

**CSC 258 Distributed Systems**

**Spring 2015**

**Project Name: Data Usage Tracker Application**

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**Table of Contents**

|  |  |  |
| --- | --- | --- |
| **No.** | **Topic** | **Pg. No.** |
| 1 | Objective |  |
| 2 | Background Information |  |
| 3 | Project Requirements and Functionalities |  |
| 4 | UML Diagram |  |
| 5 | Architecture Design |  |
| 6 | Conclusion |  |
| 7 | References |  |

# OBJECTIVE

In this project we developed a Native Android Application namely Data Usage Application to manage and track phone data usage in a family plan. The GUI is designed using Android studio while driving logic is implemented in Intellij Tool Suite with MySQL database used for data storage. The application is responsible for tracking data usage of all devices registered in our application in a family plan and notify the user when data usage threshold limit is reached. This application also provides functionality to switch off cellular data usage

# BACKGROUND INFORMATION

Data usage application is a multi-tier Mobile application implemented through extensive use of Java with the following tools and APIs used in its development.

1. Intellij IDEA Tool Suite<14.1.1> used to implement the main driving business logic in spring framework.
2. MySQL<5.6> database for persistent data storage and efficient data retrieval.
3. Java Persistence API (JPA) with the help of Hibernate tool to provide an interface for managing relational data stored in MySQL database through java platform.
4. JavaScript Object Notation (Json) format used for data exchange.
5. Android Studio for designing and developing Graphics User Interface of the application for making it interactive and user friendly.
6. Connectivity Manager API for acquiring information about current available networks, connected networks and network specifications.
7. TrafficStats API used for gathering necessary traffic statistical information.
8. TelephonyManager API for gathering information about the device.
9. Async HTTP client for handling HTTP requests and responses.
10. ngrok for hosting Web service over the internet such that it can be used by any client mobile running our application and connected to the internet.

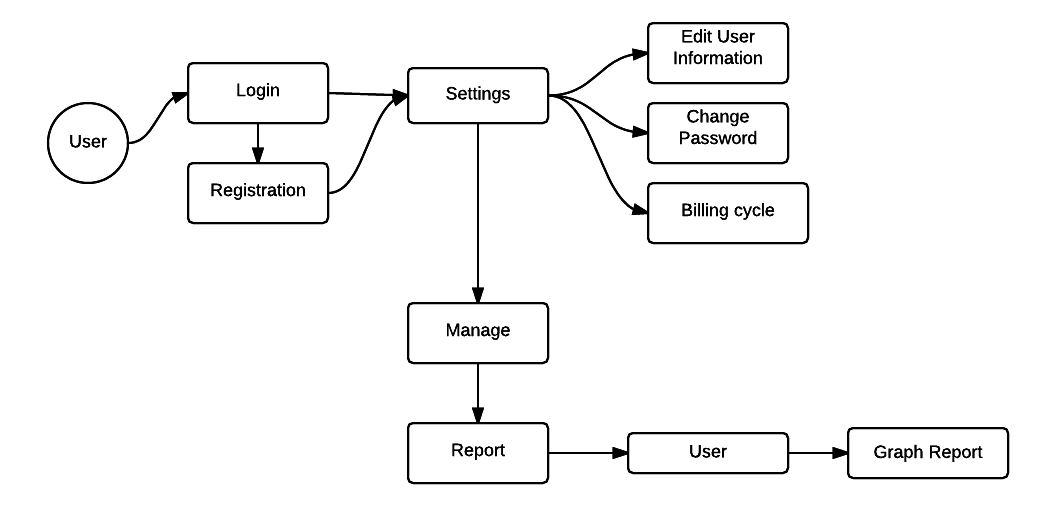
# PROJECT REQUIREMENTS AND FUNCTIONALITIES

The main motive of this project is to design a Native Android Application to have a better understanding of distributed system. The project requirements include designing User Interface for android for easy application usage, designing a multi tier distributed system using web services as its main driver logic and having database for consistent and persistent data storage. The application needs to allow user sign up and show the user its current cellular data usage. Following are the functionalities implemented in this project:

