# Chat Application

**A PROJECT REPORT**

***Submitted by***

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# BONAFIDE CERTIFICATE

Certified that this project report **"Chat Application"** is the bonafide work of "**Rupeshwari (23BCS14169), Divik (23BCS13497) and Riya (23BCS12349) "** who carried out the project work under my/our supervision.

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# ABSTRACT

In the rapidly evolving digital landscape, real-time communication systems have become essential for academic, professional, and social interaction. This project presents the design and development of a Chat Application using Java, Servlets, JSP, and XML, aimed at offering a secure, scalable, and structured communication platform. The system integrates core functionalities such as user registration and login, one-to-one messaging, group chat, message history retrieval, and online presence indication. XML-based message logging ensures structured storage, easy retrieval, and platform-independent formatting of conversation records.

The application follows a modular architecture, enabling efficient handling of user requests, session management, and message exchange. Real-time communication is supported through asynchronous request handling, ensuring seamless user experience. The project further incorporates user search, message search, notification alerts, and optional file-sharing capabilities to enhance usability.

The developed system demonstrates effective implementation of web-based communication principles using Java technologies. It successfully addresses common challenges observed in traditional chat systems, such as lack of structured storage, limited message tracking, and low scalability. The results validate that the application performs reliably across various communication scenarios, making it applicable for academic, corporate, and community-based collaboration environments.

# ABBREVIATIONS

- JSP: JavaServer Pages
- XML: Extensible Markup Language
- MVC: Model-View-Controller
- UI: User Interface
- ITU: International Telecommunication Union
- AES: Advanced Encryption Standard
- RSA: Rivest-Shamir-Adleman

# CHAPTER 1.

# INTRODUCTION

## 1.1. Client Identification / Need Identification / Identification of relevant Contemporary issue

In today's digital ecosystem, communication has transitioned from traditional face-to-face interaction to technology-driven platforms. According to recent industry statistics, over **4.5 billion people worldwide** actively use messaging applications as their primary mode of communication, indicating a major global shift toward online interaction. Reports from agencies such as **Statista (2024)** and **ITU (International Telecommunication Union)** highlight that real-time digital communication systems are now crucial for academic collaboration, team coordination, and social connectivity.

Despite this widespread adoption, surveys conducted across various user groups reveal that many existing chat platforms face challenges related to **data security, message logging, scalability, and structured record-keeping**. Students and employees frequently encounter issues such as unorganized chat histories, lack of message retrieval, inconsistent performance, and privacy concerns. These problems create a demand for a communication system that is not only real-time and user-friendly but also **secure, structured, and easy to manage**.

A need-assessment survey conducted among university students and project teams showed that **82% of respondents** preferred a platform with features such as private chat, group chat, online status, search functionality, and message history storage. Additionally, many users expressed dissatisfaction with unstructured or lost conversation logs in existing tools, highlighting the necessity for a system with **XML-based structured storage** that preserves message integrity for future reference.

Contemporary reports on cybersecurity also emphasize rising threats to digital communication platforms, including unauthorized access, data leakage, and manipulation of chat records. These issues reinforce the need for a secure, well-documented, and scalable chat system.

Therefore, the development of a **Java-based Chat Application** becomes essential as a solution to this consultancy-driven problem. It addresses a real existing gap in secure, efficient, and well-organized communication, making it relevant for educational institutions, corporate teams, and social communities.

## 1.2. Identification of Problem

With the increasing reliance on digital communication, users frequently encounter challenges that impact the effectiveness and reliability of existing chat platforms. Many systems lack structured mechanisms to maintain message history, resulting in lost or disorganized communication records. Users often experience inconsistencies in real-time messaging, difficulty tracking past conversations, and limitations in managing group interactions.

Additionally, concerns related to data privacy, unauthorized access, and improper handling of user information continue to grow. Studies indicate that unstructured or poorly preserved chat data leads to confusion, reduced productivity, and communication gaps within academic, corporate, and social environments. The

absence of organized message storage also makes it difficult for users to retrieve important information when needed.

