Rutgers University
School of Engineering

NATIONAL HEALTH CHALLENGE GAME

Electrical and Computer Engineering Capstone Design:
Software and Systems Spring 2014

PROJECT ADVISOR
DR. IVAN MARSIC

TEAM MEMBERS
NEELESH BALAJI
MOHAK TAMHANE
MICHAEL SPANIOL
THEOPHILUS MENSAH
• Abstract:

There is a thin line between what is fit and what is not. But unfortunately there is no absolute way to judge or quantify this measure. People are being deemed overweight and obese by looking at scientific measures such as BMI. But now there is an app called RunKeeper which tries to quantify workouts in terms of points and numbers associated with each workout. This app uses the concept of calories, weight, sets, and repetition to rate the workout being done by the user. This RunKeeper app is the foundation for the National Health Challenge Game that we have created. This game application is backed by a website which holds the rankings of the state. Although a user needs to register through the application and enter information in there, the website will adopt the results processed by the application to bring about a national view of the game.

The National Health Challenge Game turns exercising into a competition by using the ratings of RunKeeper of each individual to rank states in the United States of America. Along with providing the ranking of states, the application also tracks individual ratings and uses it for a national winner and local winners. The tough competition will motivate several individuals to achieve great progress in their workouts and allows USA to become a fitter country.

The points are assigned relatively. There will be a normalization process in which an individual will be given more points if he is performing higher than his local competitors, vice-versa. This process rewards the individual who is trying to change the fitness level of his state. A user also loses points if he goes about an extended sedentary period. This can be registered because there will be an extensive database component which records detailed information such as date, time, calorie count, and even modes of workout. So, there is an intricate analysis done to each individual when ranking.
History shows society that competition will produce the best results. NHC uses competition as a tool to propel the men and women in US to attain their physical goals. It is the survival of the fittest and there is no looking back!

- Introduction/Overview:

There is an ongoing debate all across our great nation that rate of obesity needs to be tapered. We also see all kinds of movements to steer this debate, including television shows (e.g. The Biggest Looser), technological inventions (e.g. Google shoe), city initiatives (e.g. The City is Going on a Diet in Oklahoma), etc., which all tout the need for people to incorporate exercising in their daily routine. Furthermore, innovators in technology have also turned to exercise tracking devices as a viable source of business; to invent items that will motivate individuals to exercise. We see this in Google shoe, Fitbits, Nike Fuel, Jawbone, etc., that are investing full-fledge in the exercise business. Although all these avenues tout the need for individuals to incorporate exercising in their daily routine, it is rather a daunting challenge for citizens to keep up with this widely accepted goal. Although people have accepted exercising as a healthy lifestyle, anyone who has tried to exercise, or maintains a rigorous and steady exercising routine will agree with the fact that it is very easy to be discouraged given the amount of stress that the body undergoes. Games have therefore been applied to health tracking and behavior changes as a source of motivation, but the scoring system of the current games are rather linear and highly predictable: more workout leads to greater achievement. See, for example, Fitbit badges (Wikipedia). This simple awarding system of the-more-exercise-the-better is inadequate, and can lead to dis-motivation. The extra motivation requirement introduced to exercise-health tracking games. These games are a source of motivation from the customer’s accounts and have worked fairly well with some people, but not so well with most people. “The people who were not satisfied with
the games actually found it very boring, due to the linear and highly predictive system of scoring: more workout leads to greater achievement.”

• Approach/Methods/Results:

The National Health Challenge Game is an idea that takes the gamification of individual exercise and expands it into a national competition, where people who participate in this challenge, are not only motivated to exercise more, but also to invite a neighbor to join them when exercising. The system was designed to challenge its players to maintain a rigorous exercising routine in order to maintain a title of “Most Fit”, while helping his/her community become the “Fittest Community”. The National Health Challenge Game changes the linear and predictive system of scoring employed in most health tracking games into an uncertain and competitive system we call a conditional calculation. In the conditional calculation system of scoring, a player will be rewarded based on the amount of exercise he/she does in a day, and on the “health of the crowd”; the number of community members that exercise in a day. This system strives to be competitive in the sense that the number of points a player gets for individual effort are based the amount of individual exercise recorded by the system the previous day, and number of points for the “health of the crowd” are based on the rank and total participation of a state’s community for the previous day. This way a player loses points for their community for not exercising frequently. This system unlike anything else, will also help us be able to answer questions like: (1) How many people in a given geographical area exercise, (2) What percentage they represent of their area’s population, (3) What is their demographics (age, gender, etc.) and how exercising is distributed across different demographic groups, and so on, which we believe may be of interest to the U.S. Department of Health and Human Services as well as Health Insurance companies. Our implementation of the National Health Challenge Game focuses mainly on states
as a player’s community in order to simplify the design; there are only 50 states, plus DC, with easy and a well demarcated maps, as compared to over 300 cities. Our system will comprise of four main parts: (1) Android RunKeeper Application, (2) State Ranking Website, (3) Android NHC Application, and (4) Content Database (backend). Our system is mobile intensive, and has Android OS as its primary mobile platform due to less developer restrictions.

