Final Project Report – Chat Application Using Flutter & Firebase

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1. Introduction

This project aims to develop a real-time chat application using **Flutter** for the frontend and multiple **Firebase services** as the backend.
The system demonstrates user authentication, real-time message exchange, chat room management, and online/offline presence tracking.

The technologies used include:

- **Firebase Authentication** – for secure user login and registration
- **Cloud Firestore** – for storing chat rooms and messages
- **Firebase Realtime Database** – for real-time presence tracking
- **Provider** – for state management inside the Flutter application

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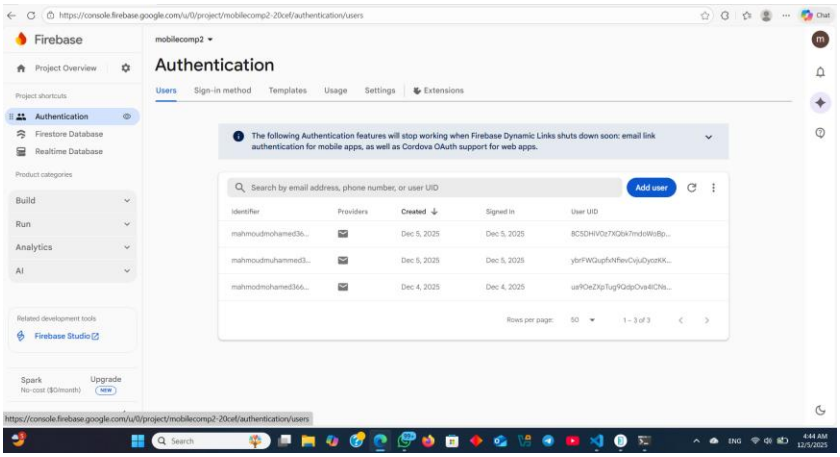
2. Firebase Authentication



2.1 Justification

Firebase Authentication is used because it provides:

- Secure email-and-password authentication
- No need for manual backend implementation
- Easy integration with other Firebase services
- Automatic handling of user sessions and auth tokens

2.2 Implementation

Users can register using:

FirebaseAuth.instance.createUserWithEmailAndPassword(email: email, password: password);

Users can sign in using:

FirebaseAuth.instance.signInWithEmailAndPassword(email: email, password: password);

User authentication state is monitored through:

_auth.authStateChanges().listen((user) { ... });

2.3 Result

- After logging in, the user is automatically redirected to the home screen.
- When logging out, the user returns to the login page.
- The authenticated user's email is displayed in the UI.

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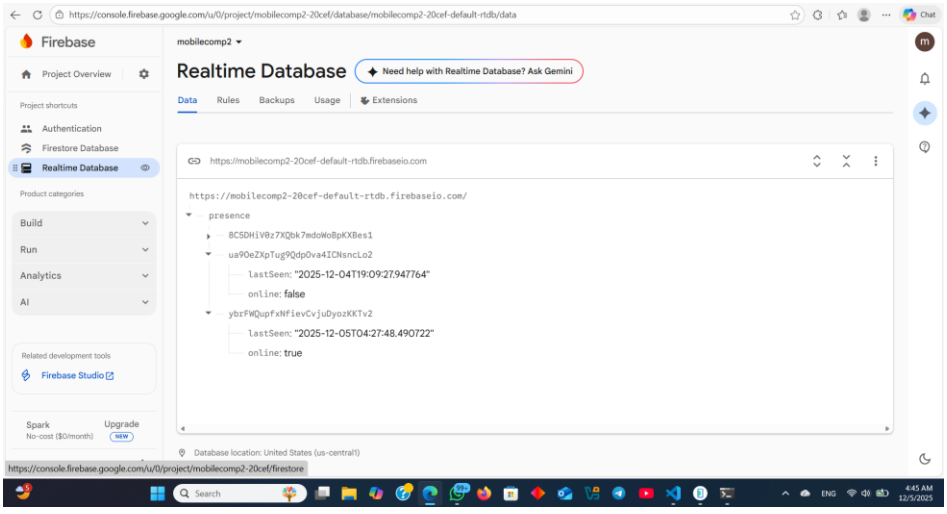
3. Firebase Realtime Database



