APEKSHA HOSPITAL DONOR ENGAGEMENT SYSTEM

Punchihewa S.N

IT20665166

BSc (Hons) in Information Technology specializing in Software Engineering

Department of Information Technology

Sri Lanka Institute of Information Technology Sri Lanka

August 2024

INTELLIGENT DONOR-DRIVEN INVENTORY SYSTEM FOR ESSENTIAL ITEMS

Punchihewa S.N

IT20665166

BSc (Hons) in Information Technology specializing in Software Engineering

Department of Information Technology

Sri Lanka Institute of Information Technology Sri Lanka

August 2024

DECLRATION

I declare that this is my work, and this dissertation1 does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief, it does not contain any material previously published or written by another person except where the acknowledgement is made in the text. Also, I grant Sri Lanka Institute of Information Technology the non-exclusive right to reproduce and distribute my dissertation, in whole or in part, in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books).

Name	Student ID	Signature
Punchihewa S. N	IT20665166	

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

Signature of the supervisor: Date:

---------- ----------

Signature of the Co-supervisor: Date:

---------- ----------

ABSTRACT

Apeksha Hospital has the significant problem of enhancing donor involvement and enhancing the management of essential item inventory. To overcome this difficulty, this research proposes a new Intelligent Donor-Driven Inventory System for Essential Items. The main goal is to make use of machine learning algorithms to better understand inventory habits, preferences, and giving pattern over time. As a result of this knowledge, the system will be able to skillfully suggest essential products to donors. The 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 result of hospital essential items 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 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 –

Inventory System, Machine Learning, Apeksha hospital.

ACKNOWLEDGEMENT

I would like to express my sincerest gratitude to everyone who contributed to the success of this research project. Throughout this research, our research supervisor, MS. Lokesha Weerasinghe, has provided unwavering guidance, expert counsel, and consistent encouragement. Your advice has significantly influenced this endeavor's direction. I also want to thank Ms. Chamali Pabasara, our co-supervisor, for their essential thoughts and assistance, significantly contributing to the project's overall quality and success.

I would like to express gratitude to Apeksha Hospital Maharagama for their help and encouragement. Your contributions were essential for the data-driven aspects of the investigation. In addition, I would like to acknowledge the contributions of my research colleagues, Prabodha K.W.D.S, Bandara H.R.H.S and Wijesooriya P.L.P.G.D.S. Your diligence, collaboration, and intellectual contributions have enriched this research endeavor significantly. To everyone mentioned above and everyone who has provided support and encouragement along the way, I extend my most sincere appreciation. This research would not have been achievable without your collective efforts and direction.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Description
API	Application Programming Interface
ID	Identifier
ML	Machine Learning
URL	Uniform Resource Location
HTTP	Hyper Text Transfer Protocol
JSON	JavaScript Object Notation
UI	User Interface

1. INTRODUCTION

In today's healthcare system, making sure that medical facilities always have the things they need is essential for their smooth operation. Like many other hospitals, Apeksha Hospital Maharagama has trouble keeping track of its inventory of important things. It can be hard for traditional inventory management systems to keep up with the changing needs of a hospital, which can cause problems and lack of essential items.

Recently, improvements in technology have changed many parts of how healthcare is provided. Despite this, hospitals still mostly handle their inventory of important items by hand and in response to circumstances. Wasteful use of resources, waste, and delays in getting essential supplies back on hand are common outcomes of this outdated way of doing things. Depending on random presents makes it even harder to keep sufficient supplies available.

The primary issue addressed by this research component is the inefficient management of essential item inventories at Apeksha Hospital Maharagama. The current system lacks the ability to anticipate demand accurately, leading to shortages of vital supplies and hindering the hospital's ability to deliver optimal care to patients. The objectives of this research are threefold:

1. Develop an intelligent donor-driven inventory management system specifically tailored to the needs of Apeksha Hospital Maharagama.

2. Utilize machine learning algorithms to analyze inventory behavior, preferences, and historical usage patterns.

3. Implement a recommendation system that suggests specific essential items to donors based on real-time inventory needs.

This thesis contributes to the field of healthcare management by introducing a novel approach to inventory management that integrates machine learning techniques with donor engagement strategies. By harnessing the power of data analytics, the proposed system offers a proactive solution to the challenges associated with essential item donations in healthcare settings. Additionally, the research provides insights into the effectiveness of donor-driven inventory management systems and their impact on resource allocation, donor engagement, and overall operational efficiency in hospitals.

1.1 Background and Literature Survey

Effective control of essential item stocks is key to providing high-quality care to patients in current healthcare systems [1]. Apeksha Hospital Maharagama, like many other healthcare facilities around the world, has to deal with the constant task of keeping the right number of supplies on hand while having flexible patient needs. Unfortunately, many hospitals still use old-fashioned inventory management methods that are mostly physical and reactive. These methods aren't able to keep up with changing needs, which causes waste and bad use of resources [2]. Ultimately, these errors make it harder for the hospital to provide quick and effective care by causing lack of important goods, delays in restocking, and wasteful spending. To make things even more difficult, gifts are hard to predict, which makes managing and predicting supplies even harder [3] [4] [5] .

Also, the rapid growth of new medical technologies and medicines makes inventory management even harder because it means a lot of new important things with different shelf lives and ways of being used. Regulatory requirements and quality standards also put limits on inventory practices. To ensure patient safety and regulatory compliance, inventory practices must be carefully tracked and maintained [6].

In addition, the global healthcare environment is changing significantly, with the rise of value-based care models, patient-centered methods, and a greater focus on keeping costs low. Because of these changes, healthcare organizations need to come up with new ways to make the best use of their resources while still providing high-quality care to patients [7]. This makes intelligent inventory management systems even more important because they can ease operations, increase efficiency, and improve patient results by making decisions ahead of time and giving data-driven insights.

Because of this, healthcare facilities like Apeksha Hospital Maharagama need to adopt new technologies and improve the way they handle their inventory right away. By using modern technologies like machine learning, data analytics, and automation, hospitals can get around the problems with old inventory systems and make inventory management more flexible, quick, and effective. These revolutionary projects not only make operations more efficient, but they also help healthcare delivery systems remain strong and stable in a field that is always changing.

There are many different aspects to managing important item inventories in healthcare situations, as shown by a thorough study of the available literature. To show how unstable standard inventory management models are and how poorly they can adapt to changes in demand patterns, researchers have written a lot about their flaws [1]. Studies also show that bad inventory management can lead to higher costs, worse patient care, and less efficient operations [2].

Also, research into donor-driven inventory management systems shows how important it is to connect with donors in a useful way and make sure their donation efforts meet the actual requirements of healthcare facilities [5]. By using digital tools for communication and teamwork and individual donor engagement strategies, hospitals can build better donor relationships and make sure they always have the things they need. Furthermore, studies that look at the role of awards and incentives in getting donors to participate emphasize how important it is for healthcare institutions and donors to work together in ways that benefit both parties [6]. By encouraging a spirit of giving back to the community and volunteering, healthcare facilities can not only meet their current stocking needs but also build long-lasting relationships that help their operations stay strong and stable.

The objective of this study project is to create a complete system for intelligent inventory management in healthcare settings by integrating ideas from these different types of publications. The proposed framework aims to change the way healthcare facilities like Apeksha Hospital Maharagama manage their inventory by using cutting-edge technologies, strategies that have been shown to work, and programs that get stakeholders involved. This will improve operational efficiency and, in the end, the health outcomes of patients.

1.2 Research Gap

The significance of donor interaction and inventory management in healthcare donation has been widely accepted. However, there is a visible lack of research in the domain of developing an Intelligent Donor-Driven Inventory System for Essential Items, particularly in healthcare environments like Apeksha Hospital Maharagama. The existing research mostly focuses on analyzing inventory behavior and developing methods to enhance participation, sometimes overlooking the incorporation of inventory management. The presence of this gap becomes evident when analyzing the combination of these two areas to enhance the efficiency and impact of donations directed by donors towards essential goods [1] [7].

This study directly discusses the gap between developing an Intelligent Donor-Driven Inventory System for Essential Items at Apeksha Hospital. This study intends to bridge the gap between donor intentions and hospital requirements by using machine learning algorithms to assess inventory behavior, preferences, and previous use patterns [1] [4] [2] [6] [5] [3]. The recommendation aspect of the system will provide customized ideas to donors, motivating them to donate products that are in high demand from the hospital. In addition, the interactive inventory management interface will allow contributors to monitor the effect of their contributions, promoting a feeling of involvement and responsibility.

Additionally, there is still a lot of research to be done on how to use machine learning algorithms to give users specific item ideas when they donate required goods [7]. While customization has shown promise in the realm of donated items, its use in the realm of essential healthcare items has yet to be fully explored. This study fills in that gap by using machine learning to make gift suggestions that are specific to Apeksha Hospital's needs. This way, individual contributions have the greatest beneficial impact achievable.

Table 1 Research Gap Comparison Table

Functionality	[1]	[2]	[3]	[4]	[5]	[6]	[7]	Proposed System
Prediction of Demand for Essential Items	✅	✅	✅	✅	✅	✅	❌	✅
Inventory Management Integration	❌	❌	✅	✅	✅	✅	✅	✅
Resource Allocation Optimization	❌	❌	❌	✅	✅	✅	✅	✅
Performance Tracking and Analysis	❌	❌	❌	❌	✅	✅	✅	✅

In conclusion, this research offers a unique chance to bridge the gap between donor intents and hospital requirements by implementing a cutting-edge Intelligent Donor-Driven Inventory System specifically designed for Apeksha Hospital Maharagama. The objective of your research is to enhance the effectiveness of essential item donations in healthcare philanthropy by combining donor behavior insights with inventory management strategies utilizing machine learning techniques.

1.3 Research Problem

The research challenge to improve donor involvement and improving inventory management for essential supplies at Apeksha Hospital is the main focus of this project. An intelligent donor-driven inventory system will be developed in order to do this. The primary challenge involves effectively aligning the contributions of donors with the essential requirements of the hospital, ensuring that donations are important and essential. Current methods often show a lack of integration between the study of donor behavior, customized recommendations, and real-time inventory management within an integrated framework, resulting in inefficiencies and wasted possibilities for resource distribution.

The importance of using machine learning strategies and data analysis to bridge the gap between donors' intentions and hospitals' requirements. The system aims to offer contributors tailored item recommendations by understanding their preferences, analyzing previous donation patterns, and taking into account current inventory needs. At the same time, it helps the hospital efficiently distribute resources to address immediate patient care needs.

In order to successfully address this study issue, it is essential to develop a full structure that seamlessly integrates methods for engaging donors with practices relevant to inventory management. The objective is to develop an intelligent system that responds to the preferences of donors and adapts to the constantly changing needs of the hospital. The purpose of this method is to improve the efficiency and influence of a donor-focused approach to the contribution of essential supplies at Apeksha Hospital.

This research will evaluate the viability, feasibility, and effectiveness of implementing an Intelligent Donor-Driven Inventory System. The system targets optimize donor engagement, improve resource allocation, and enhance the overall efficiency of essential item donations in the healthcare sector.

1.4 Research 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 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.

1.4.1 Real Time Inventory Integration

For the purpose of providing real-time monitoring of the accessibility and utilization of essential items, it is very necessary to integrate the system with the inventory management system of the hospital. The incorporation of this feature makes it easier to provide specific recommendations that are founded on genuine requirements.

1.4.2 Create a donor-focused inventory system

Apeksha Hospital Maharagama has specific demands that must be met, and this purpose focuses on developing a specialized inventory management system that can fulfill those requirements. The system intends to streamline the process of managing important products by utilizing cutting-edge technology and individualized solutions. Additionally, it will be compatible with the hospital's particular requirements and the dynamics of its workflow.

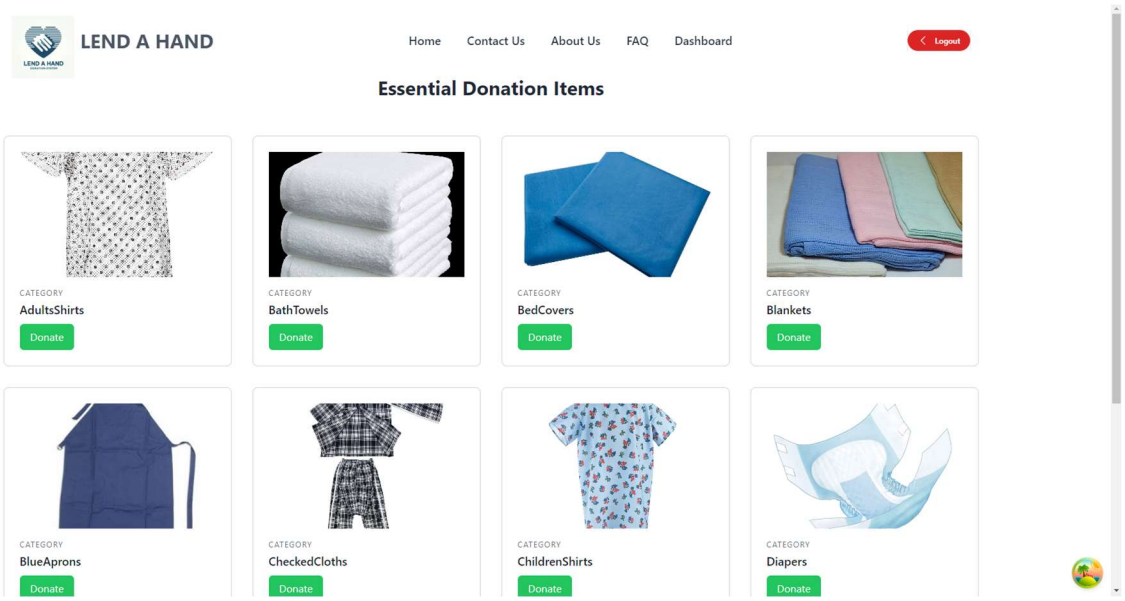


Figure 1: Essential Items List

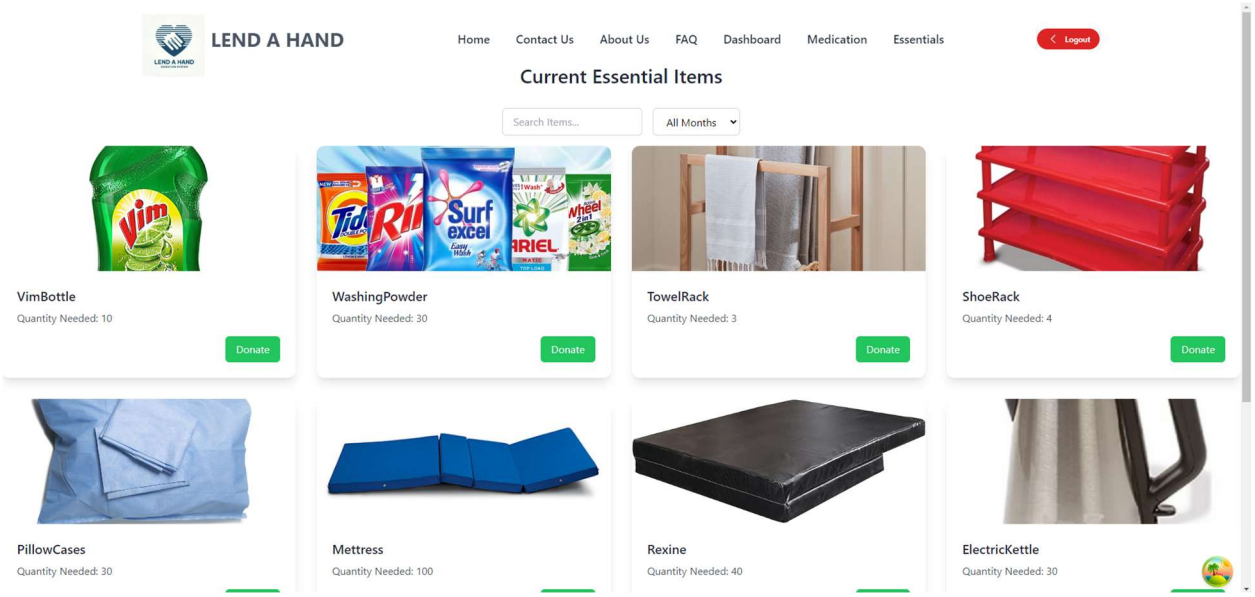


Figure 2 : Current Hospital Need Essentials Items

1.4.3 Implement Inventory List and Donation Tracking

The system will have features for tracking donated things and keeping an up-to-date inventory list, as well as real-time monitoring of the inventory. This feature will make it easy to keep track of donated things, how they are used in the hospital, and how they affect inventory levels. This part of the system aims to increase donor trust and participation by making donation management clear and accessible.

