Web Talk

By Mamta Singh

This is a web application that allows you to *chat with other people browsing the same web site as you*. It consists of Firefox extension as the client front end and a Java based web service as the backend.

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1. Getting Started

This section gives the step-by-step guide to getting started and also describes the user manual for using the application.

Installation

1. **Start the web service:** For demonstration you can start it on local host, but for real deployment you will need a dedicated server machine. The server software is packaged in a jar file and needs Java 1.6 to launch as follows.

```
$ cd server                  # go to the server sub-directory
$ cat webtalk.properties     # edit if needed using any editor
$ java -cp webtalk-server.jar WebTalkServer
```

   Once you launch the server, it starts the web server listening on default port 8080. Before starting the web server, you may edit the `webtalk.properties` file to change the configuration parameters such as port number, maximum sizes of user list and chat history per chat room, expiration duration for user data and list of domains for which the chat room is on per-page basis or disallowed. The configuration file has more documentation on these parameters. Once the web server is launched, it reads the configuration and serves any static content from the `download` sub-directory.

2. **Create the Firefox extension:** This step is needed only if you are accessing the server from non-local host. The software also contains the `webtalk.xpi` extension file in the `download` directory assuming that you are running the web service on local host. If you plan to access the web service from actual hostname or IP address you will need to re-compile the extension with the web service host name and put it in the `download` directory. First, edit the hostname in client's properties file, then build the client and copy it to server directory.

```
$ cd client                   # go to the client sub-directory
$ cat webtalk.properties      # edit if needed using any editor
webtalkURL=http://localhost:8080/api
$ ./build.sh                  # build the firefox extension
$ cd ..
$ cp webtalk.xpi server/download/webtalk.xpi
```

I will describe later how you can dynamically change the web service host name in the client if needed.

3. **Install the Firefox extension:** You can download and install the Firefox extension `webtalk.xpi` in your browser as the client side of the application. If you are accessing the web service on a remote machine, open this help page on your remote machine using the URL http://your-server-host:8080/download so that correct extension file is served, and then click on the link below to install the extension.
   Install Firefox Extension (Click here in your Firefox browser)

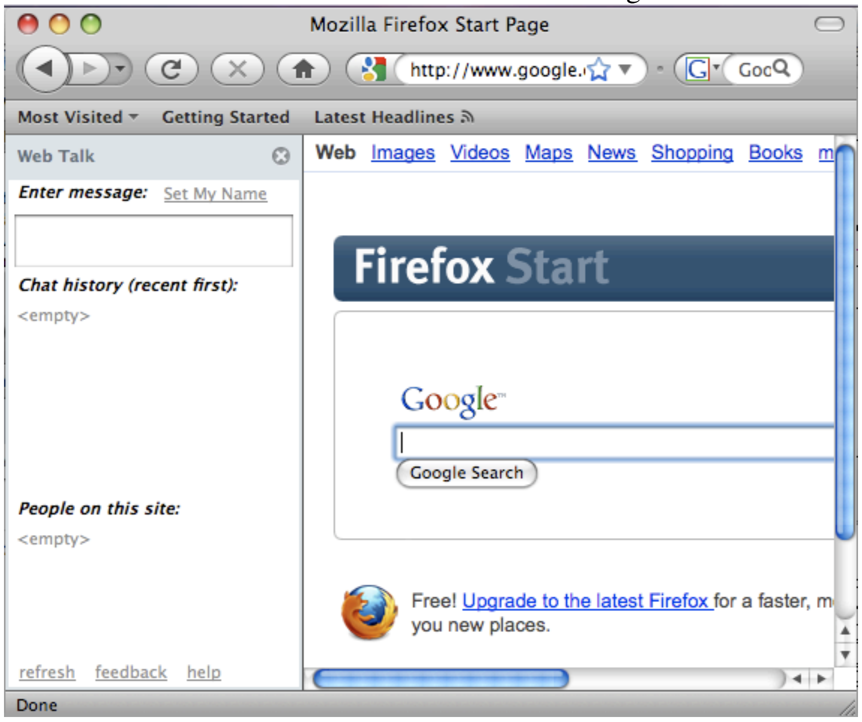
   For demonstration purpose you can create multiple profiles in Firefox, install this extension in each profile, and then communicate among different Firefox instances launched with different profiles. You can launch Firefox with profile manager using `-ProfileManager` command line option. On Mac OS X:

```
$ /Applications/Firefox.app/Contents/MacOS/firefox-bin -ProfileManager
```