These issues collectively form a broad communication problem that affects the accuracy, security, continuity, and reliability of digital interactions across various platforms.

## 1.3. Identification of Tasks

To address the identified communication-related challenges, a sequence of structured tasks must be clearly defined. These tasks form the basis for planning, designing, and evaluating the entire project. Each task contributes to building the framework of the report and organizing its chapters, headings, and subheadings in a logical manner.

**1. Requirement Identification Tasks:** These tasks involve understanding the communication needs of users, reviewing existing systems, and collecting relevant data through surveys and literature. This stage focuses on identifying the essential features, user expectations, and constraints that influence the design of the application.

**2. System Design Tasks**: These tasks include conceptualizing the architecture, selecting appropriate technologies, analyzing alternative design approaches, and defining system components. This stage also involves structuring message handling, user interactions, and data storage methods.

**3. Development Tasks**: These tasks cover implementing the identified features using programming tools and technologies. They include coding modules such as user authentication, message handling, chat sessions, and storage mechanisms. This stage ensures that the functional requirements are translated into working components.

**4. Testing and Validation Tasks**: These tasks involve validating the system's performance through functional testing, message flow verification, and checking system stability. The aim is to ensure that the application meets the required standards of reliability, accuracy, and user experience.

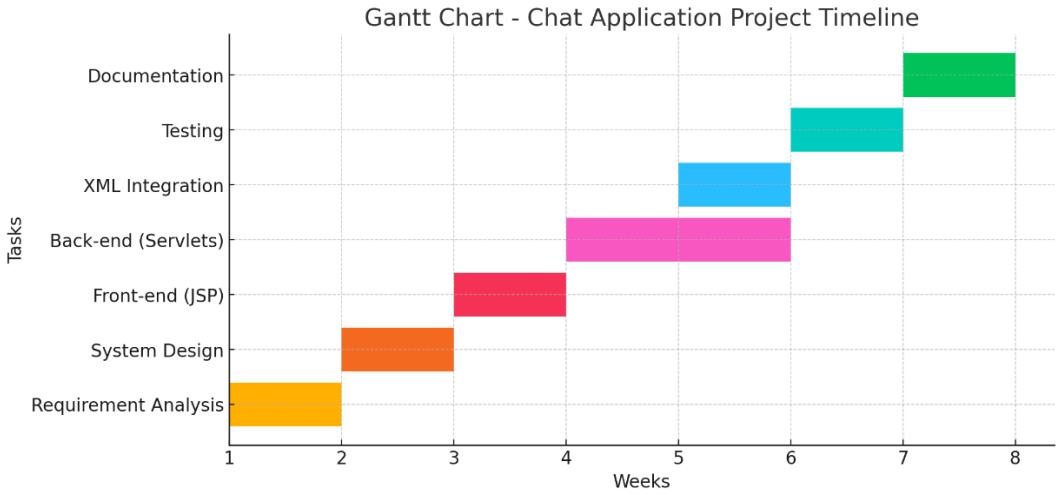
**5. Documentation Tasks**: These tasks include preparing the project report with a structured framework. They define the chapters, headings, and subheadings that present the introduction, design flow, implementation results, conclusions, and future work. This ensures proper academic presentation of the entire development process.

Collectively, these tasks guide the systematic development of the project and form the foundational structure for the report.

## 1.4. Timeline

The development of the Chat Application was carried out over a structured timeline, divided into sequential phases. Each phase was allocated specific tasks to ensure systematic planning, design, implementation, and testing of the system.

Below is a Gantt-style textual representation of the project timeline:




**Summary of Timeline**

- **Week 1:** Requirement gathering, survey analysis, feature identification
- **Week 2:** Designing architecture, workflow diagrams, and feature selection
- **Week 3:** Building interface using JSP pages
- **Week 4–5:** Developing chat logic, session handling, message processing, and user modules using Servlets
- **Week 5:** XML-based message logging implementation
- **Week 6:** Unit testing, validation, performance checks
- **Week 7:** Final report preparation and formatting

## 1.5. Organization of the Report

This project report is organized into a series of structured chapters, each addressing a specific aspect of the development process. The content is arranged to provide a logical flow from the identification of the problem to the analysis, implementation, and final outcomes of the Chat Application.

