Tribhuvan University

Faculty of Humanities and Social Sciences

A Project Report on

Rapid Reach

(Real-Time Emergency Locator)

Submitted to

BCA department

Nepal Kasthamandap College

In partial fulfilment of the requirements for the bachelor's in computer application

Submitted by

Ambhoj Adhikari

[Reg No.: 6-2-144-01-2020]

Under the Supervision of

Shyam Maharjan

August 2025

Abstract

In Nepal, accessing timely and reliable emergency services such as hospitals, police stations, fire services, ambulances, and blood banks remains a critical challenge. Rapid Reach (A Real-Time Emergency Locator) is developed as a platform to bridge this gap by providing users with accurate, location-based information about nearby emergency services. The system addresses problems such as delays in finding help, lack of verified service information, and the absence of a centralized platform for quick access to emergency resources. Through a user-friendly interface, Rapid Reach enables users to detect their real-time location, search for categorized services, view distance and availability, and directly connect through the "Call Now" feature.

The platform is designed to deliver essential details like service availability, working hours, verified status, and user ratings, ensuring reliability and efficiency. By centralizing emergency resources, Rapid Reach reduces response time and enhances public safety in critical situations. Although similar tools exist globally, the system stands out as a much-needed solution in the context of Nepal, where localized, real-time emergency service locators are limited.

Keywords: Users, Admin Panel, Agile Methodology, Upload Documents

Acknowledgement

I take this opportunity to express my heartfelt gratitude to everyone who has been instrumental in the successful completion of my project, Rapid Reach. This project was undertaken as part of my BCA Eighth Semester curriculum, and it would not have been possible without the support and guidance of many individuals.

First and foremost, I would like to express my sincere thanks to my supervisor, Mr. Shyam Maharjan, for providing me with the golden opportunity to work on this project. His valuable guidance, insightful suggestions, and constant encouragement were a great source of motivation throughout the development process. Under his mentorship, I was able to enhance my technical knowledge and gain skills essential for both academic and professional growth.

I am also deeply grateful to Nepal Kasthamandap College for providing the necessary infrastructure, resources, and a supportive learning environment. The availability of computer labs, library resources, and access to essential software contributed greatly to the smooth progress of my work. I would also like to extend my gratitude to all the faculty members of the BCA Department for their constructive feedback, academic advice, and encouragement during this journey.

Finally, I would like to thank my friends and classmates for their continuous support, encouragement, and motivation during both the challenging and successful moments of this project. Their companionship kept me inspired and focused.

This project has been a significant learning experience for me, and I remain sincerely thankful to everyone who contributed, directly or indirectly, to the successful completion of Rapid Reach.

Yours sincerely,

Ambhoj Adhikari

Table of Contents

Abstract ..... **ii**

Acknowledgement ..... **iii**

List of Figures ..... **vi**

List of Tables ..... **vii**

List of Abbreviation used: ..... **viii**

Chapter 1 Introduction **1**

1.1 Introduction 1

1.2 Problem Statement 1

1.3 Objectives 1

1.4 Scope and Limitation 2

1.4.1 Scopes 2

1.4.2 Limitations 2

1.5 Development Methodology 2

1.6 Report Organization 3

Chapter 2 Background Study and Literature Review **4**

2.1 Background Study 4

2.2 Literature review 4

Chapter 3: System Analysis and Design **7**

3.1 System Analysis 7

3.1.1 Requirement Analysis 7

3.1.2 Feasibility Study 12

3.1.3 Object Modeling using Class and Object Diagram 13

3.1.4 Dynamic Modelling using State and Sequence Diagram 15

3.1.5 Process Modelling using Activity Diagrams 16

3.2 System Design 18

3.2.1 Refinement of Class, Object, State, Sequence and Activity diagram 18

3.2.2 Component Diagram.....19
3.2.3 Deployment Diagram 20
3.3 Algorithm Details.....21
3.4.1 Haversine Algorithm 21
3.4.2 Priority Scoring Algorithm.....22
Chapter 4 Implementation and Testing.....23
4.1 Implementation.....23
4.1.1 Tools Used.....23
4.1.2 Implementation Details of Modules 25
4.2 Testing.....28
4.2.1 Unit Testing 28
4.2.2 System Testing 30
Chapter 5 Conclusion and Future Recommendations 31
5.1 Conclusion.....31
References

List of Figures

Figure 1.1: Agile Methodology....2
Figure 3.1: Use case diagram for Hospital and Blood Bank of Rapid Reach....9
Figure 3.2: Use case diagram for Police Department and Fire Department of Rapid Reach 10
Figure 3.3: Use case diagram for Police Vehicle, Fire Truck and Ambulance of Rapid Reach....11
Figure 3.4: Class diagram for Rapid Reach 14
Figure 3.5: Object diagram for Rapid Reach 14
Figure 3.6: Sequence diagram for Rapid Reach 15
Figure 3.7: Activity diagram of User for Rapid Reach....16
Figure 3.8: Activity diagram of Hospital and Blood Bank for Rapid Reach....16
Figure 3.9: Activity diagram of Police Department and Fire Department for Rapid Reach 17
Figure 3.10: Activity diagram of Ambulance, Fire Truck and Police Vehicle for Rapid Reach....17
Figure 3.11: Activity diagram of Rapid Reach 18
Figure 3.12: Component Diagram for Rapid Reach 19
Figure 3.13: Deployment Diagram for Rapid Reach 20

List of Tables

Table 3.1: Gantt chart Table for Rapid Reach 13
Table 4.1: Unit testing for Rapid Reach 28
Table 4.2: System testing for Rapid Reach 30

List of Abbreviation used:

Abbreviation	Description
API	Application Programming Interface
CSS	Cascading Style Sheet
HTML	HyperText Markup Language
JS	JavaScript
JSON	JavaScript Object Notation
JSX	JavaScript XML
MERN	Mongo Db, Express JS, React JS, Node JS
RTC	Real-Time Communication
SQL	Structured Query Language
URL	Uniform Resource Locator
XML	Extensible Mark UP Language

Chapter 1 Introduction

1.1 Introduction

Rapid Reach is a real-time emergency locator platform designed to connect users with nearby essential services when urgency strikes. Whether someone needs a hospital, police station, fire service, ambulance, or blood bank, the website provides instant access based on the user's current location. It simplifies the process of finding help by allowing users to search by category and view crucial details such as distance, availability, and working hours.

The platform also includes features like “Call Now” functionality, verified service status, and user ratings to ensure quick and reliable support. By offering accurate and up-to-date information in just a few clicks, Rapid Reach empowers people to take fast action in critical situations, saving valuable time and potentially lives.

1.2 Problem Statement

In the context of Nepal, peoples are facing numerous challenges related to health services. The problems such as:

- No centralized platform for services like Fire Department, Health Service and Police Departments.
- Lack of real-time access and direct communication.
- Delay in response time.

1.3 Objectives

The objectives of this project which are mainly focused are mentioned below:

- To develop a real-time live tracking system for ambulance, fire truck and police vehicle.
- To reduce emergency response time by applying call now feature.
- To recommend nearby departments like hospitals, fire department and police department along with vehicles services like ambulance, fire truck and police vehicle.

1.4 Scope and Limitation

1.4.1 Scopes

- It provides the services with the help of real-time search, location and contact.
- It displays essential details like availability, working hours, distance, verification status, and ratings.
- It enables direct calling to emergency services from within the platform.

1.4.2 Limitations

- It does not provide medical, legal, or emergency advice.
- It is only made for two municipality including Kathmandu and Chandragiri.

1.5 Development Methodology

The Agile methodology will be used for the system because in "Agile method" the task breaks into smaller iterations, or parts do not directly involve long term planning. In agile method the system can change requirements, even in later stages and can be kept things simple as possible.

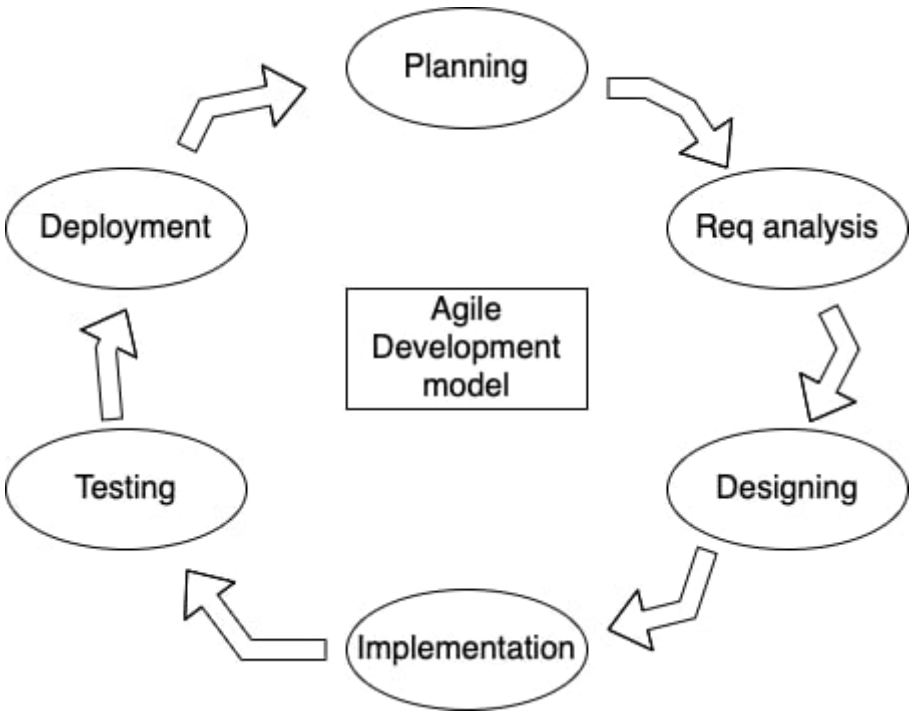

Figure 1.1: Agile Methodology

1.6 Report Organization

Introduction

It outlines the main goals of the project and the specific criteria that must be met during its execution.

