

ReceiptLog: A Consumer-Oriented Lifelog Service for Storing and Reviewing Daily Receipts

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Abstract We have previously implemented the receipt service platform, where consumers can digitize their own receipts for various applications and services. In this paper, we develop a consumer-oriented lifelog service, called ReceiptLog, by using the receipt service platform. Using the purchase history obtained from the receipts, the ReceiptLog extensively supports every end user to review daily life from financial and living viewpoints. Moreover, we also study more value-added services by integrating other lifelog services with the ReceiptLog.

Key words lifelog, receipt log, ReceiptLogService, web application, classification of lifelog services

1. INTRODUCTION

The *purchase history* of consumers have been widely used by many companies to investigate and determine their sales strategy [1] [2]. By analyzing enormous quantity of the purchase history, the companies can grasp useful information such as hot selling items, preference of the consumers, and cross-selling items. Based on the information, the companies can take efficient strategies in optimizing stocks as well as making attractive goods arrangement. Thus, the purchase history has been a key for the companies not only to increase the profits, but to improve customer satisfactions.

On the other hand, we consider that the purchase history should not be limited to the business use only. The history is also useful for the *consumers themselves*. A user can record the purchase history from his daily receipts, which we call *receipt log*. By collecting sufficient amount of the receipt log, the user can review his purchase history and may find economic information such as the bedrock price of certain goods. Integrating the receipt log with other data sources can yield more sophisticated information. For example, by using the body metrics (weight, fat, etc.) with the receipt log, the user may review the relationship between his health condition and meals.

Traditionally, the daily receipts have been recorded as the *bookkeeping*, typically written in papers/notebooks, or managed by stand-alone applications. However, the primary purpose of the bookkeeping is to grasp the daily income and outgo, which covers the financial aspect only. Beyond the conventional bookkeeping, our goal is to extend the receipt log for many other value-added services, including daily-life

improvements, health checking, social networks services, etc.

In our previous work [3], we have designed and implemented *ReceiptLogService*. The ReceiptLogService is a Web service that allows external applications to store and retrieve the receipt log easily. Our implementation consists of a receipt scanner, a MySQL data base, and the receipt Web API. The receipt data can be accessed via the API such as `getReceipt()` with parameters like username and date. Since the API is invoked by platform-independent and XML-based protocols (i.e., SOAP or REST), it is easy for various applications with different languages to access the API.

However, the ReceiptLogService provides just preliminary features for application developers. It is not easy for end-users to use the service directly. Also, the ReceiptLogService currently returns simple data only, and does not support visualization features with graphs and tables yet.

The goal of this paper is to design and implement a consumer-oriented lifelog service, called *ReciLog*, by using the ReceiptLogService extensively. Using the ReciLog, the end-user can review own daily receipts just like blog, and view the summary of the purchase with graphs. We also conduct a usability experiment with actual subjects, in order to evaluate the advantage and limitation of the ReciLog. As the future perspective of ReciLog, we also discuss the feasibility of value-added services by integrating other lifelog services with ReciLog.

2. PRELIMINARIES

2.1 Purchase History

Many companies have taken the management and sales strategies based on the purchase history of customers. In

Table 1 Classification of lifelog services

		owner	
		self	share
lifelog	single	single-self	single-share
data sources	multiple	multiple-self	multiple-share

modern systems, the purchase history is collected in database by using the Point of Sales (POS) system. The data items of the purchase history generally include date and time of purchase, age of the user, location, and so on.

The market basket analysis [1] is a popular method to analyze the purchase history. The method identifies cross-selling items by analyzing the purchase history. The company can display the items near by side, so that they are sold at the same time. Also, they sometimes arrange the cross-selling items distantly to make customers walk around in the shop.

Also, the RFM analysis [2] is a well-known method that finds good customers. The analysis determines the rank of customers with respect to Recency, Frequency and Monetary. Using the data, the company finds potentially good customers to be advertised.

