Capgemini

High Level Design & Low Level Design

Document Control :

Project Revision History

Date	Version	Author	Brief Description of Changes	Approver Signature
19.10.2022	1.0	Group 6		

Index

1. Introduction: -

1.1 Intended Audience: -

The target audience are the clients whose access rights are tracked and functions are specified. Also, the server who has to authenticate the clients and concurrently manage them.

1.2 Project Purpose: -

The purpose of this document is to track and record all the information and events occurring throughout the phonebook and keep the details organized so that we can track the progress and functionalities of the clients and the server properly.

1.3 Key Project Objectives: -

- Allow user to add and remove contacts.
- View details of users in phonebook directory.
- Allow admin user to add and remove groups.
- Allow authenticated users to change groups.

1.4 Project scope and limitation: -

This project scope is for creating and maintaining a remote phonebook for a client having a required set of features. It aims at smooth functioning and connections between the client and server. All clients should be able to access certain functions based on their level of authentication.

1.5 Functional Overview: -

1.5.1 Following header files are included in the program:

- stdio.h
- stdlib.h
- unistd.h
- sys/socket.h
- string.h
- arpa/inet.h
- signal.h
- ctype.h
- sys/ipc.h
- user.h
- stdbool.h
- server.h

- client.h

Functions:

1.5.2 SERVER FUNCTIONS:

1.5.2.1: User Authentication:

The server should authenticate the user from a poll of registered user data kept with appropriate data structure.

1.5.2.2: Server side Firewall Protection:

The server should listen to port 8028 for client connection and make the client side computer access the server port.

1.5.2.3 Service starting at boot:

The server must configure to start the service automatically at boot.

1.5.2.4 Server side concurrency:

The server should support the concurrent client connection.

1.5.3 CLIENT FUNCTIONS:

1.5.3.1: Client side program starting:

The user should start the client program to connect the Server whenever he wants.

1.5.3.2: Client side connection request:

Client should request a connection to the server on port 8028.

1.5.3.3: Client side authentication:

Client program should start with an authentication

1.5.3.4: Client side user environment:

On successful authentication the user should be placed in a public group for phone book access.

1.5.3.5: Client side environment customization:

Users can use chgrp GRPNAME to change his Working group on phone book.

1.5.3.6: Client side browsing contact:

list[A] to list out all contacts in a group

1.5.3.7: Client side contact Add:

User adds contact using this function.

1.5.3.8: Client side contact deletion:

User can remove any contact from working group

Client side Group Add and Remove:

Admin authenticated user use this to add and remove groups.

Client side quit:

The user uses the subcommand bye to terminate the connection.

1.5.4 USER FUNCTIONS:

1.5.4.1: Add contact:

User can add contact to public or desired groups depending on permission for each type of user.

1.5.4.2: Remove Contact:

User can remove contact from public or desired groups depending on permission for each type of user.

1.5.4.3: Add group:

Admin can add a group.

1.5.4.4 Remove group:

Admin can remove a group.

1.5.4.5: Change group:

Authenticated user can change group to which it has access.

1.5.4.6: List:

User can list details of public or desired groups depending on permission for each type of user.

1. Design Overview: -

Remote Phonebook comprises of the following modules:

Name of the Module	List contact & Remove contact
Handled by	Ayeshkanta Adhikari
Description	List can view user contact details. Remove can delete contact from database

Name of the Module	Server functionalities
Handled by	Buchireddy Gari Sai nath Reddy
Description	Create socket, accept connections, authenticate user, receive and process user commands, send results to clients

Name of the Module	Client functionalities
Handled by	Arpita Panda
Description	Create socket, connect with server get credentials and commands, send, receive

	and display data

Name of the Module	Add & Remove groups
Handled by	Dileep Varma
Description	These will add and remove groups. Done by Admin.

Name of the Module	Change group
Handled by	Vinaykumar J
Description	These will help authenticated user to change group to do its functionalities.

Name of the Module	Add contacts
Handled by	Utkarsh Kumar Bharti
Description	These will add contact in database depending on groupname.

2.1 Design Objectives: -

- A remote phonebook setup to be established.
- After server is started, it listens to port 8028 for clients.
- Connection between client and the server is established.
- Three user access categories based on authentication.
- Each user access category has specified functionalities.
- Contact deletion, contact addition and group addition and remove.
- Connection can be terminated by a specific command by user

2.2 Design Alternative: -

We have used file structures for performing operations in this project. Information is directly changed in file so less space is used during program execution.

2.3 User Interface Paradigms: -

The client would ask authentication from the server and after authentication they would remain in the public group by default. There would be three types of access categories for the user: anonymous, authenticated and admin authenticated. For an anonymous client, the server should support a virtual user with the name anonymous to add contact to a public group only without any password. All the authenticated users should be allowed to add, view and delete contact from the phone directory for the group they belong to. They should view the content of public groups. Users with authenticated admin access can access any contact in addition to add, remove group to phone directory.

2.4 Error Detection / Exceptional Handling: -

- If the user doesn’t have access to group and tries to change group , then it will show error "The user doesn’t belong to the group”.
- If an authenticated user tries to add contact in public group, then it will show error "Authenticated user can't add the data to the public group"
- If the user tries to remove a contact which is not present in the group , then it will show error "Entered contact name is not present".

We have handled these errors by using flags at different parts of our codes and returning that to server for checking and sending the error messages to the clients.

2.5 Performance: -

Multiple clients can be connected to the remote server. The performance shall depend upon hardware components of the clients and the internet connection.