4. **Launch Firefox and use webtalk:** After insalling a new extension, and restarting your Firefox browser instance(s), you can enable the `webtalk` extension, and see and chat with other people browsing the same web site as you. After installing the webtalk extension, the first time you launch your Firefox browser, you will be notified of the new extension. Just close that window and proceed with your browsing. See the user manual below for more details on how to use the client extension.

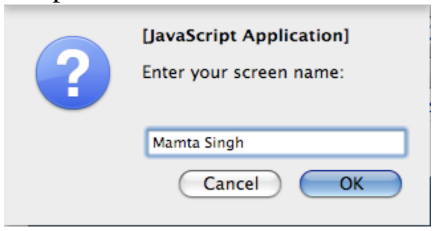
User Manual

1. **Open or close webtalk sidebar:** The webtalk extension in your browser can be opened or closed using three methods: in the "View->Sidebar->Web Talk" menu option, the shift-command-M short-cut key combination, and right-click context menu's "Web Talk" option. Additionally, you can click on the close button of the webtalk sidebar to close it. The webtalk sidebar looks like the following:



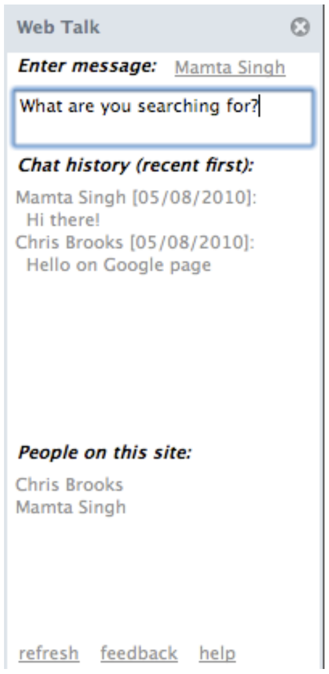
If the webtalk sidebar is opened, it will join the chat room for the web site you are browsing. You can see the chat history and user list for the chat room. You can also send chat messages.

2. **Setting your screen name:** You can click on your screen name or `Set My Name` link on the top of the sidebar. You are required to set your screen name before you can send any chat messages. You can enter your new screen name in the dialog prompt as shown below.


[JavaScript Application]
Enter your screen name:
Mamta Singh

After you change your screen name, the new name is stored in preferences so that next time you launch your browser, it restores your name. After you set your screen name, it also updates the user list for the chat room with your user data so that you can notice your name in the user list of the chat room.

3. **Sending chat messages:** You can click on the chat input box or use the shift-command-E short-cut key combination to bring the docus to the chat input box. Then type some text and press "enter" key. This will send a text message to the chat room you are in. After you send a chat message, your chat history is refreshed immediately so that you can see your chat message. For other people in the same chat room, the chat history is refreshed periodically, so their may be delay of few seconds in seeing your chat message by other people. The following shows screenshot with two people on the chat room, and two chat messages in the chat history.


Web Talk
Enter message: Mamta Singh
What are you searching for?
Chat history (recent first):
Mamta Singh [05/08/2010]:
Hi there!
Chris Brooks [05/08/2010]:
Hello on Google page
People on this site:
Chris Brooks
Mamta Singh