Background Study and Literature Review

It involves examining the current system, conducting a detailed analysis, and gaining a comprehensive understanding of its history and context.

System Analysis and Design

It outlines both the functional and non-functional requirements of the system, including data modelling, process workflows, database schemas, and the overall architectural design.

Implementation and Testing

It specifies the tools and technologies that will be utilized for the system's development, along with the testing procedures to be followed, including the creation and execution of test cases.

Conclusion and Future Recommendation

It provides a comprehensive summary of the project through documentation, highlighting key features and suggesting areas for potential system improvement.

Chapter 2 Background Study and Literature Review

2.1 Background Study

In Nepal, timely access to emergency services such as hospitals, ambulances, police stations, fire services, and blood banks is crucial but often challenging. Many people struggle to quickly find and contact the nearest emergency help due to a lack of centralized, real-time information. This problem is more pronounced in rural and remote areas, where digital infrastructure and service visibility are limited, leading to dangerous delays during critical situations.

Currently, individuals rely on outdated directories, word-of-mouth, or random internet searches, which are inefficient and unreliable when every second counts. Even in urban areas, the absence of verified, up-to-date details about service availability, working hours, and direct contact options causes confusion and mistrust. This gap in emergency response accessibility puts lives at risk and highlights the urgent need for a comprehensive digital solution.

Rapid Reach is developed to address these challenges by providing a real-time emergency locator platform that connects users with verified emergency services based on their location. With features like live GPS tracking, categorized searches, instant calling, and information on working hours and ratings, Rapid Reach empowers users to act quickly and confidently during emergencies. By enhancing accessibility and trust, Rapid Reach aims to improve emergency response outcomes and save lives across Nepal.

2.2 Literature review

The Nepal Ambulance Service (NAS) is a non-profit initiative dedicated to the establishment of an emergency medical response system (EMS) in the greater Kathmandu and Patan municipalities, later to be expanded nationwide. This system will provide rapid ambulance transport to hospitals along with life-saving medical care by trained emergency medical technicians (EMTs) for sick and injured people regardless of ability to pay. NAS aims to operate fully equipped and staffed ambulances via a central dispatch facility with radio communication between area hospitals and ambulances in order to ensure rapid transport and treatment for individual patients. NAS EMTs will be trained by Stanford University School of Medicine (USA) experts from Stanford Emergency Medicine International (SEMI). [1]

Ashal Chhimeki Nepal-ACN (Good Neighbours Nepal-GNN) is a non-government organization, established in 2002 at Kathmandu, Nepal with the aim of transforming the community for the sustainable development holistically. The major areas of interventions are Livelihood, Health, Gender Equality & Social Inclusion, Sanitation & WASH, Education, Network building and Partnerships, Emergency response, and Advocacy. Nepal remains one of the poorest countries in the world where 25% of the people are living on less than 100 Rupees (less than $1) a day. Hence, GNN seeks to work on supporting marginalized people in the overall community development. In addition to this, GNN also provides relief support during natural disasters such as the recent earthquake we faced in 2015. The projects are designed on need based principle outlined by the target group/community. [2]

Hospital for Advanced Medicine & Surgery (HAMS) is a multi-disciplinary tertiary care hospital situated in Dhumbarahi, Kathmandu. With over 25 years of experience and expertise, we have been providing quality and affordable healthcare to the community. We are proud of our highly experienced clinicians, technicians & administrators, backed by state-of-the-art technology and dependable infrastructure. Our hospital is fostered by highly trained and caring nurses who strive to give you the best patient care and experience the town has to offer. [3]

Alka Hospital, established in 2006, evolved from Alka Pharmacy (1995) and Alka Polyclinic (2000). With 100 beds, advanced diagnostic, curative facilities, and a commitment to quality healthcare. To Start with, Alka hospital had its footprints in the form of Alka Pharmacy that was established in 2052 BS (1995 AD) with the aim of supplying sufficient and proper quality medicine to the People within its vicinity. Within two year, with god's grace and endless effort of the staff, the management team thought to expand its services resulting the alka poly clinic (2057BS,2000AD) along with its pharmacy. [4]

The Nepal Police, established in 1951, plays a crucial role in maintaining law and order, ensuring public safety, and upholding the rule of law in Nepal. Scholarly literature highlights the organization's efforts in modernizing its services, especially in response to evolving security challenges and democratic transitions. Studies have examined its role during periods of political instability, the civil conflict (1996–2006), and its reforms in community policing and human rights training. However, critiques often focus on issues of corruption, political interference, and inadequate resources, which hinder effective service

delivery. Recent research also emphasizes the importance of institutional reform and capacity-building to enhance public trust and accountability within the force. [5]

Existing blood management system in Nepal is manual, cumbersome and inefficient. Most blood banks record the information on blood collection/supply manually in registers. Maintaining blood stock inventory is tedious with laborious back-office paperwork and managing information on availability and shortage of blood is a tall task. A social initiative for a smart, transparent and holistic blood management service from collection to supply. When it comes to blood, right information at the right time can be the answer to a life and death situation. [6]

FIRE AID was founded in 2012 in a café in Kent, where a group of like-minded experts, dedicated to supporting first responders globally, came together with a shared vision. Their goal was to create a central hub that would streamline the exchange of knowledge and resources to enhance emergency response efforts worldwide. In early 2013, like-minded organizations gathered at the House of Commons for a meeting chaired by Jim Fitzpatrick, who was a serving MP at the time. During this meeting, funding was secured through the FCDO to establish FIRE AID's database and website. Jim served as Chair until September 2023. FIRE AID’s first collaborative project was launched in Ukraine, followed closely by projects in Moldova and Tajikistan. [7]

On 14 February 2002, a medical branch was established at the Armed Police Force headquarters in Kathmandu to provide healthcare to APF personnel and their families. Despite limited resources, it offered services like OPD, emergency care, X-ray, physiotherapy, and pharmacy. For specialized care, renowned hospitals like Teaching Hospital and Bir Hospital were consulted. On 15 December 2003, with the expansion of APF offices nationwide, the branch became APF Hospital. By 16 February 2005, due to increased patient volume, the government approved the construction of a new 110-bed hospital at Balambu, Kathmandu, reserving 5 beds each for the National Investigations Department and local residents, with 100 beds allocated for APF staff. [8]

Chapter 3: System Analysis and Design

3.1 System Analysis

The system analysis of the system is done by conducting requirement analysis and feasibility analysis as follows:

3.1.1 Requirement Analysis

Requirements analysis is a crucial step for determining the success of a system or software project. Requirements are generally split into two types.

a. Functional requirements

For User:

- User can register and login the system through email and password.
- User can locate nearby services by the help of Haversine Algorithm.
- User can contact to available services from Call Now feature.

For Hospitals:

- Hospital's user can locate nearby users.
- The name of the Hospital will be displayed in the map along with location.
- The operating hours will be displayed.

For Ambulance:

- The ambulance user's locations will be tracked live.
- The ambulance user will be contacted by nearby users.
- The ambulance can locate nearby hospitals and users.

For Police Department:

- Department's user can locate nearby emergency.
- Department can contact to police vehicle crews.
- Department's will be contacted by users.

For Police Vehicles:

- The vehicles crew's location will be tracked live.
- The vehicles crew will be informed when a nearby emergency is occurred.
- In emergency situations the vehicles crew's can call for backup from department.

For Fire Department:

- The fire department will be notified or called for emergency.
- The fire department will dispatch vehicles for rescue to the location.
- The fire department can track the live location of fire truck.

For Fire Truck:

- The vehicles crew's location will be tracked live.
- The vehicles crew will be informed when a nearby emergency is occurred.
- In emergency situations the vehicles crew's can call for backup from department.

For Blood Bank:

- The name of the Blood Bank will be displayed in the map along with location.
- The Blood bank will be contacted by users and hospital's users for blood.
- The operating hours will be displayed.

For Admin:

- Admin can login to the system.
- Admin can see the total number of accounts.
- Admin will be allowed to manage accounts.
- Admin can view the live tracker.

