PROPOSED DESIGN AND DATA MODEL

for

Yabber

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Contents

1 Introduction

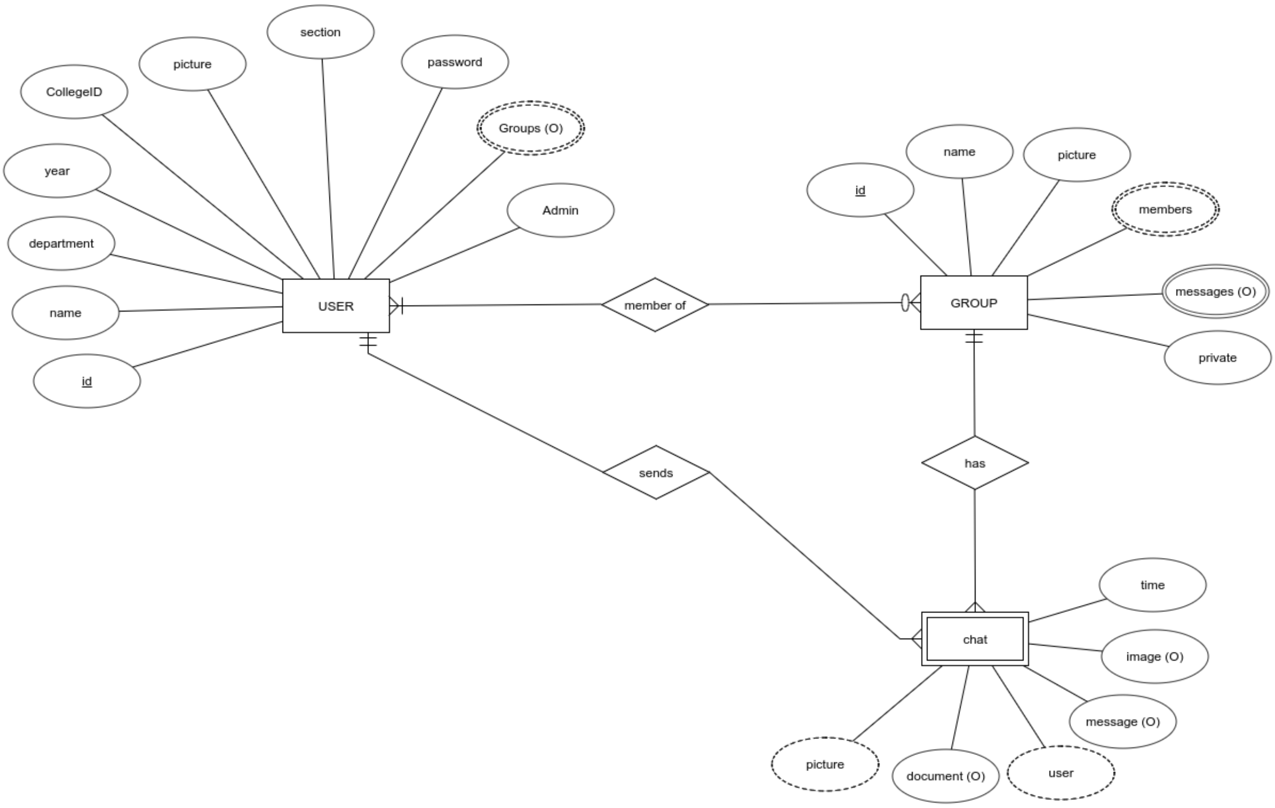
”Yabber” is a real-time chat application specially built to work on LAN in college. Each user is given a login credential using which the user can access the application. The application uses web sockets to quickly send and receive messages and the messages are cached using Redis to quickly retrieve it. There are two kinds of users in yabber: standard and admin. Admin users get the extra privilege to access the admin panel to add, remove and modify user data. The application allows the user to create groups in which multiple users can chat at once. The user is allowed to send text messages, emojis, images and documents (.doc, .docx, .pdf, .ppt) up to a size of 50MB. The formats are restricted since the application is meant to be used within a college.

2 Data Model

The application uses MongoDB as the data store and Redis for caching. MongoDB is a document based NoSQL database. It uses documents to store the data which is very similar to records in SQL. Documents are stored in BSON(Binary JSON) format. The specialty of Document Databases are that we can store what we query directly without creating complicated relations and views. This improves querying performance and schema designing time, but however, schema-lessness of MongoDB might result in a poorly structured database. Hence, we use mongoose.js(MongoDB ODM for Node.js) to design the application's models.