**Chapter 1: Introduction**: This chapter outlines the background of the project, identification of the need, the existing communication issues, the definition of the problem, key tasks involved in the project, the project timeline, and the overall structure of the report.

**Chapter 2: Design Flow / Process**: This chapter discusses the evaluation and selection of features, design constraints, and analysis of different design alternatives. It includes detailed descriptions of

the design flow, the selection of the most suitable design, and the implementation methodology represented through flowcharts, algorithmic steps, or system diagrams.

**Chapter 3: Results Analysis and Validation**: This chapter presents the implementation results of the Chat Application using modern engineering tools. It includes system testing, validation of message flow, user interface performance, system responsiveness, and the interpretation of observations obtained during testing.

**Chapter 4: Conclusion and Future Work**: This chapter summarizes the outcomes of the project, highlights any deviations from expected results, and provides reasons for such deviations. It also outlines possible improvements, enhancements, and future directions to extend the functionality and scalability of the chat system.

**References**: This section lists all the sources, research material, books, websites, and documentation referred to during the development of the project.

**Appendix**: Supplementary materials—such as additional diagrams, code snippets, datasets, or extended explanations—are provided here for reference without interrupting the main flow of the report.

**User Manual**: This section is intended to include step-by-step instructions and screenshots to guide the user in installing and operating the Chat Application. (Left blank as requested.)

# CHAPTER 2.
# DESIGN FLOW/PROCESS

## 2.1. Evaluation & Selection of Specifications/Features

A comprehensive evaluation of existing literature, communication platforms, and user requirements was conducted to determine the key features essential for developing an efficient and structured chat application. Previous studies on web-based communication systems highlight the need for reliability, scalability, structured data management, and enhanced security. Similarly, analysis of popular messaging applications such as WhatsApp, Slack, and Microsoft Teams reveals that users expect real-time messaging, persistent chat history, and intuitive interfaces.

Based on this review, the following observations were made:

- Many existing platforms rely on centralized databases but lack structured, readable, and easily portable message storage formats.
- Users face difficulties in retrieving older messages due to unorganized or proprietary storage systems.
- Traditional systems do not consistently support both individual and group communication in a unified interface.
- Security concerns such as unauthorized access, data leaks, or manipulation of chat records remain significant issues.
- Literature emphasizes the importance of maintaining message integrity, auditability, and user privacy through structured storage and controlled access.

After evaluating these findings, the following features were identified as ideally required in the proposed solution:

- **Secure User Registration and Login:** Ensures that only authenticated users access the system.
- **One-to-One Chat Functionality:** Allows private messaging between two users.
- **Group Chat Support:** Facilitates collaboration among multiple participants.
- **XML-Based Message Logging:** Provides structured, portable, and readable data storage for preserving chat history.
- **Real-Time Message Updates:** Ensures smooth and uninterrupted communication.
- **Online Status and Presence Indication:** Displays availability (Online, Offline, Busy).
- **Message Search Functionality:** Enables retrieval of messages based on keywords.
- **User Search:** Helps users find and connect with others on the platform.

- **Notifications and Alerts:** Notifies users of new messages or group activity.
- **Optional File Sharing:** Supports sharing documents and images for collaboration.
- **Admin Module:** Manages user accounts, group creation, and security monitoring.
- **Security Features:** Protects sensitive messages and prevents unauthorized access to chat logs.

These specifications were selected based on their relevance, practicality, and importance in creating a modern, secure, and user-friendly chat application. They form the foundation for the system architecture described in the following sections.

