University of North Carolina Charlotte

Calorie Management System

Project Report

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Data Warehousing by Dr. Atif Mohammad

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CHAPTER I: INTRODUCTION

"Watch what you eat"

Food is the most important factor for all living beings. Proper consumption of food is necessary for health and social well-being. In a scientific study, it has been found that higher intake of food on a daily basis, results in obesity and thus leading to heart related diseases resulting in shorter life span. In medical and research terms, food is always measured in terms of calories. Another study has reported that, food with higher calorie content are more responsible for health problems than food with lower calorie content. On the other hand, less consumption of calories can also lead to diseases such as cardiac arrest, intestine problems and on a research study, it has been observed that over 140 trillion children across the globe are suffering from mal-nutrition. On a separate research conducted on improper calorie consumption, it has been observed that improper calorie intakes for an extended duration of time can lead to cancer and cancer related diseases. One has to balance the amount of calorie intake for a healthy life.

"Burn what you have"

While calorie intake is a nuisance and since it is not easy to maintain the balance of calorie intake, researchers has observed that burning the calories via workout and physical activities can help to balance the amount of calories inside the body. For example, if we take two persons A and B both consuming the same amount of calories

each day. A goes to a workout daily and B never workout. The probability of B getting a disease is higher than A. The reason behind this is that workout helps to burn calories and thus helps to maintain the optimal amount of calories inside the body.

"It's not so easy as it sounds"

Calorie intake and workout can help us maintain the calorie content inside the body but it is not so easy as it sounds. The reasons are so many and some of them are listed below:

- Different foods have different calories. The foods which are tastier can be dreadful to the body.
- Sticking to the same workout regime doesn't work. After a while, the body adopts to the workouts performed and doesn't burn the calories.
- Not easy to keep a note on the amount of calories added and burned on a daily basis.
- People often forget to pay attention to these things.

"Solution"

In this project report, we describe our approach to address the above mentioned issues with the help of a *Calorie Management System*, an application pipeline which pervasively make stores information on calories taken and burned, and reports to the user whenever it is necessary.

CHAPTER II: MOTIVATION FOR A CALORIE MANAGEMENT SYSTEM

Calorie intake and workout can help to maintain the calorie content inside the body. It is not easy because the users always tend to forget to take a note on these things. The need for calorie management systems has been increasing everyday as the people are getting busier with their everyday activities. The existing calorie management systems are either laboratory based in which the users will approximately predict the number of calories consumed and burned to a medical practitioner for their advice or the calorie management is approximated based on the user's weight. Both of these approaches have drawbacks as they are not pervasive and are only based on approximations.

Calorie management system needs to be pervasive and the user has to be able to enter the details whenever he wants. Mobile applications are best suited for this purpose because of two reasons: they are pervasive and the users can directly check the reports on his calorie consumption directly on his mobile whenever he wants. The easy of inputting the calorie intakes/burns and getting reports on a frequent basis brings flexibility to the calorie management system.

In this project, we have developed a calorie management system using android application. Everyone can register with this calorie management system and get insights about their calories consumed/burnt.

CHAPTER III: DATA WAREHOUSE

Data warehousing is a technology that aggregates structured data from one or more sources so that it can be compared and analyzed for greater intelligence, here intelligence includes analysis and reports generated from the data. Data warehouses are typically used to provide greater insight on the data stored. A Data warehouse is different from a database and they use a different design from standard operational databases (Example: MySQL RDBMS, MongoDB, etc..,). The latter are optimized to maintain strict accuracy of data in the moment by rapidly updating real-time data. Data warehouses, by contrast, are designed to give a long-range view of data over time. They trade off transaction volume and instead specialize in data aggregation.

