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An Information Provider for Exercise Data using IoT techniques

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ABSTRACT

Recently, people have become more and more interested about their health. For this reason, people want to know how much calorie they have consumed during exercise. Considering the user requirements, we suggest an application to check the calories which is consumed daily. Our program includes IoT techniques which provides an interface to interact with devices. The proposed program has several functions such as the calorie measurement, walking pattern analysis, and recommendation system. We used hive as the data collection and analysis tool. To visualize our result, we implemented our program in an android smart device.

Key words: IoT, Hive, walking data, calorie.

1. INTRODUCTION

IoT(Internet of Thing) is technique to link human-to-device and device-to-device using internet service. Using the technique, we can interact with anything such as smartphone, car, and ATM. Also, device can interact with other devices based on IoT. The necessary skills for IoT are the sensing technology, wired and wireless communications & network infrastructure technology, service interface technology, security technology, etc. Using these techniques have been used more and more IoT of ways. Examples of the technique using the IoT may include: Monitoring of parking spaces availability in the city, Monitoring of combustion gases and preemptive fire conditions to define alert zones, Control remotely the swimming pool conditions, Energy consumption monitoring and management, Access control to restricted areas and detection of people in non-authorized areas.

As people grow interest in health, people began calculating calorie intake, how many they should burn calorie, calorie that according to the exercise method rather than just blindly exercise. Also, people who are interested in the diet are increased interest in whether people need to consume more calories much exercise. In this paper, using the service interface description of the IoT based on the increase of interest in the calorie consumption of these people, we propose a method that user can know a little easier to consume calories a day and their calorie consumption.

In fact, because students attending a school or professionals do not have much time to invest in a movement to walk, we calculate the calories burned by measuring the time and distance user have walked. Calories to be consumed per day were measured by considering the user's gender, age, height, weight together, to walk calories burned were measured using a standard officially listed. Using these two measurement method, we represent how much time people should walk and how much distance user should walk by calculating the difference between calories consumed on their long walk in the calories user need to consume per day. These simple presentations are easy to know that identify the remaining amount to achieve its goals to user. Also we calculate the calorie consumption based on user is underweight, overweight or normal. This information identifies using the user's gender, age, height, weight.

We use the Hive for storage and analysis of data necessary for the method proposed in this paper. Apache Hive provides data summarization, query and analysis capabilities into the data warehouse running on Hadoop infrastructure. The disadvantage of Hive is that it is not suitable for small amount of jobs, but in this paper, this method is expected that the user demand will increase then the size of the data will be enough big. Hive's latest version is 0.12.0, and was implemented in the Java language. Hive stores metadata in the built-in database, but also provides the option to use other database. And Hive now support four file formats. Textfile, sequencefile, orc and rcfile.

Our method is convenient because we only need a smart phone without the need for another device for measure several data and watch measurement result. It is not necessary to understand the user and through the analysis of complex data, because the result is to be confirmed by a simple UI. Instead of measuring the total moving distance for each day, we calculate moving distance based on time. In this reason, we can analyze user walking patterns. The proposed method in this paper can be seen through these points that are useful enough.

The organization of the paper is as follows. In the second section, we will introduce the related works, and in the third section, we will provide and explanation of calculating calorie

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algorithm and we deal with implementation. In the last section, we provide the conclusion and further study.

2. RELATED WORKS

In this section, we briefly introduce the IoT paradigm. First, we present some fundamental information (e.g. how Internet evolved, what is the IoT), definitions, and IoT applications. And, we describe Apache Hive, which will be used at our project. Also we describe e-Health.

2.1 Internet of Things (IoT)

A. Evolution of Internet

In the late 1960s, communication between two computers was made possible through a computer network [1]. In the early 1980s the TCP/IP stack was introduced. Then, commercial use of the Internet started in the late 1980s. Later, the World Wide Web (WWW) became available in 1991 which made the Internet more popular and stimulate the rapid growth. Web of Things (WoT) [2], which based on WWW, is a part of IoT.
Later, mobile devices connected to the Internet and formed the mobile-Internet [3]. With the emergence of social networking, users started to become connected together over the Internet. The next step in the IoT is where objects around us will be able to connect to each other (e.g. machine to machine) and communicate via the Internet [4].