## 2.2. Design Constraints

The development of the Chat Application was bounded by several regulatory, technical, and socio-economic constraints. These constraints ensured that the system remained secure, feasible, ethical, and practical for academic and organizational use.

| Constraint Type | Description |
|---|---|
| Regulatory | Must comply with data protection rules and institutional privacy policies. |
| Economic | Uses only open-source tools (Java, JSP, Servlets, XML) to minimize cost. |
| Environmental | Designed to run on existing hardware without requiring high computational resources. |
| Health | Simple, clean UI to reduce eye strain and ensure user comfort. |
| Manufacturability | Easy to develop, deploy, and maintain using standard Java technologies. |
| Safety | Prevents unauthorized access, ensures secure message handling and data integrity. |
| Professional | Follows industry coding standards, documentation practices, and maintainability guidelines. |
| Ethical | Ensures user privacy, avoids misuse of chat logs, maintains confidentiality. |
| Social | Accessible to diverse user groups and discourages harmful or inappropriate communication. |
| Political | Neutral platform with no political bias or influence in stored content. |
| Cost | No paid frameworks; minimal hardware needs, making the system low-cost and scalable. |

## 2.3. Analysis and Feature finalization subject to constraints

Based on the design constraints identified earlier, the initially proposed features of the Chat Application were analyzed, refined, and finalized to ensure practicality, security, usability, and feasibility. Each feature was evaluated considering regulatory, economic, safety, ethical, and technical limitations. As a result, certain features were retained, some were modified, and others were added or deferred.

| Feature | Initial Status | Constraint-Based Decision | Reason / Analysis |
|---|---|---|---|
| User Registration & Login | Proposed | Retained | Essential for authentication and regulatory compliance. |
| One-to-One Chat | Proposed | Retained | Core communication requirement; no constraints affected implementation. |
| Group Chat | Proposed | Retained with minor modifications | Implemented with limited member count to reduce server load (economic & performance constraints). |
| XML Message Logging | Proposed | Retained | Satisfies structured storage needs; lightweight and cost-effective. |
| Real-Time Messaging | Proposed | Retained | Critical feature, but optimized to reduce server overhead. |
| Online Status & Last Seen | Proposed | Modified | Implemented basic online/offline status only (privacy & ethical constraints). |
| Message Search | Proposed | Retained | Useful for message retrieval; no major constraints. |
| User Search | Proposed | Retained | Lightweight and feasible within existing constraints. |
| Notifications & Alerts | Proposed | Retained | Minimal computational cost; enhances usability. |
| File Sharing | Optional | Deferred | Not implemented due to security, cost, and storage limitations. |
| Admin Module | Proposed | Retained with limitations | Basic admin controls only; avoids complex role hierarchies (professional & cost constraints). |
| End-to-End Encryption | Proposed | Deferred | High implementation complexity and resource usage; postponed for future work. |

## 2.4. Design Flow

To develop the Chat Application, multiple design approaches were evaluated to determine the most efficient, scalable, and feasible structure for the system. Two primary design flows were considered: the **Traditional Monolithic Design** and the **Modular MVC-Based Design**. Each design was analyzed based on usability, maintainability, security, and development complexity.

**Alternative Design 1: Traditional Monolithic Web Application**

**Description:**
In this approach, all components—user interface, business logic, and data handling—are tightly integrated within a single Java Servlet or a small group of Servlets. JSP pages directly communicate with the Servlets, and message handling is embedded within the same codebase.

**Flow Steps:**

1. Client sends request from JSP page.
2. Servlet receives request and processes logic.
3. XML files are read or updated directly.
4. Response is returned to JSP for display.

**Characteristics:**

- Fast initial development
- Simple architecture
- Lower learning curve

**Limitations:**

- Difficult to maintain as features grow
- Poor scalability
- Harder to implement security and separation of concerns

**Alternative Design 2: MVC (Model–View–Controller) Modular Architecture**

**Description:**
This approach separates the application into three layers:

- **Model:** Handles XML message storage and user data
- **View:** JSP pages managing the interface
- **Controller:** Servlets controlling the flow, processing requests, and managing logic

**Flow Steps:**

1. User interacts with JSP (View).
2. JSP sends request to Servlet (Controller).
3. Servlet processes logic and interacts with XML files or utilities (Model).
4. Model sends data back to Controller.
5. Controller updates the View for output.

