Smart Lost and Found

End Semester Evaluation

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ABSTRACT

As the number of students studying at Thapar Institute of Engineering and Technology is on the increase, the number of items lost and found daily is on the rise. Unfortunately, the campus's Lost and Found mail system is outdated and highly unreliable, as most emails regarding found items and lost item claims are sent to spam.

The smart lost and found system aims to make the process of returning the lost item back to the original owner hassle-free and user-friendly. In this application, the user can register himself as a student and post a query on the app depicting its details, location and pictures. The trained ML model will match the query with the item that is already found and present in the system database. If a match is found, then a reply is formulated and mailed to the respective user posting the query.

The above-mentioned system, although fully functional, has certain shortcomings. For example, the authentication of the ownership of the lost item is quite difficult for a variety of entities such as bags, clothes, bottles et cetra.

DECLARATION

We hereby declare that the design principles and working prototype model of the project entitled Smart Lost and Found is an authentic record of our own work carried out in the Computer Science and Engineering Department, TIET, Patiala, under the guidance of Dr. Harkiran Kaur and during 7th semester (2022).

Date: 18 December 2022

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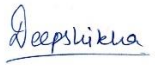
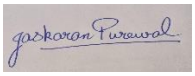
101917124	Deepshikha Dohare	
101917129	Jaskaran Singh Purewal	

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We would like to express our thanks to our mentor Dr. Harkiran Kaur. She has been of great help in our venture and an indispensable resource of technical knowledge. She is truly an amazing mentor to have.

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They always wanted the best for us, and we admire their determination and sacrifice.

Date: 18 December 2022

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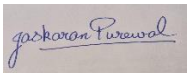
101917129	Jaskaran Singh Purewal	

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LIST OF ABBREVIATIONS

S No.	Abbreviation Used	Full Form
1	CNN	Convolution Neural Network
2	CV	Computer Vision
3	mAP	Mean Average Precision
4	UML	Unified Modelling Language
5	DB	Database
6	IEEE	Institute of Electrical and Electronics Engineers
7	SPICE	Software Process Improvement and Capability Determination
8	GPS	Global Positioning System
9	UI	User Interface
10	ML	Machine Learning
11	ER	Entity Relationship

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CHAPTER 1: INTRODUCTION

1.1 Project Overview

Losing an item of value can be hard to take. The prevalent system of managing the lost items on our campus is relatively inflexible and not suited for our hectic lives. University students are especially busy, so they frequently lose or misplace possessions they hold dear. Unfortunately, the campus's Lost and Found mail system is outdated and highly unreliable, as most emails regarding found items and lost item claims are sent to spam.

This project's primary goal is to develop a centralized Web-based Application that will help the students retrieve their lost items more efficiently and reduce the task of in-person verification of lost items as much as possible. The main features of this web application will include a registration and login system with their respective Roll Number. Users can add information about the items by making posts describing the item they have lost or found in detail. An admin panel will be implemented, giving admins special privileges like deleting and modifying posts. A multi-dimensional matching model based on text, image, and geographic location, will accurately match the items under consideration. After matching the valid requests, various techniques will be used to verify the item's ownership, and a record of items returned will be maintained.

We aim to integrate all these data and processes in one place, which will add a convenience factor for the students and any central authority responsible for maintaining the system.

1.2 Need Analysis

Thapar Institute of Engineering and Technology is one of India's oldest and most reputed engineering colleges. Established in 1956, all the Lost and Found management was carried out through conventional paperwork. Nowadays, all the related work is carried out through mail on official email. But the current system has some severe drawbacks.

- College's official email-id is daily flooded with countless lost and found emails, due to which critical information is often missed.
- Absence of a centralized platform and the whole system is managed by just one person. Dependency on e-mail and WhatsApp is more.
- In-person verification is tedious and time-consuming, and the chances of false claims are higher.
- Sensitive details like phone number, address, and card details are revealed.
- No peer-to-peer option is possible.

1.3 Research Gaps

Table 1: Research Paper Gaps

Title	Research Gaps
[Base Paper] Deep Correlation for Matching Images and Text	• It is not yet known how to employ canonical correlation for text generation rather than image-text matching. • The chances of bogus claims are higher.
Fast image similarity search by distributed locality-sensitive hashing	• As a data-independent method, long codes are needed. • Long hash codes reduce the recall. • Many hash tables must be used to balance precision and recall. • LSH increases memory requirement and query time.
ILFS: Intelligent Lost and Found System using Multidimensional Matching Model	• There are no counter-measures to avoid false claims. • No option available other than peer to peer.

1.4 Problem Definition and Scope

The current TIET students' email system is not viable, and at certain times the emails are considered spam. There is no dedicated system for managing the lost and found items in our campus. The students face difficulties if they ever lose personal belongings, and the method of retrieval and authentication of lost items is quite time-consuming as all the work is done manually.

Our project aims to bridge this gap between the available technology and the technology utilized on the campus while centralizing the data and relevant processes. The information related to lost items will be stored on a centralized database, and the online portal will enable the users and admin to carry out all the processes smoothly, minimizing the hassle and paperwork.

1.5 Assumptions and Constraints

- In order to add a lost or found item entry, the person needs to have an active and stable internet connection.
- We assume the communication in our system is instant and without any delay
- The user is ideal; that is, he/she will upload the correct details of the item.
- The idle time will be set to 30 minutes, and users will be asked to refresh the page and log in again after that
- The server is always up and running to process the user requests 24*7

1.6 Standards

Table 2: Standards

PHASE OR ACTIVITY GROUP	NUMBER	STANDARD TITLE
Requirement specification	IEEE 830	Recommend practice for software requirement specification

	IEEE 1233	Guide for developing system requirement specification
Design	EEE 1016	Software design description
	IEEE 1062	Software design description
Implementation, acquisition, and tools	IEEE 1462	Guidelines for evaluation and selection of CASE tools.
Testing	IEEE 829	Software test documentation
	IEEE 1008	Software unit testing
	IEEE 1012	Software verification and validation

1.7 Approved Objectives

- To create a cross-platform centralized web-based portal for Lost and Found Management.
- Enable login/signup functionality (using Thapar's existing student database, if possible).
- Provide data security
- To reduce in-person verification of lost items and automate the process.
- To make a user-friendly, easy-to-use interface.
- To make the process of item retrieval smooth and hassle-free.

1.8 Methodology

In this section, we go through the design specifications that will be followed in the project and the reasoning for reaching that technique.

We start with the technologies to be used to build the application considering that it is easy to use, accessible from anywhere that is through any device as well as is self-explanatory.

Before making the application, we will move on to designing a scalable database keeping in mind the features needed as specified above so that as the project progresses, we will have to face fewer issues in the schema as well, as if it scales afterwards, the developers will not have to go into the hassle of changing the existing schema.

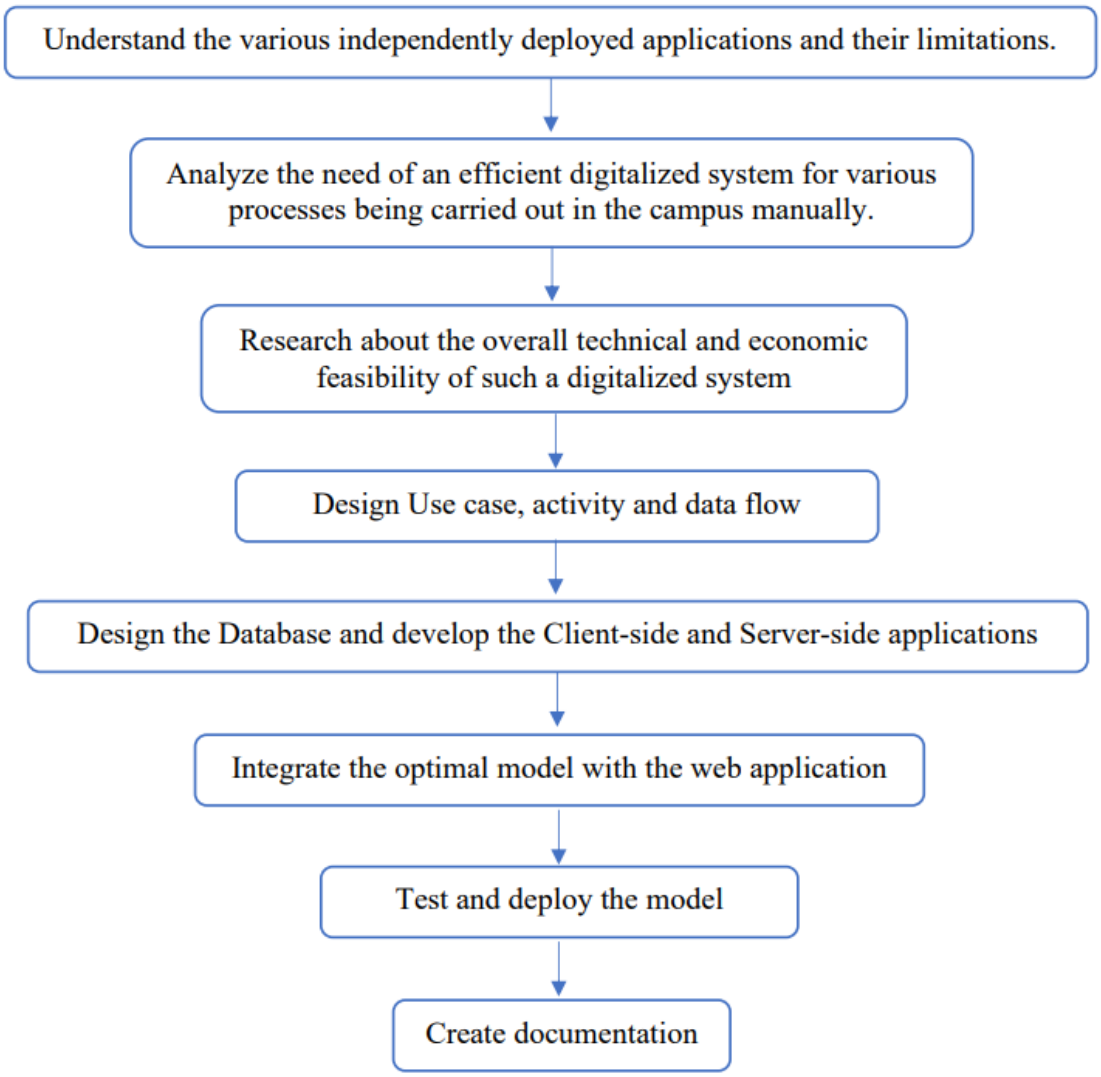

Figure 1: Flowchart of the system's overall functionality

Before starting our project, we first need to understand the applications that are already deployed and discuss their limitations. We need to analyse the need for an efficient system which can be used to replace the current manual system of the campus. After doing the research related to various technologies, we designed use cases, activity and data flow diagrams. After deciding on the database and integrating the optimal model with the web application, we will test and deploy the model.

1.9 Project Outcomes and Deliverables

- After completing this project, a fully functional Smart Lost and Found system will be created, which will be more efficient than the existing manual system.
- The verification process will be automatic, and manual verification will be reduced.
- Data privacy will be maintained.

1.10 Novelty of Work

The current lost and found system at Thapar is very inefficient and involves a lot of manual work. It uses the college mail system, and everyone in the college is notified about a lost item. Our project aims to reduce the manual work and make the lost and found a system more efficient. It only notifies the concerned people instead of informing the whole college and flooding everyone's inbox with unnecessary emails. In all the lost and found systems, the person with a lost item can view the available lost item entries and choose from them. In our model, the person can only view the item once the complete description matches any one of the existing entries. This reduces false claims made by people.

CHAPTER 2: REQUIREMENT ANALYSIS

2.1 Literature Survey

2.1.1 Theory Associated With Problem Area

This project's primary goal is to develop a centralized Web-based Application that will help the students retrieve their lost items more efficiently and reduce the task of in-person verification of lost items as much as possible. The main features of this web application will include a registration and login system with their respective Roll Number. Users can add information about the items by making posts describing the item they have lost or found in detail. An admin panel will be implemented, giving admins special privileges like deleting and modifying posts. A multi-dimensional matching model based on text, image, and geographic location, will accurately match the items under consideration. After matching the valid requests, various techniques will be used to verify the item's ownership, and a record of items returned will be maintained.

2.1.2 Existing Systems and Solutions

- **RepoApp**

[3] is an interactive web application that helps organizations manage lost and found property. It allows its users to view the items in a list format. Each item is labelled with a unique ID and has a description of the item and the date on which it was found

- **Reclaim Hub**

[4] is a simple lost and found cloud-based software developed to allow companies to record and track their found items that are reported as lost. A smart matching system will also compare and return matching items to one another.

- **LoFo App**

[5] is an application that is focused on helping its clients retrieve lost items or post details about found items. Some novel features of this app include a reward-based system for found items.

- **Existing Lost and Found System in TIET Campus**

The prevalent Lost and Found Management system at work on campus comprises a central authority sending mails about items found and lost item reports to all the students and faculty at the same time. It is pretty inefficient as most people direct the mails to spam. The current method has significant security and data privacy

flaws, as sensitive information like bank card details or ID proof details is often shared. There is also the tedious manual verification of claims and management of records of returned items.

Table 3: Comparative Analysis of Previous Software/System

Software/System	Technology	Verification	Security
At TIET Campus	Mail	Manual	All lost posts are visible to everyone
RepoApp	Web App	Manual	All lost posts are visible to everyone
Reclaim Hub	Cloud-Based Software	None	All lost posts are visible to everyone
LoFo App	Mobile App	Manual	All lost posts are visible to everyone

2.1.3 Research Findings for Existing Literature

Table 4: Research Paper Survey

S. No.	Roll Number	Name	Title	Tools/ Technology	Findings	Research Gaps	Citation
1	101917111	Garv Bareja	[Base Paper] Deep Correlation for Matching Images and Text	Matching images and caption in a joint latent space learned with DCCA - Deep canonical correlational analysis	The average length of the captions generated per image from [7] is 28.2 words instead of 12.9 and 14.4 words in Flickr8K and Flickr0K, respectively.	• It is not yet known how to employ canonical correlation for text generation rather than image-text matching. • The chances of bogus claims are higher.	Yan [6]
2	101917115	Raghav Virmani	Fast image similarity search by distributed locality sensitive hashing	The image similarity analysis is to be improved by LSH on distributed data, instead of using ANN. Distributed locality sensitive hashing	The query time performance (in ms) on SIFT-1M, by the Selected Hash Function Set is 0.50 and 1.86 for 50 and 200 hash tables, respectively, which is better when compared to the older hash	• As a data-independent method, long codes are needed. • Long hash codes reduces the recall. • Many hash tables must be used to balance precision and recall. • LSH increases memory requirement and query time.	Osman [8]

					function set, 0.72 and 2.51 for 50 and 200 hash tables respectively.		
3	101917129	Jaskaran Singh Purewal	ILFS: Intelligent Lost and Found System using Multidimensional Matching Model	The traditional lost and found system which is manual and ineffective, is to be automated by an advanced ML matching model using Multidimensional Matching Model	ILFS introduced a push mechanism that reduces user time consumption and platform maintenance cost relative to traditional lost and found platforms.	• There are no counter-measures to avoid false claims. • No option available other than peer to peer.	Yao [9]
4	101917124	Deepshikha Dohare	A Survey on Automatic Image Caption Generation	Automatically generating a caption for an image using Multi-model embedding, attention mechanism.	A detailed discussion is done on different methods of classifying image caption approaches and these methods are compared on benchmark dataset.	• Employing more powerful network structures will improve the performance of image caption generation. • Image captioning grounded by image regions should be a future research direction.	Bai[11]

2.1.4 Problem Identified

- Verification process is manual.
- Details of items are made publicly available to anyone posting a claim.
- Data privacy is lacking.

2.2 Software Requirement Specification

2.2.1 Introduction

2.2.1.1 Purpose

This paper aims to provide a full description of the software component that will be utilised in our 'Smart Lost and Found System,' as well as how it should work. It describes the system's goal and characteristics, as well as what it will perform, the limitations it must work under, and how it will react to external stimuli. This paper is intended for both stakeholders and developers of the system.

2.2.1.2 Intended Audience and Reading Suggestions

The document aims to assist both developers and stakeholders. This document will aid developers in fully comprehending requirements and stakeholders in better documenting them. This document will provide you with a clear picture of the system you're creating. Depending on the project's requirements and chosen solutions, it can be utilized in any situation.

2.2.1.3 Project Scope

The software consists of a web portal that allows users to report and find a lost/found item.

- The application will run on all platforms
- Any registered person will be able to access the portal and add lost/found item entries.
- Data collected will be analysed using machine learning for matching lost and found items and providing a better user experience.

2.2.2 Overall Description

2.2.2.1 Product Perspective

This project's primary goal is to develop a centralized Web-based Application that will help the students retrieve their lost items more efficiently and reduce the in-person verification of lost items as much as possible. The main features of this web application will include a registration and login system with their respective Roll Number. Users can add information about the items by making posts describing the item they have lost or found in detail. An admin panel will be implemented, giving admins special privileges like deleting and modifying posts. A multidimensional matching model based on text, image, and geographic location, will accurately match the items under consideration. After matching the valid requests, various techniques will be used to verify the item's ownership, and a record of items returned will be maintained.

We aim to integrate all these data and processes in one place, which will add a convenience factor for the students and any central authority responsible for maintaining the system

2.2.2.2 Product Features

Firstly, the smart lost and found management system is an application to manage the lost items put up by students which are approved by the respective authorities and then stored accordingly and returned to the owner.

Additionally, this application uses an ML model to categorize the items and match them to the items which are found by individuals, reducing the manual labour of authorization and communicates the top matches via email to the respective users.

2.2.3 External Interface Requirements

2.2.3.1 User Interface

The user will have a platform to post descriptions about the lost items and also any items which have been found. All this information would be carried forward through the model and specific matches will be shared by the controlling authority to the matched user. User will also have the information regarding the meeting place where his/her item would be returned.

2.2.3.2 Software Interfaces

The website can be run on any version of the browsers Safari, Google Chrome, after Mozilla Firefox 4.0 and after Internet Explorer 6.0. Software interface used in the project are as follow:

Table 5: Software Description and Usage

Software Description	Usage
● **Python 3.8** Python is a programming language which helps in analysing data and visualizing it with the help of its libraries. It also has certain APIs, very useful in gathering data of stocks and other financial assets.	All back-end functions are written in python, with the help of the standard libraries and flask modules.
● **Django** Django is a micro framework which helps build backend applications easily compatible with python ML models.	We will route our http requests with the help of Django framework and also use it for interactions between the back-end UI
● **HTML, CSS, JavaScript** Used for building the UI. Easy to use framework and language to work with	We will help user provide options and preferences in UI with the help of HTML, CSS and Java Script components in front end

2.2.4 Other Non-functional Requirements

2.2.4.1 Performance Requirements

● **Usability:**
(i) The UI/UX has been made very user friendly and no prior knowledge is required to access the portal.
(ii) All the major features have been prominently displayed on the portal.

● **Performance:** The Web app is responsive and would be able to perform the required task and obtain favourable results.

● **Scalability:** Our web application has been designed with scalability in mind and will seamlessly and efficiently accommodate its growth in size in future.

● **Data integrity:** The accuracy and consistency (validity) of student's data present on the portal is maintained.

2.2.4.2 Security Requirements

For security, to make sure no one else controls the web application. We need to ensure that the accuracy of the model is maintained and not exposed to an environment where it can be stolen, destroyed or tampered with.

2.3 Cost Analysis

Our project is totally software-based, so no hardware equipment or resources are required to be purchased. In our project, we just require a smartphone or laptop in which a user can access the internet using a web browser. So, no extra cost is required and hence this project is cost-efficient.

2.4 Risk Analysis

There are a few risks involved:
• Poor internet connection can affect the speed of model evaluation. Hence, delaying the displaying process.
• Server crashes due to excess access requests on the platform.

CHAPTER 3: METHODOLOGY ADOPTED

3.1 Investigative Techniques

In this chapter, we go through the design specifications that will be followed in the project and the reasoning as to why we reached that technique. We start with the technologies to be used to build the application considering that it's easy to use, accessible from anywhere that is through any device as well as is self-explanatory. Before making the application, we'll move on to designing a scalable database keeping in mind the features needed as specified above so that as the project progressed, we will have to face fewer issues in the schema as well as if it scales afterward, the future developers won't have to go into the hassle of changing the existing schema and functions.

