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Multi-User Web Chat Application using Node.js and Socket.io

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Abstract: *There are numerous chat applications available today that can be downloaded to a phone or accessed via a computer, but each has its own set of issues and may even collect user data. On the other hand, the Multi-user online chat application makes group communication extremely simple to use and navigate. The UI is as minimalistic as it gets in order to provide a distraction-free environment for consumers. It is a light-weight, hassle-free manner of communication designed with Node.js and socket.io. One can rapidly establish rooms, enter them for discussion, and leave them without leaving any data behind because it isn't meant to hold records of customer conversations.*

Keywords: Multi-user Web chat, Node.js, Socket.io, Single-page Application (SPA).

I. INTRODUCTION

Online chat can refer to any type of Internet communication that allows for real-time text message transmission from sender to receiver. To allow other participants to respond quickly, chat messages are usually short. Chatting is distinguished from other text-based online communication formats such as Internet forums and email because it creates a feeling comparable to a spoken conversation. Online chat can be used for point-to-point communication, multicast communications from one sender to many receivers, voice and video chat, or as part of a web conferencing service.

1.1 History

The first online chat system was called Talkomatic, created by Doug Brown and David R. Woolley in 1973 on the PLATO System at the University of Illinois. It offered several channels, each of which could accommodate up to five people, with messages appearing on all users' screens character-by-character as they were typed. Talkomatic was very popular among PLATO users into the mid-1980s. In 2014, Brown and Woolley released a web-based version of Talkomatic.[1]
The first online system to use the actual command "chat" was created for The Source in 1979 by Tom Walker and Fritz Thane of Dialcom, Inc.[2]

Other chat platforms flourished during the 1980s. Among the earliest with a GUI was BroadCast, a Macintosh extension that became especially popular on university campuses in America and Germany.[3]
The first transatlantic Internet chat took place between Oulu, Finland and Corvallis, Oregon in February 1989.[4]

1.2 Chatiquette

Chatiquette (chat etiquette) is a variant of netiquette (Internet etiquette) that outlines the basic rules of online communication. These standards or norms were designed to eliminate misunderstandings and make communication between users easier. Chatiquette is a term that describes fundamental courtesy and varies from community to community. As an example, it is considered rude to write only in upper case, because it appears as if the user is shouting. The word "chatiquette" has been used in connection with various chat systems (e.g. Internet Relay Chat) since 1995.[5][6]
Chatrooms can produce a strong sense of online identity leading to impression of subculture.[7]

1.3 Criticism

The objections of internet chat revolve around the fact that it substitutes shorthand or an almost entirely new hybrid language for regular English.

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Writing is evolving as it adopts some of the roles and characteristics of spoken language. Users can engage with whoever happens to be in cyberspace via Internet chat rooms and quick real-time teleconferencing.

With the increasing population of online chatrooms there has been a massive growth[8] of new words created or slang words, many of them documented on the website Urban Dictionary. Sven Birkerts wrote: "as new electronic modes of communication provoke similar anxieties amongst critics who express concern that young people are at risk, endangered by a rising tide of information over which the traditional controls of print media and the guardians of knowledge have no control on it".[9]

II. Objective

The basic goal of the Multi-user online chat application is to allow users to quickly create groups known as 'rooms,' which they may join by simply entering a username and the room's name, and so hold discussions or chats.

2.1 Functionalities Provided by Multi-User Chat Application

- To create groups or rooms.
- Veryify and check for duplicate users.
- Send location through a Google maps link containing the longitude and latitude coordinates of the sender.
- Tracking the users present in a room and display the users present in a certain room in the sidebar alongside the chat application.

III. System Design And Components

The Multi-user chat application is a single-page application (SPA) which is a web application or website that interacts with users by dynamically rewriting the current web page with new data from the web server, rather than loading complete new pages as is the typical way. The application is designed with the help of technologies such as Node.js and Socket.io for the backend and bi-directional connection, Express to create and initialise the server, HTML for rendering the app, Cascading Style Sheets(CSS) for styling the app, mustache.js to render the messages inside the app, qs.min.js for parsing the querystring and finally moment.js to keep track of the time the messages were sent at.