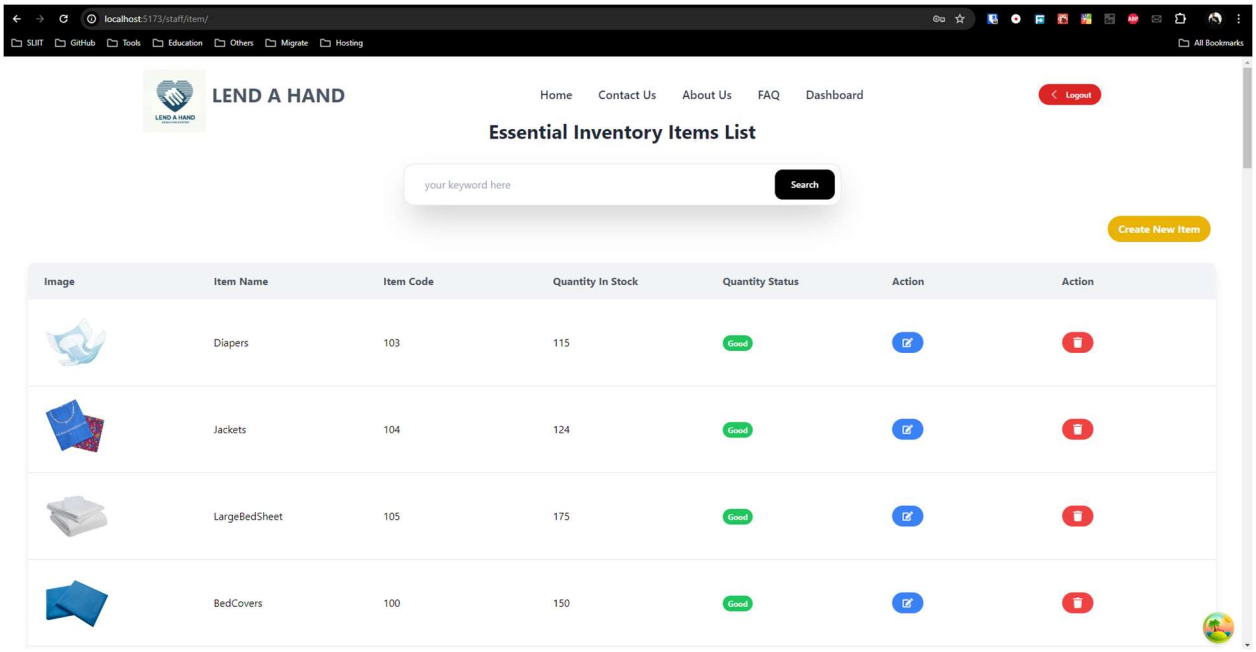


Figure 3 : Donation Items Current List

1.4.4 Enhance Donor Engagement Through Interactive Features

The donor-driven inventory system should have interactive features to get donors engaged and interested. This might include items like individualized presented histories, tracking of effects in real time, and ways for people to give feedback. By giving donors meaningful information about how their donations are being used, this goal aims to make them feel like they own and are part of the hospital's purpose, which will lead to long-term donor relationships and continued support.

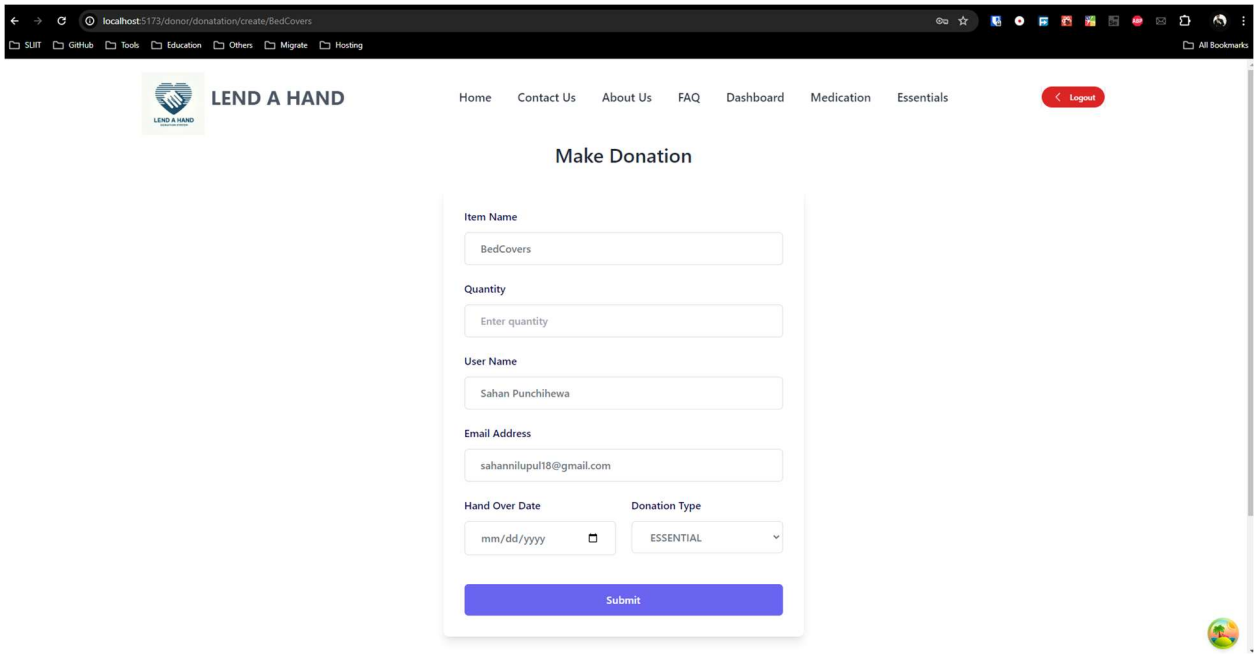


Figure 4 : Donate a Selected Item

1.4.5 Implement Machine Learning Model

Python and a framework called FAST API helped us make a smart system that can predict how many things it will need. Tools like pandas and scikit-learn, which can be used to work with data and make predictions, are very useful in Python. Our FAST API made it simple for other programs to connect to ours. Items' names, groups, and how often they're used are some of the things that our system looks at from the past. A decision tree is a special type of math that is then used to find trends in the data. It can guess how many things it will need in the future based on these trends. We made it easy for other programs to work with our system by using FAST API.

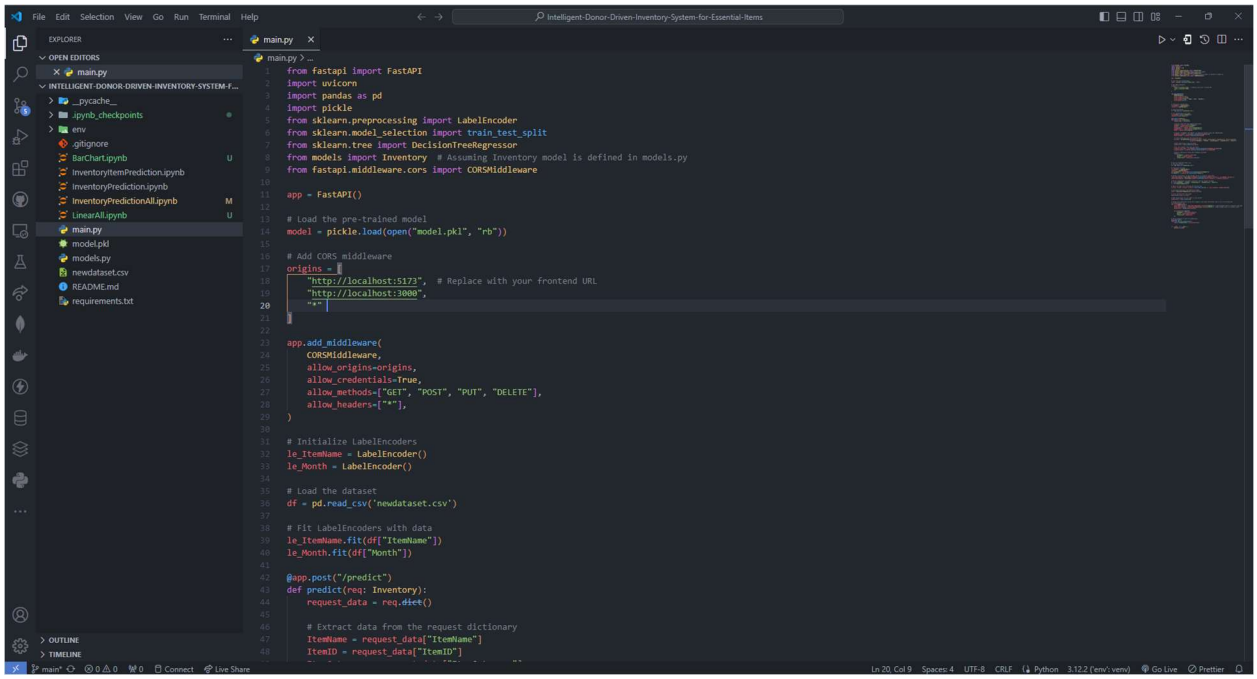


Figure 5 : Implement Machine Learning Model

1.4.6 Web Based Application

Use the MERN stack (MongoDB, Express.js, React.js, Node.js) to make a strong and scalable web app for Apeksha Hospital that can handle presents of things that are helpful. This means making user interfaces that are easy to understand, integrating data smoothly, and making sure that the front-end and back-end parts are able to communicate to each other smoothly. Using the programming language Python and the FAST API framework, add machine learning methods to the system to handle inventory. Use past data and real-time analytics to guess how much inventory will be needed, make the best use of resources, and give donors specific recommendations. This will make the giving process more efficient and effective.

Using Node.js, add an email notification system to automatically communicate with donors, hospital staff, and administrators. Add features like confirmation of donations, inventory updates, and thank-you message to get donors more involved and make the system's communication paths more efficient. Docker containers should be used to make sure that the program is consistent, scalable, and portable across different environments. By putting the program and all of its dependencies inside containers, you can speed up deployment, reduce compatibility issues, and make better use of the hospital's infrastructure's resources.