Use Case Diagram (Hospital and Blood Bank)

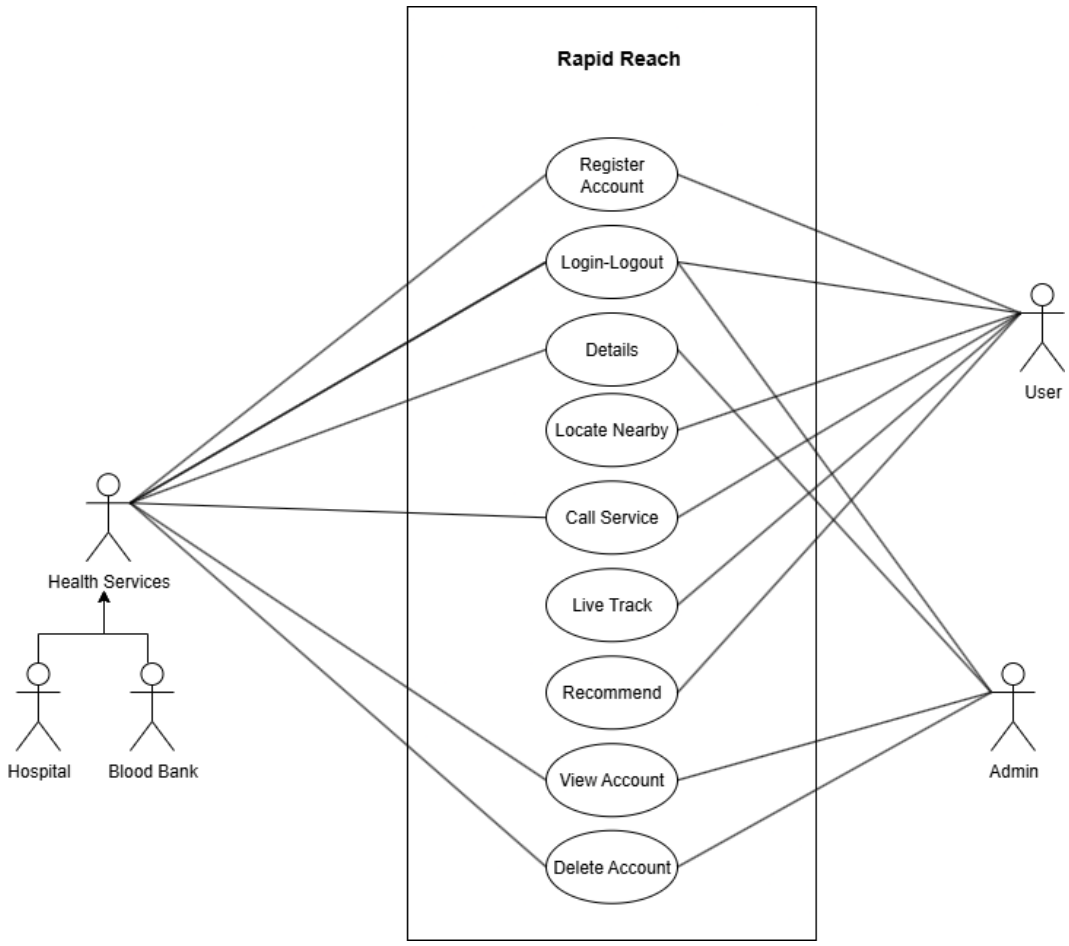

Figure 3.1: Use case diagram for Hospital and Blood Bank of Rapid Reach

This is a use case diagram of Rapid Reach, which explains how users can interact with the system. First, a user can register for a new account and later log in or log out. After logging in, they can manage their personal details, view their account information, or even delete the account if needed. The main services include the ability to locate nearby emergency services, call those services directly, and even track them live. Additionally, users have the option to recommend services to others. Overall, the diagram highlights both the account management features and the emergency service functionalities, showing how the system is designed to support users during urgent situations.

Use Case Diagram (Police department and Fire department)

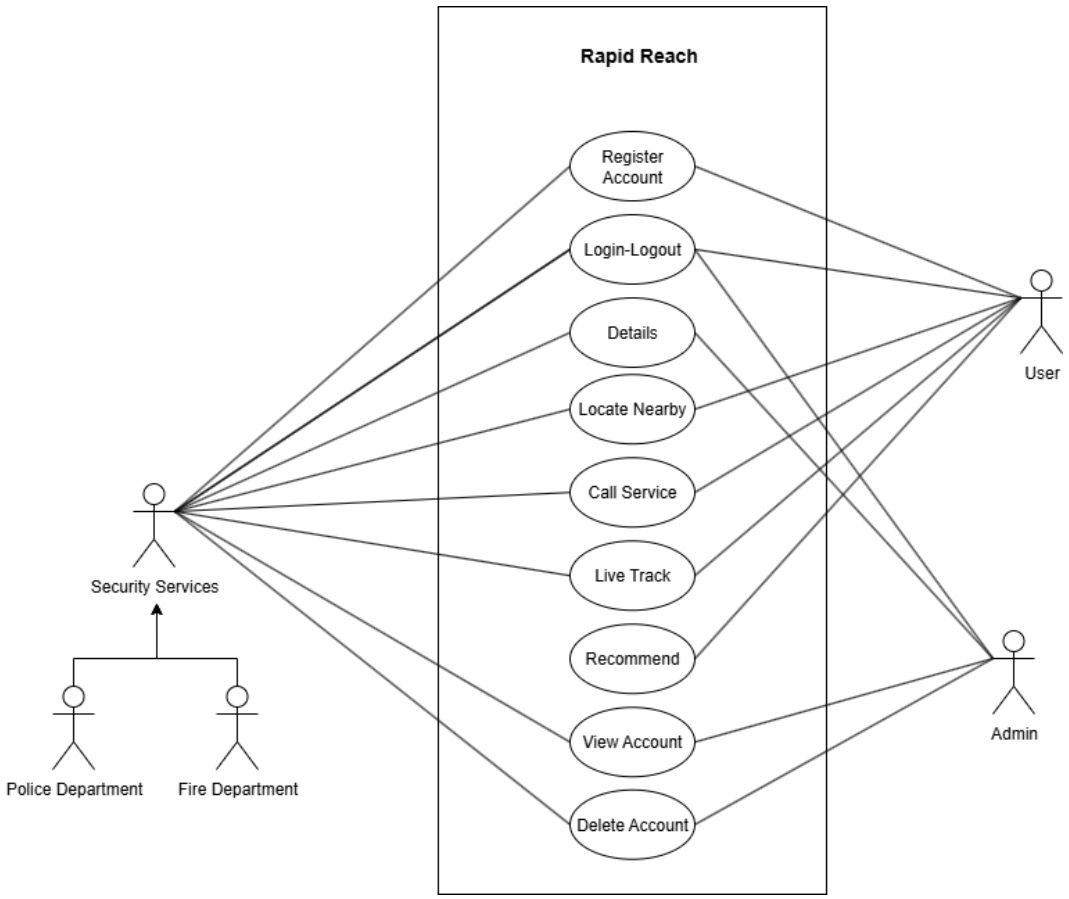

Figure 3.2: Use case diagram for Police Department and Fire Department of Rapid Reach

This use case diagram shows how different emergency departments interact with the Rapid Reach system. A Police Department can be contacted by users in case of crimes or emergencies, and users can also live with a police response. The Fire Department can be reached directly when there is a fire or hazard, and users can locate nearby fire stations and request help instantly. A Hospital is available for medical emergencies, where users can view hospital details, call for medical help, and track ambulance services live. Similarly, a Blood Bank helps users to locate available blood supplies, request blood, and get contact details. All departments can be recommended by users to others for reliability, and users can still manage their accounts (register, log in/out, view, or delete).

Use Case Diagram (Police vehicle, Fire truck and Ambulance)

