
Integrating Recommended Physical Activity in Everyday Mobility

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Abstract

Nowadays, wearables can easily monitor and display physical activities throughout the day. Health recommendations are often used to set daily goals, but these barely take individual requirements into account. In addition, due to limited individual adaptability, there are various life situations in which these goals are not achieved due to missing motivation or time. In this position paper we discuss in particular how health recommendations can be integrated into everyday life and what challenges arise. We also address spatial requirements that are necessary for an active lifestyle.

Author Keywords

Health, Navigation, Spatial Planning, Machine Learning

ACM Classification Keywords

H.5.2 [Information interfaces and presentation (e.g., HCI)]: User Interfaces

Introduction

Mobile devices offer a variety of opportunities to track daily activities. Daily steps, for example, can be monitored through inertial measurement units [2]. In addition, heart rate can be measured by motion sensors and cameras on the back of smartphones [14].

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In recent years, wearables such as smartwatches and wristbands have established themselves in the market for tracking daily and sporting activities. Their simultaneous automatic collection of various health data make it easy for users to monitor their lifestyle [2]. By integrating health-related data from other smart devices such as scales or blood glucose meters, it is possible to adapt mobile health applications individually to the user's goals, like weight loss or more sporting activities [6].

The definition of a healthy lifestyle is often based on WHO or CDC recommendations [4, 10]. However, such recommendations can be difficult to achieve depending on the particular situation in life or motivation. Especially the daily use of passive means of transportation, such as cars, can cause a sedentary lifestyle.

In our research we focus on avoiding a sedentary lifestyle through the individual integration of health recommendations into everyday life. In this position paper, we present several recommendations, challenges, and open questions that need to be addressed in order to integrate those recommendations into everyday life. We also suggest possible solutions.

Health Recommendations

Health recommendations are usually based on easy-to-calculate formulas or memorable values motivated by the statistics of a population. They indicate a healthy lifestyle and can help to prevent various diseases if the conditions are fulfilled [4]. However, there are often difficulties in applying such general rules, as they do not take individual circumstances into account.

An example of this is the Body Mass Index BMI, which only considers the total weight and height of a person [5]. Already starting from a BMI of 25 a person is considered as

obese and starting from 30 as adipose. With a BMI of less than 18.5, a person is considered to be underweight and at or below 17 as anorexic. These categorizations may lead to frustration and misjudgment, as, for example, the muscle mass and water percentage in the body are not taken into account.

One of the best known guidelines is the 10,000 steps a day rule which was introduced and marketed together with the Manpo-Kei pedometer in the 1960s [13]. Many researchers evaluated this rule and have found the risk of non-communicable diseases to be reduced [15] for persons following this rule. However, in everyday life, for example, in office work, this requirement is often difficult to fulfill, partly due to a lack of time or motivation.

In general, various health organizations propose a weekly moderate to vigorous physical activity of 150 minutes in three to five sessions per week [4, 10]. They also emphasize that the intensity of activities is much more important than the frequency. This requirement should also be fulfilled by elderly people with frailty in order to increase their functional ability [8].

Challenges

Individual requirements represent a variety of challenges that must be taken into account from the user's and developer's perspective.

Accuracy of sensor data & tracked activities

Depending on the parts of the body to which the sensors are attached, different activities can be tracked with varying degrees of accuracy. For example, it is difficult to measure physical activities on the upper body with sensors on the lower body. Even with suitable sensor placement, there may be confusion with other similar activities. By fusing different sensors, such challenges can be alleviated, but

not completely prevented [9]. From the user's point of view, misclassifications can lead to distrust in the application or demotivation for single activities [11].

Recognition of well-being

Depending on the well-being of users, various activities can also lead to a worsening of their situation. For example, activities such as running should be avoided in case of knee pain or obesity. Therefore it is necessary to allow users to enter their personal state of health and to adjust the activity goal accordingly. Diseases such as eating disorders could also be automatically detected by wearables and smart scales for setting daily goals [3]. Furthermore, applications should actively support the user in the healing process in the future.