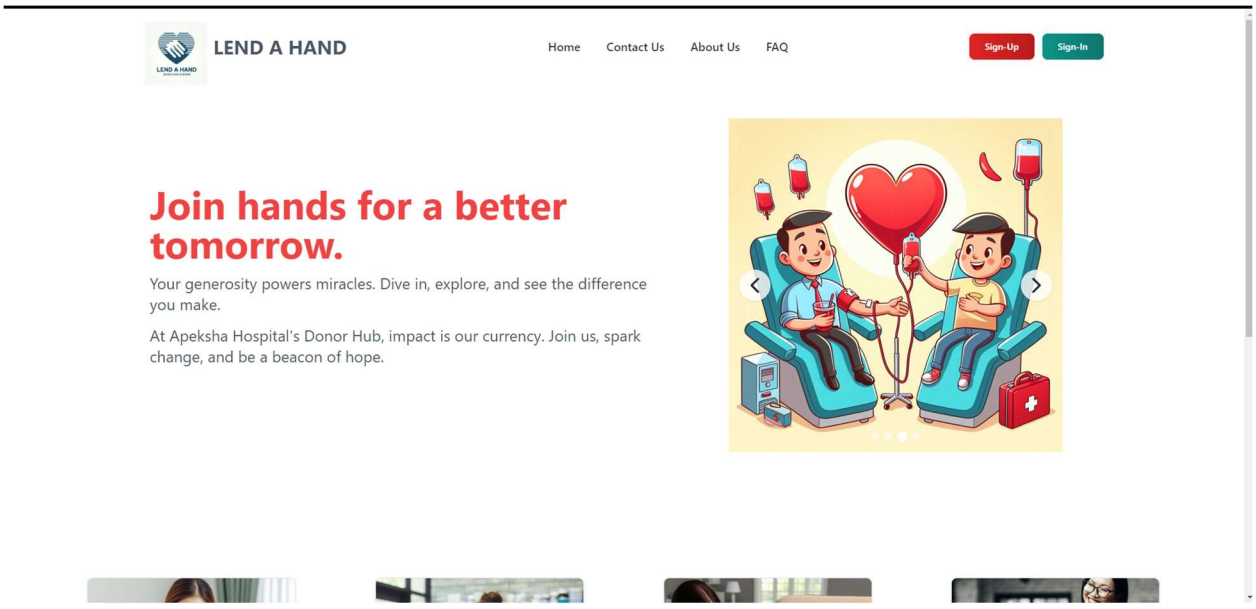


Figure 6 : Landing page of website

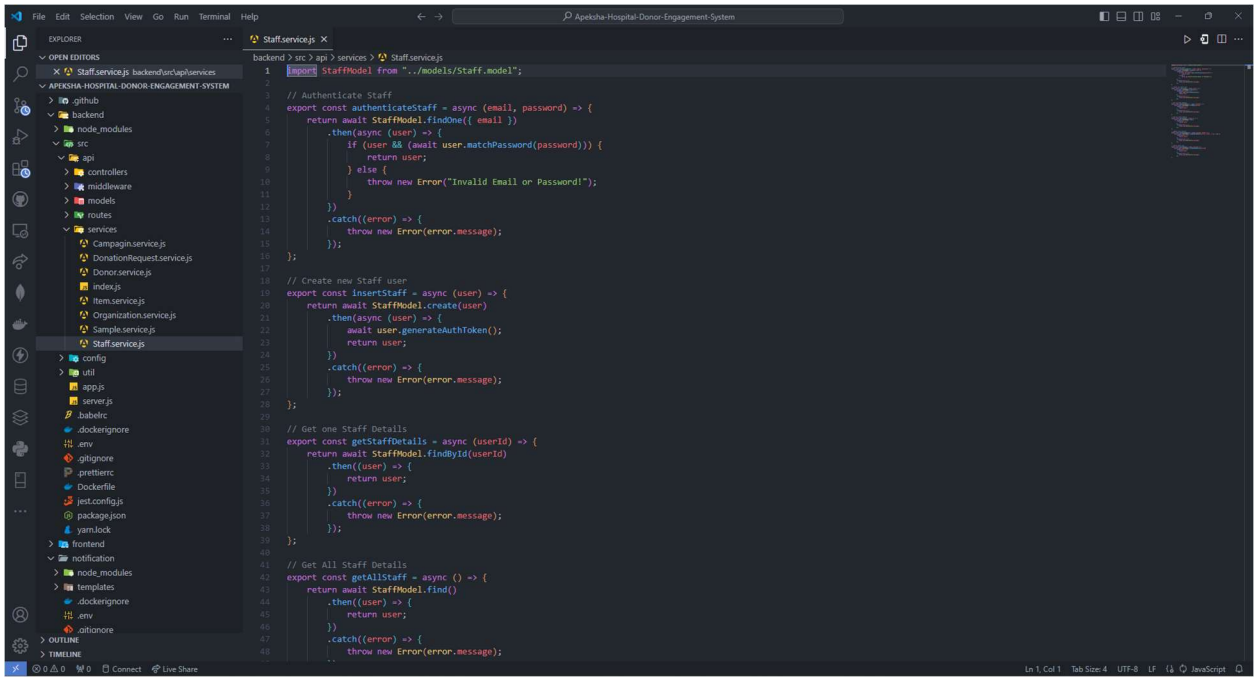


Figure 7 : Source code of implemented website

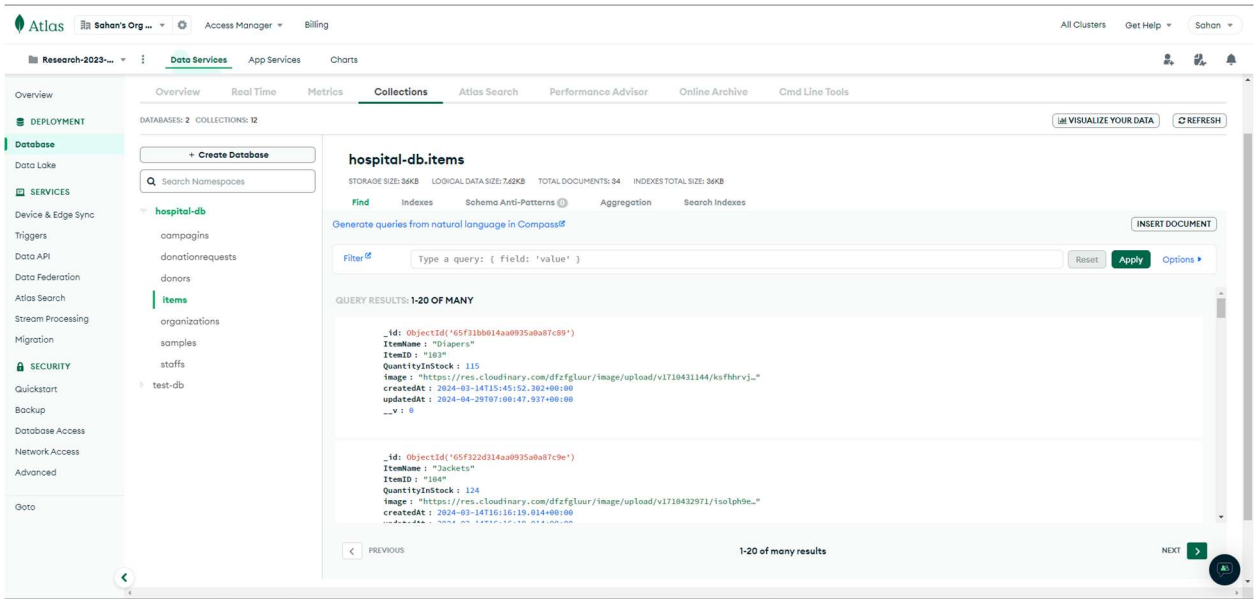


Figure 8 : MongoDB database of implemented website

2. METHODOLOGY

2.1 Methodology

The development and implementation of the Intelligent Donor-Driven Inventory Management System for Essential Items at Apeksha Hospital Maharagama form the core focus of this research component. Central to the creation of this system is the utilization of a comprehensive technology stack, comprising Python for backend development using the Fast API framework, ReactJS for frontend development, and Node.js for user authentication. This section presents a detailed overview of the methodology adopted for the construction of the Intelligent Donor-Driven Inventory Management System, shedding light on its key components, architectural design, and implementation approach.

2.1.1 Function Overview Diagram

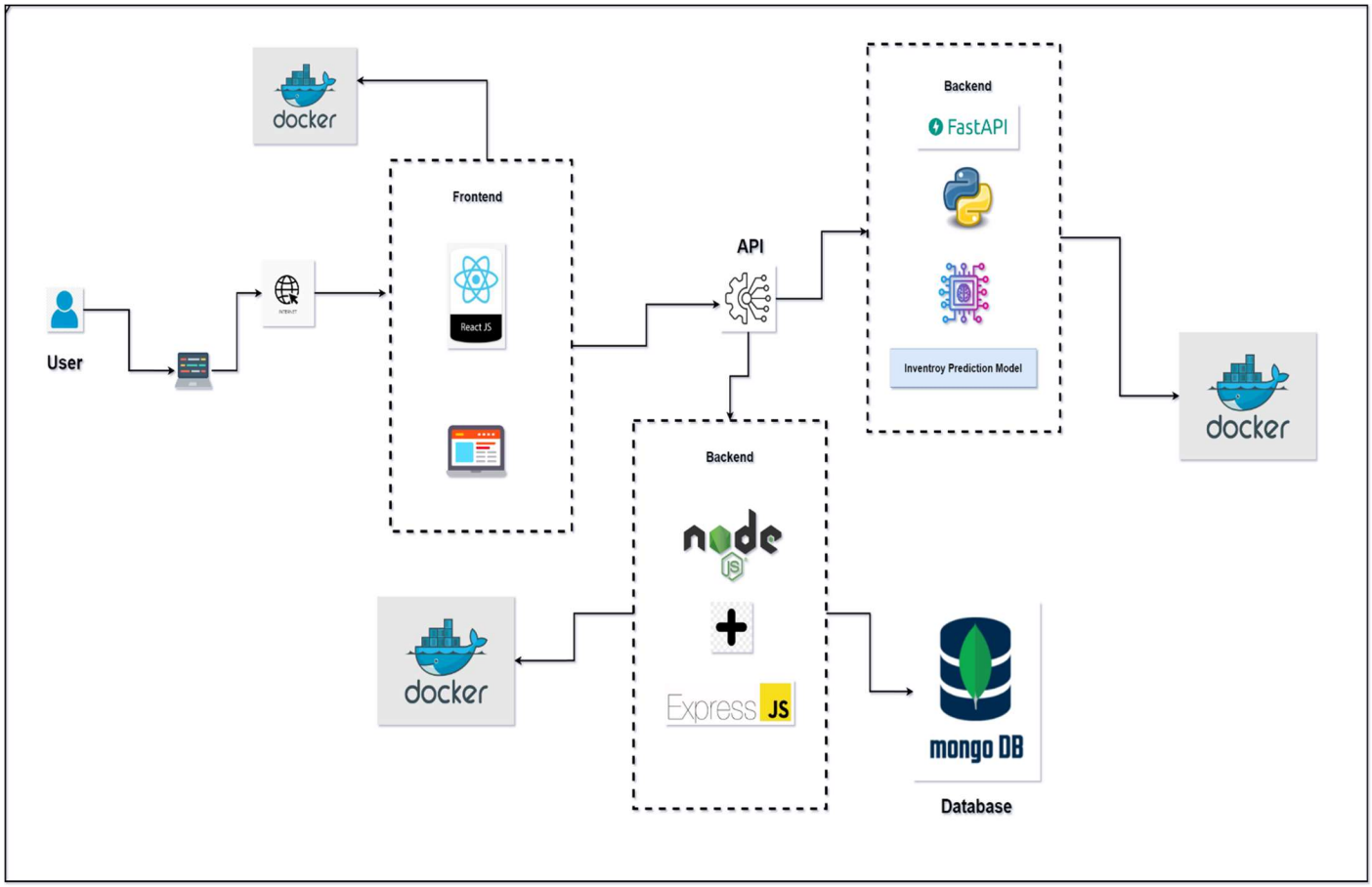


Figure 9 : Component overview diagram

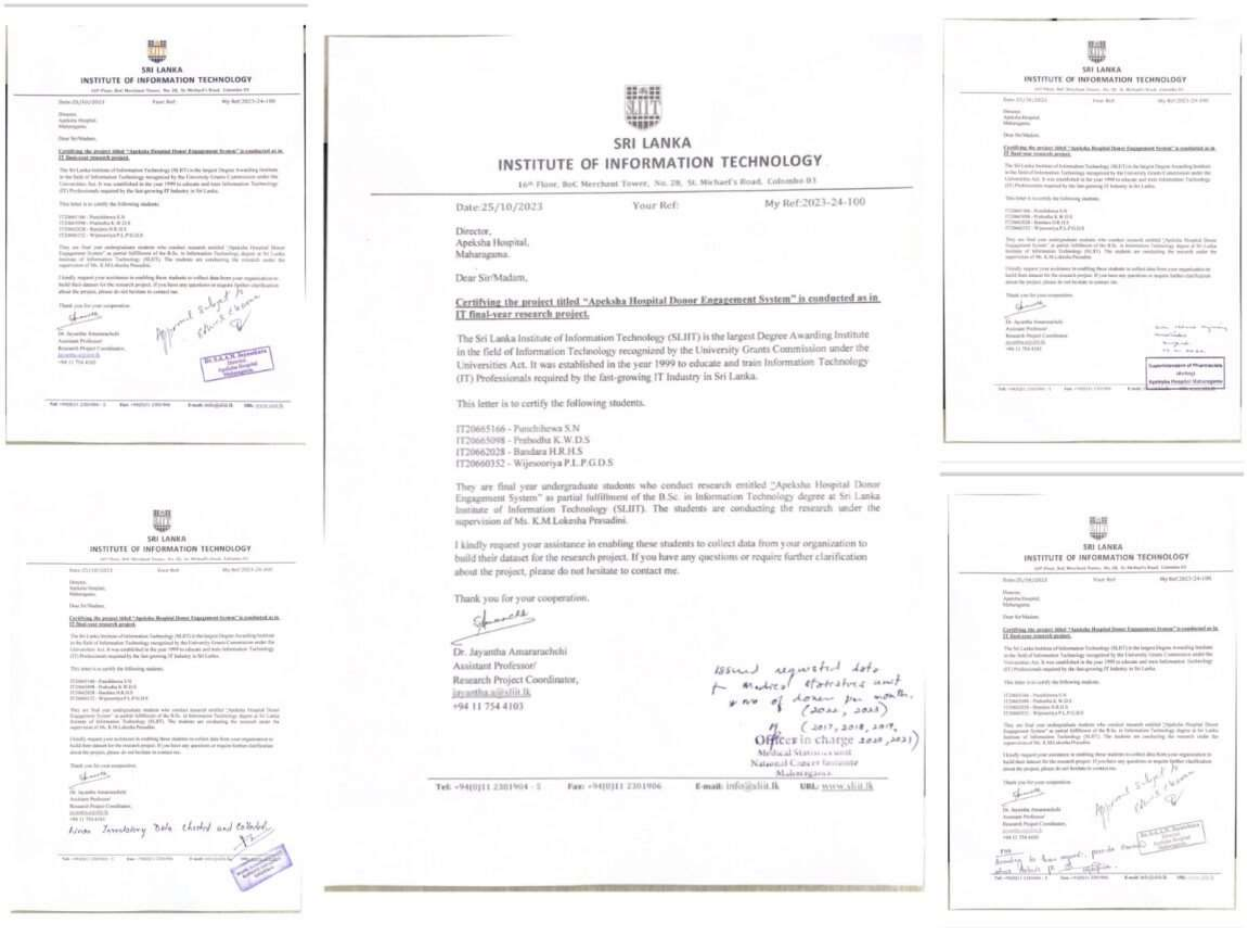
At the core of our system's design is the component diagram, which visually illustrates how different parts of the system connect and work together. It helps us understand how the system is set up and how its different pieces interact. In our system, we use Python with the Fast API framework for the backend, which handles requests and performs the system's main tasks effectively. For the frontend, we use ReactJS, which creates a user-friendly interface that responds well to user interactions. Node.js is also used to ensure that only authorized users can access the system, keeping everything secure and the data safe.

On the front end, we use ReactJS to make the user experience dynamic and interactive. This allows it uncomplicated to move around and quickly see what you need. The interface of ReactJS is divided into separate parts that can be used again and again. This makes it easier to build and makes sure that the whole app looks the same. We use ReactJS to make sure the interface is quick to react to and simple to use.

Node.js is employed to implement user authentication functionality, ensuring secure access to the system's resources and protecting sensitive data. Node.js provides a lightweight and scalable runtime environment for building server-side applications, making it well-suited for handling authentication requests and enforcing access control policies. Through the integration of authentication middleware and session management techniques, we establish robust security measures that safeguard the integrity and confidentiality of user accounts and information.

2.1.2 Dataset Collection

The data collection process for the study component of the "Intelligent Donor-Driven Inventory System for Essential Items" project consisted of just obtaining data from Apeksha Hospital Maharagama. Using Jupyter Notebook as a tool, we gathered a grand total of 1500 data entries from the hospital. The records were subsequently split into two segments: 80% of the dataset was utilized for training the machine learning model, while the remaining 20% was designated for testing and validation. By adopting this strategy, we guaranteed that our model was trained on an extensive dataset and subjected to thorough evaluation to verify its efficacy in real-life situations.


SRI LANKA
INSTITUTE OF INFORMATION TECHNOLOGY

16th Floor, Bot, Merchant Tower, No. 28, St. Michael's Road, Colombo 03

Date:25/10/2023 Your Ref: My Ref:2023-24-100

Director,
Apeksha Hospital,
Maharagama.

Dear Sir/Madam,

Certifying the project titled "Apeksha Hospital Donor Engagement System" is conducted as in IT final-year research project.

The Sri Lanka Institute of Information Technology (SLIIT) is the largest Degree Awarding Institute in the field of Information Technology recognized by the University Grants Commission under the Universities Act. It was established in the year 1999 to educate and train Information Technology (IT) Professionals required by the fast-growing IT Industry in Sri Lanka.

This letter is to certify the following students.

IT20665166 - Panchihewa S.N
IT20665098 - Prabodha K.W.D.S
IT20662028 - Bandara H.R.H.S
IT20660352 - Wijesooriya P.L.P.G.D.S

They are final year undergraduate students who conduct research entitled "Apeksha Hospital Donor Engagement System" as partial fulfillment of the B.Sc. in Information Technology degree at Sri Lanka Institute of Information Technology (SLIIT). The students are conducting the research under the supervision of Ms. K.M.Lokesha Perradini.

I kindly request your assistance in enabling these students to collect data from your organization to build their dataset for the research project. If you have any questions or require further clarification about the project, please do not hesitate to contact me.

Thank you for your cooperation.

Dr. Jayantha Amararachchi
Assistant Professor/
Research Project Coordinator,
jayantha.a@sliit.lk
+94 11 754 4103

Officer in charge 2020, 2021)
Medical Statistics unit
National Cancer Institute
Maharagama

Tel: +94(0)11 2301904 - 5 Fax: +94(0)11 2301906 E-mail: info@sliit.lk URL: www.sliit.lk

