



Daffodil
International
University

**Project Report on Interactive Robotic Simulator and Robotic Lab
Web Application**

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Submitted To

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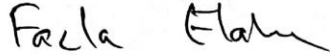
Department of Software Engineering

This Project Report has been submitted to the Department of Software Engineering (SWE) at Daffodil International University in the fulfillment of the requirements for the degree of Bachelor of Science in Software Engineering

APPROVAL

This project titled on “Interactive Robotic Simulator and Robotic Lab Web Application”, submitted by Md Mostofa Kamal (ID: 201-35-526) to the Department of Software Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of Bachelor of Science in Software Engineering and approval as to its style and contents.

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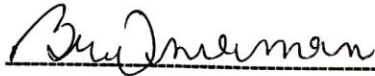
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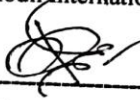
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DECLARATION

I hereby declare that I have done this project under the supervision of **Dr. Md. Fazla Elahe Assistant Professor & Associate Head**, Department of Software Engineering, Daffodil International University. I also declare that this project is my original work for the degree of B.Sc. in Software Engineering and neither the whole work nor any part of this project has been submitted for another degree in this or any other university.

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ABSTRACT

The Interactive Robotic Simulator & Robotic Lab Web Application is a cutting-edge platform designed to revolutionize the field of robotics education and research. This innovative tool combines the power of simulation and hands-on experimentation, providing users with a comprehensive and immersive learning experience. The simulator component offers a realistic virtual environment where users can design, program, and simulate the behavior of various robotic systems. Leveraging advanced physics engines and accurate modeling, users can test algorithms, control strategies, and intricate robotic mechanisms in a risk-free and controlled setting. This simulation capability enhances the efficiency of prototyping and significantly reduces the time and cost associated with physical experimentation. Complementing the simulator, the Robotic Lab Web Application seamlessly integrates with user-friendly interface, researchers and students can interact with a diverse range of robotic platforms, from basic educational robots to sophisticated industrial manipulators. This integration fosters a hands-on approach to learning, promoting a deeper understanding of robotics principles and fostering practical skills. They can create, publish, and interact with blog posts. The search functionality allows users to find specific blogs, research, and content based on keywords and filters. The system prioritizes security, performance optimization, user-friendly interfaces, compatibility across devices and browsers, and scalability. Overall, this web application represents a pivotal advancement in robotics education and research, providing a unified platform that seamlessly integrates simulation and physical experimentation. By offering a versatile, collaborative, and immersive learning environment, the Interactive Robotic Simulator & Robotic Lab Web Application empowers users to explore, innovate, and advance the field of robotics in an unprecedented manner.

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Chapter-1 Introduction

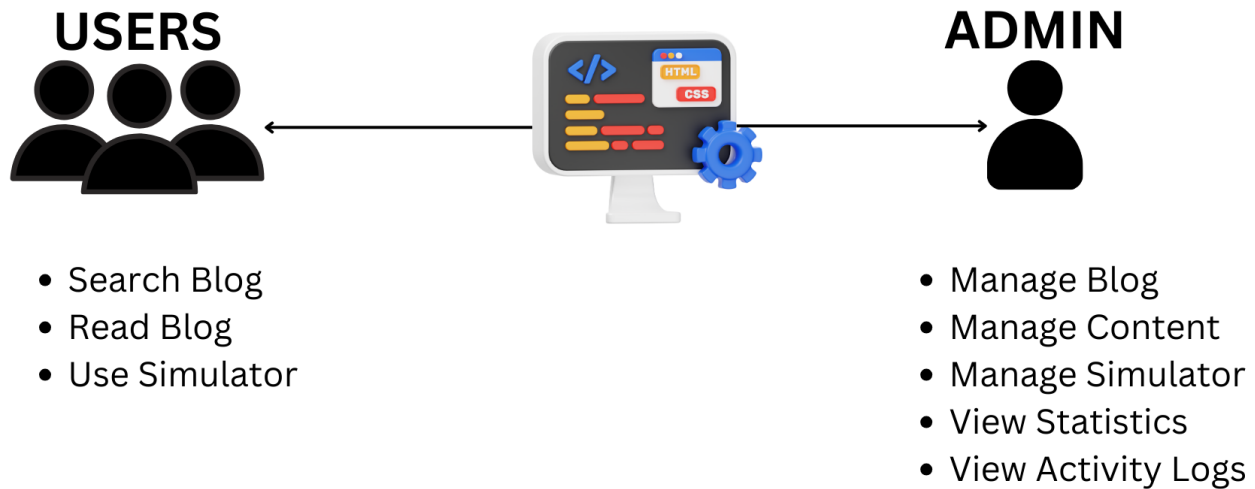
1.1 Project Overview

An innovative platform that aims to transform robotics education and research is the Interactive Robotic Simulator & Robotic Lab Web Application. This cutting-edge tool gives users an all-encompassing and immersive learning experience by fusing the power of simulation with practical experimentation. The simulator component allows users to design, program, and simulate the behavior of different robotic systems in a realistic virtual environment. In addition to the simulator, researchers and students can interact with a wide range of robotic platforms, from simple educational robots to complex industrial manipulators, through the user-friendly interface of the Robotic Lab Web Application. They are able to write, publish, and reply to blog entries. Using keywords and filters, users can find specific blogs, research, and content with the help of the search functionality. The system places a high priority on scalability, compatibility with various devices and browsers, security, performance optimization, and user-friendly interfaces. This web application, which offers a unified platform that seamlessly integrates simulation and real-world experimentation, represents a significant advancement in robotics education and research overall.

1.2 Project Purpose

The purpose of the Interactive Robotic Simulator & Robotic Lab Web Application is to provide an immersive and educational platform that enables users to explore and interact with virtual robots in a simulated environment. This project aims to bridge the gap between theoretical knowledge and practical application in the field of robotics by offering a comprehensive and user-friendly interface for both beginners and advanced users.

1.2.1 Proposed System Model



1.3 Background

This platform aims to enable learners, enthusiasts, and professionals in the field of robotics to explore, experiment, and master the intricacies of this dynamic field. Interactive robot simulators and robot labs are more than just a platform, they are a gateway to the future of robotics education. Interactive Robotic Simulator & Robotic Lab combines the power of simulation, collaboration, and structured learning to enable individuals to explore the endless possibilities of robotics in virtual space, creating the conditions for innovation and advancement in the field. Welcome to Interactive Robotic Simulator & Robotic Lab.

1.4 Objective

Developing a cutting-edge online learning environment that facilitates interesting, useful robotics activities is the aim of the Interactive Robotic Simulator & Robotic Lab Web Application project. Users should be able to simulate, explore, and learn about various robotic systems in a dynamic, user-friendly virtual environment with the aid of this comprehensive web application.

The key objectives of the project include:

Simulation Excellence: Create realistic and versatile robot simulation environments that accurately model the behavior and interactions of a variety of robotic systems. This includes simulations of both industrial and educational robots of varying complexity.

User-friendly interface: Develop an intuitive and easy-to-access web interface aimed at users with a variety of robotics expertise. Create seamless, responsive designs to improve user experience and drive engagement.

Educational Modules: Integrates various educational modules covering basic and advanced concepts of robotics. These modules should include interactive lessons, assignments, and real-life scenarios to enhance the learning process.

Remote access to the robot lab: Allows users to remotely access the physical robot lab and control the actual robots via a web application. This feature expands hands-on learning opportunities and allows users to apply theoretical knowledge to real-world situations.

Collaborative Learning: Implement features that encourage collaborative learning, such as shared simulation environments and collaborative projects. Promote a sense of community and teamwork among users.

Performance Analytics: Integrate tracking and analysis systems to monitor user progress, evaluate performance, and provide personalized feedback. This allows users to track their learning progress and allows teachers to customize their teaching methods.

Compatibility and Scalability: Ensure cross-browser and cross-platform compatibility to reach a broad user base. Additionally, systems should be designed with extensibility in mind, allowing for future expansions, updates, and integration with new technologies.

Security and Privacy: We implement robust security measures to protect user data and ensure the privacy of users participating in remote robotics lab sessions. Adhere to industry best practices and standards for data protection.

The Interactive Robot Simulator and Robot Lab web application revolutionizes the way individuals learn and engage with robotics, fostering a community of learners and practitioners who are well-equipped to advance in the field.

1.5 Benefits and Beneficiaries

The interactive robotic simulator and robotic lab project offers several benefits to its users and stakeholders, enhancing the overall lab and simulator experience. The key benefits include:

Realistic Simulation Environment: Provides a realistic and immersive simulation environment for robotics experimentation. Mimics real-world scenarios to enhance learning and testing experiences.

Cost-Efficient Training: Reduces the need for physical robots and equipment, leading to cost savings in training and education. Minimizes expenses associated with maintenance and repair of physical hardware.

Accessible Learning Anytime, Anywhere: Enables users to access the robotic simulator and lab from any location with an internet connection.

Enhanced Safety in Experimentation: Provides a risk-free environment for experimentation, reducing the chance of accidents and injuries. Allows users to test and iterate without concerns about damaging physical equipment.

Industry-Relevant Skills Development: Equips users with skills that align with industry demands, preparing them for real-world applications. Bridges the gap between academic knowledge and practical skills required in the workforce.

The beneficiaries of the project include:

Educational Institutions: Universities, colleges, and schools can integrate the web application into their robotics and engineering programs, offering students practical and hands-on experience.

Students and Researchers: Provides a platform for students and researchers to experiment, innovate, and enhance their understanding of robotics in a safe and controlled environment.

Industry Professionals: Allows professionals to stay updated on the latest advancements in robotics and experiment with new technologies without the need for physical setups.

Robotics Enthusiasts: Appeals to hobbyists and individuals interested in robotics, providing them with an accessible and engaging platform for learning and experimentation.

1.6 Project Stakeholders

The 'Interactive Robotic Simulator & Robotic Lab' project involves various stakeholders who have an interest in its success and contribute to its development and utilization. The primary stakeholders of the project include:

Project Sponsor: Responsible for providing financial support and overall project approval. Typically a high-ranking executive or department head.

Project Manager: Leads the project team and ensures that the project goals are achieved within the specified constraints.

Development Team: Developers, programmers, and engineers responsible for creating and maintaining the web application. Includes experts in robotics, simulation, and web development.

End Users: Professors, students, researchers, and anyone who will interact with the Interactive Robotic Simulator & Robotic Lab Web Application.

Academic Institutions: Universities, colleges, and educational organizations that might adopt the web application for teaching and research purposes.

Industry Partners: Companies and organizations with an interest in robotics and simulation technology. May provide input, collaboration, or financial support.

Regulatory Authorities: Any relevant regulatory bodies that oversee standards or compliance for educational software and robotics applications.

Marketing and Communications: Develops strategies to promote the web application and communicates updates to relevant stakeholders.

1.7 Project Schedule

The project is planned to be completed within the allocated time frame of 13 weeks. A detailed project schedule, including milestones and specific deadlines for each development phase, will be established to ensure efficient project management and timely delivery.

1.7.1 Gantt Chart

Activities	w1	w2	w3	w4	w5	w6	w7	w8	w9	w10	w11	w12	w13
Market Research													
Specification													
Planning													
Design													
Development													
Testing													
Assessment													
Documentation													

Figure 1.7.1: Project Schedule Gantt Chart

1.7.2 Release Plan and Milestone

The release plan and milestones are given below:

ACTIVITIES	DURATION (WEEK)	TOTAL DAYS
Research	w1	7
Specification	w2, w3	14

Planning	w3, w4	14
Design	w5, w6, w7	21
Development	w6, w7, w8, w9	28
Testing	w10, w11	14
Assessment	w11, w12	14
Documentation	w12, w13	14

Figure 1.7.2: Project Release Plan & Milestone

CHAPTER - 2: SYSTEM ANALYSIS

2.1 Functional Requirement

Functional requirements are descriptions of the services that the software must provide. Describes a software system or its components.

2.1.1 User Management

- The system shall provide user registration functionality, allowing users to create new accounts by providing necessary details such as username, email address, and password.
- The system shall support user login functionality, enabling registered users to securely log into their accounts using their credentials.
- The system must implement a user authentication mechanism to verify the user's identity during the login process.
- To maintain their information current, users will be able to update their login, email address, and password through the system.