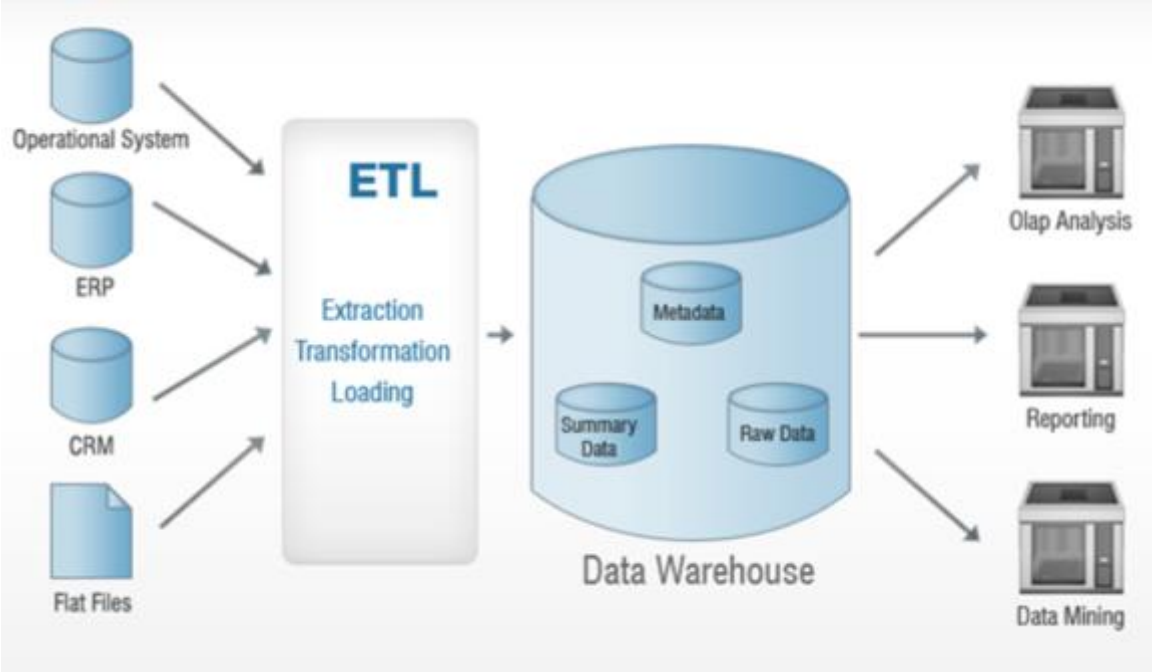

Figure 1 Example of a Data Warehouse

Apart from a relational database, a data warehouse environment must comprise of an online analytical processing (OLAP) engine; an extraction, transportation, transformation, and loading (ETL) solution; client analysis tools, and a number of additional applications that allow the enterprises to effectively gather data and deliver it to their business users.

During its process, the warehouse obtains data and information from heterogeneous production data sources either along with their generation or periodically, which allows the system to run queries over data that originally came from different sources in a smooth and streamlined manner. It converts the data gathered into business ready, meaningful information that is ready to fulfill all enterprise reporting requirements for all levels of users. The data warehouses can further deliver the interactive content to anyone in the extended enterprise, such as customers, partners, employees, managers, and executives.

Core characteristics of a data warehouse pertain to the different approaches adopted by it, and the primary goals it aims to achieve. Usually, a data warehouse must be subject oriented. For instance, in order to learn more about its sales data, a company can build a warehouse that concentrates on sales. Using this, the queries like "Who was the best customer for a certain item last year?" can be easily resolved. This ability to define a data warehouse by subject matter, sales in this case, makes the data warehouse subject oriented.

Similarly, it's imperative that a data warehouse is seamlessly integrated with its subject orientation. Data warehouses must put data from disparate sources into a consistent

format. It helps in effective prevention of naming conflicts and inconsistencies among units of measure. A data warehouse must also be nonvolatile, which means that the data must not alter after it is once entered into the warehouse. The core purpose of a data warehouses are to enable an enterprise to analyze what has occurred, hence no volatility of the data definitely plays an important role in the process.

Humongous amounts of data are required for analyzing business trends rapidly in the ever expanding world of today. This symbolizes stark difference from the online transaction processing (OLTP) systems, where old data is required to be moved to an archive after the processes are over. Hence, the focus of a data warehouse on change over time effectively proves the fact that time variance is a yet another important and necessary feature that must be exhibited by data warehouses in both policy and practice.

In this project, we have used a data warehouse to store the calorie intake of and calorie burns of each user for two reasons: One is to store the historical information of all the users and their calorie consumption and second to provide the data to researchers and allow them the provide insights of calorie management of each user.