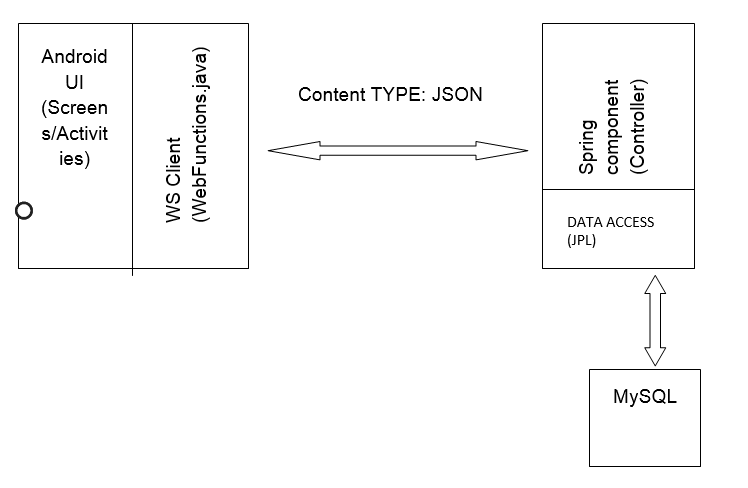
1. User Sign-up: Provides User Registration for new users and User Login for existing users. A user is identified by unique Phone No. and password. They also have the option of changing password in case they forget password. For User Registration inputs required from the user include username, email-id (for notifying user and for changing password in case the user forgets current password) and password. For User Login email-id and password are the only two inputs require.
2. Settings: Once the user has logged in, the user can view all the other users that are in his family plan. The user can also see the current billing cycle and current data usage limit and threshold. Settings also include an option for changing password.

For an administrator, apart from the above mentioned utilities, some more functionalities are provided or we can say that a normal user functionality is extended where in the administrator user can add users into his family plan, set their maximum data usage quota and threshold, and also set billing cycle start date.

1. Manage: This functionality provides the user with the information about the network it is currently connected to. User can change cellular network type by choosing Network preferences. User can also set (ON or OFF) WIFI and also Cellular network.
2. Report: This functionality provides the user with graphical representation of data usage. It gives information about how much data has been already used by the user from his assigned quota with the help of a progress bar. It also provides a bar graph representing daily usage of cellular data of the user.
3. **UML DIAGRAM**



1. **ARCHITECTURE DESIGN**

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# Client tier

Intents and Activities

1. Login Activity: The main purpose of this activity is authentication of the already registered users. Email address and password is used for authentication. This activity also provides links in case of user forgot password and link to register new user. Once logged in, application opens as 3 tabs namely “Settings”, “Manage” and “Report”.
2. Registration Activity: This activity provides interface for registration of a new user for this application. User must enter valid email, user’s phone number, group administrator’s phone number and a username to get registered onto this application.
3. Setting Activity: This activity is responsible for providing interface for setting up a user’s account. Only the administrator of the group is given privileges to set data limits and thresholds for all the users. This activity allows administrator to add more users, set billing cycle for the whole group, and also change password feature. This activity also provides an option to remove user but only the administrator has the privilege to do so.
4. Manage Activity: This activity provides user with the information about the current network configuration. It tells the user if it currently connected to wifi, and which cellular data network it is currently connected to.
5. Report Activity: This activity provides information on current data usage of the user. It shows the usage with the help of graphs and progress bars providing easy to understand graphics to understand the data usage till date for the current blling cycle.
6. Traffic Activity: This activity runs continuously in background collecting traffic statistics of the user’s device data usage.

# Server Tier/Business Tier

List of Controllers

1. User Controller: The User controller implements the basic business functionality for a device (user as each device is treated as different user in this application). This controller is responsible for addition of new user, managing current existing users and removing users.
2. Data Controller: The data controller implements the logic for fetching data usage of a device, storing it in the permanent storage and generating required statistics and reports from the data stored.
3. Quota Controller: Quota controller implements the logic of managing data usage limit and threshold of a user.
   1. **Web Services tier**
      1. User Controller: list Users: /user/allusers

This web service is used to list all the users that are in the same group as the current user. It internally checks for the administrator of the group and then fetches all the users that are in the group of this particular administrator.