Such conventional applications of the purchase history have been conducted mainly by companies who have many customers (consumers). However, it has not been practically used from the viewpoint of consumers. Our long-term goal is to make full use of the purchase history to develop various value-added services for consumers themselves.

2.2 Lifelog

The *lifelog* [4] is a social activity to record various human life in terms of events, status, and relationships. The recorded log is used to look back and improve daily life, to discover the identity, to determine actions, etc. Recently, a variety of *lifelog services* appear in the Internet. Popular services include; blog for writing diary, *Twitter* [5] for delivering one's status known as tweets, *Flickr* [6] for storing and sharing pictures, *FoodLog* [7], *karadalog* [8] for recording body measurements (weight, fat, etc.) for health and diet.

In our previous work [3], we have proposed a classification method of lifelog services based on two attributes: *data source* and *owner*, as shown in Table 1.

The data source can take two values: *single* or *multiple*. The single means that the service uses a single data source of lifelog. On the other hand, the multiple represents that the service aggregate multiple sources of lifelog for more sophisticated service. The owner also takes two values: *self* or *share*. The self means that the user uses the own lifelog data for himself. Whereas, the share means that the lifelog is shared by multiple users as in the social network services.

By combining the two attributes, we presented four classes of lifelog services. For example, a *single-self* service refers to

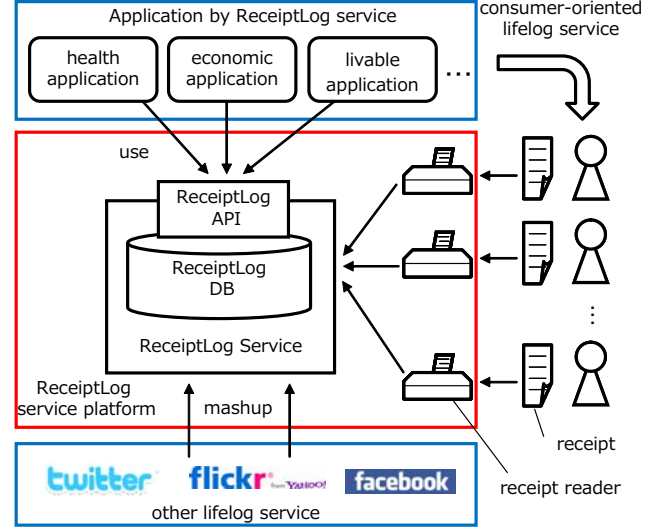


Figure 1 ReceiptLogService architecture

a service where a user recalls his lifelog only. A *multiple-share* represents the one that a user publish different types of lifelog among the community.

2.3 ReceiptLogService: Service Platform for Recording Daily Receipts [3]

We consider that recording the daily receipts by customers themselves can be a consumer-oriented lifelog service (single-self) that reflects their purchase history. Also, sharing the receipt log data within the community may achieve a social lifelog service (single-multiple). Moreover, integrating the receipt log with other data sources (e.g., pictures, body measurements, etc.) may implement sophisticated multiple-share services.

To facilitate the development of such lifelog services, we have designed and implemented a service platform, called *ReceiptLogService*, for storing and retrieving data of the daily receipts [3]. Figure 1 shows the architecture of ReceiptLogService. First, each user digitizes daily receipts by using a receipt scanner [9]. Then, data items such as a shop name, purchase date and time, a list of items, are extracted and stored in a global database, called *ReceiptLog DB*. The data can be accessed from external applications via *ReceiptLogAPI*. The ReceiptLogAPI has been implemented as Web service, so that the receipt log can be accessed from various platforms. In the following, we introduce two typical APIs: *getReceipt()* and *getUserOutgo()*.

- *getReceipt(user, date)* returns a list of receipts of a specified user issued on the date.
- *getReceiptDetail(user, receiptID)* returns the details of a specified receipt.
- *getUserOutgo(user, startDate, endDate)* returns the total outgo spent by the user during the period.

