Analysis of Sequential Tasks in Use Context of Mobile Apps

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ABSTRACT

Most of the work on context-aware systems has focused on the context of time, location, and activity. Previous studies on the context flow have been primarily conducted on a qualitative basis. This paper proposes a new approach from a quantitative perspective. We gathered the data from automated task service, "If This Then That (IFTTT)", and analyzed the sequential tasks in terms of event occurrence in smart devices through association rule mining. We found out three consecutive tasks in cross-applications. The results of analysis have potential to find hidden use patterns as telling what kinds of services and channels are associated with each other. The findings provide some insights on the development of design guidelines for context-aware services.

Author Keywords
Task automation; sequence task; context-aware services

ACM Classification Keywords
H.4.1 Office Automation

INTRODUCTION

Using various devices and applications is extremely common to perform their tasks in recent years. Thus, more research regarding the contextual task flow is needed in order to productivity improvement of task. The purpose of this study is proposing an approach to analysis of the task flow in cross-application, and then understanding user's mental model of use patterns depending on the context. However, context-awareness information has been the focus of time and location [3]. Furthermore, previous studies have been conducted with subjective methods such as observations, interviews, and survey [5, 6]. The latest used application is important hint to predict subsequent used application by user [3]. Therefore, this approach using association rule is significant as focusing on user's sequential task depending on events occurred.

If This, Then That

IFTTT (If This Than That) is automated task service. IFTTT executes specify tasks (That) when pre-specified events occurrence (This). There are "trigger" channels and "action" channels to create "recipes" that accomplish the specific tasks. It offers 179 web-based services "channels".

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Association Rules

Association rules is a method for discovering interesting patterns between items from given transaction data [1]. Typical association rule mining is a rule of the form $A \Longrightarrow B$, where $A, B \subseteq I$, and $A \cap B \neq \emptyset$. The set of items, *itemsets* A is called antecedent, while B is consequent. In order to find out interesting rules from the set of all possible rules, user-specified minimum support and minimum confidence are fixed [2]. There are valuation standards in result of association rule: support, confidence and lift. *Support* is defined as the percentage of records containing itemsets A and B together to the total number of records in the database. *Confidence* is the percentage of records containing items A that also contain items B. *Lift* represents a measure of the distance between $(B|A)$ and (B), or equivalently, the extent to which A and B are not independent [1].

METHODOLOGY

We identified user behavior patterns in cross-application through Apriori algorithm among association rule mining using R. Apriori is a seminal algorithm as it is based on prior knowledge of frequent itemset properties [2]. We supposed association rules could reveal a correlation between trigger channels and action channels, in addition, the cause-and-effect relationship between the two channels. We gathered 641 recipes downloaded more than thousand times in IFTTT official homepage (http://www.ifttt.com). We separated channels in recipes to trigger and action channels, and then classified the trigger channels according by functionality on the basis of IFTTT. Provided that support and confidence are high, it is indicative of strong connection and causation [3]. Suppose there are A, B, and C channels. If confidence $P(C|B)$ is greater than $P(B|C)$, then it can be interpreted that channel A, B, and C are performed in a sequence (Figure 1). We set two thresholds, minimal support and minimal confidence to 20 percent and 30 percent, respectively.

RESULTS AND DISCUSSIONS

Productive

The result suggests that when an event of productive channel happens, users use Facebook page and then Facebook or Twitter (Table 1).

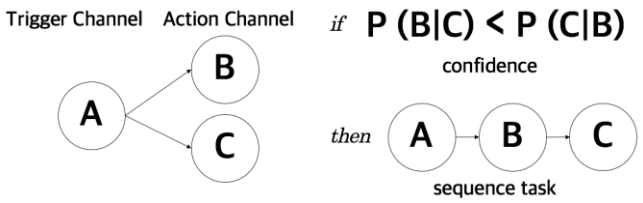

Figure 1. Concept of the result analysis

antecedent		consequent	sup	con	lift
Facebook page	=>	Facebook	0.22	1.00	2.00
Facebook page	=>	Twitter	0.22	0.98	1.28
Facebook, Twitter	=>	Facebook page	0.21	0.61	2.80

Table 1. 'Productive' channels association result

Photo and Video

In this category, social network channels like Facebook, Twitter and Tumblr occupy consequent most. It seems that community managers and blog editors use IFTTT to organize blog or social network posts. Thus, it found out users would store photos and videos on cloud service safely and then share on various social network (Table 2).

antecedent		consequent	sup	con	lift
Dropbox	=>	Twitter	0.35	1.00	1.75
Facebook	=>	Twitter	0.23	0.98	1.71
Facebook	=>	Dropbox	0.21	0.91	2.63
Dropbox, Facebook	=>	Twitter	0.21	1.00	1.75
Facebook, Twitter	=>	Dropbox	0.21	0.93	2.69
Dropbox, Twitter	=>	Facebook	0.21	0.61	2.63
Facebook	=>	Tumblr	0.21	0.88	3.75

Table 2. 'Photo and Video' channels association result

Mobile

It shows when mobile channels satisfy conditions, IFTTT saves data on Dropbox or Google drive. After that, it sends user an email to notify the information or result (Table 3).

antecedent	consequent	sup	con	lift
Dropbox =>	Email	0.35	1.00	1.92
Google drive =>	Email	0.29	0.63	1.21
Dropbox =>	Google drive	0.23	0.63	1.42
Dropbox, Google drive =>	Email	0.23	1.00	1.92
Email, Google drive =>	Dropbox	0.23	0.79	2.24

Table 3. 'Mobile' channels association result

Blogging

In accordance with the result, users publish same contents in blogs and social networks in order. IFTTT can upload the same contents to other social network as a marketing tool to reduce repetitive tasks (Table 4).

antecedent	consequent	sup	con	lift
Facebook =>	Twitter	0.36	0.72	1.03
Facebook page =>	Facebook	0.22	1.00	2.00
Facebook page =>	Twitter	0.22	1.00	1.27
Twitter, Facebook page =>	Facebook	0.22	1.00	2.00
Facebook, Twitter =>	Facebook page	0.22	0.61	2.81

Table 4. 'Blogging' channels association result

CONCLUSION

We approached the quantitative analysis method to predict expected three-process tasks between cross-applications utilizing association rule mining. This study analyzed IFTTT recipes categorized by functional application. Therefore, the quantitative analysis result can interpret the sequential tasks in smart environment.

The analysis has potential to illustrate what kinds of services and channels are associated with each other, thus telling us about what cross-application interactions and behaviors are common. These reported outcomes give insights into the development of design guidelines for context-aware services. It also contributes to predict patterns of users' behavior according to the context of use in smart devices. Moreover, the suggested approach can appropriate as a preliminary step to understand user's task flow for a large-scale project of developing user interfaces.

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