* + 1. User Controller: Add User: / register/add

This web service is responsible for validating information entered by the user and adding the user in the specific group as specified by the user. The user is required to enter the

* + 1. User Controller: do Login: /login/doLogin

This web service is responsible for user login, it checks for the username and password in the database and if they are correct allows the user to login into the application.

* + 1. User Controller: fetch Family Users: /list/familyUsers

This web service is responsible for fetching all the users in the family of the current user.

* + 1. User Controller: is Admin: /login/isAdmin

This web service is responsible for checking if the current logged in user is an Admin or a general family member user.

* + 1. User Controller: Change Password: /login/changePwd

This web service is responsible for Changing the password of a user. This webservice can be called from two places, one from the login page (if the user has forgotten password and is not able to login) and from settings (if the user needs to change the password for security issues).

* + 1. User Controller: Remove User: /login/removeUser

This web service is responsible for Removing a user and deleting all the information related to that particular user from the application.

* + 1. Data Controller: data Usage:/dataUsage/addData

This web service is responsible for adding user data to the permanent storage that is MySql database in the backend.

* + 1. Data Controller: data Usage:/familyData

This web service is responsible for fetching the statistical information of all the users that belong to the same family as the current user.

* + 1. Data Controller: Threshold Notify: /thresholdNotify

This web service provides notification when data usage reaches (equals) or crosses threshold, notifying the user that he has already crossed threshold and giving him an option of switching off the data usage.

* + 1. Quota Controller: Add User Data: /manageQuota/addUserData

This web service is responsible to add and set the data usage quota for each user.

* + 1. Quota Controller: User Quota: /manageQuota/UserQuota

This web service is responsible for setting the user quota of each user.

* + 1. Quota Controller: Add Admin Data: /manageQuota/addAdminData

This web service is specific to the admin and is responsible to add the data usage of the family data

* + 1. Quota Controller: Add Admin Data: /manageQuota/addAdminQuota

This web service sets the family data usage quota and threshold.

* + 1. Quota Controller: All Admin Quota:/manageQuota/allAdminQuota

This web service gets or fetches the data usage of the whole family that of all the users in the group.