Figure 1 shows the UML diagram of the application:

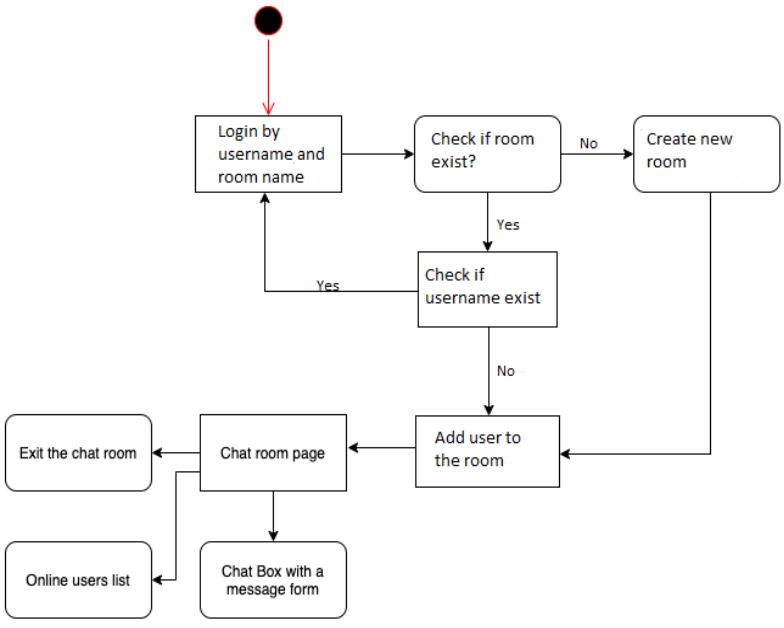

Figure 1: UML Diagram of Multi-User Chat Application

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3.1 Node.js

Node.js is a scalable network application builder that uses an asynchronous event-driven JavaScript engine. Many connections can be handled simultaneously in the following "hello world" example. The callback is invoked with each connection, but if there is no work to be done, Node.js will sleep.[10]

```
const http = require('http');

const hostname = '127.0.0.1';
const port = 3000;

const server = http.createServer((req, res) => {
  res.statusCode = 200;
  res.setHeader('Content-Type', 'text/plain');
  res.end('Hello World');
});

server.listen(port, hostname, () => {
  console.log(`Server running at http://${hostname}:${port}/`);
});
```

Figure 2: Example Code Showing Node.js

3.2 Socket.io

Socket.IO is a library that allows a client and a server to communicate in a low-latency, bidirectional, and event-based fashion.

Figure 3: Bi-directional Connection between Server and Client

It is based on the WebSocket protocol and includes features such as HTTP long-polling fallback and automatic reconnection.

Although Socket.IO indeed uses WebSocket for transport when possible, it adds additional metadata to each packet. That is why a WebSocket client will not be able to successfully connect to a Socket.IO server, and a Socket.IO client will not be able to connect to a plain WebSocket server either.[11]

3.2.1 WebSocket Protocol

WebSocket is a computer networking protocol that allows for full-duplex communication over a single TCP connection. In 2011, the IETF standardised the WebSocket protocol as RFC 6455. Websocket holds distinction over HTTP. Both protocols are on the OSI model's layer 7 and rely on TCP on layer 4. WebSocket "is meant to work over HTTP ports 443 and 80 as well as to support HTTP proxies and intermediates," according to RFC 6455, making it HTTP compliant.