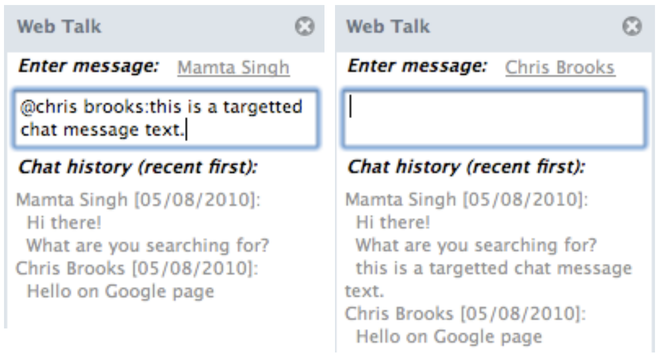
4. **Understanding chat rooms:** Note that the chat room is specific to the web site you are browsing currently in the current browser tab. If you go to a different web site or open a new tab with new web site, then you will leave the previous chat room and join the new chat room of the new web site. In this case your chat history and user list will be refreshed to that of the new chat room. If you are browse to a new web page within the

same web site, then you remain in the same chat room for that web site, and your user list and chat history remains the same. It is possible by the server to define some web sites to have chat rooms for each page or to disallow a chat room. The default configuration of the server disables the chat room for yahoo mail pages, hence when you visit the yahoo mail site, you will see a note indicating so. Also the youtube web site is configured to have chat room per page instead of global for domain. Hence, when you visit youtube web pages, you will join the chat room for each page and will be able to chat with other users on the same page. All other web sites are configured to have chat room per domain, for example two people browsing any page within www.usfca.edu will be able to chat with each other.

5. **Understanding chat history:** The chat history is refreshed periodically so that you can see new chat messages posted by others in this chat room. The number of chat messages in the history is limited by default to 30 as configured by the web service. The chat history is in reverse order so that most recent user posts are displayed first. This is similar to the existing blog comments listing on other web sites. However, to avoid confusion in reading multiple comments successively posted by the same user, the successive posts by the same user are listed in forward order. This avoids confusion in reading paragraph backwards, if an user has an habit of positing small sentences. To give smooth chat experience, as soon as you send a chat message, your chat history is updated so that your message gets displays in the chat history. You can click on the refresh link on the bottom of the side bar to explicitly refresh the chat history immediately.

6. **Understanding user list:** The user list is refreshed periodically so that you can see other users joining or leaving this chat room. The user list is sorted by name and limited in size to 30 by default as configured by the web service. The client uses a unique randomly generated client-id to associated your screen name with. Even if two different users have the same screen name, the client-id will be different, hence you will see the screen name twice in the user list. When you visit a new web site, your user name is removed from old chat room's user list and added to the new chat room's user list. When you change your screen name the existing name is updated for your client-id in the user list. Sometimes, if the user browser crashes or closes without a chance to remove that user data from user list, you will see stale user data in your user list. This will get cleaned up by the server periodically by removing expired user data. Your client periodicaly sends your user data to the server to refresh. You can click on the refresh link on the bottom of the side bar to explicitly refresh the user list immediately.

7. **Sending targetted chat message:** By default, if you send a chat message, it is visible to all users in that chat room. You can send targetted chat messages to a specific user in the user list using the following convention: `@target user:text message`. The following screen shots show the sender, sending a target message, and the receiver after receiving the message.


Web Talk
Enter message: Mamta Singh

@chris brooks:this is a targetted chat message text.

Chat history (recent first):

Mamta Singh [05/08/2010]:
Hi there!
What are you searching for?
Chris Brooks [05/08/2010]:
Hello on Google page

Web Talk
Enter message: Chris Brooks
Chat history (recent first):

Mamta Singh [05/08/2010]:
Hi there!
What are you searching for?
this is a targetted chat message text.
Chris Brooks [05/08/2010]:
Hello on Google page

Note that the target user is compared as case insensitive, and if multiple users in the user list match the name, the chat request is visible by all those users. If the target user does not exist in the chat room user list, an error message is displayed, so that the sender knows that the message was not viewed.

8. **Changing client configuration:** The chat input box also allows you to change some configuration items, e.g., refresh interval or the webservice URL. You can enter text of the form `{webtalk.property}` to display the value of the configuration `property` and `{webtalk.property=value}` to set the value. For example, enter the text as `{webtalk.service=http://your-new-server:8080/api}` to change the web service to `your-new-server` host. This feature allows you to use the Firefox extension built for one web service to be used by web service hosted on another server, or to change the default 5 second refresh interval of the client to save your bandwidth.