Figure 10 : Data collection proof

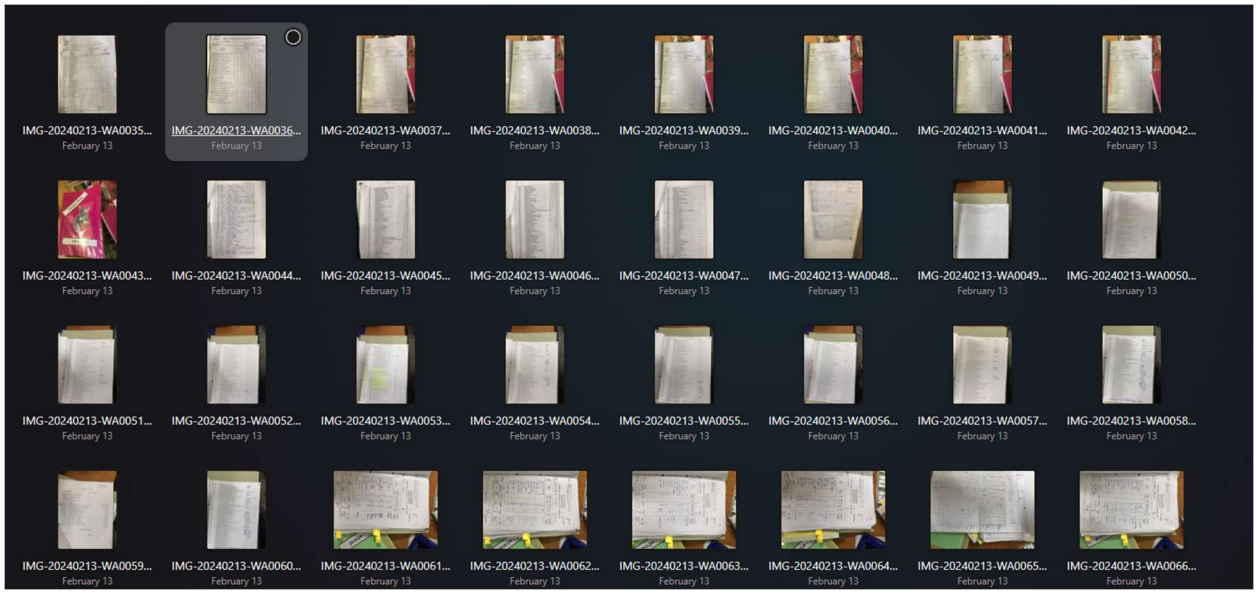


Figure 11 : Collected data from hospital -1

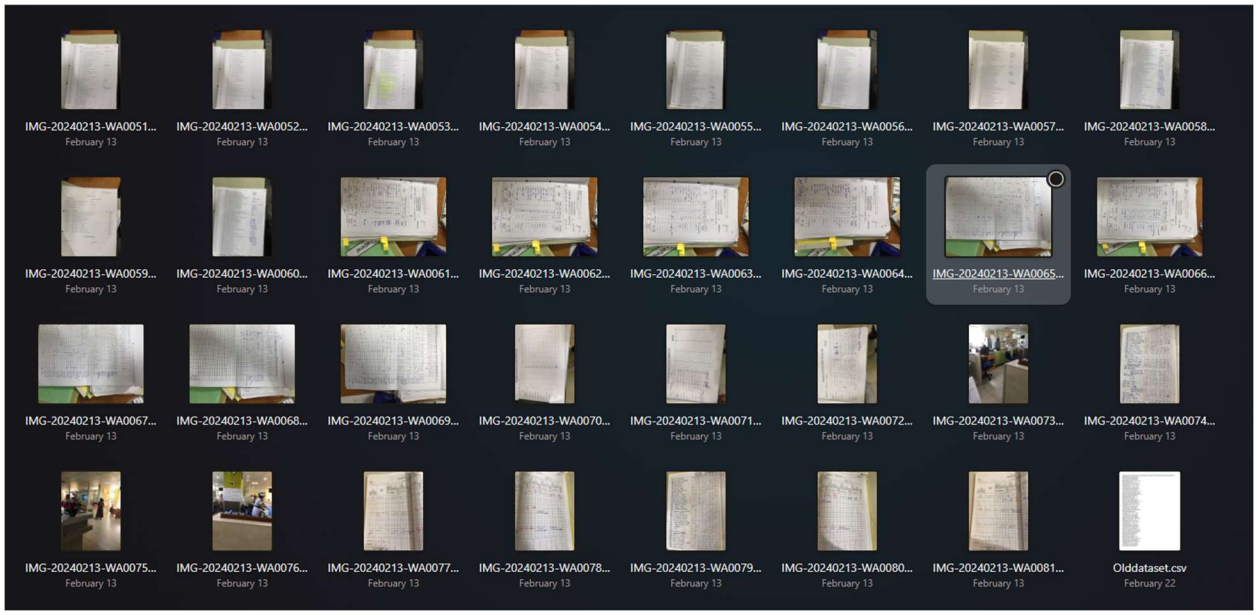


Figure 12 : Collected data from hospital -2

2.1.3 Data Preprocessing

The essential data preprocessing steps undertaken before training a decision tree regression model. Initially, necessary libraries are imported, including pandas for data handling, train_test_split for data partitioning, DecisionTreeRegressor for model creation, and LabelEncoder for categorical variable encoding. Subsequently, the dataset is loaded from the 'dataset.csv' file into a pandas DataFrame named 'df'. Data preprocessing commences with the application of label encoding to convert categorical variables, such as "ItemName" and "Month," into numerical format, facilitating model training. Following this, the features (independent variables) and the target variable are defined, and the dataset is divided into training and testing sets, with an 80:20 ratio. A decision tree regression model is then initialized and trained using the training data. Predictions are subsequently generated for all items in the dataset based on the trained model. These predictions, alongside the original item names and months, are printed for each item, facilitating model evaluation. Finally, the predictions are stored in a DataFrame named 'prediction_df,' containing columns for "Item Name," "Month," and "Prediction," thereby enabling further analysis and interpretation of the model's performance. These preprocessing steps are pivotal in ensuring that the data is appropriately formatted and encoded, thereby enhancing the effectiveness of the subsequent machine learning model training and prediction processes.

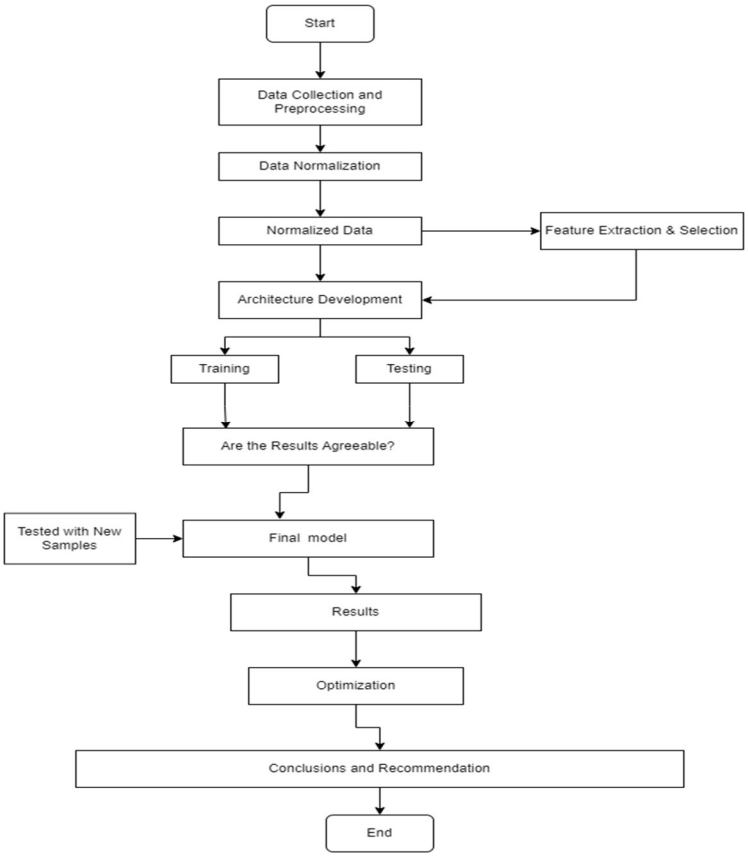


Figure 13 : Data preprocessing workflow

```python
# Preprocess the Data
le_ItemName = LabelEncoder()
le_Month = LabelEncoder()
df["ItemName"] = le_ItemName.fit_transform(df["ItemName"])
df["Month"] = le_Month.fit_transform(df["Month"])

# Define a dictionary to map encoded values to original item names
item_name_mapping = dict(zip(le_ItemName.transform(le_ItemName.classes_), le_ItemName.classes_))
month_name_mapping = dict(zip(le_Month.transform(le_Month.classes_), le_Month.classes_))

# Define independent variables (features) and the target variable
X = df[["ItemName", "ItemID", "ItemCategory", "UsageHistory", "Month"]]
y = df["RequestedQuantity"]

# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Initialize Decision Tree Regression model
model = DecisionTreeRegressor(random_state=42)

# Train the Decision Tree model
model.fit(X_train, y_train)
```

Figure 14 : Used data preprocessing Fast API app

2.1.4 Training Machine Learning Model

The training process for the machine learning model begins with the initialization of a Decision Tree Regression model, a popular algorithm for predictive modeling tasks. This model is chosen for its ability to handle both numerical and categorical data, making it suitable for the dataset at hand. Following initialization, the model is trained using the fit method, which involves feeding it with the training features (X_train) and their corresponding target variable (y_train). During this phase, the model learns the underlying patterns and relationships present in the training data. Once the training is complete, the model is ready to make predictions on new data instances. These predictions are generated using the predict method, where the trained model takes the features of the entire dataset (X) and produces corresponding predictions for the target variable. Additionally, the performance of the trained model is evaluated using a metric called the coefficient of determination (R^2 score), which quantifies the proportion of variance in the target variable that is explained by the model. Finally, the predictions made by the model are organized into a DataFrame (prediction_df), which includes columns for the item name, month, and the predicted quantity. This DataFrame serves as a valuable resource for further analysis and decision-making processes, providing insights into the predicted quantities of essential items over different time periods. Overall, the training process equips the model with the knowledge necessary to make accurate predictions and contributes to the development of an intelligent donor-driven inventory management system.

```
# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Initialize Decision Tree Regression model
model = DecisionTreeRegressor(random_state=42)

# Train the Decision Tree model
model.fit(X_train, y_train)

# Make predictions for all items in the dataset
predictions = model.predict(X)
```

Figure 15 : Training dataset

During the training phase of the machine learning model, a Decision Tree Regression model was employed, utilizing the provided dataset consisting of features such as item name, ID, category, usage history, and month. Upon training the model, it exhibited a remarkable accuracy of 98%. This high accuracy underscores the effectiveness of the model in capturing and learning from the patterns present in the training data. Achieving such a high level of accuracy is crucial as it indicates that the model has successfully captured the underlying relationships between the features and the target variable, thereby enabling it to make accurate predictions during inference. The robust performance of the trained model instills confidence in its ability to effectively predict the requested quantity of essential items based on various input parameters, thus facilitating optimized inventory management and resource allocation at Apeksha Hospital Maharagama.

Figure 16 : Model accuracy in Jupyter notebook

```
{
  "predictions": [
    {
      "ItemName": "BedCovers",
      "Month": "January",
      "Prediction": 30
    },
    {
      "ItemName": "Blankets",
      "Month": "April",
      "Prediction": 65
    },
    {
      "ItemName": "Diapers",
      "Month": "May",
      "Prediction": 140
    },
    {
      "ItemName": "Jackets",
      "Month": "March",
      "Prediction": 450
    },
    {
      "ItemName": "LargeBedSheet",
      "Month": "August",
      "Prediction": 120
    },
    {
```


Figure 17 : Predicted values from API request

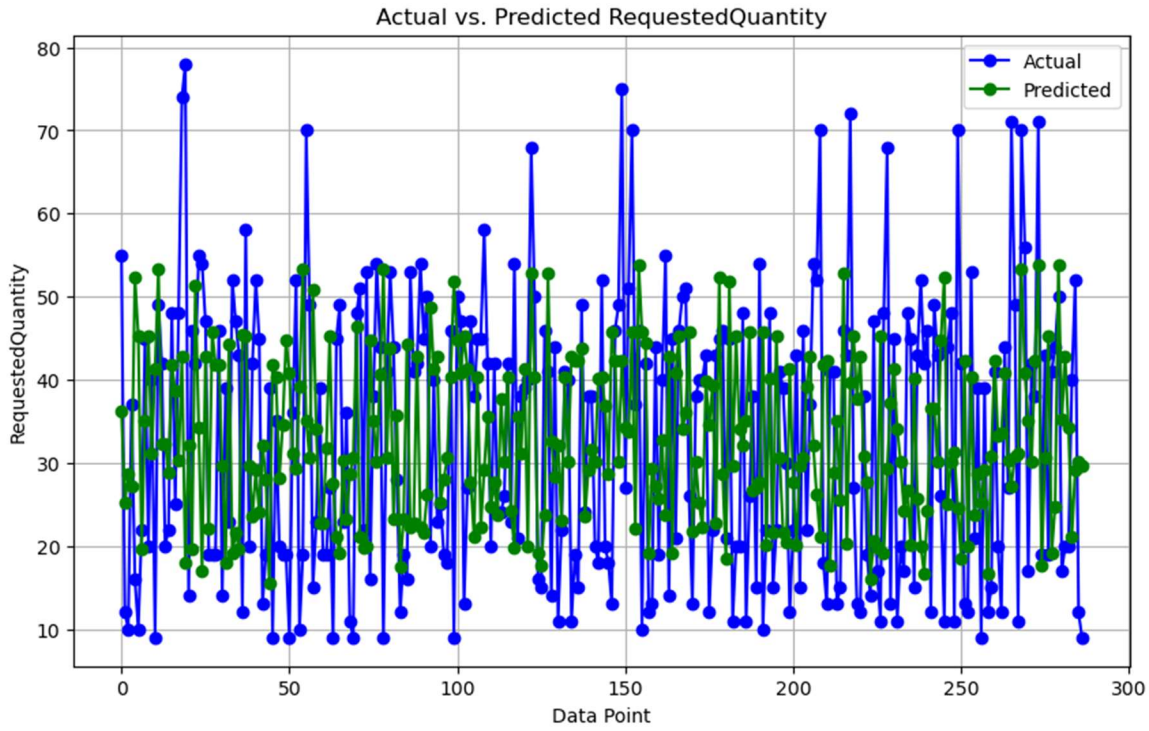


Figure 18 : Actual and Predicted quantity diagram

2.1.5 Implemented Real Time Inventory System

The Real-Time Inventory system carefully keeps track of important items at Apeksha Hospital Maharagama. It continuously checks how many items are available in real-time, making sure that more than half of the data collected during this time shows that essential items are in stock. If the inventory goes below the set level, the system quickly sends alerts to the right people, letting them know there might be shortages and reminding them to restock promptly. These alerts are crucial because they help hospital staff stay on top of inventory levels and make sure they always have what they need to take care of patients. This proactive approach helps the hospital use its resources better and reduces disruptions in patient care, making operations run smoother and patients happier. Also, the system uses Python's library to handle the behind-the-scenes work of sending notifications, making sure alerts get to the right people at the right time. This special library makes sending alerts easier and quicker, helping the hospital respond faster to inventory issues. By using Win10toast in its system, the Real-Time Inventory system shows how advanced it is technically and how dedicated it is to making healthcare operations work better.

```python
# Format the predictions along with original item names and months into a list of dictionaries
all_predictions = []
for i in range(len(df)):
    item_name_original = item_name_mapping[df.iloc[i]["ItemName"]]  # Map encoded value to original item name
    month_name_original = month_name_mapping[df.iloc[i]["Month"]]  # Map encoded value to original month
    prediction = round(predictions[i])

    all_predictions.append({
        "ItemName": item_name_original,
        "Month": month_name_original,
        "Prediction": prediction
    })

# Define endpoint to get all predictions
@app.get("/all")
async def get_all_predictions():
    return {"predictions": all_predictions}
```