2.6 Maintenance: -

Very little maintenance should be required for this setup. An initial configuration will be the only system required interaction after system is put together. The only other user maintenance would be any changes to settings after setup, and any specified special cases where user settings or history need to be changed. Physical maintenance on the system’s parts may be required, and would result in temporary loss of data or Internet. Upgrades of hardware and software should have little effect on this project but may result in downtime.

3 SYSTEM ARCHITECTURE: -

3.1 Structure Details:

The system consists of three structures Server, client and User functionalities :

1.5.2 SERVER:

1.5.2.1: User Authentication:

The server should authenticate the user from a poll of registered user data kept with appropriate data structure.

1.5.2.2: Server side Firewall Protection:

The server should listen to port 8028 for client connection and make the client side computer access the server port.

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The server must configure to start the service automatically at boot.

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The server should support the concurrent client connection.

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1.5.4 USER:

1.5.4.1: Add contact:

User can add contact to public or desired groups depending on permission for each type of user.

1.5.4.2: Remove Contact:

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1.5.4.3: Add group:

Admin can add a group.

1.5.4.4 Remove group:

Admin can remove a group.

1.5.4.5: Change group:

Authenticated user can change group to which it has access.

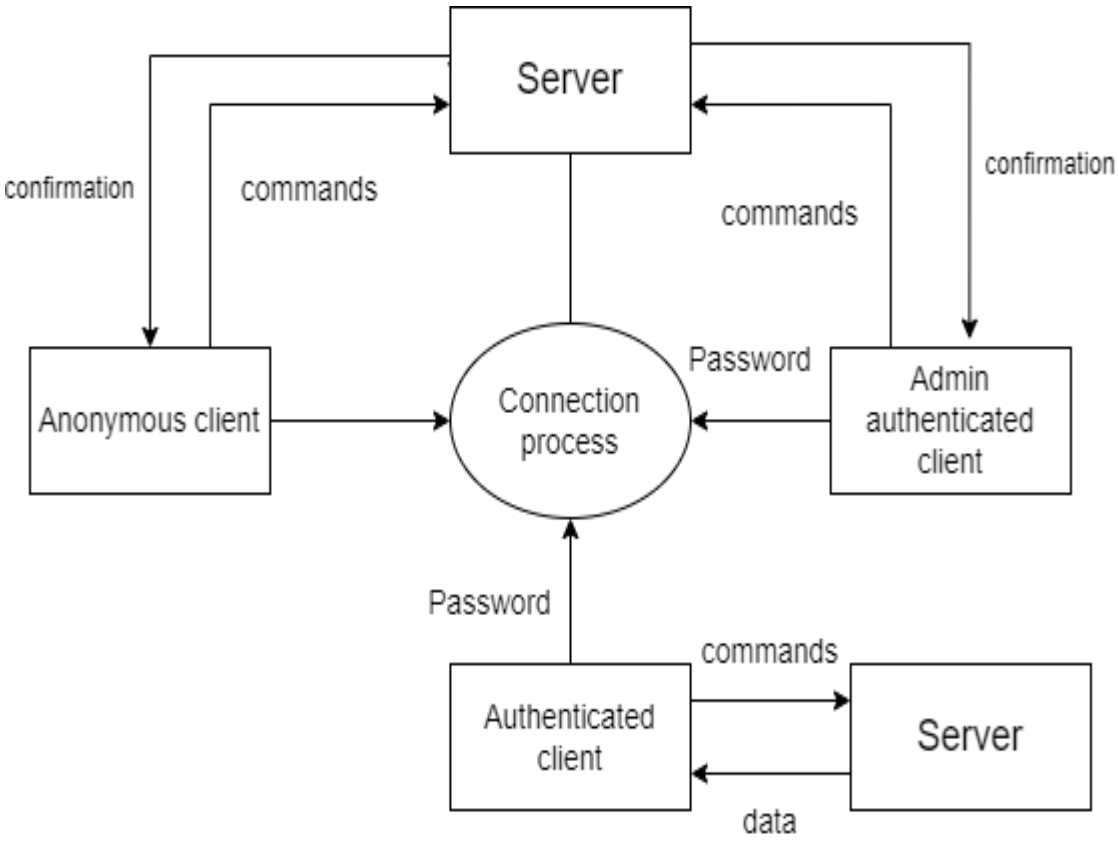
1.5.4.6: List:

User can list details of public or desired groups depending on permission for each type of user.