2.1.2 Robotic Lab Integration

- Physical robotic labs shall be integrated into the platform.
- The system should support connectivity with various robotic hardware.
- Users should have the ability to remotely access and control physical robotic labs.
- Instructors must be able to manage lab access permissions.

2.1.3 Interactive Features (Simulator)

- Users (Instructors/Students) shall be able to create virtual robots.
- The system should support a variety of robotic components and sensors.
- The platform shall provide a 1D, 2D and 3D simulation environment for virtual robot testing.
- Users should be able to define scenarios and environmental conditions. The system shall support real-time interaction with virtual robots.
- Users should be able to control and monitor virtual robots during simulations.

2.1.4 Learning Management

- Instructors shall be able to create courses and assign virtual or physical labs to students.
- Instructors should be able to upload and share learning materials with students.
- The system shall track and display student progress in simulations and lab experiments.
- Instructors should have access to detailed reports on student performance.

2.2 Non-functional Requirements

2.2.1 Security

All user data, including simulation models, should be encrypted during transmission and storage.

User authentication should follow industry best practices, supporting multi-factor authentication.

The system should have protection mechanisms against common web application security threats, such as cross-site scripting and SQL injection.

2.2.2 Performance

Responsiveness: The system should support a minimum of 100 concurrent users without any degradation in response time.

Scalability: The system should be scalable to accommodate a 50% increase in user base within a year without significant changes to the infrastructure. The simulator should be designed to scale horizontally to support an increasing number of robotic components and scenarios.

Resource Optimization: To guarantee effective system performance and reduce response times, optimize the use of resources, such as memory and CPU.

2.2.3 User Interface

Intuitive Design: Create user interfaces that are intuitive, user-friendly, and easy to navigate to increase user satisfaction and minimize learning effort.

Responsiveness: Design user interfaces that are responsive and adaptable to different screen sizes and devices to ensure a consistent user experience across platforms.

Accessibility: Ensure that the user interface is accessible to users with disabilities, adhering to accessibility standards and guidelines.

2.2.4 Compatibility

Browser Compatibility: Ensure that the system functions properly across popular web browsers, including Chrome, Firefox, Safari, and Edge.

Device Compatibility: Test and optimize the system for compatibility with various devices, such as desktops, laptops, tablets, and smartphones, across different operating systems.

Scalability

Database Scalability: Design your database to efficiently handle growing data and ensure smooth system performance as the amount of data increases.

System Load Balancing: Implement load balancing techniques to evenly distribute the system workload, improve performance, and prevent single points of failure.

Redundancy and Fault Tolerance: Incorporates redundancy and fault tolerance mechanisms to minimize downtime and ensure system availability in the event of failure or interruption.

2.3 Feasibility Analysis

The proposed Interactive Robotic Simulator & Robotic Lab Web Application aims to provide a virtual environment for users to simulate and interact with robotic systems. This feasibility analysis assesses the technical, economic, operational, and scheduling aspects of the project.

2.3.1 Technical Feasibility

- **Hardware Requirements:** Evaluate the availability and compatibility of the required hardware for running the simulation and lab activities.
- **Software Requirements:** Ensure that the necessary software tools and libraries are accessible and can be integrated into the web application.
- **Development Expertise:** Assess the availability of skilled developers with expertise in robotics, simulation, and web application development.

2.3.1 Operational Feasibility

- **User Acceptance:** Conduct surveys or interviews to gauge potential users' interest and acceptance of the proposed application.
- **Scalability:** Ensure that the application can handle a growing user base and increased demand for simulation resources.
- **Maintenance:** Assess the feasibility of maintaining and updating the application over time.

CHAPTER - 3: SYSTEM DESIGN & SPECIFICATION

3.1 Use Case Diagram

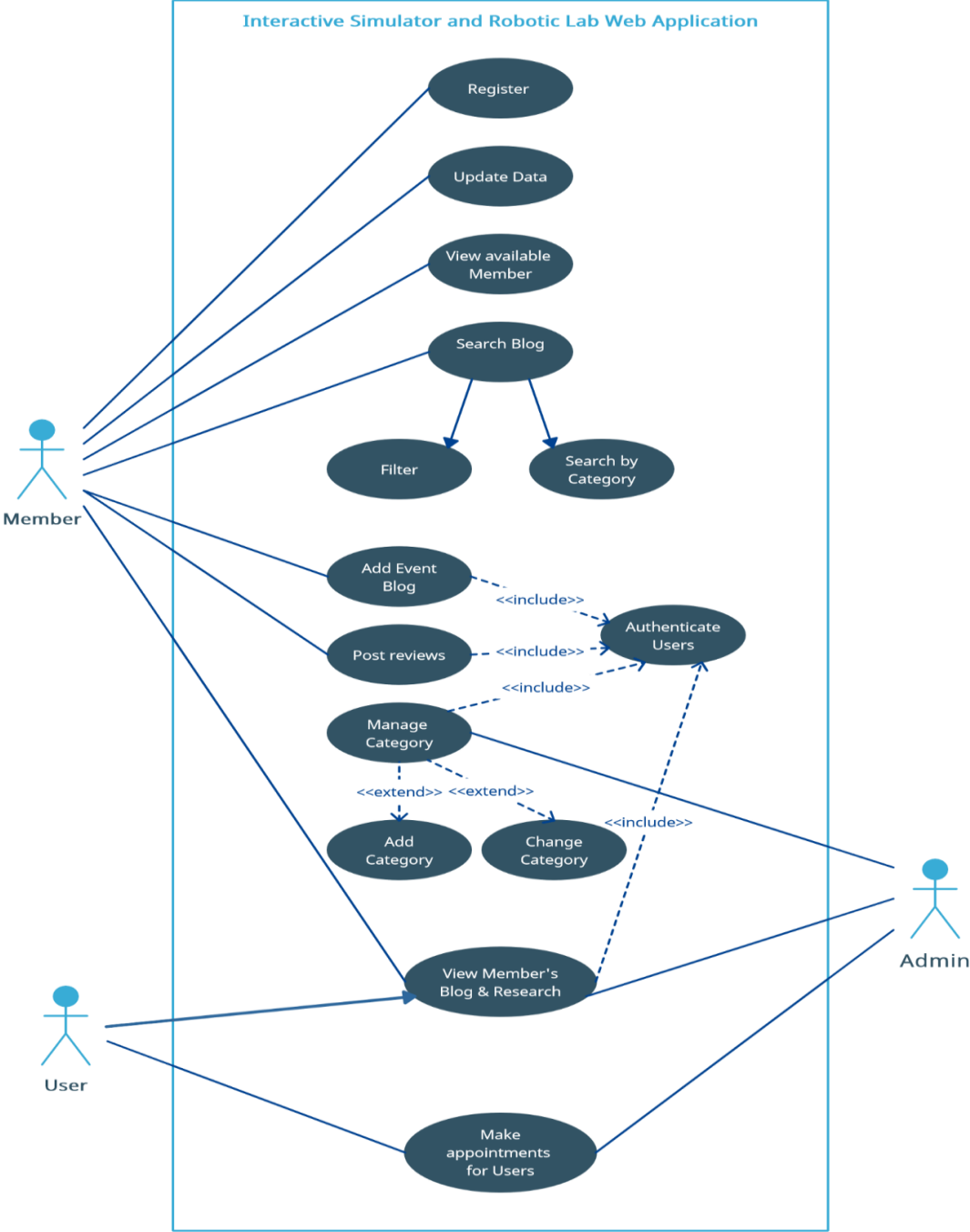


Figure 3.1: Use case diagram

3.1.1 Use Case Descriptions

User Registration

Description:

- Actor: User
- Preconditions: The web application is accessible.
- Postconditions: The user has a registered account.

Main Flow:

1. The user navigates to the registration page.
2. The user enters personal information (username, email, password).
3. The system validates the information.
4. If validation is successful, the system creates a user account.
5. The user receives an email confirmation from the system.

User registration is a fundamental part of the Interactive Robot Simulator and Robot Lab web application project, designed to provide a seamless and secure onboarding experience for users. After registration, users can enjoy a personalized experience and explore various features of the robot simulator and laboratory interface. This user-centered approach aims to foster a collaborative and engaging environment within the robotics community and enable individuals to realize the full potential of our cutting-edge web applications.

Logging In

Description:

- Actor: User
- Preconditions: The user has a registered account.
- Postcondition: User is logged into the system.

Main Flow:

1. The user navigates to the login page.
2. The user enters their username and password.
3. The system validates the credentials.
4. If validation is successful, the system logs the user into the application.

Login is a critical step in interactive robot simulator and robot lab web application projects, serving as the gateway to a comprehensive and immersive experience. With a seamless sign-up process, users embark on a journey within her web application, opening the door to endless possibilities in robotics research through the fusion of technology and education.

Accessing Robotic Lab

Description:

- Actor: User
- Preconditions: The user is logged into the system.
- Postconditions: The user gains access to the Robotic Lab.

Main Flow:

1. The user selects the "Robotic Lab" option from the main menu.
2. The system presents the user with the available robotic lab scenarios.
3. The user chooses a specific robotic experiment or simulation.

The lab will serve as a dynamic hub where researchers, engineers, and developers come together to explore the field of robotics through hands-on experiments and virtual simulations. This web application allows users to remotely access lab resources and control and manipulate robot prototypes and simulations in real time. Whether it's educational activities, developing prototypes for new robotic solutions, or conducting research, the Robotics Lab is a beacon of innovation, driving the development of robotics in the digital age.

Running Robotic Simulation

Description:

- Actor: User
- Preconditions: The user has accessed a specific robotic simulation.
- Postconditions: The robotic simulation is executed.

Main Flow:

1. The user configures parameters for the robotic simulation.
2. The user initiates the simulation.

3. The system runs the simulation and provides real-time feedback.
4. The user can interact with the simulation environment during runtime.

This ambitious project involves the creation of a sophisticated robot simulation environment in which virtual robots can be run and tested in a dynamic and interactive manner. The simulation aims to recreate real-world scenarios and provide engineers, researchers, and hobbyists with a platform to experiment with various robot algorithms and capabilities. The web application seamlessly integrates this simulation and provides a user-friendly interface that can be accessed from any browser.

Saving Simulation Results

Description:

- Actor: User
- Preconditions: The user has run a robotic simulation.
- Postconditions: The simulation results are saved for future reference.

Main Flow:

1. The user reviews the simulation results.
2. The user chooses to save the results.
3. The system stores the results associated with the user's account.

Additionally, the storage mechanism supports version control, allowing users to track changes and improvements over time. Implementing a comprehensive, user-centered approach to storing simulation results improves the overall functionality and user satisfaction of the Robotic Lab web application, contributing to a more efficient and user-friendly research and learning environment.

Collaborative Lab Work

Description:

- Actor: User
- Preconditions: Multiple users are logged into the system.
- Postconditions: Users can collaborate on a single robotic experiment.

Main Flow:

1. The user initiates a collaborative session within the robotic lab.
2. Other users will also be invited to join the session.
3. Participants can view and interact with the simulation simultaneously.
4. Changes made by one user are reflected in real-time for all participants.

At the same time, the Robotic Lab web application complements this by facilitating collaboration between users and allowing them to seamlessly share insights, code snippets, and results. By harnessing the power of technology and collaborative tools, this project seeks to revolutionize the way we teach, learn, and innovate in the exciting field of robotics.

Accessing Learning Resources

Description:

- Actor: User
- Requirement: A user is logged on to the system.
- Postconditions: The user can access educational resources related to robotics.

Main Flow:

1. The user navigates to the “Learning Resources” section.
2. The system provides access to tutorials, documentation, and instructional materials.
3. Users can enhance their understanding of robotics principles and techniques.

You can primarily gain basic knowledge by exploring online courses and tutorials on robotics, simulation, and web application development. Finally, attending conferences, workshops, and networking events in the field of robotics and web development can give you insight into the latest advancements and best practices in the industry. By integrating these learning resources, you can build a solid foundation for successful implementation of your interactive robot simulator and robot lab web application projects.