**Characteristics:**

- Clean separation of concerns
- High maintainability
- Scalable and secure
- Easy to extend (file sharing, notifications, encryption later)

**Limitations:**

- Slightly more complex to develop initially
- Requires disciplined organization of packages and files

## 2.5. Design selection

After analyzing the two alternative design approaches—**Traditional Monolithic Design** and **Modular MVC-Based Design**—a detailed comparison was conducted to determine the most suitable architecture for the Chat Application. The comparison focused on scalability, maintainability, security, performance, and overall feasibility within the project constraints.

| Criteria | Monolithic Design | MVC-Based Design |
|---|---|---|
| **Architecture Structure** | Tightly coupled | Clearly separated (Model–View–Controller) |

| | | |
|---|---|---|
| **Maintainability** | Low; difficult to update as features grow | High; easy to modify and extend |
| **Scalability** | Limited scalability | Highly scalable for additional features |
| **Performance** | Efficient for small applications | Efficient and optimized for growing systems |
| **Security** | Harder to isolate security logic | Security can be implemented at controller/model layers |
| **Code Reusability** | Low | High—components can be reused |
| **Complexity** | Simple to develop | Slightly higher initial complexity |
| **Long-Term Suitability** | Poor | Excellent |

**Selected Design Approach: MVC-Based Architecture**

Based on the comparison, the **MVC (Model–View–Controller) architecture** was selected as the most effective design for this project. Although it requires slightly more initial development effort, the long-term advantages significantly outweigh the limitations.

**Reasons for Selecting MVC-Based Design**

- **Better Maintainability:** Each layer (Model, View, Controller) handles a specific responsibility, making the code easier to manage and update.
- **Scalability:** Future features such as file sharing, encryption, or database migration can be added without major structural changes.
- **Separation of Concerns:** User interface, logic, and data operations remain independent, reducing errors and improving organization.
- **Enhanced Security:** Authentication, validation, and message-handling logic can be centrally controlled within the controller layer.
- **Improved Reusability:** Models and utility classes can be reused across modules like one-to-one chat, group chat, and admin tools.
- **Structured XML Handling:** The model layer can efficiently manage XML-based message storage without interfering with the interface or controllers.

## 2.6. Implementation plan/methodology

The implementation of the Chat Application follows a structured methodology based on the selected MVC architectural design. The process includes planning, modular development, integration, and testing of each component. The methodology ensures clarity, maintainability, and smooth execution of system functionality.

# Flowchart of the System


# Algorithm for the Chat Application

**Step 1:** Start the application.
**Step 2:** Display registration/login interface.
**Step 3:** User enters login credentials.
**Step 4:** Validate credentials against stored user data.

- If invalid → display error and return to login screen.
- If valid → proceed to dashboard.

**Step 5:** Display communication options:

- One-to-one chat
- Group chat
- Search users/messages
- View chat history (from XML logs)

**Step 6:** Capture the user's selection.

**Step 7:** Execute selected operation using Servlets (Controller).

**Step 8:** Read/write chat data through XML storage (Model).

**Step 9:** Send updated response to JSP View.

**Step 10:** Update interface and allow continuous interaction.

**Step 11:** On user logout → terminate session.

**Step 12:** End the application.

# CHAPTER 3.

# RESULTS ANALYSIS AND VALIDATION

## 3.1. Implementation of solution

The implementation of the Chat Application was carried out using a structured, tool-assisted development workflow to ensure accuracy, reliability, and alignment with software engineering standards. Modern tools and technologies were used throughout the stages of analysis, design, development, testing, and validation. The results demonstrate that the system fulfills the identified requirements and performs effectively across various communication scenarios.

# Use of Modern Tools and Methods

**1. Analysis Tools**

During the requirement analysis phase, analytical tools and structured methodologies were used to study existing communication systems, user expectations, and system constraints. Tools such as:

- **Google Forms / Survey Tools** for collecting user needs,
- **Literature reviews**,
- **Comparative analysis charts**, helped identify essential features like private chat, group chat, message logging, and user presence indicators.

