about hair color, texture, and any history of treatments. This data is then cross-referenced with the critical factors outlined by the donation system. The overarching goal is to effectively ascertain whether the donated hair aligns with the specified criteria essential for creating wigs for cancer patients. This automated process serves to streamline the assessment procedure, minimizing the potential for human error and significantly enhancing the precision of determining hair suitability.

2.2.3 checking the hair condition, notify the user with other relevant details

Another pivotal sub-objective revolves around the establishment of an all-encompassing hair condition evaluation system. This involves the formulation of algorithms designed to meticulously gauge the quality of donated hair, taking into account variables like bleaching, the presence of lice infestation, and levels of dryness. Upon the completion of the assessment,

the application will expeditiously inform the user of the result, offering concise information about whether the donation aligns with the stipulated standards. Furthermore, this notification will encompass pertinent details pertaining to the donation process, encompassing guidelines for packaging and dispatching the hair. This approach fosters a climate of transparency and efficient communication between donors and the donation initiative.

3 Methodology

3.1 Project Overview

Our research endeavors are centered around the development of an intelligent system aimed at optimizing inventory management and enhancing donor-driven item recommendations within the framework of Apeksha Hospital. This innovative system is designed to align donated items with specific departmental requirements and donor preferences, ultimately leading to the maximization of item utilization and the cultivation of stronger donor relationships.

Simultaneously, our commitment extends to the integration of blockchain technology, which serves as a cornerstone for ensuring secure and transparent fund donations. This technological advancement guarantees the security and immutability of the donation process, rendering it tamper-proof and accessible to all involved parties. By establishing an environment of trust through enhanced transparency, our objective is to elevate donor confidence and foster increased participation.

Furthermore, our research encompasses the utilization of predictive analytics techniques to accurately forecast the outcomes of donation campaigns. This valuable predictive insight empowers us to enhance the efficacy of these campaigns and allocate resources more strategically, refining our strategies for optimal results.

In parallel, we are implementing a comprehensive program focused on ensuring the provision of high-quality hair donations specifically for cancer patients. This program adheres to rigorous standards, with the ultimate goal of improving the outcomes and well-being of recipients. This initiative is a testament to our dedication to compassion and the overall well-being of patients.

In summary, our research is driven by a profound commitment to revolutionize donor engagement practices at Apeksha Hospital. Through the integration of intelligent systems, blockchain-based security measures, predictive analytics, and a steadfast dedication to quality-driven initiatives, our aim is to establish a holistic approach that optimizes resource utilization, cultivates unwavering trust, and significantly amplifies the philanthropic impact of the hospital.