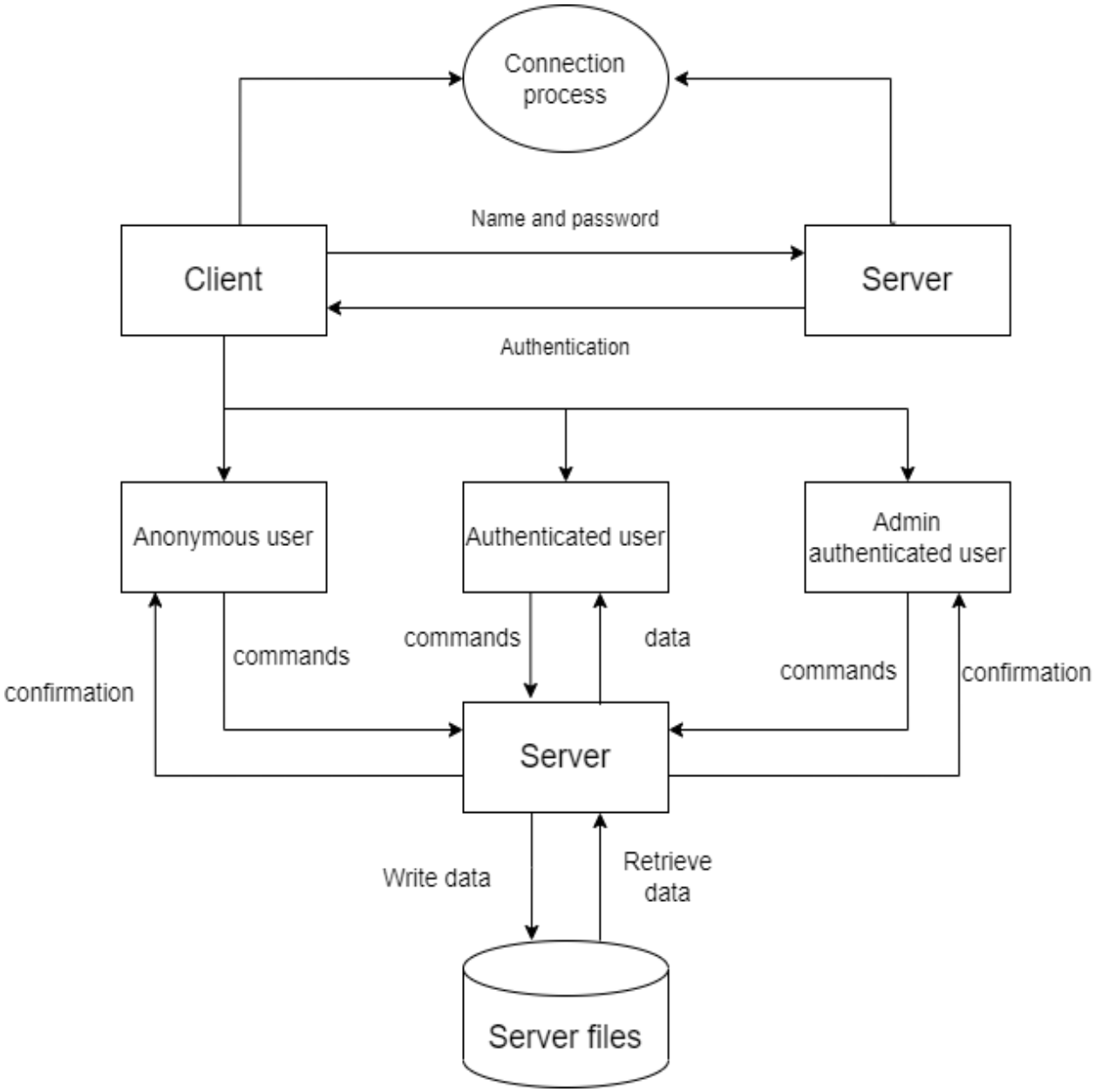
2. Detailed System Design

Design Overview

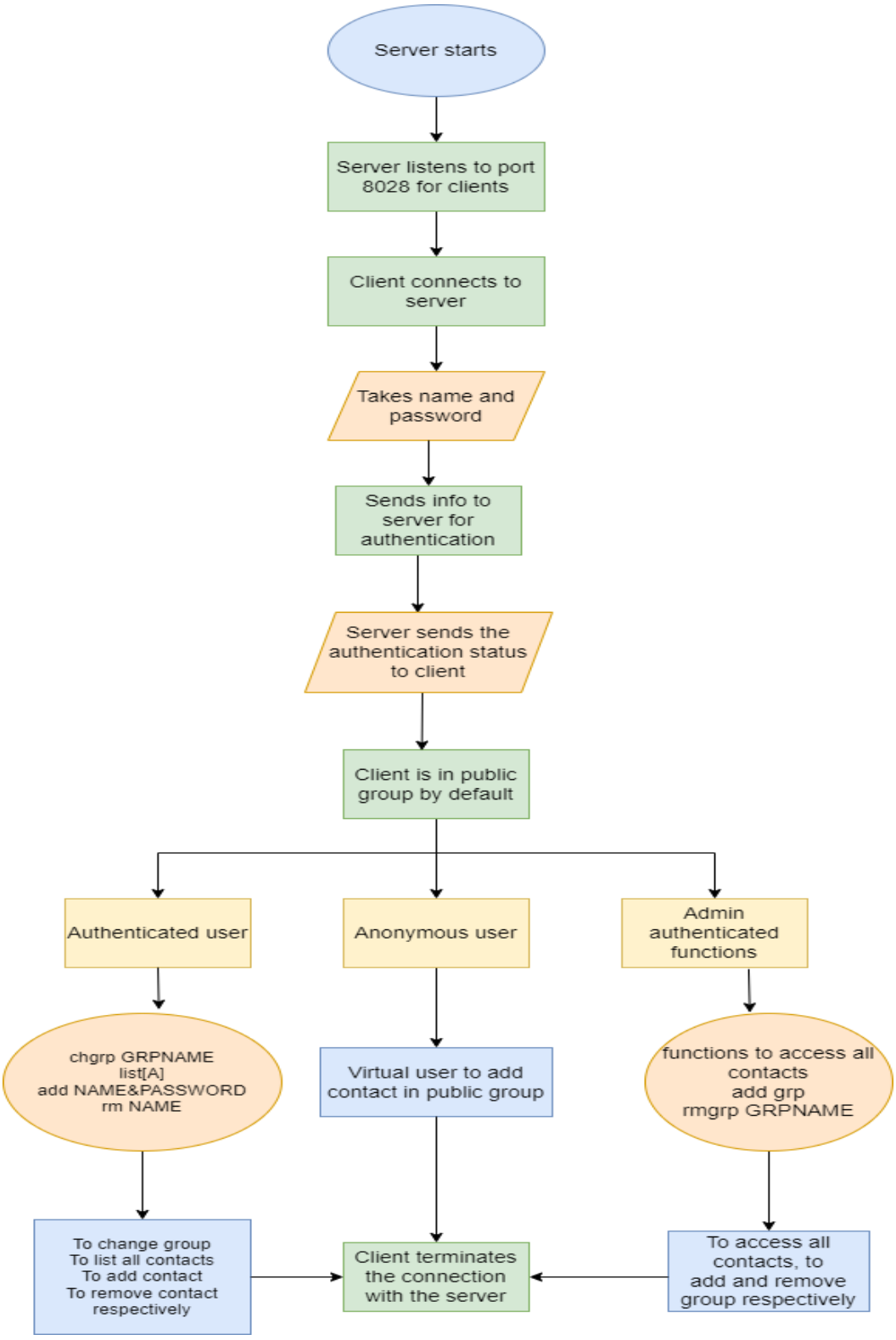
Data Flow Diagram Level 0:



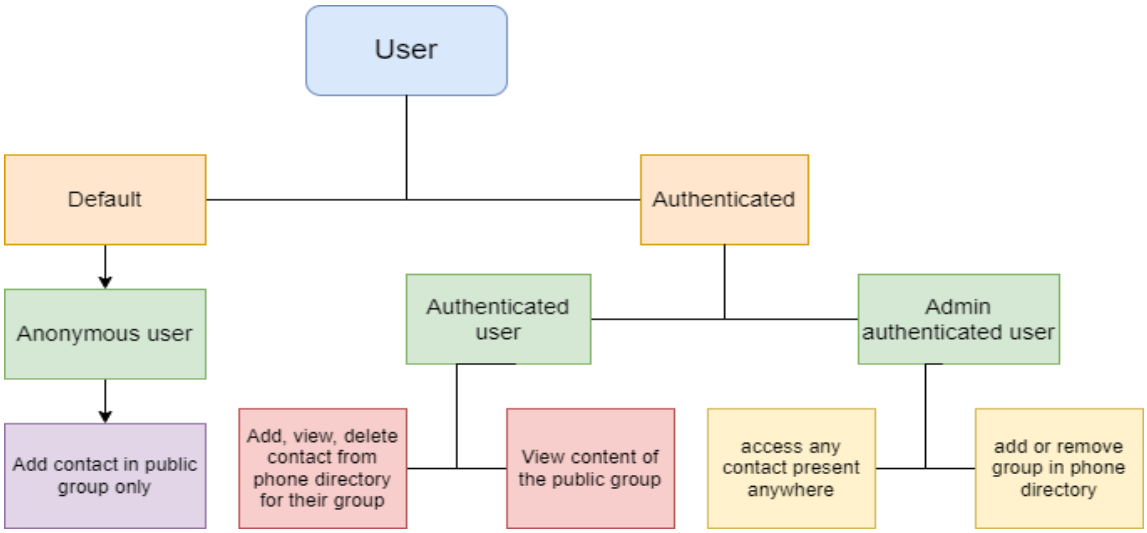
Data Flow Diagram Level 1:



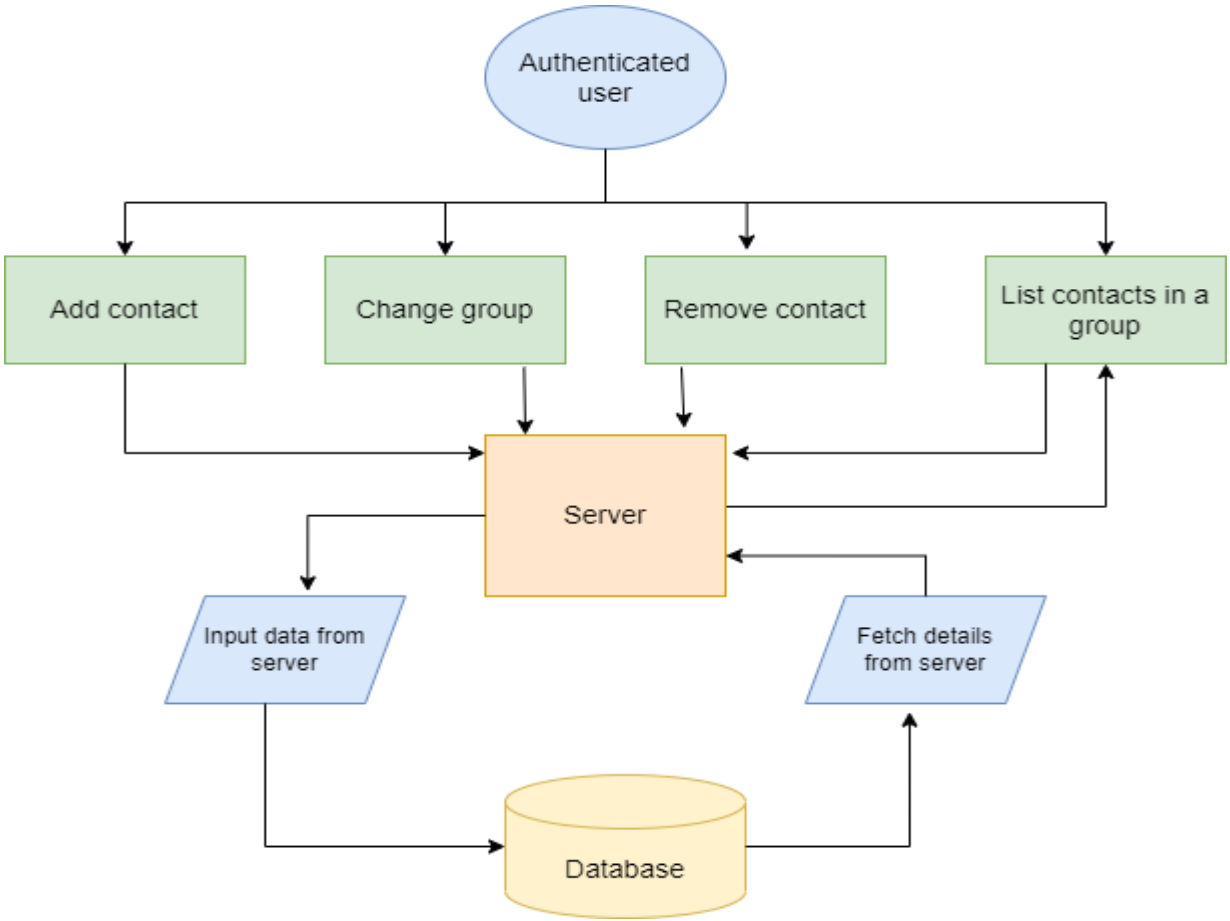
Flowchart for Remote phonebook:



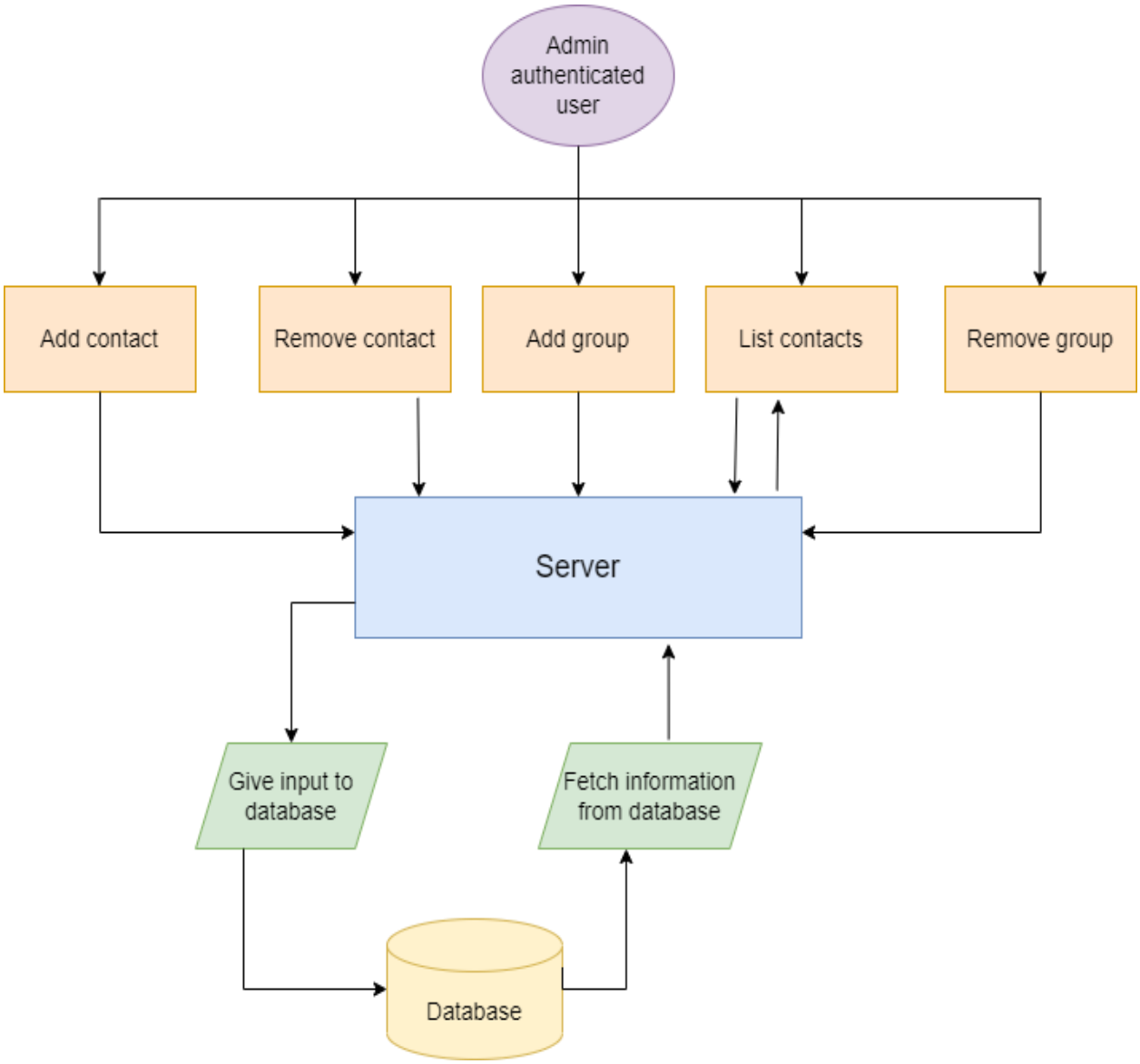
Flowchart for user:



Flowchart for functions of authenticated user:



Flowchart for functions for admin authenticated user:



3. Environment Description: -

5.1 Time Zone Support: - IST- Kolkata

5.2 Language Support: - English

5.3 User Desktop Requirements: -

- 64-bit processor, 1 GHz or faster
- At least 10 GB free hard drive space
- At least 1 GB RAM **Server**

5.4 Server-Side Requirements:

- 64-bit processor, 1 GHz or faster
- At least 2 GB free hard drive space
- At least 1GB RAM

5.4.1 Deployment Considerations: -

- Local storage is used
- No network latency to consider
- To scale buy a bigger CPU, more memory, larger hard drive, or additional hardware

5.4.2. Application Server Disk Space: -

No such disk space is required as the program is fully functional on online IDE(s) as well. Local Operating System is required and some txt files to store the records of phonebook.