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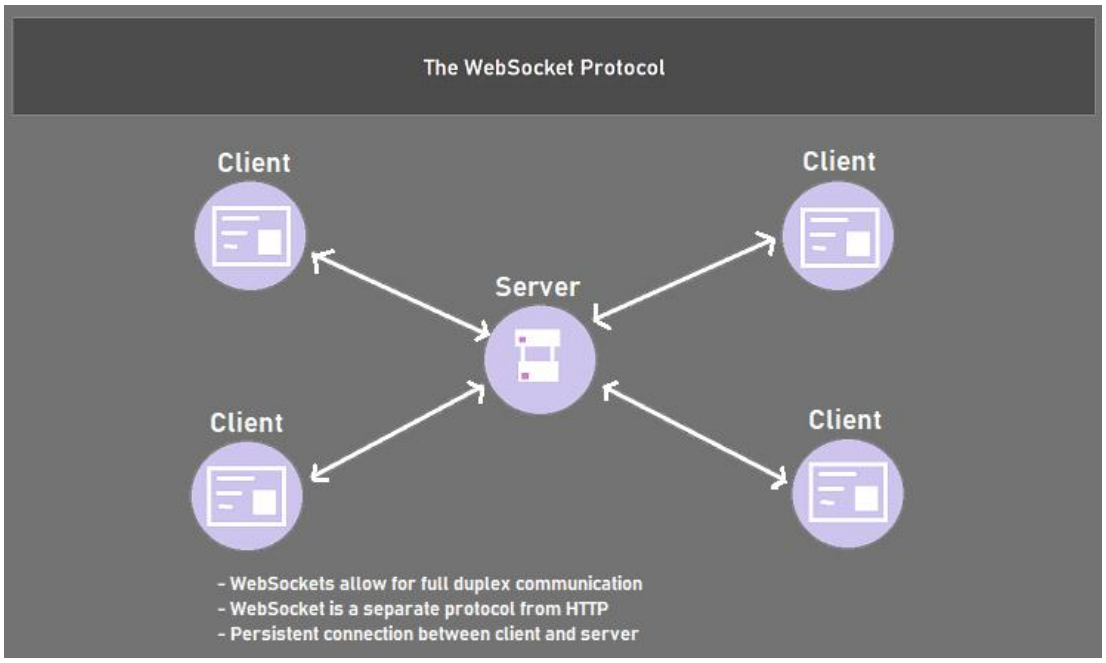

Figure 4: Bi-directional Connection through WebSocket Protocol

The WebSocket protocol facilitates real-time data transfer from and to the server by allowing interaction between a web browser (or other client application) and a web server with less overhead than half-duplex alternatives like HTTP polling. This is accomplished by allowing the server to transmit content to the client without first receiving a request from the client, as well as allowing messages to be transferred back and forth while the connection is open. The client and server can have a two-way continuous dialogue in this manner.