3.2 Activity Diagram

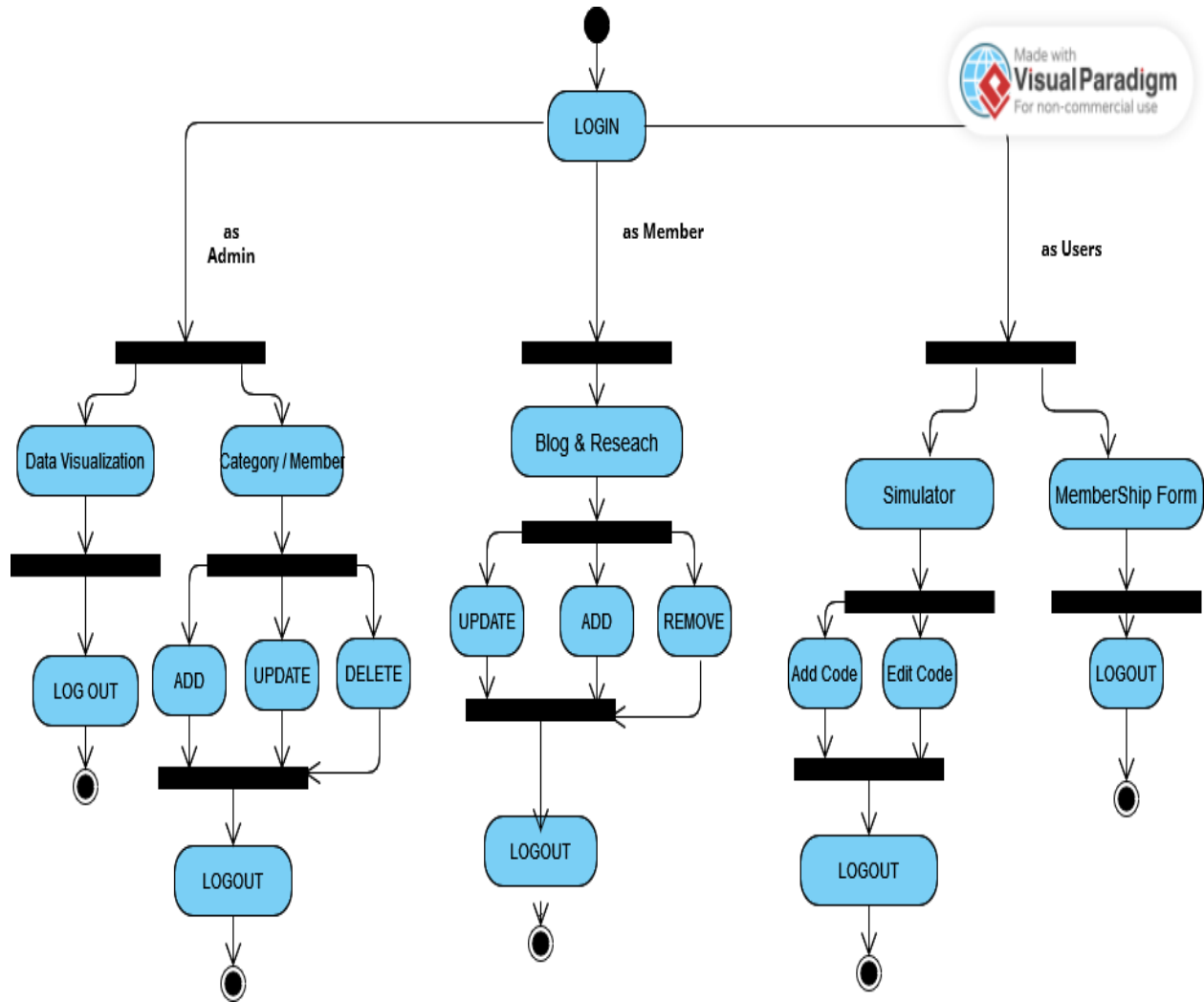


Figure 3.2.1: Activity diagram for All Users

Activity diagram for login

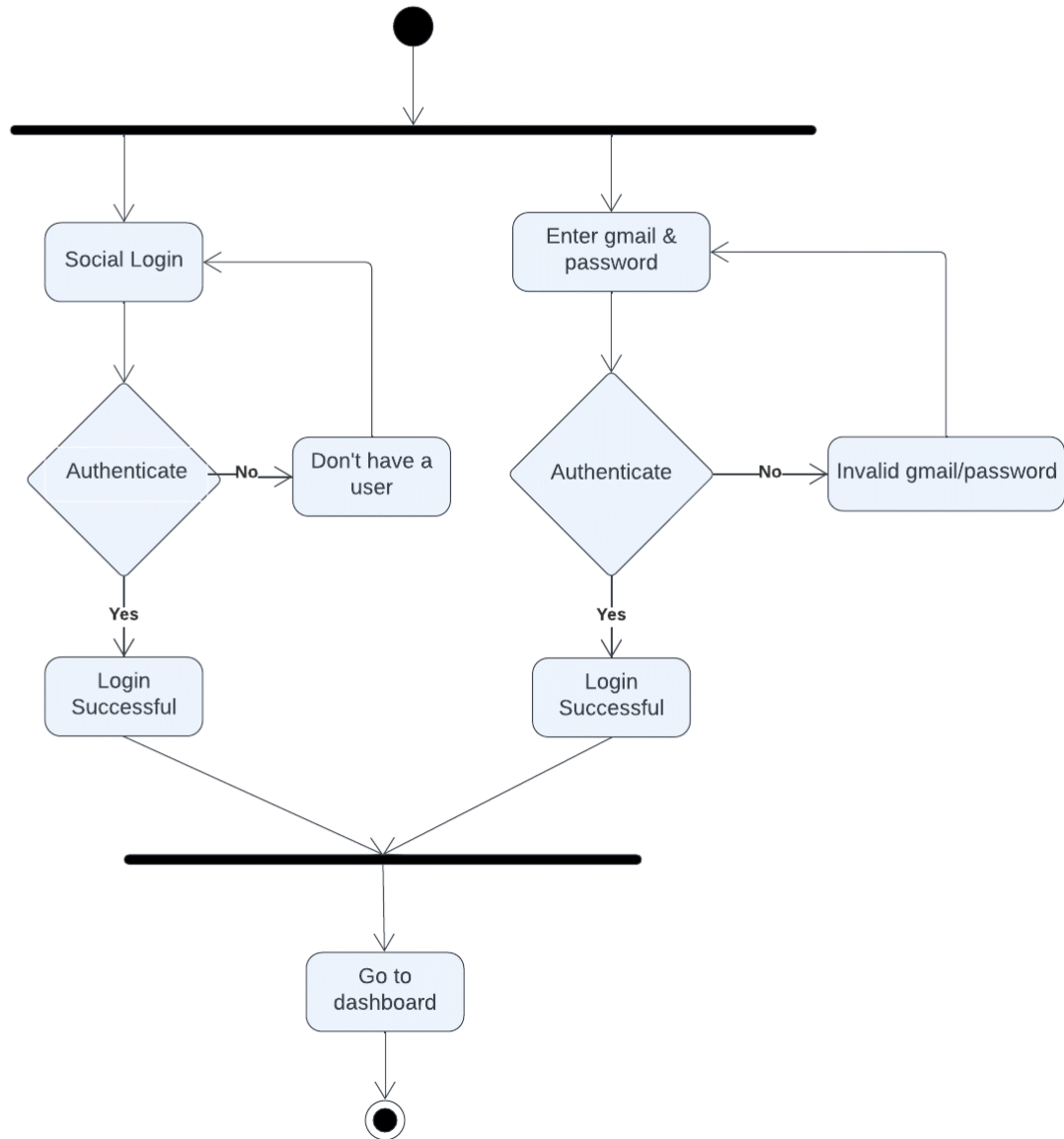


Figure 3.2.2: Activity diagram for Login

Activity diagram for Registration

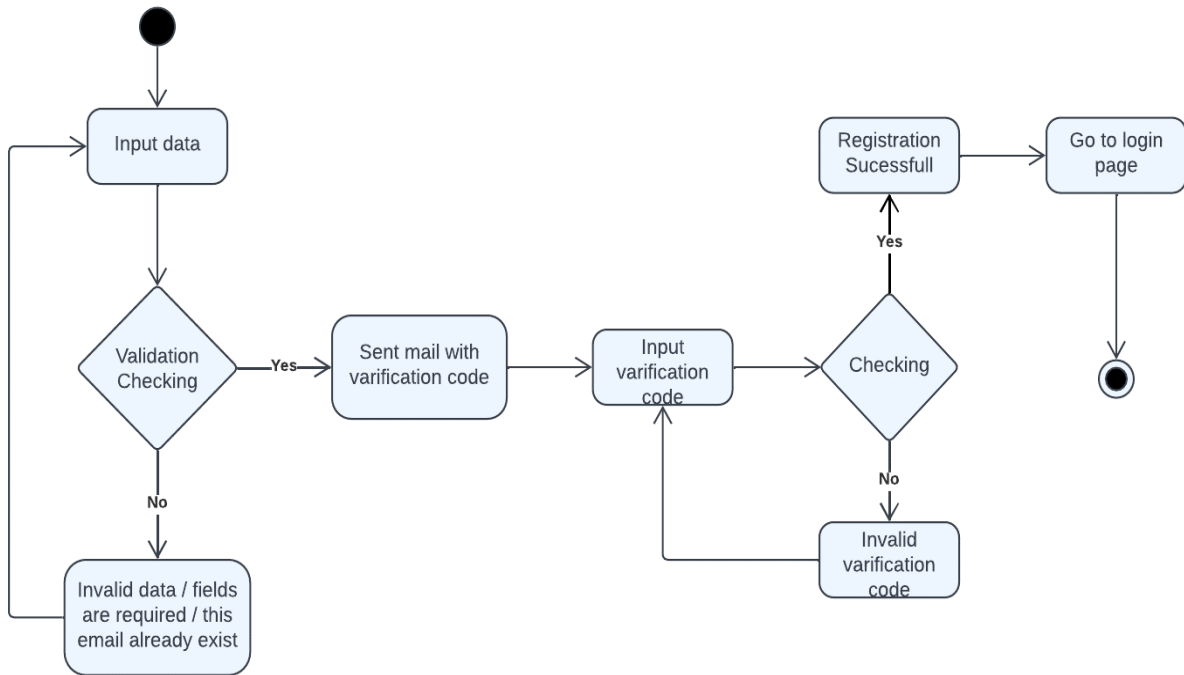


Figure 3.2.3: Activity diagram for Registration

Log Out

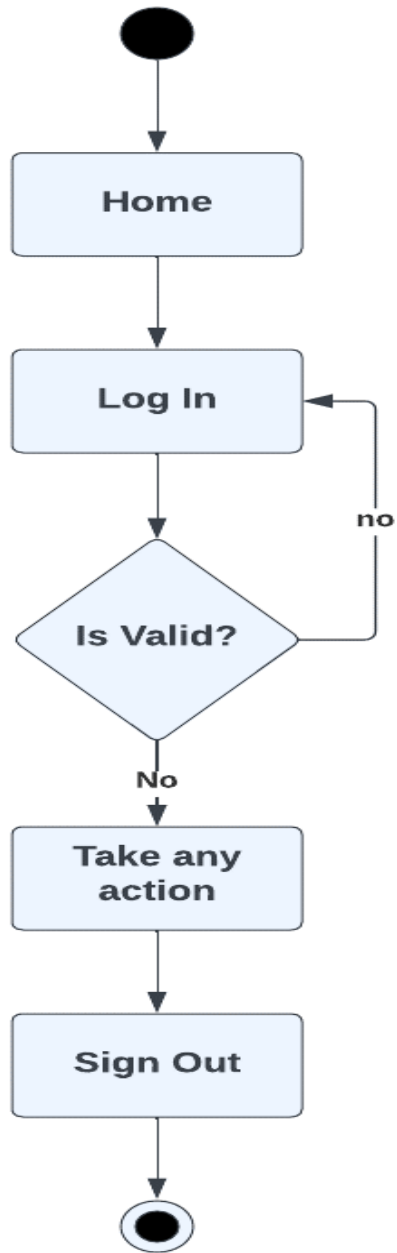


Figure 3.2.4: Activity diagram for Log Out

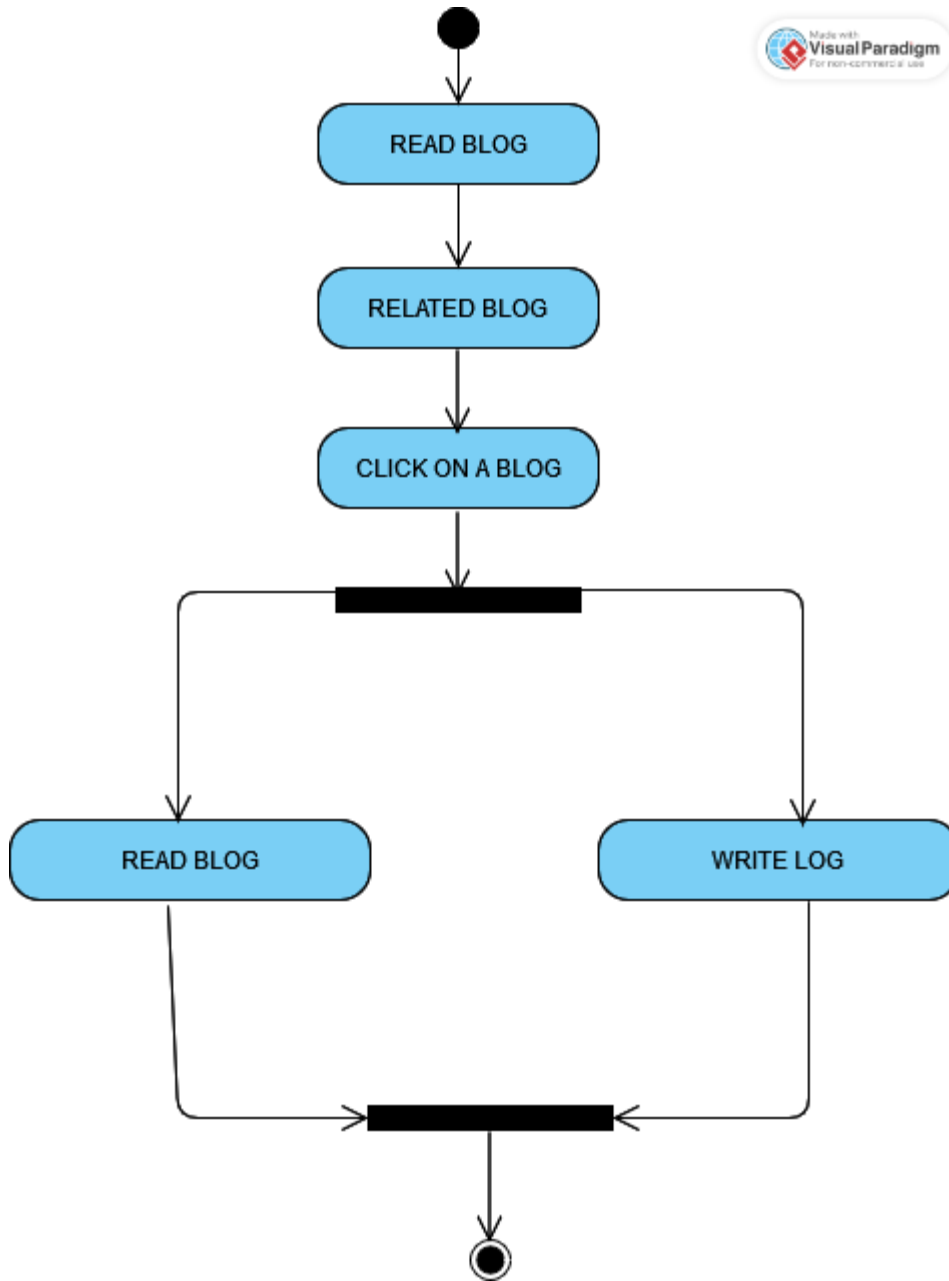


Figure 3.2.5: Activity diagram for Blog

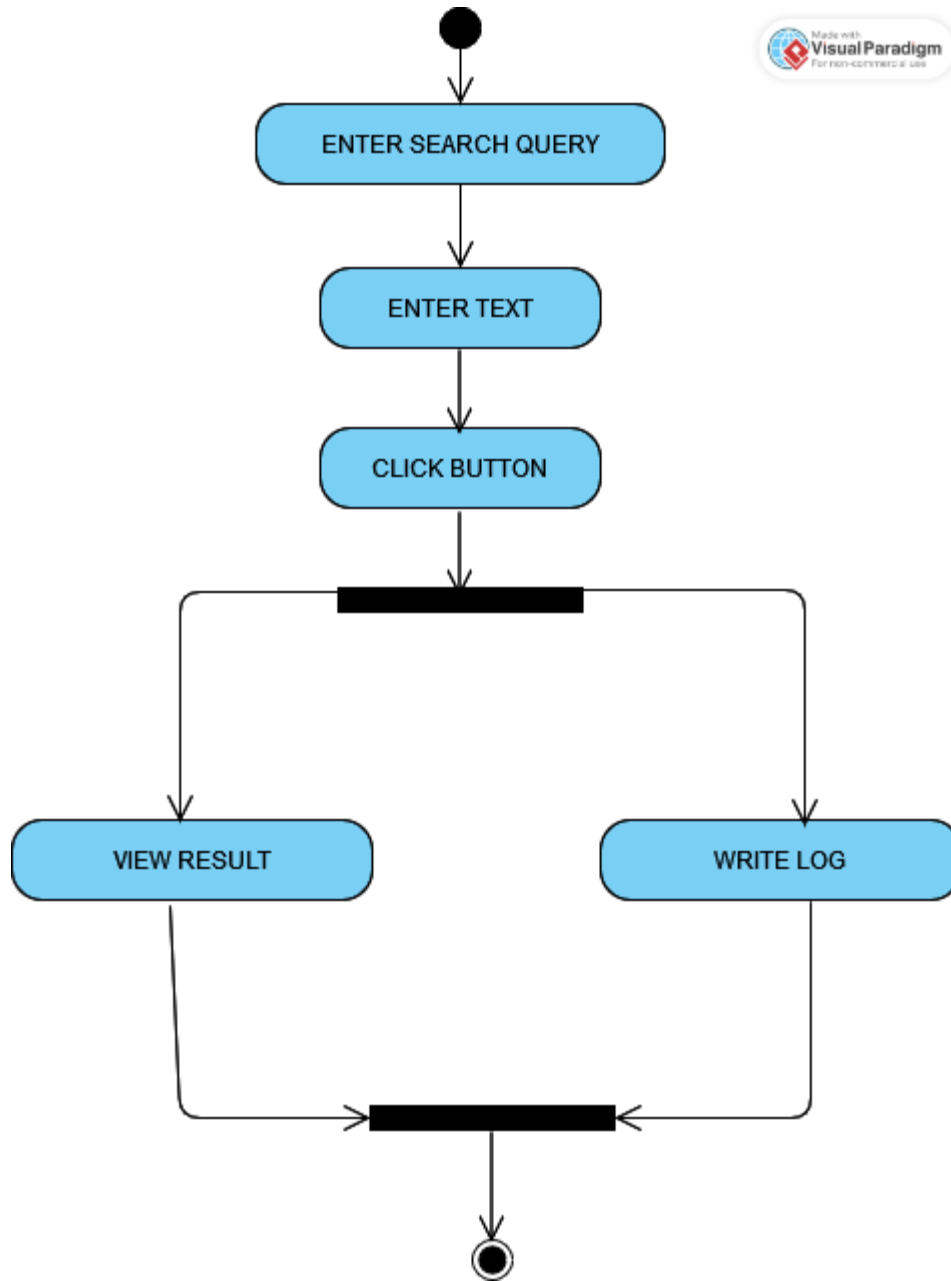


Figure 3.2.6: Activity diagram for Search

3.3 Sequence Diagram

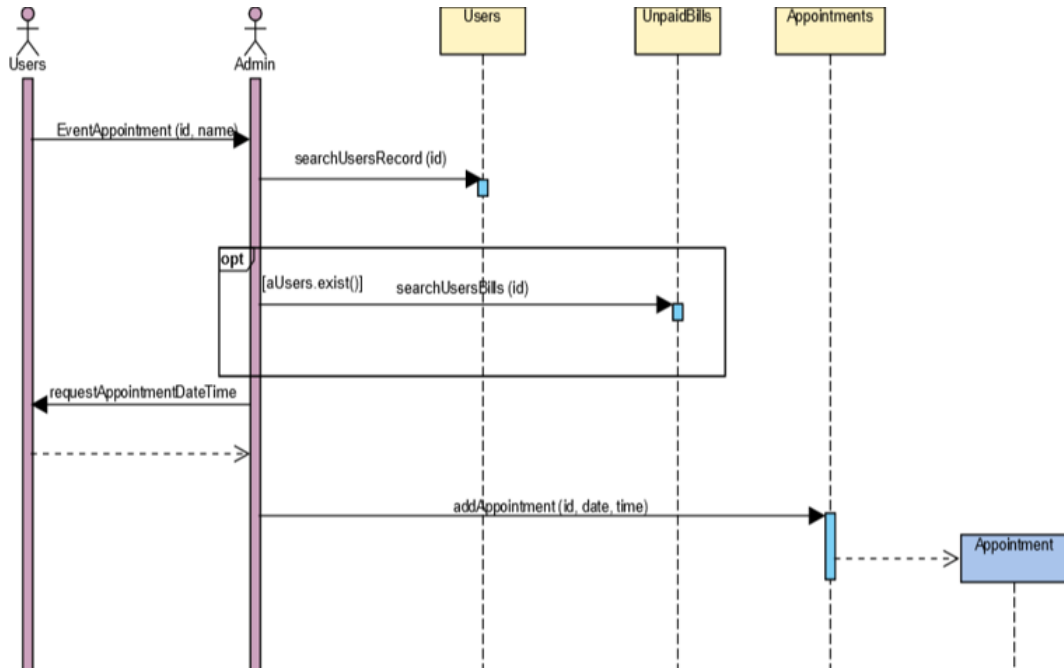


Figure 3.3.1: Sequence Diagram for Users

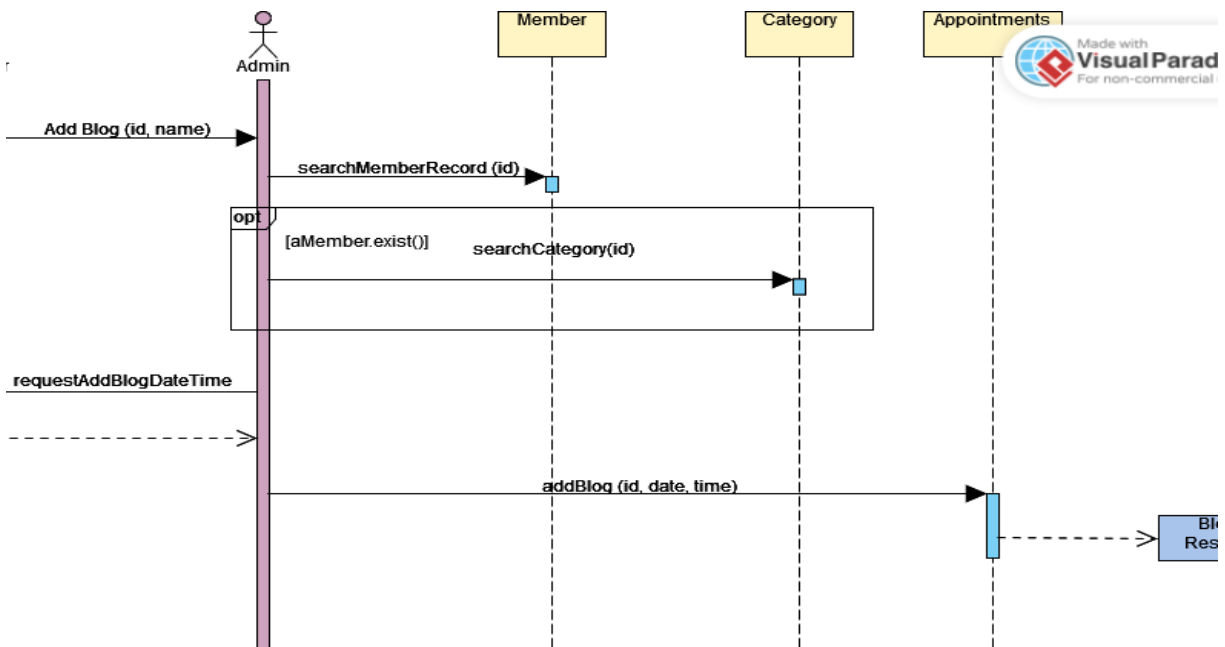


Figure 3.3.2: Sequence Diagram for Member

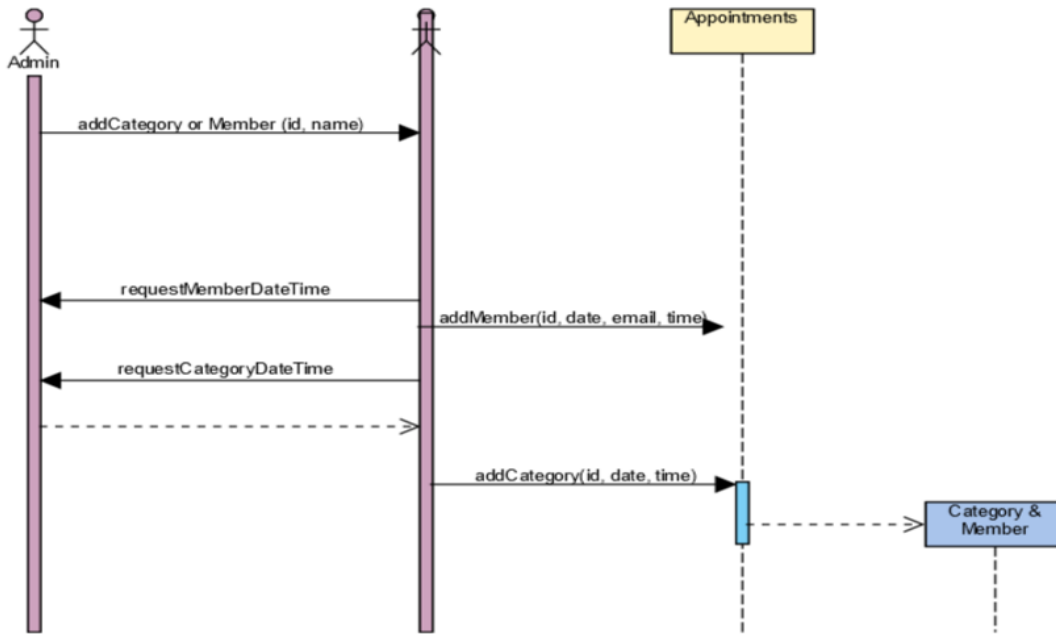


Figure 3.3.3: Sequence Diagram for Admin

Blog Post

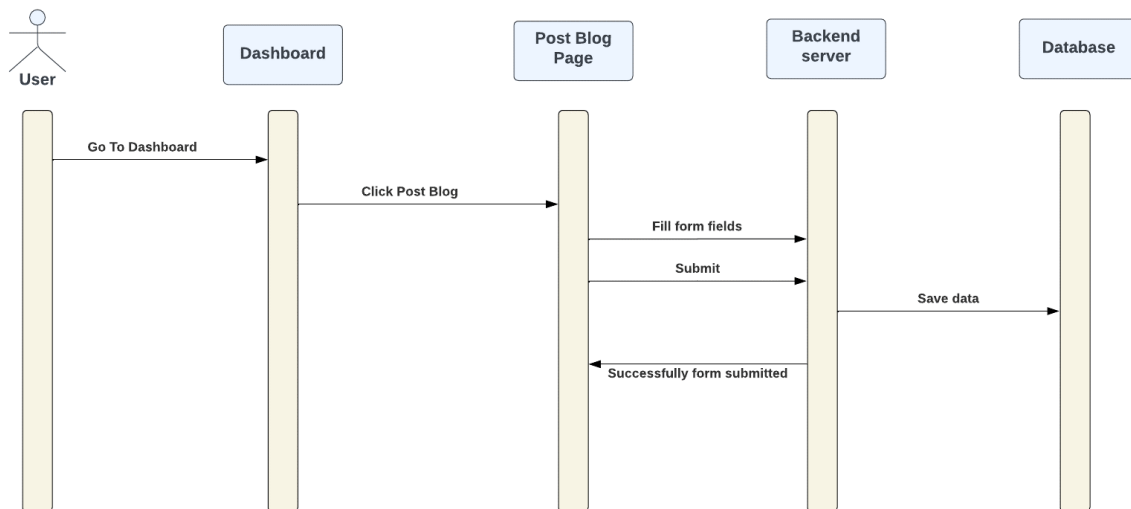


Figure 3.3.4: Sequence Diagram for Blog

Search & Filter

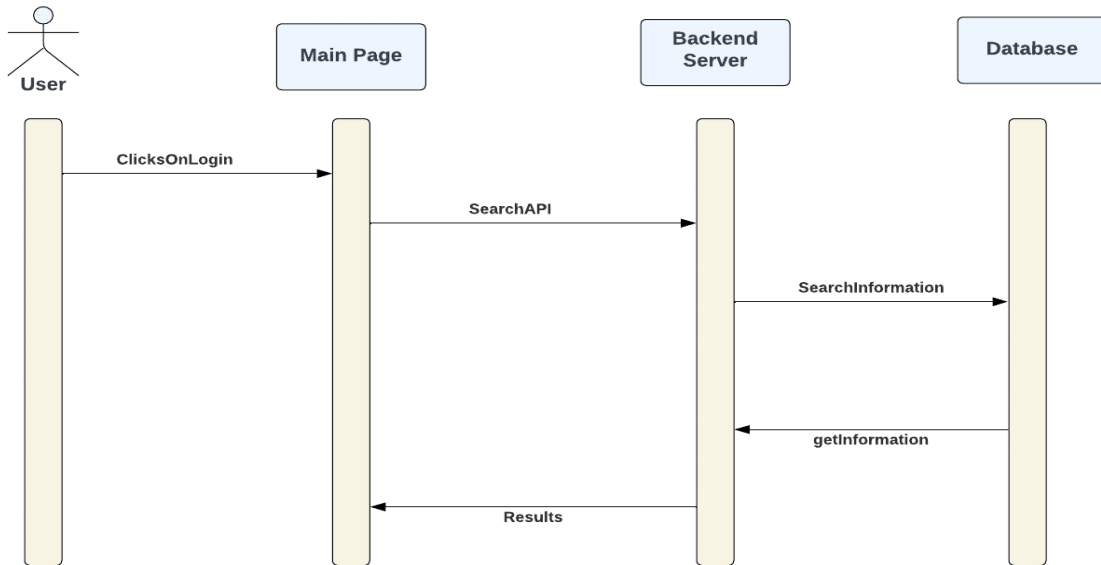


Figure 3.3.5: Sequence Diagram for Search

Log In

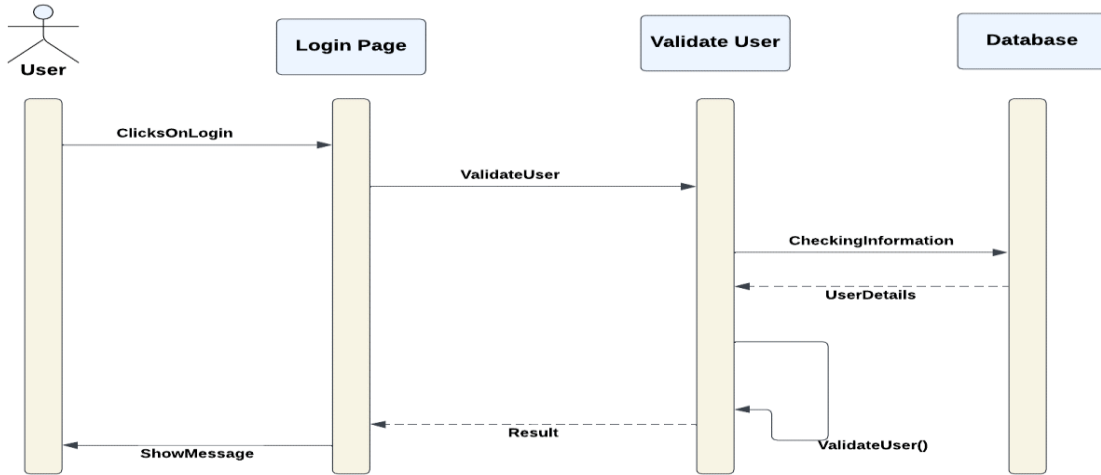


Figure 3.3.6: Sequence Diagram for LogIn

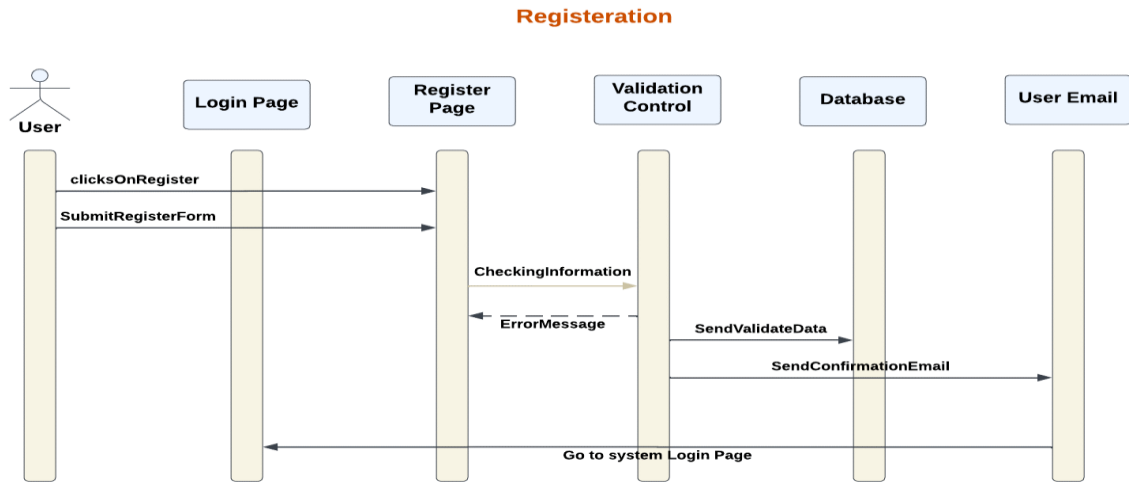


Figure 3.3.7: Sequence Diagram for Registration

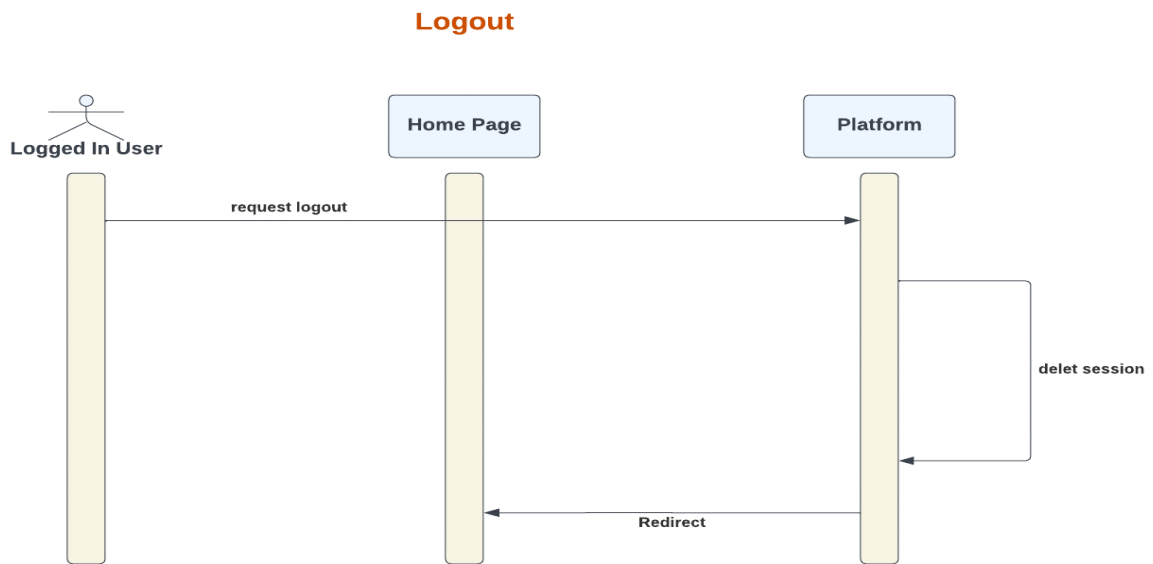


Figure 3.3.8: Sequence Diagram for logout

3.4 ER Diagram

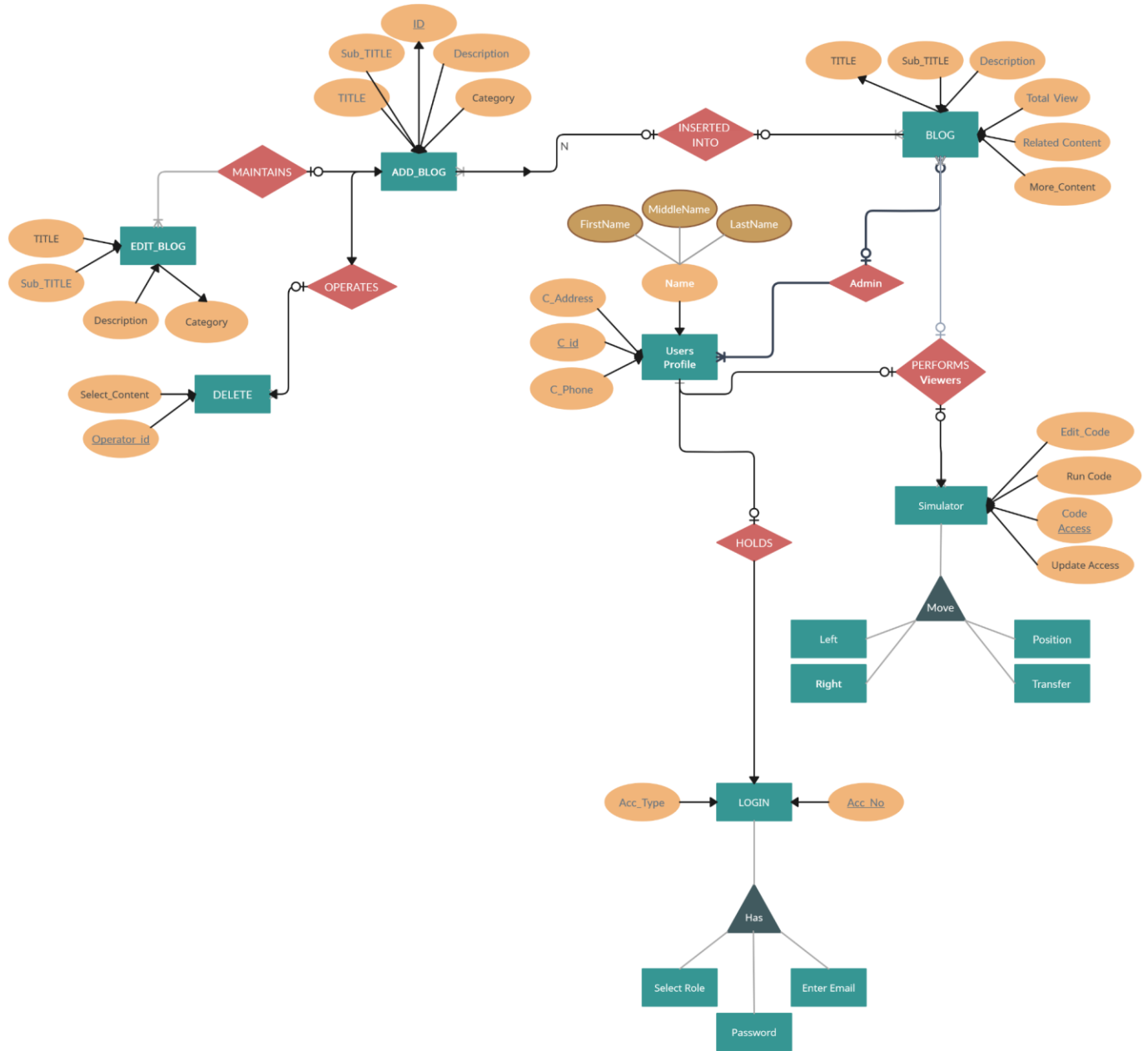


Figure 3.4.1: ER Diagram for The Entire Lab and Simulator Guide System