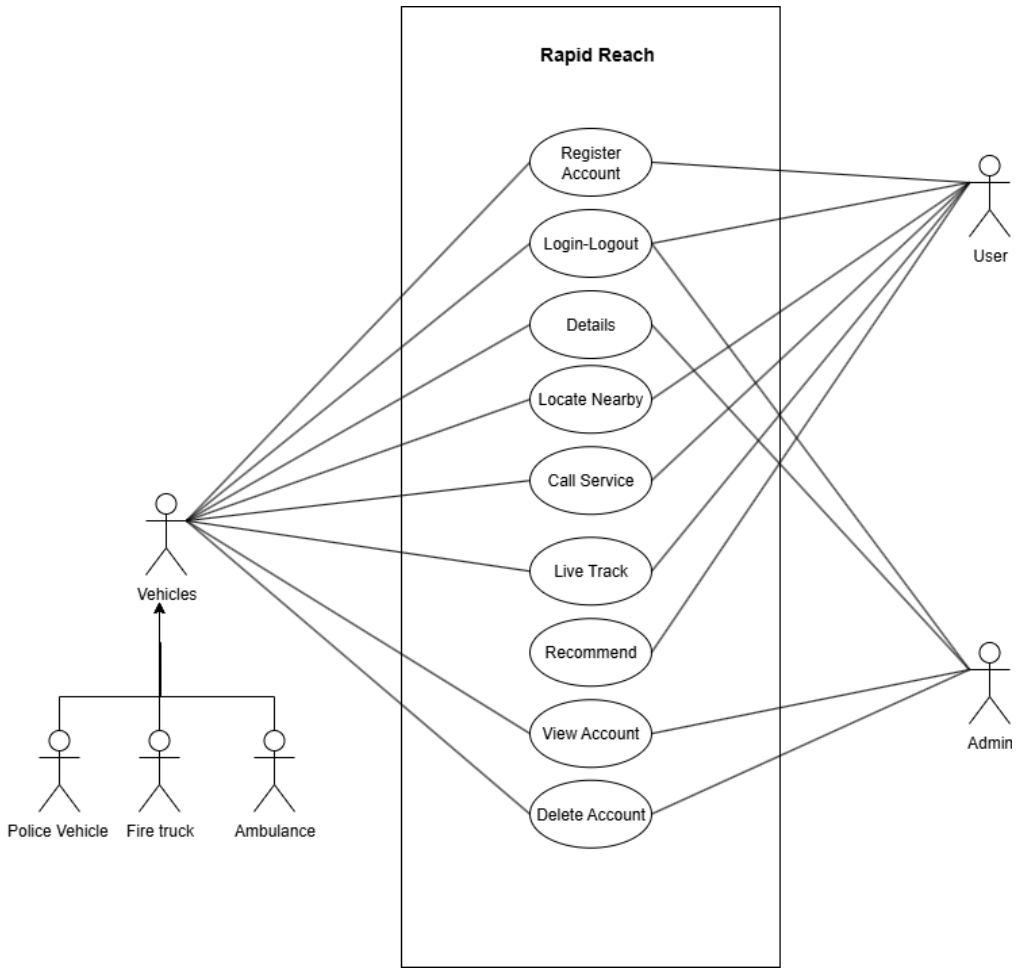

Figure 3.3: Use case diagram for Police Vehicle, Fire Truck and Ambulance of Rapid Reach

This use case diagram would represent how users can interact with emergency vehicles through the system. A Police Vehicle can be requested when users report an incident, and they can track the vehicle live until it arrives. A Fire Truck can be called during fire emergencies, where users can locate the nearest fire station, request a truck, and monitor its movement in real-time. Similarly, an Ambulance can be contacted for medical emergencies; users can call it directly, track its live location, and view details like availability and estimated arrival time. Just like before, users still have the ability to register/login, manage accounts, and recommend services.

b. Non-Functional Requirement

i. Availability

It will be available as a website. The system works on multiple web browsers like Chrome, Mozilla Firefox and Opera and will be available 24 hours when it is deployed.

ii. Security

The system has accounts for its users and only authorized users can access the system with username and password. The register system contains form validations so that non-authorized users cannot access.

iii. Performance

This system will be designed for smooth performance with optimization and good response.

3.1.2 Feasibility Study

i. Technical feasibility

The website will be developed with the help of MERN Stack along with the help of Haversine and Priority scoring Algorithms for better user experience, which helps to recommend nearby services along with top rated services.

ii. Operational feasibility

The help of current developing tools and deployment tools, the web site can run smoothly in both desktop devices along with mobile devices.

iii. Economic feasibility

As per the research, system doesn't need any funding while it is being developed. However, to build the system it needs software like Visual Studio Code which is free on website.

iv. Schedule feasibility

The scheduled time for the project can be seen below with the help of Gantt Chart table.

Table 3.1: Gantt chart Table for Rapid Reach

Task	May 10	May 30	June 15	June 26	July 27	Aug 3	Aug 15	Estimation
Planning								20 days
Research								15 days
Design								25 days
Implementation								35 days
Testing								25 days
Documentation								120 days

3.1.3 Object Modeling using Class and Object Diagram

The Class Diagram for the project represents three main classes: User, Post, and Comment. The User class includes attributes like userId, userMail, and userImage, and methods for creating posts and comments. The Post class has attributes like postId, postContent, and references to the User, and it allows adding comments. The Comment class contains attributes like commentId, commentContent, and references to both the User and Post. The diagram also defines the relationships: a User can create many Posts, each Post can have many Comments, and a User can write many Comments.

The relationships among these classes were also clearly defined: a User can create many Posts, each Post can have multiple Comments, and a User can write many Comments. These relationships were represented using one-to-many associations between the respective classes.

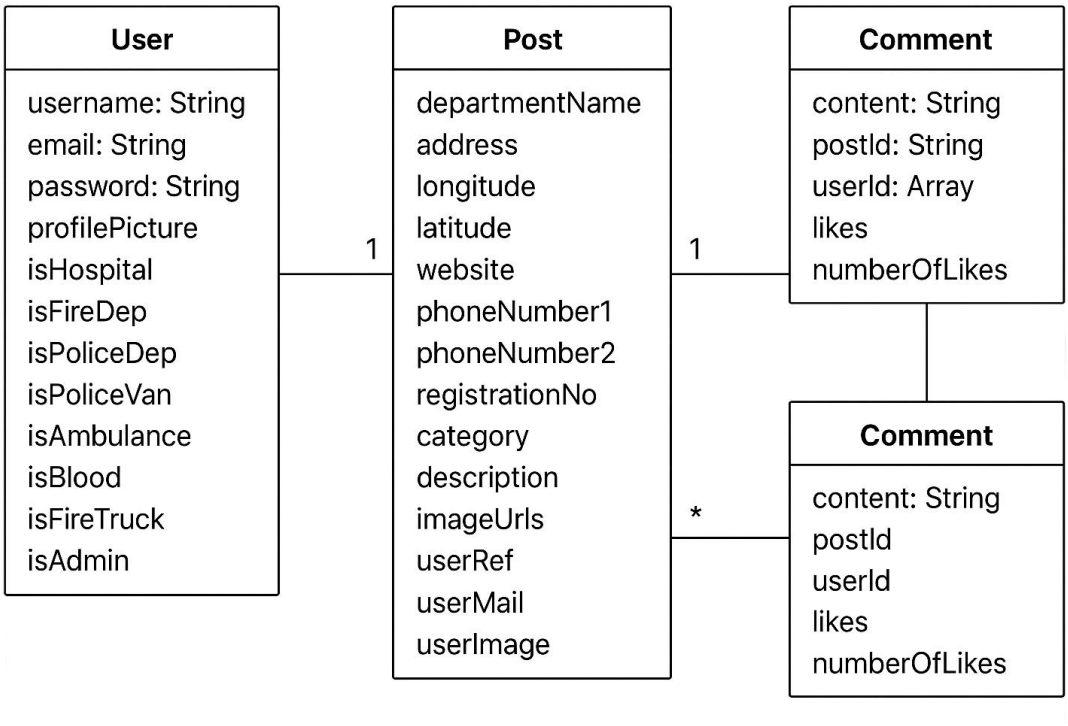

Figure 3.4: Class diagram for Rapid Reach

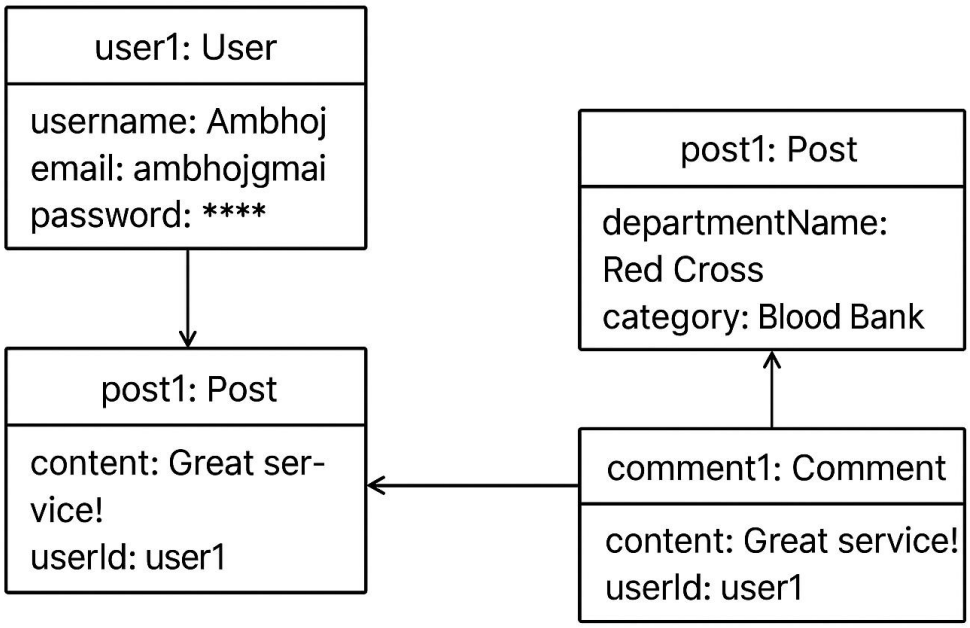

Figure 3.5: Object diagram for Rapid Reach

3.1.4 Dynamic Modelling using State and Sequence Diagram

Dynamic modeling represents how a system behaves and how objects interact over time. It shows the changes in the system's state during execution, complementing static models like class diagrams that focus on structure. Dynamic models, such as sequence diagrams, demonstrate how objects communicate and how data flows between them.