5.4.3. Database Server Disk Space: -

No such disk space is required as the program is fully functional on online IDE(s) as well. Local Operating System is required and some txt files to store the records of phonebook.

5.4.4. Integration Requirements: -

- Language: - C
- Tools: - Valgrind, Makefile ,Cunit, gprof, splint, gcov
- Complier: - gcc
- Linux Environment

5.4.5. Network: - End to End

5.5 Configuration: -

5.5.1. Operating System: - Linux environment

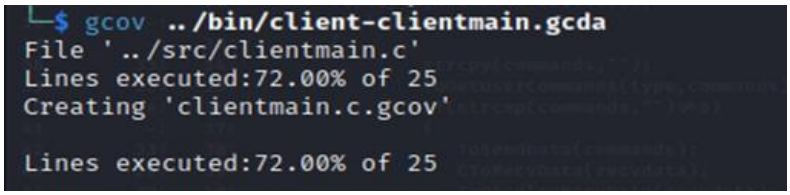
6. Reference: -

The references are:

- https://www.geeksforgeeks.org/socket-programming-cc/
- https://www.javatpoint.com/file-handling-in-c
- https://www.educative.io/answers/how-to-create-a-simple-thread-in-c

7. TOOLS AND TESTING

Gcov report:



```
        -:    0:Source:../src/clientmain.c
        -:    0:Graph:../bin/client-clientmain.gcno
        -:    0:Data:../bin/client-clientmain.gcda
        -:    0:Runs:4
        -:    1://program to define the server main function
        -:    2:#include <stdio.h>
        -:    3:#include <signal.h>
        -:    4:#include <string.h>
        -:    5:#include <stdlib.h>
        -:    6:#include "client.h"
        -:    7:int sockid ;
    #####:    8:void signalHandler(int signal)
        -:    9:{
    #####:   10:        if(signal==SIGINT)
        -:   11:        {
    #####:   12:                send(sockid,"bye",3,0);
    #####:   13:                exit(0);
        -:   14:        }
    #####:   15:}
        -:   16:
        -:   17://main function to execute client
        -:   18:
        4:   19:int main ()
        -:   20:{
        4:   21:        signal(SIGINT,signalHandler);                   //signal to cut the client from server
        4:   22:        char recvdata[200]="",credentials[200]="",commands[200]="";
        4:   23:        Client();                                       //creating a client
        4:   24:        sockid=ToGetSockfd();                           //calling the getsockfd of client
        4:   25:        ToGetCredentials(credentials);                  //calling the getcredentials functions of client
        4:   26:        ToServerConnect() ;                             //calling the serverconnect function to connect to the server
        4:   27:        ToSendData(credentials);                        //sending the credentials to server
        4:   28:        CToRecvData(recvdata);                          //receiving the message from the server using recvData function
        4:   29:        char type[200]="";
        4:   30:        strcpy(type,recvdata);
        4:   31:        ToDisplayRecvData(recvdata);                    //calling the funtion to display the data
        -:   32:        while(1)
        -:   33:        {
       33:   34:                strcpy(commands,"");
       33:   35:                ToGetUserCommands(type,commands) ;  //calling the function to get the usercommands
    33*:   36:                if(strcmp(commands,"")!=0)
        -:   37:                {
       33:   38:                   ToSendData(commands);                //sending the user commands to the server
       29:   39:                   CToRecvData(recvdata);               //receiving the data from the server
       29:   40:                   ToDisplayRecvData(recvdata);         //displaying the received data from the server
        -:   41:                }
        -:   42:                else
        -:   43:                {
    #####:   44:                        printf("Subcommand can't be empty");
    #####:   45:                        continue;
        -:   46:                }
        -:   47:        }
        -:   48:        return EXIT_SUCCESS;
        -:   49:}
        -:   50:
```

Gprof report:

```
└─$ gprof -b ../bin/client gmon.out
Flat profile:

Each sample counts as 0.01 seconds.
 no time accumulated

  %   cumulative   self              self     total
 time   seconds   seconds    calls  Ts/call  Ts/call  name
  0.00      0.00     0.00        7     0.00     0.00  ToSendData
  0.00      0.00     0.00        6     0.00     0.00  CToRecvData
  0.00      0.00     0.00        6     0.00     0.00  ToDisplayRecvData
  0.00      0.00     0.00        6     0.00     0.00  ToGetUserCommands
  0.00      0.00     0.00        1     0.00     0.00  Client
  0.00      0.00     0.00        1     0.00     0.00  ToCloseClientConnections
  0.00      0.00     0.00        1     0.00     0.00  ToGetCredentials
  0.00      0.00     0.00        1     0.00     0.00  ToGetSockfd
  0.00      0.00     0.00        1     0.00     0.00  ToServerConnect
```

```
                     Call graph

granularity: each sample hit covers 2 byte(s) no time propagated

index % time    self  children    called     name
                0.00    0.00       7/7           main [15]
[1]     0.0     0.00    0.00       7         ToSendData [1]
                0.00    0.00       1/1           ToCloseClientConnections [6]
-----------------------------------------------
                0.00    0.00       6/6           main [15]
[2]     0.0     0.00    0.00       6         CToRecvData [2]
-----------------------------------------------
                0.00    0.00       6/6           main [15]
[3]     0.0     0.00    0.00       6         ToDisplayRecvData [3]
-----------------------------------------------
                0.00    0.00       6/6           main [15]
[4]     0.0     0.00    0.00       6         ToGetUserCommands [4]
-----------------------------------------------
                0.00    0.00       1/1           main [15]
[5]     0.0     0.00    0.00       1         Client [5]
-----------------------------------------------
                0.00    0.00       1/1           ToSendData [1]
[6]     0.0     0.00    0.00       1         ToCloseClientConnections [6]
-----------------------------------------------
                0.00    0.00       1/1           main [15]
[7]     0.0     0.00    0.00       1         ToGetCredentials [7]
-----------------------------------------------
                0.00    0.00       1/1           main [15]
[8]     0.0     0.00    0.00       1         ToGetSockfd [8]
-----------------------------------------------
                0.00    0.00       1/1           main [15]
[9]     0.0     0.00    0.00       1         ToServerConnect [9]
-----------------------------------------------


Index by function name

   [2] CToRecvData             [3] ToDisplayRecvData       [4] ToGetUserCommands
   [5] Client                  [7] ToGetCredentials        [1] ToSendData
   [6] ToCloseClientConnections [8] ToGetSockfd            [9] ToServerConnect
```