We use MongoDB because it reduces the relationship between the group and the messages as embedded sub-document. This improves querying time.

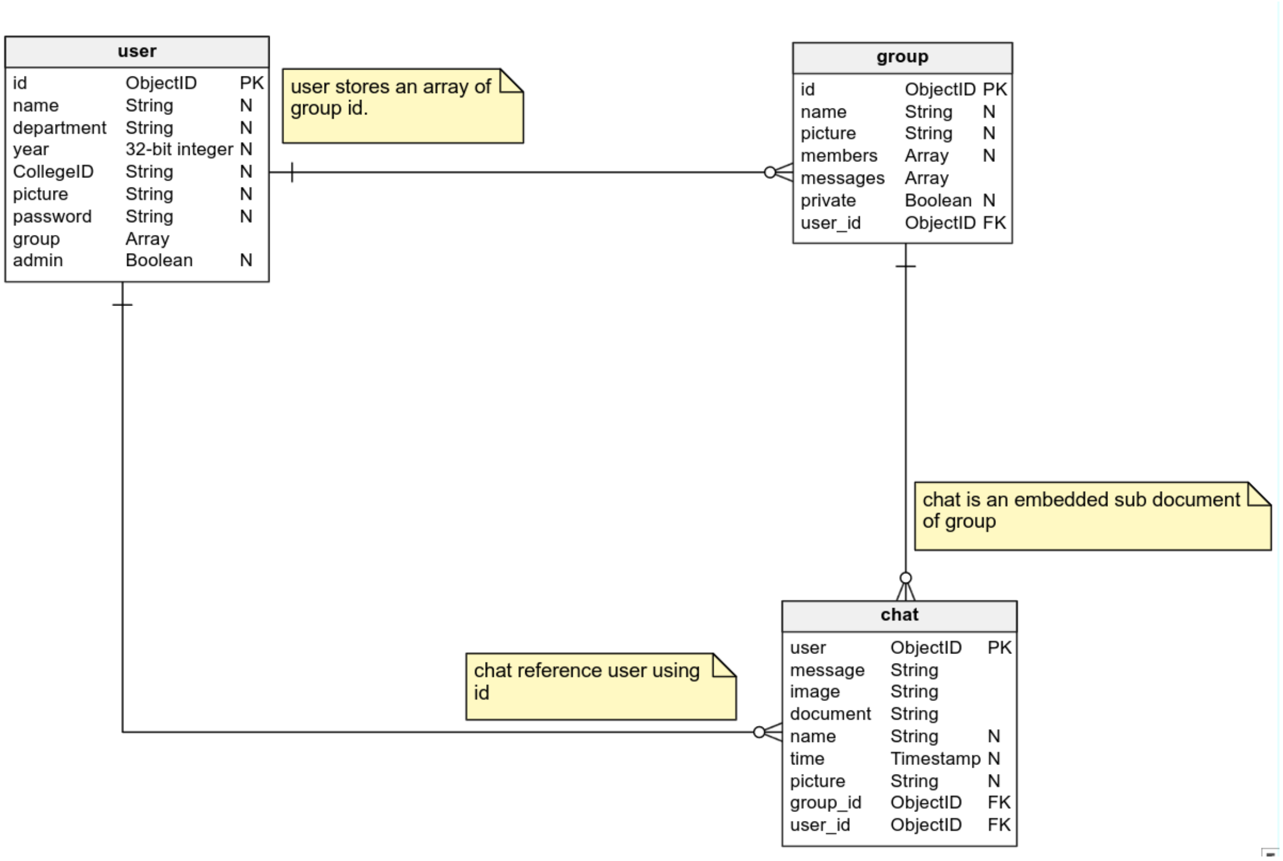
Yet, writing every message to the database is a large overhead. Hence, we use Redis for caching our messages. Redis is an in-memory data structure store. It is in order of magnitudes faster compared to MongoDB. We use it only for catching because it runs in memory and can be an overhead to use since it's API is atomic.



Each user can be a part of many groups and each group can contain many users, hence the cardinality is many-to-many. Chat is the message sent in the group. A group can have many chats(aka messages) but a chat can only belong to a group. Hence one-to-many relation exists. Similarly, a message can be sent only by one user whereas a user can send many messages, hence one-to-many relation exist.