In the context of Rapid Reach, a sequence diagram can be used to illustrate the interactions between the User, Post, Role, Contact, and Authentication (Auth) systems. When a User logs in, the Auth system verifies their credentials, checking the username and password. Once verified, the Auth system returns the User's Role, such as Admin or User, to define the level of access.

The diagram illustrates the flow of actions: first, the login request, then the post creation, and finally the contact addition. Each interaction shows how objects, such as User, Post, and Contact, change state or communicate with each other during these processes.

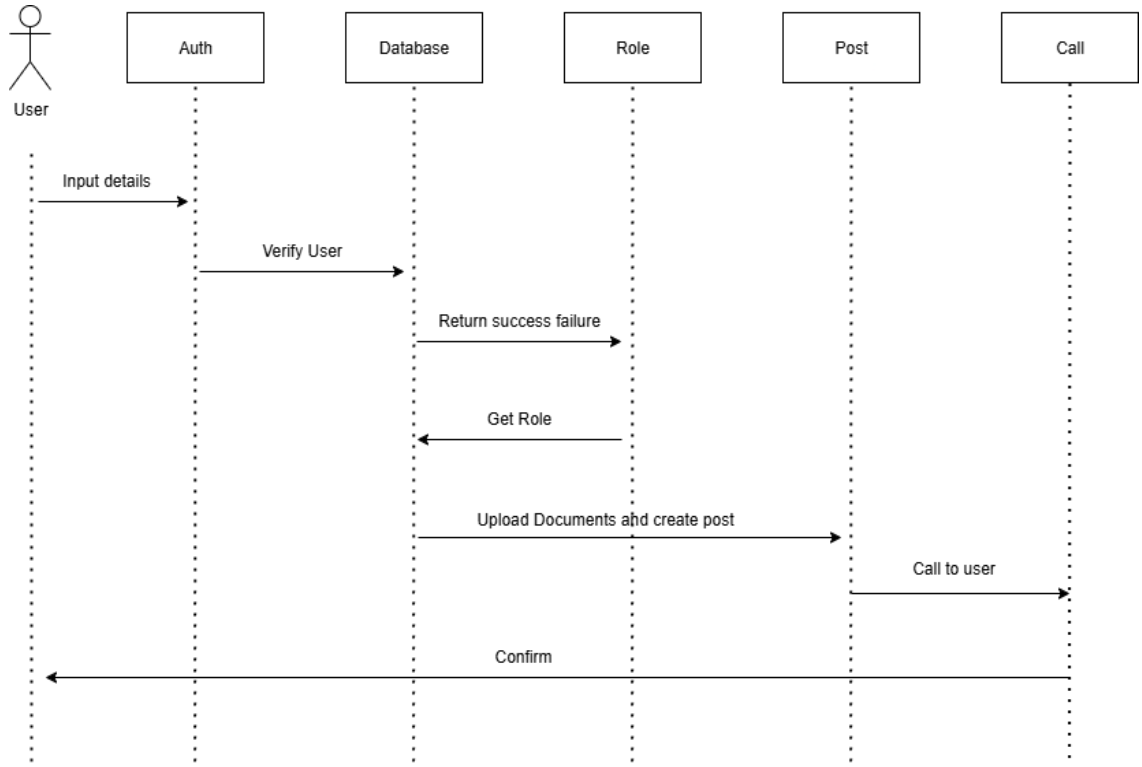

Figure 3.6: Sequence diagram for Rapid Reach

3.1.5 Process Modelling using Activity Diagrams

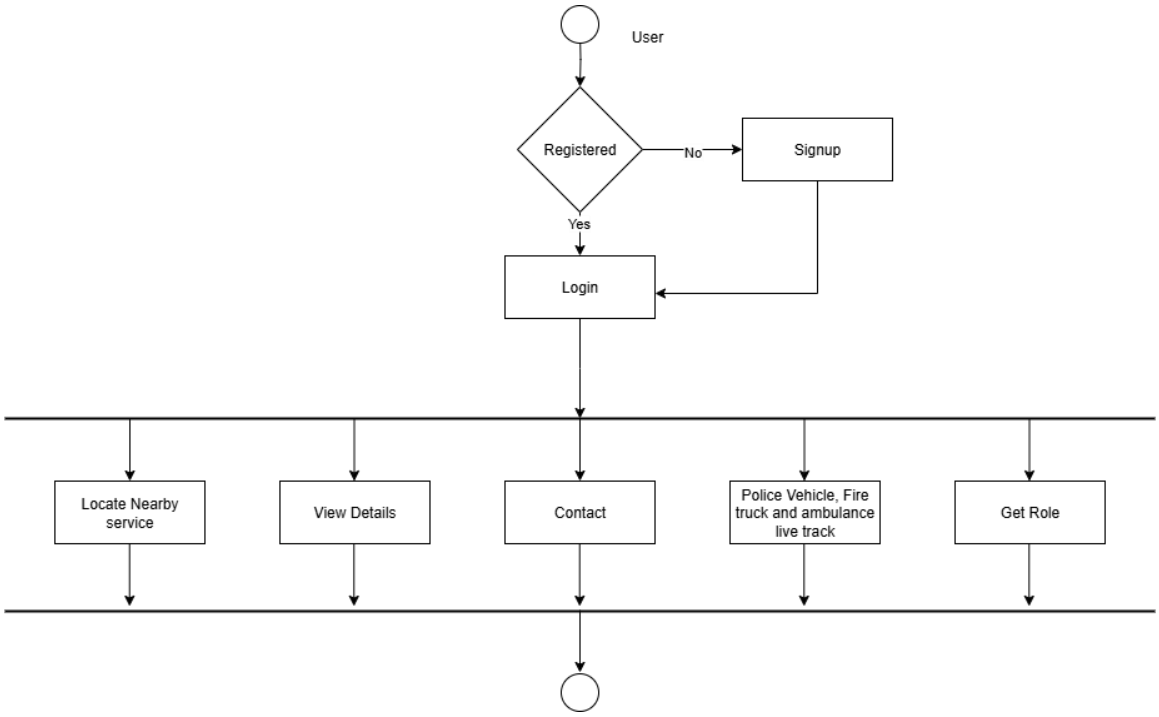

Figure 3.7: Activity diagram of User for Rapid Reach

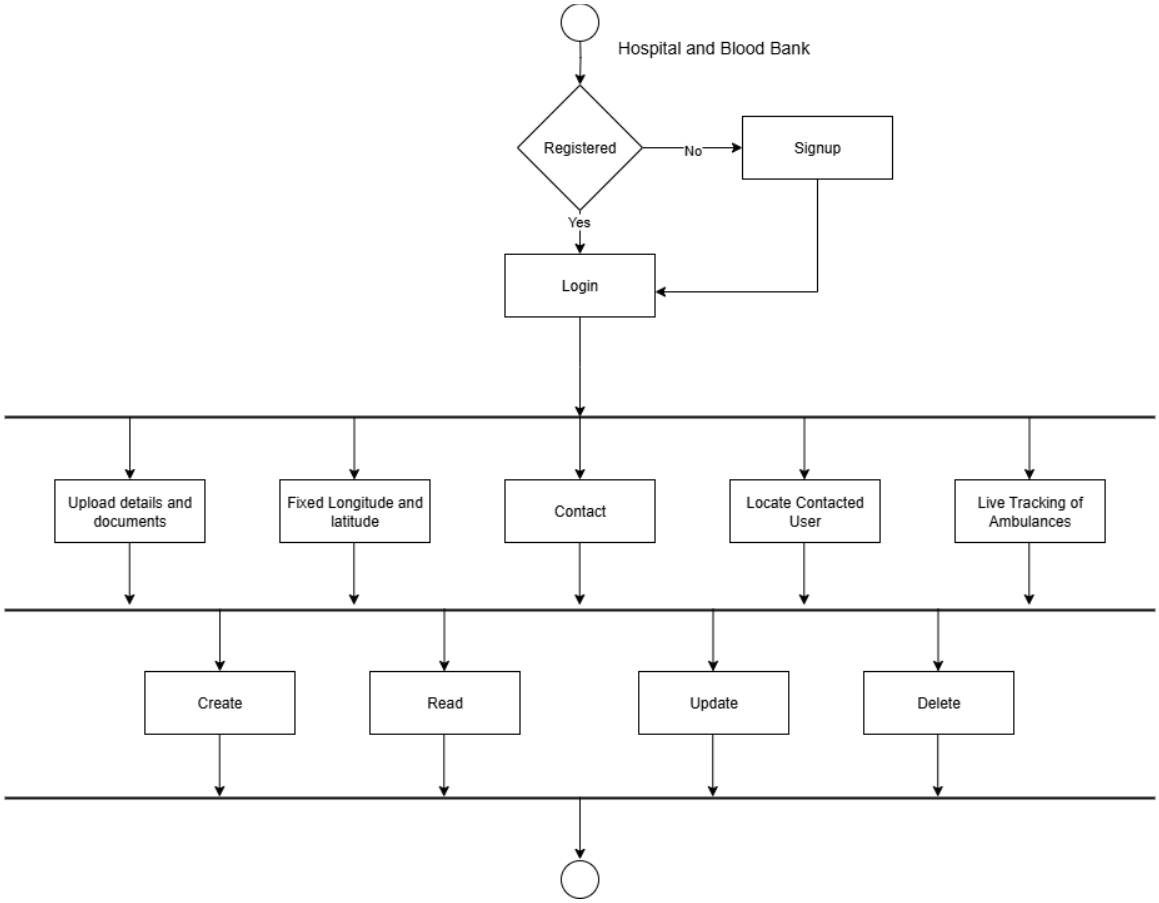

Figure 3.8: Activity diagram of Hospital and Blood Bank for Rapid Reach

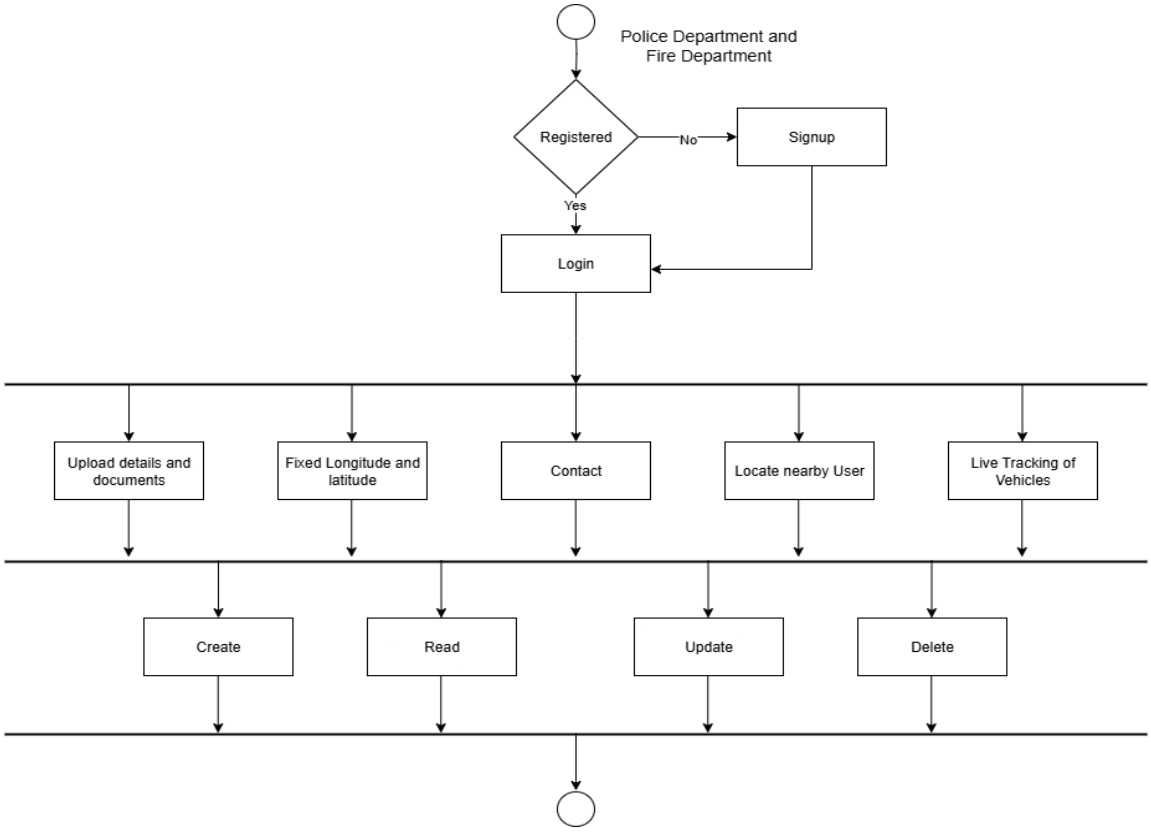