B. Definition of IoT

The term 'Internet of Things' was firstly coined by Kevin Ashton [5] in a presentation in 1998. He has mentioned *"The Internet of Things has the potential to change the world, just as the Internet did. Maybe even more so."*. Then the MIT Auto-ID center presented their IoT vision in 2001 [6]. Later, IoT was formally introduced by the International Telecommunication Union(ITU) by the ITU Internet report in 2005 [7].
The IoT encompasses a significant amount of technologies that drive its vision. In the document, *Vision and challenges for realizing the Internet of Things*, by CERP-IoT [8], a comprehensive set of technologies was listed. IoT is a very broad vision. The research into the IoT is still in its infancy. Therefore, there aren't any standard definitions for IoT. The following definitions were provided by different researchers.

- Definition by [9]: *"Things have identities and virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate within social, environment, and user contexts."*
- Definition by [4]:*"The semantic origin of the expression is composed by two words and concepts: Internet and Thing, where Internet can be defined as the world-wide network of interconnected computer networks, based on a standard communication protocol, the Internet suite (TCP/IP), while Thing is an object not precisely identifiable Therefore, semantically, Internet of Things means a world-wide network of interconnected objects uniquely addressable, based on standard communication protocols."*
- Definition by [10]: *"The Internet of Things allows people and things to be connected Anytime, Anyplace, with Anything and Anyone, ideally using Any path/network and Any service."*

Fig. 1 illustrates the definition more clearly.

Figure 1:. Definition of the Internet of Things

C. Applications

Potentialities offered by the IoT make possible the development of a huge number of applications, of which only a very small part is currently available to our society. Many are the domains and the environments in which new applications would likely improve the quality of our lives: at home, while traveling, when sick, at work, etc. These environments are now equipped with objects with only primitive intelligence, most of times without any communication capabilities. Giving these objects the possibilities to communicate with each other and to elaborate the information perceived from the surroundings imply having different environments where a very wide range of applications can be deployed[11]. These can be grouped into the following domains:

- Transportation and logistics domain
- Healthcare domain
- Smart environment (home, office, plant) domain
- Personal and social domain

2.2 Apache HIVE

The Apache HIVE [12] is data warehouse infrastructure built on top of Hadoop for providing data summarization, query, and analysis. While initially developed by Facebook, Apache Hive is now used and developed by other companies such as Netflix. Amazon maintains software fork of Apache Hive that is included in *Amazon Elastic MapReduce* on Amazon Web Services.

Apache Hive supports analysis of large datasets stored in Hadoop's HDFS and compatible file systems such as Amazon S3 file systems. It provides an SQL-like language called HIVEQL with schema on read and transparently converts queries to map/reduce, Apache Tez and in the future Spark.

Apache Hive is higher level query language, so it can simplifies working with large amounts of data. Also Apache Hive can lower learning curve then Pig or MapReduce, because HiveQL is much closer to SQL then Pig, and less trial and error than Pig.

2.3 e-Health

e-Health [13] is a relatively recent term for healthcare practice supported by electronic processes and communication, dating back to at least 1999. Usage of the term varies: some would argue it is interchangeable with health informatics with a broad definition covering electronic/digital processes in health while others use it in the narrower sense of healthcare practice using the Internet. It can also include health applications and links on mobile phones, referred to as m-health. Since about 2011, the increasing recognition of the need for better cyber-security and regulation may result in the need for these specialized resources to develop safer e-Health solutions that can withstand these growing threats.

In healthcare, the possibilities are so great, that we really need to imagine a few finite use cases to prioritize and illustrate likely, near-term scenarios. Today, more than one billion adults worldwide may be classified as obese, a condition in which their weight imperils their health.