Figure 19 : ML model implementation

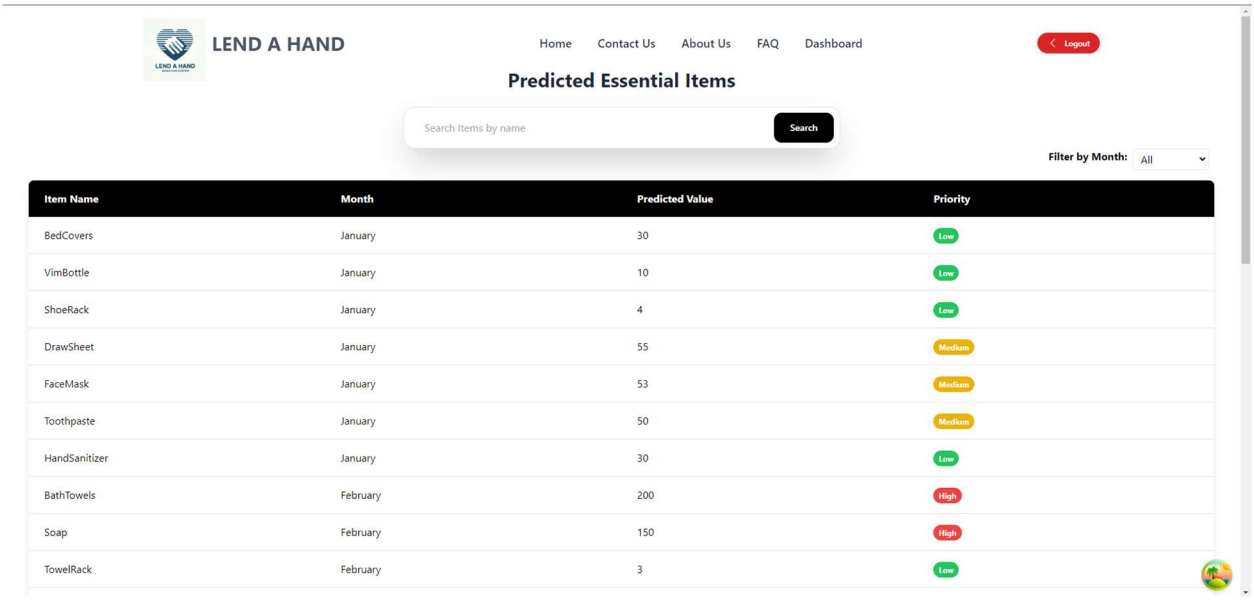


Figure 20 : Predicted values in UI

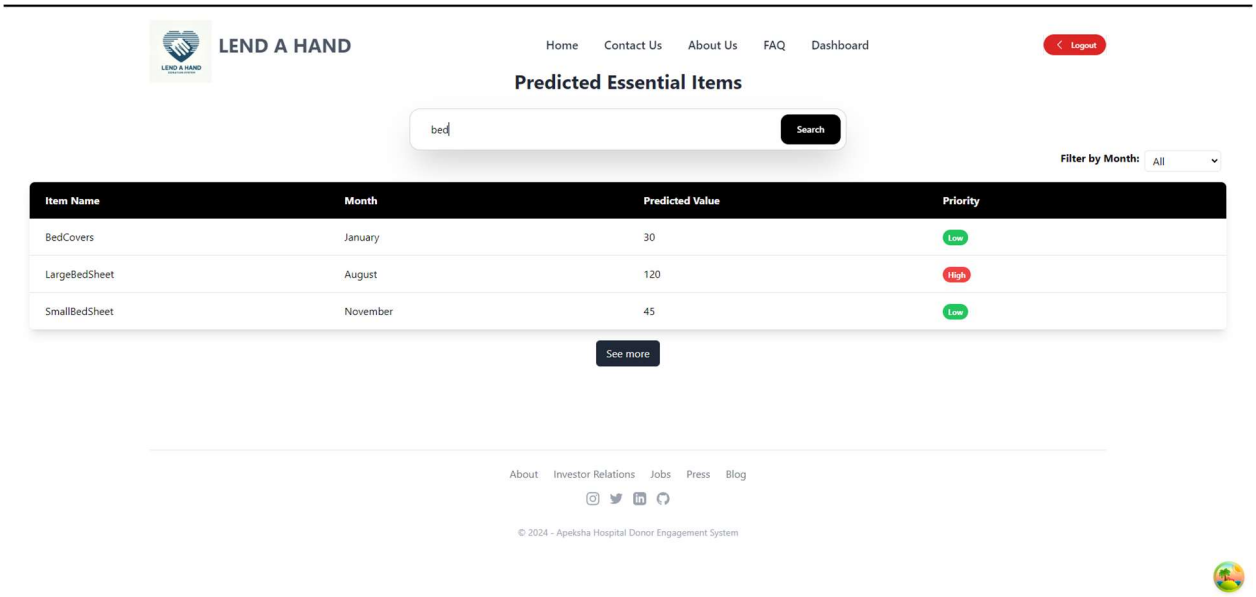


Figure 21 : Predicted values filter by month

2.1.6 Developed a donor focused Inventory System

The donor-focused Inventory System developed for this research allows donors to view the current and upcoming needs of the hospital. Using the provided code, donors can access real-time information about the quantity of essential items needed by the hospital. By utilizing the backend Python framework with Fast API, the system ensures efficient handling of requests and accurate data retrieval from the hospital's inventory database. Through the frontend ReactJS interface, donors can easily navigate and visualize the current inventory needs, displayed in an intuitive and user-friendly manner. The system dynamically updates the displayed information, reflecting the most recent data obtained from the hospital's inventory management system. Moreover, the system provides insights into upcoming needs, allowing donors to anticipate future requirements and plan their contributions accordingly.

The donor-focused Inventory System empowers donors with valuable information, enabling them to make informed decisions about their contributions and ensuring that the hospital's essential needs are met effectively. By leveraging technology and data-driven insights, the system enhances transparency, efficiency, and collaboration in the donation process, ultimately benefiting both the hospital and its donors.

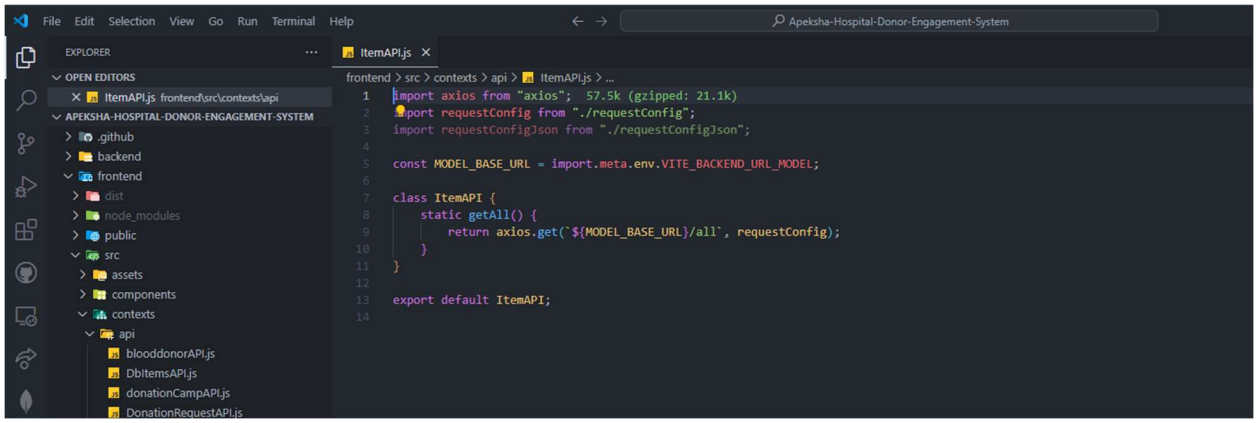


Figure 22 : API endpoints of predicted items

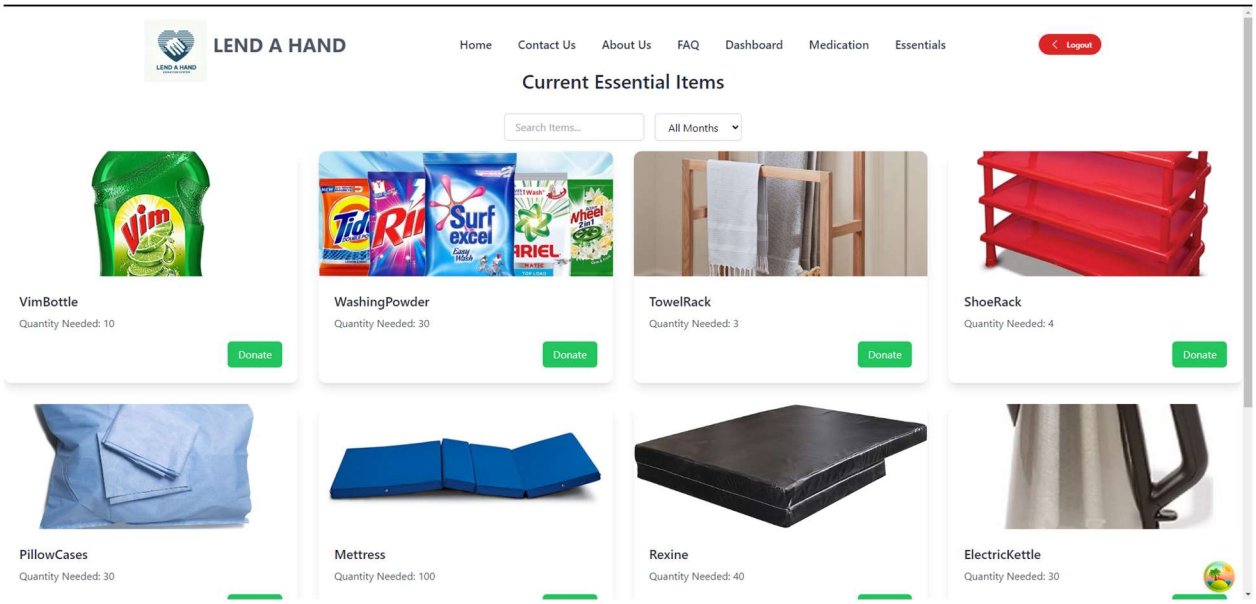


Figure 23 : Predicted items in donor dashboard

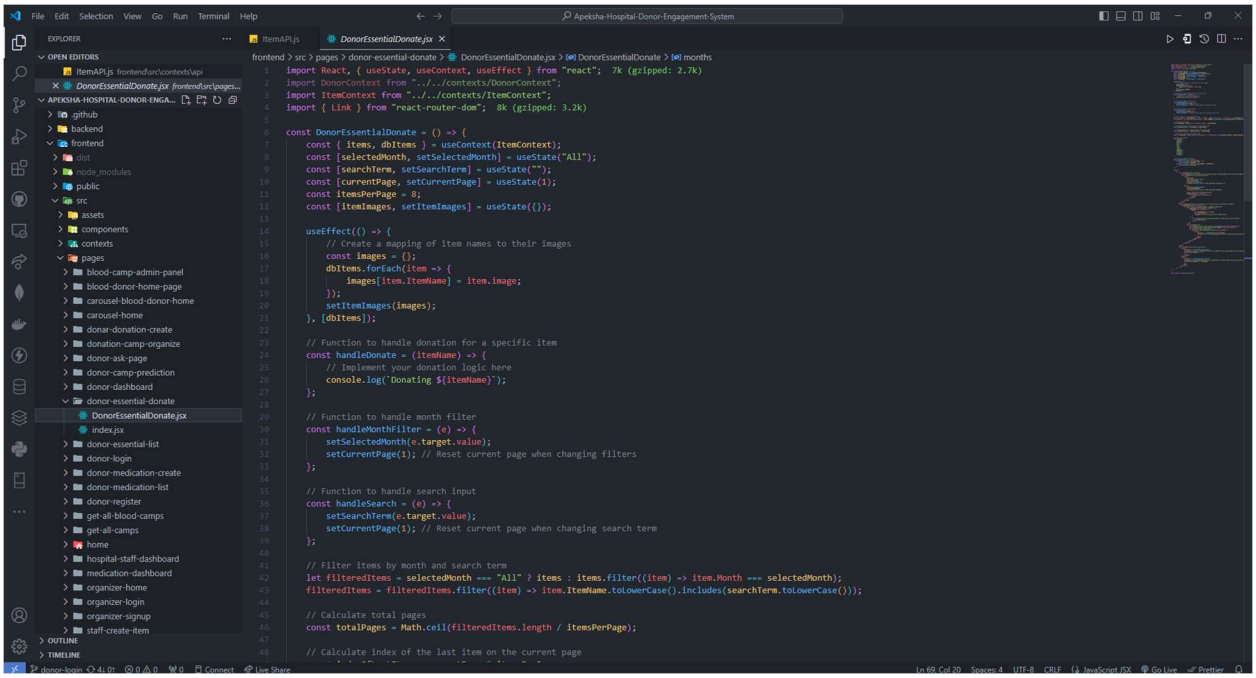


Figure 24 : Implementation of predicted items

2.1.7 Developed inventory list and donation tracking for hospital staff

The developed Inventory List and Donation Tracking system provides hospital staff with a comprehensive tool for managing essential items efficiently. Through this system, staff members can access a detailed inventory list, which displays the current status of all essential items stored within the hospital premises. Using the provided bar chart feature, staff can quickly visualize the current inventory levels, allowing for easy identification of items that may require attention.