The admin user is differentiated from the standard user using the ”admin” attribute of the user entity, which as a boolean entity.

The private chats are considered as two member groups by the internal structure since they both have a similar schema.



user

id	ObjectID	PK
name	String	N
department	String	N
year	32-bit integer	N
CollegeID	String	N
picture	String	N
password	String	N
group	Array	
admin	Boolean	N

user stores an array of group id.

group

id	ObjectID	PK
name	String	N
picture	String	N
members	Array	N
messages	Array	
private	Boolean	N
user_id	ObjectID	FK

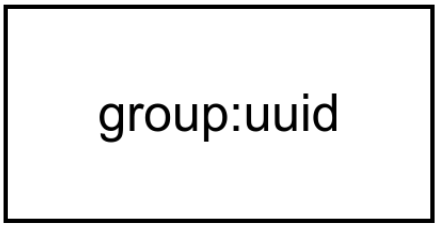
chat is an embedded sub document of group

chat reference user using id

chat

user	ObjectID	PK
message	String	
image	String	
document	String	
name	String	N
time	Timestamp	N
picture	String	N
group_id	ObjectID	FK
user_id	ObjectID	FK

The above is the schema diagram for the application's models. The user and the group schema have a referenced relationship which means the user has an array of group id which he is a part of and the group has an array of user id for who are present in it. Similarly, chat has the id of the user document. Here, the chat stores name and picture link of the user redundantly, so we don't have to query the database twice.



The above schema represents the format in which the chat is stored in Redis. Redis is an in-memory data structure store. It stores data as key-value pairs and provides internal data structures. Here, we cache the messages as lists. The name of the list is in the format: 'group: ⟨ group's uuid ⟩ '.

3 Design

3.1 Technology Stack

- Since we are building a real-time chat application, we need the messages to transmit instantaneously. So, we need the application to be asynchronous. Hence, we use Node.js which it is built to be asynchronous in nature.
- We use it with the Express.js since it is a light-weight unopinionated framework and hence allows us to build a light weight application which is best suited for this application since scalability is not an important aspect since it is meant to be used within the college's LAN.
- We use MongoDB to store the data since it is schemaless and hence allow us to quickly prototype the application. Moreover, light relations like the relation between chat(aka message) and the group can be reduced as embedded sub-documents an hence reducing the reducing the querying time.
- Since MongoDB is schemaless, we use mongoose ODM which allows us to design the schema at the application level and treat documents as objects.
- We use Redis to cache the messages and store it until a threshold of 50 messages is reached then move it to the database. This greatly improves performance since the number of database writes is reduced and moreover, the user can retrieve the instant past messages quickly since Redis is an in-memory data store.
- Socket.io is used to establish the web socket connection between the client and the server since it provides a high-level API to use web sockets and fall back to long polling in legacy browsers.
- We use Twemoji, which is twitter's emoji library which allows us to parse unicode to image tag to maintain consistency.
- Passport.js is used to create the authentication system.
- bcrypt is used to hash the passwords before storing.
- Morgan is used for logging.
- Gulp is used to build automation process.
- The frontend is built using Typescript and Angular 2 since this is a single page application and Angular 2 provide a clean component based separation for the interface.

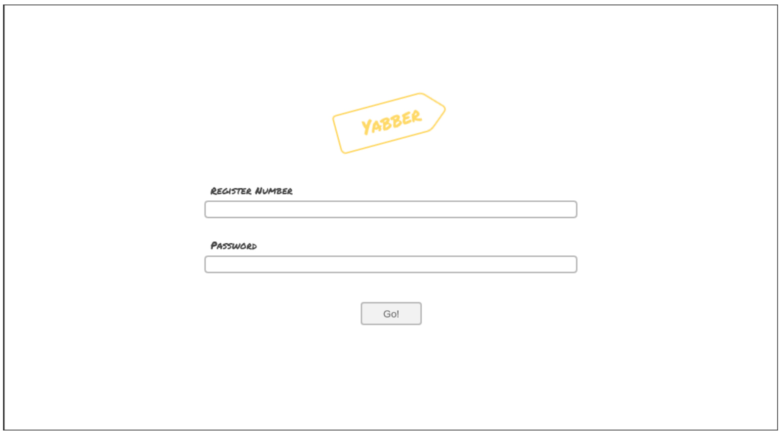
- SASS 3(SCSS) is used to style the frontend since it is a superset of CSS and provide additional features which enable us to be more productive.
- Bootstrap is used to design a responsive interface quickly.
- Normalize.css is used to make the interface consistent throughout different browsers.