3.5 Class Diagram

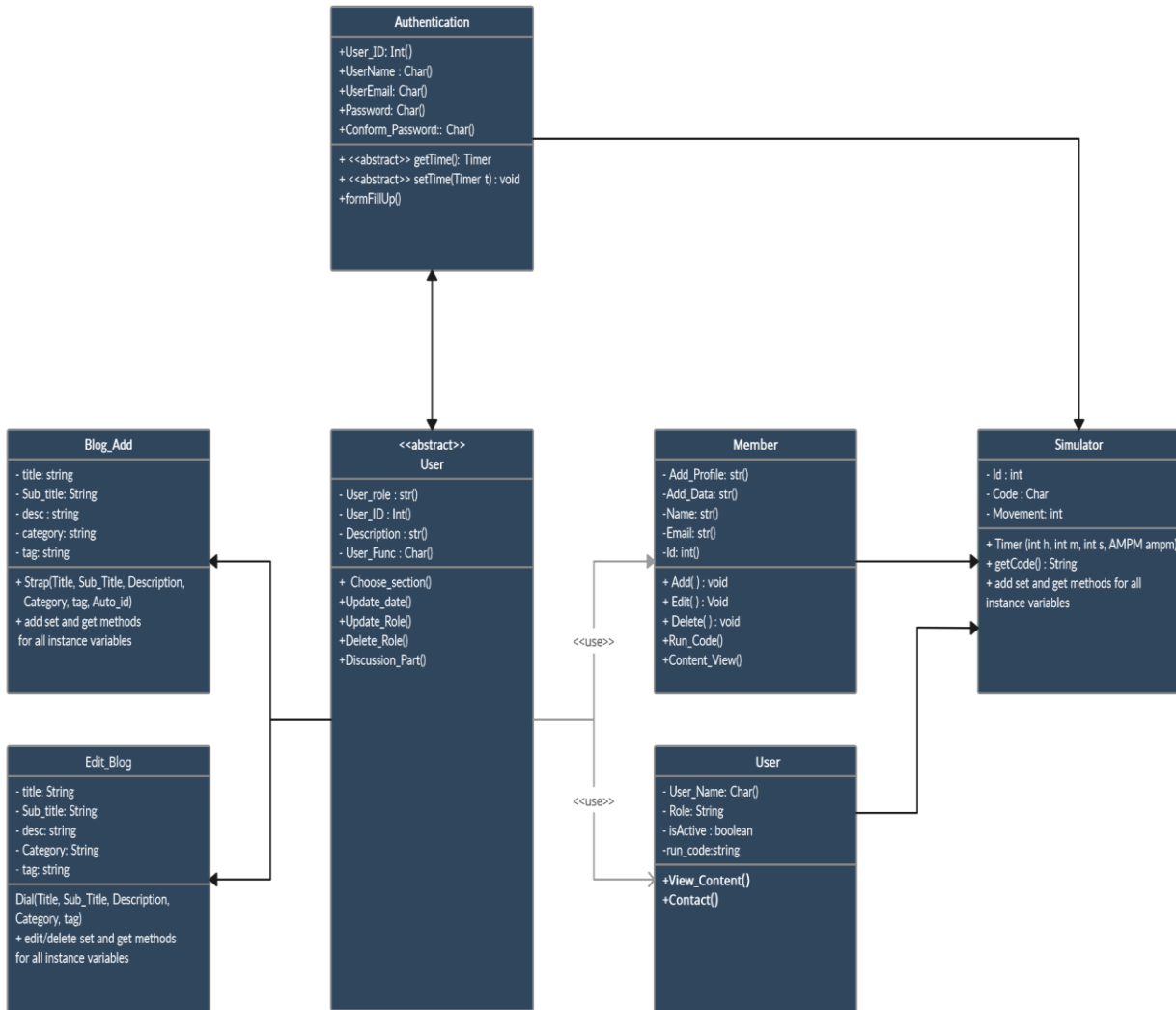


Figure 3.5.1: Class Diagram for The Entire Lab and Simulator Guide System

CHAPTER -4: TOOLS AND TECHNOLOGIES

4.1 Backend Framework: NodeJS

Node.js is an open-source, cross-platform JavaScript runtime that runs JavaScript code outside of your web browser. It's based on the V8 JavaScript runtime engine, the same engine that Google Chrome uses to run JavaScript in the browser. Node.js allows developers to write server-side code using JavaScript to develop scalable, high-performance web applications. Popular for building real-time applications, APIs, and server-side applications. Node.js uses an event-driven, non-blocking model, making it suitable for handling concurrent connections and executing tasks asynchronously.

4.2 Frontend Technology: ReactJS

ReactJS, commonly referred to as React, is an open-source JavaScript library used for building user interfaces or UI components, particularly for single-page applications where user interactions are dynamic and frequent. React was developed and is maintained by Facebook, and it is widely used by developers and companies to create interactive and efficient web applications.

4.3 Database: MongoDB