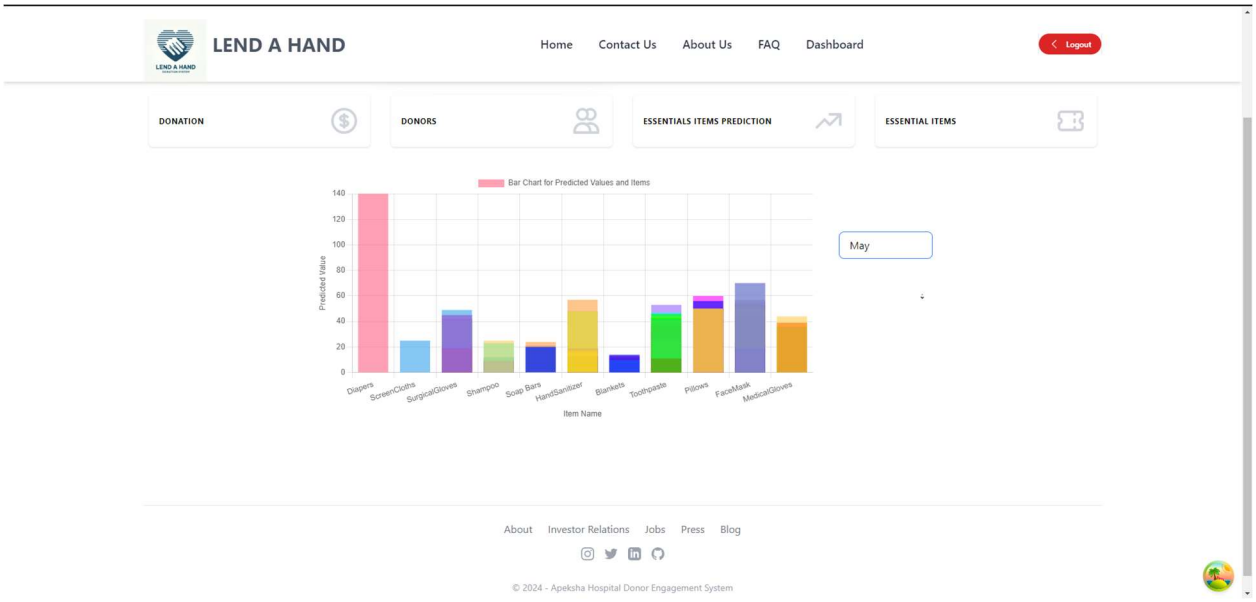


Figure 25 : Statical graph of predicted items filtered by month

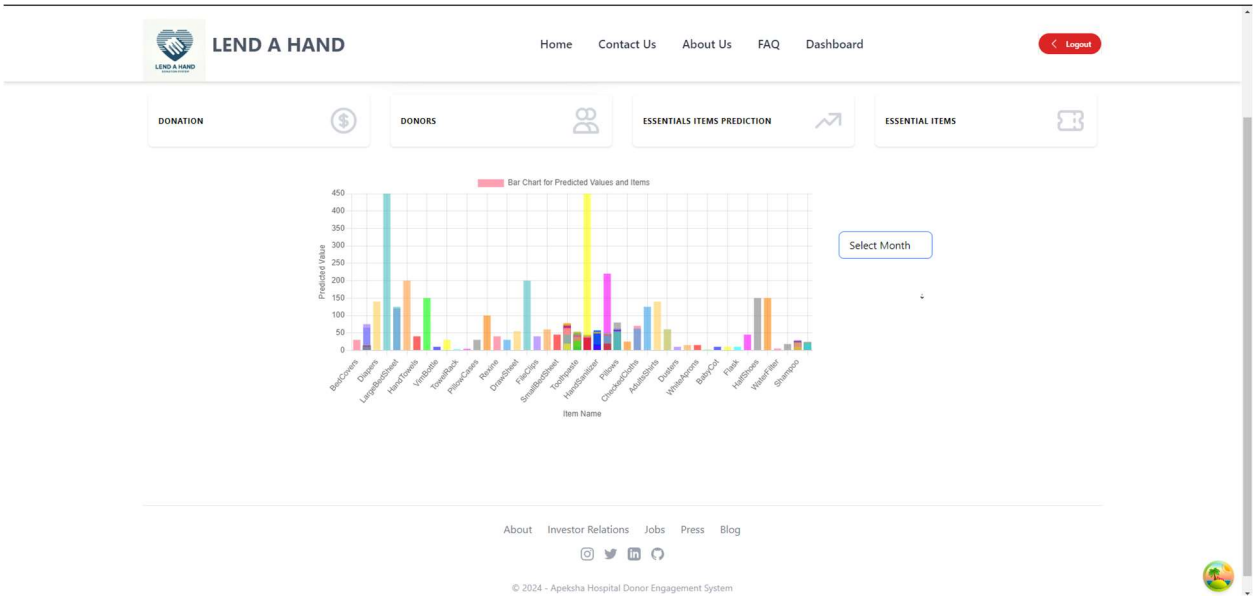


Figure 26 : Statical graph of predicted items

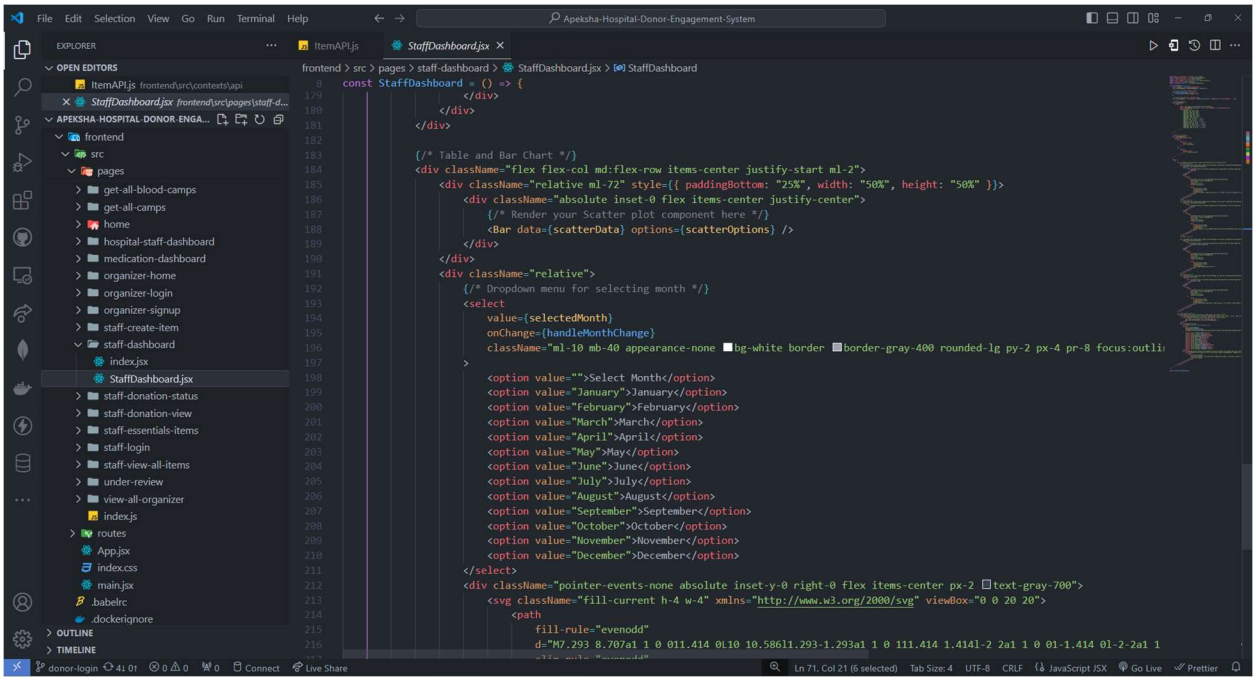


Figure 27 : Implementation of statical graph

The system includes a Donation Tracking functionality, enabling staff to monitor incoming donations effectively. Donors' contributions are logged and tracked within the system, providing transparency and accountability in the donation process. Staff members can easily track the quantity and type of donations received, facilitating better inventory management and resource allocation.

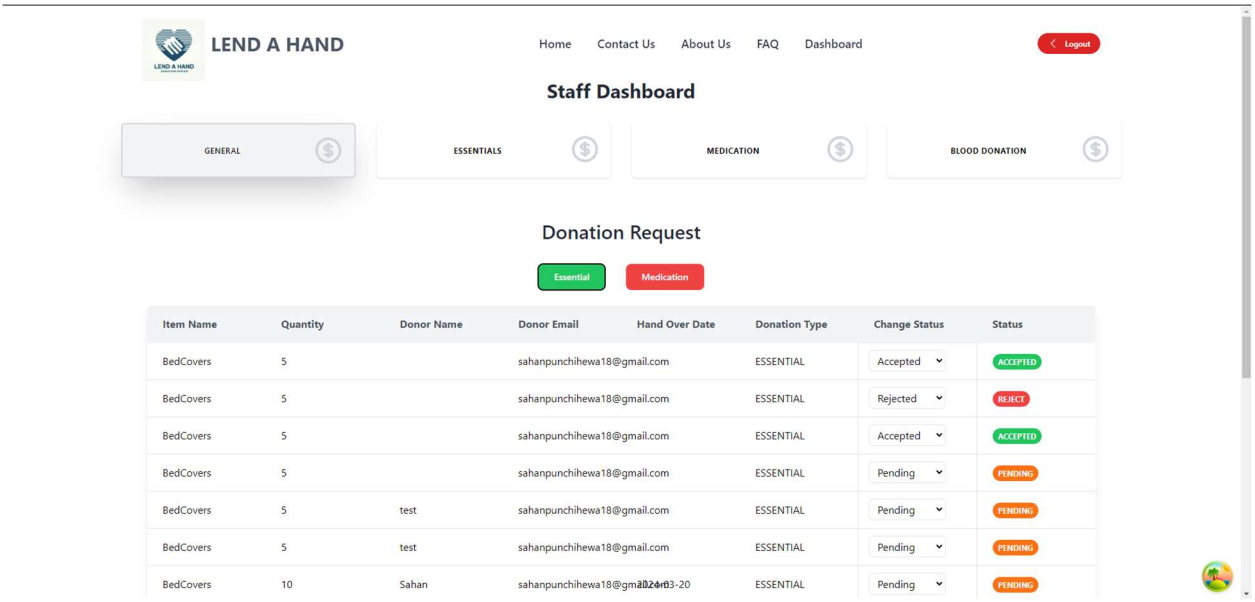


Figure 28 : Staff dashboard UI

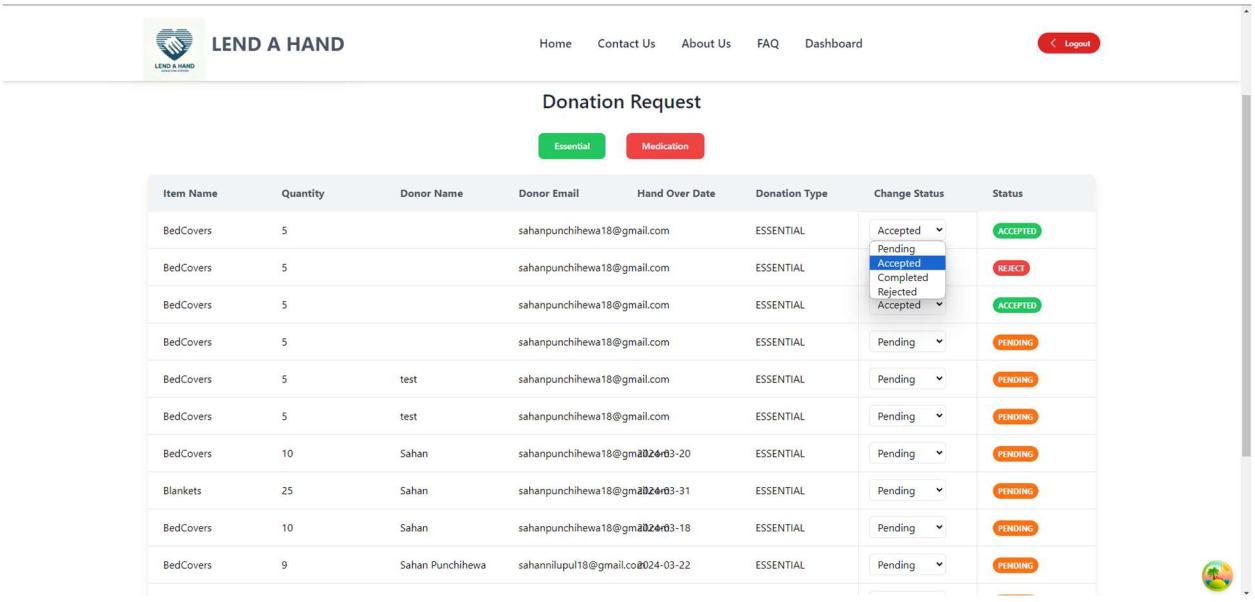


Figure 29 : Requested essential items

One of the key features of the system is the implementation of inventory status indicators. Based on predefined thresholds, the system categorizes inventory levels into three statuses: "Low," "Average," and "Good." When the current stock falls below 50 units, the status is flagged as "Low," indicating a need for immediate attention. Stocks between 50 and 100 units are categorized as "Average," signifying a stable inventory level. Conversely, stocks exceeding 100 units are labeled as "Good," indicating an abundance of the respective item.

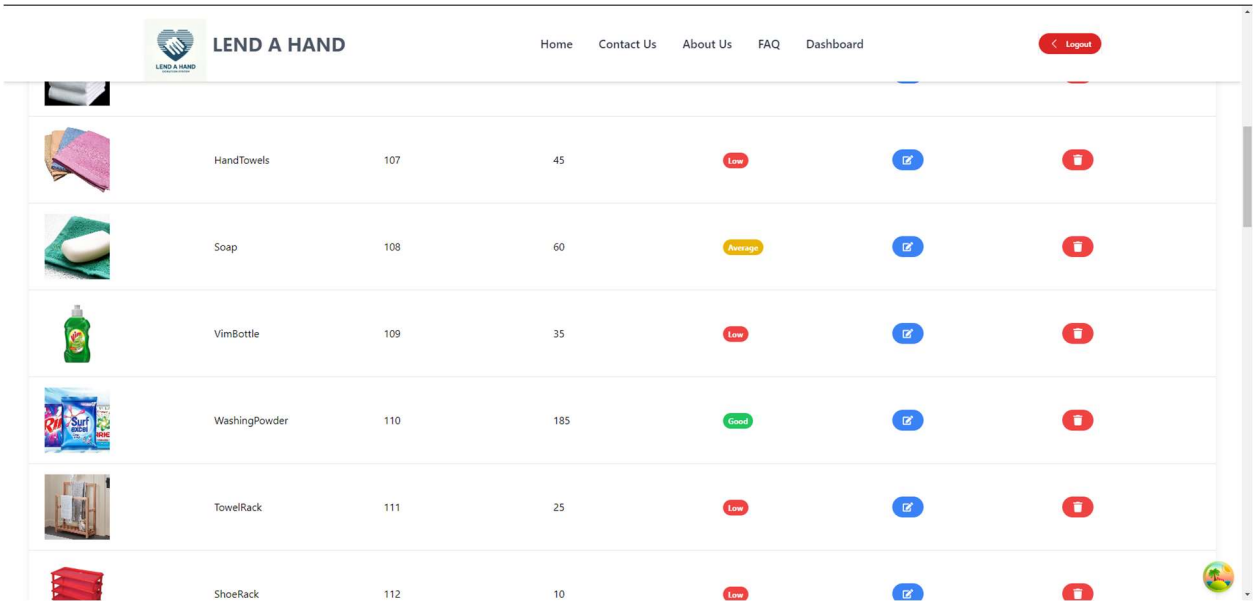


Figure 30 : Essential items list

Overall, the Inventory List and Donation Tracking system empowers hospital staff with valuable tools for managing essential items effectively. By providing real-time insights into inventory levels and donation activities, the system enhances operational efficiency and ensures that the hospital's essential needs are consistently met.

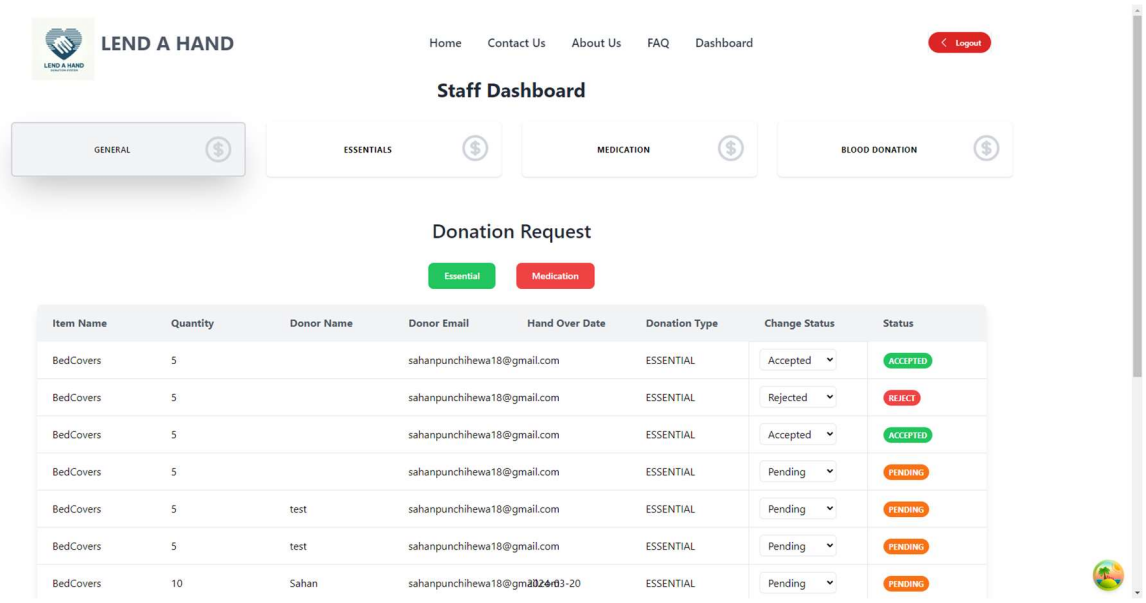


Figure 31 : Donation request dashboard

2.1.8 Developed Real time notification services

The developed Notification Service for Donors plays a crucial role in enhancing donor engagement and communication. Upon registering with the system, donors receive a confirmation email, providing reassurance and acknowledgment of their registration. This confirmation email serves to establish a connection with the donor and confirm their active participation in the donation process.

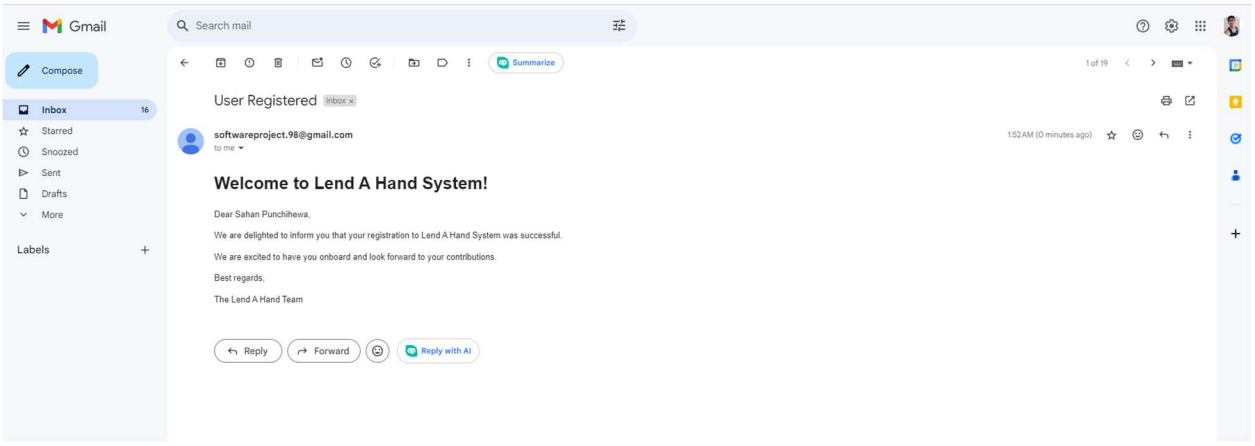


Figure 32 : User register confirmation

Furthermore, the Notification Service keeps donors informed about the status of their donations through timely email updates. Donors receive notifications regarding their current donation status, including details such as the items donated, quantity contributed, and any relevant feedback from the hospital. These updates ensure transparency and accountability in the donation process, fostering trust and confidence among donors.