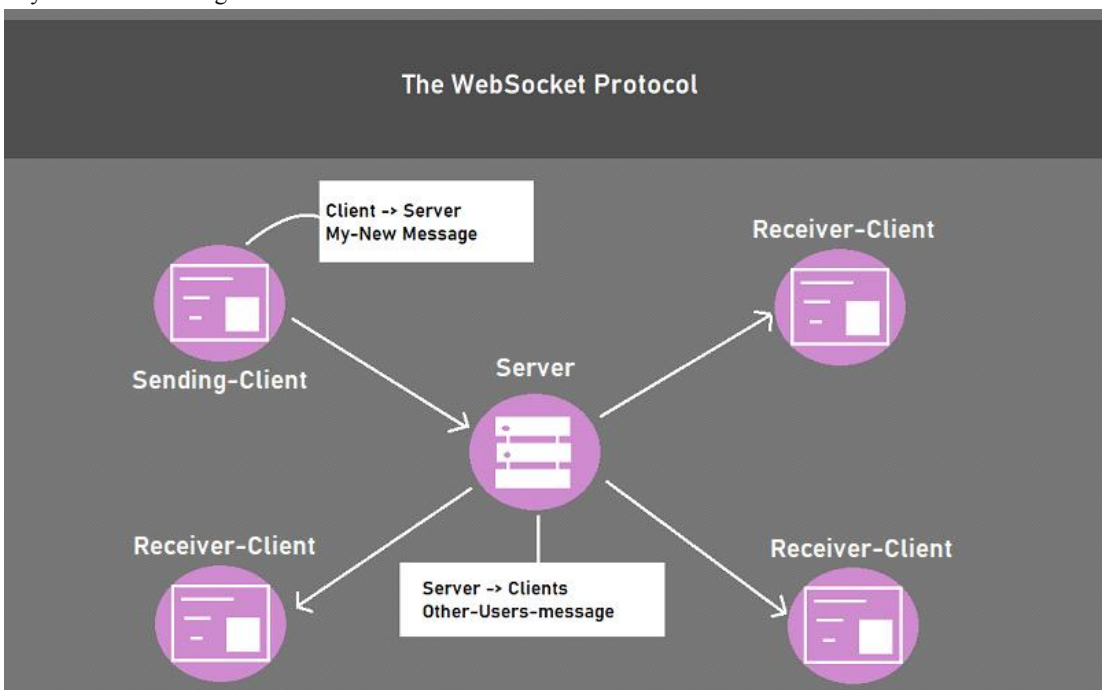

Figure 5: WebSocket Protocol: Event of Sending a message

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TCP port 443 (or 80 in the case of unprotected connections) is used for communications, which is useful in circumstances where non-web Internet connections are blocked by a firewall. Most current browsers, including Chrome, Firefox, Microsoft Edge, Safari, and Opera, support the WebSocket protocol.

3.3 Mustache.js

Mustache.js is a JavaScript implementation of the moustache template system with no dependencies. Mustache is a template syntax with no logic. It can be used for anything, including HTML, configuration files, and source code. It works by taking data from a hash or object to extend tags in a template. Because there are no if statements, else clauses, or for loops, we call it "logic-less." There are only tags instead. Some tags are replaced by a value, while others are replaced by a series of values.[12]

3.3.1 Template

A moustache template is a string with any number of moustache tags in it. The double moustaches that surround tags denote that they are tags. {{person}} is a tag.

```
const html = Mustache.render(messageTemplate ,{
username : message.username,
message: message.text,
createdAt: moment(message.createdAt).format('h:mm a')
```

Here, Mustache.render() function takes two parameters: 1) the mustache template and 2) an object that contains data and code needed to render the template.

The template messageTemplate selects the template through an ID as shown below:

```
const messageTemplate = document.querySelector('#message-template').innerHTML
```

Where the template inside the html document looks like :

```
<script id="message-template" type="text/html">
    <div class="message">
      <p>
        <span class="message__name">{{username}}</span>
        <span class="message__meta">{{createdAt}}</span>
      </p>
      <p>{{message}}</p>
    </div>
  </script>
```

3.4 Moment.js

MomentJS is a JavaScript library that makes it simple to parse, validate, manipulate, and display date/time in JavaScript.

Example Syntax:

```
moment(message.createdAt).format('h:mm a')
```

Where the message.createdAt attribute contains the time and is formatted according to the string representation specified in the format() function.

3.5 Qs.js

A library for parsing and stringifying querystrings with some enhanced security.

Example Syntax:

```
const {username , room} = Qs.parse(location.search , {ignoreQueryPrefix : true})
```

Where location.search contains the username and room-name entered and submitted through an HTML form.

3.6 Express.js

Express.js is a Node.js web application framework that is free and open-source. It is used to quickly and easily design and create web apps. Express.js makes it simple to create a single-page, multi-page, or hybrid online application. Express.js

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is a lightweight server-side framework that aids in the organisation of web applications into a more ordered MVC architecture.

Hello World Example:

```
const express = require('express')
const app = express()
const port = 3000
app.get('/', (req, res) => {
 res.send('Hello World!')
})
app.listen(port, () => {
console.log(`Example app listening on port ${port}`)
})
```

This app starts a server and waits for connections on port 3000. For requests to the root URL (/) or route, the app answers with "Hello World!" It will return a 404 Not Found response for all other paths.

3.7 Cascading Style Sheets CSS)

CSS (Cascading Style Sheets) is a stylesheet language for describing the presentation of an HTML or XML document (including XML dialects such as SVG, MathML or XHTML). CSS specifies how elements should appear on a screen, on paper, in speech, or in other forms of media.

Example Syntax:

```
body {
 background-color: lightblue;
}
```

Where body is the body element of the HTML document and in this case, the body will now appear to have lightblue as the background color.

3.8 HTML

Hyper Text Markup Language (HTML) is a markup language that is used to create web pages. It outlines the structure of a Web page and is the standard markup language for creating them.