MongoDB is a popular open-source NoSQL database management system that provides a flexible and scalable way to store and manage data. It is classified as a document-oriented database and belongs to the NoSQL database family. MongoDB stores data in a format called BSON, which is a binary-encoded serialization of JSON-like documents. MongoDB is widely used in web development, especially in scenarios that require data model flexibility and when dealing with large, rapidly changing data sets. It is gaining popularity due to its ease of use, scalability, and ability to process unstructured or semi-structured data.

4.4 Hardware and Infrastructure

4.4.1 Server Infrastructure

This project uses cloud-based server infrastructure to host applications and manage backend services. The server infrastructure includes virtual machines or containers to deploy and run the backend components of the system. The cloud platform used for hosting may include providers such as Amazon Web Services (AWS), Microsoft Azure, or Google Cloud Platform (GCP).

4.4.2 Database Server

The project employs a dedicated database server to store and manage the application's data. The database server may run on a separate physical or virtual machine and is responsible for data storage, retrieval, and management.

The choice of database server technology depends on project requirements and may include options like MySQL, PostgreSQL, or MongoDB.

4.4.3 Networking Infrastructure

The project is based on a robust network infrastructure to ensure seamless communication between the various components and users.

This includes routers, switches, firewalls, and load balancers that facilitate secure data transmission, network connectivity, and traffic management.

Network protocols such as TCP/IP, HTTP, and WebSocket are utilized for data transfer and communication between the frontend and backend systems.

4.4.4 Client Devices

The project caters to various client devices, including desktop computers, laptops, smartphones, and tablets.

The application's front-end interface is responsive and compatible with different screen sizes and resolutions.

Users can access the application through modern web browsers such as Google Chrome, Mozilla Firefox, Safari, and Microsoft Edge.

4.4.5 Additional Hardware

Depending on project requirements, additional hardware components such as servers, storage devices, and networking equipment may be employed.

Hardware considerations also include ensuring adequate processing power, memory, and storage capacity to handle user traffic and data storage needs.

4.5 Feature Implementation Details

This section provides an overview of the implementation details for the key features of the 'Interactive Robotic Simulator & Robotic Lab' project:

4.5.1 Simulation Environment

3D Rendering Engine: Utilize WebGL for high performance 3D rendering, enabling the creation of detailed and interactive robotic environments.

Physics Engine Integration: Incorporate a physics engine to simulate realistic interactions between robotic components, considering factors such as gravity, friction, and collisions.