9. **Error notifications:** Any error or notifications are displayed in the text input box. Please see the troubleshooting section for information on errors. The example errors are web service failure if the server is unreachable or not running. Example notifications are failure to send targetted chat message or disabled chat rooms for a web site.

10. **Other user interface components:** To see more information about this extension, you can click on "Tools->Add Ons" menu option. Then in the "Extensions" tab, right-click on the "Web Talk" extension to access the "Visit Home Page" and "About Web Talk" menu options. The bottom side-bar links allow you to send email to the author for feedback or open this help page.

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2. Motivation and Goals

(This section similar to the project proposal I submitted earlier, so you may ignore it if you have already read the project proposal.)

This web application allows you to interact with other people who are browsing on the same web site as you. Today, people use blog posts and comments or forums to discuss a common topic of interest, and separate instant messaging applications to do real-time interaction. This project aims at combining the two, so that users can interact in real-time with other people who are viewing a common topic page or on a common web site. A new Firefox extension captures browsing events, and let the user automatically join the website specific chat room and interact with other users. The backend server acts as a chat server as well as stores the chat room specific data.

Motivation

Web started out as a document sharing system and eventually also evolved into a global social interaction and social presence system. User generated content such as blog, forums, etc., are means to share views and ideas on common topics of interest, and their value increases as more people participate by leaving comments to blog or posting replies in forums. Such dynamic social content, in addition to emails, has become asynchronous mode of communication among users. On the other hand, synchronous communication such as instant messaging, text chat and phone calls are used to do more real-time interaction between friends, family and colleagues.

There is a need to combine the two: asynchronous communication among strangers on common topic, and synchronous communication among friends. This can be done by expanding the boundaries of synchronous communication to people interested in common topics by bringing the text chat to your browsing activity itself. If you are browsing a particular web page of web site, you already have a common topic with others browsing the same site. Enabling text chat among these people, and allowing them to interact in real-time brings a new social dimension to your browsing activity.

As an example, when you view cricket score on web sites, there is a shout-box area where all users can post their comment and interact in real-time about the ongoing game. There are other web sites that allow such chat boxes using web site specific JavaScript. This project makes this feature independent of web site, and puts it in the browser, and hence available to all web sites. This is different than traditional instant messenger where you have fixed list of friends. Instead, the user list is dynamic and mostly strangers.

Goals and Features

- The client is a Firefox extension as a side bar, and displays the user list and chat box. The chat box has chat history and text input box.
- You can choose and edit your screen name that appears to others in the chat room.
- When you visit a web site, the client joins you to the chat room for that web site, updates the user list and chat history, and allows you to send chat messages in the chat room.
- The client allows you to send targetted chat message to specific user, using the `@user:` convention.
- When you visit a new web site, the client removes you from the previous chat room and join you to the new chat room of the new web site. The user list and chat history reflect the current chat room. A single browser's sidebar client will be connected to only one chat room at a time
- The server is written using RESTful architecture and stores and serves the chat room data.
- The server limits the size of user list and chat history for each chat room for scalability.
- The server allows configuring three types of web sites by their domain: default is to have domain-specific chat room so that users browsing anywhere on that web site domain are in the same chat room; some web sites such as youtube have page-specific chat rooms so that each video page as a chat room and people browsing different video are in different rooms; some web sites such as Yahoo mail disallow a chat room.
- Periodic polling is used to refresh the user list and chat history instead of any asynchronous push from server to client, so that all session state is maintained in the client and server can be stateless.
- (New) Optimization of bandwidth in polling by using version of user list and chat history. If the server has the same version as the client then the server returns "304 Not Modified" response without any data to save bandwidth.
- The server periodically removes the expired user data from various chat rooms to handle crashed or unresponsive browsers. If stateless web requests are used, and the browser is closed or crashed, then the client may not get a chance to send a leave request to the chat room. In this case the server times out the client.

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3. Software Design

This section describes the design and implementation of this client-server project. The client is a Firefox extension and runs in your browser application, and the server standalone web service implemented using Java restlet framework. The server uses in-memory data structures instead of external databases. This should change in future for larger scale deployment.