A. Apple Health

Apple Health is one of e-health examples. Apple made a big deal about the HealthKit initiative kicked off on iOS 8. HealthKit is digital healthcare platform developed by Apple, similar to Google Fit. The goal is to have HealthKit work with third-party apps and accessories to track iPhone owners' health and fitness activities. HealthKit allow apps that provide health and fitness services to share their data with the new Health app and with each other. A user's health information is stored in a centralized and secure location and the user decides which data should be shared with user's application. The Health Application in iOS is the hub for Health Kit. It gathers health and fitness data collected by third-party apps (e.g. Apple Health) and accessories and displays it in one places. The Health app had been tracking every step I'd taken in the week since turning on the iPhone for the first time. Walking is the central theme in my health regiment, and it was great to see the total number of steps taken each day and the distance covered.

There are two items in the dashboard that detailed my walking. The first tracked it in number of steps taken, and the second in distance. The latter indicated both walking and running distance.

Figure 2. Health App Dashboard Screenshot

This clearly demonstrates the benefits of Healthkit. Without any action on the user's part, the iPhone and accessories produced to work with it track exercise. The Health app gathers that information and displays a dashboard (see Figure 2) to produce an overview of the monitoring.

3. IMPLEMENTAION

According to [14] walking for 30 to 60 minutes per day is recommended for health and weight management. The body's basal metabolic rate depends on weight, height and age, basal metabolism of everybody is different. According to the user personal data we calculate the accurate time which recommended walking and alert user kcal consumption at present. In order to encourage user to complete the walking mission per day, the system will alert an inspiring message to user. We assume that our device application system which gather user personal information and walking data and design

the import page of our device application system. Figure 3 is the user configuration setting page which contain user personal information. Based on the page we make the user data which is explained in the part of table schema.

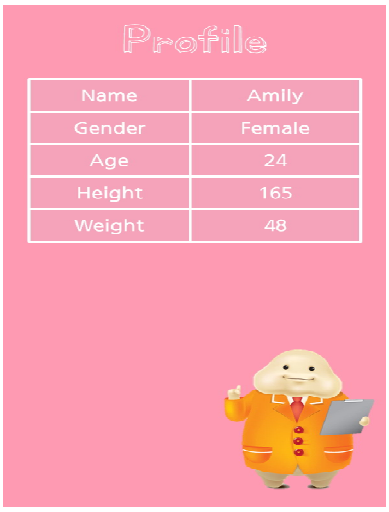

Figure 3 User configuration setting page

Figure 4 is the page of recoding time which display the distance as time goes by. When user press the start button in the Figure 4 of left side, the system records the starting times and calculate the sum of the distance that the user go for a walking in that time. When user press the stop button, the system records the time that user finish walking and the total distance that the user go for a walking between starting times and end time. Based on the page of recoding time, we make the walking information data which also explain in detail in table schema part.

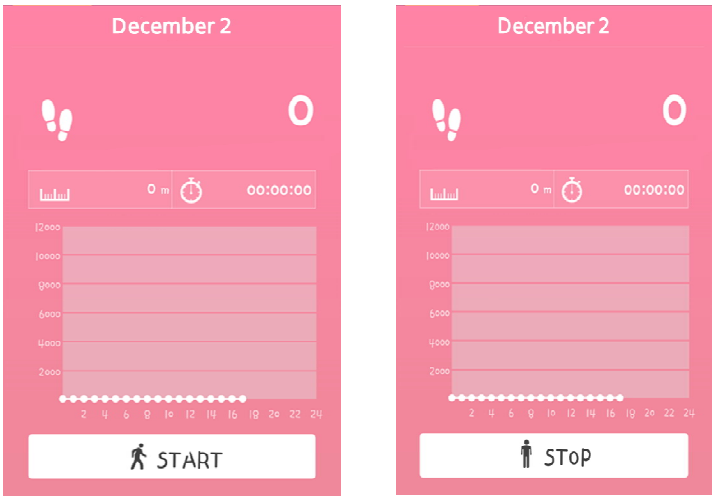

Figure 4 page of recording time

3.1 Table Schema

We make data in csv file which contain user personal information and walking information. There are two csv file. One is contain user personal information, the other one contain the time which spent on walking and distance information. We explain the data used in this paper as a table. Table 1 shows the structure of user data which is used in this paper.