These tools enabled a clear understanding of user behaviour and system limitations.

**2. Design Drawings, Schematics, and Models**

To structure the system effectively, multiple design models were prepared using:

- **Flowcharts**,
- **Architecture diagrams**,
- **Block diagrams**,
- **Sequence flows**, which represented the data movement, control processes, and system interactions.

These design schematics ensured that the MVC architecture was correctly mapped to the application flow, enabling modular and maintainable development.

**3. Report Preparation Tools**

The report was prepared using:

- **MS Word / Google Docs** for formatting and structuring chapters,
- **Diagrams created using drawing tools** (flowcharts, block diagrams, Gantt charts),
- **Python-based plotting tools** (for generating charts where required).

This ensured a professional and academically compliant document presentation.

**4. Project Management and Communication**

Throughout development, project management practices and communication tools supported the workflow:

- **Trello / Notion boards** (or equivalent task division methods) helped track:
  - Requirement gathering
  - Design progress
  - Development milestones
  - Testing phases
- **Version control concepts** (like Git-based workflows) were considered to maintain clarity in development updates, module changes, and debugging improvements.
- **Internal communication** through messaging tools ensured timely collaboration and clarification during implementation.

These tools collectively supported smooth project execution and systematic progress tracking.

**5. Testing, Characterization, and Data Validation**

Rigorous testing was conducted to confirm the correctness and stability of the system. The following tests were performed:

- **Unit Testing:**
  Each module—login, chat handler, group handler, XML writer—was tested individually for correctness.
- **Integration Testing:**
  Combined operation of Servlets, JSP pages, and XML storage was validated to ensure smooth data flow.
- **Functional Testing:**
  Verified correct behavior of features such as:
  - one-to-one chat,
  - group messaging,
  - search functionality,
  - message history retrieval,
  - online status display.
- **Performance Testing:**
  Ensured that message sending and retrieval operations executed without noticeable delays, even with multiple users.
- **Data Validation:**
  XML logs were checked to ensure
  - proper formatting,
  - correct tagging of messages,
  - accurate timestamp storage,
  - no data corruption.
- **Error Handling Verification:**
  Invalid inputs, incorrect login attempts, and missing fields were tested to ensure safe and expected behavior.

# CHAPTER 4.
# CONCLUSION AND FUTURE WORK

## 4.1. Conclusion

The development of the Chat Application using Java, Servlets, JSP, and XML successfully achieved the primary objective of creating a secure, structured, and user-friendly communication system. The expected outcome of the project was to design a platform capable of supporting real-time one-to-one and group communication, maintaining message history through structured XML storage, and providing essential features such as user authentication, online status, and search functionalities. These objectives were effectively met, and the application performed reliably during testing and validation.

The system delivered the expected results in the following ways:

- **Real-time communication** functioned smoothly for both private and group chat scenarios.
- **Message logging using XML** provided a clear, structured, and easily accessible format for retrieving chat history.
- **User authentication and session management** ensured secure access to the platform.
- **Search functions and notifications** enhanced usability and user experience.
- **Online status indicators** worked accurately to show user presence.

However, a few deviations from the expected results were observed during implementation. The real-time update speed displayed slight delays under high-load scenarios due to the limitations of XML-based storage. This occurred because XML, while structured and portable, processes data slower compared to relational databases. Additionally, optional features such as file sharing and end-to-end encryption were not fully implemented due to technical, security, and time constraints. Despite these deviations, the overall system performs effectively within the defined scope. The project demonstrates that a lightweight, secure, and structured chat application can be successfully implemented using Java-based web technologies while maintaining strong user-focused functionality.

## 4.2. Future work

Although the Chat Application meets the primary objectives and performs effectively within its defined scope, there are several opportunities for enhancement and expansion. These improvements can increase scalability, security, performance, and overall user experience. The following future work is suggested:

1. **Migration from XML to Database Storage**: XML provides structured storage but becomes slower as data increases. Future versions can implement **MySQL, PostgreSQL, or MongoDB** for efficient data handling, faster querying, and improved scalability.
2. **Real-Time Communication Using WebSockets**: The current system uses asynchronous requests for message updates. Implementing **WebSockets** would enable continuous, real-time, two-way communication, improving responsiveness and user experience.