Example Document

```
<html>
<head>
<title>Page Title</title>
</head>
<body>
<h1>My First Heading</h1>
<p>My first paragraph.</p>
</body>
</html>
```

IV. RESULT

The output of the multi-user chat application can be seen in the images below. Every time a new user joins the chat room, they must first provide their user-names. After getting a name, the server then proceeds to check if the room exists or not. If the room exists then it will go on to further verify the availability of the username, upon the confirmation of which, user is added to the room and any other member, if present, is then notified of the arrival of the new user by a default 'xyz has joined the room' message. In the case the room does not exist, the server will then create a new room and add the creator as the first member of the room and will then work and be available as an option to join for other users. Finally, when a user sends a message, it is forwarded to all recipients along with the sender's name. Additionally, there is also an option to be able to send a location message which sends a link of google maps containing the location coordinates of the sender.

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- Joining a room - by providing a username and a roomname, one can enter an already existing room or create one if it doesn't exist.

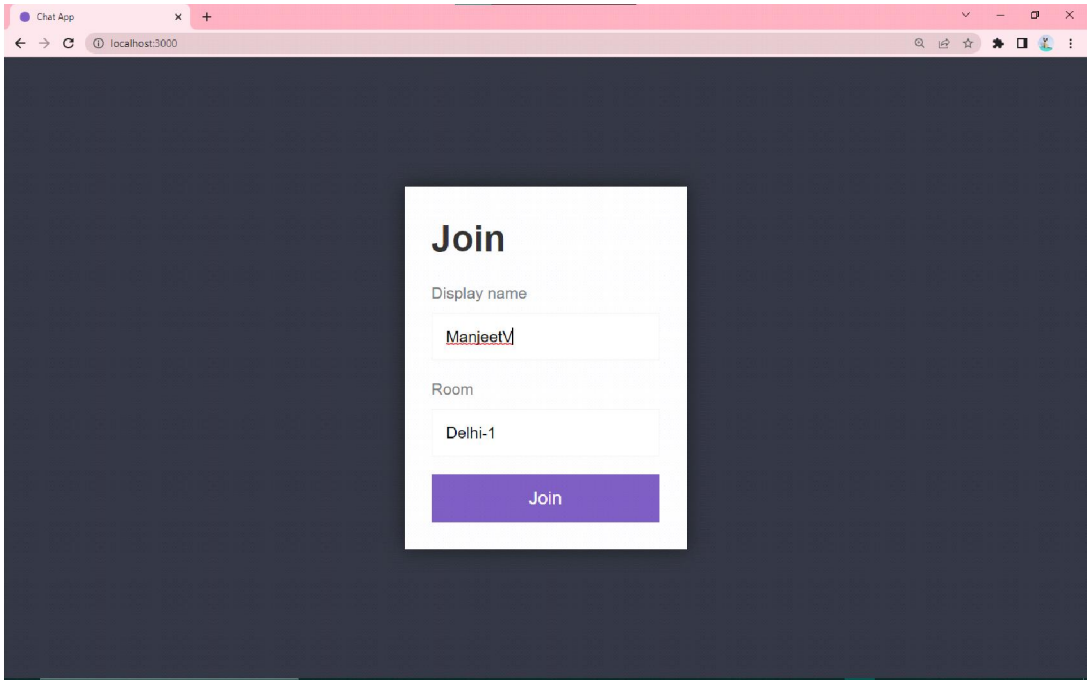

Figure 6: Multi-User Chat Application: Joining a room

- Default look of the room, the welcome message and sending a 'hello!' message. The left side-bar shows the list of active users present in the room which is updated as soon as a user joins or leaves the chat room.