3.1 Justification

Firebase Realtime Database is used for **presence tracking** because:

- It provides extremely fast real-time updates
- It is optimized for simple data that changes frequently
- Ideal for storing fields like:
    - online: true/false
    - lastSeen: timestamp

3.2 Implementation

Inside auth_service.dart, user presence is updated as follows:

```
_presenceRef.child(user!.uid).set({
  'online': online,
  'lastSeen': DateTime.now().toIso8601String(),
});
```

Presence is updated:

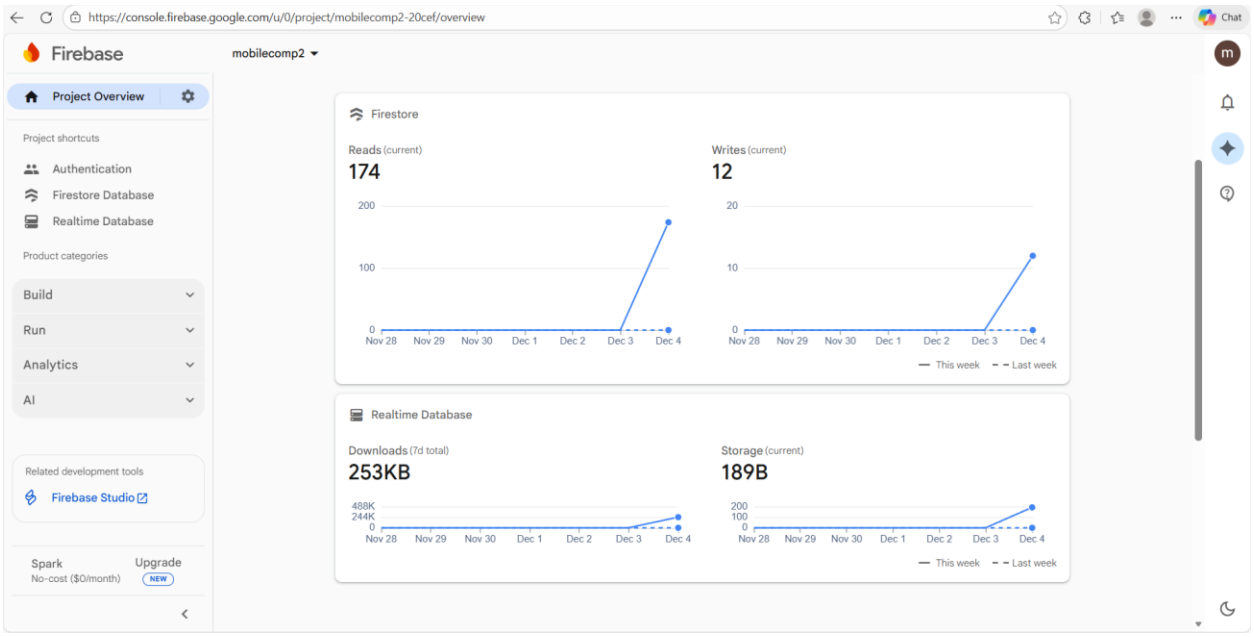
- When the user signs in → online = true
- When the user signs out → online = false