Figure 3.9: Activity diagram of Police Department and Fire Department for Rapid Reach

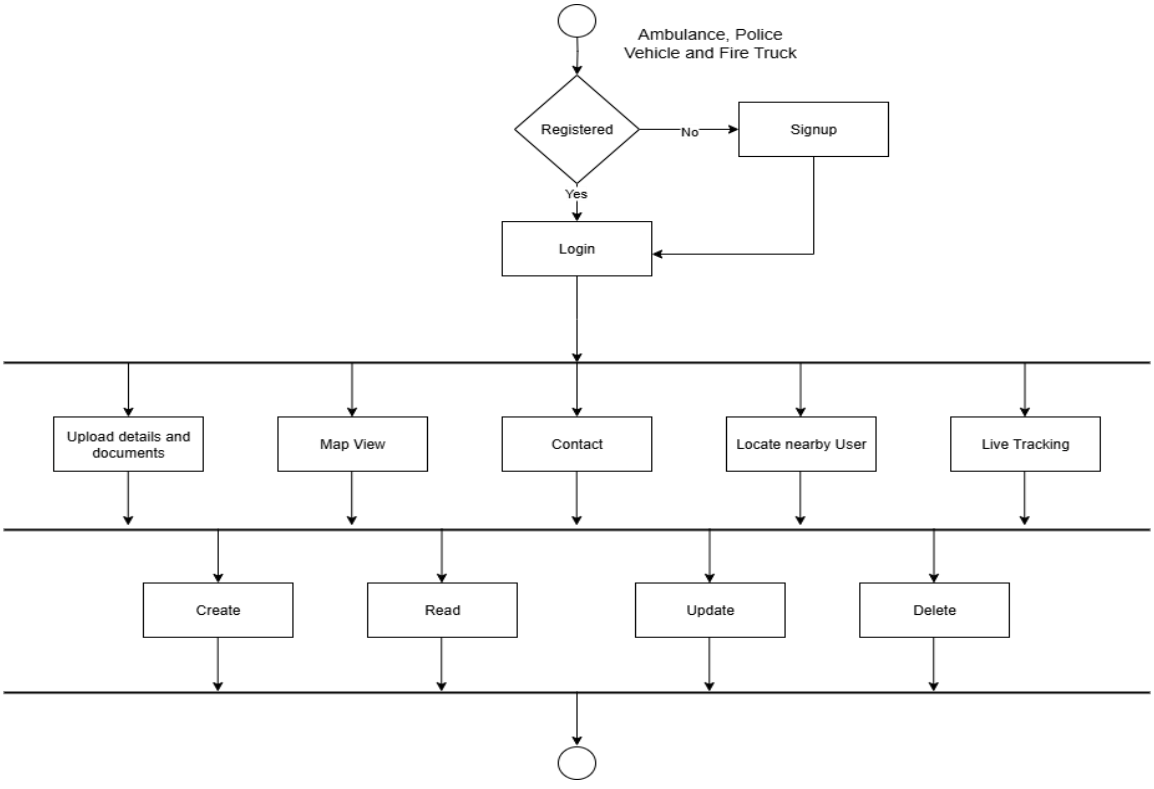

Figure 3.10: Activity diagram of Ambulance, Fire Truck and Police Vehicle for Rapid Reach

3.2 System Design

3.2.1 Refinement of Class, Object, State, Sequence and Activity diagram

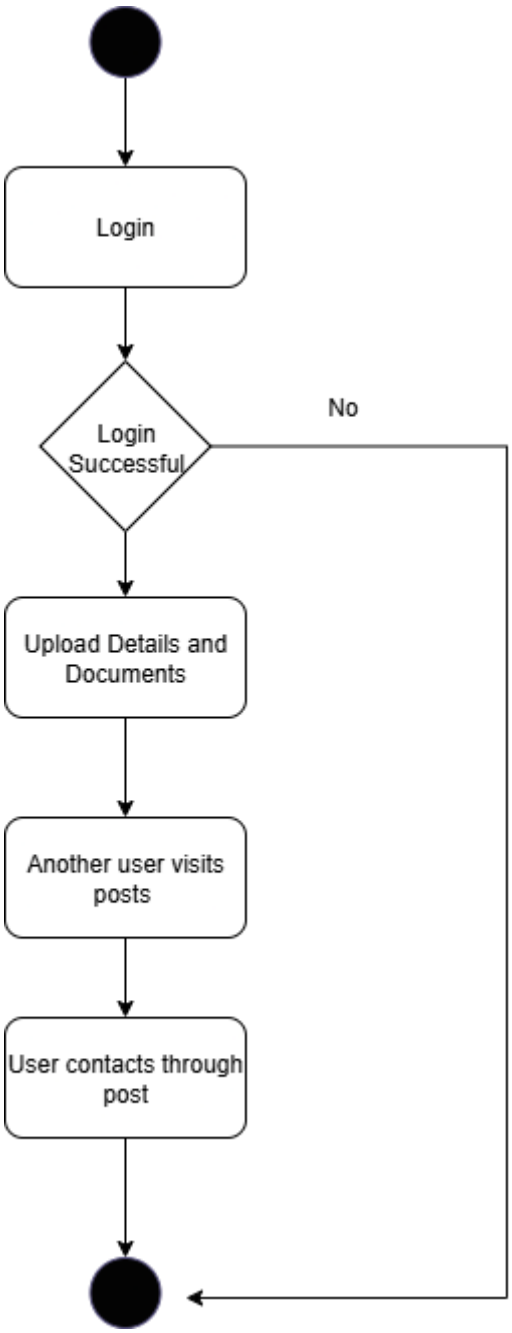

Figure 3.11: Activity diagram of Rapid Reach

This Activity Diagram outlines the process of a User logging into the system, creating a Post, and interacting with it. First, the User logs in, and a check is made to determine if the login credentials are valid. If the login is invalid, an error message is displayed, and the process ends. If the login is successful, the User proceeds to create a Post. The Post is then saved in the database. Once saved, another User may view the post and can write a

Comment. The Comment is then saved in the database, and the process ends. The diagram helps visualize the flow of actions and decisions that take place during this sequence.

