Motivate: Context Aware Mobile Application for Activity Recommendation

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Abstract. This paper presents the design, implementation and evaluation of a context-aware recommendation system that promotes the adoption of a healthy and active lifestyle. A Smartphone application that provides personalized and contextualized advice based on geo information, weather, user location and agenda was developed and evaluated by a user study. The results show the potential of this mobile application in triggering behavior change by suggesting simple daily activities.

Keywords: context-aware, mobile application, healthy living, recommendation system.

1 Introduction

According to WHO by 2015, approximately 2.3 billion adults will be overweight and more than 700 million will be obese [1]. Overweight and obesity can lead to many serious health problems. It is a challenge to stay motivated to maintain a sufficient amount of physical activity. Nowadays with the development of mobile technologies, mobile device may act as powerful persuaders because they can intervene in the right context and a convenient way in order to prompt users into behavior change [2]. The mobile device tracks context and prompts users to take action, as Fogg's description of one persuasive role of mobile phones - "coach" [3]. Ubiquitous computing and context-aware persuasive technologies [3] offer a new healthcare opportunity to promote health behavior by presenting "just-in-time information" [4]. The newest trend of using Smartphone and location-based technologies makes the just-in-time information presented at a right location and time feasible.

In this paper, we present a Smartphone application "Motivate" that provides users with personalized and contextualized advice on possible physical activities to do. We introduce the design, implementation and an evaluation test of the "Motivate" system. The main focus of the design is to motivate people to behave more physically active by providing recommendations fitting their daily life. The reason is that lifestyle interventions can yield positive and long-term effects in terms of increasing the levels of moderately intense physical activity [5].

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2 Motivate Design and Implementation

Motivate system consists of Motivate service, Motivate web application and Mobile API which communicates with Motivate mobile application. The Motivate mobile application is compatible with Android phone version 2.0. It sends the phone location detected by either GPS or GSM localization to Motivate service which generates advice. Users get advice on the phone application and send their responses back to the Motivate Service. The Motivate web application is developed for users to edit user personal information and for system administration. The Motivate Service consists of services including Advisor, Location, Agenda, Weather, Profile, Time and Event.

2.1 Advice Generation

The Advisor Service sends a query to one or more of the Services and acquires their analysis results. It calculates for each advice in the advice database its suitability for the given situation. Each advice consists of a process and a template. The If-Then rules defined in the "process" specify which constraints must be met for each advice. If any good advice is found, the Advisor Service creates a message to send to the mobile UI and then store it in the Message Database. There were in total 34 pieces of advice including 20 kinds of activities with different constraints. The constraints are:

- Location: suggested activity location must be within a certain distance or travel time. The geo information of green places such as parks, lakes, forests from OpenStreetMap [6] is added in the geo database. Shopping centers, markets, cinemas, users' significant locations, namely home and work place, etc were implemented in the geo database.
- Agenda: it is used to determine the timing of each advice, e.g., a lunch walk advice being sent during lunch time. Users can add activities such as "Go to work", "Work", "Lunch", "Go home", "Dinner" and "Busy" with the starting and ending time of that activity by using Motivate web applicaiton. It is a weekly schedule and can be adapted for each week
- Weather: outdoor activity advice requires good or fair weather conditions. The weather history data is retrieved from the website of Weather Underground [7] and stored in whether cache. The Weather Service updates the database and picks up the weather record with the time closest to the query time.
- Profile: users edit their profile such as gender, age, family status, transportation, home, work place address, etc. advice such as cycling to work requires users' possession of bike.
- Time: suggested activity is applicable for a certain specified time period (e.g., Saturday morning to go to the market)
- Event: the detailed information of events of every weekend in the city was added to the database and sent to users 2-3 days before the events.

If all the constraints are met, the advice becomes a candidate to be randomly chosen. One example of a "Lunch walk advice" contains the following constrains: the day of week is a weekday; a user's agenda activity "Lunch" starts within twenty minutes; a user's agenda is free for one hour; the current weather is fair; there is a green place

within walking time (within 300m for a short walk). The field "template" of the chosen advice can dynamically compile the text of the message to be sent. In this example the template is "It's pretty good weather outside, how about a short walk to < the name of suggested the green place in the geo database> during lunch break?" To avoid repetition we keep track of the sent messages and categorize them into different types. They are configured that the same type of advice won't occur within a certain time, e.g., at most 1 taking stairs advice per day or 1 walking to supermarket advice in 3 days.

2.2 Motivate Mobile User Interface

The application is developed using the Android Software Development Kit. If there is a message found, a notification is sent to a user. A message is shown on the screen (see Fig. 1, upper left). By clicking the map icon, a user can view the suggested place on Google map and where he or she is at that moment (see Fig. 1, lower left). The 4 possible responses are as follows for users to choose:

- *"Yes, I will do it now"* (referred as Yes)
- *"Yes, I will do it later"* (referred as Yes Later)
- *"Yes, because I am already doing or have planned something similar"* (referred as Yes Already)
- *"No, I will not do it"* (referred as No)