3.3 Result

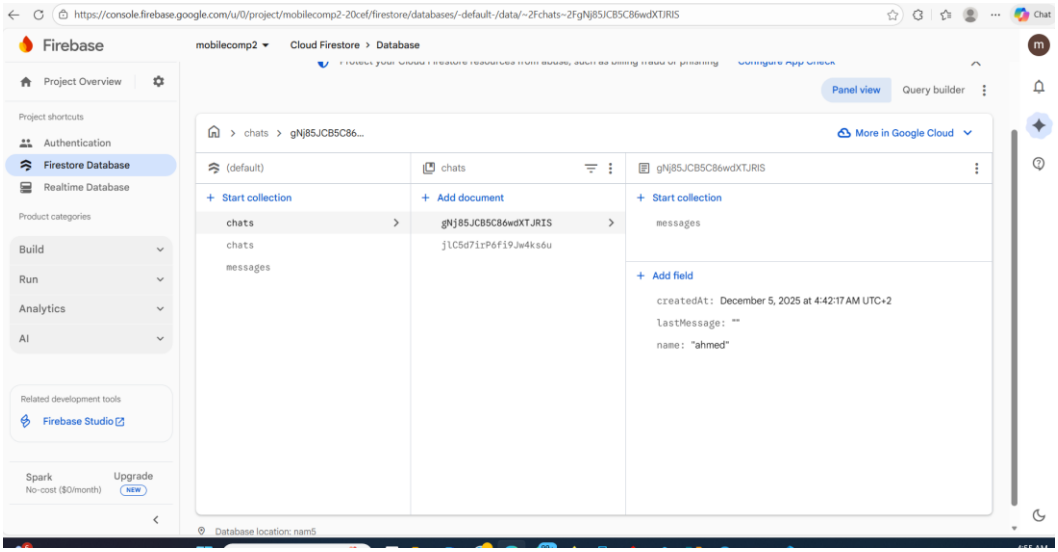
The home screen displays active users:

2 users online

This number updates in real-time across all running devices.



4. Cloud Firestore Database



4.1 Justification

Firestore is used for storing chat messages and chat rooms because:

- It supports real-time listeners
- Allows structured and scalable data through Collections and Documents

- Provides powerful queries (orderBy, filters, indexing)
- More appropriate than Realtime Database for complex chat data

4.2 Implementation

Database Structure

```
chats (Collection)
  └── chatId (Document)
      name: "General Chat"
      createdAt: timestamp
      lastMessage: "Hi"
      lastMessageTime: timestamp

      messages (Subcollection)
        └── messageId (Document)
            text: "Hello"
            senderId: "user123"
            senderEmail: "example@gmail.com"
            timestamp: timestamp
```

Sending a Message

```
FirebaseFirestore.instance
 .collection('chats')
 .doc(chatId)
 .collection('messages')
 .add({
  'text': text,
  'senderId': uid,
  'senderEmail': email,
```

```
  'timestamp': DateTime.now(),
});
```

Also updates the chat preview:

```
FirebaseFirestore.instance.collection('chats').doc(chatId).update({
 'lastMessage': text,
 'lastMessageTime': DateTime.now(),
});
```

Receiving Messages in Real Time

```
StreamBuilder(
 stream: FirebaseFirestore.instance
  .collection('chats')
  .doc(chatId)
  .collection('messages')
  .orderBy('timestamp')
  .snapshots(),
 ...
);
```

Messages update instantly on all connected devices.