Wearability of sensing devices

Since the accuracy of the tracked physical activities also depends on the position of the sensors, it is may be necessary to carry several devices or to accept a smaller number of classifiable activities. Especially in everyday and sporty use, wearing comfort plays an important role. Placement of mobile measuring devices can lead to high accuracy in different activities but at the same time cause inconvenience to users.

Privacy of sensor data

Data such as weight can be very sensitive to users in terms of privacy. Since the weight can also be used as an indicator of the user's health, it must be taken into account when displaying such data that the user's privacy must be guaranteed [1]. For motivational purposes the user should nevertheless be able to share their activities and health status but always have the opportunity to make changes.

Open Issues

Although the recommendations give the user a good indication of a healthy lifestyle, not all influencing factors of the user are being considered. Depending on the individual circumstances, the applications must adapt the information and notifications displayed for an active lifestyle.

Health reminders

Notifications can remind and even motivate the user to engage in physical activity when used moderately. However, the way in which physical activities are integrated into everyday life very much depends on the user's specific circumstances. In office work, sports activities are often performed at the end of the day. Future research should for this reason also focus on the forecasting of physical activity to avoid a flood of messages.

Spatial influences

The 10,000 steps a day rule does not take weather data into account. This can lead to life-threatening situations, for example, during storms. For this reason, it must be possible to automatically adapt daily targets to the environment in the future.

Another factor influencing the pleasure of walking outside is the amenity value. Various spatial structures, green space, and plants, benches, and lighting can be supportive whereas disturbance sources, lacking accessibility and traffic safety reduce the amenity value of open space. To provide enjoyable routes and positive walking experiences suitable map-based information should be provided. An extensive overview of spatial design elements and structures for walkable open space is given by the City of New York [7]. They report a significant impact of urban planning on improving health and well being of a population.

Means of transportation

Due to the large variety in the means of transport, different levels of physical activity can be achieved. Often the car is preferred because of its comfort, whereby over 30% of daily car trips cover distances of less than 3 km and could be converted into 20 minutes of brisk walking [4]. This problem could be further aggravated in the future by the use of autonomous vehicles. Therefore, it is important to motivate the user to pursue alternatives such as taking the bicycle or, under certain circumstances, to adapt navigation systems in such a way that physical activities are integrated into the routes.

Individualization with contextual information

To customize recommendations to the user, other contextual information is also necessary. In addition to health data, analysis from other sources can help improve users' lifestyles. For example, the analysis of posts in social networks can help to measure well-being [12]. Calendar data can also provide information about planned physical activities, which may allow moderate use of notifications. Additional map material such as stairs and elevators can be contribute to integrating activities into everyday life. Future research needs to explore how such data can be collected and used. User acceptance and willingness to provide personal data to allow these applications to function also require clarification.

Integration of Health Recommendations

To address the aforementioned open issues and challenges we explore how navigation software can automatically adjust the path selection based on health related data. We investigate which distances, depending on the weather and spatial conditions during a car journey or other passive means of transport, are additionally acceptable to users without frustration. Moreover calendar entries are taken into

account to enable a seamless integration into everyday life. On walked routes, we explore how stairs and elevators can be used, identified and included in map material and route selection algorithms to provide the user feedback and notifications for suitable physical activities. To limit the number of reminders as well as the additional distances for walked paths we include an activity forecast based on previously sensed steps and motion data. For that purpose it has to be found out, which accuracy of a forecast is necessary to achieve an individual adaptation to one's everyday life.

Conclusion

In this position paper we have motivated that abstract recommendations on physical activity are not sufficient to make qualified statements about activities for a healthy lifestyle of an individual. Additional information has to be taken into account when applying health recommendations in mobile and wearable applications. Furthermore we have also shown that wearables alone are not enough to measure the well-being of users with sufficient reliability. Contextual information also has to be considered and daily goals must be individually adjustable. This requires further investigation to determine what personal data can be collected from the user's and developer's perspective. Besides the recommendations, it is in general important to seamlessly integrate activities into everyday life so as to foster a healthy lifestyle. Therefore, in addition to the developer's and user's point of view, spatial planning should also be taken into account in future research. We propose to regulate the route selection for daily routes in such a way that physical activities are also taken into account. In addition, individual adaptability is to be achieved through activity forecasting based on health-relevant data.

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