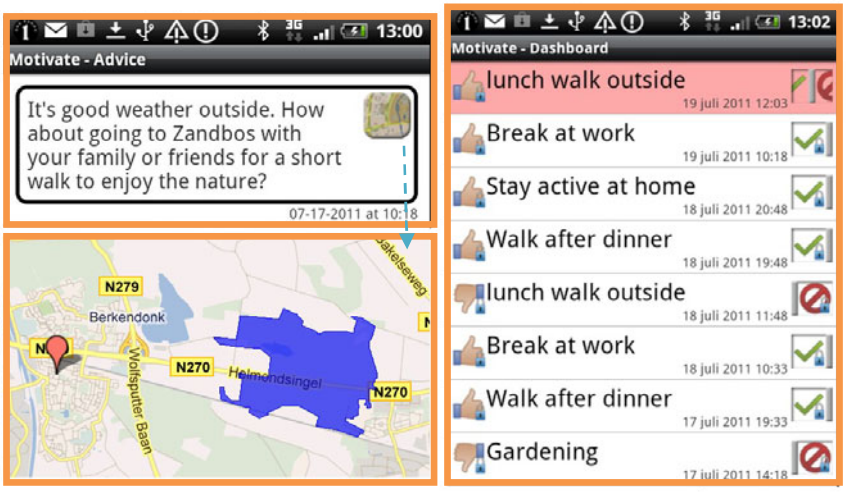

Fig. 1. Motivate mobile application screenshots

If a user chooses "No, I will not do it" he is asked to choose from a list of reasons (details in the results section) or give their own reasons. All the received messages were listed in the main interface of the application. The left thumb up or thumb down icon indicates the response of users indicating if they have any intention of behavior change. In order to measure whether there is any actual behavior change, we ask users

to report if they have followed the advice later by "validation". By clicking the icon to the right of each message indicates they can validate their choice by choosing green check for "Yes, I did it" or red circle for "No, I didn't do it". The pink background indicates that the message has not been validated yet. This validation process is designed to record if there's any actual behavior change based on users' self report (see Fig.1, right).

3 Evaluation User Study

25 Android phone users were recruited for the user test through our Motivate website. They (8 females and 17 males) aged from 21 till 54 years old with average age of 34 years old. They all went to work at least 4 days per week. According to BMI calculation 7 of them were overweight while 18 of them are with normal weight. Each participant was required to use Motivate for 5 weeks in total. In the first week, we collected user location data and added their home and work location into the database. After this assessment period participants started to receive messages for another 4 weeks. The Motivate application is running in the background continuously and communicates with the server every 15 minutes. Users get a notification when they receive a message.

3.1 Results and Discussions

In total 3556 messages were sent to participants, which is on average 3-4 messages per day. This number varied for individual participant from 1.4 to 5.5. 2854 (80.3%) out of all the messages were given responses. 47.8% of the messages were given positive response (24.5% for "Yes", 12.5% for "Yes Later", 10.8% for "Yes Already"). 52.2% of the messages were given negative response. The mostly chosen reasons for not following the advice were: "I already have other plans" (29.6%) and "I am busy and have no time" (23.3%), which indicates the lack of detailed information of Agenda service is one major cause for negative responses. The other reasons were "I don't feel like doing it" (22.3%), "Not feasible to follow" (10.3%), "unsuitable weather" (3.6%, mostly duo to problems with the data of Weather Underground [7]), "unsuitable location" (2.0%) and other reasons (6.1%, e.g., "I am sick").

There were 2352 (82.4%) out of the answered 2854 messages that were validated. 85.5% of messages were validated consistently which means their behavior matched their earlier responses of their intention. In overall 46.8% of the messages were given "Yes, I did it" while 53.2% of them were reported as "No, I didn't do it."

The messages were categorized into different types in Table 1. The more frequently sent messages were suggesting outdoor activities and taking a small break. For the advice of taking a break, taking stairs and doing some housework were given positive responses more than the other types. These activities required fewer efforts compared with the activities such as planning a cycling trip or going to an event. Although these small activities do not increase the physical activity dramatically in turns of calorie burning, they do help users to adopt a healthy lifestyle by changing habits. This is in line with the reason that we only include simple daily activities in the advice database [5].

Table 1. Messages and responses

Messages	Example	Positive responses
Outdoor activity (35.7%)	A small walk during lunch; cycle to green places	28.7%
Break (28.3%)	Walk to the coffee corner, stretch, workout at home	64.7%
Weekend activity (9.7%)	Go to movie, events in the city	25.5%
Shopping (7.9%)	Supermarket, market; weekend shopping	33.7%
Take stairs (7.1%)	Take stairs during work	49.5%
Transportation (6.4%)	Walk/cycle to work for a change; detour home	15.8%
Housework (5.0%)	Mopping, washing dishes, gardening	47.1%

4 Conclusions

This paper has presented the design and user evaluation of Motivate mobile application. We made personalized and contextualized recommendation available for the user's mobile device at any time. The integration of various inputs such as geo information, weather, user agenda, and city events is shown to be efficient for generating various advices. The results show that almost half of the responses to messages were positive and the validation suggested certain consistency between intention and actual behavior. The simple-to-do activities that required fewer efforts could trigger more behavior change. The application is believed to be beneficial for people who want to pursue a healthy lifestyle, especially for those who have a regular job and participate insufficient in physical activity. The "Motivate" can be a gentle push and reminder for simple daily activities, as well as offering innovative activity ideas for their free time. Further analysis of possible influence in different context such as location and time on user feedbacks will be performed in the future.

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