CHAPTER IV: CALORIE MANAGEMENT SYSTEM

Calorie Management System is an android based application system. The application allows users to register, allows users to input their food intake and workouts performed on each day. When asked, the users can get useful insights about the calories he consumes and burns frequently. The user can select various food items consumed along with quantity. The user can also select various workouts to select the type of calories burnt. The user can select the number of hours worked out. The project was intended to focus more on data warehousing part. In the project, we have followed the ETL (Extract Transform & Load) process to load the data into the data warehouse. First, the data was *extracted* from the mobile front end, it is *transformed* at the server end and later it is *loaded* into the data warehouse. The figure below demonstrated the application workflow:

Figure 2 Workflow of Calorie Management System

4.1 Android application:

In this project, we have used an android application to collect the calorie intake and calorie burnt data from each user. The data collected is then sent to the server via HTTP/ HTTPS for post-processing. Figure below explains the architecture for data collection. The application was developed using *Android Studio 2.1.2.*

Figure 3 Data aggregation via Android application

4.1.1 User Authentication

To provide individualized feedback to each user and to respect the privacy of each user, we have set up a simple user authentication. The authentication is separated from data warehouse and is done by *google firebase*, a readymade database built on NoSQL platform for storing data and authentication. In this project, we have used *firebase* only for user authentication.

Once the user opens the calorie management system application, the user is prompted with a login screen, a link is provided at the bottom of the screen if the user has not been previously registered with us.

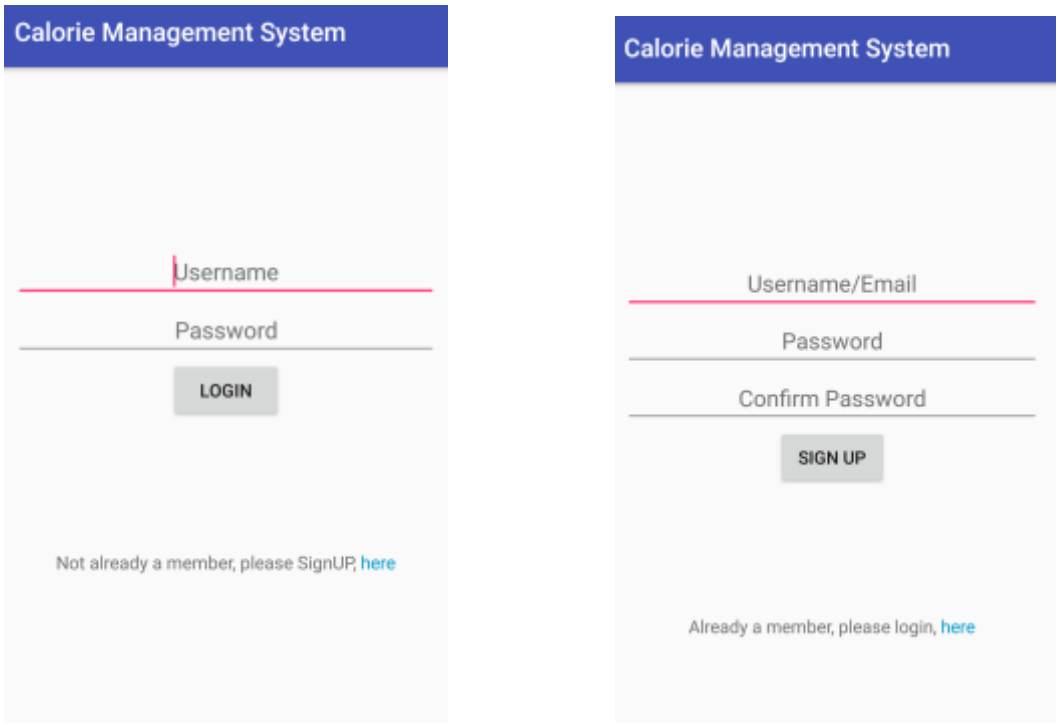

Figure 4 Login and Sign Up screens

The registered users are now stored in firebase as shown in figure below. The information such as login id/username, password, etc. can be handled by the admin who now has access to the firebase account.