The API can be invoked by standard Web service protocols

```

<ns:return type="jp.kobe_u.cs27.hns.bean.Receipt">
  <ax2126:address>兵庫県神戸市灘区六甲台町1-1</ax2126:address>
  <ax2126:date>2010-05-25</ax2126:date>
  <ax2126:goukei>196</ax2126:goukei>
  <ax2126:image>09005111081062010052529.tif</ax2126:image>
  <ax2126:receiptid>29</ax2126:receiptid>
  <ax2126:tenpo>セブソーレブン神戸大学工学部店</ax2126:tenpo>
  <ax2126:time>10:29:00</ax2126:time>
  <ax2126:uid>tokunaga</ax2126:uid>
</ns:return>
<ns:return type="jp.kobe_u.cs27.hns.bean.Receipt">
  <ax2126:address>兵庫県神戸市灘区六甲台町1-1</ax2126:address>
  <ax2126:date>2010-05-25</ax2126:date>
  <ax2126:goukei>458</ax2126:goukei>
  <ax2126:image>09005111081062010052534.tif</ax2126:image>
  <ax2126:receiptid>34</ax2126:receiptid>
  <ax2126:tenpo>セブソーレブン神戸大学工学部店</ax2126:tenpo>
  <ax2126:time>12:13:00</ax2126:time>
  <ax2126:uid>tokunaga</ax2126:uid>
</ns:return>
<ns:return type="jp.kobe_u.cs27.hns.bean.Receipt">
  <ax2126:address>兵庫県神戸市灘区高羽町3-14-10</ax2126:address>
  <ax2126:date>2010-05-25</ax2126:date>
  <ax2126:goukei>256</ax2126:goukei>
  <ax2126:image>09005111081062010052737.tif</ax2126:image>
  <ax2126:receiptid>37</ax2126:receiptid>
  <ax2126:tenpo>コープこうべコープミニ高羽</ax2126:tenpo>
  <ax2126:time>20:40:00</ax2126:time>
  <ax2126:uid>tokunaga</ax2126:uid>
</ns:return>
<ns:return type="jp.kobe_u.cs27.hns.bean.Receipt">
  <ax2126:address>兵庫県神戸市灘区六甲台町1-1</ax2126:address>
  <ax2126:date>2010-05-25</ax2126:date>
  <ax2126:goukei>330</ax2126:goukei>
  <ax2126:image>09005111081062010053147.tif</ax2126:image>
  <ax2126:receiptid>47</ax2126:receiptid>
  <ax2126:tenpo>神戸大学生協工学部食堂</ax2126:tenpo>
  <ax2126:time>19:00:00</ax2126:time>
  <ax2126:uid>tokunaga</ax2126:uid>
</ns:return>

```

(a) Result of getReceipt()

```

<ns:return type="jp.kobe_u.cs27.hns.bean.Meisai">
  <ax2126:kakaku>50</ax2126:kakaku>
  <ax2126:receiptid>3</ax2126:receiptid>
  <ax2126:seq>1</ax2126:seq>
  <ax2126:shouhinmei>南瓜煮物</ax2126:shouhinmei>
  <ax2126:uid>tokunaga</ax2126:uid>
</ns:return>
<ns:return type="jp.kobe_u.cs27.hns.bean.Meisai">
  <ax2126:kakaku>320</ax2126:kakaku>
  <ax2126:receiptid>3</ax2126:receiptid>
  <ax2126:seq>2</ax2126:seq>
  <ax2126:shouhinmei>中華丼</ax2126:shouhinmei>
  <ax2126:uid>tokunaga</ax2126:uid>
</ns:return>

```

(b) Result of getReceiptDetail()

Figure 2 Example of ReceiptLogAPI invocations

(i.e., SOAP and REST). Figure 2(a) shows a REST invocation of `getReceipt()`, where we can see four receipts of user `tokunaga` issued on 2010-05-25. Similarly, Figure 2(b) represents the result of `getReceiptDetail()` of a receipt #3 of user `tokunaga`.