Therefore,

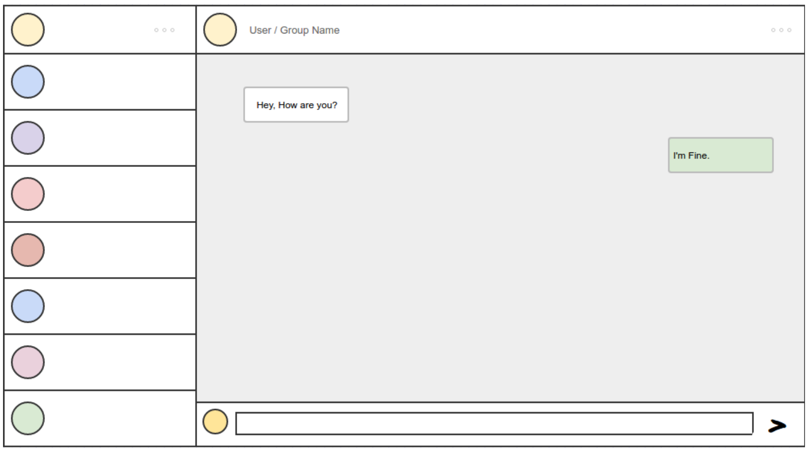
- Backend
  - Node.js
  - Express.js
  - MongoDB with Mongoose ODM
  - Redis
  - Socket.io
  - Passport.js
  - bcrypt
  - Morgan
  - Gulp
- Frontend
  - Angular 2 with TypeScript
  - SCSS
  - Normalize.css
  - Bootstrap

3.2 User Interfaces

When a user opens the client side with their browser, the login page appears. In this interface, the user can enter their register number and password to enter to the chat application.



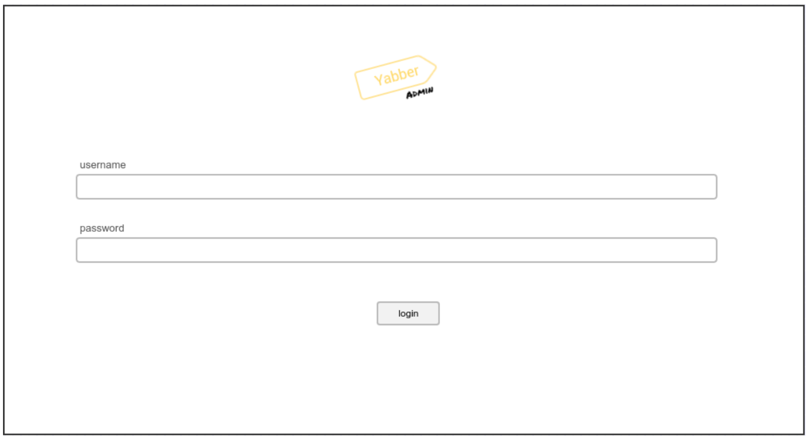
The next interface on the client side would be the chat interface. Here, the user can create groups, select group / other user and chat with them. When the user clicks on the list item on the left side menu, the chat column on the right side is updated with that chat's controls. The user can send emojis using the smiley icon left of the input box and upload images and other document using either the hamburger menu on the top right or by using the right-click context menu.



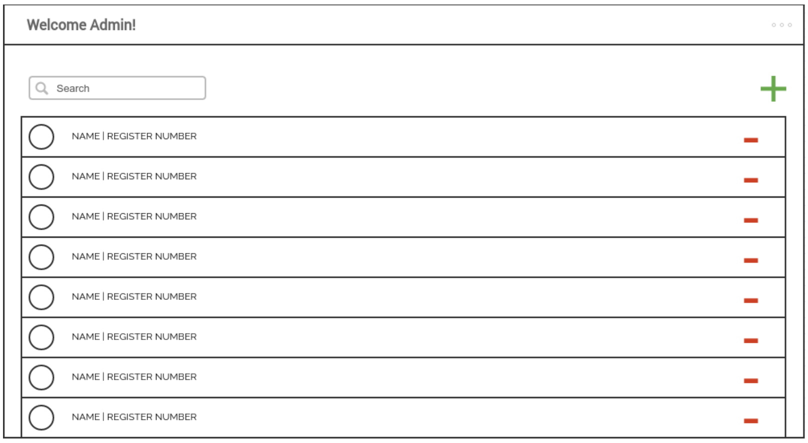
Hey, How are you?