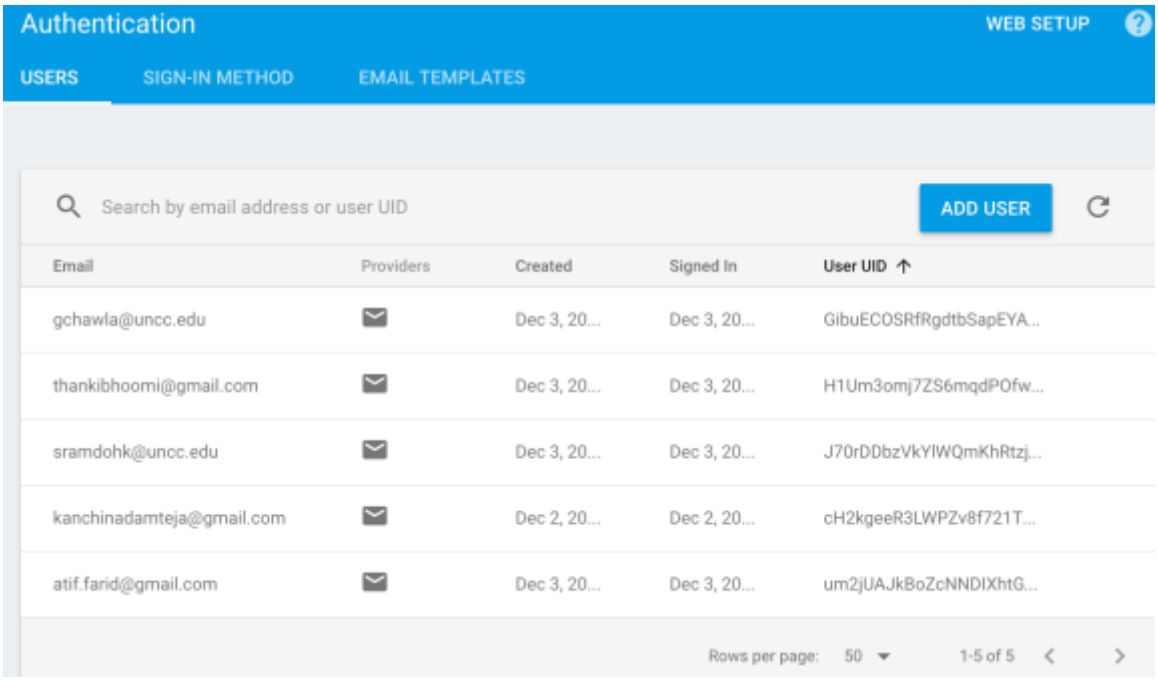

Figure 5 A snapshot of firebase user authentication tab

Once the user registered has been completed, the user can directly login to the main page of the application. The user can enter details in two ways, Calorie intake (Food picture) and Calorie burnt (Workout picture).