Directory Structure

The project directory structure is shown below with a brief description of what each file does. All the source files are already well commented, so I am not repeating the detailed description here.

```
assignment5/                                        main project
  +---- client/                                     client (Firefox extension)
  |       |---- build.sh                            script to build the extension
  |       |---- config_build.sh                     configuration to build the extension
  |       |---- chrome.manifest                     extension's manifest file
  |       |---- install.rdf                         extension's entry point
  |       +---- content/                            source files of the extension
  |                 |---- firefoxOverlay.xul        main overlay changes in Firefox
  |                 |---- about.xul                 user interface for 'about' dialog box
  |                 |---- sidebar.xul               user interface for sidebar
```

```
 |               |---- webtalk.js             main script defining webtalk class
 |               |---- webtalk.properties     defines web service URL
 +---- server/                                server (RESTful web service)
           |---- webtalk-server.jar           compiled web service JAR
           |---- webtalk.properties           server configuration
           +---- .classpath, .project, bin/   eclipse project files
           +---- lib/                         external libraries
           +---- src/                         source files of the implementation
           |       |---- WebTalkServer.java       main server application
           |       |---- Database.java            in-memory data store
           |       |---- RoomTypeResource.java    handle GET roomtype
           |       |---- UserListResource.java    handle GET, POST userlist
           |       |---- ChatHistoryResource.java handle GET, POST chathistory
           |       |---- StaticResource.java      handle GET download/
           +---- download/                    static files for help and download
                   |---- webtalk.xpi          downloadable extension for localhost
                   |---- index.html           this help file
                   |---- *.png                supporting images for this help file
```

Data Model

The data model defines the semantics of various data structures. A chat room `location` uniquely identifies a chat room. A location is either the domain, e.g., "www.cs.usfca.edu" for domain-specific chat rooms, or a full URL of the form "www.youtube.com/watch?v=somevideoid" for page-specific chat rooms. The location property is used as index in various tables to identify the chat room specific data.

The chat room types is stored in a `sites` table which is created on startup by reading the configuration file, and determines chat room type for particular domain names. It is indexed by domain name string, e.g., "www.youtube.com" or "mail.yahoo.com", and contains value of true if it has page-specific chat rooms and false if the chat room is disallowed. A missing domain in this table indicates default behavior of domain-specific chat rooms.

```
sites: table(domain => boolean)
```

The `userloc` table maps a user's client-id to the `location` of his current chat room. Each browser instance creates a new randomly generated client-id on launch and supplies it to the web service to identify the user. If the user is not in any chat room, his client-id is missing from the table.

```
userloc: table(client-id => location)
```

The `userlist` table maps the chat room `location` to the `UserList` data of that chat room. The `UserList` data of a chat room represents a list of `User` data, one per user, indexed by the user's client-id. The `User` data of each user has her client-id and screen name properties, and a timestamp when this user data will expire unless refreshed earlier. The `UserList` also has a `version` attribute which is updated each time the list is modified for that chat room.

```
userlist: table(location => UserList)
UserList: {
  version: int,
  data := table(client-id => User) }
User:     {
  client-id: string,
  name: string,
  expires: long }
```

The `chathistory` table maps the chat room `location` to the `ChatHistory` data of that chat room. The

`ChatHistory` data of a chat room represents a list of `Chat` messages, one per text message. The `Chat` data represents a single text chat message and has properties such as `sender`, `target`, `timestamp` and `text` for sender name, optional target receiver name, timestamp of the message and the text of the message, respectively. The `target` property is optional, and if present, indicates the target user name to which this message is available, otherwise the message is available to all users in the chat room. The `ChatHistory` also has a `version` attribute which is updated each time the chat history is modified for that chat room.

```
chathistory: table(location => ChatHistory)
ChatHistory: {
  version: int,
  data := list(Chat) }
Chat:        {
  sender: string,
  target: string (optional),
  timestamp: long,
  text: string }
```

Web Service

The server exposes a RESTful web service API that allows the client to access the data on the server. The data is represented using JSON (JavaScript Object Notation) in the message body as needed. Additional attributes are supplied in the URL parameters. This section describes the web service details.