2.4 Goal of Paper

The ReceiptLogService is just a service platform. So, it is basically for developers of various lifelog services. To evaluate its effectiveness, we try to implement an actual lifelog service for end-users in this paper. More specifically, we implement a Web application that extensively uses the ReceiptLogService platform.

3. RECILOG: SOCIAL NETWORK APPLICATION FOR REVIEWING AND SHARING RECEIPT LOG

3.1 Application Overview

In this paper, we develop a social network web application, called *ReciLog*, as a client application of ReceiptLogService. The ReciLog is constructed by the ReceiptLogAPI and has three main features. The main feature is the *reviewing feature*, which allows the consumers to review daily receipts just like the blog. So we can recall receipt log easily as if we look back on the diary. Moreover, the ReciLog has the *sharing feature*, with which the users can exchange comments and recommendations about goods and purchase. Also, the ReciLog provides the *reporting feature*, which summarizes the statistics of the purchase using graphs and tables.

Figure 3, 4 and 5 shows screenshots of the ReciLog. The next subsection explains details of the features.

3.2 Features of ReciLog

3.2.1 Reviewing Feature

The reviewing feature helps a user to review the daily receipts easily. The user can add comments to each receipt, to describe the explanation of the goods, the motivation of the purchase, and the impression and so on. Figure 3 shows a screen, where a user logs in the service. Once the login is succeeded, the blog-like reviewing screen appears (Figure 4). In this screen, the user can review the latest receipts and add some comments. By clicking the calendar at the left side of screen, the user can move back to the older receipts issued on the specified date.

According to our classification presented in Table 1, the reviewing feature achieves a single-self lifelog service.

3.2.2 Sharing Feature

The sharing feature of the ReciLog allows the user to share the receipt log with friends. This feature is analogous to the one of the conventional social network services, where a user can form a community. The lower-left corner of Figure 4 enumerates the friends of the user. By clicking the icon of a friend, the user moves to the receipt log of the friend, where the user can add comments to the purchase of the friend. This yields communication caused by the purchase.

Thus, the sharing feature can implement a single-share lifelog service.

3.2.3 Reporting Feature

Finally, the reporting feature presents statistics of the receipt log using graphs and tables. The ReciLog currently supports (a) the visualization of monthly expenses, (b) the visualization of breakdown of the money. Figure 5 shows a screen summarizing the total outgo spent by `tokunaga` in 2010.



Figure 3 Screenshot of ReciLog: Login Screen



Figure 4 Screenshot of ReciLog: Reviewing Self Receipts

Using the reporting feature, the user can easily outlook the receipts for a long period. Moreover, integrating the reporting feature with the sharing feature, we can obtain consumption statistics within the community. Thus, the reporting feature can achieve not only a single-self service, but also a single-share service in Table 1.