Robot Models: Integrate a library of robot models, allowing users to choose from a variety of pre-built robots or import custom models in commonly used formats.

Sensor Simulation: Implement realistic sensor simulations, including cameras, lidars, and proximity sensors, to replicate the sensing capabilities of actual robotic systems.

4.5.2 Programming Interface

Implementation Overview: Provide a user-friendly programming interface to allow users to code and control robotic systems within the simulation environment.

API Documentation: Create comprehensive API documentation, detailing the available functions, classes, and methods for users to interact with the simulation programmatically.

Scripting Language Support: Support popular scripting languages for coding robot behaviors and control logic.

4.5.3 Robotic Lab Integration

Implementation Overview: Integrate the web application with physical robotic labs to bridge the gap between simulation and real-world experimentation.

Hardware Interface: Develop an interface to connect the web application with robotic hardware, facilitating communication and control.

Data Synchronization: Implement mechanisms for synchronizing simulation data with physical robotic systems, ensuring consistency between virtual and real-world scenarios.

4.6 Deploy and Hosting

Server specifications: For best results, a dedicated server with at least 4 CPU cores, 8 GB of RAM, and 100 GB of storage is advised.

Network Infrastructure: To guarantee efficient communication and data transfer, a steady, dependable network connection with enough capacity is needed.

Operating System: Linux, macOS, and Windows can all be used with the system.

Web Server: It is advised to host the system using ExpressJS Web Server version 4.18.2 or higher.

Database: In order to store user information, blog entries, and system configurations, MongoDB 6.0.7 or later is needed.

Dependencies: For frontend development, the system requires JavaScript frameworks (such as React or Angular) and NodeJS version 16.16.0 or later.

CHAPTER - 5: SYSTEM TESTING

5.1 Testing Features

The Test Plan outlines the approach, objectives, and strategies for testing the 'Interactive Robotic Simulator & Robotic Lab' project. It defines the scope of testing, identifies test scenarios, and outlines the resources and schedule required for each type of testing.

5.1.1 Feature to be tested

The primary objectives of the testing phase are as follows:

- Validate the functionality of each module and component in the 'Interactive Robotic Simulator & Robotic Lab' system.
- Verify the system's compliance with the specified requirements.
- Identify and report any defects or issues for resolution.
- Evaluate the performance, security, and user experience of the system.
- Ensure that the system works as intended and meets the needs of end-users.

Features	Priority	Description
Log in	1	The user has to be authenticated before using the system
Log out	3	The session must be killed after logging out
Registration	1	Register to the system first so that the system can recognize the user.
Search Blog	1	When users input search keyword in the search field, a live time search result will be displayed
Read Blog	2	Blog will load when student click on Read Blog

Run Simulator	3	Users can easily use simulators and run simulators.
Manage Simulator	3	Admin manage simulator section add new content
Blog List	1	Users can save their favorite Blog to read it later.
Add Blog	2	Admin can be able to add blog if he has the access
Edit Blog	1	If admin has access admin can be able to edit blog information excluding the blog file and content
Delete Book	1	If access admin will be able to delete a blog
Manage Admins	3	Admin will be able to add another admin. He can edit/delete any other admins. All these actions require access of doing it
View Statistics	2	Admin can view statistics about the system and locker key distribution. Access required
Activity Logs	2	Activity Logs can be viewed by the admin if he has access. Admin can clear all the activity logs
Contact	1	Admin can be manage Contact form and user can use contact section

5.2 Testing Strategies

5.2.1 Test Approach

To ensure the quality of the system, two different sorts of testing have been used. Mainly, it is focused on Black Box Testing and White Box Testing.

- **Black Box Testing:** Black Box Testing is also called functional testing. It is a testing strategy where internal mechanisms are ignored and only focus on the output. For some specific input some outputs are generated. Then these outputs compare with the expected output. If it matches, the function is accepted.
- **White Box Testing:** White Box Testing is called structural testing. In this testing strategy, the internal mechanism of the system is considered.

5.2.2 Testing Schedule

Test Phase	Time
Testing plan creating	1 Week
Unit test	During Development
Component testing	During Development
Testing user interfaces	1 Week
Performance test	2 Week
Accessibility test	2 Week

5.3 Test Cases

Test Case ID	Test Case Description	Test Steps	Test Data	Expected Results	Actual Results	Pass/Fail
1	Check user Login with valid Data	Go to Site Enter Email Enter Password Click Submit	User-Email = Email User-Password = Password	User should Login into an application	As Expected	Pass

2	Check user Registration with valid Data	Go to Site User Name Enter Email Enter Password Click Submit	User-Name = Name User-Email = Email User-Password = Password	User should Registration into an application	As Expected	Pass
3	Manage Blog with valid Data	Go to Site Title, Description, Image, SubTitle, Category Click Submit	Title = title Description = description Image = image SubTitle = subtitle Category = category	Admin add Blog into an application	As Expected	Pass
4	Manage Simulator with valid Data	Add command Left, Right, Move, Room number	Left, Right, Move, Room number	User Command Simulator into an application	As Expected	Pass

CHAPTER 6: USER MANUAL

6.1 Navbar



Figure 6.1.1: Navbar for user

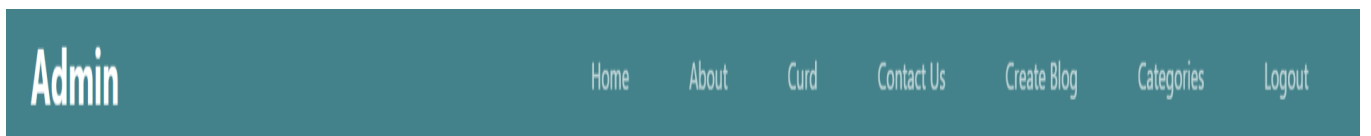


Figure 6.1.2: Navbar after admin

6.2 Login Page

The screenshot displays the login page layout. At the top, a dark teal header contains a logo on the left and navigation links: Home, About, News & Events, Contact Us, and SIGN IN & SIGN UP. The main content area features a white box titled "SIGNIN" with two input fields: "Email" and "Password". Below these fields are two buttons: a dark teal "SIGNIN" button and a light blue "SIGNUP" button. The footer is a dark teal bar with four columns: "Company" (Home, About Us, News & Events, Our Services, Contact), "Get Help" (FAQ, Contact, Number, Office), "Our Mission" (Our Networks, Our Teaching, Our Facilities, Research Groups), and "Follow Us" (Facebook, Twitter, Instagram, LinkedIn icons).

Figure 6.2: Login page

6.3 Registration Page

The screenshot displays the registration page layout. At the top, a dark teal header contains a logo on the left and navigation links: Home, About, News & Events, Contact Us, and SIGN IN & SIGN UP. The main content area features a white box titled "SIGNUP" with three input fields: "Name", "Email", and "Password". Below these fields are two buttons: a dark teal "SIGNUP" button and a light blue "SIGNIN" button. The footer is a dark teal bar with four columns: "Company" (Home, About Us, News & Events, Our Services, Contact), "Get Help" (FAQ, Contact, Number, Office), "Our Mission" (Our Networks, Our Teaching, Our Facilities, Research Groups), and "Follow Us" (Facebook, Twitter, Instagram, LinkedIn icons).

Figure 6.3: Registration Page

6.4 Home Page

Bristol Robotics Laboratory
Bristol Robotics Laboratory (BRL) is the most comprehensive academic centre for multi-disciplinary robotics research in the UK. It is a collaborative partnership between the University of the West of England (UWE Bristol) and the University of Bristol.

[Let's Talk](#)

Fintech is all about excellence in the world of business

Our History
Lorem ipsum dolor sit, amet consectetur adipiscing elit. Rerum officis quis omnis, cum culpa nisi!
Lorem ipsum dolor sit, amet consectetur adipiscing elit. Rerum officis quis omnis, cum culpa nisi!

[READ MORE](#)

Vision & Mission
Lorem ipsum dolor sit, amet consectetur adipiscing elit. Rerum officis quis omnis, cum culpa nisi!
Lorem ipsum dolor sit, amet consectetur adipiscing elit. Rerum officis quis omnis, cum culpa nisi!

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Business engagement
Curabitur convalis ac quam vitae laoreet. Nulla mauris ante, euismod sed lacus sit amet, congue bibendum eros. Etiam mattis lobortis porta. Vestibulum ultrices lacus enim imperdiet egestas. [Read more](#)

Research areas
Curabitur convalis ac quam vitae laoreet. Nulla mauris ante, euismod sed lacus sit amet, congue bibendum eros. Etiam mattis lobortis porta. Vestibulum ultrices lacus enim imperdiet egestas. [Read more](#)

Feature Mission
Curabitur convalis ac quam vitae laoreet. Nulla mauris ante, euismod sed lacus sit amet, congue bibendum eros. Etiam mattis lobortis porta. Vestibulum ultrices lacus enim imperdiet egestas. [Read more](#)

Who we are
Bristol Robotics Laboratory (BRL) is the most comprehensive academic centre for multi-disciplinary robotics research in the UK. It is a collaborative partnership between the University of the West of England (UWE Bristol) and the University of Bristol, and home to a vibrant community of over 450 academics, researchers and industry practitioners.

What we do
The primary mission of BRL is to understand the science, engineering and social role of robotics and embedded intelligence. In particular, the key challenges surrounding adaptive robotics, namely: dealing with people and their unpredictability, unstructured and uncertain environments, and equipping robots for flexible roles.

Company
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[About Us](#)
[News & Events](#)
[Our Services](#)
[Contact](#)

Get Help
[FAQ](#)
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Our Mission
[Our Networks](#)
[Our Teaching](#)
[Our Facilities](#)
[Research Groups](#)

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Figure 6.4: Home Page

6.5 About Page

The screenshot displays the 'About Us' page of the Bristol Robotics Laboratory (BRL). At the top, a navigation bar includes links for Home, About, News & Events, Contact Us, and a Sign In & Sign Up option. The main hero section features a background image of a robotic arm and a person working, with the text: "BRL is a unique collaboration that harnesses the collective strengths of its university partners, and brings together the best expertise from industry and the academic community to spearhead Britain's efforts to be a world leader in modern advanced robotics". A quote from David Willetts, Minister of State for Universities and Science (2010-2014), is also present.

The 'Who we are' section describes BRL as the most comprehensive academic centre for multi-disciplinary robotics research in the UK, a collaborative partnership between the University of the West of England (UWE Bristol) and the University of Bristol, home to over 450 academics, researchers, and industry practitioners. It is an internationally recognised Centre of Excellence in Robotics, with state-of-the-art facilities covering over 4,600 sq. metres (50,000 sq. feet).

The 'What we can do for you' section outlines the primary mission: to understand the science, engineering, and social role of robotics and embedded intelligence, focusing on adaptive robotics for unstructured and uncertain environments. It lists four key statistics in a grid:

- Established Years: 2006
- Research Groups: 18
- Total Members: 450+
- Incubator Companies: 28

Below this are three columns of content:

- Our networks:** BRL maintains strong national and international links with both industry and other research institutes and has an enviable track record of successful research and innovation. It is involved in multiple innovative applications of robotics for commercial and industrial exploitation, including the Bristol Technology Solutions programme, the Robotics Technology Business Incubator, and the Robotics.
- Our teaching:** In addition to its core research activities, BRL offers PhD level research programmes through its EPSRC funded Centre for Doctoral Training in Robotics and Autonomous Systems. It offers a full range of taught courses at undergraduate and postgraduate levels, Masters level research programmes, and selected internships. Additionally, BRL hosts FARSCOPE.
- Our facilities:** The Laboratory is located in Bristol, South West England. On-site facilities include full mechanical workshops, wet labs, rapid prototyping facilities, an ambient assisted living studio, flying arena, a 16,000L test pool, and 3 Vicron 3D positioning systems. It also hosts a lecture theatre, seminar rooms, and a fully equipped video conference suite.