3.2.2 Component Diagram

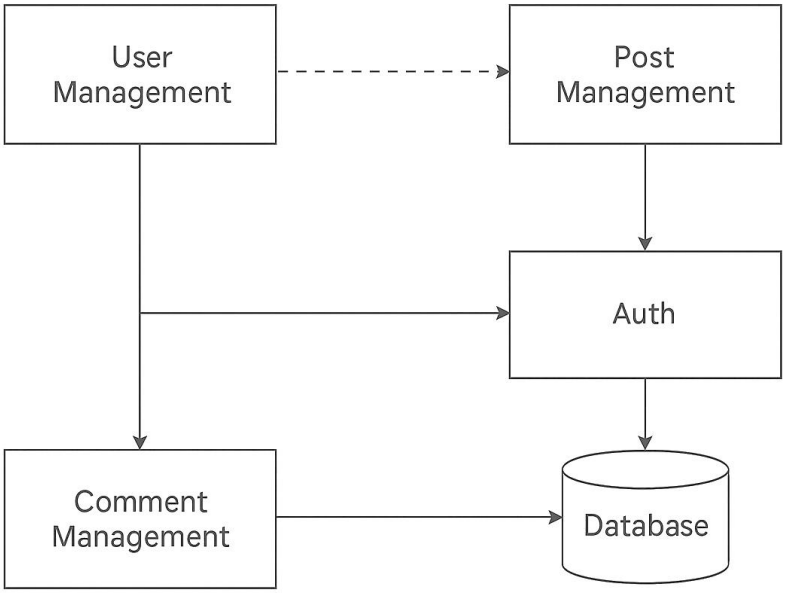

Figure 3.12: Component Diagram for Rapid Reach

The component diagram for Rapid Reach outlines a modular system designed for efficient user interaction and content management. It features distinct components for user, post, and comment management, all secured through a centralized authentication module. Each of these components communicates with a shared database, ensuring streamlined data flow and integrity. This architecture promotes scalability, maintainability, and secure access, making Rapid Reach a robust platform for dynamic user engagement and real-time content operations.

3.2.3 Deployment Diagram

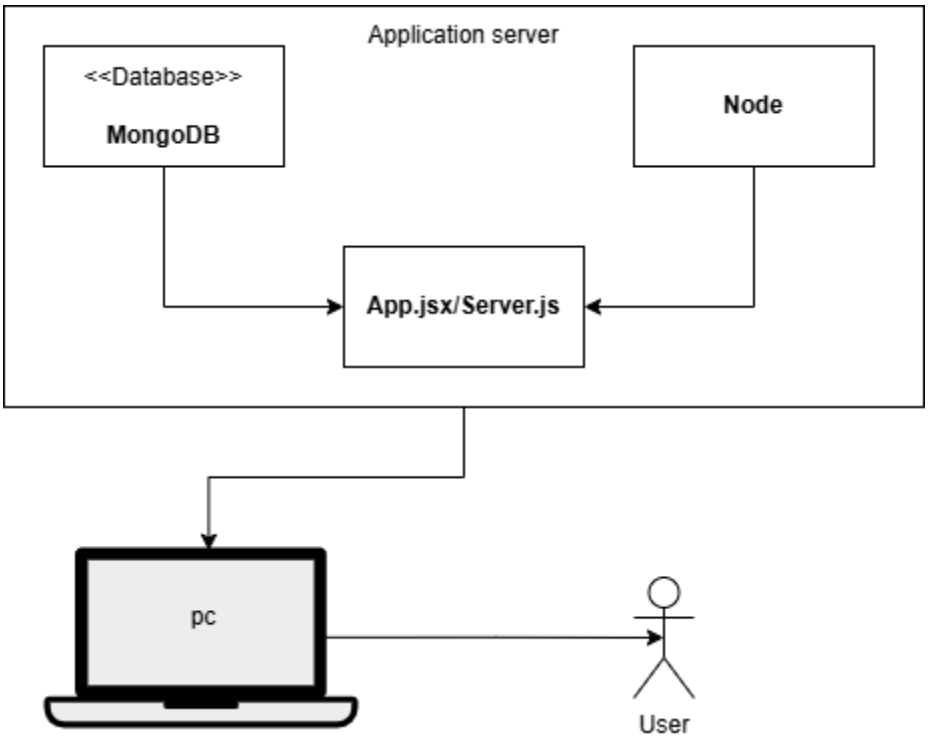

Figure 3.13: Deployment Diagram for Rapid Reach

3.3 Algorithm Details

Algorithms are used in websites to deliver functionality, personalization, performance, and security.

3.4.1 Haversine Algorithm

In the Rapid Reach system, the Haversine algorithm is used to calculate the shortest distance between the user's current location and nearby emergency services. By applying this formula to the latitude and longitude coordinates, accurate distance values are generated, which are then displayed to the user. This ensures that emergency services are listed in order of proximity, allowing quicker access to the nearest available help.

Haversine Formula

- $\phi 1, \phi 2$ be the latitudes of point 1 and point 2 (in radians)
- $\lambda 1$, $\lambda 2$ be the longitudes of point 1 and point 2 (in radians)
- r is the radius of the Earth (mean radius ≈ 6,371 km)

Then the Haversine formula is:

$$a = sin^2\left(\frac{\Delta \emptyset}{2}\right) + \cos(\emptyset 1) . \cos(\emptyset 2) . sin^2\left(\frac{\Delta}{\lambda}\right)$$

$$c = 2. archtan2(\sqrt{a}, \sqrt{1-a})$$

$$d = r.c$$

Where:

- $\Delta\phi = \phi 2 - \phi 1$
- $\Delta\lambda = \lambda 2 - \lambda 1$
- d is the distance between the two points (along the surface of the sphere)

3.4.2 Priority Scoring Algorithm

In the Rapid Reach system, a priority scoring method is applied to rank emergency services based on multiple factors such as distance, availability, verified status, and user ratings. Scores are automatically calculated, and services are displayed in order of priority, ensuring that the most reliable and accessible options are highlighted first. This approach enables users to make faster and more informed decisions during emergencies.

Priority Score Formula:

- n be the number of factors (criteria)
- x_i be the score for the i-th factor
- w_i be the weight assigned to the i-th factor (where $\sum_i^n w_i = 1$

$$Priority\ Score = \sum_{i=1}^{n} (w_i . x_i)$$

or written out:

$$Priority\ Score = w_1 x_1 + w_2 x_2 + \cdots + w_n . x_n$$

Chapter 4 Implementation and Testing

4.1 Implementation

4.1.1 Tools Used

Various tools were implemented for the development of this project. Following are the tools that are used for the development of this project:

ReactJs

ReactJS is a popular open-source JavaScript library used for building user interfaces, especially for single-page applications. Developed by Facebook, it allows developers to create reusable UI components that update efficiently when data changes. React uses a virtual DOM to improve performance and makes it easier to manage the state of an application. It's widely used for building fast, dynamic, and responsive web applications.

Node,js

Node.js is an open-source, server-side JavaScript runtime built on Chrome's V8 engine. It allows developers to run JavaScript outside the browser, making it possible to build fast and scalable network applications. Node.js uses an event-driven, non-blocking I/O model, which makes it efficient and suitable for real-time applications like chat apps, APIs, and streaming services. It’s commonly used with frameworks like Express.js for building web servers and backend services.

Express.js

Express.js is a lightweight and flexible web application framework for Node.js. It simplifies the process of building web servers and APIs by providing a set of easy-to-use tools and features, such as routing, middleware support, and request/response handling. Express allows developers to quickly create robust and scalable backend applications, and it's widely used in building RESTful APIs and full-stack web apps when combined with frontend frameworks like React.

CSS

Tailwind CSS is a utility-first CSS framework used for rapidly building custom user interfaces. Instead of writing custom CSS, developers use pre-defined utility classes directly in HTML to style elements. This approach makes styling faster, consistent, and

easier to maintain. Tailwind is highly customizable and works well with modern frontend frameworks like React, Vue, and Angular. It helps developers create responsive and clean designs without leaving their HTML.