3.2 Proposed Solution

a) Scalable Database

MySQL Cluster automatically shards (partitions) tables across nodes, enabling databases to scale horizontally on low cost, commodity hardware to serve read and write-intensive workloads, accessed both from SQL and directly via NoSQL API.

b) mySQLbackupFTP

SQLBackupAndFTP is MySQL backup tool for Windows that runs scheduled backups of MySQLdatabases,runs local file/folder backup, compresses and encrypts the backups, stores them on a network folder, FTP server or in the cloud (Amazon S3, Google Drive, Dropbox, Box, OneDrive, Backblaze B2, Yandex.Disk), removes old backups, and sends an email confirmation on the task's success or failure. SQLBackupAndFTP runs on Windows machines and backups remote MySql databases via TCP/IP (SSH) connection or by means of phpMyAdmin Export. In both cases it creates a MySql backup script that later can be run to restore the MySql database. When TCP/IP connection is used the backup is accomplished using mysqldump utility.

3.3 Work Breakdown Structure

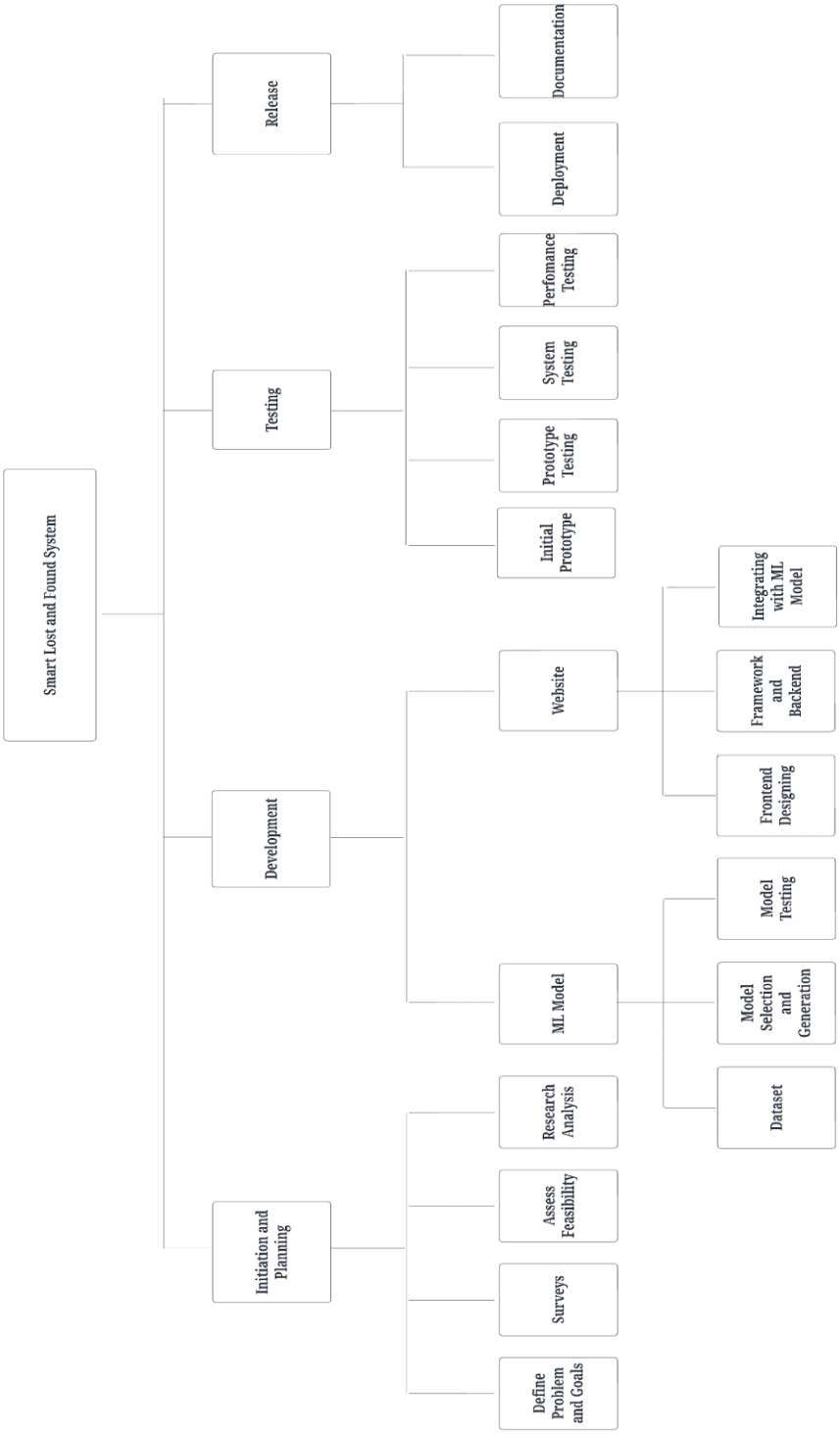

Figure 2: Work Breakdown

In the smart lost and found system there will be mainly four stages. In the first stage of initialization and planning we define problem statements and goals related to our project, survey, various research papers and applications related to our project and discuss feasibility of our project.

In the development stage we will train an ensemble ML model and design a web application for the project. After testing the web-app on various parameters we will deploy the website.

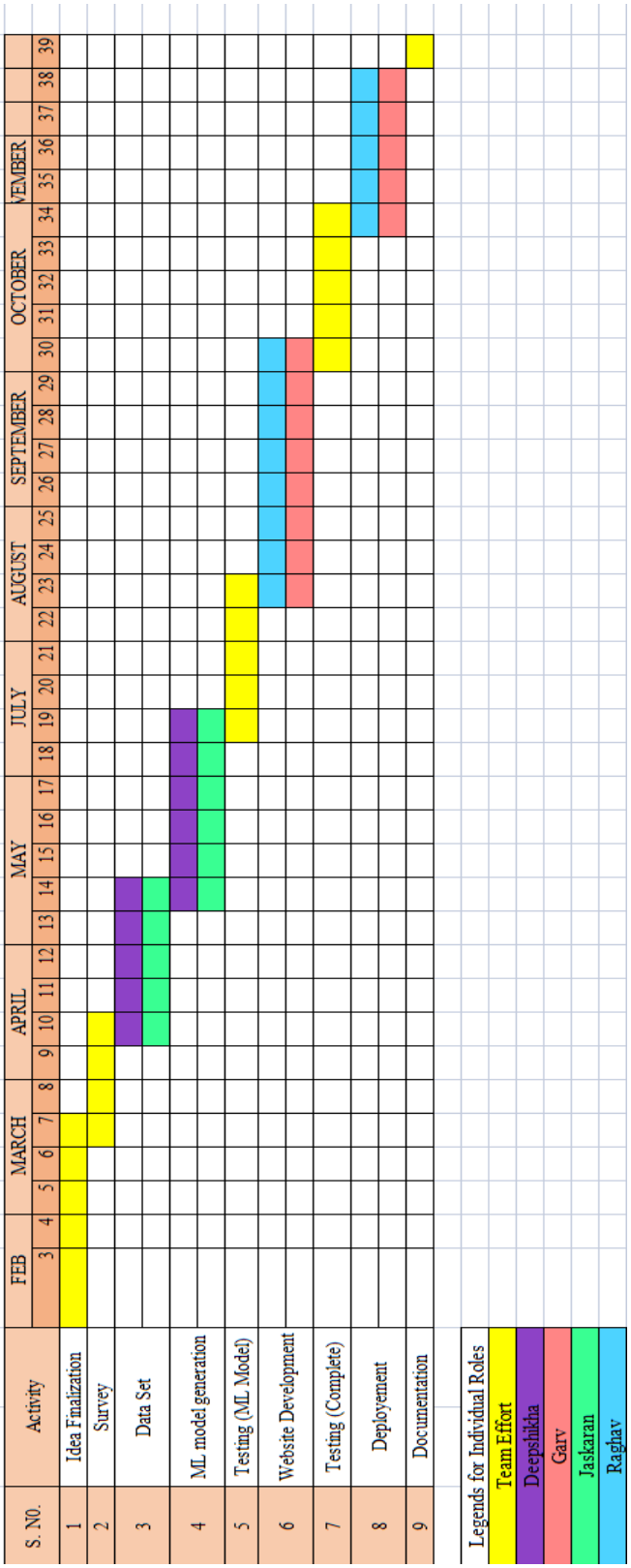

Figure 3: Work Breakdown using Gantt chart

The timeline as depicted in the Gantt chart are project started in February 2022 and would be completed near the end of this semester that is first week of December. As of now we are right on track.

3.4 Tools and Technology

The entire project would consist of a centralized web portal. We have thought that the application should be user-friendly, easy to access, and should be available on any device. Thus we have decided to develop it as a Web Interface.

The application as it has to be built on web must be having three major components: -

- Client-Side Interface that is Front-End
- Server-Side Interface that is Back-End
- Database for storing all the information.

Based upon the requirements we will be using the following major technologies along with the mentioned purposes they are being used for:-

- Python based micro-service, Django: - Backend for Server-Side Programming
- HTML, CSS, JS: - Frontend for Client-Side Programming.
- Bootstrap: - For beautifying the Client-Side Interface and making it Mobile Friendly.
- MySQL: - For Handling the DB end of the application.

This the full list of libraries we are planning to use segregated upon their usage goals:

- Django.core.mail: – For using mailing services to notify users through mail.
- Django-Session: - To create user sessions.
- Django_MysqlDb: - To use Flask in accordance with MySQL
- CSV & MKDTemp: - To generate reports in CSV or XLS format for the teachers.
- OS: - To handle the OS related operations to handle files.

CHAPTER 4: DESIGN SPECIFICATIONS

4.1 SYSTEM ARCHITECTURE

Block Diagram

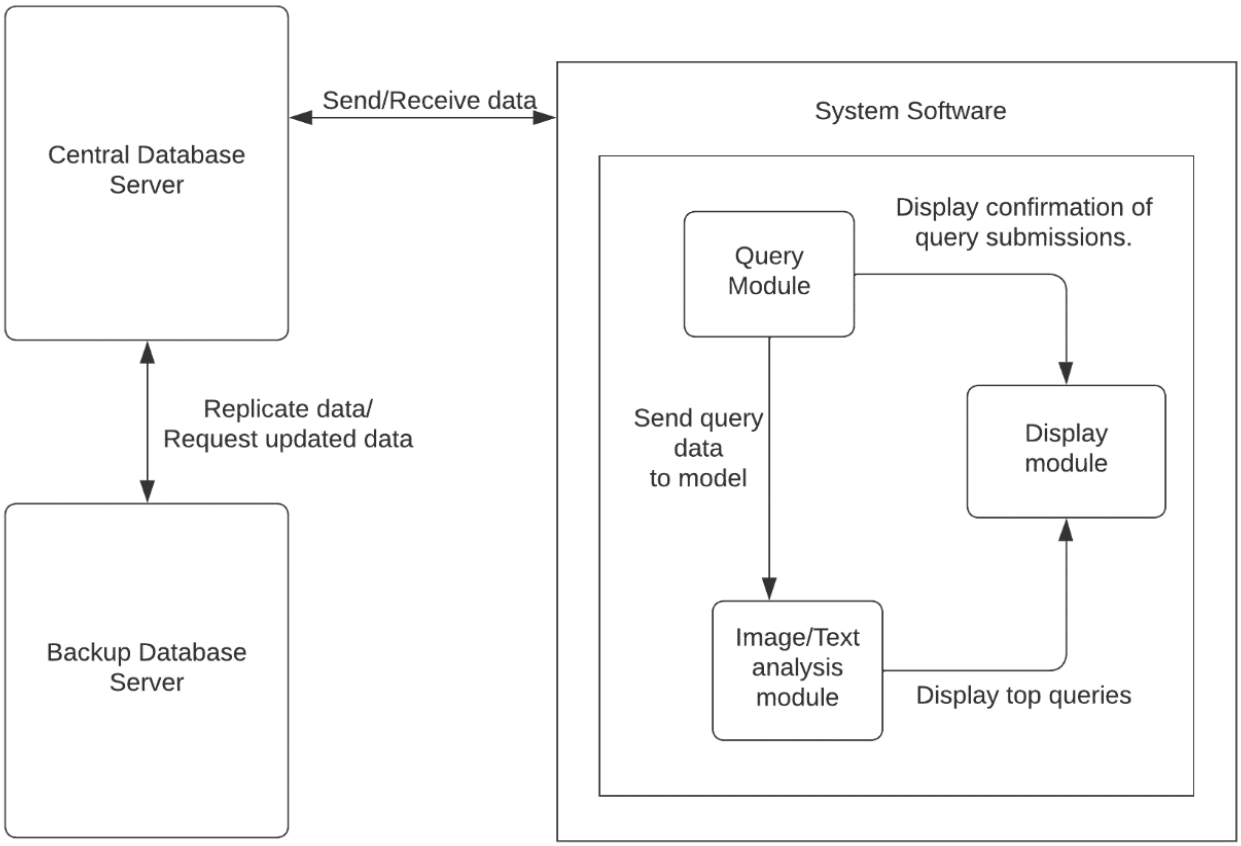

Figure 4: Block Diagram

In our Smart Lost and Found System, there will be mainly three modules namely Query module, which will manage the lost and found query data and the authorization query data, Display module which will display top matched queries, lastly the image text analysis module which will match the lost and found item data and return top matched queries.

MVC Architecture

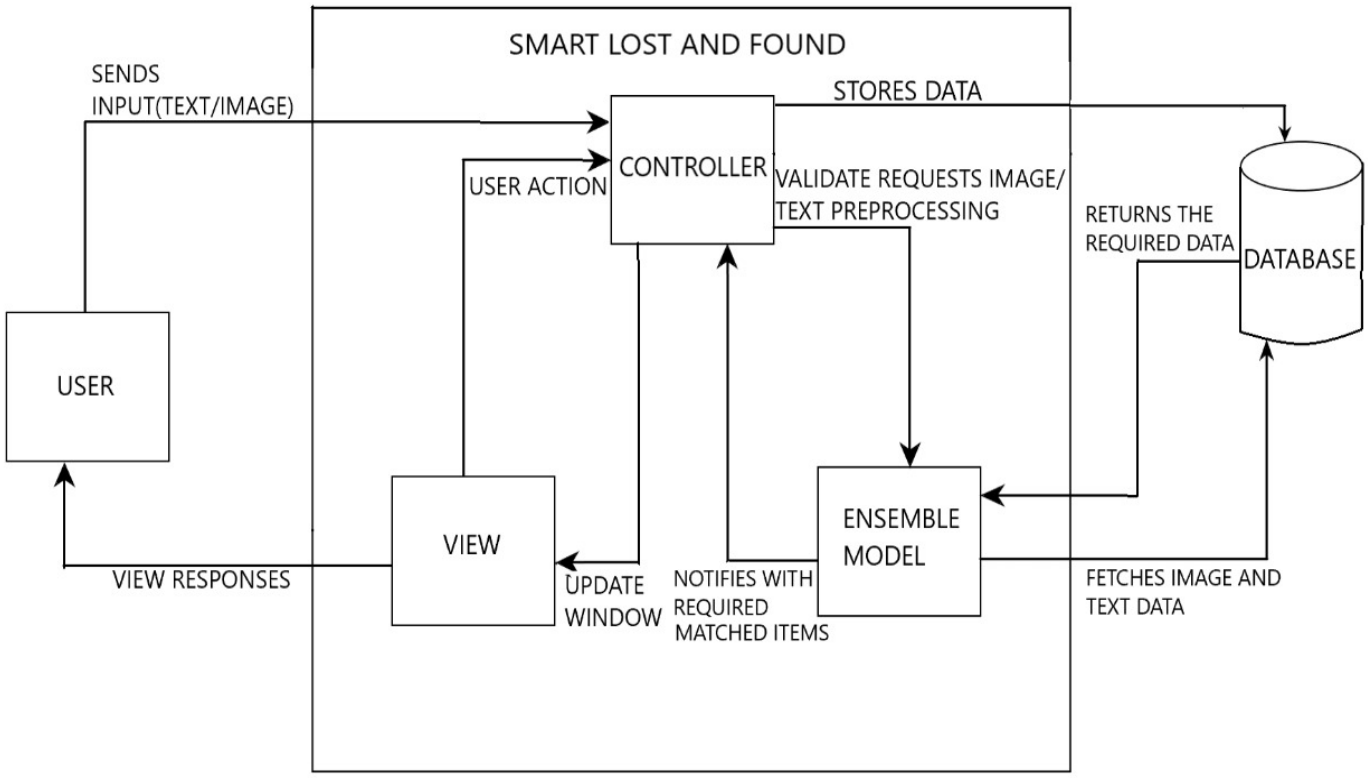

Figure 6: MVC Architecture

The Smart and Found System follows the MVC architecture in which the user (admin) can view responses from the ensemble model. The controller stores the data in the database, validates requests for image and text pre-processing and gets notified by the model regarding the required matched items.

4.2 DESIGN LEVEL DIAGRAMS

Data Flow Diagrams

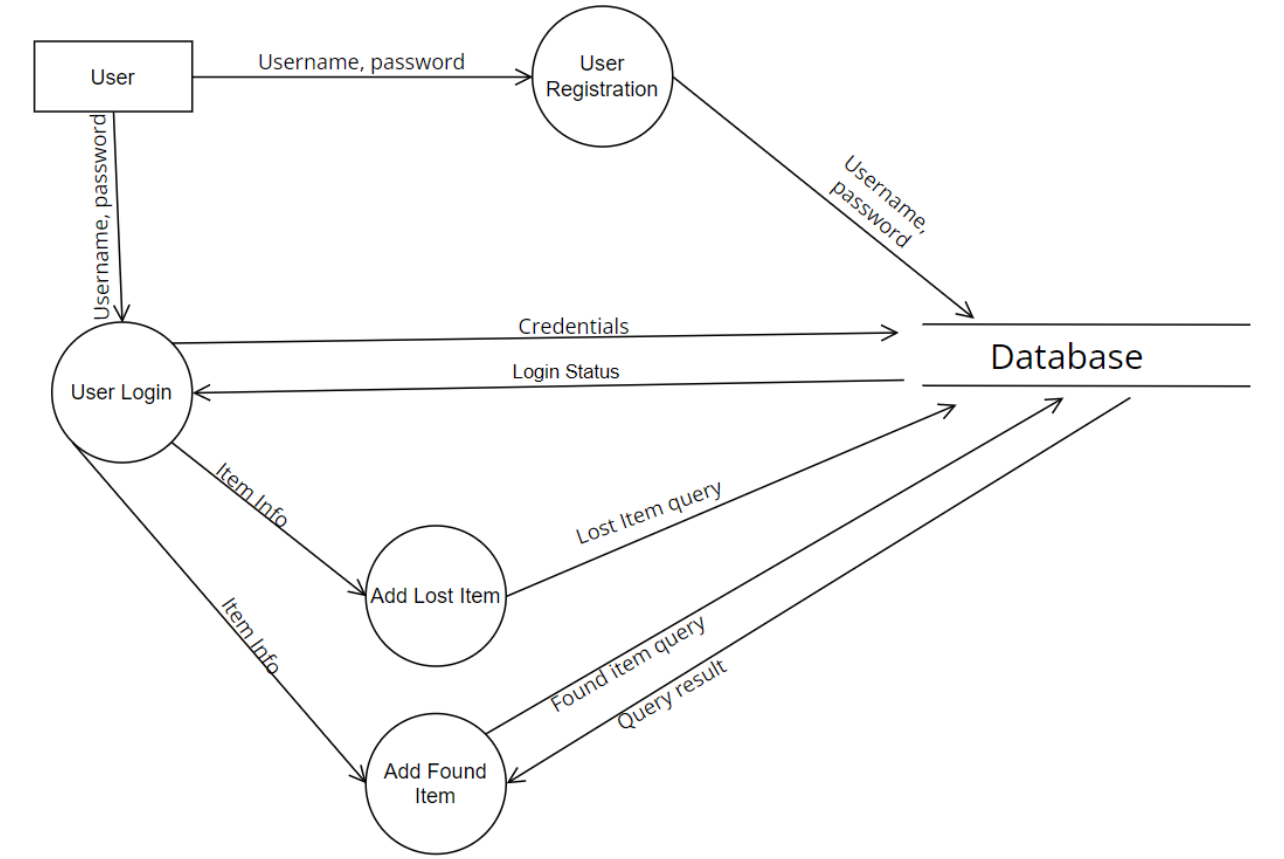

Figure 6: DFD level 1- User

A new user can register himself and store his username and password in the database. A registered user can login the web application and post a lost item query as well as a found item query. The text and image (optional) data will then be stored in the database.