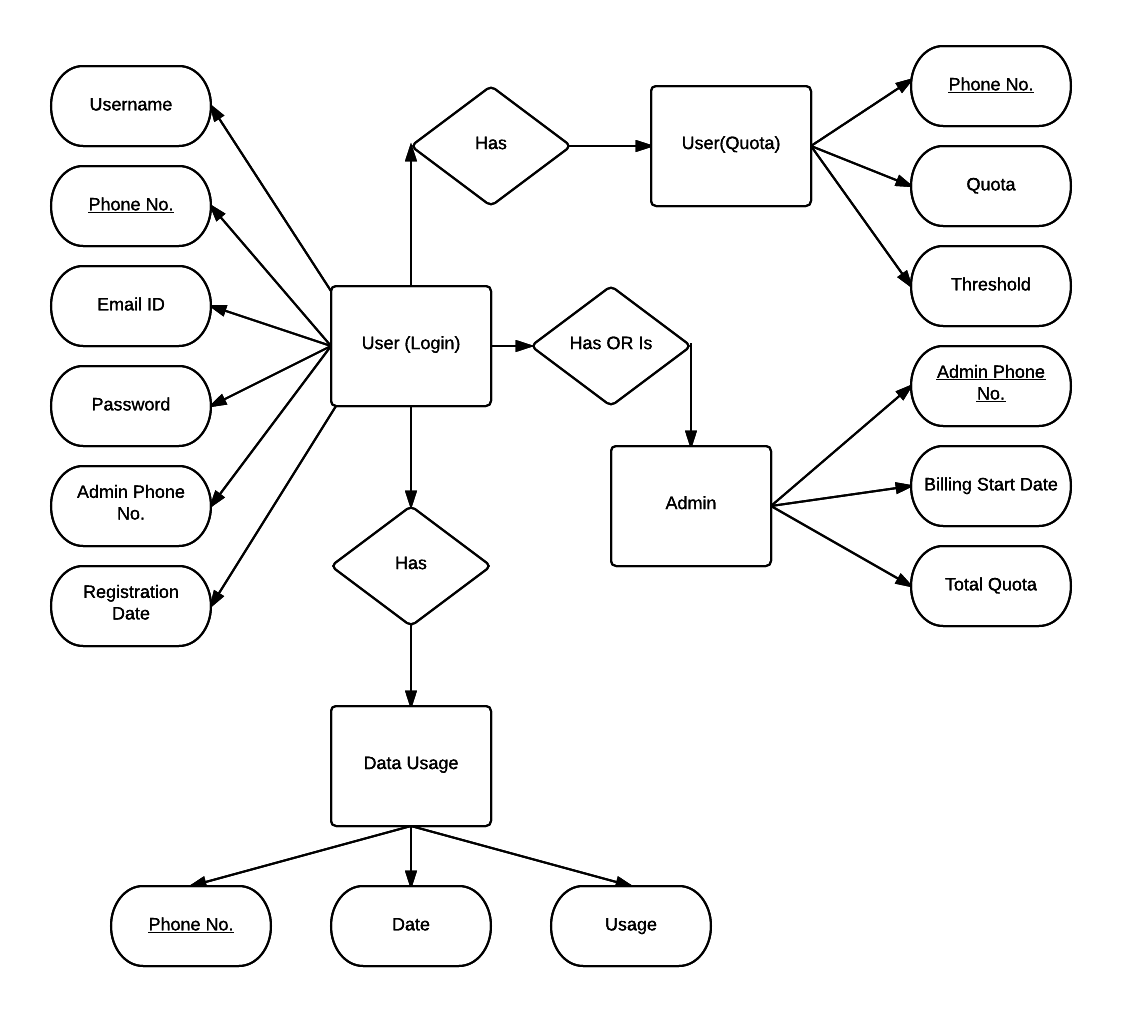
* + 1. Quota Controller: Get billing cycle date:

/manageQuota/getBillingCycleDate

This web service is used to fetch the billing cycle date so that we are able to calculate the number of days to display graphs and calculate other data statistics.

# Database design: ER diagram; triggers; stored procedures if applied

We have used MYSQL database for data storage. We organized data into tables based on whether the data is static (data does not change frequently, requires very low updating) or dynamic (needs continuous updating). We first listed all the attributes required to be stored, organized into tables based on data dependency, which we further divided whether the data is static or dynamic.



According to the above ER-Diagram we have four tables.

# UserLogin: This table stores the basic information about a user that is entered during registration and used subsequently for login. This table is updated with a new row every time a new user registers and is queried for every user login. Data stored by this table is mostly static, that is, not changed frequently. Altered only when user wants to change email ID or password.

1. UserQuota: This table stores static data usage information about each user. Primary key of this table being the Phone No., this table stores the maximum usage quota assigned(by admin) for the user and the threshold usage.
2. AdminQuota: This table stores information about the administrators of groups; the phone No. of the administrator being the primary key, start date of the billing cycle and the total data usage quota assigned to the group.
3. DataUsage: This table is very dynamic and stores the data usage of every user every 4 seconds. WE retrieve the data by grouping it on phone No. and date which gives us the daily usage of a user.

The Phone No. and Admin No. field share the primary key – foreign key relation as every administrator is also a user but every user is not an administrator.

Here is the schema of our Database named DataUsage.

