Personalized Training Plan Recommendation and Activity Tracking for a Healthier Lifestyle

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Abstract

Throughout the last decade, there has been an alarming decrease in daily physical activity among both children and adults. Medical experts agree that physical activity is critical to maintaining fitness, reducing weight and improving health. Yet so many people have difficulty increasing and maintaining physical activity in everyday life. According to World Health organization, more than 60% of population fails to exercise enough on a daily basis. We believe, that in order to become successful in fight with sedentary lifestyle of the modern generation, we need to provide comprehensive solution which addresses all the key factors – activity recommendation, tracking, evaluation and motivation. Goal of this project was to design and develop an personalised activity recommendation along with efficient way how to measure it. This work was integrated within an larger system called *Move2Play*, on which design and development was author involved.

Categories and Subject Descriptors

H.1.m [**Information Systems**]: Models and Principles—*Miscellaneous*; J.3 [**Computer Applications**]: Life and Medical Sciences—*Health*; I.2.1 [**Artificial Intelligence**]: Applications and Expert Systems—*Medicine and science*

Keywords

Personalized Training Plan Recommendation, User Model, Activity Tracking, GSM Signal Strength Fluctuation

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Bielik, P. Personalized Training Plan Recommendation and Activity Tracking for a Healthier Lifestyle. Information Sciences and Technologies Bulletin of the ACM Slovakia, Special Section on the ACM Student Project of the Year 2011 Competition, Vol. 3, No. 4 (2011) 39-40

1. Introduction

Thanks to information campaigns we all know that people should be more active, we all know that people need more physical exercise. However, these campaigns fail to bring the required impact, fail to change the sedentary lives of the majority. We believe that smart use of information technologies can achieve this impact and can help actively promote a healthier lifestyle.

We designed *Move2Play* [2], a system through which we propose a comprehensive process of physical activity management, driven by various kinds of motivational factors, both intrinsic and extrinsic, supporting its users in achieving the required amount of physical activity per day. The process consists of three steps – *recommendation* of the physical activity, *tracking* of activity done by user and *evaluation* of performed physical activity.

We realized this process by taking advantage of the capabilities of widely available smartphones to measure, assess and recommend physical activity.

2. Personalised Training Plan Recommendation

When considering appropriate training plan recommendation, our goal was to design and develop recommendation, which takes into account individual needs of our users and is based on principles of *Effectiveness, Achievability* and *Sustainability*.

Recommendation of physical activity needs to be based on users' characteristics such as their physical condition, habits, health condition, etc, as they all have smaller or greater effect on fulfillment of aforementioned recommendation principles. To address this, we designed two models containing most important characteristics, inspired by known design principles of adaptive systems [4]:

- *User Model* is a user-specific model and contains attributes important in a given domain – *physical fitness, activity by time of day and activity preferences*. This model is built incrementally as users use the system. In order to prevent a *new-user cold start problem*, each user's model is bootstrapped by a generic model, which is subsequently tailored to the user's specifics.
- *Domain Model* represents general knowledge about a domain and the context of environment namely *day of week and month, age, gender and weather*.

The domain model, as opposed to the user model, holds stable facts and does not change very often.

Based upon expert consultations and literature review, we designed following three training plans, each with duration between 9 and 14 weeks, which form basis for a training plan recommendation:

- *Walking programme*, based on a well known *10 000 daily steps walking programme*.
- *General activity plan*, in which we evaluate broad range of physical activities using METs.
- *Point programme*, based on point system created by Dr. Cooper [3] aimed at aerobic activities.

For the purpose of recommendation itself, we propose three methods of personalised recommendation. First is used when recommending appropriate *amount of activity* for *individual users*, represented in a form of a daily plan, which users try to fulfill. The other two methods recommends apart from *amount of activity* also *activity type* for both individual user and groups. They use modified spreading activation method and produce ordered list of activities which are most appropriate and lead to daily plan fulfilment.

We implemented the recommendation using a rule-based engine with if-then rules, which uses the forward chaining method for the inference. Knowledge about training plans, user and domain model are described using set of facts and rules.

3. Activity Tracking

Tracked activity is one of the main inputs which make the solution work as a whole. Activity tracking is performed using current generation of smartphones, which present an ideal platform for a non-intrusive activity measurement while achieving accuracy comparable to dedicated tracking devices.

3.1 GPS

To provide user with information about his activity throughout day we used GPS sensor. We found out that a simple distance calculation between two consecutive locations, although sufficient in certain situations, can be quite inaccurate in urban environment. For this purpose, we have adjusted raw measurement with:

- *Filtering inaccuracy caused by buildings* by interpolating route between accurate measurements.
- *Filtering measurements occurred when travelling in a vehicle* by setting a speed limit for different types of activity.

Proposed filters has proven to be effective in practice with a minimal battery load.

3.2 GSM Signal Fluctuation

GSM signal strength fluctuation analysis is used to determine whether an activity is taking place or not. Based on this knowledge we can decide when to turn on and of the more energy consuming sensors such as GPS. Conserving battery life is an important part of our solution as we track activity throughout the whole day, as opposed to many other solutions, where tracking must be explicitly invoked by a user.

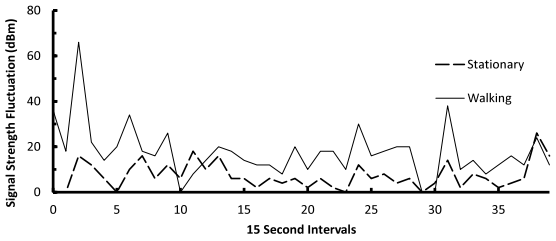

Figure 1: GSM signal strength fluctuation.

For the purpose of fluctuation calculation, we take advantage of fact that mobile phone is connected to multiple cell towers at the same time, with signals of various strength coming from these cell towers. We use assumption that the fluctuation of these signals is lower when mobile phone is stationary compared to when it is moving which was confirmed by field testing. After a manual inspection of acquired testing data (Fig. 1) we setup a threshold value to distinguish between stationary and moving states. The process could be further refined by using neural network [1] as opposed to our static threshold.

4. Conclusions

In our work we designed and develped activity tracking module and personalised training plan recommendation and integrated them into *Move2Play* system. The Personalised training plan recommendation takes into account individual characteristics of its users using user and domain models we proposed.

For activity tracking we use GPS sensor with advanced processing in order to improve precision of measurements and filer out travelling in a vehicle. Additionally, we have created a method to conserve battery life based on GSM signal strength fluctuation. Evaluation of our GSM fluctuation method on multiple Android devices showed us that there is a notable shift in data quality obtained from sensors of different devices. We believe that they are caused by different sensor hardware and plan to investigate this in more detail in our future work.

Acknowledgements. This work was partially supported by the grant VG1/0675/11.

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