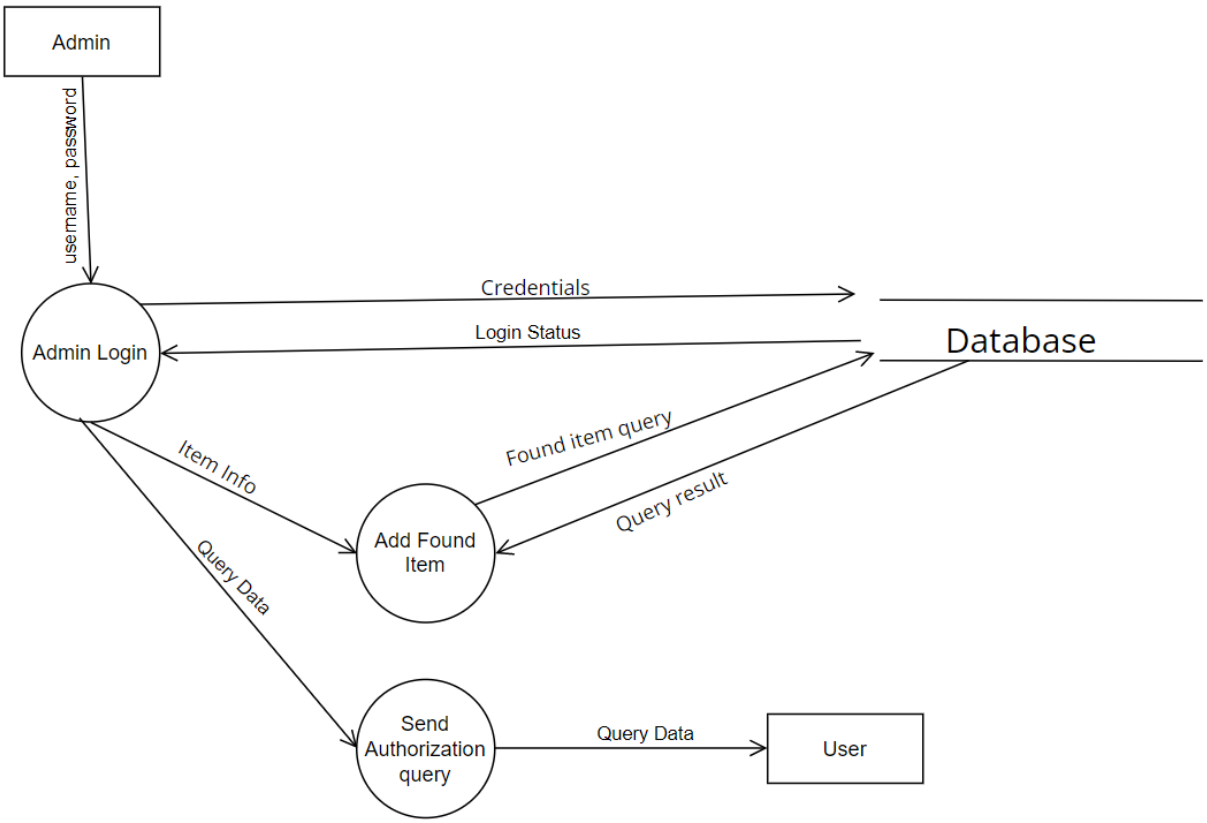

Figure 7: DFD level 1- Admin

The admin can login the web application using his credentials and add a found item query, whose text and image data will be stored in the database. The admin can also view the top matched queries related to the lost item queries and send authorization queries to the respected user.

State chart Diagram

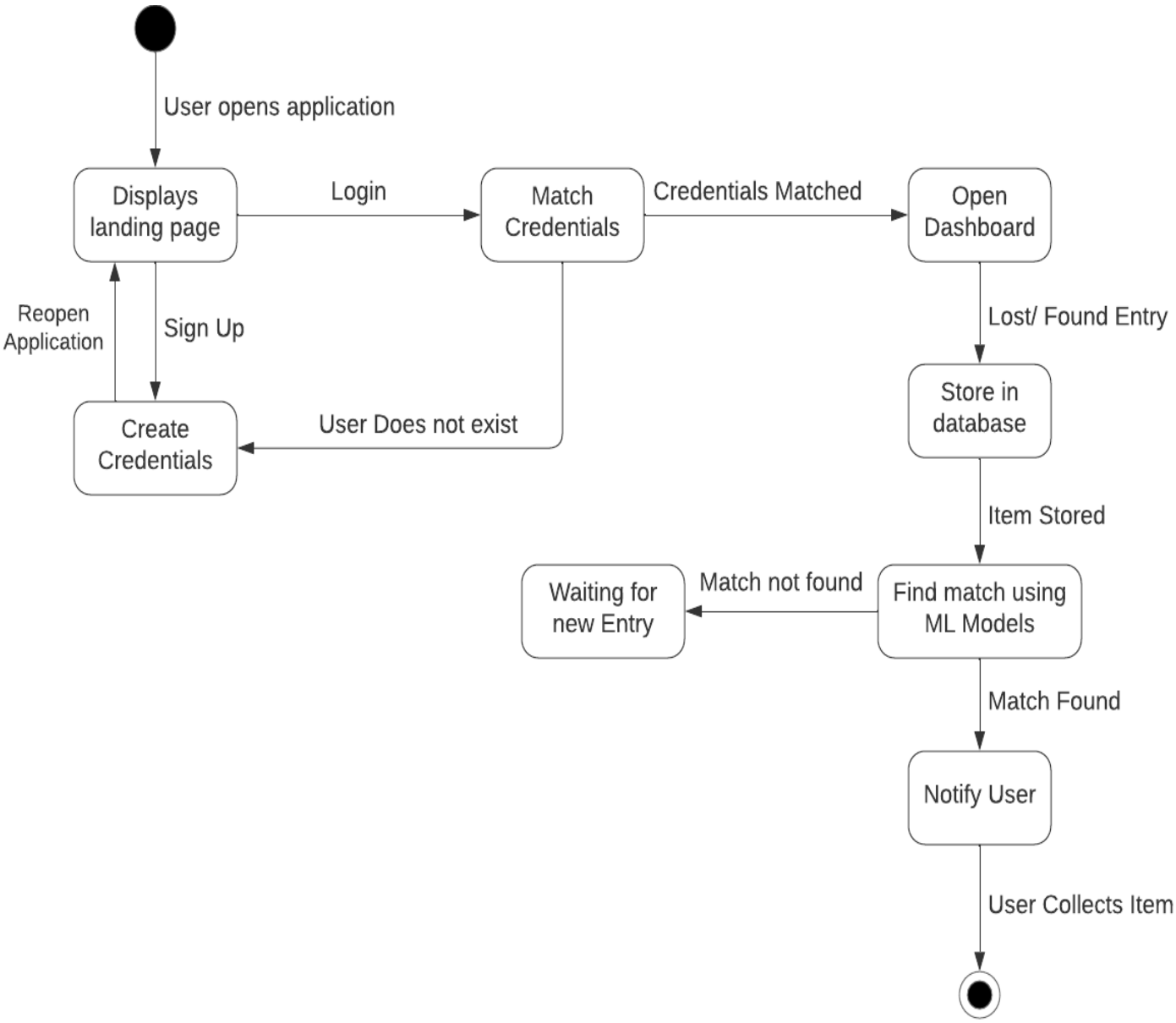

Figure 8: State Chart Diagram

After opening the web application the user and either sign up or login with his credentials. After which a dashboard will be opened. A user can only post a lost item or a found item query, while an admin will be able to not only post a found item query but also see the top matched results from the ML model and send the authorization query to notify the respected matched user.

Sequence Diagram

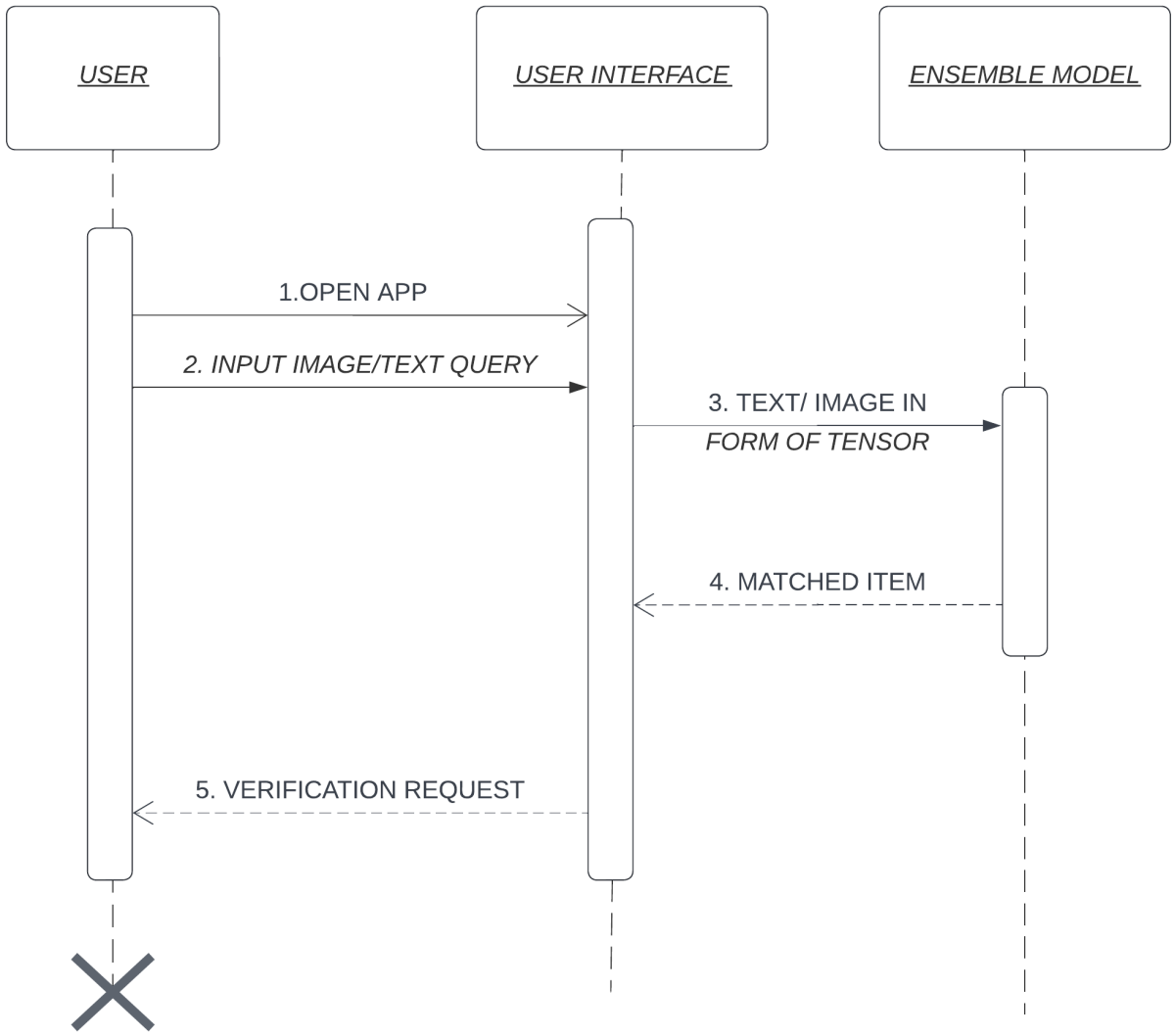

Figure 9: Sequence Diagram – User

The user can open the application and generate a lost/found query by adding text and/or the image description. The user interface converts the query into the form of tensor and sends it to the Ensemble model. The model returns the matched item, and the user interface sends a verification request to the user.

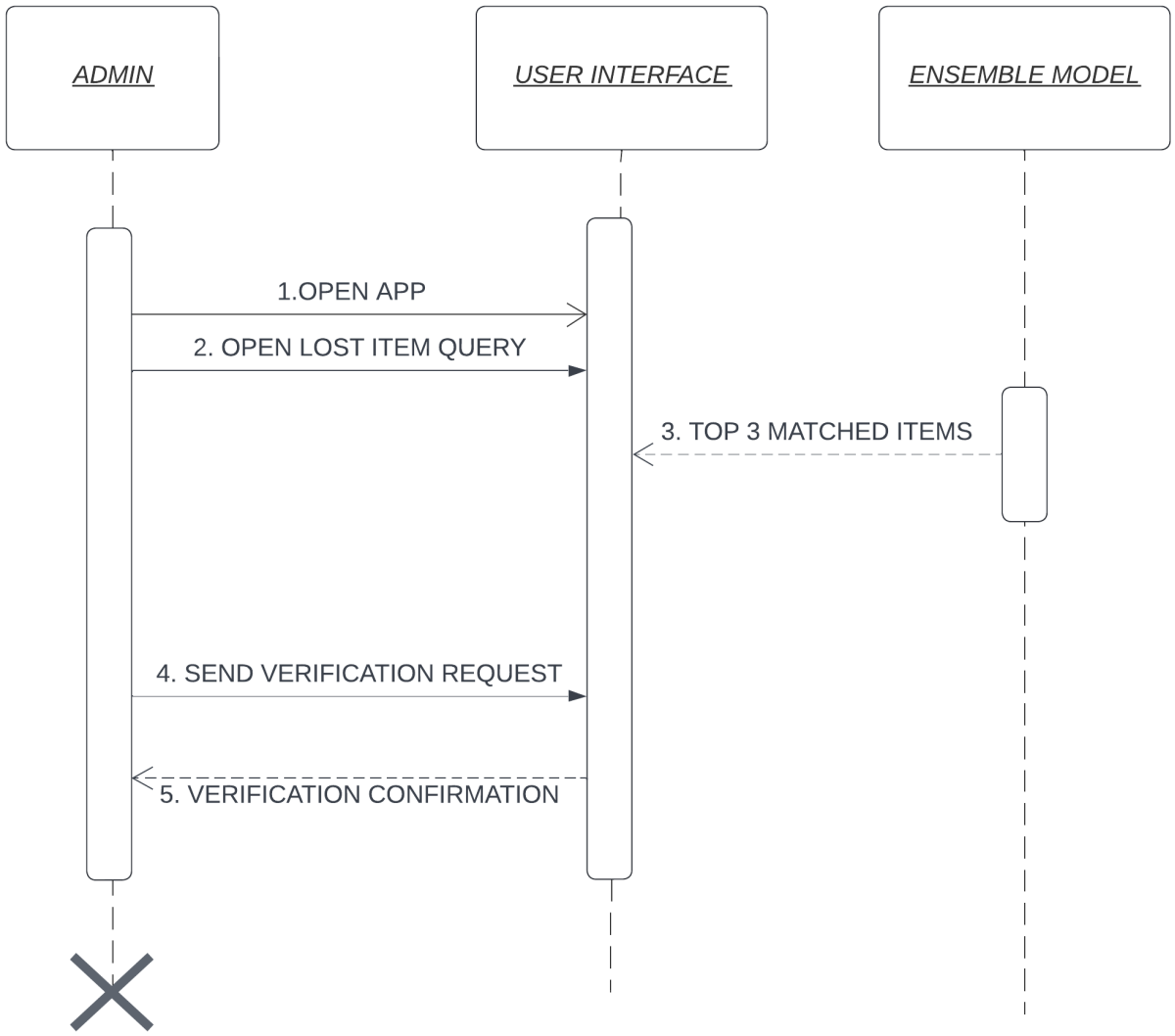

Figure 10: Sequence Diagram – Admin

Admin can open the application and select the lost item query. The Ensemble model returns the top 3 matched items. The admin selects the matched item and sends a verification request. After the user verifies the match a verification confirmation is sent to the admin.

ER Diagram

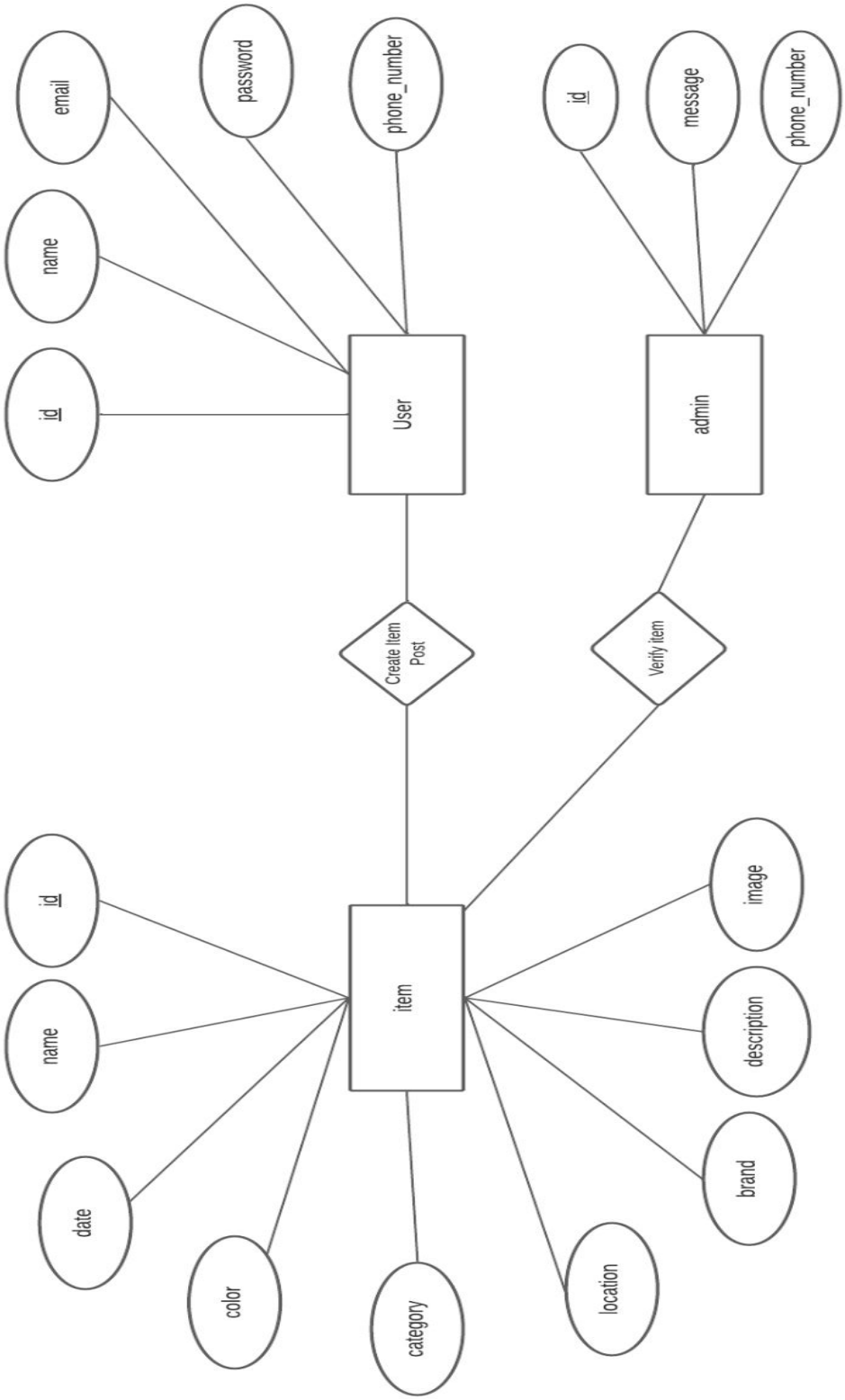

Figure 11: ER Diagram

As per the ER diagram, there are 3 entities namely, item, User and admin. The item entity has a name, id, date, image and other descriptors related to it. The User entity as a name, id, email, password and phone number associated with it. The admin entity has id, message and phone number. User can post an item query while admin can verify the item.