Table Name: User\_Login

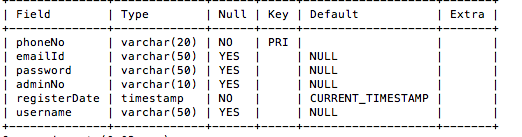


Table Name: User\_Family

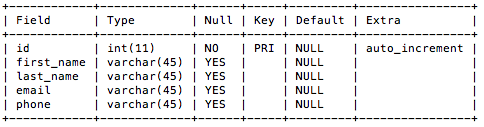


Table Name: User\_Quota

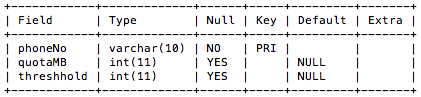


Table Name: Data\_Usage

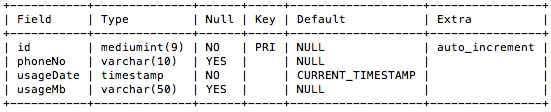
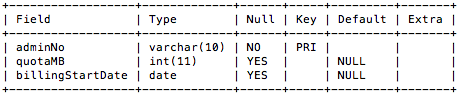
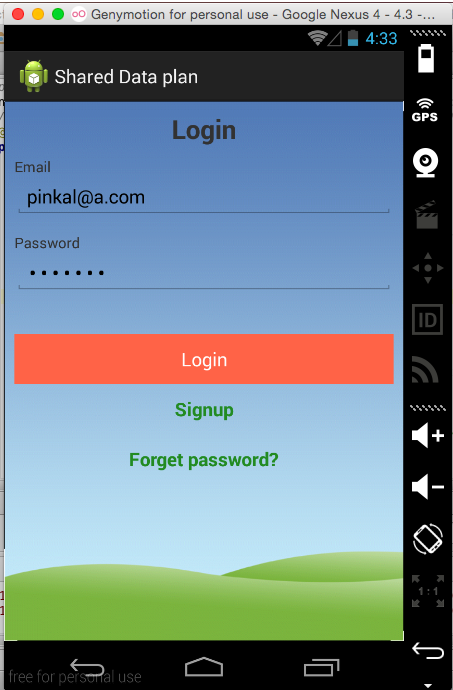


Table Name: Admin\_Quota

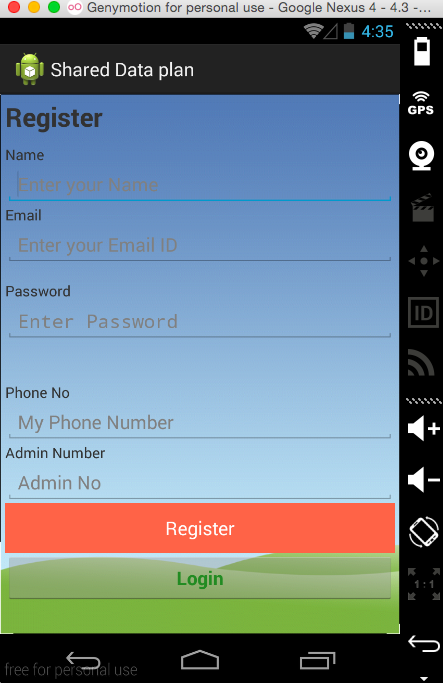


# MOBILE INTERFACE: SCREEN SHOTS

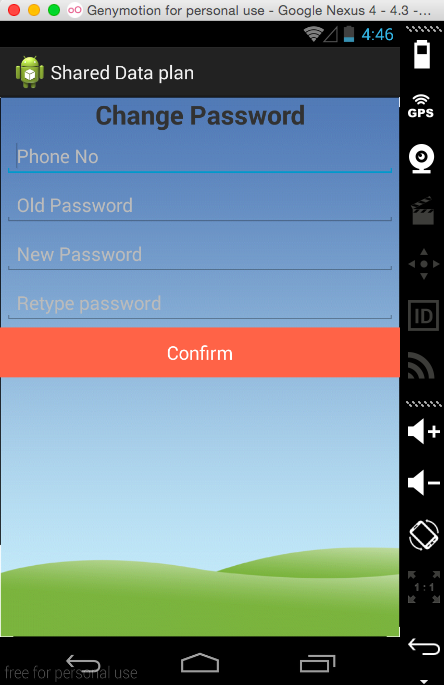
Login screen with user data.