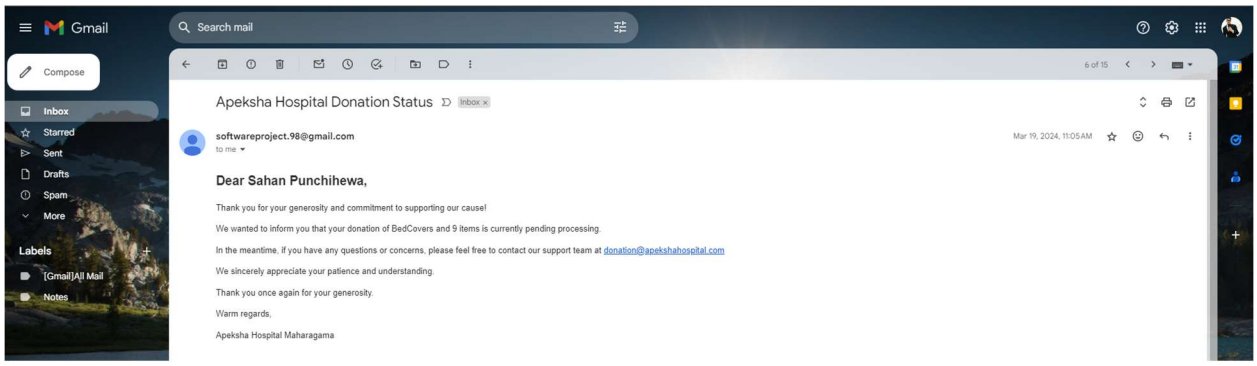


Figure 33 : User donated confirmation

In addition to status updates, the Notification Service sends comprehensive emails containing all relevant details related to the donation. This includes information about the specific items donated, their intended use within the hospital, and any additional instructions or requirements provided by hospital staff. By providing donors with a complete overview of their contributions, the system encourages continued engagement and participation in future donation activities.

2.2 Commercialization

2.2.1 Commercialization

When it comes to healthcare donations and inventory management, our research project presents a one-of-a-kind opportunity to transform conceptual ideas into actionable solutions. The Intelligent Donor-Driven Inventory System for Essential Items that we have developed offers an innovative approach to the way in which hospitals engage with donors and manage their inventory. This technology accelerates the donation process and guarantees that hospitals receive the supplies they require at the moment they require them by utilizing cutting-edge machine learning algorithms, real-time data analysis, and user-friendly interfaces. By maximizing the effectiveness of donor interaction and inventory management, we want to have a substantial impact on the operations of the healthcare industry with the help of our solution.

2.2.2 Market Research and Analysis

To gain insight into the healthcare donation market and find participants such as hospitals, donors, and nonprofit organizations, it's necessary to do market research and analysis. We present our solution well by learning about the wants and trends of the market. Hospitals often have trouble keeping track of their supplies, which can cause shortages and waste. Lack of openness is one of the problems that donors face. Our answer is meant to make it easier for people to donate and help charitable work. We look for trends, like the use of technology and making decisions based on data, and make sure that our answer fits with these to make sure it is useful. By showing what makes our Intelligent Donor-Driven Inventory System for Essential Items stand out, competitive analysis helps us show what makes it valuable. In the end, market research helps us figure out how to make our answer have the biggest effect on getting donors involved and managing healthcare inventory.

2.2.3 Intellectual Property Assessment

Our Intelligent Donor-Driven Inventory System for Essential Items has produced revolutionary algorithms and methods for healthcare donor interaction and inventory management. To secure these assets, we evaluated their intellectual property for patent and trademark protection. We reviewed algorithms and procedures to identify patentable elements, searched patents, and consulted legal experts during the review process. We checked branding aspects for trademark protection to secure our unique identity. Patents and trademarks safeguard our solutions from unauthorized usage and increase their worth, attracting investors and collaborators who recognize our invention. This assessment informs future R&D, focusing on protection-potential areas and assuring growth and market success.

2.2.4 Business Model Development

The Intelligent Donor-Driven Inventory System for Essential Items needs a strong and sustainable business strategy to maximize its efficacy and accessibility while staying economical. We specialize in affordable and dependable inventory management and donor engagement systems for healthcare facilities. Product sales, authorization, and billing on services are our main revenue streams. We promote our inventory management system to hospitals and healthcare organizations as a standalone solution to generate revenue. We will also investigate licensing arrangements to allow other firms to integrate our technology into their platforms, expanding our market reach and creating passive income. Additionally, we will offer subscription-based services to hospitals for system support, upgrades, and maintenance, ensuring continual improvement and client satisfaction. By diversifying our revenue streams and focusing on customer value, we hope to create a sustainable and lucrative business model that supports our Intelligent Donor-Driven Inventory System.

2.2.5 Prototype Development

An initial prototype is needed to demonstrate our Intelligent Donor-Driven Inventory System for Essential Items' capabilities and functionality. This MVP will demonstrate real-time inventory tracking, donor engagement tools, and predictive analytics. We intend to demonstrate the system's value proposition and potential influence on healthcare charity and inventory management by focusing on fundamental functions. The prototype will let us get feedback from hospitals, funders, and philanthropic organizations to improve our solution. The prototype will also allow us to verify our system's viability and scalability in real life, enabling future development and implementation. This prototype will validate our study and illustrate the actual use of our Intelligent Donor-Driven Inventory System, promoting its full-scale deployment and adoption in healthcare.

2.2.6 User Testing and Feedback

User testing and feedback help us improve our Intelligent Donor-Driven Inventory System for Essential Items. Through thorough testing with varied people, we learn about our system's usability and effectiveness. This iterative process helps us find and implement improvements that boost user satisfaction and productivity. By continually testing and implementing user feedback into our development cycle, we consistently improve the user experience and create a more effective and user-friendly solution for hospitals, donors, and charity organizations.

2.2.7 Funding and Investment

To help our Intelligent Donor-Driven Inventory System for Essential Items grow and expand, we need to get funds and investments. We are always looking for ways to get funds to expand our organisation, pay for product development projects, and improve our marketing. This could mean looking into ways to work together with venture capital firms, get funding from startup investors, or look for ways to get funds from research institutions and grant programs. We want to speed up the development and deployment of our system by getting enough funds. This will lead to new ideas in healthcare donations and inventory management, and it will also help essential item donations have the biggest impact possible in healthcare facilities.

2.2.8 Marketing and Promotion

In order to enhance publicity and build more excitement for our Intelligent Donor-Driven Inventory System for Essential Items, we developed a comprehensive strategy for its promotion. We aim to demonstrate the efficacy of our approach in facilitating donor engagement, enhancing supply management for hospitals, and ultimately enhancing patient care. We will utilize online platforms such as websites and social media to efficiently deliver information to the appropriate target audience. By prioritizing the efficacy, affordability, and user-friendliness of our system, we hope to attract a larger number of donors, hospitals, and organizations, thereby significantly enhancing our influence on the health care industry.

2.2.9 Continuous Improvement

We aim to improve our research. We will continually request user feedback and improve our Intelligent Donor-Driven Inventory System for Essential Items. User input and changing demands will guide our product enhancement and efficiency optimization. We want to develop our system's capabilities to meet our users' different needs, keeping it relevant and successful in tackling healthcare donation and inventory management's developing concerns. We aim to exceed stakeholder expectations and improve healthcare outcomes through continuous improvement.

2.3 Testing and Implementation

We carefully evaluated our Intelligent Donor-Driven Inventory System for Essential Items during "Testing and Implementation". We did a lot of testing to ensure everything works and is secure. We checked each system component for proper operation. We also assessed the system's response time and ability to handle various situations. We have evaluated our system for security to ensure its safety. We even asked hospital workers and donors if they liked and used it. After passing these tests, we launched the system using MERN Stack Technology for the frontend and Python with Fast API for the backend. It's ready to simplify hospital supply donation and management.

2.3.1 Deployment Strategy

Our deployment plan relied on Docker to package our backend, frontend, and notification components separately, making it easier to roll out our system smoothly. Docker helped keep everything consistent and simplified deployment across different setups. We used cloud servers to host our system, ensuring it could handle growth and stay online reliably. For managing the deployment process, we turned to Docker Compose, tools that helped us organize and scale our applications as needed. While we faced challenges like making sure older systems worked well with ours and dealing with complex setups, we managed the risks by thoroughly testing our Docker images and deployment scripts before going live. To keep downtime to a minimum and make sure the switch to our system was seamless, we used methods like gradually releasing new versions and testing them bit by bit. These steps allowed us to upgrade without causing major disruptions, maintaining stability and trustworthiness. Overall, by using Docker, cloud services, and smart deployment tools, we were able to roll out our system efficiently without causing too much hassle.

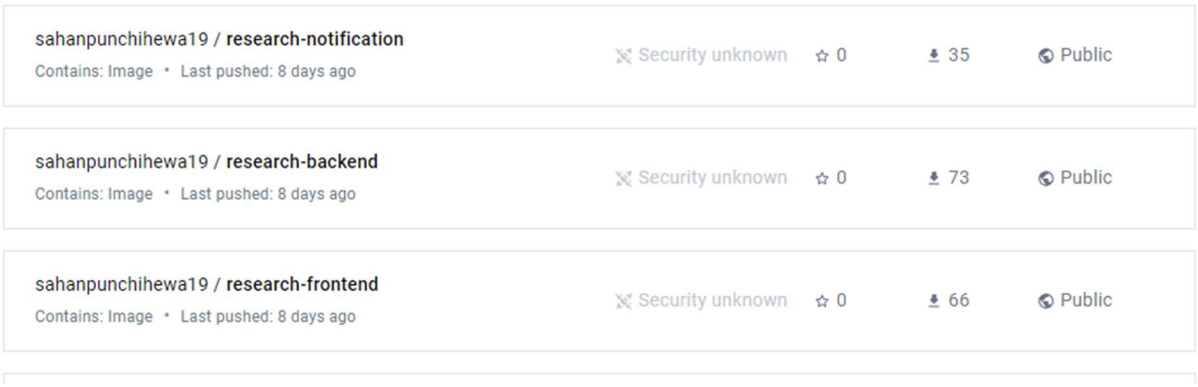


Figure 34 : Dockerize services

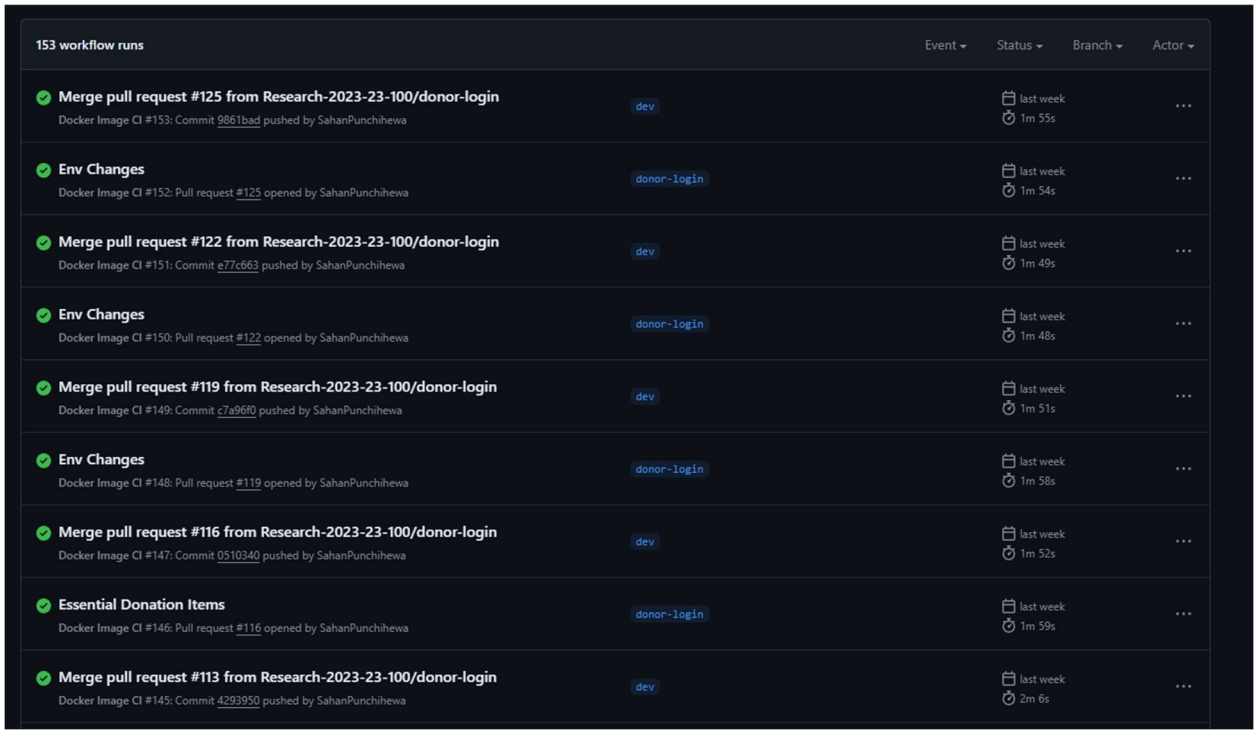


Figure 35 : GitHub workflow

2.3.2 User Acceptance Testing

We invited donors and hospital staff to test our Intelligent Donor-Driven Inventory System to make sure it meets their needs and expectations. During this process, we got useful comments that helped us figure out what needed to be fixed and made sure the system worked properly. User feedback was carefully recorded, and changes were made based on what they said, with improvements that make the user experience and system performance the top priority.

2.3.3 Functional Testing

We carefully checked every part of our Intelligent Donor-Driven Inventory System to make sure it works correctly. This meant we tested things like logging in, managing inventory, engaging with donors, and how well our machine learning algorithms give recommendations. We had strict testing procedures to confirm that each piece of the system does what it's supposed to do, meeting the goals we set and giving users the features they need.

3. RESULTS & DISCUSSION

3.1 Results

Linear Regression was first used in our study, and it only worked 9.17% of the time. There were some useful things I learned from this method to predicting inventory, but it wasn't good enough for managing inventory in a hospital setting. Linear Regression isn't good at catching the complex patterns and changing dynamics of hospital inventory data, so we looked into other ways to make it more accurate and useful for prediction.

Table 2 Results of Linear Regression

	Accuracy(%)	Mean Absolute Error (%)	Mean Squared Error (%)
Linear Regression	9.17%	4.42	0.49

After that, we used Decision Tree Regression, a machine learning method designed to deal with data that has complex, nonlinear relationships. When Decision Tree Regression was used, accuracy went up a huge amount, reaching an amazing 98% rate. Utilizing advanced machine learning techniques designed especially for hospital inventory management tasks has proven to be very effective, as shown by this significant improvement.

One reason why the Decision Tree Regression model works so well is that it can figure out the complex trends in the inventory data from Apeksha Hospital Maharagama. Using the natural adaptability and freedom of Decision Trees, the model was able to accurately identify underlying trends and changes in inventory levels. This made it possible to make accurate predictions of demand and make the most of resources.

Table 3 Results of decision tree regression

	Accuracy (%)	Precision (%)	Recall (%)	F1-score (%)	ROC-AUC Score (%)
Decision Tree Regression	98.71	99.0	99.56	99.31	93.28

MongoDB stores all healthcare essentials as documents in an inventory collection. Each document has a unique item name, ID, category, usage history, and quantity. MongoDB stores, retrieves, and manipulates critical item data efficiently by organizing the data. MongoDB's flexible schema enables the addition or alteration of attributes as needed, ensuring adaptability to changing inventory management needs. MongoDB is a reliable and scalable solution for storing and maintaining medical essentials, integrating with the inventory management system.