Class Diagram

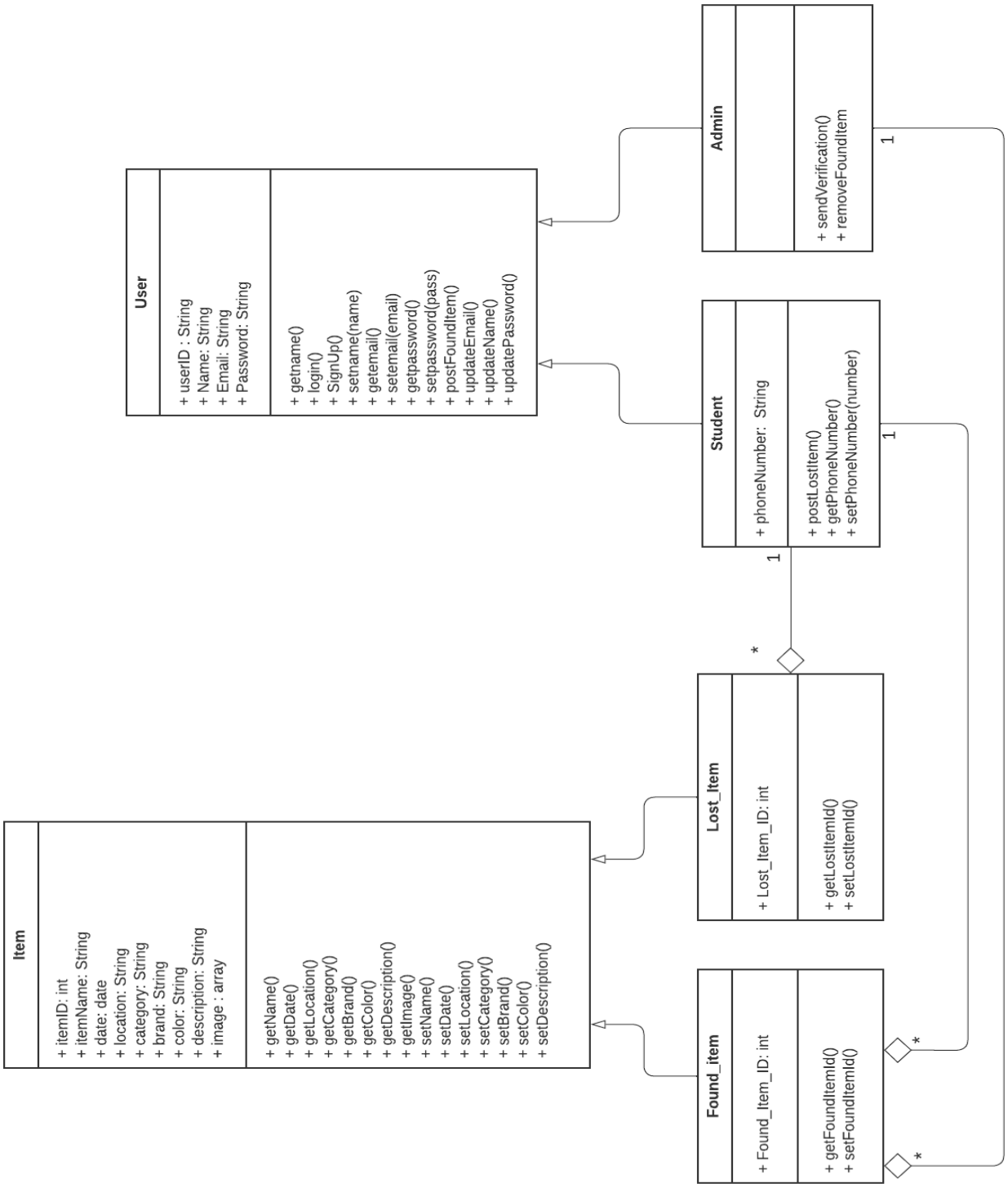

Figure 12: Class Diagram

There are two parent classes namely Item and User. The item class has two child classes for the Lost_item and Found_item. The User class has two child classes that is the student class which can post both lost and found item query, and the Admin class which can post a found item query and send verification to the matched users.

Activity Diagram

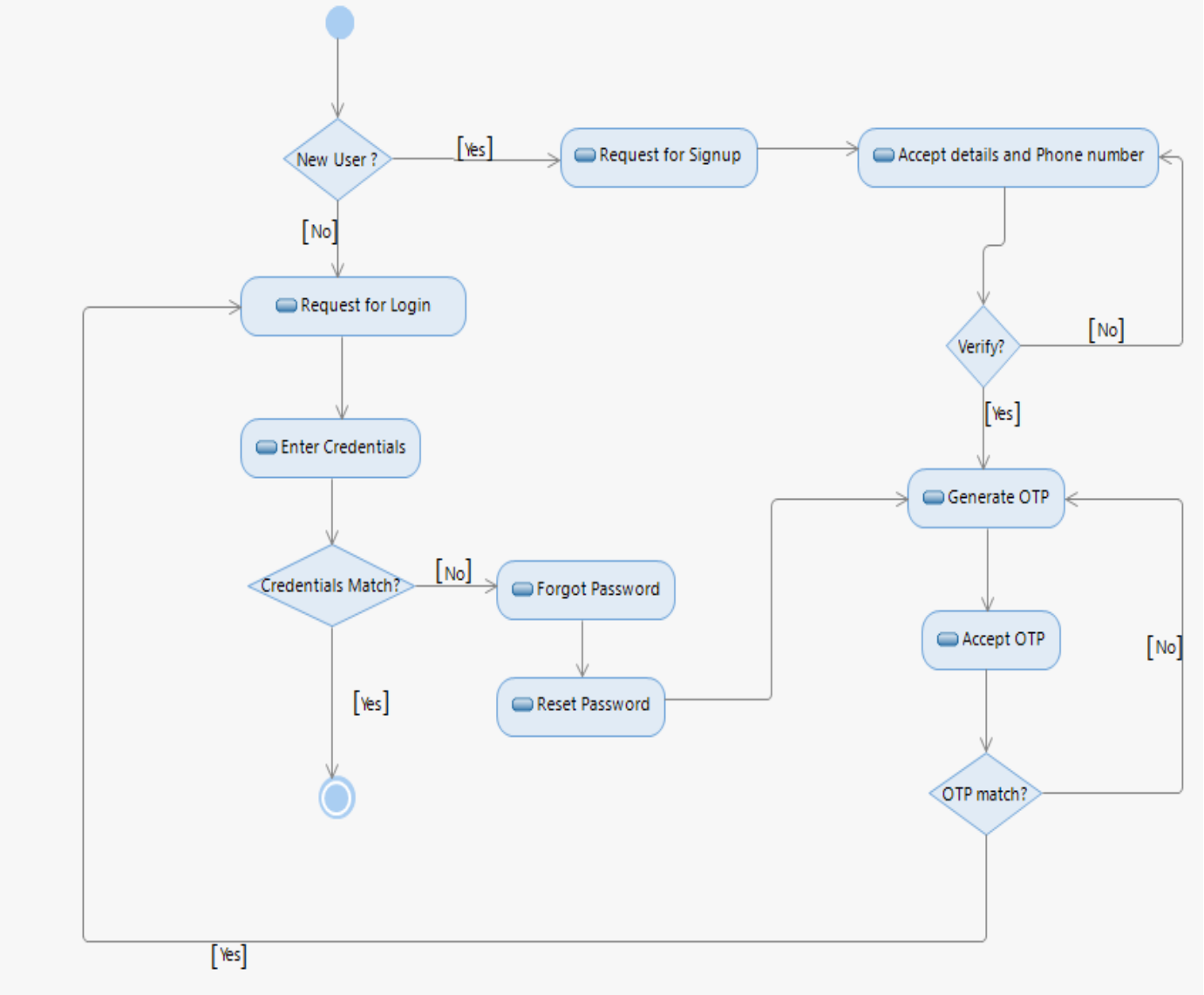

Figure 13: Activity Diagram for Login/Signup

A new user can request for signup and give the required details. After verification the user can use the credentials for login. There is also a forget password option available to the user.

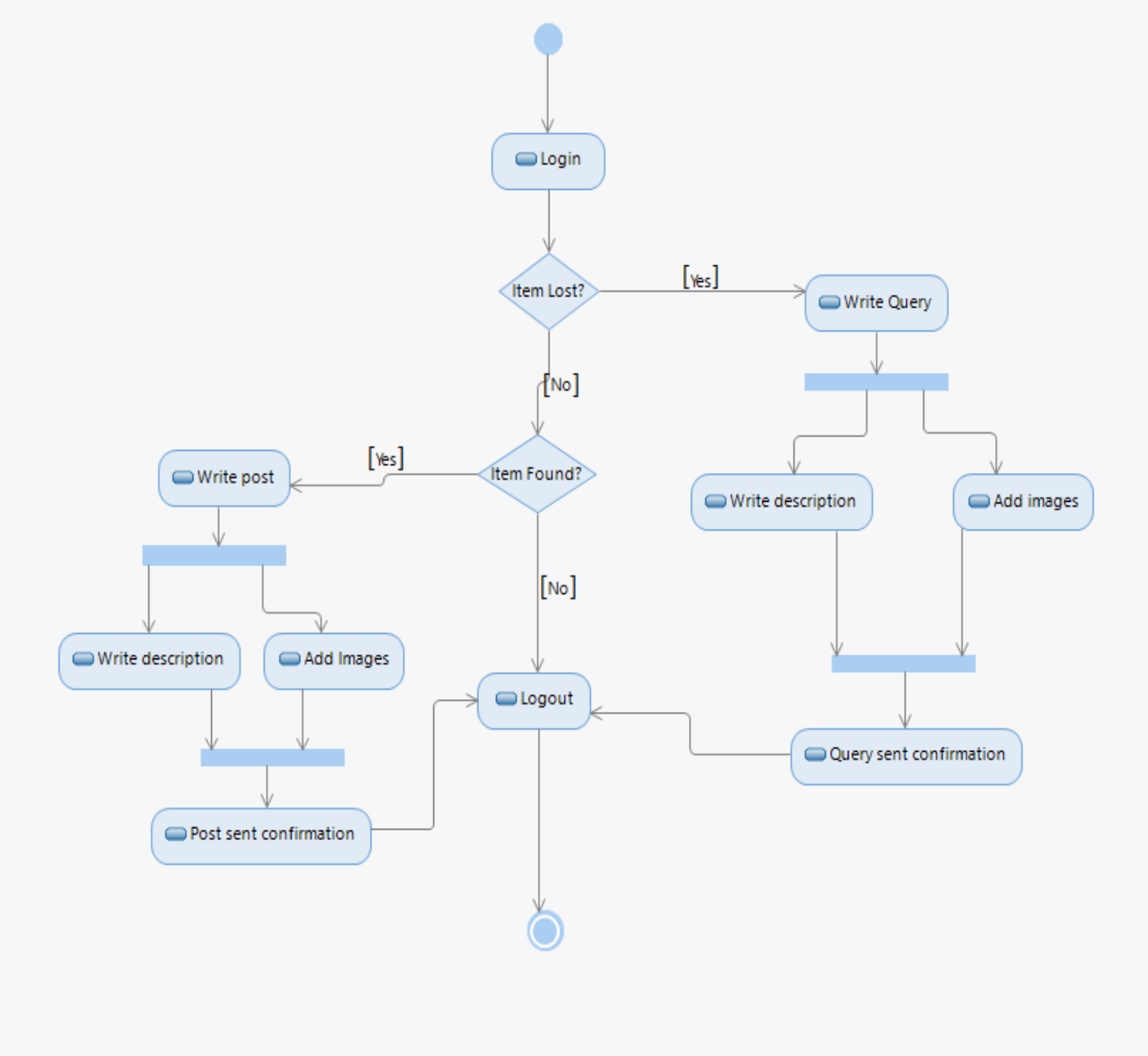

Figure 14: Activity Diagram for Lost and Found System

After login, the user can write a found item query as well as a lost item query. The user must add a text description for the query. Images can also be added with the description.

Swimlane Diagram

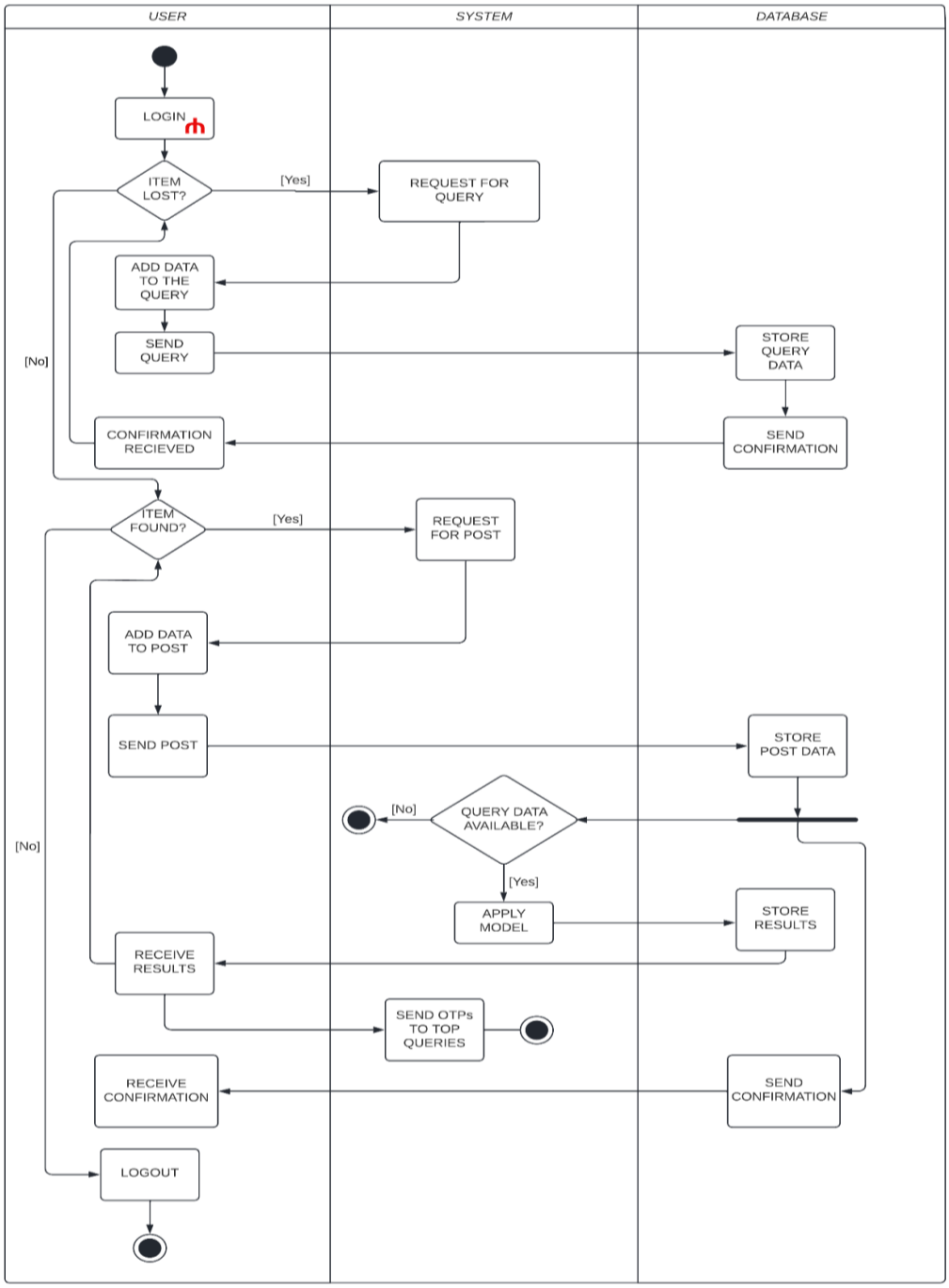

Figure 15: Activity Diagram for Lost and Found System

The user logs in to the application. If an item is lost, the system requests a query. User adds data to the query and submits the query. The query is stored in the database. A confirmation is generated and sent to the user. If an item is found, the system requests a post. The user adds data to the post and submits the post. The post is stored in the database. If more entries are available in the database, the system applies the ML model to find a match and stores the results in the database. The results are sent to the user and the system generates OTP for the top queries. A confirmation is generated and sent to the user. When there is no lost/found item, the user will log out.

4.3 USER INTERFACE DIAGRAMS

Use Case diagram

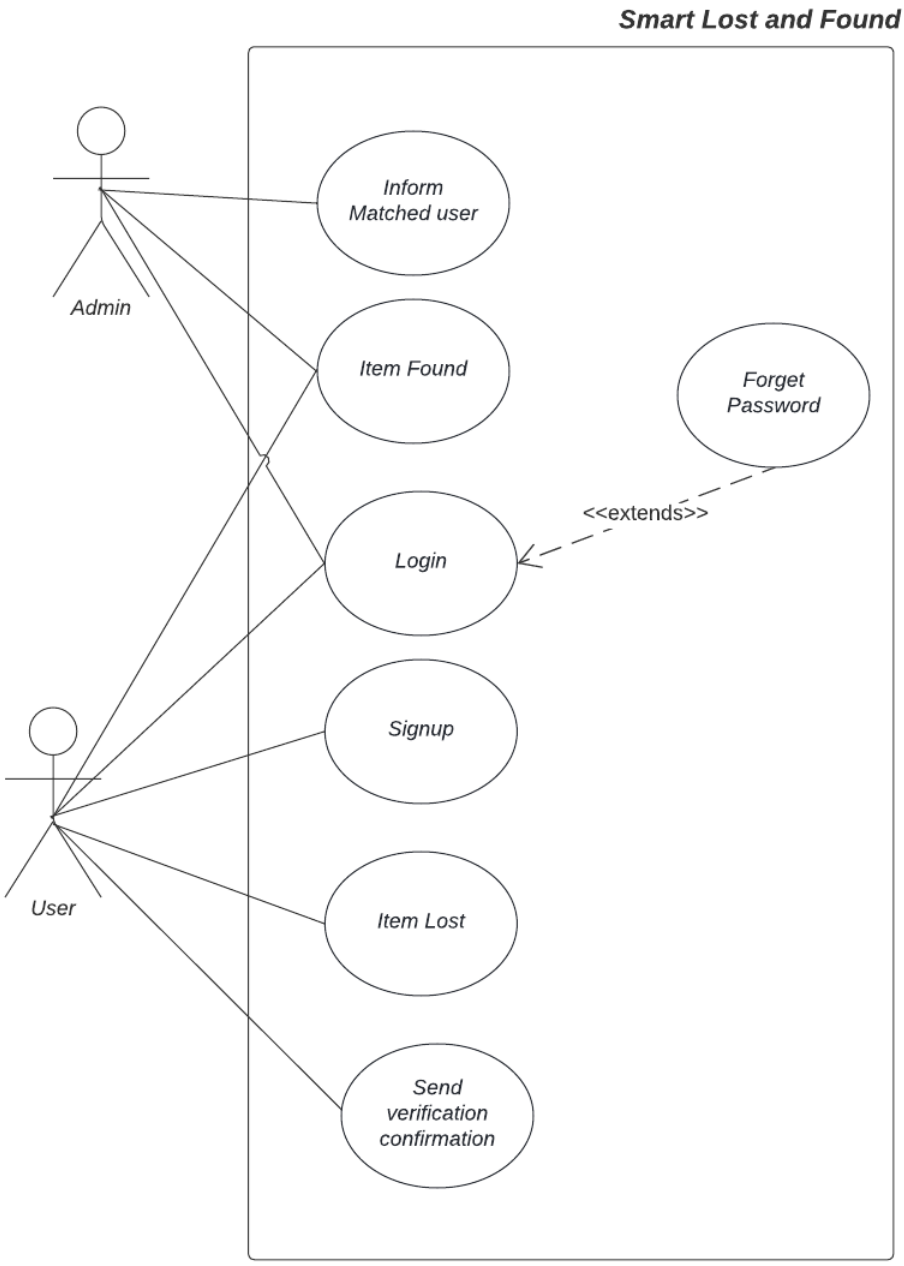

Figure 16: Use Case Diagram

There are two actors in the Smart Lost and Found project, namely the User and Admin. Both the User and Admin can login and report a found item. The User can also report a lost item. The Admin can inform the matched user.