I'm Fine.

The admin panel consists of an Admin login interface using which the college management can login into the admin panel.

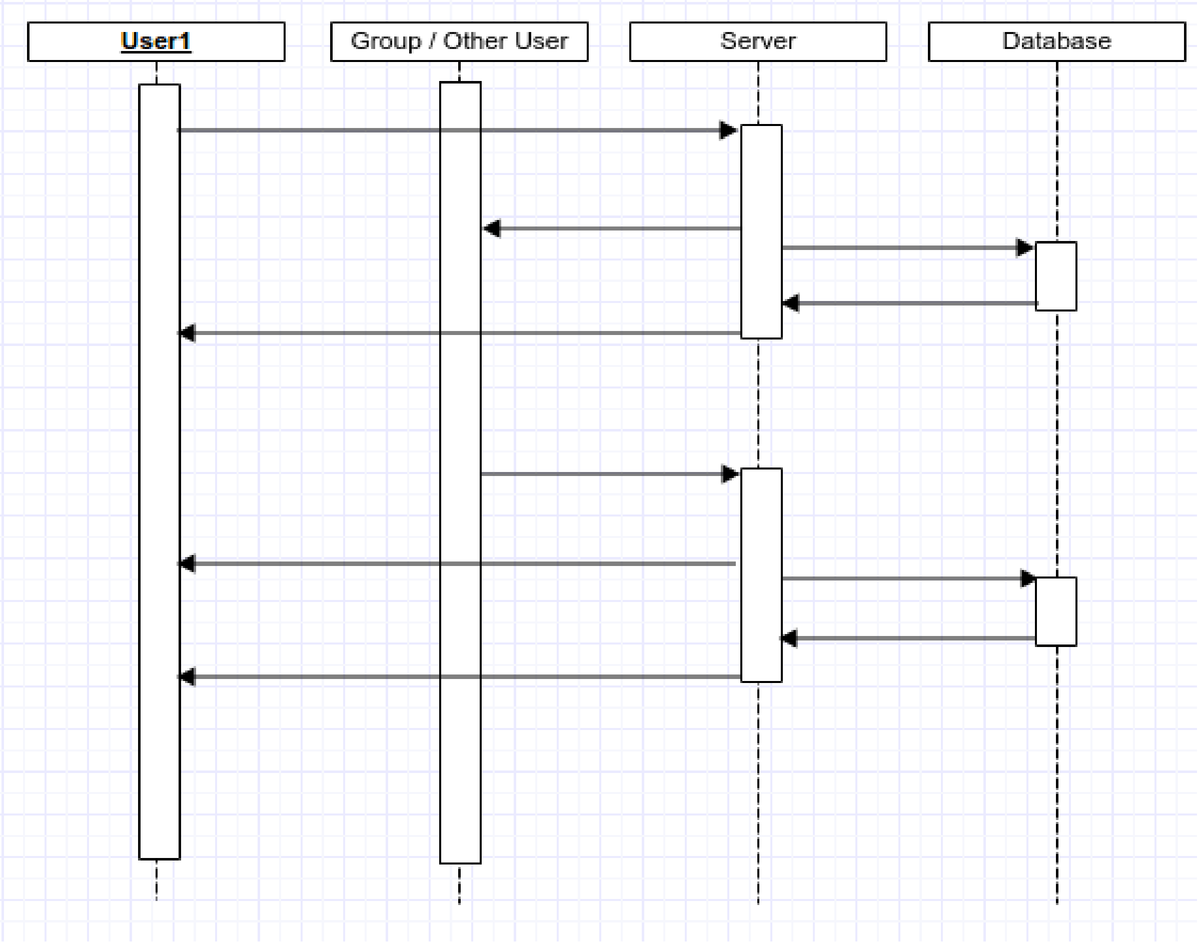


The logged in admin user can add a new student using the green plus button on the top right side and remove a student using the red minus sign next to the student's name. The admin can modify details about the student by double clicking the student's listing.



3.3 Interaction Diagram

Since Yabber is a real-time chat application, the chat process can be clearly explained using sequence diagram. The below is the sequence diagram of the messaging process. The first set represents user sending message and the second set represent user receiving the message.


User1
Group / Other User
Server
Database