3.3 Implementation

We have implemented the ReciLog by the PHP and the

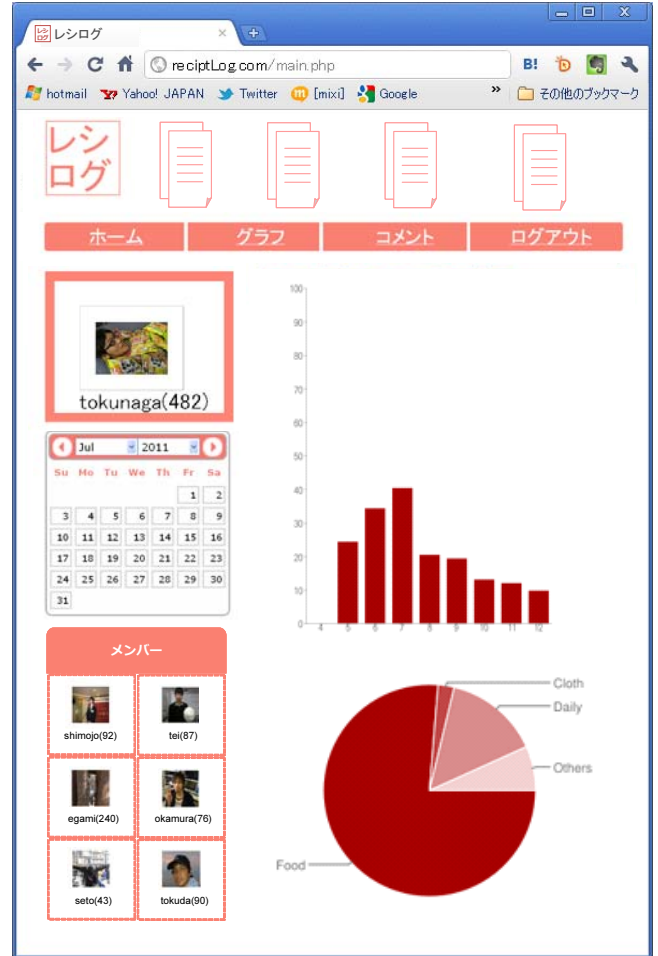


Figure 5 Screenshot of ReciLog: Visualizing Statistics of Receipts

JavaScript. The total lines of code was 920, and the development effort was 4 man-months. Thinking to the ReceiptLogService platform, the program size was quite small for its features. Basically, the program invokes the ReceiptLogService API, parses the results in XML, and layouts the data within the screen.

To improve the usability, we used the Ajax programming so that the user can add comments without transition of pages. We also used the jQuery JavaScript library to improve the portability of the program. To drawing graphs and charts in the reporting features, we used the Google Chart API [10], which is provided by Google Inc. The ReciLog is deployed and operated under the following environment: Apache 2.2 Web Server, Tomcat 5.5 Application Server.

4. EXPERIMENTAL EVALUATION

4.1 Experiment Overview

In order to evaluate the ReciLog, we have conducted an experiment, where subjects actually use the ReciLog to review their own receipt log. In the experiment, we gave two types of tasks to the subjects. The first task (Task 1) is

Table 2 Question about recall by oneself

Pro/Cons	comments
+	I could review monthly expenditure, which I did not care before.
+	It is interesting to figure out my trend and boom.
+	It is convenient to recall when, where and for what I spent money.
+	I realized eating cost much more than I expected.
+	I figured out how I haven't been eating enough vegetables.
—	I want more detailed statistics. I cannot figure out from such simple graphs.
—	I could not figure out nutritional balance for a whole day, because I had only lunch receipts.

Table 3 Result of Task 1: What did you think to review your receipts by yourself ?

Score	(None)	1	2	3	4 (Very)
Q1: Interesting?	0	1	3	0	
Q2: Useful?	0	1	2	1	

to evaluate the *single-self* aspect of the ReciLog, where each subject reviews own receipt log from economic and health aspects. The second task (Task 2) is to see the *single-share* aspect, where the subjects share the receipt log within the community.

Four master course students participated in the experiment. They were all single male. Two of the four were living with parents, and two were living alone in apartments. The total number of receipts registered in the ReciLogService was 471, which had been collected for 12 months. After the tasks were finished, we collected a questionnaire from every subject. The questionnaire consisted of the following questions for each of Tasks 1 and 2.

Q1: Was the task interesting for you? (1, 2, 3, 4)

Q2: Did you find it useful to improve your life? (1, 2, 3, 4)

Q3: Was the service useful to review your economic aspect?

Q4: Was the service useful to review your health aspect?

The questions Q1 and Q2 were marked by the 4-levels scale. For Q3 and Q4, the subjects answered by text comments.