Use Case Templates:

Table 6: Use Case Template for Sign up

Use Case ID	UC001
Use Case	Sign up
Use Case purpose	To let prospective users create a user account on the web portal for continued and regular use of the platform.
Use case description	Prospective users will be prompted to create an account using their Thapar registered roll number or email id. On providing the roll number or email-id, the user will be asked for a password. Next, the user will be prompted to input their mobile number. On providing the mobile number, the user will receive an OTP and on verification of the OTP, an account will be created and they shall gain access to the web-portal applications.
Assumptions	The user is a registered student of TIET with an email-id or roll number allotted and has access to the mobile network and active data connection.
Variation	-
Trigger	User-click on a cell/button on the home screen of the web portal asking to create an account.
Primary Actor	User
Secondary Actor	-
Precondition	-

Normal Scenario	1. Click on the Sign-up button to create an account. 2. Enter roll number or email-id and proceed. 3. If the roll number or email-id is correct and unique, the user is asked for a password. 4. Enter mobile number and proceed. 5. If the mobile number is correct and unique, the user is sent an OTP. 6. Receive OTP through text message. 7. If OTP is correct then create a password. 8. If no errors then the user is signed up.
Extension Points	User moves to login screen (UC002)
Alternate scenario	• At step 2 user fails to provide a roll number or an email-id and presses cancel to exit the sign-up process. • At step 4 user fails to provide an OTP and presses cancel to exit the sign-up process.
Post Conditions	User Account is successfully created and the user can log into their account.
Special Requirement	-

Table 7: Use Case Template for Login

Use Case ID	UC002
Use Case	Login
Use Case purpose	To let prospective user gain access to the web application by providing credentials known to them.
Use case description	User will be asked to provide their roll number and password. If provided credentials match with those stored, the user is logged in to the application.
Assumptions	The user is a registered student of TIET with an email-id or roll number allotted and has access to the mobile network and active data connection.
Variation	-
Trigger	User clicks on a cell to action on the home screen of the application asking to log in to have access to the application.
Primary Actor	User
Secondary Actor	-
Precondition	User should already have an account
Normal Scenario	1. Click on the Login button. 2. Enter the roll number and password to continue. 3. Credential match and the user is logged into the application
Extension Points	-
Alternate scenario	Step 2a: the user provides a username and password that is incorrect, the user will be prompted to retry.

Post Conditions	User successfully logs in to the application and gets access to permissible content only.
Special Requirement	Security 1. The system will toggle functionality for the visibility of password entered by the user. 2. Password will be hashed

Table 8: Use Case Template for Item Found

Use Case ID	UC003
Use Case	Item Found
Use Case purpose	To let user upload details of a found item
Use case description	User will be asked to provide the description of the item they found and upload an image for the same.
Assumptions	-
Variation	-
Trigger	User clicks on a cell to action on the home screen of the application asking if an item is found.
Primary Actor	User
Secondary Actor	-
Precondition	User should already have an account and should be logged in.
Normal Scenario	1. Select the category of item. 2. Enter a description of item 3. Upload an image of item. 3. If the description matches with an existing lost item entry then the user will be notified for the top query. 4. The user can schedule time for meeting in person with the matched user.
Extension Points	-

Alternate scenario	-
Post Conditions	Unique ids are generated for both finder and receiver with meeting place and time.
Special Requirement	-

Table 9: Use Case Template for Item Lost

Use Case ID	UC004
Use Case	Item Lost
Use Case purpose	To let user report a lost item
Use case description	User will be asked to provide the description of their lost item and upload an image if possible
Assumptions	User clicks on a cell to action on the home screen of the application asking if an item is lost.
Variation	-
Trigger	-
Primary Actor	User
Secondary Actor	-
Precondition	User should already have an account and should be logged in.
Normal Scenario	1. Select the category of item. 2. Enter a description of item 3. Upload an image of item.
Extension Points	-
Alternate scenario	-

Post Conditions	If the description matches with an existing found item entry in the next 7 days then the user will be allotted a unique id and notified with meeting place and time else the lost query will be deleted.
Special Requirement	Security 1. The user will not see the list of found items to avoid false claims.

CHAPTER 5: IMPLEMENTATION AND EXPERIMENTAL RESULTS

5.1 Experimental Setup

The setup consists of web-application, a dedicated online portal for the management of all lost and found items. The experimental setup consists of centralizing the data of the people who have list the item and the persons who have found the items, thereby reducing the redundancy and inconsistency in data. The Smart Lost and Found system is also there to be used by an admin to track the lost and found item entries and their similarity percentage based on the description given. The database in MySQL which contains the details of the one who has posted a query is updated regularly. The system also has suitable email authentication, without which no user will be able to utilise the system's features.

5.2 Experimental Analysis

This section describes the data and performance parameters used in the project.

5.2.1 Data

The web-application has the portal for the admin, the person who has lost an item and the person who has found an unclaimed item. Each user except the admin must create an id that is to be authenticated by email verification, for logging in to the portal. To make a query, user must first complete his profile by filling the details such as name, phone number, location, hostel, and other contact details.

Pre-processing of text data:

```
X = X.lower()
Y = Y.lower()

X_list = word_tokenize(X)
Y_list = word_tokenize(Y)

sw = stopwords.words('english')
```

Figure 17: Pre-processing of data

The code snippet shows the text pre-processing techniques applied before the data is put through the model. These pre-processing techniques consists of removing case-sensitivity, tokenizing the description text and removing stop words from the remainder.

5.2.2 Performance Parameters

- Accuracy of data: The accuracy measure as depicted clearly by the below graph clearly demonstrates the generalizing feature of cosine similarity as compared to other methods.

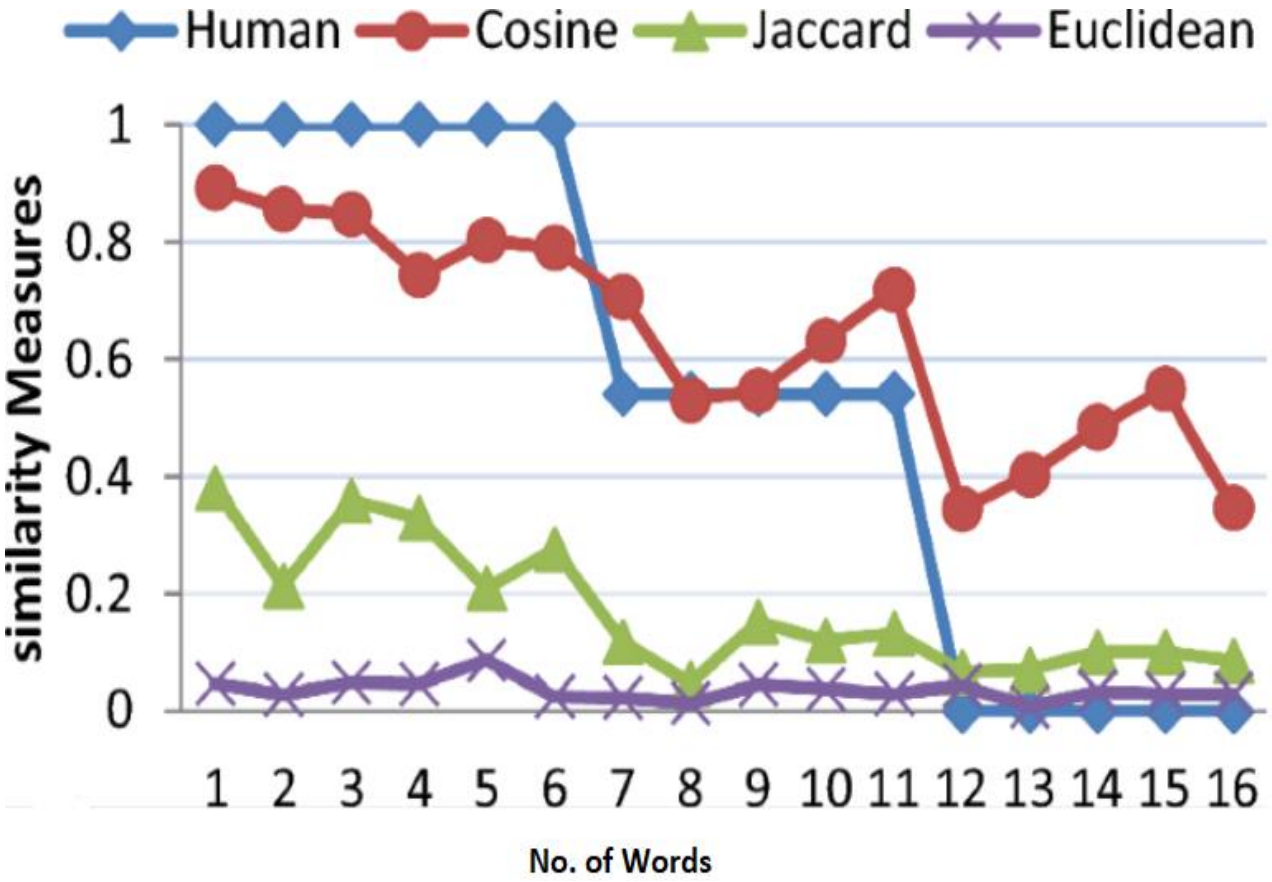

Figure 18: Similarity graph of various techniques

As clearly depicted by the similarity measure graph with respect to the number of words, the cosine similarity index has clearly generalised the text as the word count increases as compared to Jaccard and Euclidean distance metric. The Euclidean distance graph shows a very low similarity index for the wide range of words ranging from 1 till 16. Hence, we ruled it out. The Jaccard distance gives average similarity values for a shorted word count, but the generalization of the model decreases as the word count increases above 12 words per document. We have assumed a human to correctly verify similar texts as per the psychology of my peers. Hence, the overall generalisation and the low calculation complexities of the above techniques narrows down our search for the ideal algorithm down to cosine similarity.

- Usability of model: The UI is designed quite user friendly, and no prior knowledge or training is required to use the portal, which has all of its key features adequately displayed.

- Safety of model: The system is equipped with email authentication which will significantly reduce the number of spam queries. Only a legitimate admin is able to see the queries and issue a valid claim. He can also see the previously claimed records.

5.3 WORKING OF THE PROJECT

5.3.1 Procedural Workflow

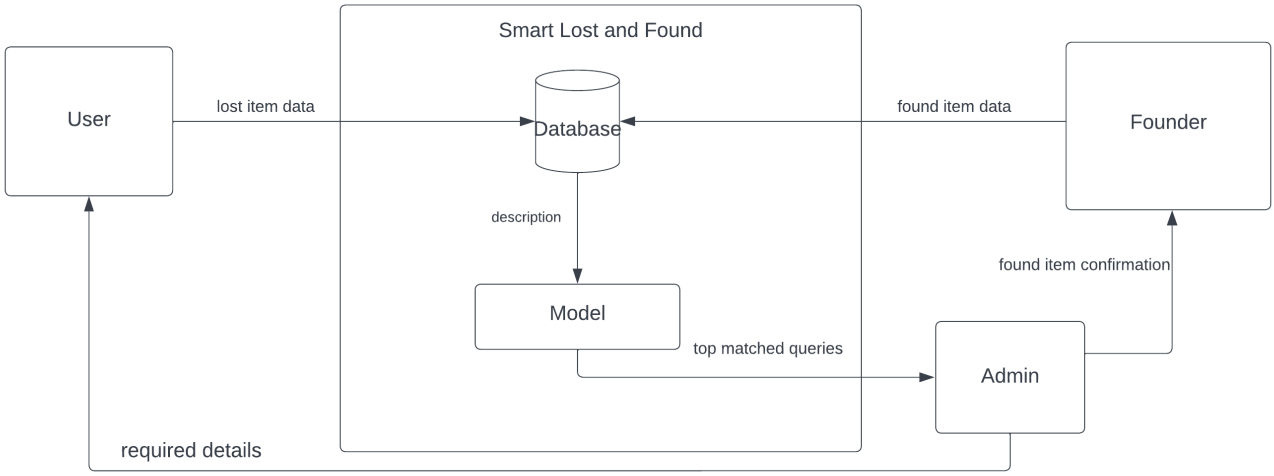

Figure 19: Procedural Workflow

The user used his email id to login to authenticate and login into our Smart Lost and Found portal. After which the user completes his profile. After completing the profile, the user can either lodge a lost item query or a found item query. No user can directly see the query, as all the queries are only visible to the admin.

All the description text data is analysed by the model and the text similarity index is generated between all the lost and found item queries.

The admin can login with his given credentials. He can see a window which displays all the lost and found items. He can also check all the claimed item history as well. He then authenticates the claim based on the text similarity index filtering list of claims and uses the input of any secret authentication id if given any by the user who has put in the query.

After using the claim item button, an email is sent to the respective user who have posted the found item query related to the details of the user who has posted the query of the lost item.

The query is then moved from the current list of unclaimed items to the history.

5.3.2 Algorithmic Approaches used

- User creation: A user id is created in the web application that is authenticated by his email address. His profile is created with his details and location. The data is stored in the database. The Web-application pulls the data from that dataset and uses it in the admin section.

- Similarity testing: The similarity in the description between the lost and found items is calculated using cosine similarity index. We can sort the similar items in descending order of their percentage. It can be represented mathematically as

$$\text{cosine similarity} = S_C(A,B) := \cos(\theta) = \frac{\mathbf{A}\cdot\mathbf{B}}{\|\mathbf{A}\|\|\mathbf{B}\|} = \frac{\sum_{i=1}^{n} A_i B_i}{\sqrt{\sum_{i=1}^{n} A_i^2}\sqrt{\sum_{i=1}^{n} B_i^2}}$$

```
import nltk
nltk.download('punkt')
nltk.download('stopwords')
nltk.download('corpus')
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize
import imgcompare
import PIL.Image as Image
def getSim(X,Y):

    X = X.lower()
    Y = Y.lower()

    X_list = word_tokenize(X)
    Y_list = word_tokenize(Y)

    sw = stopwords.words('english')
    l1 =[];l2 =[]

    X_set = {w for w in X_list if not w in sw}
    Y_set = {w for w in Y_list if not w in sw}

    rvector = X_set.union(Y_set)
    for w in rvector:
        if w in X_set: l1.append(1)
        else: l1.append(0)
        if w in Y_set: l2.append(1)
        else: l2.append(0)
    c = 0

    for i in range(len(rvector)):
            c+= l1[i]*l2[i]
    cosine = c / float((sum(l1)*sum(l2))**0.5)

    return cosine*100
```

Figure 20: Implementation of cosine similarity

The following code first cleans the input text description data using tokenising, case lowering and stop word removal, then implements the cosine similarity and outputs the value index as percentage.