Mongodb

MongoDB is a popular open-source NoSQL database designed for storing large volumes of unstructured or semi-structured data. Unlike traditional relational databases, MongoDB stores data in flexible JSON-like documents (called BSON), which makes it easier to work with dynamic data structures. It is highly scalable, supports high performance, and is commonly used in modern web applications for storing user data, posts, comments, and more. MongoDB integrates well with Node.js and is often used in the MERN stack

Cloudinary

Cloudinary is a cloud-based service used for managing, storing, and delivering images and videos in web and mobile applications. It allows developers to easily upload, optimize, transform, and serve media files using simple URLs or APIs. Cloudinary supports automatic image resizing, format conversion, and compression, which helps improve website performance and load times. It's commonly used in applications where users can upload profile pictures, posts with images, or videos—making media handling efficient and scalable.

Socket.io

Socket.IO is a JavaScript library that enables real-time, bidirectional communication between web clients and servers. Built on top of WebSockets, it allows data to be sent and received instantly without refreshing the page. Socket.IO is commonly used in applications like chat apps, live notifications, online games, and collaborative tools. It works with Node.js on the backend and can be easily integrated with frontend frameworks like React or plain JavaScript to create interactive, real-time user experiences.

WebRTC

WebRTC (Web Real-Time Communication) is an open-source technology that enables real-time audio, video, and data sharing directly between browsers and devices without needing plugins or third-party software. It allows users to make video calls, voice calls, or share files peer-to-peer over the internet.

4.1.2 Implementation Details of Modules

For users,

- **Register:** Users can register into the system through email and password. They can create their accounts and gain access to services.
- **Login:** Users can log into the system using their email and password to access their account.
- **Live-Track:** Users can view live tracking information of nearby ambulances, police vehicles, and fire trucks.
- **View Nearest Services:** Users can locate nearby services such as hospitals, ambulances, and police stations using the Haversine Algorithm.
- **Direct Call:** Users can directly contact nearby services (e.g., ambulance, hospital) through the "Call Now" feature.

For Hospitals:

- **Locate Users:** Hospitals can locate nearby users in need of medical services.
- **Display on Map:** The hospital's name and location will be displayed on the map for easy access.
- **Operating Hours:** Hospitals will display their operating hours to inform users about availability.

For Ambulance:

- **Live-Track:** Ambulances will have their live locations tracked for real-time updates.
- **Contact Users:** Ambulances can be contacted by nearby users in case of emergency.
- **Locate Nearby Hospitals & Users:** Ambulances can find nearby hospitals and users for immediate assistance.

For Police Department:

- **Locate Emergencies:** The police department can locate nearby emergencies using the system.

- **Contact Police Vehicles:** The department can communicate directly with police vehicles' crews.
- **Receive User Requests:** The department will be contacted by users in case of an emergency.

For Police Vehicles:

- **Live-Track:** Police vehicles' locations will be tracked live to monitor their positions during an emergency.
- **Notify Crew of Emergencies:** Police vehicle crews will be notified when there is a nearby emergency.
- **Request Backup:** Police vehicle crews can call for backup from the police department during critical situations.

For Fire Department:

- **Receive Emergency Alerts**: The fire department will be notified of nearby emergencies.
- **Dispatch Vehicles:** The fire department can dispatch fire trucks to the location of the emergency.
- **Track Fire Trucks:** The fire department can track the live location of fire trucks in real-time.

For Fire Trucks:

- **Live-Track:** Fire truck crews' locations will be tracked live during emergency situations.
- **Notify Crew of Emergencies:** Fire truck crews will be informed about nearby emergencies and dispatched accordingly.
- **Request Backup:** In emergencies, fire truck crews can request backup from the fire department if needed.

For Blood Bank:

- **Display on Map:** The name and location of the blood bank will be displayed on the map for easy access.
- **Contact for Blood:** Users and hospitals can contact the blood bank for blood requests during emergencies.
- **Operating Hours:** The blood bank's operating hours will be displayed for reference.

For Admin:

- **Login**: Admin can log in to the system using their credentials to manage system operations.
- **Manage Accounts:** Admin has the ability to manage and monitor all user accounts within the system.
- **View Analytics:** Admin can view the total number of accounts and other analytics related to the system.
- **Live Tracker:** Admin can view live tracking information of ambulances, police vehicles, fire trucks, and more.

4.2 Testing

4.2.1 Unit Testing

Unit testing in Rapid Reach is a crucial step to ensure the reliability and accuracy of individual modules within the system. It involves designing and executing test cases that simulate different scenarios for both users and emergency service providers. By conducting unit tests, we verify that each feature, such as location detection, service search, availability display, and call functionality, performs as expected. The system is developed in a modularized pattern, and each module is tested independently to confirm proper functionality. Until the desired accurate output is achieved from a module, testing and refinement continue. Input forms and search fields are also thoroughly tested to ensure they do not accept invalid or incomplete data, thereby maintaining system integrity and reliability.

Table 4.1: Unit testing for Rapid Reach

S.N.	Test Name	Input	Expected Outcome
1.	Open Application	http://localhost:5173/	Homepage
2.	Enter invalid username, email, password, confirm password & click register button	Username= user2forbloodbank Email=godfather59@gmail.com Password=	Fill out required field
3.	Enter credentials & click register button	Username=user2forbloodbank Email=user2@gmail.com Password=user2	User registered successfully
4.	Enter email & invalid password	Email= user2@gmail.com Password=wilson2022	User not found & refresh the fields in same page

	& click login button		
5.	Enter email & valid password & click login button	Email= user2@gmail.com Password= user2	Login successful & redirect to home page
6.	Upload documents and Create post	http://localhost:5173/create-post	Please fill up all the details.
7.	Redirect to post page and map view	http://localhost:5173/post/post._id	Details displayed along with Map.
8.	Haversine Algorithm implementati-on	http://localhost:5173/gridview?category=hospital	On selected nearest the nearest service along with the distance is shown
9.	Open Admin	http://localhost:5173/dashboard?tab=dashb	Rapid Reach admin login
10.	Enter email & invalid password & Click login button	Email=notadmin@gmail.com Password=admin2022	User not found & redirect to login page
11.	Enter email & valid password & Click login button	Email=gp16373@gmail.com Password=gp16373	Welcome & redirect to Homepage.

4.2.2 System Testing

System testing plays a crucial role in ensuring the smooth integration and functionality of all modules and components within Rapid Reach. This testing phase involves validating the system to ensure seamless cooperation among its various parts.

Table 4.2: System testing for Rapid Reach

S.N.	Test Case	Expected Outcome	Test Result
1.	Launch website	Homepage	Pass
2.	Entered valid email and password	Go to home page with user image in headings.	Pass
3.	Did not filled all the inputs.	Please fill out this field	Pass
4.	Upload image other than JPEG and PNG	Error: Please upload an image file	Pass
5.	Selected Nearest in Dropdown.	Nearest is shown with the distance	Pass
6.	On click the call now button in post page.	A popup appears with username and image for call.	Pass

Chapter 5 Conclusion and Future Recommendations

5.1 Conclusion

Rapid Reach addresses a critical need for a fast, reliable, and user-friendly emergency response tool, especially in regions like Nepal where access to real-time emergency information is often limited. By centralizing essential services such as hospitals, police stations, fire services, ambulances, and blood banks, the platform empowers users to act swiftly during emergencies and reduces the time taken to reach help.

With features like location-based search, verified listings, service availability, and instant calling, Rapid Reach offers a practical solution to improve public safety and emergency responsiveness. Built on the MERN stack, it ensures a scalable, secure, and responsive experience, providing users with dependable access to life-saving information when it matters most.

References

[1] P. Aacharya, “Nepal Ambulance Service: Saving lives along the way,” Nepal Ambulance Service, 2022. [Online]. Available: https://nepalambulanceservice.org/.

[2] A. Timilsina, “Good Neighbours Nepal: Ashal Chhimeki Nepal-ACN,” Good Neighbours Nepal, 2016. [Online]. Available: https://goodneighbours.org.np/.

[3] B. R. Pant, “Hospital for Advanced Medicine & Surgery : A multi-disciplinary tertiary care boutique hospital,” Hospital for Advanced Medicine & Surgery, 2024. [Online]. Available: https://hamshospital.com/.

[4] S. B. Silwal, “Alka Hospital Pvt. Ltd: We care to cure,” Alka Hospital Pvt. Ltd, 2023. [Online]. Available: https://www.alkahospital.com/.

[5] D. Thapa, “Nepal Police: Truth, Service and Security,” Nepal Police, 2022. [Online]. Available: https://www.nepalpolice.gov.np/.

[6] S. Chettri, “Hamro Life Bank:Vein to Vein,” Hamro Life Bank, 2019. [Online]. Available: https://hamrolifebank.com/.

[7] J. Fitzpatrick, “Fire-Aid: We send in specialist teams to support communities,” Fire-Aid, 2019. [Online]. Available: https://www.fire-aid.org/.

[8] R. Maharjan, “Nepal APF Hospital: Armed Police Force,” Nepal APF Hospital, 2021. [Online]. Available: https://hospital.apf.gov.np/.