The main driving force behind this system is gaining players’ exercise data. The National Health Challenge Game requires all users to provide access to their exercise data through the Android RunKeeper application or provide a link to download one from the Google Play Store if they don’t already have one at setup. RunKeeper was chosen because it is the only readily available open source health tracking application that has an Application Programming Interface (API). The “health of the crowd,” is obtained from an implementation of a MySQL database, which accumulates the amount of exercise for each state in the United States, contributed by the citizens of that state who participate in the National Health Challenge Game. The database also calculates the ranks and statistics of each state as user data is uploaded to the system. A countrywide map is publicly displayed on the State Ranking Website (http://128.6.29.222:8080/nhcgame/) which ranks each state based off the database tables. The Android NHC application is the main point of user interaction with the entire system. The data from the Android RunKeeper application is collected and processed by the Android NHC application. The processed user data is then stored in the. Registered users have the option to log into their Android NHC application account to view their rank as well as points and other statistics.

The scoring system was developed with the intention of rewarding users and their communities for their hard work and for their devotion to exercising. As users upload their exercise data, the system keeps track of who has exercised. At a specified time in the system, the percentage of users who exercised out of
the total registered users in each state is calculated. This percentage is then used to determine how many points that state should earn for its combined efforts. The max points this “health of the crowd” percentage can yield is determined by the rank of the state corresponding to that percentage. This is to promote users to invite their friends to play as well as encourage them to try their hardest and exercise daily.

The system exchanges information between its three parts (Android Application, Database, Website) through MySQL statements.

```java
String uploadData = "INSERT INTO Upload(distance, p_username, eType, upload_date, upload_time) "
   + "VALUES (?,?,?, NOW(),CURTIME())";
   PreparedStatement ps2 = conn.prepareStatement(uploadData);
   ps2.setDouble(1,distance);
   ps2.setString(2,username);
   ps2.setString(3,dtype);
   ps2.executeUpdate();
   conn.close();
```

This code is one of several instances of how we exchange data through the database. This particular instance takes an established connection (conn) to the MySQL database and then executes an update using the PreparedStatement (ps2) generated from the String ‘uploadData’.

To test this system in such short time, a program was created to generate fake users for the database. These users were created for each state based on the state’s obesity percentages. To keep the sample size small enough to not burden the system, a fraction of the state’s population was taken first and then the program takes the fraction of people who aren’t obese and multiplies it by the fraction of the population. The number generated is the number of users generated for that state.

```java
for(int i=0; i<51; i++){
   fakepop[i] = (int)((Integer.parseInt(state_pop[i])/100000) *
   (1-state_per[i]/100));
}
```
Another program was created to simulate users updating the database with RunKeeper data. The program pulls the list of users from the database and updates a percentage of the users based on user inputs. The amount each user has exercised is randomly generated and is sent to the database just as if a real user had uploaded their data.

```java
while(inc < count){
    String hold = rs.getString("username");
    double upp = rand.nextDouble() * 5;

    stmt1 = (PreparedStatement) con.prepareStatement("INSERT INTO Upload(distance, p_username, eType,upload_date,upload_time) VALUES ("+upp+","+hold+","walking", NOW(), CURTIME())");
    stmt1.executeUpdate();
    inc++;
    rs.next();
}
```

In this code, ‘upp’ is the randomly generated points to be uploaded, ‘hold’ holds the current username to upload, and count is the number of users that should be updated in order to test the system’s generation of “health of the crowd” points.