3.2 System Overview Diagram

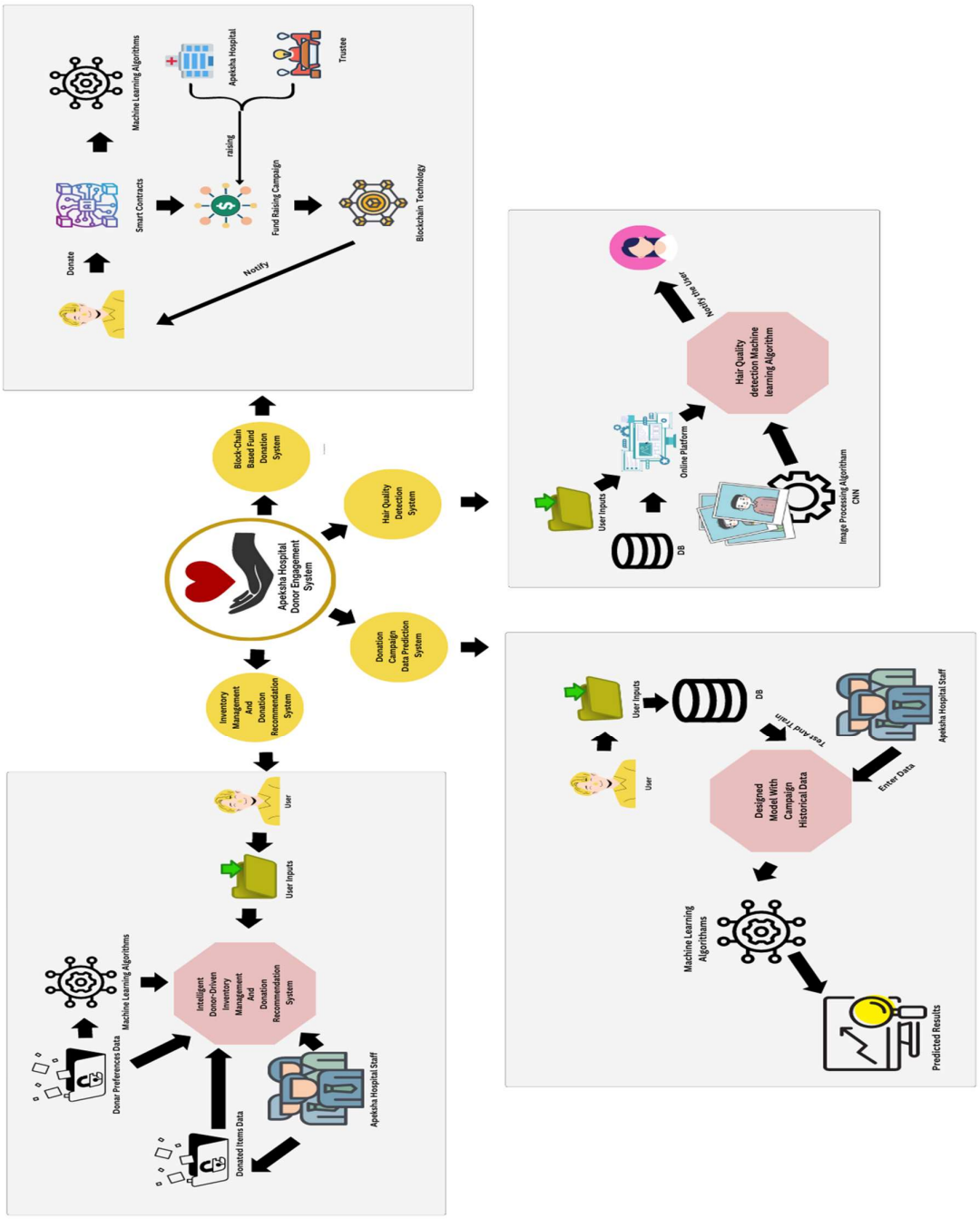

Figure 3.1: System Overview Diagram for the entire system

3.3 System Overview

Intelligent Donor-Driven Inventory Management and Recommendation System, Secure and Transparent Blockchain-based Fund Donations, Predictive Analytics for Donation Campaign Success and Promoting quality hair donation for cancer patients. These functionalities will be modeled into 4 major components (will be developed as modules) which will work together to deliver the above main objective.

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3.3.1 Intelligent Donor-Driven Inventory Management and Recommendation System

Develop an intelligent donor-driven inventory management and recommendation system in Apeksha Hospital. Utilize ML to analyze donated item data, identify donor preferences, and develop personalized recommendations. Implement an interactive inventory interface for donors to select and track their impact. Evaluate system effectiveness through surveys, donation patterns, and inventory metrics. Analyze impact on donor engagement and resource efficiency.

3.3.2 Secure and Transparent Blockchain-based Fund Donations

Explore blockchain for secure, transparent fund donations. Develop a system recording and verifying donation transactions, ensuring immutability and transparency. Investigate smart contracts for automated donations and enhanced trust. Evaluate effectiveness in fraud prevention, transparency, and improving donor confidence. Use machine learning for transaction analysis and anomaly detection to enhance security.

3.3.3 Predictive Analytics for Donation Campaign Success

Utilize predictive analytics to forecast campaign success. Develop models considering content, timing, segmentation, and external factors. Analyze historical data for patterns and predictors. Evaluate model accuracy in planning and resource allocation for optimal donor response.

3.3.4 Promoting quality hair donation for cancer patients.

Donors ensures donated hair meets hospital standards. Image processing checks hair length, split ends, and condition. Only accept natural color dye or bleached/highlighted hair if in good condition. Encourages donors to provide hair meeting relevant standards.

3.4 Promoting quality hair donation for cancer patients – Individual Component

Figure 3.2 shows the tentative architecture of the component of Promoting quality hair donation for cancer patients.