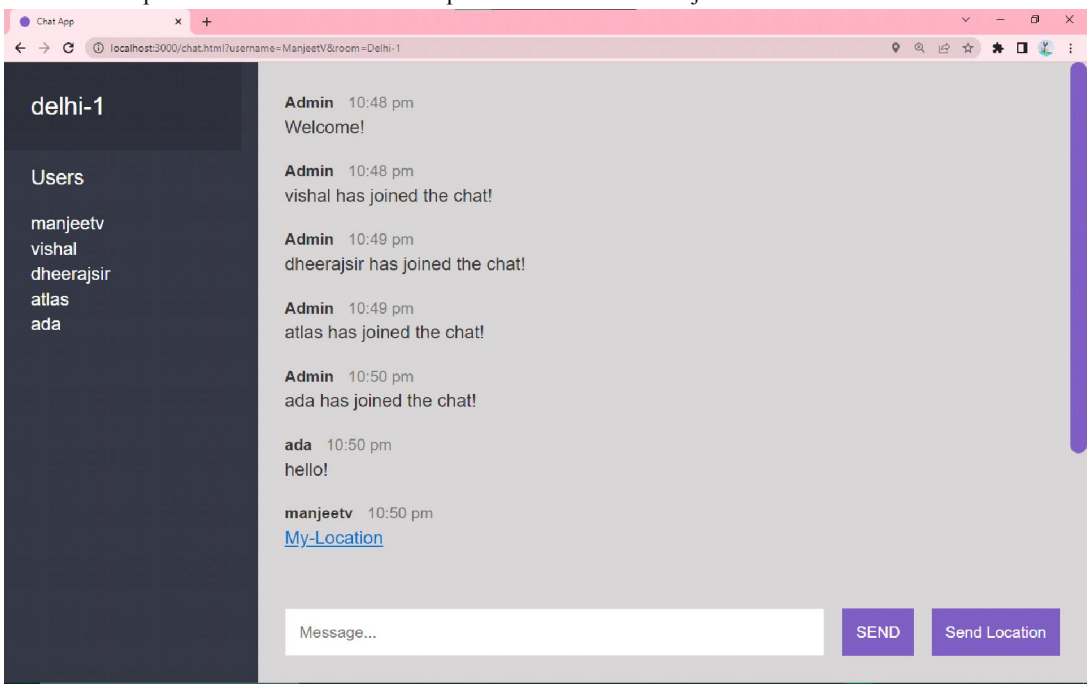

Figure 7: Multi-User Chat Application: Minimalistic User-Interface

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- Clicking on the 'My-Location' message opens a separate tab and marks the sender's location on the map with the coordinates at the time of sending the message.

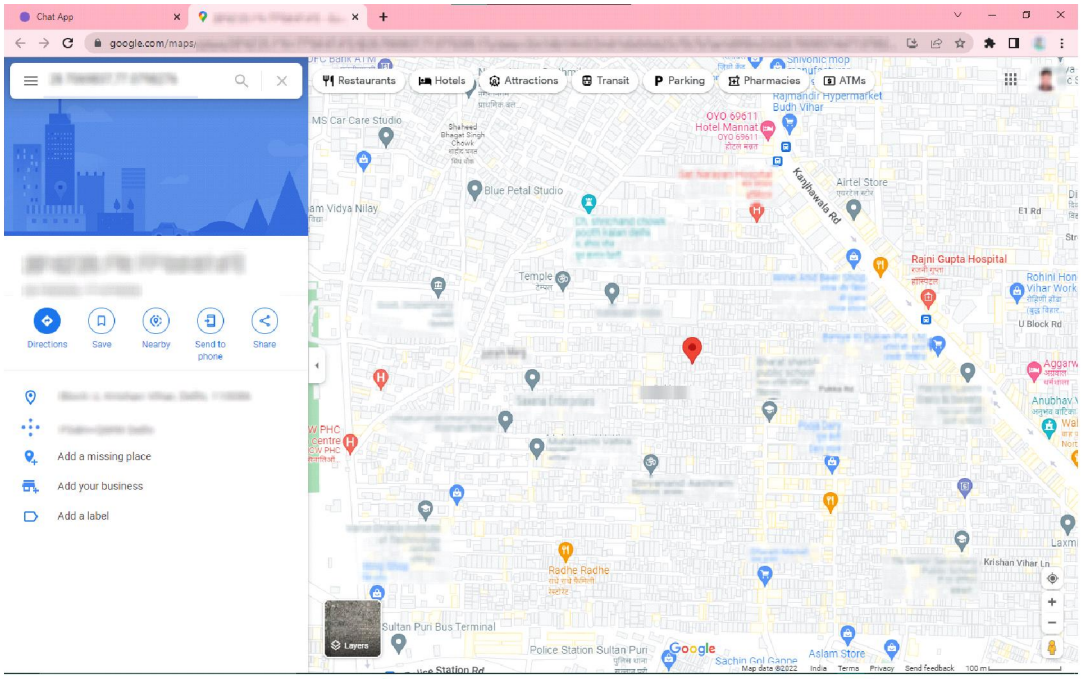

Figure 8: Multi-User Chat Application: Sending location through Google Maps

- Keeping track of users leaving the room. The remaining users are notified of any leaving member's departure and the room exists as long as there remains a user in the room.