The result of all of this is a system consisting of an android application, a website, and a database, which communicate through MySQL queries through the database.
The NHC game website with Texas selected. Ranks are on the left while Texas Stats are on the right.

View of a user’s profile from the NHC application
• Cost/Sustainability Analysis:

  Major Costs
  
  - Database Server to accommodate large number of users
  - The users access to the actual system all have an efficiency of $O(1)$
  - Environmentally there is no effect

  Website component
  - Marketing
  - RunKeeper app and point calculation

Cost Analysis

1. The database cost is associated with the number of users being stored, cost of the hardware, and the cost of the application it is supporting. Considering an exponential growth the number of users are going to significantly increase according to the factor $e^t$, where $t$ is the time. Now considering that the population of the United States is about 300 million and 1/3 of them are going to use that application. This means that we need a server to support 100 million users. Now considering there are 15 tables each with about 20 bits, there is a total of 300 bytes associated with one user. So the approximate amount of memory needed is $2.794 \times 10^{-7} \times 100,000,000$. About 28 GB of RAM is needed while a 500 GB SSD RAID Storage costs about $500. Now considering the need to maintain sustainability SSD should be used instead of HDD in order to support dynamic storage. The cost would be less than $100.$
2. The user access to the actual system, which includes the database, is an O(1) event considering that a majority of the user’s interaction with the actual application will be creating a detailed profile. Considering these profiles are similar to that of Facebook’s, there will be a cost associated with that. The storage costs were already discussed in the database section and hence there are no more additional costs to accommodate the user’s access to the application.

3. Environmentally there are no costs because this an android application which does not affect any environmental factors.

4. The website component is dominated by 3 sections of costs: domain, server hosting, and connection to software. Private domains cost up to $10 per year due to the registering a separate domain based on the host. So the domain name is crucial in creating an identity for the site and hence is mandatory. The next component is server hosting. The server currently used is a PHP embedded server. Although the choice of a free web host is manageable with small amounts of data being passed through, with mass amounts the server will constantly be down and process the packets very slowly. Again, the cost of a stable server that handles traffic is more than $10 a month. Now, the transfer of points from the
application to the website is done based on triggers. So after an algorithm is used to calculate points associated with each user and state, the information is passed onto the website for a display of rankings. While the physical costs will be handled by the server, the only cost left is the efficiency cost. That cost will be described in the algorithm section. All in all, the cost of the website is very small considering the actual database costs.

5. The marketing component is calculated considering the medium of the advertisement. Newspaper articles and electronic advertisements are the main way to send the message to the mass. Considering the application will predominantly dominate the United States, the major articles are the times, Daily news, Washington Post and so on. Electronic advertisement is associated with a short description ads associated with most used applications including Facebook and Twitter. The cost should be minimal if more electronic advertisements are used and assuming that you do not pay for reviews. So marketing can be considered very small or negligible.

6. The foundation for the NHC application is a RunKeeper application and an android phone. A user will be required to have an android device with RunKeeper installed so the cost of the phone, which can be free depending on the user’s phone plan; is incurred by the user. The algorithm for calculating a state’s points, which was explained previously in this report, is an O(n^2) event. This is because the system needs to first calculate the amount of points a state deserves based on the activeness of its users and then needs to add those points to the states. This needs to be done in two steps as two different tables need to be queried for these calculations to occur, thus resulting in O(n^2).

• Conclusion/Summary:
The framework of the system and the main functionalities were all implemented. The Android application was developed in Eclipse using Java and XML programming. The main functionality of this application that was implemented was connecting the user’s NHC account and their RunKeeper account together and importing their exercise data from RunKeeper into the database. The application was also given the functionality to view the user’s statistics, send invites to others through text, view the website, and view the state rankings.

The Database was given the necessary tables to hold the incoming user data. It was also given triggers in order to calculate each state’s ranks and points as user data is fed to the system. This was done using MySQL.

The Website displays an interact map that displays the statistics of whichever state the user selects. The Rankings of each state is also displayed on the left side of the site. This was done using JSP, HTML5, CSS3, and JavaScript.

In conclusion, the NHC Game has been fully implemented and can function as intended. The next steps from here would be to improve aesthetics and to add more functionality that could allow more user interaction between other users through the actual application. Even without these though, the system functions as a game which promotes exercise.

- Bibliography:

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