Splint report:

```
Splint 3.1.2 --- 21 Feb 2021

< Location unknown >: Field name reused:
  Code cannot be parsed.  For help on parse errors, see splint -help
  parseerrors. (Use -syntax to inhibit warning)
< Location unknown >: Previous use of
< Location unknown >: Previous use of
server.c: (in function ToAcceptConnections)
server.c:138:16: Unrecognized identifier: SIGCHLD
  Identifier used in code has not been declared. (Use -unrecog to inhibit
  warning)
server.c: (in function AuthenticatedUserFunctionalities)
server.c:151:10: Parameter 1 (comm) to function strcpy is declared unique but
    is aliased externally by parameter 2 (tok) through alias comm
  A unique or only parameter is aliased by some other parameter or visible
  global. (Use -aliasunique to inhibit warning)
< Location unknown >: Field name reused:
< Location unknown >: Previous use of
clientmain.c:19:5: Function main defined more than once
  A function or variable is redefined. One of the declarations should use
  extern. (Use -redef to inhibit warning)
   servermain.c:15:1: Previous definition of main
< Location unknown >: Previous use of
client.c:18:5: Variable sockfd redefined
   server.c:11:5: Previous definition of sockfd
client.c:19:20: Variable servaddr redefined
   server.c:12:20: Previous definition of servaddr
client.c:20:16: Variable slen redefined
   server.c:14:8: Previous definition of slen
client.c:20:21: Variable mlen redefined
   server.c:14:18: Previous definition of mlen
client.c:20:26: Variable connectfd redefined
   server.c:15:5: Previous definition of connectfd
< Location unknown >: Previous use of

Finished checking --- 10 code warnings
```

Valgrind report:

```
└─$ valgrind -s ./../bin/client
==48232== Memcheck, a memory error detector
==48232== Copyright (C) 2002-2022, and GNU GPL'd, by Julian Seward et al.
==48232== Using Valgrind-3.19.0 and LibVEX; rerun with -h for copyright info
==48232== Command: ./../bin/client
==48232==
Enter the Username :admin
Enter the password :1
admin

Enter the subcommand :ADD arpita,8998576897
Provide three inputs name,phonenumber,filename

Enter the subcommand :ADD arpita,8998576897,public group
contact added to the given group

Enter the subcommand :rm arpita,public group
contact removed from the given group

Enter the subcommand :addgrp services
Group added

Enter the subcommand :rmgrp services
Group removed

Enter the subcommand :list a,public group
Matching contacts:
ad1,de1


Enter the subcommand :bye
==48232==
==48232== HEAP SUMMARY:
==48232==     in use at exit: 0 bytes in 0 blocks
==48232==   total heap usage: 2 allocs, 2 frees, 2,048 bytes allocated
==48232==
==48232== All heap blocks were freed -- no leaks are possible
==48232==
==48232== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
```

```
└─$ valgrind -s ./../bin/client
==53578== Memcheck, a memory error detector
==53578== Copyright (C) 2002-2022, and GNU GPL'd, by Julian Seward et al.
==53578== Using Valgrind-3.19.0 and LibVEX; rerun with -h for copyright info
==53578== Command: ./../bin/client
==53578==
Enter the Username :sai nath
Enter the password :group6
authenticated user

Enter the subcommand :list a
Matching contacts:
ad1,de1


Enter the subcommand :chgrp production
Group changed

Enter the subcommand :ADD jist,89989899998
Contact added

Enter the subcommand :rm jist
Contact removed

Enter the subcommand :bye
==53578==
==53578== HEAP SUMMARY:
==53578==     in use at exit: 0 bytes in 0 blocks
==53578==   total heap usage: 2 allocs, 2 frees, 2,048 bytes allocated
==53578==
==53578== All heap blocks were freed -- no leaks are possible
==53578==
==53578== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
```

TESTING REPORT

Unit testing report:

```
./../bin/test


     CUnit - A unit testing framework for C - Version 2.1-3
     http://cunit.sourceforge.net/


Suite: suite for removing contact frrom a file...
  Test: Test for removecontact() in sunny cases  ...passed
  Test: Test for removecontact() in rainy cases  ...passed
Suite: suite for changing group...
  Test: Test for ToChgrp() in sunny cases  ...passed
  Test: Test for ToChgrp() in rainy cases  ...passed

Run Summary:    Type  Total    Ran Passed Failed Inactive
              suites      2      2    n/a      0        0
               tests      4      4      4      0        0
             asserts     20     20     20      0      n/a

Elapsed time =    0.001 seconds
```