5.3.3 System screenshots

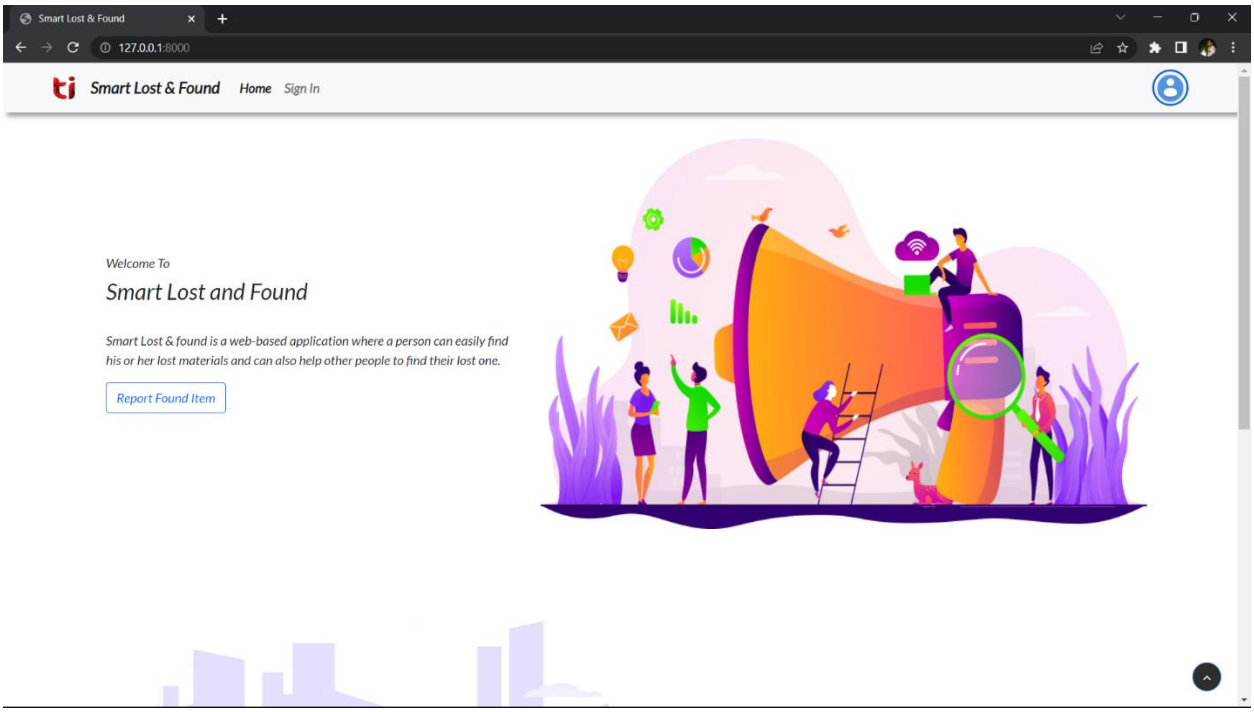

Figure 21: Home Page for User displaying report found item

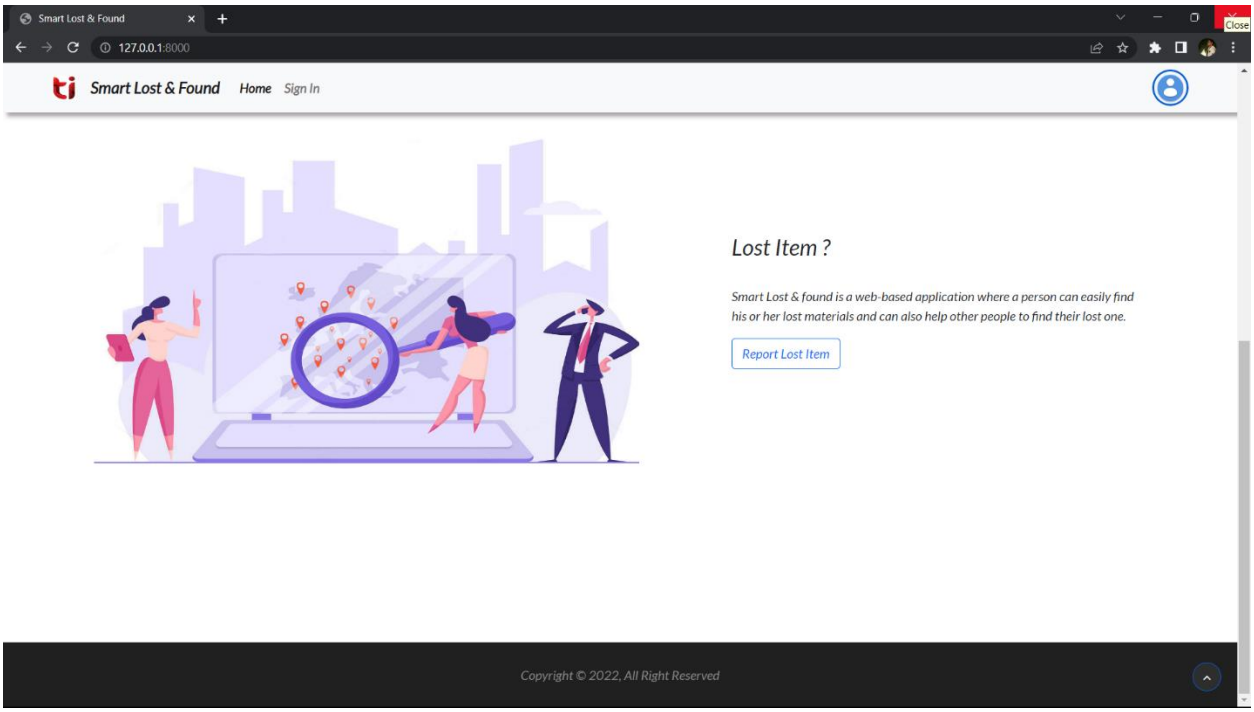

Figure 22: Home Page for User displaying report lost item

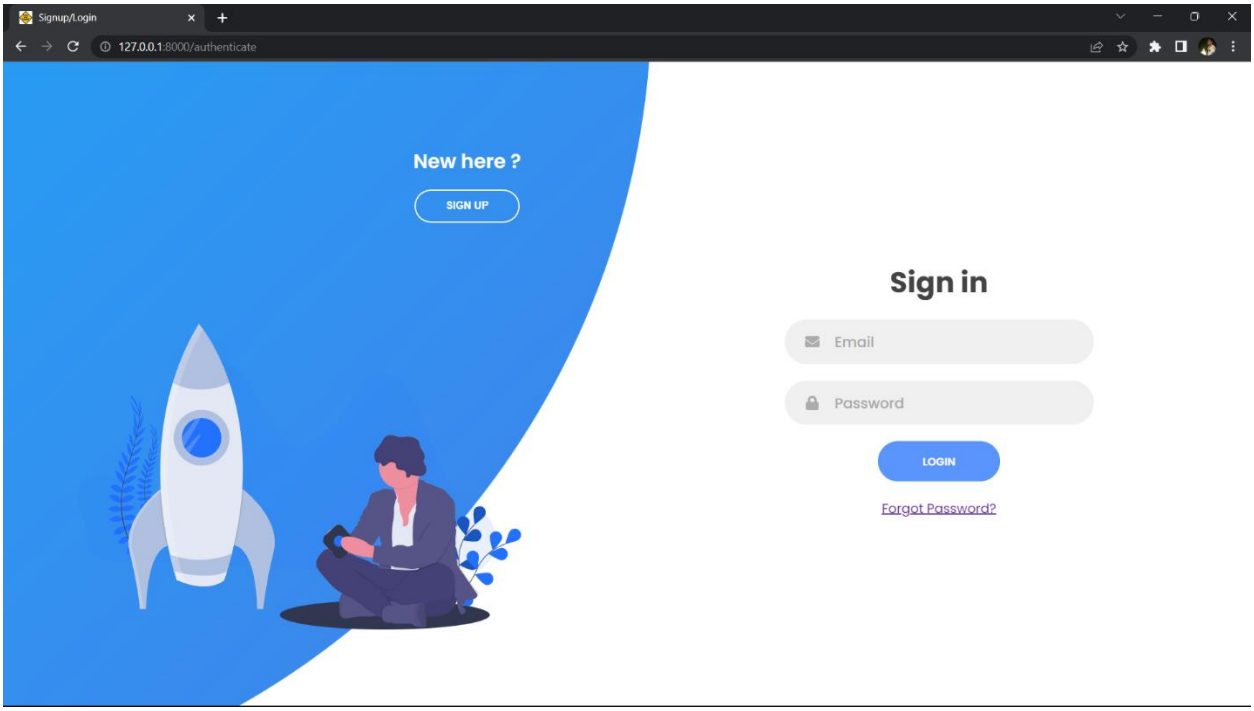

Figure 23: Login Page

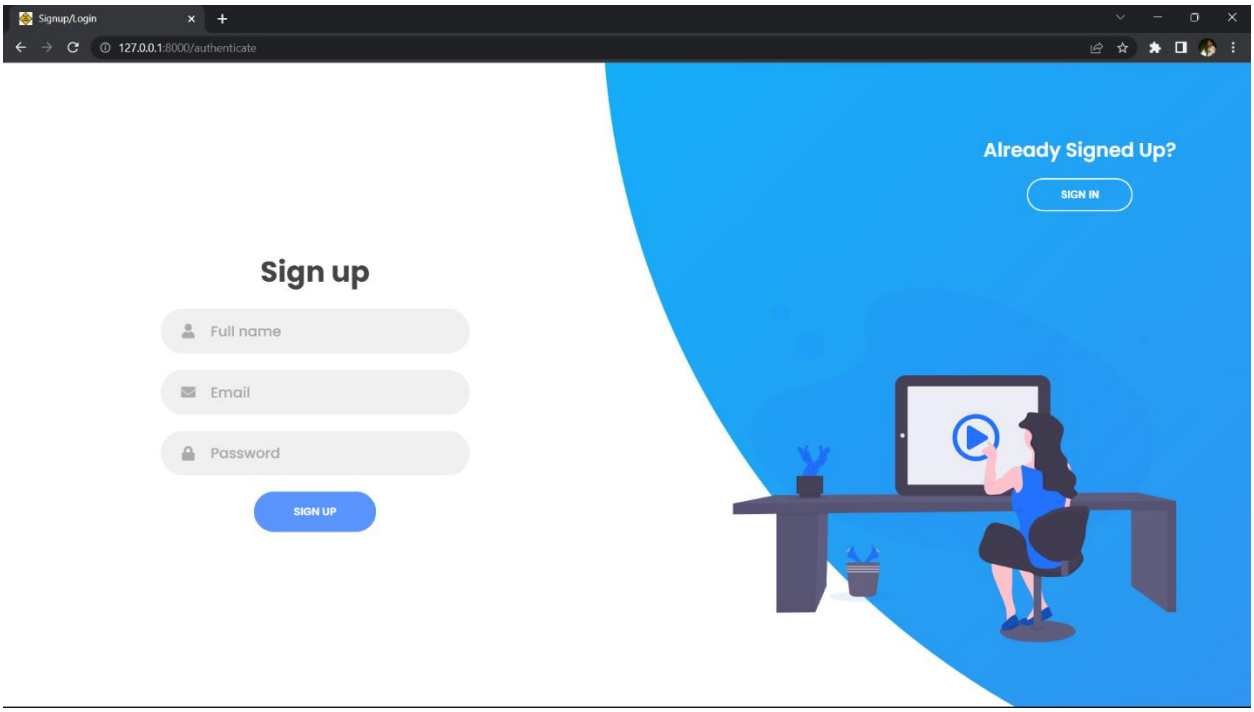

Figure 24: Sign Up page

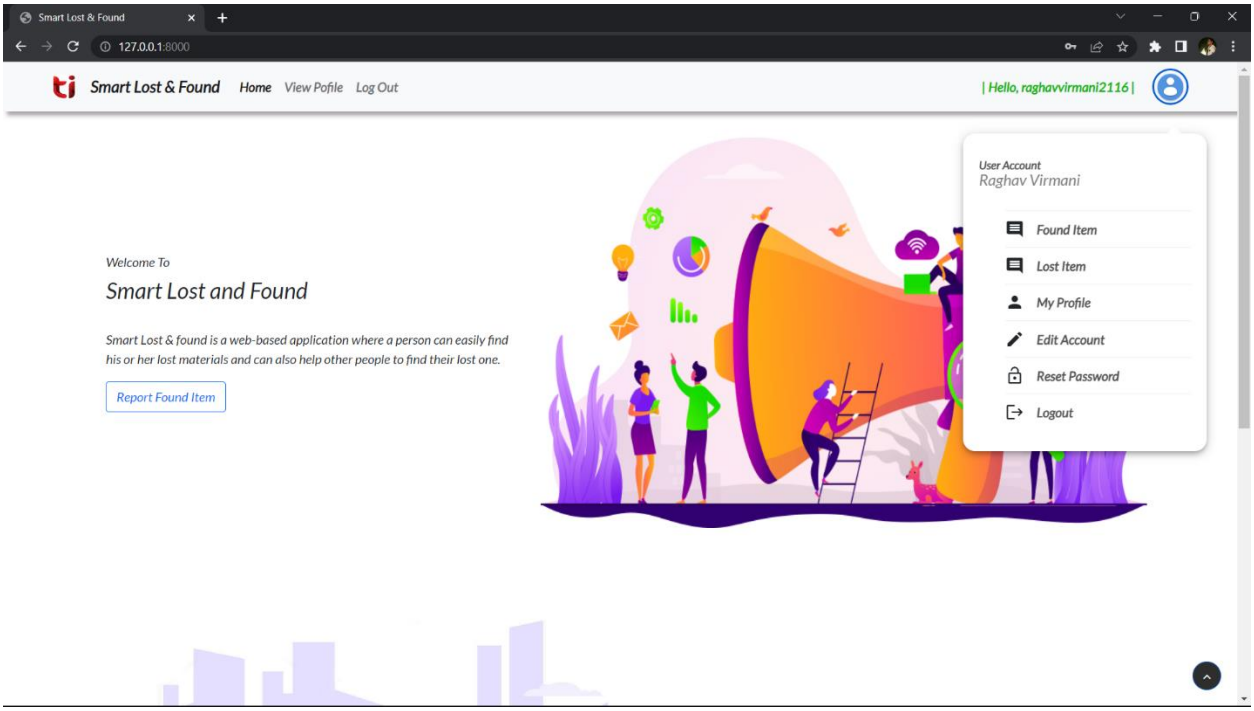

Figure 25: Depicting drop-down menu for logged in user

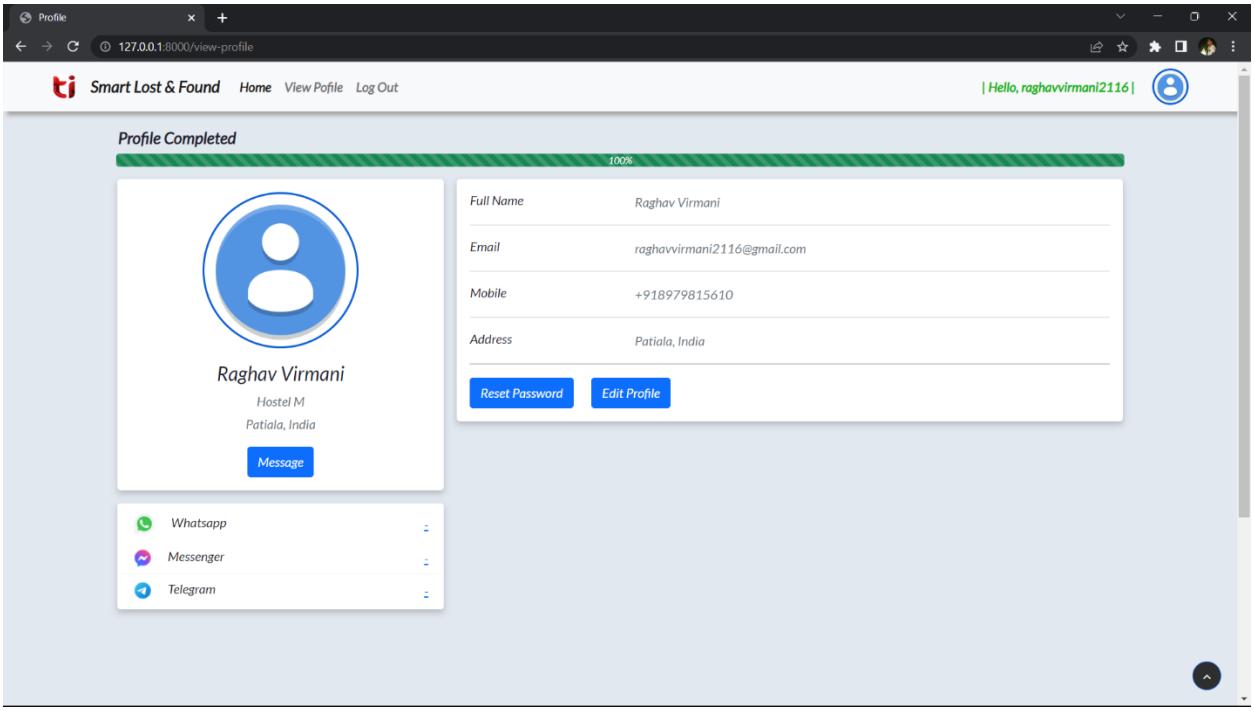

Figure 26: Profile description of user

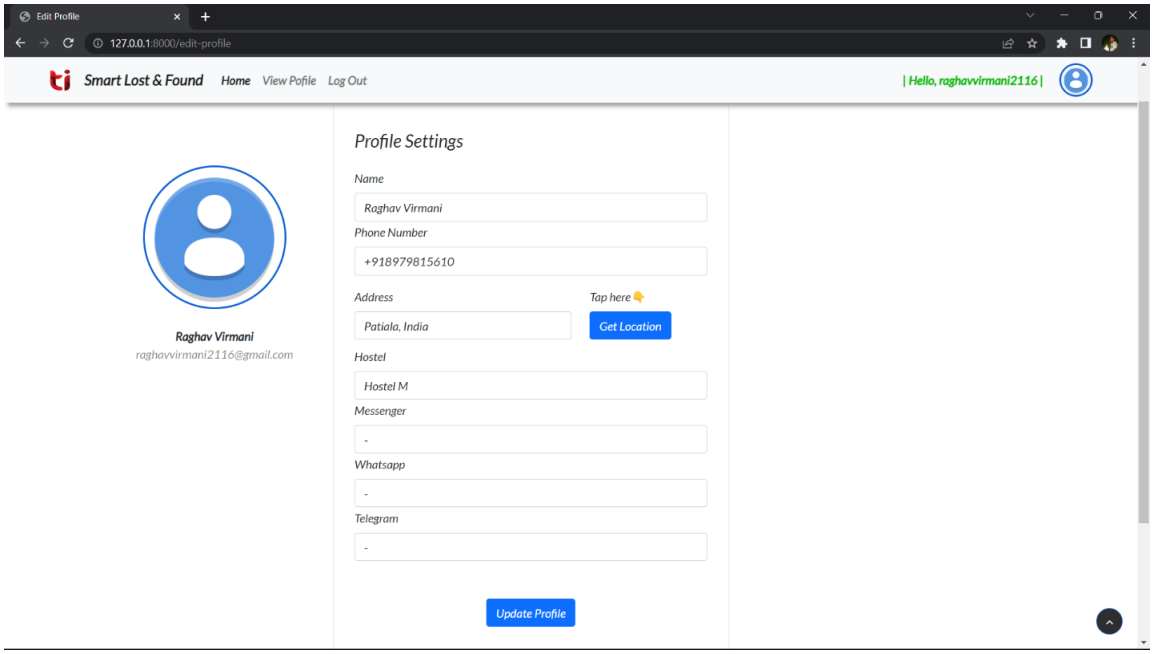

Figure 27: Edit profile page of user

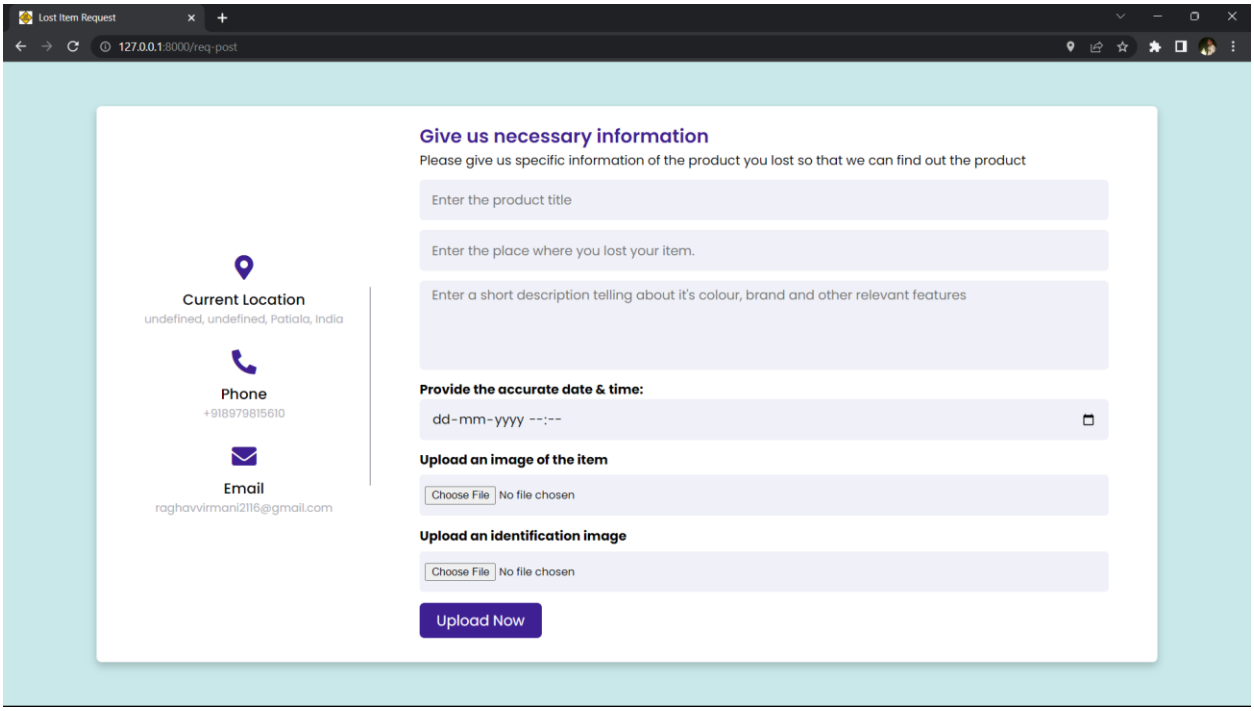

Figure 28: Query description page

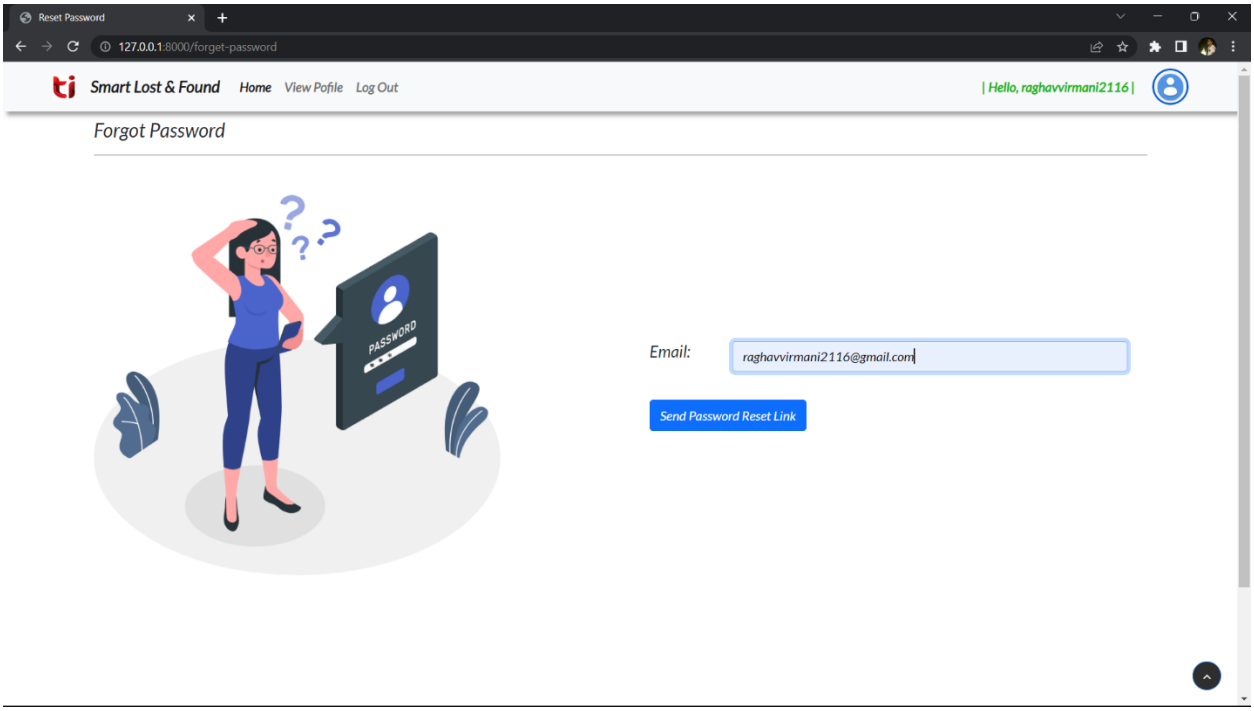

Figure 29: Forgot Password page

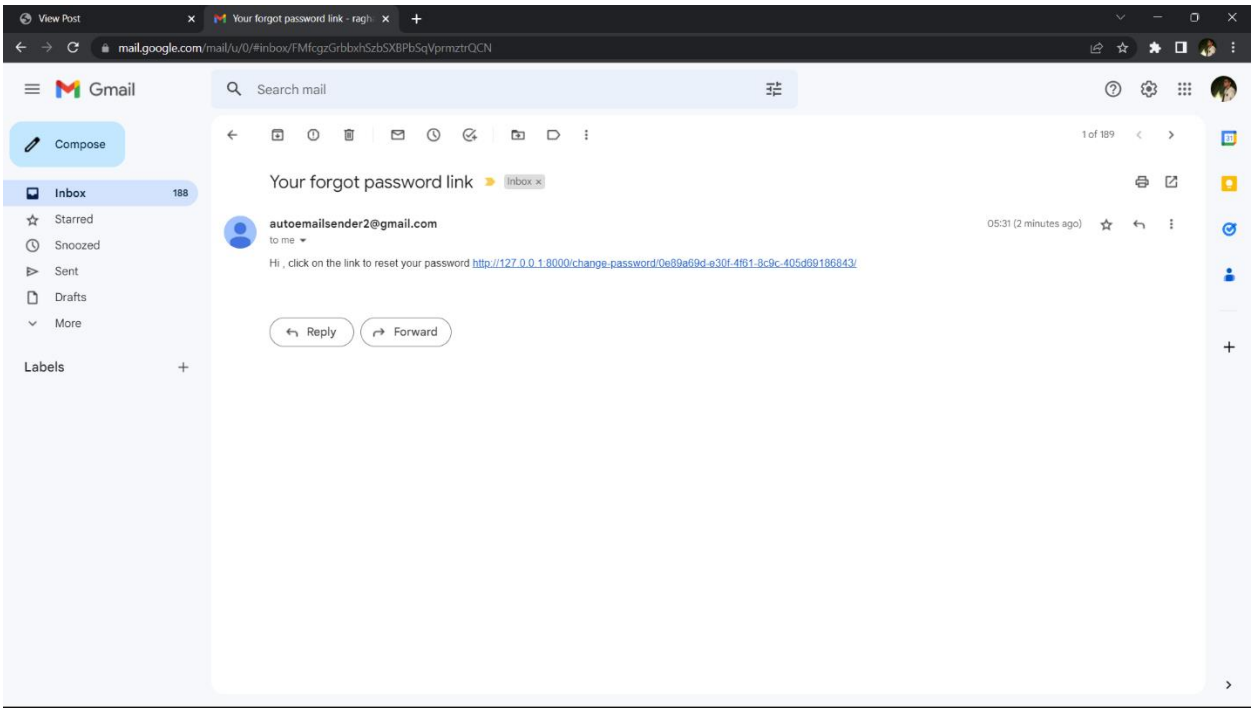

Figure 30: Password link for re-setting password