A 'PRACTICE ROBO' section contains a code editor with the following JavaScript code:

```
const taskinput = document.getElementById('taskinput');
const taskList = document.getElementById('taskList');
if (taskinput.value.trim() !== '') {
  alert('Please enter a task');
  return;
}
const taskItem = document.createElement('li');
taskItem.className = 'task';
taskItem.innerHTML = `taskList.appendChild(taskItem);`;
```

Below the code is a 'Run Code' button. The footer contains four columns of links:

- Company:** Home, About Us, News & Events, Our Services, Contact
- Get Help:** FAQ, Contact, Number, Office
- Our Mission:** Our Networks, Our Teaching, Our Facilities, Research Groups
- Follow Us:** Facebook, Twitter, Instagram, LinkedIn

Figure 6.5: About Page

6.6 News and Event

Home About News & Events Contact Us SIGN IN & SIGN UP

BRL News

Socially intelligent robot helps autistic Somerset pupils

Filter Your Blog: All

Search your title

Powering Machines With Gas...
Clearly, my dampen hands have hindered my writing schedule. Thank

Robot Stomachs: Powering ...
The Scientist idiom, "stomachs are coliding," is probably the best

Pepper The Robot Helps Aut...
Why did the robot cross the road? To tell jokes and lead dances in the

Laboratory Hosts Virtual Co...
The conference brings together leading robotics researchers and

Bristol Robotics Laboratory ...
Bristol Robotics Laboratory hosts virtual conference to showcase

Pepper The Robot Based At ...
Somerset has been taking part in social activities designed to help

Socially Intelligent Robot He...
A robot has been helping autistic pupils with regulating their emotions.

Machine Vision in Collabora...
There's an opportunity to apply for a funded full-time PhD in the Centre for

Phd Opportunity With Cent...
PhD Opportunity with Centre for Machine Vision in collaboration with

Load More

Our Events

Study at BRL

PhD in Robotics
The PHD in Robotics is designed to provide you with a wide understanding of advanced robotics and automation systems with broad applications. It is sufficiently general to give you an excellent background for a professional career in the robotics sector whilst also providing the specialism necessary for a career as a researcher. The programme is jointly delivered by the University of Bristol and the University of the West of England, and draws on the combined expertise of both universities and Bristol Robotics Laboratory – a world-leading facility for robotics research.

MSc in Robotics
The MSc in Robotics is designed to provide you with a wide understanding of advanced robotics and automation systems with broad applications. It is sufficiently general to give you an excellent background for a professional career in the robotics sector whilst also providing the specialism necessary for a career as a researcher. The programme is jointly delivered by the University of Bristol and the University of the West of England, and draws on the combined expertise of both universities and Bristol Robotics Laboratory – a world-leading facility for robotics research.

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Figure 6.6: News and Event

6.7 Category Page

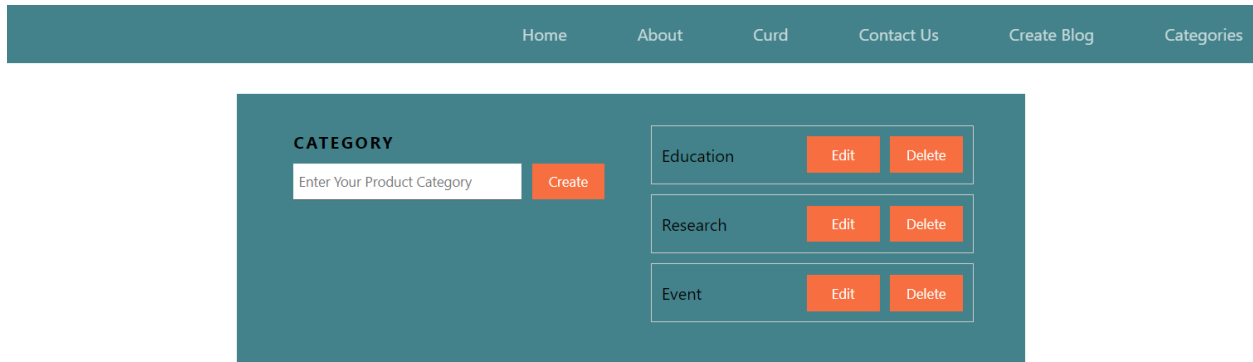


Figure 6.7: List of Category

6.8 Create Blog Page

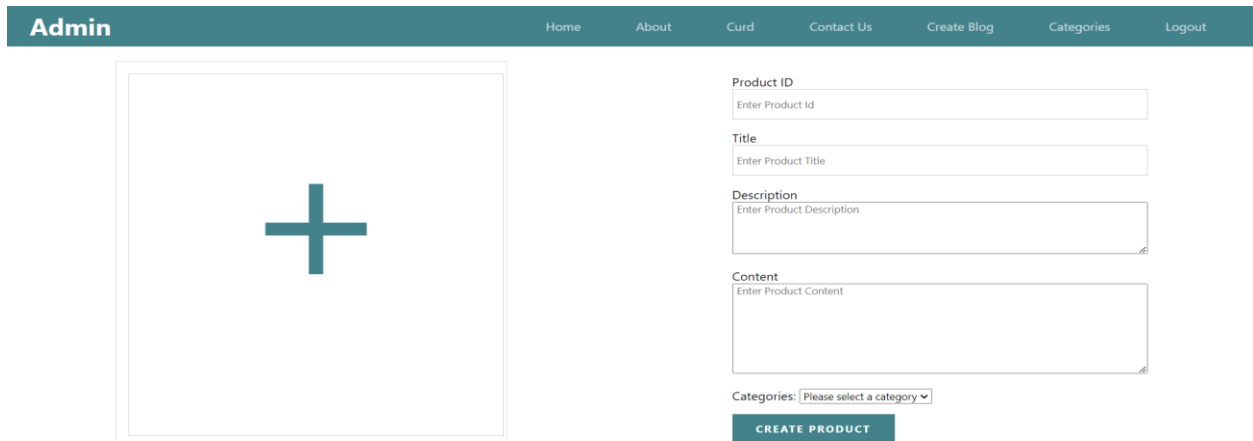



Figure 6.8: Create Blog page

6.9 Simulator Coding Section

Robotic movement with our responsibility



A screenshot of a web-based robot simulator. The main area shows a red maze with a green robot icon at the start. On the right, there's a control panel with a directional pad and a 'Run' button. Below the maze, there's a 'Clear Obstacles' button.

Simulator History

Lorem ipsum dolor sit, amet consectetur adipiscing elit. Rerum officiis quis omnis, cum culpa nisi!

Lorem ipsum dolor sit, amet consectetur adipiscing elit. Rerum officiis quis omm officiis quis omnis, cum culpa nisi!

[READ MORE](#)

Run Simulator with Vision & Mission

Lorem ipsum dolor sit, amet consectetur adipiscing elit. Rerum officiis quis omnis, cum culpa nisi!


Lorem ipsum dolor sit, amet consectetur adipiscing elit. Rerum officiis quis omm officiis quis omnis, cum culpa nisi!

[RUN SIMULATOR](#)

Figure 6.9: Simulator Coding Section

6.10 Simulator Page

Welcome to Robot Simulation

Place the Robot on table first

X: Y: North


Move and Directions


Report Robot Position

X: Y: Facing:

Figure 6.10: Simulator Page

6.11 Blog Detail

[Home](#) [About](#) [News & Events](#) [Contact Us](#) [SIGN IN & SIGN UP](#)


X

ROBOT STOMACHS: POWERING MACHINES WITH GARBAGE AND PEE

The Seinfeld idiom, "worlds are colliding," is probably the best description of work in the age of Corona.


The Seinfeld idiom, "worlds are colliding," is probably the best description of work in the age of Corona. Pre-pandemic, it was easy to departmentalize one's professional life from one's home existence. Clearly, my dishpan hands have hindered my writing schedule. Thank goodness for the robots in my life, scrubbing and vacuuming my floors; if only they could power themselves with the crumbs they suck up. The World Bank estimates that 3.5 million tons of solid waste is produced by humans everyday, with America accounting for more than 250 million tons a year or over 4 pounds of trash per citizen. This figure does not include the 34 billion gallons of human organic materials that is processed in water treatment centers across the country each year. To the fictional Dr. Emmett Brown, this garbage is akin to "black gold" – ecologically powering cities, cars, and machines. In reality, the movie, "Back to The Future II" was inspired by the biomass gasification movement of 20th century in powering cars with wood during World War II when petroleum was scarce. The technology has advanced so much that a few years ago the GENeco water treatment plant in the United Kingdom built a biomethane gas bus that relied solely on sewage. In reflecting on the importance of the technology, Collin Field of Bath Bus Company declared, "We will never, ever, ever, while we are on this planet, run out of human waste."

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Figure 6.11: Blog Detail

43

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6.12 Contact Page

The image shows a contact page with a teal header and a dark teal background for the main content area. The header contains a chat icon, a home icon, and navigation links: Home, About, News & Events, Contact Us, and SIGN IN & SIGN UP. The main content area features a large 'CONTACT US' heading over a network graphic. Below this is a contact form with three input fields: Name, Email, and Comment, followed by a SUBMIT button. A section titled 'Travelling to Bristol' contains three columns of text: 'By Car', 'Car Parking', and 'Open Days'. The footer is teal and contains four columns: 'Company' (Home, About Us, News & Events, Our Services, Contact), 'Get Help' (FAQ, Contact, Number, Office), 'Our Mission' (Our Networks, Our Teaching, Our Facilities, Research Groups), and 'Follow Us' (Facebook, Twitter, Instagram, LinkedIn icons).

Home About News & Events Contact Us SIGN IN & SIGN UP

CONTACT US

Name

Email

Comment

SUBMIT

Travelling to Bristol

By Car
Please enter the Frenchay Campus through the North Entrance and follow the red signs. The Frenchay Campus is easily accessible from Junction 1 of the M32. The M32 joins the M4 at Junction 19. For Satellite Navigation purposes use BS34 8QZ.

Car Parking
Parking for BRL visitors is available at the front of T Block. Please ensure arrangements have been made with your host for a parking pass to be available for collection from the Bristol Robotics Laboratory reception. Alternatively, please request a Car Parking Permit by email prior to your visit.

Open Days
Unfortunately we are unable to offer tours of Bristol Robotics Laboratory to the public. However the laboratory is sometimes accessible as part of the guided tours offered during open days for the University of the West of England (UWE).

Company

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Figure 6.12: Contact Page

6.13 Footer

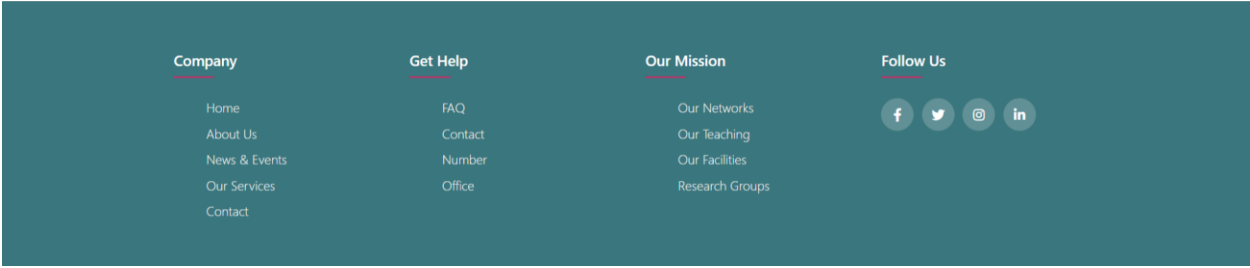


Figure 6.13: Footer

CHAPTER - 7: CONCLUSION

7.1 Project Link

GitHub: <https://github.com/mostofa247/Robotic-Lab-Website.git>

7.2 Limitations

- ❖ Discussion and member functionality could not be implemented
- ❖ 2D and 3D Simulator could not manage to keep large as we don't have any paid storage
- ❖ Risk of unauthorized accessibility

7.3 Future Scope

There are some future scopes of this project which may be useful in future. In future, it is possible to add a feature where the user will be able to see his/her own Coding result. We can use Machine Learning technology to distribute the simulator in future. A feature of registered users can be joined discussion as a member. Simulator can be updated so that we can add more functionality. For better security, we can use monolithic architecture technology where the system is more first and secure. It will ensure more security. Adding all these features will make the project more interesting, effective and better.