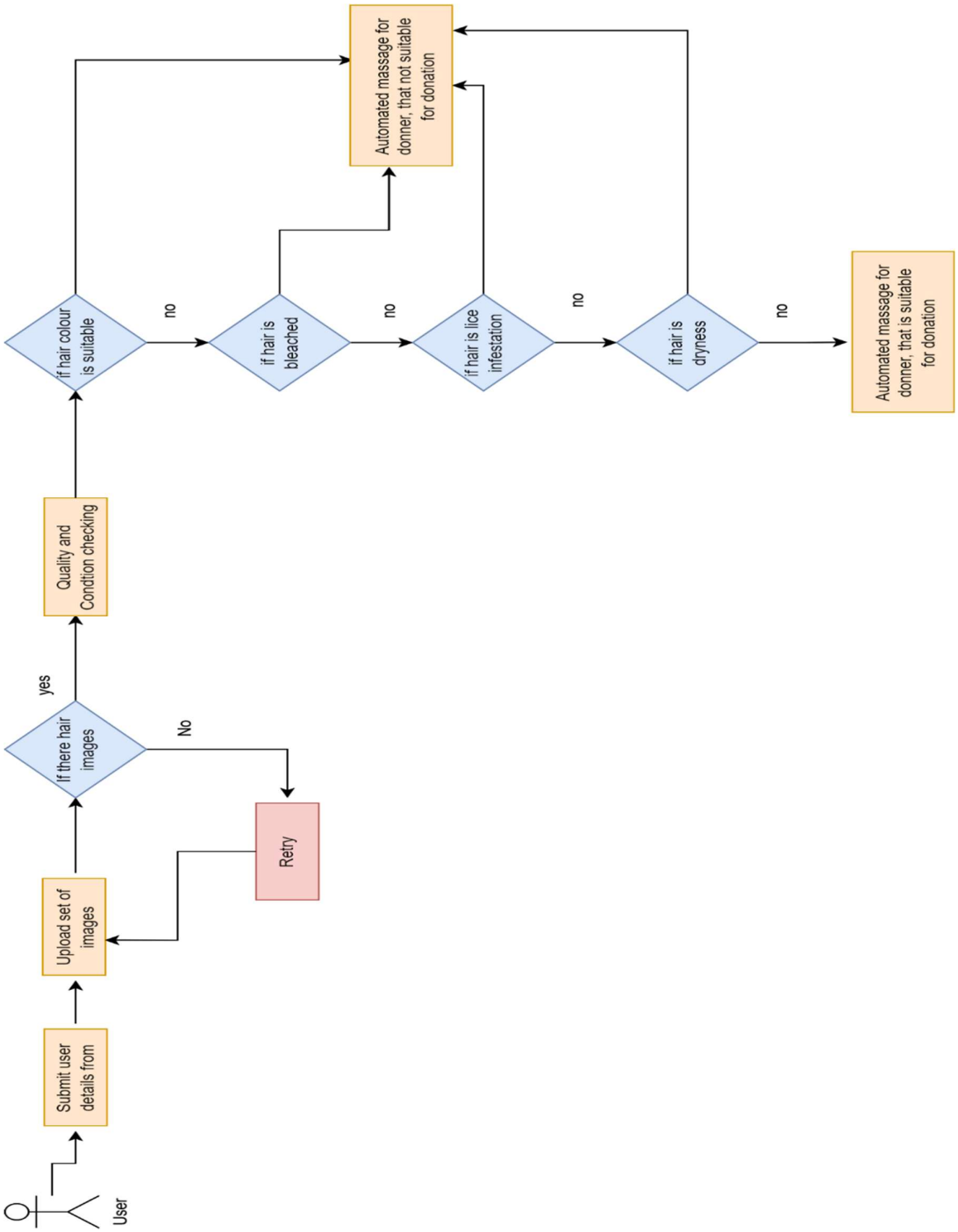

Figure 3.2:Flow Diagram for the Individual Component

System Architecture for the function – Promoting quality hair donation for cancer patients.