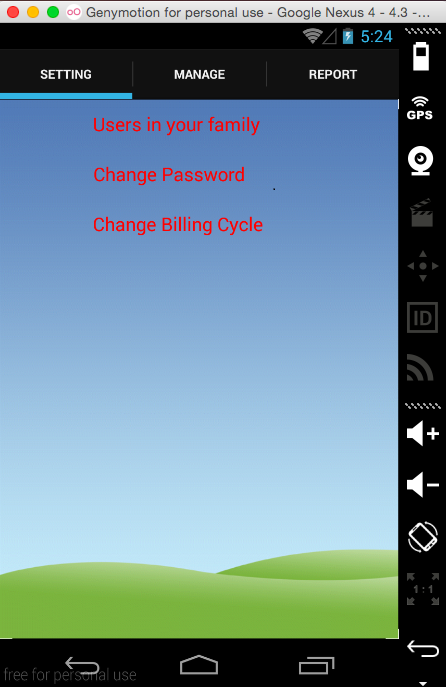
Registration Page that allows new user to register into the application.



Change Password Screen



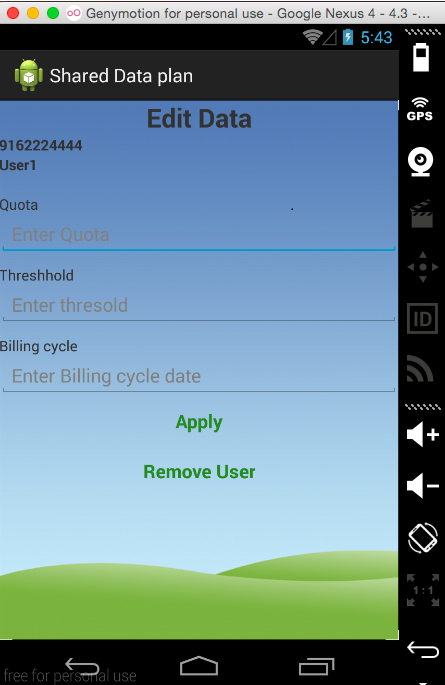
Settings Page: The main activity that loads on user login.



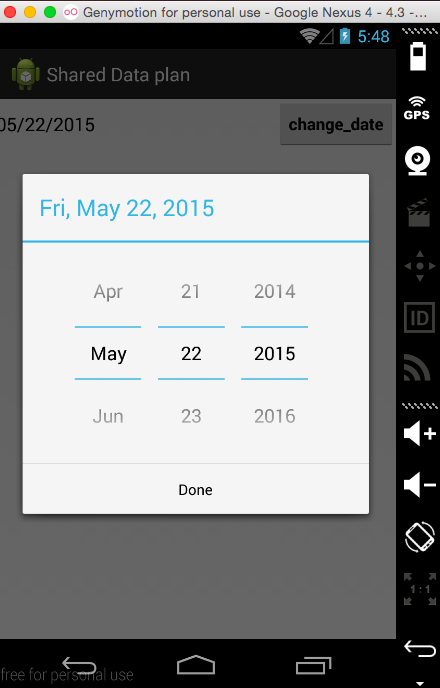
On click o User, this page shows the list of user that are in the family plan.



Page to change/edit user details



Date time picker implemented to choose/change Billing Cycle date



# CONCLUSION

We have successfully implemented a data usage application that developed the Graphical user interface using Android Studio and the business logic using Intellij with MySql database for permanent storage of information. We have successfully implemented web services and deployed the main server on the cloud using ngrok so that our application can work even when the server and the mobile are in different networks. This gave us the experience of implementing an application taking into consideration most of the real time difficulties that we face while developing an application in real world.

# REFERENCES

# <http://developer.android.com/index.html>

1. <http://slidenerd.com/category/android/>
2. Android Programming: The Big Nerd Ranch Guide (Big Nerd Ranch Guides) by Bill Phillips and Brian Hardy.