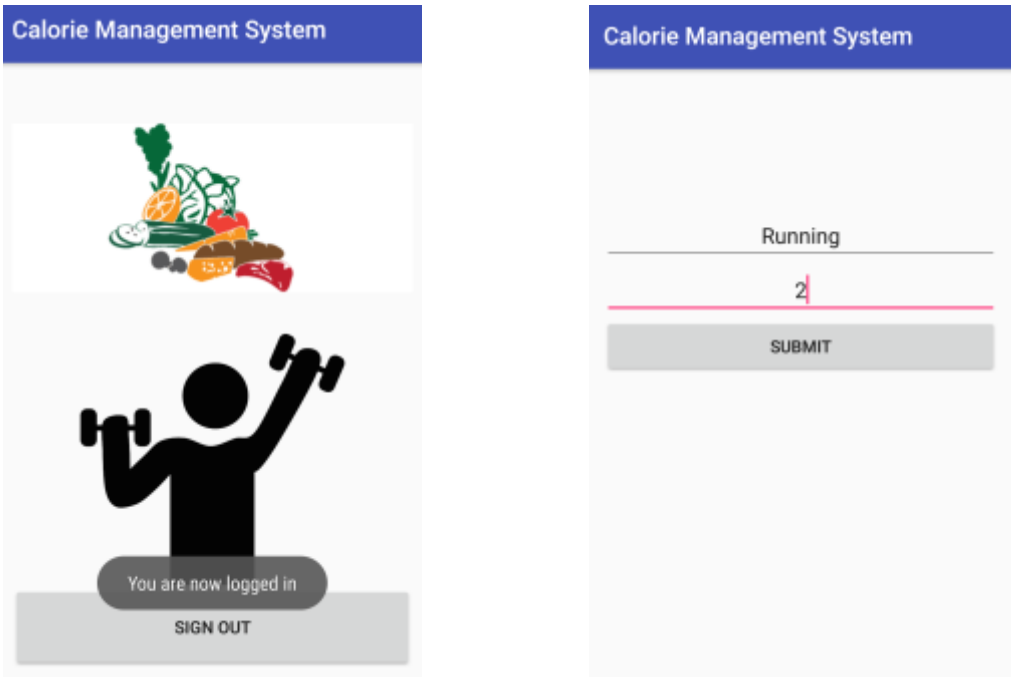

Figure 6 Main screen and Workout section

Upon selecting the workout picture as shown in the above figure, the user is prompted to calorie burnt page. The user can enter details such as the name of the workout and the number of minutes of the workout. The information is then sent to the server via HTTPS. Similarly, upon clicking the food picture, the user is prompted to the food intake tab and the user is allowed enter details such as food item consumed and the quantity of the food item consumed.

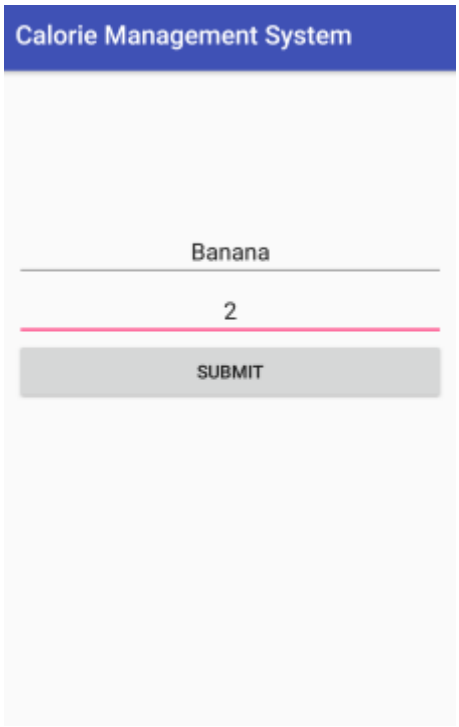

Figure 7 Food section of Calorie Management System

4.1.2 Setting up dependencies on Android Studio

The application was developed with a goal that it can be easily recreated or extended. However, there are some additional dependencies which are unavoidable. Here is the list of dependencies which needs to be addressed.

1. Register a firebase account and create a new firebase project for android. This will generate a *google-services.json* file. Replace the old *google-services.json* file in the android project and replace it with the new *google-services.json* file.
2. Upload the server specific files given with this project to a cloud server and provide URL's in the android studio project.

Figure 8 Replacing google-services.json file

Figure 9 Replacing the server URL's on Android Studio

4.2 Transforming data on the server

The data sent from the mobile application is then sent to the server via HTTPS. The figure below demonstrates the work flow. Initially, the data entered by the user for calorie intake/burn is encoded into a JSON format and it sent to the server via HTTPS. The server receives the data and it transforms the data into the calories. This transformation is explained by the figure 4.