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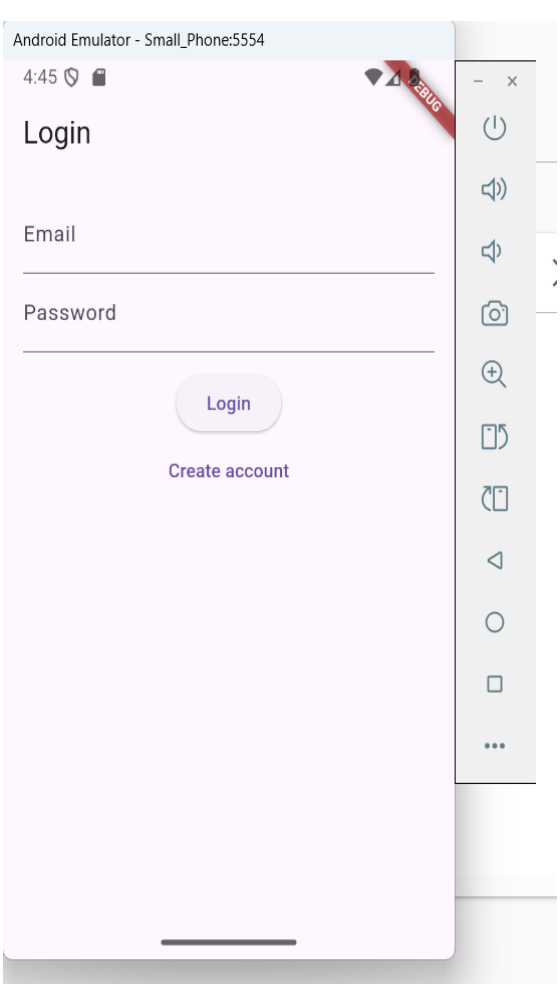
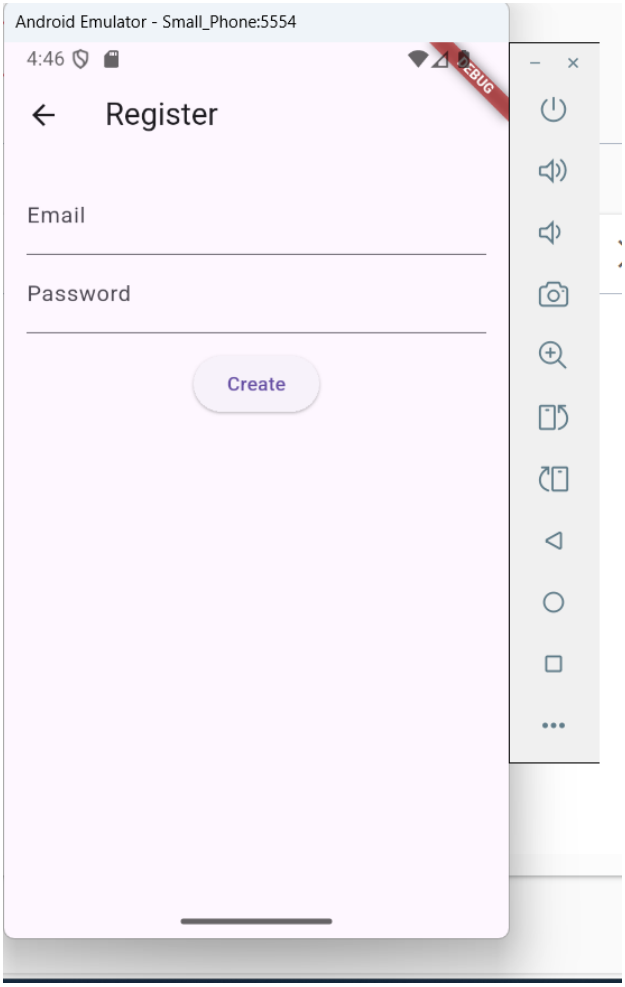
5. Chat Application Implementation