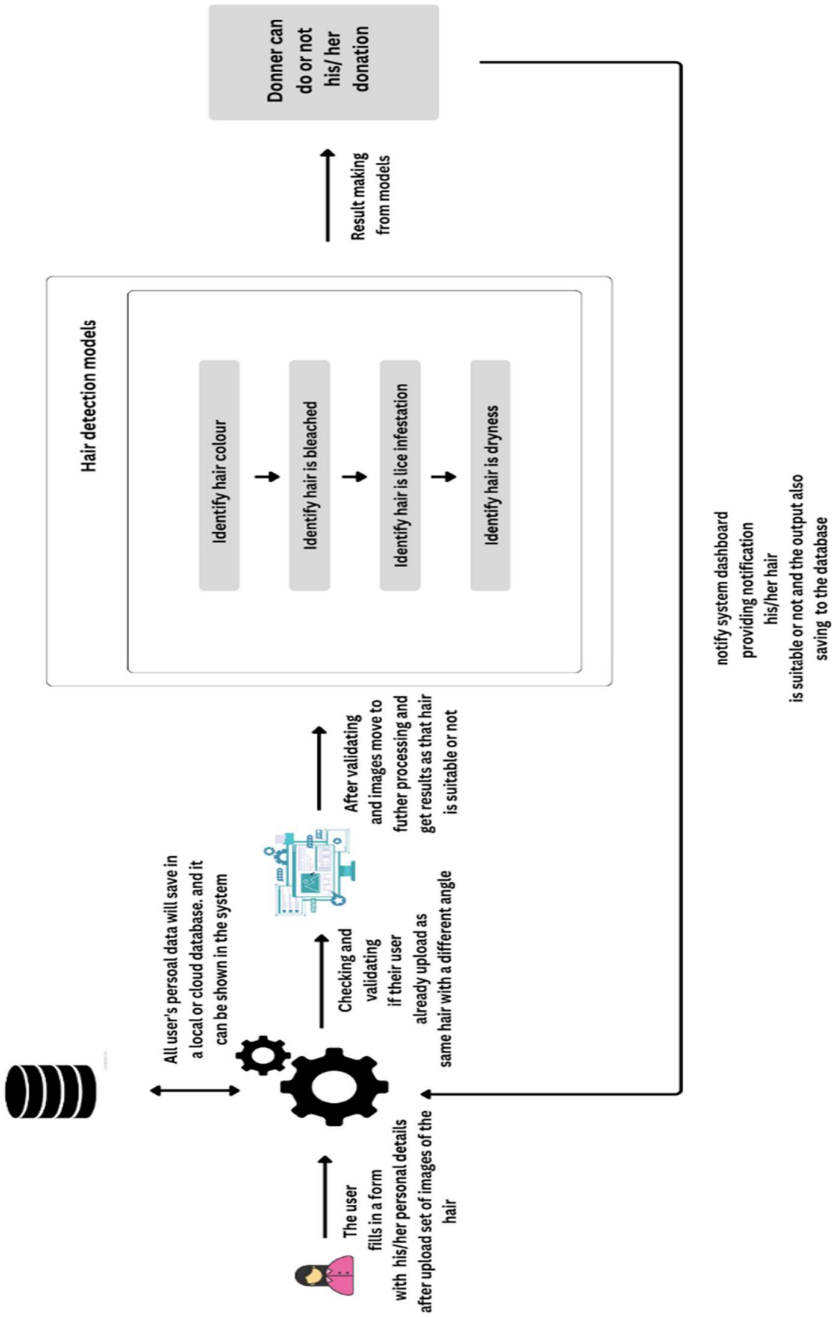

Figure 3.3: System Architecture Diagram for the Individual Component

3.5 Requirement Analysis

3.5.1 Functional requirements

3.5.1.1 Verification of Donor-Provided Photographs

The system needs to ensure that the photographs submitted by donors genuinely depict the hair they intend to donate. This involves a process to validate the authenticity of the images and confirm that they accurately represent the donated hair. This step is crucial to prevent any misleading or fraudulent submissions.

3.5.1.2 Matching Donor-Provided Photos with System Criteria

The system should compare the photographs provided by donors with specific predefined criteria. These criteria are based on factors like hair color, texture, length, and overall quality. The goal is to assess how closely the donor's hair attributes align with the established criteria. This comparison helps determine if the hair meets the necessary standards for donation.

3.5.1.3 Verification of Donor-Provided Photographs

Based on the analysis of donor-provided photographs and their alignment with the predefined criteria, the system must accurately decide whether the hair is suitable or unsuitable for donation. This decision is critical to ensure that only hair that meets the required quality and characteristics is accepted. Unsuitable hair could include factors like hair that has been bleached, is excessively dry, or has signs of lice infestation.