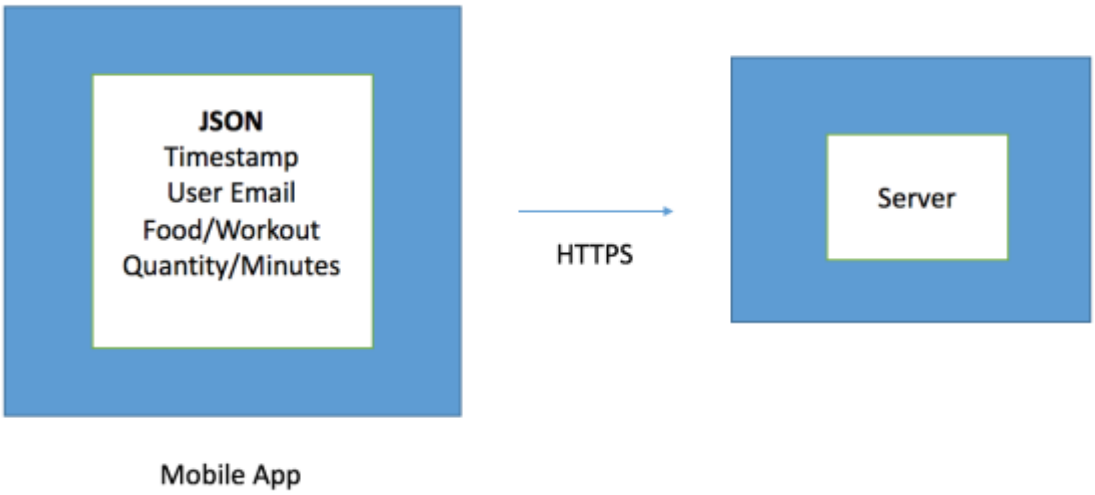

Figure 10 Posting data from Mobile application to a server on the cloud

Figure 11 Transforming the raw data to calories

The mapper function is responsible for transforming the data into calories. We have manually entered the calorie per item and calorie burnt per minute for each food item [APPENDIX A] and workout [APPENDIX B] to an array and compared it with the incoming data, thus transforming the data into calories. The data is then loaded into the data warehouse.

There are some dependencies on the server part too. *connection.php* file needs to be changed for setting the database connection with the server.

4.3 Loading data into the Data Warehouse

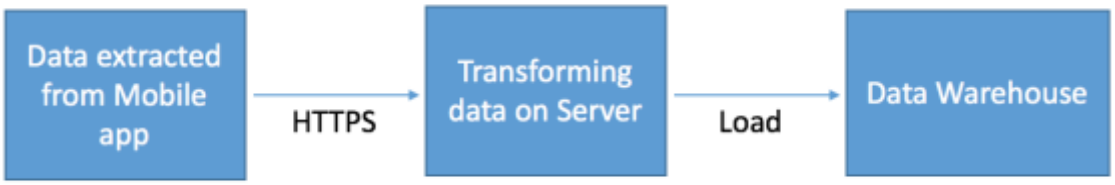

Figure 12 Loading data into the data warehouse

The data extracted from the mobile device is sent to the server via HTTPS. The server transforms the data into calories and loads the data into the data warehouse.

4.3.1 Star Schema

The star schema separates business process data into facts, which hold the measurable, quantitative data about a business, and dimensions which are descriptive attributes related to fact data. Examples of fact data include sales price, sale quantity, and time, distance, speed, and weight measurements. Related dimension attribute examples include product models, product colors, product sizes, geographic locations, and salesperson names.

The star schema used in this project comprises of a single fact table and three dimension tables. Figure 5 explains the star schema used for calorie management system and these tables were created on a MySQL RDBMS.