The `roomtype` resource allows knowing the room type of any domain. The server looks up the `sites` table to determine the room type and returns either domain, page or none in response.

```
GET /api/roomtype?location=www.google.com
Response-body: domain
GET /api/roomtype?location=www.youtube.com
Response-body: page
GET /api/roomtype?location=mail.yahoo.com
Response-body: none
```

The `userlist` resource represents the user list of a chat room location. Fetching the user list looks up in the `userlist` table and returns list of users.

```
GET /api/userlist?location=www.google.com
Response-body: {"version":5, "userlist":[
    {"clientId":"12345678", "name":"Mamta Singh"}]}
```

If a `since` parameter is supplied, then the server returns "304 Not Modified" response if the user list version in the server is same as the parameter value, otherwise return "200 OK" with response-body if the server data is different version. This helps in reducing the bandwidth for steady state operation when user list does not change.

```
GET /api/userlist?location=www.google.com&since=5
304 Not Modified
```

Doing a POST on the `userlist` resource allows a user to add his user data to the chat room user list. The server updates the `userlist` as well as `userloc` tables to add the user in the new location and remove from her old location based on the client-id.

```
POST /api/userlist?location=www.yahoo.com
Request-body: {"clientId":"12345678","name":"Mamta Singh"}
```

Besides implicit removal from old chat room, the client can explicitly remove the user from a chat room using the delete service on the `userlist` resource. The server removes the user data from the `userlist` and `userloc` table for her client-id. Since DELETE method is not easy to work with in JavaScript I use the following format.

```
POST /api/userlist/delete?location=www.yahoo.com
Request-body: {"clientId":"12345678","name":"Mamta Singh"}
```

The `chathistory` resource represents the chat history of a chat room location. Fetching the chat history looks up in the `chathistory` table and returns a list of chat messages. The `since` parameter is similar to earlier, where the server returns "304 Not Modified" if its version is same as the client version.

```
GET /api/chathistory?location=www.yahoo.com&since=12&target=Mamta%20Singh
Response-body: {"version":14,"chathistory":[
  {"sender":"Chris Brooks","timestamp":1234567890,"text":"Hello on Google page"},
  {"sender":"Mamta Singh","timestamp":1234567892,"text":"Hi There"},
  {"sender":"Mamta Singh","timestamp":1234567894,"text":"What are you searching for?"}]}
```

If a `target` parameter is supplied, then the server also returns any chat messages that are specific for this target user in addition to the other public messages. Note that the location and target parameters must be escaped so that the server can correctly parse them. Additionally, Restlet interpretation of URL also requires that any "/" be escaped in the parameters, e.g.,

```
GET /api/chathistory?location=www.youtube.com%2fwatch...&target=Mamta%20Singh
```

Doing a POST on the `chathistory` resource adds a new chat message to the chat room.

```
POST /api/chathistory?location=www.yahoo.com
Request-body: {"sender":"Mamta Singh","timestamp":1234567892,"text":"Hi There"}
```

If a `target` parameter is supplied, then the server adds the `target` attribute to the `Chat` data, otherwise it is null indicating public message. If the target is supplied, then the server also checks whether the target user exists in the user list of the chat room and returns "404" response if not.

```
POST /api/chathistory?location=www.google.com&target=some%20user
404 Target User Not Found
```

There is no explicit mechanism to delete a chat history message. The server limits the size of the chat history per chat room by removing oldest messages.

Additionally, the server supports the `/download` resource to expose this help page as well as other static content such as installable `webtalk.xpi` extension file.

Firefox extension

As mentioned before, the client is implemented as a Firefox side bar extension and displays the user list and chat history for the current chat room based on the web site visited on the current browser tab. The user manual section gives description of the user interface and how to use the client. This section describes the software design of the client.

The user interface are defined in various `xul` files, e.g., firefoxOverlay.xul defines main changes in the Firefox overlay such as menu additions and short-cut key handling, the about.xul defines the layout of the about dialog box that is displayed when you click on the "About Web Talk" menu item, and the sidebar.xul defines the layout of the sidebar such as the chat input box, chat history and user list. The webtalk.js file defines the main application class named `webtalk`. There are several properties and methods defined and well commented in this file. Rest of this section defines the working of the client.