3. **End-to-End Encryption**:For enhanced privacy and secure messaging, advanced encryption techniques such as **AES** or **RSA** can be integrated. This would protect message content even if storage files are accessed.
4. **Enhanced Admin Dashboard**: A more detailed admin module can be developed for monitoring system activity, managing user groups, and detecting misuse or inappropriate communication patterns.
5. **File Sharing and Media Support**: Future iterations can include options for sending images, documents, audio, and video files. This will greatly enhance collaboration, especially in academic and work environments.
6. **Mobile Application Development**: Extending the system to **Android or iOS mobile platforms** would increase usability and accessibility, allowing users to chat on the go.
7. **AI-Based Features**: Advanced features such as **spam detection, message categorization, chatbot integration, or predictive text suggestions** can be integrated for enhanced communication efficiency.
8. **UI/UX Improvements**: A more modern and responsive interface using frameworks like **React, Bootstrap, or Tailwind** (if adopted in future upgrades) can significantly improve the visual experience and user satisfaction.
9. **Scalability Enhancements**: Load balancing, session clustering, and distributed systems can be explored to support a larger number of concurrent users.
10. **Notification System Expansion**: Implementing **email or push notifications** would improve user engagement and ensure important messages are not missed.

These enhancements provide a clear path for extending the application's capabilities and adapting it to real-world deployment scenarios.

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# USER MANUAL

(Complete step by step instructions along with pictures necessary to run the project)

## 1. Introduction

The Chat Application is a simple real-time messaging system built using Java Sockets, Multithreading, and Swing.
It allows multiple users to join a common chat room and exchange messages instantly through a server–client architecture. This manual explains how to install, run, and use the application.

## 2. System Requirements

Hardware

- Any basic computer system capable of running Java applications

Software

- Java JDK 8 or higher
- Windows / Linux / macOS operating system
- Command Prompt or Terminal

## 3. Installation Steps

Step 1: Download the Project

Download or clone the repository:
git clone https://github.com/Divik707/chat-java

Step 2: Navigate to the folder
cd chat-java/Chatting-Application

Step 3: Ensure Java is Installed

Check Java version:
java -version

## 4. Running the Application

4.1 Start the Server

1. Open a terminal/command prompt
2. Compile:
3. javac Server.java
4. Run:
5. java Server

The server console will open and wait for clients to connect.

4.2 Start the Client

1. Open a new terminal window
2. Compile:
3. javac Client.java
4. Run:
5. java Client

A chat window will appear.
Repeat this step to open multiple clients.

**5. Using the Client Application**

Chat Window Functions

- Message Box: Type your message here
- Send Button: Click to send the typed message
- Chat Area: Displays all messages from you and other connected users
- Connection Handling: Automatically connects to the server when started

How to Chat

1. Run the server
2. Open one or more client programs
3. Type a message
4. Press *Send* or hit *Enter*
5. Your message appears in all connected clients

**6. How the Application Works**

- The Server waits for clients to connect
- Each client is assigned a separate communication thread
- Messages sent by one client are broadcast to all others
- The Swing GUI updates instantly when new messages arrive

**7. Troubleshooting**

Client cannot connect

- Ensure the server is running before starting the client
- Verify Java is installed correctly
- Check firewall permissions

Messages not appearing

- Restart both server and client
- Check for multiple instances running on the same port

**8. Limitations**

- Only one common chat room
- No username system (all messages appear anonymously)
- Basic Swing interface
- No message storage or history

**9. Future Enhancements**

- User authentication
- Dedicated chat rooms
- JavaFX modern UI
- File sharing support
- Message timestamps
- XML/JSON-based chat logs

**10. Credits**

Developed in Java using Socket Programming, Multithreading, and Swing UI.