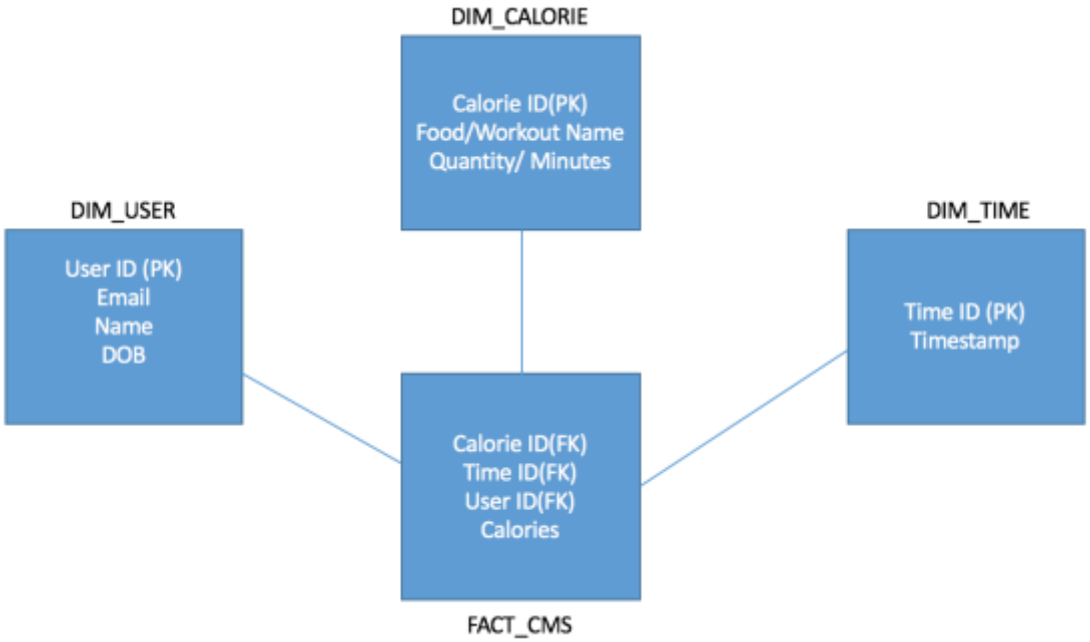

Figure 13 Star Schema for Calorie Management System

The dimension tables are prefixed with the letters DIM and the fact table is prefixed with the letters FACT. A fact table works with dimension tables. A fact table holds the data to be analyzed, and a dimension table stores data about the ways in which the data in the fact table can be analyzed. Thus, the fact table consists of two types of columns. The foreign keys column allows joins with dimension tables, and the measures columns contain the data that is being analyzed. The Calories attribute in the fact table can be positive/negative. If the user input was food intake, the calories would be stored as positive and if the user input was calories burnt, the calories would be stores as negative values.

The screenshots of fact table from the data warehouse is shown below. The positive values indicate the calorie intake and the negative values indicates the calories burnt.

TIME_ID	CALORIE_ID	USER_ID	CURRENT_CALORIES
13	1	1	30
14	2	1	30
15	3	1	30
16	4	1	30
17	5	1	-30
18	6	1	300
19	7	1	300
20	8	1	300
21	9	1	300
22	10	1	300
23	11	1	300
24	12	1	-75

Figure 14 FACT table of Calorie Management System

CHAPTER V: CONCLUSION and FUTURE WORK

In this project, we have a developed a simple Calorie Management System using Android, PHP and MySQL technologies. At this point of time, the users can feed information about their calorie intake/burns to our data warehouse. The reports have to be generated manually by performing data mining on the data from data warehouse. The importance of this calorie management system is that the data warehouse design, even though it is simple, it is more robust and can handle large amounts of data (includes historical data) of each user.

There is a lot of scope of future work from this project. Here is the list of functionalities which we think can be readily made available:

- Generating reports in the server so that the user can view his progress/insights from his mobile itself.
- User authentication can be moved to the data warehouse instead of using *google firebase.*
- Extending the APPENDIX-A and APPENDIX-B sections by adding more food items and workout names. Getting accurate measured for these values.
- Polishing the mobile application and create good user experience.

ACKNOWLEDGMENTS

We would like to thank Dr. Atif Mohammad for teaching the concepts of Data Warehousing and giving us the opportunity to work on this project. He is a great professor, mentor and his guidance has helped us to finish this project. We would also like to think the teaching assistant for the course Pradeep Samuel. Pradeep was always available whenever we ran into any trouble and he maintained the class well in the absence of professor. Next, we would like to extend our appreciation to all the guest lecturers of this course and thank them for sharing their valuable knowledge with us. We would also like to thank all the classmates of this course for their support and for sharing their knowledge with us throughout the semester.

APPENDIX-A FOOD ITEM MAP

Food Item	Calorie (per Quantity)
Potato	283
Milk	103
Banana	105
Bread	79
Kidney Beans	613
Rice	206
Avocado	234
Oat Meal	158
Wheat	651
Eggs	78
Chicken	335
Beef	213
Cereal	307
Other	150

Table 1 Table explaining food item and the corresponding calorie amount per item

APPENDIX-B WORKOUT MAP

Workout Name	Calories (per Hours)
Swimming	500
Running	500
Walking	170
Cycling	472
Dancing	325
Badminton	266
Aerobics	384
Other	150

Table 2 Table explaining workout name and the corresponding calorie burns per hour