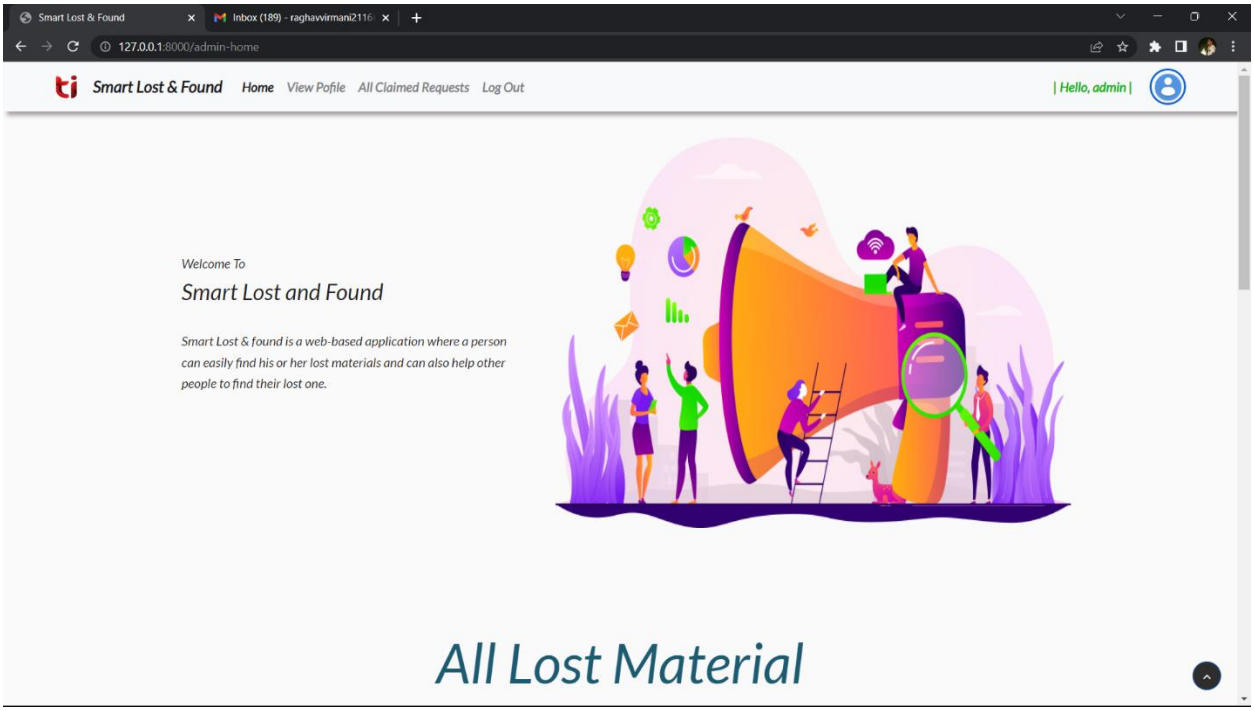

Figure 31: Admin home page

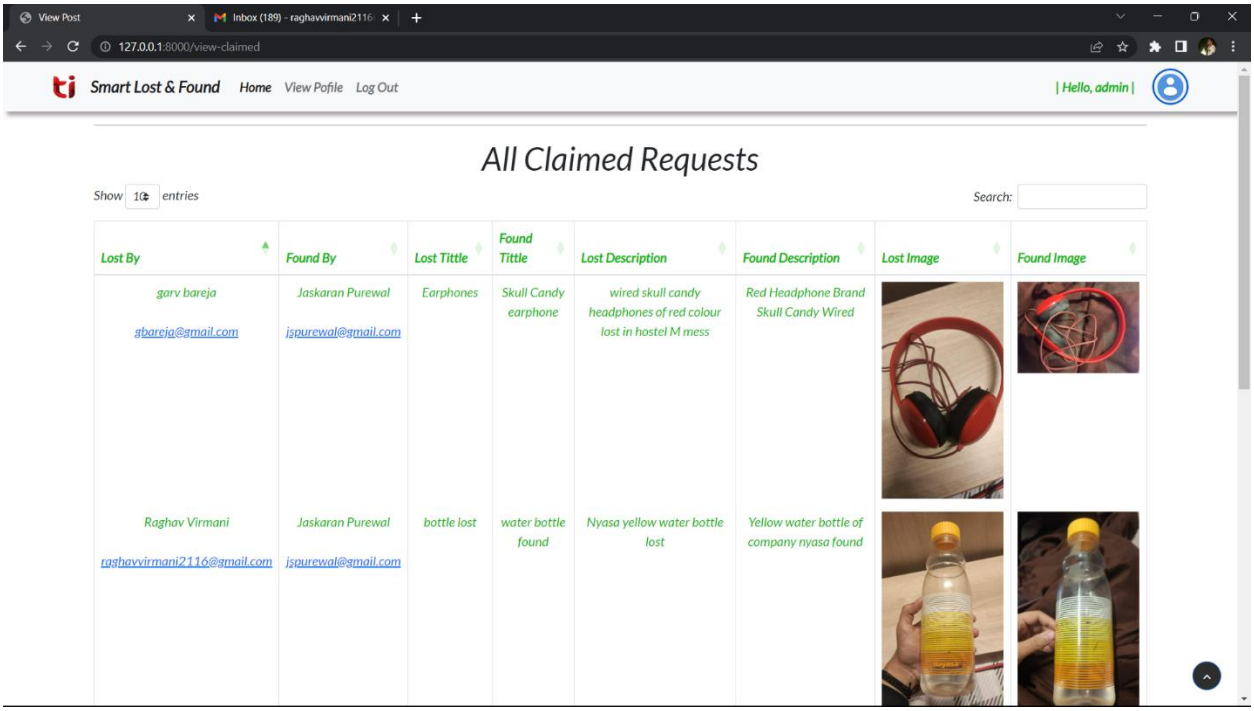

Figure 32: All claimed items with their respected lost and found query

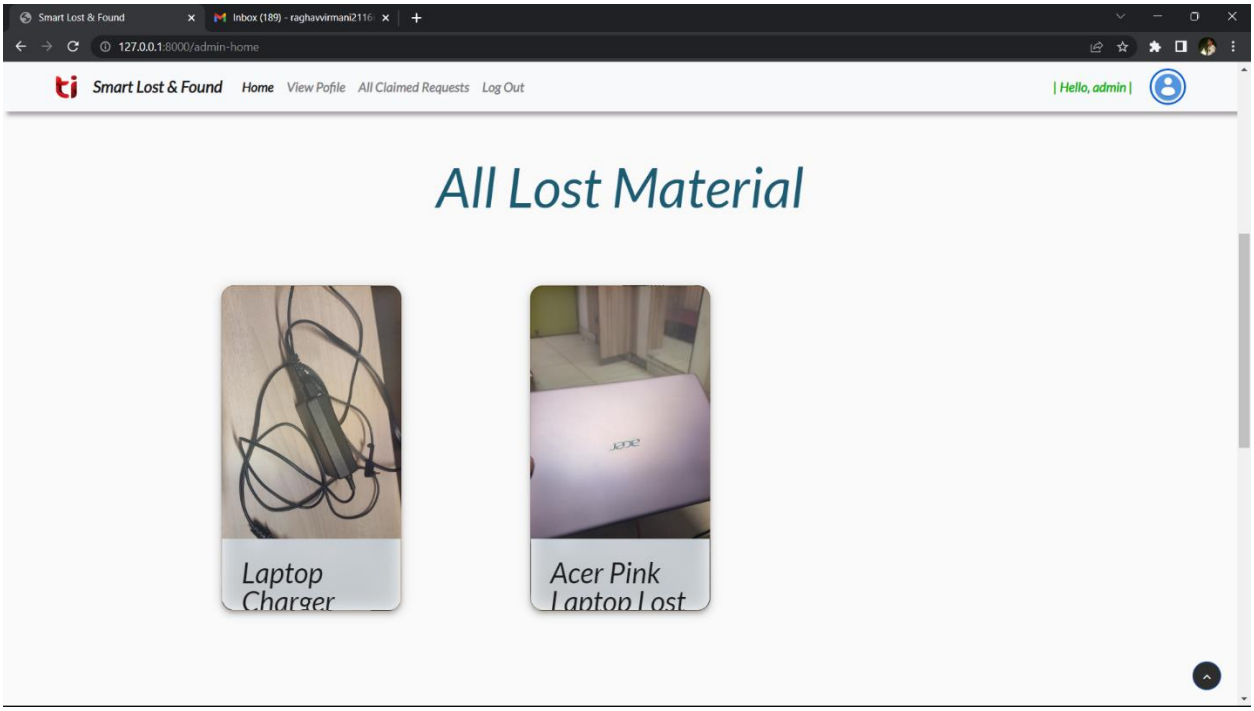

Figure 33: All currently lost item queries

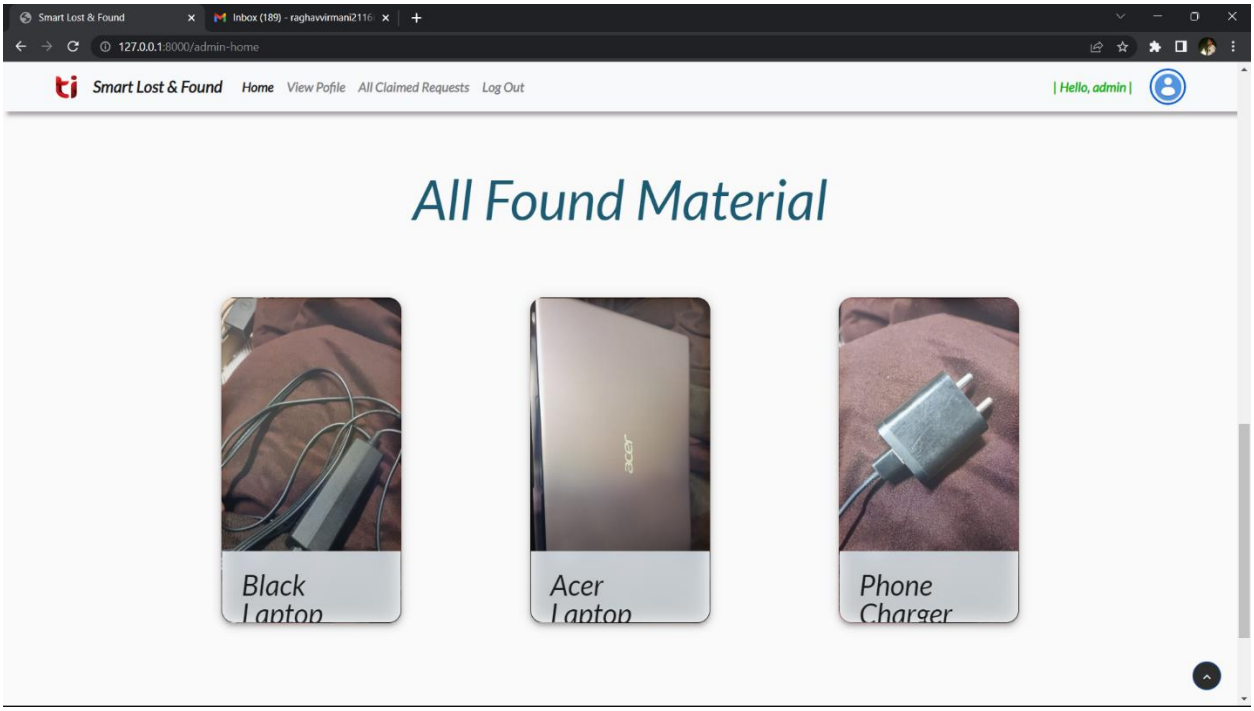

Figure 34: All currently found item queries

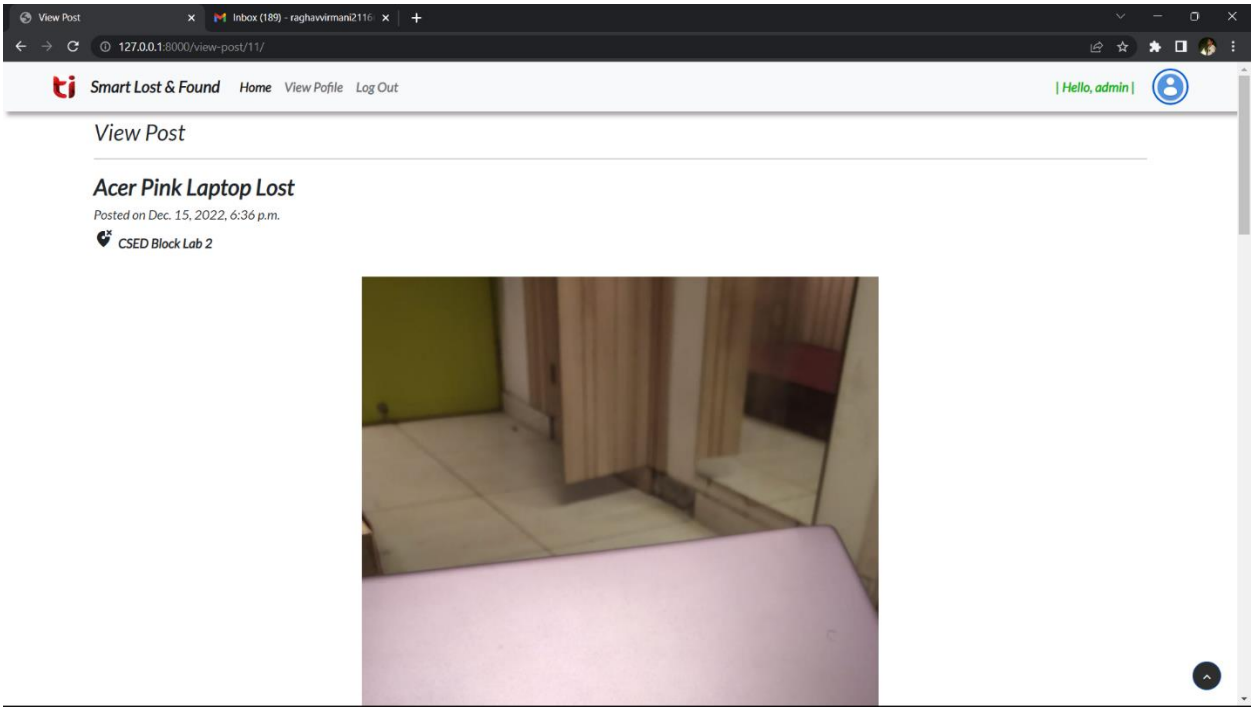

Figure 35: Query description

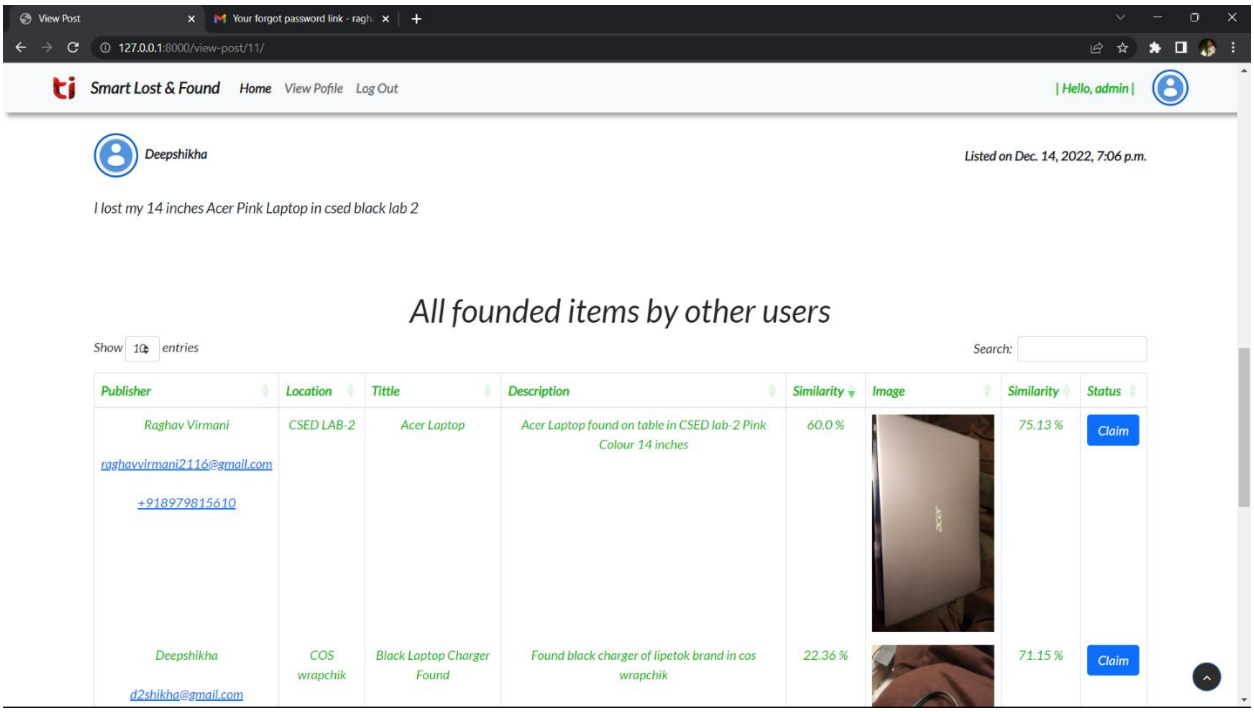

Figure 36: Admin window displaying similarity index and claim button

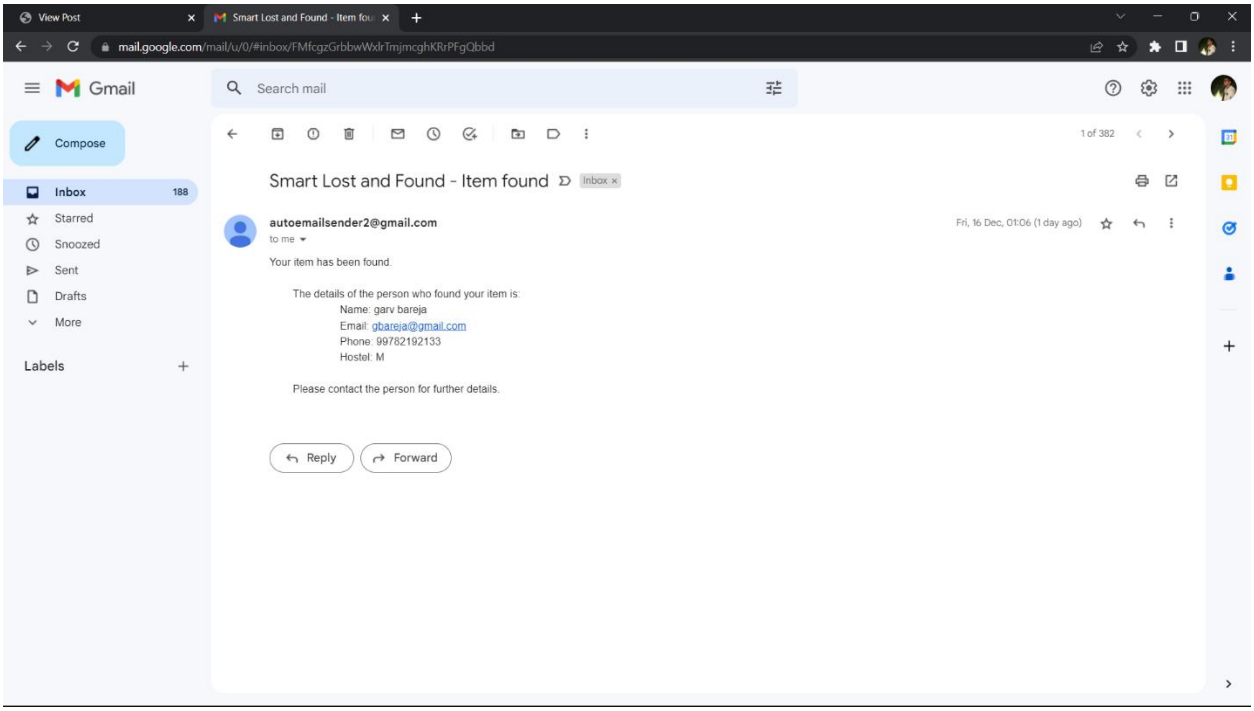

Figure 37: Email displaying the lost item query user's contact information

5.4 Testing Process

This section describes the complete testing process including the techniques employed for testing and fixing, test cases and results after testing.