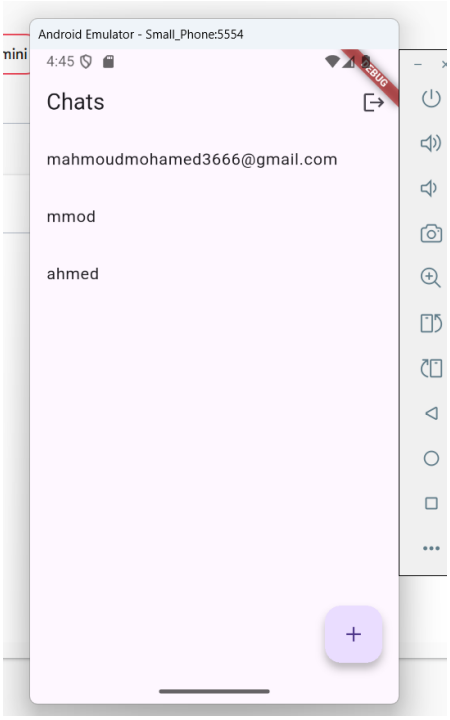


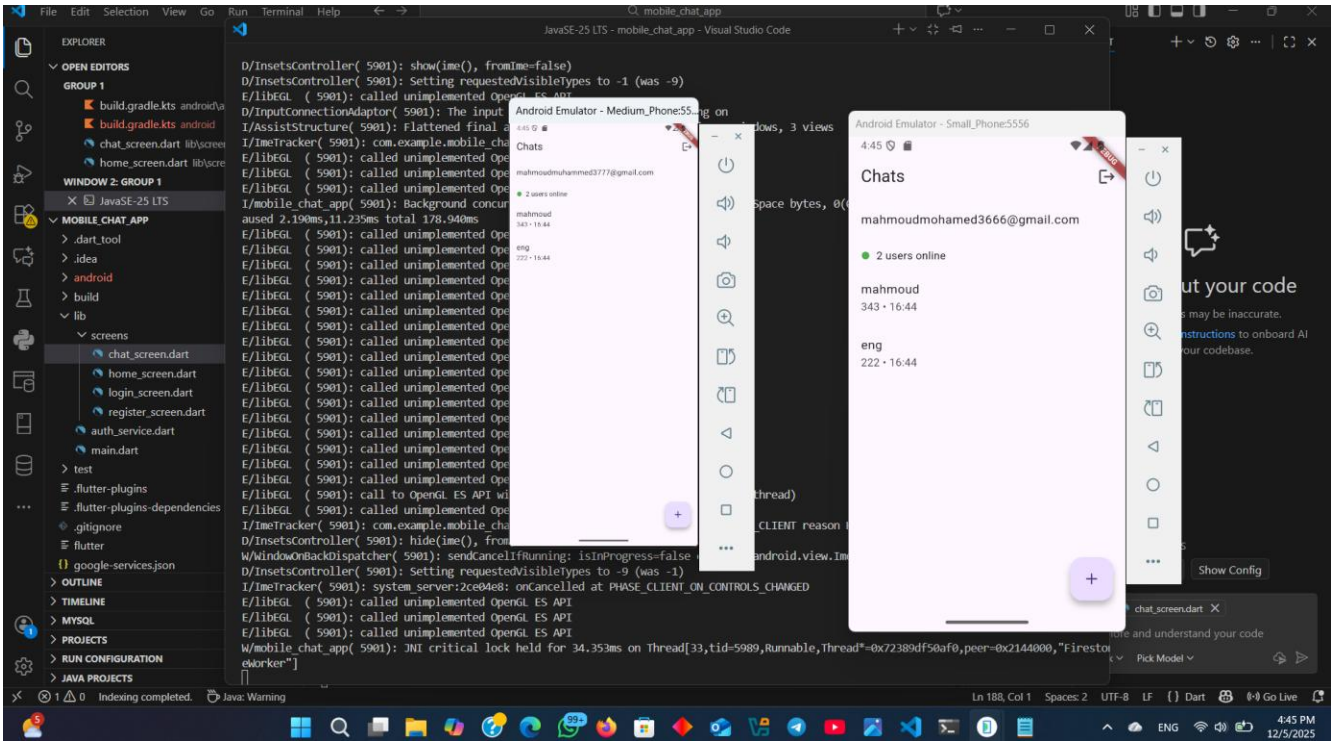
5.1 Home Screen

The Home Screen displays:

- The logged-in user's email
- A list of chat rooms stored in Firestore
- The number of online users from Realtime Database
- A Floating Action Button that allows creating new chat rooms

5.2 Chat Screen





The Chat Screen includes:

- Live streaming of messages using StreamBuilder

- Message bubbles displayed left/right depending on the sender
- A message input field + send button
- Automatic scroll to the latest message
- Updating chat preview (lastMessage) on Firestore

5.3 Multi-Device Real-Time Chat

By running multiple emulators, users can:

- Send messages to each other instantly
- See presence changes (online/offline) immediately
- Share chat rooms and message history

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6. Features Implemented

Feature	Status
Firebase Authentication	✓ Implemented
Realtime Database Presence Tracking	✓ Implemented
Firestore Chat Rooms	✓ Implemented
Real-Time Messages	✓ Implemented
Multi-User / Multi-Device Chat	✓ Implemented
Last Message Preview	✓ Implemented
Online User Counter	✓ Implemented

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7. Conclusion

This project successfully demonstrates how Flutter and Firebase can be combined to build a complete real-time chat application without traditional backend servers.

The system uses each Firebase service in an optimal way:

- **Authentication** for login
- **Firestore** for chat logic
- **Realtime Database** for fast presence tracking

The app is scalable, real-time, and easy to extend with features such as:

- Sending images or files
- Group chats
- Notifications
- Typing indicators
- Read receipts