Table 1 User data

User_id	Name	Age	Job	Height	Weight	Calori c

User table contain basic personal information such as user's unique id, name of user, age, job, height, weight, and BMI(body mass index). BMI is a measure of body fat based on height and weight that applies to adult men and women[16]. BMI consist of low weight, proper weight, overweight and obesity. We calculate the value of BMI in Korean site [17]. Table 2 shows the structure of walking data.

Table 2 Walking data

User_id	Date	Start_tim e	End_time	Distance

Walking table contain 5 columns such as user_id, date, start time, end time and distance. The column of start time is the starting times which user start walking in and the column of end time is the ending times which user finish walking in that day. We can use time information to calculate the time and caloric which spent on walking.

3.2 Load data in hive

We load data, make table and retrieve information in hive. Hive is a data warehouse infrastructure built on top of Hadoop for providing data summarization, query, and analysis[15]. Figure 5 shows the execution of hive in VMware Workstation on the top of Hadoop.

```
Logging initialized using configuration in jar:f
-0.12.0/lib/hive-common-0.12.0.jar!/hive-log4j.p
hive> show tables;
OK
Time taken: 13.252 seconds
hive>
```

Figure 5 Execution of hive

According to the table schema we create table in hive. Figure 6 shows the user table which contain user personal data.

```
hive> CREATE TABLE user(
    >   userID int,
    >   name string,
    >   gender string,
    >   age int,
    >   job string,
    >   height int,
    >   weight int,
    >   caloric_req int
    > ) ROW FORMAT DELIMITED FIELDS TERMINATED BY ',';
OK
Time taken: 1.337 seconds
```

Figure 6 User table

Figure 7 shows walking table which contain staring times and end times which spent on walking. The structure of walking information table based on walking data which is in csv file.

```
hive> CREATE TABLE walking(
    >   userID int,
    >   date string,
    >   Start_time date,
    >   End_time date,
    >   Distance double
    > ) ROW FORMAT DELIMITED FIELDS TERMINATED BY ',';
OK
Time taken: 12.05 seconds
```

Figure 7 walking information table

After creating database we load data which is saved in csv file into user table and walking information table. In order to get the walking distance, the caloric at present and the distance which is continue to walk for today, we use simple select query and join multiple tables. Figure 8 shows the results of the complex queries.

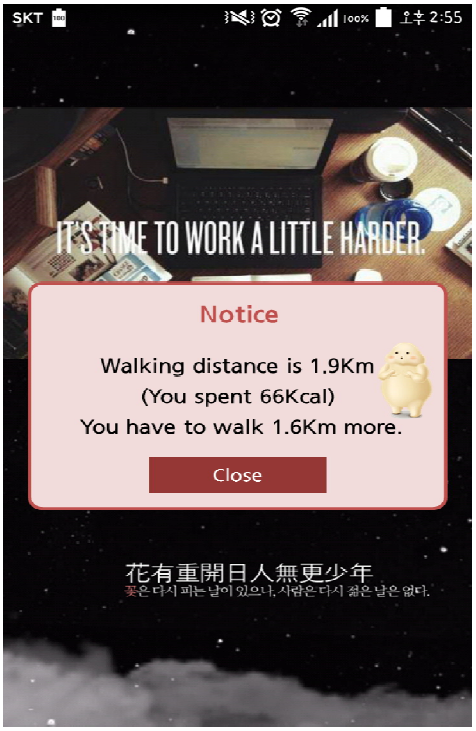

Figure 8 The result of query execution

4. CONCLUSION AND FUTURE WORK

We assume that the walking application for smart phone and design the import page of application. According to the smart phone application, we create data in csv file and load data in hive.

In this paper we only consider the caloric which is spent walking for one day, we can also consider caloric which is spent eating for one day in future. To get the real walking data which include a bunch of people walking information, we may implement the walking application which also contain the real function.

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