When the webtalk sidebar is opened or closed, the `webtalk` object starts or terminates the web service requests. The client keeps the current location of chat room if any. It periodically fetches the user list and chat history as well as posts the user data to the chat room. This timer is active if the sidebar is open and client has joined a room. The decision when to join a chat room depends on the browser's location bar.

When the browser starts, the client installs the listener for the browser location change event. When the browser location or current tab's location changes, it finds out the room type of the domain of the new location. The result is cached so that next time it does not send the room type request for the same domain. Once the client knows the room type, it can determine whether the change in the browser location will result in the change in the chat room. For example, if the browser location was changed from "abc.com/first" to "abc.com/second" but room type of "abc.com" is "domain", indicating domain specific chat room, then the chat room hasn't changed. Whereas if the room type was "page" indicating page specific chat room, then the chat room has changed. Similarly if the browser location changes from "abc.com/first" to "xyz.com" then the chat room always changes irrespective of the room type because the domain of the location has changed.

If the client determines that the chat room has changed, it invokes three web service requests: first it posts the local user data to the chat room's user list, then it fetches the current chat history and then user list for the chat room. To avoid out-of-order of POST and GET of user list, the GET user list request is delayed by few milliseconds, so that the fetched user list contains my user data.

When the user enters a text in the input box to send a chat message, the client invokes the POST chat history web service to send the chat message. The client also parses any special format such as for targetted chat message or client configuration commands and acts accordingly.

When the user list and chat history are fetched, the version number is stored, so that in the next refresh interval, this version is supplied to the web service. The version is reset everytime the chat room location changes. The version saves bandwidth in steady state when user list or chat history is not modified in successive polling requests. The client updates the user interface whenever a new update of user list or chat history is received. The client displays the user list in sorted order, and the chat history in reverse timestamp order as described earlier so that it doesn't cause confusion in reading multiple sentences sent by the same user successively in the chat history. If the client receives any error response such as disabled chat room for a location, it indicates so in the text input box.

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4. Troubleshooting and Known Issues

This section lists some known issues and trouble shooting tips.

1. In-memory data storage: the server stores the data in data structures instead of external data base or file, hence data will be lost if you restart the server. In future, we can easily replace Database.java with a connection to external persistent database using JDBC.
2. Network connectivity: if the client-server connectivity is disrupted, the client will not be able to do periodic refreshes, and will display appropriate error message. Since the GET web services can be directly accessed from the browser by going to the web service URL, you can test whether the client-server connectivity is working.
3. Server exception and warning: sometimes you will see some SocketException (Unable to shutdown server socket). This is not a bug in my code. This is a known issue in Restlet 1.x as documented in http://restlet.tigris.org/issues/show_bug.cgi?id=732 but has been fixed in Restlet 2.0 as mentioned in

http://restlet.tigris.org/issues/show_bug.cgi?id=927 Since 1.x version is stable, I have used only 1.x. Apparently this exception can be ignored in 1.x.

4. Repeated user name: sometimes the extension doesn't get a chance to send the delete web service request before terminating the browser. If you restart your browser immediately, your user name may appear twice in the user list. The reason is that each instance of the browser launch generates a new random and temporary client-id, and user list is unique for the client-id, and not for the screen name. However, the server will periodically remove the expired user from the list, with default interval of one minute, so the client user list will get corrected after some time.

5. Ideas for Future Work

I think this project is very nice idea and I would like to further explore it for open source or commercial reasons. I am listing a few ideas that can further enhance the software.

1. The polling based chat system have two problems: higher bandwidth and hence load on the server, and delay in updates of chat or presence. I have solved the bandwidth problem by using the version number of resources and returning "304 Not Modified" if resource is not modified. Some form of asynchronous client-server interaction will work better for more real-time, interactive chat and presence. Perhaps Flash application or Java Applet based client application will help here.
2. The periodic polling interval should be made dynamic based on the request load on the server and client. May be the client can use some exponential backoff of refresh interval in case of failure or unresponsive server. The server may return a 5xx response indicating overload. This will help in scaling the system to larger user base.
3. Additional features that are present in existing instant messengers can be added to this project, e.g., emoticons, file sharing, etc.

6. References

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