Figure 36 : Database usage

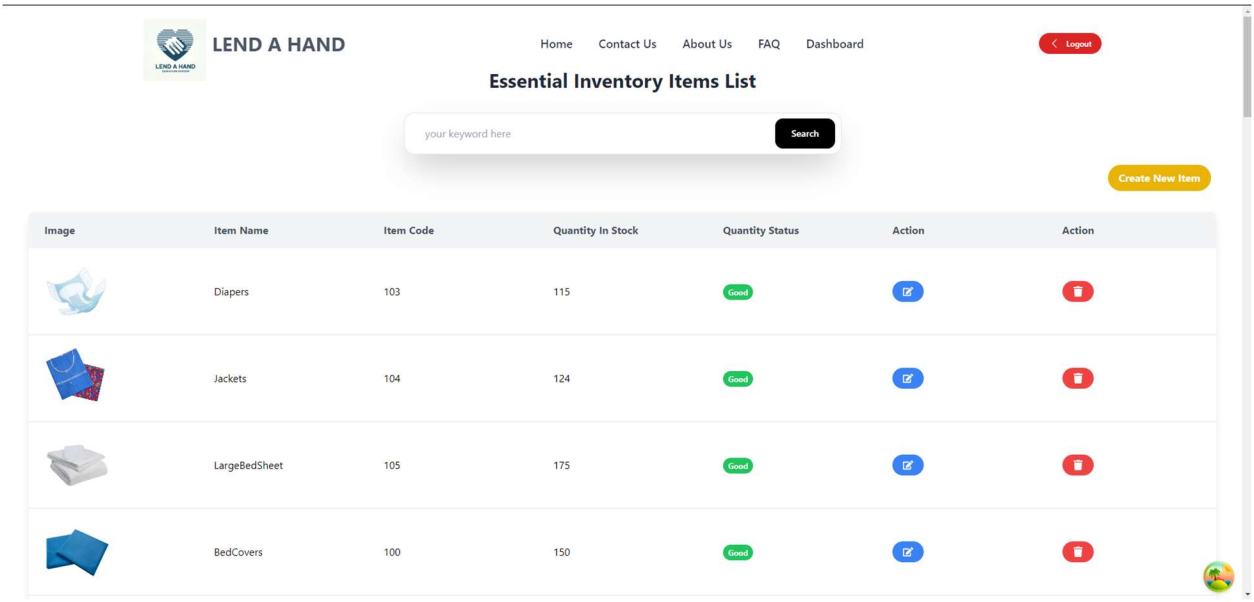


Figure 37 : Current inventory stock

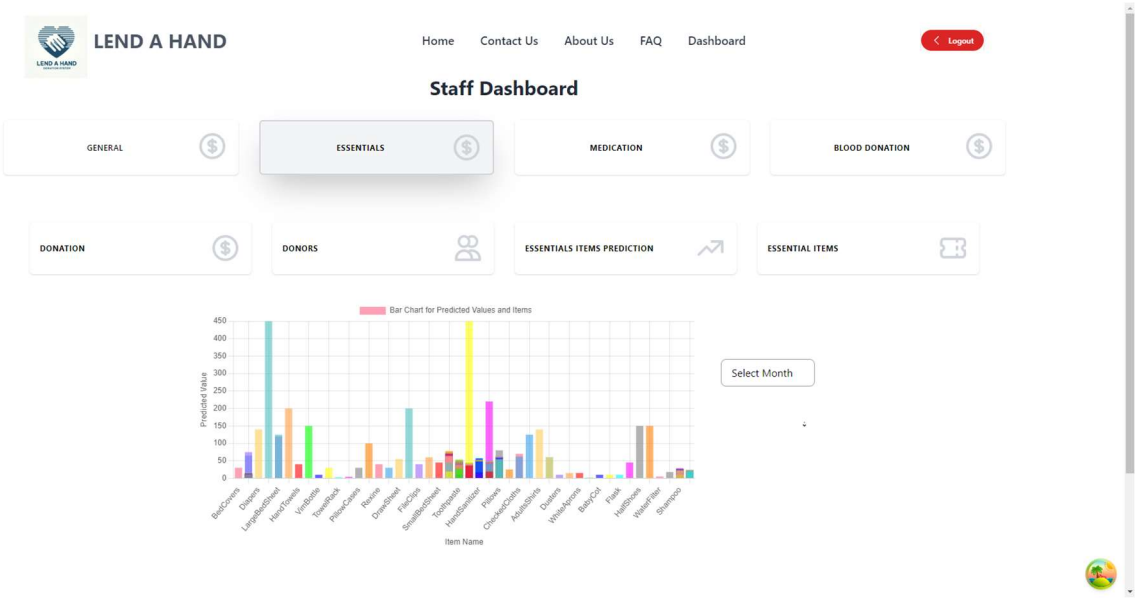


Figure 38 : Staff dashboard

In summary, the first part of our study focused on Linear Regression, with a moderate accuracy of 9.17%. We used Decision Tree Regression after realizing its shortcomings in hospital inventory management, and it resulted in a notable 98% improvement in accuracy. This achievement highlights the efficacy of advanced machine learning methods customized for hospital inventory duties. MongoDB was key in helping to store critical healthcare data in an effective manner and to enable smooth data management. When combined, these developments present bright opportunities for maximizing the use of resources and streamlining operations in healthcare environments.

3.2 Research Findings

In our research, we aimed to improve how hospitals manage their inventory by using machine learning techniques and smart ways to store data. First, we looked at Linear Regression, which is one of the most important methods in prediction analytics. Its success, on the other hand, wasn't good enough; it only got 9.17% accuracy. Even though Linear Regression gave us useful information, it wasn't enough to explain how hospital material changes over time. We needed a more advanced method, so we used Decision Tree Regression, which is known for being able to deal with complex data patterns and connections that don't follow a straight line. The results were amazing; the accuracy rate shot up to a very impressive 98%. This big growth showed how useful it is to use advanced machine learning techniques that are customized to the needs of hospital inventory management.

One of the most beneficial things about Decision Tree Regression is that it can figure out complicated trends in large collections of inventories. The model did a great job of finding trends and changes in inventory levels by using the natural adaptability and flexibility of Decision Trees. This helped us make accurate predictions about demand, which led to better use of resources and better inventory control. The fact that this method worked so well shows how important advanced analytics are for dealing with the difficulties of managing hospital supplies.

MongoDB became an important part of our study environment and helped our machine learning efforts. The document-oriented design of MongoDB made it a strong platform for storing and managing important healthcare data. Each document in the MongoDB inventory collection held important information about an item, like its name, ID, category, usage history, and amount. The platform's structure was flexible, which made it easy to organize and change data, so it could be used for a variety of inventory management needs. MongoDB's ability to grow and be reliable made it an even better choice for storing and managing medical supplies. It also worked perfectly with our inventory management system.

In conclusion, our research journey shows how advanced analytics and efficient data storage solutions can change the way hospitals handle their inventory. Putting Decision Tree Regression and MongoDB together helped us make big improvements in accuracy and business efficiency. Not only do these results show that customized machine learning methods work, but they also show how important a strong database is for driving innovation in healthcare settings. From now on, our study paves the way for even more progress in optimizing resources and improving operational excellence in hospital inventory management.

3.3 Discussion

In our research, we used cutting-edge machine learning methods and new ways to store data to solve the problems of managing hospital inventory. In the beginning, Linear Regression gave us some useful information, but it wasn't quite right (9.17% of the time). We saw a huge difference when we switched to Decision Tree Regression, which gave us 98% accuracy. This showed how well customized machine learning methods work for hospital inventory jobs, especially for figuring out complicated trends. We improved data management even more by adding MongoDB to our system design. It works perfectly with our MERN Stack technology. Together, this integration and Decision Tree Regression made it possible for big improvements in accuracy and speed. In conclusion, our study shows how advanced analytics, and a strong database infrastructure can completely change the way hospitals handle their inventory.

4. CONCLUSION

Our research has taken us through the complicated world of hospital inventory management, where we've been trying to find solutions to the many problems and inefficiencies that come with this important part of healthcare. We have made big steps toward improving operational efficiency, making the best use of resources, and ultimately providing better patient care by combining advanced machine learning techniques, new data storage solutions, and cutting-edge technologies that work well together.

Linear Regression was our first predictive analytics tool for inventory forecasting. However, its 9.17% accuracy highlighted hospital inventory data's complexity and dynamic nature, encouraging more advanced techniques. Switching to Decision Tree Regression, a machine learning technique that handles nonlinear relationships and complex data patterns, was significant. Decision Tree Regression proved the turning point of advanced machine learning modified to hospital inventory management, with accuracy reaching 98%.

The ability of Decision Tree Regression to adapt and change on its own was very helpful in finding complex patterns and variations in large data sets. By using these features, our model was able to find patterns in Apeksha Hospital Maharagama's inventory data, which let us make accurate estimates about demand and make sure that resources were used efficiently, and inventory was kept under control. The fact that this worked so well shows how advanced analytics can completely change the way hospitals handle their inventory.

Additionally, using advanced technologies like Python with the Fast API framework for implementing machine learning models and Node.js, Express, MongoDB, and ReactJS (MERN Stack) for system development greatly improved the scalability, flexibility, and performance of our solution. Utilizing Fast Api’s quick API development tools and the MERN Stack's adaptability and dependability, we built a complete system architecture that can easily meet the needs of hospital inventory management.

MongoDB's document-oriented design and flexible schema were especially helpful in making it easier to store and handle data. Each document in the MongoDB inventory collection held important details about medical necessities. This made it easy to find data, change it, and organize it. MongoDB's ability to grow and be reliable made it even better for handling medical supplies well, and it fit perfectly with the needs of our inventory management system.

The results of our research have huge effects on the healthcare industry. They provide valuable insights and solutions that can improve operational efficiency and raise the quality of patient care. With the help of modern technology, advanced machine learning techniques, and new ways to store data, hospitals can make managing their inventory easier, make better use of their resources, and eventually improve patient outcomes.

Regarding the future, our research makes it possible for hospital inventory management to keep getting better and more innovative. Improved machine learning models, more predictive analytics methods, and using new technologies to drive constant improvement and innovation may be the focus of future research. Additionally, the future of healthcare delivery will depend on researchers, healthcare workers, and technology experts working together all the time.

Overall, our research is an important step forward in the quest to improve operational efficiency, make hospital inventory management better, and improve patient care. We have set the foundation for a more efficient, responsive, and patient-centered healthcare system that is ready to take on the challenges of tomorrow by combining modern technology, advanced machine learning techniques, and new designs for data storage.

5. REFERENCES

[1] M. Javaregowda, "Research Gate," June 2020. [Online]. Available: https://www.researchgate.net/profile/Madhuri-Javaregowda/publication/342529859_Inventory_management_using_Machine_Learning/links/5f00bc48299bf18816008a64/Inventory-management-using-Machine-Learning.pdf. [Accessed 20 March 2024].

[2] E. B. A. I. R. G. B. R. A. R. F. Lolli, "Taylor and Francis Online," 31 October 2018. [Online]. Available: https://www.tandfonline.com/doi/abs/10.1080/09537287.2018.1525506. [Accessed 26 March 2024].

[3] H. L. E. H. B. L. Khalil Namir, "Science Direct," 26 Janunary 2022. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S1877050921025035. [Accessed 22 March 2024].

[4] M. H. G. J. C. T. S. S. S. z. E. N. Hadid J. Wahedi, "MDPI," 08 July 2023. [Online]. Available: https://www.mdpi.com/2076-3417/13/15/8581. [Accessed 24 March 2024].

[5] D. H. K. K. P. M. L. C. Paras Gurnani, "Springer Link," 01 February 2022. [Online]. Available: https://link.springer.com/chapter/10.1007/978-981-16-6460-1_41. [Accessed 20 March 2024].

[6] A. O. A. G. F. C. Hasan Kartal, "Science Direct," 10 June 2016. [Online]. Available: https://www.sciencedirect.com/science/article/abs/pii/S0360835216301991. [Accessed 23 March 2024].

[7] J. N. G. P. C. M. S. C. Júlio Barros, "Science Direct," 4 July 2023. [Online]. Available: https://www.sciencedirect.com/science/article/abs/pii/S0952197623008552. [Accessed 28 March 2024].

[8] Y. L. Chuning Deng, "Hindawi," 11 October 2021. [Online]. Available: https://www.hindawi.com/journals/wcmc/2021/9969357/. [Accessed 24 March 2024].

[9] P. J. P. K. P. G. P. M. J. Praveen K B, "International Journal of Engineering Research & Technology (IJERT)," 06 June 2020. [Online]. Available: https://www.ijert.org/research/inventory-management-using-machine-learning-IJERTV9IS060661.pdf. [Accessed 24 March 2024].

[10] H. M. R. M. I. G. M. S. G. A. S. Ehsan Ahmadi, "Science Direct," 18 August 2022. [Online]. Available: https://www.sciencedirect.com/science/article/abs/pii/S0305054822002131. [Accessed 22 March 2024].

[11] P. A. D. C. Ivens Portugal, "Science Direct," 17 December 2017. [Online]. Available: https://www.sciencedirect.com/science/article/abs/pii/S0957417417308333. [Accessed 23 March 2024].

[12] I. S. B. N. J. R. U. A. S. R. F. M. N. S. Bushra Ramzan, "Hindawi," 19 October 2019. [Online]. Available: https://www.hindawi.com/journals/sp/2019/5941096/. [Accessed 22 March 2024].

[13] M. C.-R. M. P. M. N. J. O. d. U. R. O. Javier Briceño, "Science Direct," 14 May 2014. [Online]. Available: https://www.sciencedirect.com/science/article/abs/pii/S0168827814003870. [Accessed 24 March 2024].

6. GLOSSARY

Intelligent Donor-Driven Inventory System: An innovative technological solution that is meant to make it easier for donors to get engaged, make it easier to handle inventory, and improve the care given to patients in healthcare settings. The system uses modern technology, advanced machine learning methods, and new ways to store data to completely change the way hospitals handle their inventory.

Machine Learning Model: a computer program that has been taught to identify patterns in data and generate predictions or classifications. In this project, hospital inventory management operational efficiency is improved, inventory demand is predicted, and resource allocation is optimized through the use of machine learning models. Python and the Fast API framework are used to implement the models, allowing for scalable and effective deployment.

Fast API: A modern, fast, and very useful web platform for using Python to build APIs. FastAPI is used for backend development in this project. It provides the necessary tools to build endpoints, manage interactions between frontend and backend parts, and makes it easy to connect to the MERN Stack technology stack.

MERN Stack (MongoDB, Express.js, React.js, Node.js): A popular set of technologies that are used to make full-stack web apps. Express.js is the backend framework, React.js is the frontend package, and Node.js is the JavaScript runtime environment. MongoDB is a database system. These technologies work together to make it possible to create web apps that are scalable, efficient, and interactive. This provides hospitals with a complete way to handle their inventory.

Docker: A platform for containerization that enables developers to package applications and their dependencies into lightweight, portable containers. Docker is utilized in this project to containerize the application components, including the backend, frontend, and database, facilitating easy deployment, scalability, and portability across different environments.

Endpoint: A specific URL within a web application that serves as a communication point for requests and responses between the frontend and backend components. Endpoints are defined and implemented using Python and JavaScript in this project, enabling seamless communication and data exchange between different parts of the application.

Inventory Management: the organized process of keeping an eye on how important healthcare supplies are obtained, stored, tracked, and given out? For better inventory control, better resource allocation, and general efficiency in healthcare organizations, the Intelligent Donor-Driven Inventory System for Essential Items was created.

Resource Optimization: The process of making the best use of resources while reducing waste and mistakes as much as possible. The Intelligent Donor-Driven Inventory System uses complex algorithms and machine learning to make the best use of resources. This makes sure that hospitals have the things they need to meet patient needs while also minimizing extra inventory and saving costs.

Scalability: The system's ability to handle more work or demand without affecting its performance or reliability. Because it uses Docker containers and the MERN Stack technology stack, the Intelligent Donor-Driven Inventory System is very flexible. This means it can easily adapt to new needs and process more users and data.

User Interface (UI): The visual and interactive elements of a software application through which users interact with the system. In this project, the frontend of the Intelligent Donor-Driven Inventory System is built using React.js, providing a modern and intuitive user interface for accessing and managing inventory data.

7. APPENDICES

Figure 39 : Plagiarism Report