In summary, the functional requirements of the system focus on maintaining transparency, accuracy, and quality in the hair donation process. By verifying photographs, comparing them with established criteria, and correctly identifying suitable and unsuitable hair, the system aims to streamline the donation process while ensuring that the wigs created for cancer patients are made from hair that meets their specific needs and preferences.

3.5.2 Nonfunctional requirements

Certainly, let's briefly explain the main non-functional requirements of the system:

3.5.2.1 Accuracy:

Accuracy refers to the system's ability to correctly verify and assess donor-provided photographs and their alignment with predefined criteria. The system must ensure that the decisions it makes about the suitability of donated hair are reliable and error-free. This requirement is crucial to maintain the credibility of the hair donation process and provide cancer patients with high-quality wigs.

3.5.2.2. Usability:

Usability focuses on how easily users can interact with and navigate the system. For this system, it means that both donors and administrators should find the interface intuitive and straightforward. Donors should be able to submit photographs and receive clear feedback, while administrators should manage the verification process seamlessly. Ensuring good usability enhances user satisfaction and encourages continued engagement.

3.5.2.3. Availability:

Availability pertains to the system's accessibility and uptime. It should be available for use whenever donors or administrators need it. A dependable system that is consistently accessible ensures that donors can participate in the donation process without interruptions and administrators can manage the donations effectively.

3.5.2.4. User-friendliness:

User-friendliness relates to the overall ease of use and comfort that users experience when interacting with the system. The system should present a user-friendly interface, clear instructions, and concise feedback. This aspect contributes to a positive user experience and encourages donors to participate and contribute their hair donations.

3.5.2.4. Efficiency:

Efficiency measures how effectively the system performs its tasks. In this context, the system should process donor-provided photographs and make suitability determinations in a timely manner. Swift processing helps donors receive quick feedback, supports timely decision-making, and streamlines the overall donation process.

In summary, the non-functional requirements of the system encompass accuracy in decision-making, user-friendly interactions, continuous availability, usability for both donors and administrators, and efficient processing. By meeting these requirements, the system aims to provide a seamless and dependable experience for donors and stakeholders while maintaining the integrity and quality of the hair donation process for cancer patients.