4.2 Result of Task 1: ReciLog as Single-Self Lifelog Service

First, we show the result of Task 1, where each subject reviews own receipt log. Table 3 shows the frequency distribution of the questions Q1 and Q2. The average scores of Q1 and Q2 were 2.75 and 3.00, respectively. This result shows that the subjects felt interesting and found it useful to review the receipt log.

Table 2 shows comments collected from the questions Q3 and Q4, where + or — respectively indicate positive or negative comments. The positive comments includes that the subject could grasp the monthly expenses that had been un-

Table 4 Result of Task 2: What did you think to share your receipts with friends?

Score	(None)	1	2	3	4 (Very)
Q1: Interesting?	0	1	2	1	
Q2: Useful?	0	1	3	0	

aware of. Also, a subject said that he became aware of the lack of vegetables. Moreover, apart from the economic or health aspects, a subject was really absorbed in the activity of storing and reviewing the receipt log, since the receipt log can reveal the trend of himself.

On the other hand, a subject commented negatively that the reporting function was too poor to conduct the detailed analysis. Another subject said that he couldn't review all his diet. The reason is that he did not have receipts for the dinner, since he was living with parents. Thus, the ReciLog can treat single users under the present circumstances. In the future, it will be necessary for the ReciLog to group multiple users as a unit such as family.

We consider there are two reasons why the average score of Q1 and Q2 went no further than 3.00. The first reason is that the amount of receipt log was not sufficient. The second is that the reporting function is too poor to derive interesting results. As for registering the receipt data, we completely rely on the motivation of the subjects, which imposes not a little overhead to the subjects. So, it is necessary to enrich the system so that it can motivate the users to register the receipts spontaneously.

4.3 Result of Task 2: ReciLog as Single-Share Lifelog Service

Next, we show the result of Task 2, where the subjects share the receipt log within the community. Table 4 shows the frequency distribution of Q1 and Q2. The average score of Q1 and Q2 were 3.00 and 2.75, respectively. From the result, we can see that the subjects were a little bit interested in sharing the receipt log.

Table 5 shows comments collected from Q3 and Q4 in Task 2. A subject, who is living with parents, was quite interested in sharing the receipts, since he can compare his dietary habit with others who are living alone. On the other hand, neg-

Table 5 Question about share receipt log

Pro/Cons	comment
+	I am interested because I could see the consumption of single life.
+	The dietary habit of others helps me to improve my life.
−	It is not interesting at all to see others' receipts as they are.
−	I am not motivated very much to see others' data, because I did not know what kind of data others have.

ative comments include the one that it is not interesting at all to see others receipts as they are. This is because the ReciLog currently supports to review the others receipts and to add the comments only. In the future, we plan to implement more powerful features that can take full advantages of social network (e.g., trend analysis, sales information).

4.4 Future Perspective of ReciLog

We here summarize features to be added in the future, requested in the subsequent interview to the subjects.

Features supporting the health aspect

- alerts too much sugar or oily foods
- checks if a user has enough vegetable

Features supporting the economic aspect

- allows more sophisticated statistics analysis
- uses the shop information for some services

Features supporting multiple-share services

- allows mashup with other lilelog sources
- displays other users who bought the same goods.
- compares expenses of others at the same screen.

Based on the comments gathered, we plan to extend the ReciLog, so that it can be accepted more and more people.

5. CONCLUSION

In this paper, we have developed a social network Web application, called ReciLog, which allows consumers to review their daily receipts. The ReciLog was developed as a client application of the service platform, ReceiptLogService, which we had built in the previous work.

We then conducted an experimental evaluation of the ReciLog with actual subjects. The experimental results showed that it was interesting and useful for end users to review and share the receipt log. We also confirmed that the ReciLog enables users to review the life not only in the economic aspect but also in the health aspect.

Our future work is to implement the features requested in Section 4.4. It is also important to conduct the evaluation with more users with various ages, genders, and roles.

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