Integration testing report:

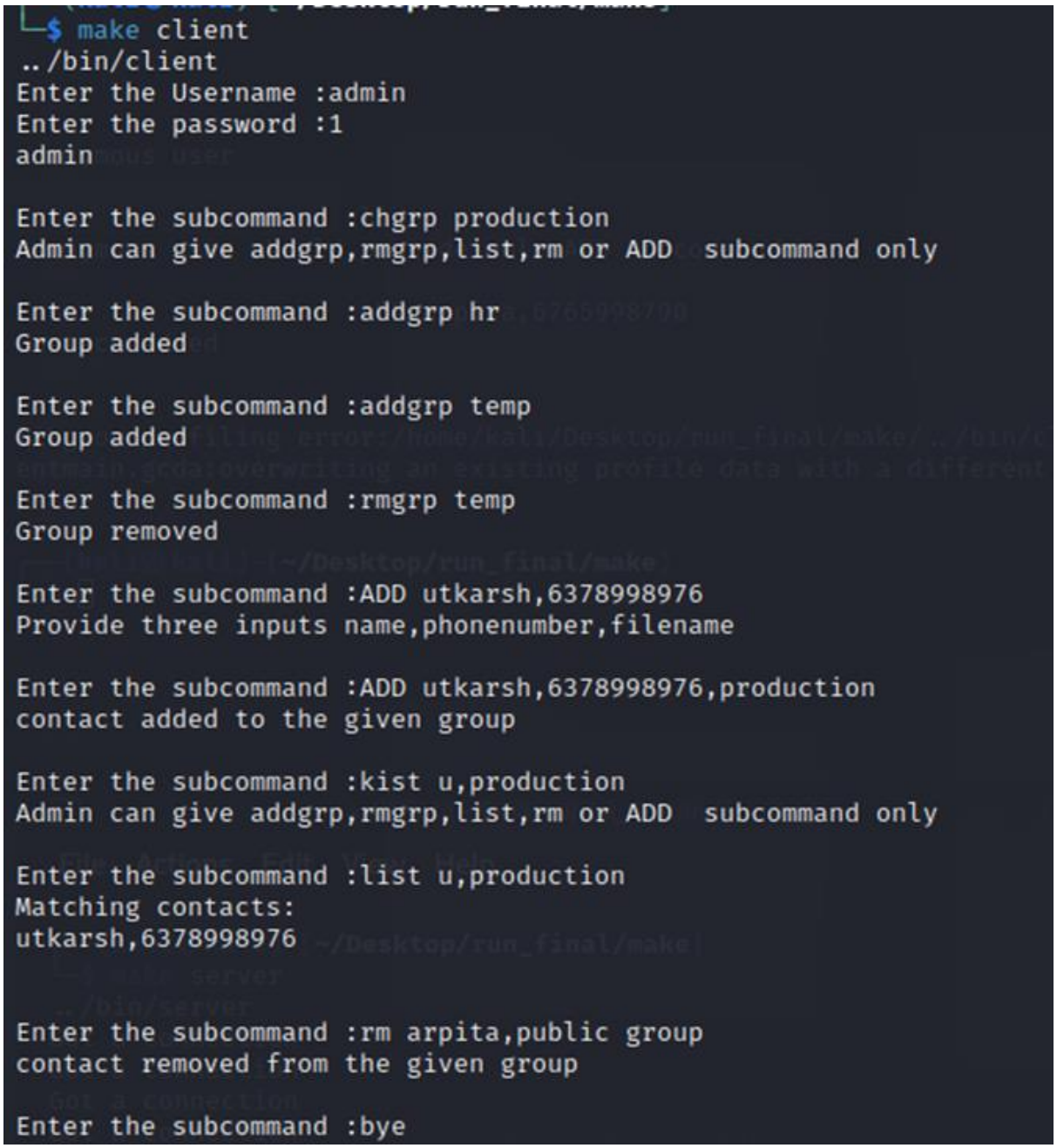
Case 1:Anonymous user

```
└─$ make client
../bin/client
Enter the Username :
Enter the password :
anonymous user

Enter the subcommand :ADD
ADD command should have two fields

Enter the subcommand :ADD 1
ADD command should have two fields

Enter the subcommand :list
Anonymous user should provide only ADD subcommand

Enter the subcommand :ADD sai,9009989098
Contact added

Enter the subcommand :addgrp
Anonymous user should provide only ADD subcommand

Enter the subcommand :chgrp
Anonymous user should provide only ADD subcommand

Enter the subcommand :ADD Ayeshkanta,8909089988
Contact added

Enter the subcommand :bye

┌──(kali㉿kali)-[~/Desktop/run_final/make]
```

Case 2:Authenticated user

```
└─$ make client
../bin/client
Enter the Username :sai nath
Enter the password :group6
authenticated user

Enter the subcommand :addgrp
Authenticated users can only use ADD,rm,list,chgrp and bye/Bye subcommand
s
Enter the subcommand :ADD virat,1234
Authenticated user can't add the data to the public group
Enter the subcommand :list a
Matching contacts:
ad1,de1

Enter the subcommand :chgrp production
Group changed

Enter the subcommand :ADD vinay,7777888890
Contact added

Enter the subcommand :list v
Matching contacts:
vinay,7777888890

Enter the subcommand :list vin
Matching contacts:
vinay,7777888890

Enter the subcommand :list q
No contacts with given pattern

Enter the subcommand :rm vinay
Contact removed

Enter the subcommand :list q
No contacts with given pattern

Enter the subcommand :bye
```

Case 3:Admin authenticated user



Case 4: Handling multiple clients