3.6 Work Breakdown and Gantt Chart

3.6.1 Work breakdown structure

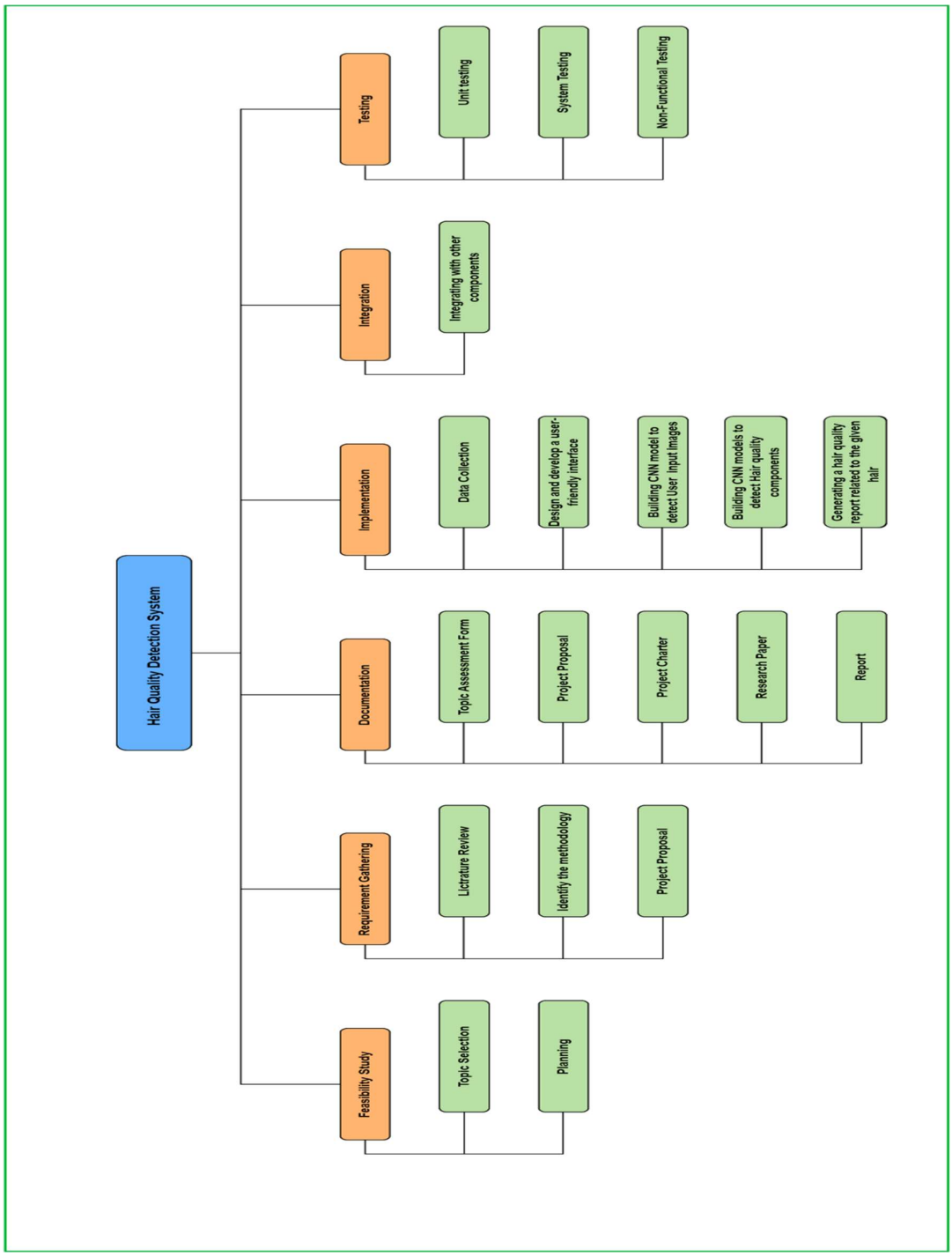

Figure 3.4: Work Breakdown Structure

3.6.2 **Gantt Chart**

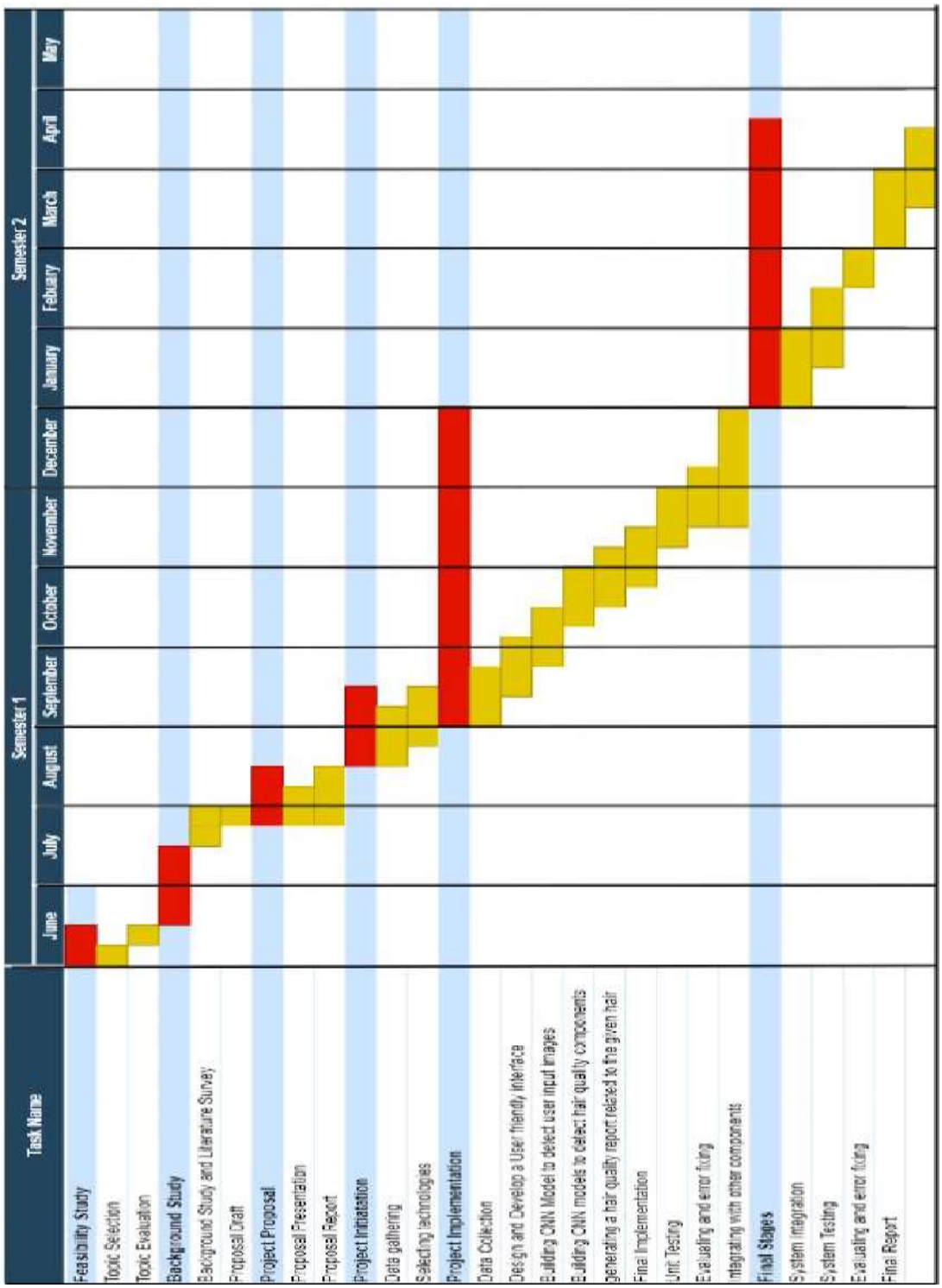

Figure 3.5: Gantt Chart for the individual component

4 Budget and Budget Justification

Please note that the below budgets are only estimations that can vary as the project progresses.

4.1 Group Budget

Table 4.1: Group Budget

Product	Cost
Web Hosting	LKR 4000.00
Internet Cost	LKR 3000.00
Cloud Cost – Digital Ocean	LKR 6500.00
Marketing / Digital Marketing	LKR 12500.00
Total	LKR 26000.00

4.2 Individual Budget

Table 4.2: Individual Budget

Resources	**Costs (LKR)**
Electricity	4000.00
Stationary	2000.00
Internet	12000.00
Communication	500.00
Software purchasing	0.00
Total	**25500.00**

5 Commercialization

The proposed research envisions the commercialization of a comprehensive hair donation program tailored to cancer patients at Apeksha Hospital. This endeavor entails a strategic approach that integrates technological advancements, addresses the identified research gap, and focuses on enhancing patient well-being through high-quality hair donations. The commercialization strategy encompasses key aspects, including measuring success, continuous improvement, scalability, and technical infrastructure.

- Measuring Success and Continuous Improvement:

To gauge the effectiveness and impact of the proposed platform, a set of key performance indicators (KPIs) will be defined. These KPIs will encompass metrics such as donation frequency, donor retention rates, and campaign effectiveness. The platform's success will be measured by tracking the frequency at which donors contribute, ensuring sustained engagement over time. Additionally, donor retention rates will be monitored, reflecting the platform's ability to establish lasting relationships with contributors. Campaign effectiveness will be evaluated by assessing the success of specific initiatives in garnering support.

Continuous improvement will be an integral part of the commercialization strategy. Feedback mechanisms, such as donor surveys and recipient testimonials, will be employed to gather insights for refinement. Regular data analysis and feedback evaluation will guide iterative enhancements to the platform, ensuring its alignment with donor preferences and recipients' needs. This ongoing improvement process will contribute to the platform's sustainability and relevance in meeting the evolving demands of cancer patients.

- Scalability and Technical Infrastructure:

The commercialization plan recognizes the potential for growth and scalability in the future. A robust technical infrastructure will be established to accommodate a growing number of donors and transactions. The platform will be designed with scalability in mind, ensuring its ability to handle increased donor participation without compromising performance.

The technical infrastructure will leverage cloud-based solutions and scalable architecture to ensure smooth operations even during periods of high demand. Investment in reliable servers, data storage systems, and load balancing mechanisms will support the platform's scalability. Additionally, the integration of a secure payment gateway will facilitate efficient transactions and donor interactions.