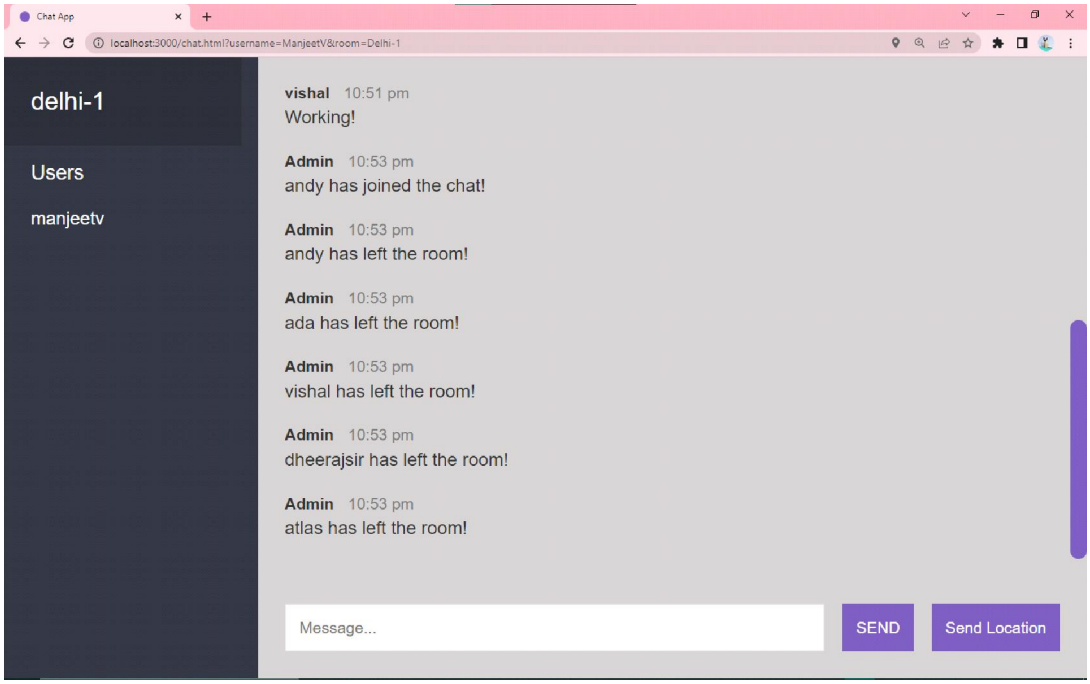

Figure 9: Multi-User Chat Application: Notifying users of leaving members

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The final system will be a communication programme that allows users to converse in real-time with ease. The user can create chat rooms and then engage with anyone else who joins the room afterwards. Users can share their opinions and information about a variety of topics in these chat rooms. In these public chat rooms, the user's identity can also be masked.

V. Conclusion and Future Scope

In any product application, no matter how good or efficient it is, there is always room for improvement. At the present, the app primarily implements and focuses on a minimalistic and distraction-free user interface while delivering a simple texting or chat service for friends or coworkers. In the future, the app may get a few additional major features, the most notable of which are:

- Voice messaging.
- Video message.
- Audio call
- Video call
- File transfer.
- Chat-Bots
- Personalised message tunes
- Personalised themes

VI. Acknowledgment

This work would not have been possible without the cooperation of many others, some of whom contributed directly and others indirectly, such as the various resources available online including and not limited to various other chat applications, libraries, research papers, theoretical notes etc which allowed us to recognise this notion. We owe a debt of gratitude and respect to our Project mentor, Dheeraj Gurjar(Assistant Professor-CSE), for his invaluable guidance, opinion, encouragement, and support during the semester. We appreciate the college's assistance in providing the required infrastructure and technical support for the project's completion. Finally, we want to express our gratitude to our family and friends for their unwavering support.

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