5.4.1 Test Plan

We planned different features to be tested and checked their pass or fail criteria.

5.4.2 Features to be tested

The features we tested are:

- Logging into the portal.
- Signup and email authentication.
- Submitting a lost item query.
- Submitting a found item query.
- Check the description similarity percentage.
- Profile completion by a user.
- Claim action taken by the admin.
- Claim email received by the user.

5.4.3 Test Strategy

We tested different features of our web-application for errors. If we encountered any errors, we tried to correct them and made sure no new errors arose out of our corrections.

- Unit Testing: We tested various features of the web-application, such as signup, login, lost item query submission, found item query submission, claim item approval, et cetera, in order to make sure that they were working according to objectives of the project. This include all the features that are available. All field entries are working properly. The entry screen, queries and responses are not delayed.
- Integration Testing: Our web-application was tested on the basis of various input data, and it was found to function appropriately as a complete project. No defects in the main objectives were not encountered.
- System Testing: All integrated system features including Django and MySQL are working in synchronisation. The similarity model is also giving predictable results. The system meets all the functional requirements of the project and more.
- Acceptance Testing: The entire web-application is tested and certified by comparing it to the set of approved results.

5.4.4 Test Techniques

Black Box testing: The tester first interacts with the user interface, provide relevant inputs and then checks the outputs without actually seeing the underlying code completely.

White Box testing: The tester firstly investigates the internal logic and structure of the code and then checks if every single component of the code is working fine or not.

- Functional Testing: It involves the testing methods Unit testing, Integration testing, System testing and acceptance testing in that particular order.
- Non-functional Testing: It includes performance, security, usability and compatibility testing.

We have tested the web-application in a variety of situations, one for each instance and then proceeded to repeat the same. Then we evaluated it as a whole project, to check if it produces the required outcome. Using manual and automated testing, we developed better test cases.

5.4.5 Test Cases

Table 10: Test Cases

Test Case ID	Scenario	Test Case Type	Test Step	Expected Outcome	Actual Outcome
T001	Checking login page	Input based	Login details already in DB	Login without errors	Login successful
T002	Checking login page	Input based	Login details not in DB	Error Message and asked to signup	Error message displayed correctly

T003	Checking login page	Input based	Entering wrong credentials	User should be unable to login and error message generated	Correct error message generated
T004	Email check for approved claim	Input based	User verifies his email by clicking link	User should be able to use his credentials to login	Login Successful
T005	Application Testing	UI based	Using the web-application	The web-application should be responsive and working smoothly	The web-application ran smoothly and was responsive

5.4.6 Test Results

All the test cases passed successfully and error-free. The web-application reached our expectation, and it was found to run smoothly. All the invalid ways to login to the portal were unsuccessful when tested.

5.5 Results and Discussions

The web-application integrates all the features and data on a single place. Thus, in turn led to the development of a dedicated Smart Lost and Found system for the university. The portal will make the lives of the students convenient and also the job of the admin stress free and easier. The spam mails in the official email ids of the students will be reduced and the procedure of transfer of found item to the correct owner streamlined.

5.6 Inferences Drawn

So, in conclusion to the above testing, our web-application runs smoothly and without errors.

CHAPTER 6: CONCLUSION AND FUTURE SCOPE

6.1 Work Accomplished

• Objective, Overview and feasibility of the project is determined
• Requirement Gathering and Analysis.
• Creation of UML diagrams like Use-Case Diagram, Class Diagram, DFD, E-R Diagram, Block Diagram, Sequence Diagram etc.
• Creation of Work Breakdown Structure.
• Study of Literature Surveys and selection of best features according to it.

6.2 Conclusion

In this work, we have proposed a solution that can be used by the lost and found management system in TIET to integrate manual work from various sections to make the functioning efficient and reliable. The user can choose to frame queries and push them onto the database which can be further operated on. In addition to this, making an automated website which backs up data on a regular interval is reliable. This project will run on Python Framework and libraries.

6.3 Environmental/Economic/Social Benefits

This project aims mainly to result in the integration of all the data in one place. The portal will make the lives of students convenient and also bring all the important relevant objects in one place. This product is quite cheap and the subscription to the database will also not cost much. So, the product also has great economic benefits.

6.4 Future Work Plan

As the portal integrates together, it builds up a variety of opportunities to give the project a new turn to interact in a better way with the intended audience. We plan not to restrict this project to our college but extend its implementation to different colleges and corporate workspaces. Currently the users can access the portal via website only, we plan on deploying an app for the same. ML model's image matching accuracy will only improve overtime because of regular feedback, a better model replaces itself regularly.

CHAPTER 7: PROJECT OUTCOME

7.1 Challenges Faced

While the development of our project was underway, we faced numerous hardships. We took every challenge in a positive way and dealt it patiently. We faced to following hurdles while implementing the project:

- Syncing Django version: The difference the version of Django and python in our system delayed the progress of our work. A single change in version causes the file to corrupt.

- Data Integration: We collect the data from various sources; hence it has to be insured that the data is not corrupted and redundant. The task is quite challenging as the process has to be automated.

- Model training: The ML model had to be trained and optimised in order to reduce the overfitting of data. We implemented various techniques and settled on one which fit the test cases in a generalized manner. The version difference between keras, tensorflow and python was a very major setback. So many good models were disregarded as they were no compatible with our frontend. Data pipelining was also a tedious task as it was quite new for us.

7.2 Relevant Subjects

This project required the practical knowledge of most of the subjects that we had studied through the course of our bachelor's degree. Each of the subjects mentioned below has its own role to play when it came to the integration of different modules of the project.

Table 11: Relevant Subjects

Subject Code	Subject Name	Usage in the project
UCS503	Software Development	To develop the web-application and making sure that every step of the SDLC cycle is followed
UML501	Machine Learning	To train and test the NLP machine learning model
UCS301	Data Structures	Arrays, Lists, Strings used as different data structures
UCS310	Database Management System	The techniques to store data in an organized manner and to retrieve it efficiently

7.3 Interdisciplinary Knowledge Sharing

The main inspiration behind our project lies in the fields of digitalization of non-redundant data. Development of our interface required an extensive knowledge of the SDLC cycle. The back-end of the project required knowledge and understanding high-level languages like Python along with its vast libraries and functions which can be utilized for achieving our objectives. We also had to

have certain in-depth knowledge of various machine learning techniques in order to make our system smarter, efficient and more user-friendly.

7.4 Peer Assessment Matrix

The assessment criteria is 5 as the maximum and 1 being the lowest score.

Table 12: Peer Assessment Matrix

Evaluation of ➞Evaluation by↓	Raghav Virmani	Garv Bareja	Deepshikha Dohare	Jaskaran Singh Purewal
Raghav Virmani	5	5	5	5
Garv Bareja	5	5	5	5
Deepshikha Dohare	5	5	5	5
Jaskaran Singh Purewal	5	5	5	5

7.5 Role Playing and Work Schedule

Table 13: Role and Contribution

Name	**Contribution**
Garv Bareja	Coding – User Interface Designing & Back-end Development Report Documentation
Raghav Virmani	Coding – User Interface Designing & Back-end Development Report Documentation
Deepshikha Dohare	Coding – User Interface Designing, Base Code (Text Pre-processing, training) Report Documentation

Jaskaran Singh Purewal	Coding – Machine Learning Base Code (Text/Image Pre-processing, training, validation and testing) Report Documentation

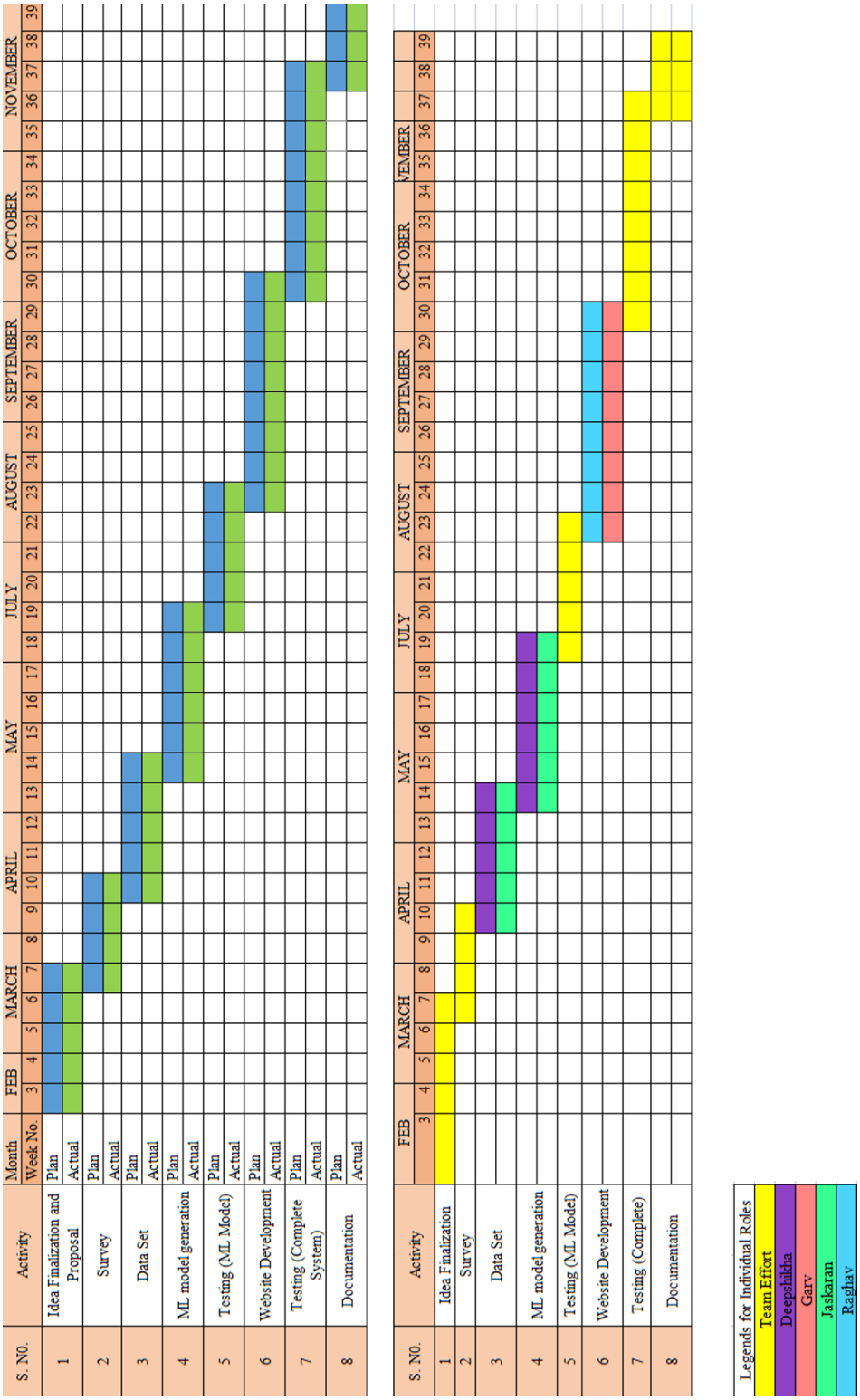

Figure 38: Gantt chart

7.6 Students Outcome

Table 14: SO1-SO7 mapping for the course 'UCS794- Capstone Project'

SO	SO Description	Outcome
1.1	Ability to identify and formulate problems related to computational domain	Several engineering disciplines were involved in the development of the Smart Lost & Found Portal, including computer science and software development.
2.1	Design computing system(s) to address needs in different problem domains and build prototypes, simulations, proof of concepts, wherever necessary, that meet design and implementation specifications.	The initial drawing of the use case and data flow diagrams is good for prototyping.
3.1	Able to communicate effectively with peers in well organized and logical manner using adequate technical knowledge to solve computational domain problems and issues.	At each meeting, everyone would raise their problems and all found solutions to them. Some problems required discussion with the mentor.
4.1	Aware of ethical and professional responsibilities while designing and implementing computing solutions and innovations.	Since most of the project is software based and the project aims to make lost and found system smart and hassle-free, it has a positive impact and is ethical in nature
5.1	Participate in the development and selection of ideas to meet established objective and goals.	Everyone had a clear vision of the project from starting. From day one, the team's goals were very clear.
5.2	Able to plan, share and execute task responsibilities to function effectively by creating collaborative and inclusive environment in a team.	There were regular team meetings weekly and a work plan was first established. There was a delay due to placements in between.
6.1	Applying mathematical concepts to obtain analytical and numerical solutions	The training of text similarity is done using cosine similarity index. This can be represented mathematically as $S_C(A,B) := \cos(\theta) = \frac{\mathbf{A}\cdot\mathbf{B}}{\|\mathbf{A}\|\|\mathbf{B}\|}$ $= \frac{\sum_{i=1}^{n} A_i B_i}{\sqrt{\sum_{i=1}^{n} A_i^2}\sqrt{\sum_{i=1}^{n} B_i^2}}$
7.1	Able to explore and utilize resources to enhance self-learning.	Use YouTube videos, research papers, and open-source software to better understand the project and lighten workload.

7.7 Brief Analytical Assessment

Q1. What sources of information did your team explore to arrive at the list of possible Project Problems?
Ans: The team members were aware of the requirements of the project and a few problems that needed to be explored. We explored the existing lost and found systems available and analysed their limitations and shortcomings by looking at various technical magazines and journals from IEEE and Google Scholar. After thorough discussion, the idea was discussed with mentor and proper listing of requirements were done and finalized the capstone project.

Q2. What analytical, computational and/or experimental methods did your project team use to obtain solutions to the problems in the project?
Ans: The analytical methods to reach solutions were performing literature survey to analyse existing lost and found frameworks and identifying research gaps and studying existing solutions. Designing diagrams and UML diagrams along with software requirement specification were equally very important to think through the solution ideas and make necessary changes. Experimental methods like prototyping and then it's analysis, checking efficiency of the product though testing also helped in reaching the final solution.

Q3. Did the project demand demonstration of knowledge of fundamentals, scientific and/or engineering principles? If yes, how did you apply?
Ans: Yes, the project did demand demonstration of knowledge of fundamentals, scientific and/or engineering principles. We had to use the fundamentals of various subjects like Data structure & Algorithms were used to write down the code of the project and Machine Learning for developing the model. Also, the principles of software engineering were used to document our project in a well-defined manner.

Q4. How did your team shares responsibility and communicate the information of schedule with others in team to coordinate design and manufacturing dependencies?
Ans: The team members communicated frequently throughout the tenure through in-person meetings as well as zoom meetings and a WhatsApp group was also created for sharing of information. In the meeting all the discussions used to take place regarding the things which the team completed till now and future things needs to be implemented. For each module of the project, it was broken into further sub modules and distributed amongst the team members. We maintained the coordination by sharing our research and work during weekly meetups with the other team members. All the objectives were distributed, and team members successfully delivered on their responsibilities thus finishing the work on time.

Q5. What resources did you use to learn new materials not taught in class for the course of the project?
Ans: The main technologies used in our project were react Django and python. We used the main documentation of these languages while also taking help of articles available online on websites like stack-overflow, YouTube and medium. We reached out to our mentor for any doubts that we had regarding our project.

Q6. Does the project make you appreciate the need to solve problems in real life using engineering and could the project development make you proficient with software development tools and environments?
Ans: Yes, our project helped us and gave us an opportunity to solve real life problems using the learnings from various subjects of engineering. We gave a well-defined and structured solution to

the problem which can be implemented in campuses and organizations for hassle-free lost and found of items. We had to come up with an user-friendly web-application which made us familiar with various development tools and technologies used in the project.

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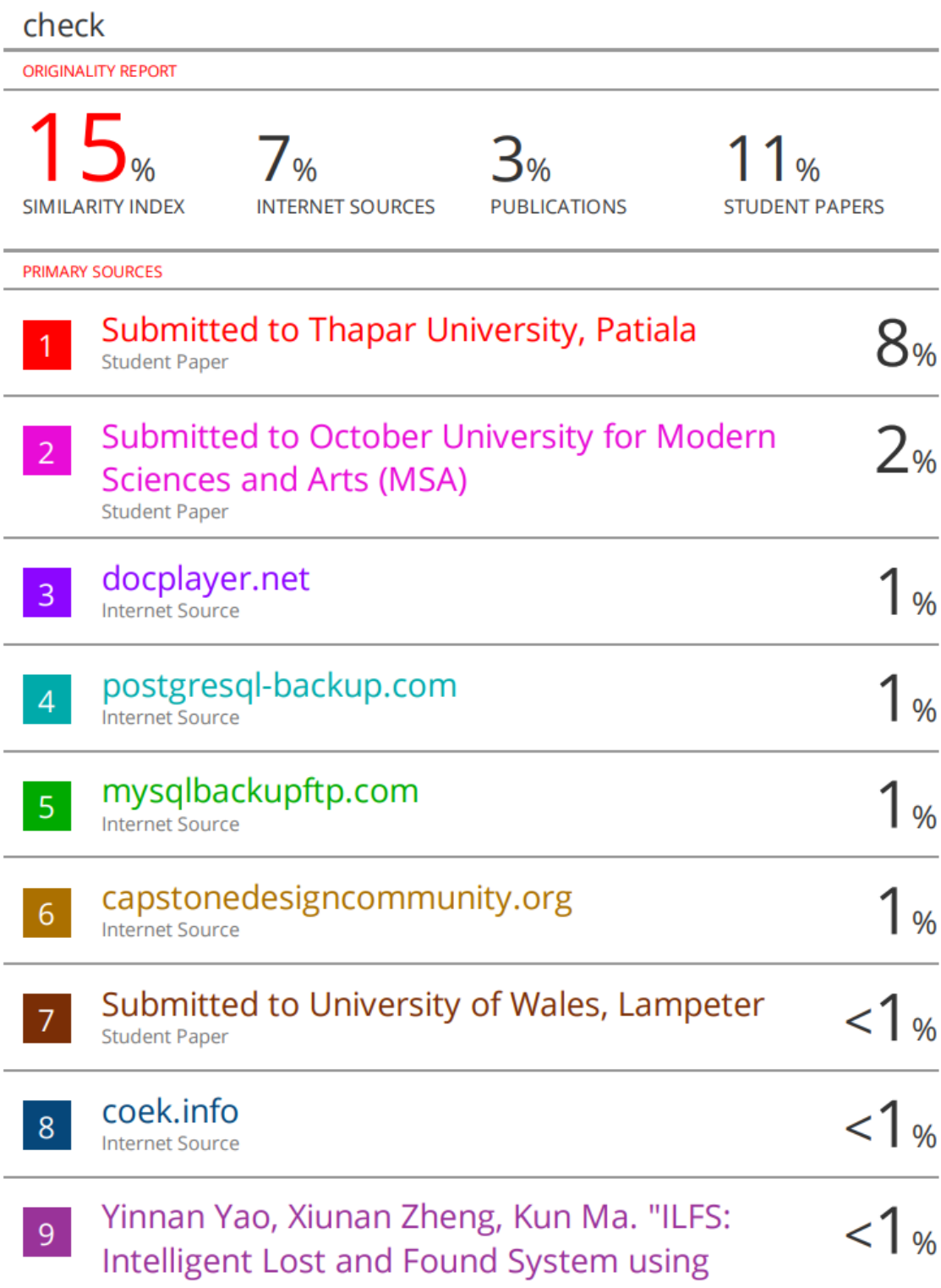

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