As the number of donors and transactions increase, the platform's scalability will ensure a seamless experience for all stakeholders. This approach not only enhances the platform's viability but also underscores its commitment to accommodating a broader community of contributors and beneficiaries.

In conclusion, the commercialization of the proposed hair donation program hinges on the strategic measurement of success, continuous improvement, scalability, and robust technical infrastructure. By defining KPIs, embracing iterative enhancements, and planning for growth, the commercialization strategy seeks to optimize the impact and sustainability of the platform, ultimately benefiting cancer patients and enhancing their well-being.

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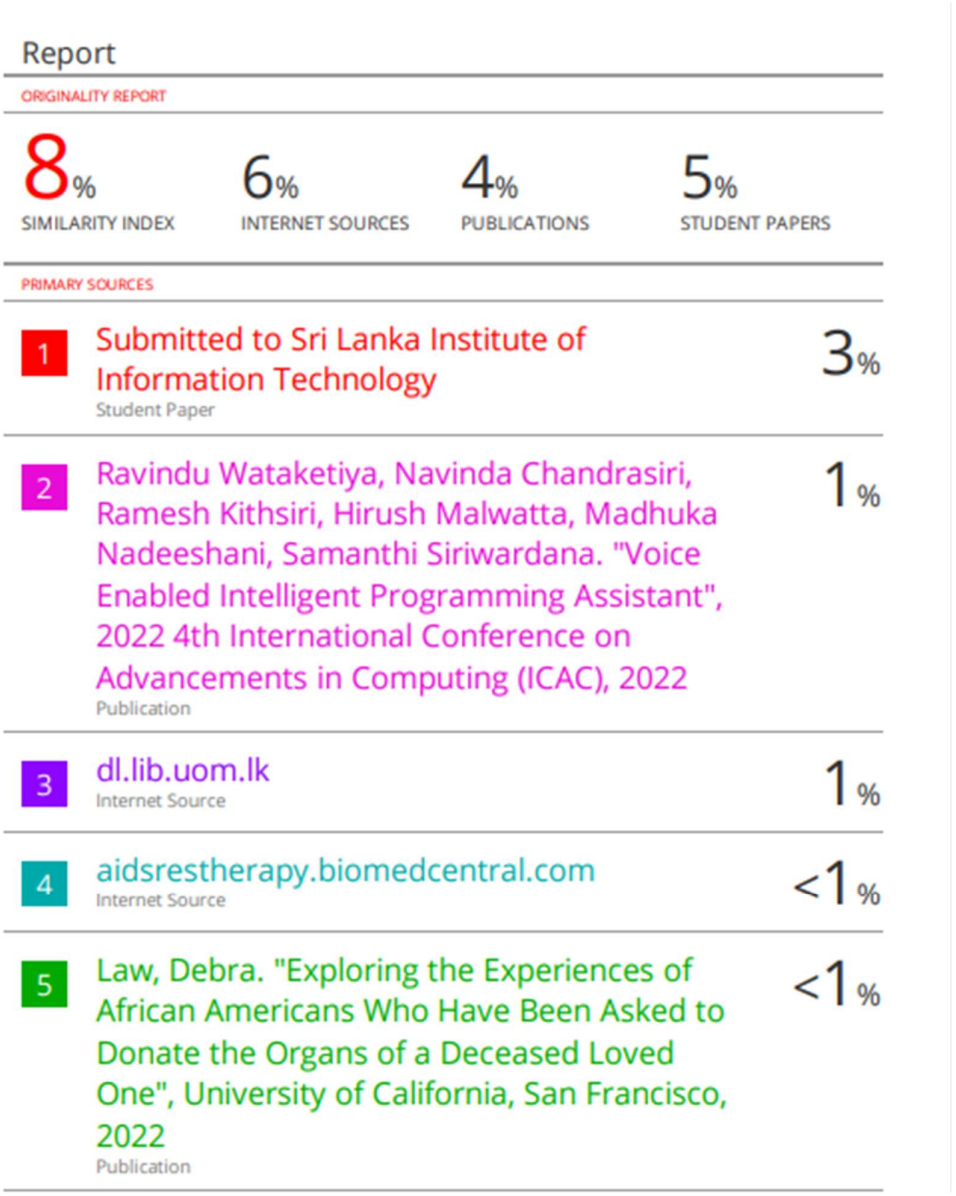
Appendix : Plagiarism Report



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