OmniSports – Encouraging Physical Activities in Everyday Life

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Abstract
Doing sports on a regular basis is beneficial for personal health and well-being. This paper introduces the concept of a mobile app, called OmniSports, which has the goal to assist people already keen on doing sports. It will provide a digital training schedule, which is not only updated automatically in instrumented fitness centers, but also during outdoor exercises which are done as part of digital fitness trails. Within this paper, we present the results of two initially conducted studies: an analysis of current training schedules and an investigation of people's ability to create and use outdoor spots for exercises.

Author Keywords
Physical activities; Mobile assistance; Outdoor exercises; Community-created content

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous.

Introduction
Doing sports on a regular basis is beneficial for personal health and well-being [2, 9]. Nonetheless, it is in general difficult to encourage people to do so [9]. A possible strategy to overcome this problem is the use of persuasive computing systems [7]. The work already done in the

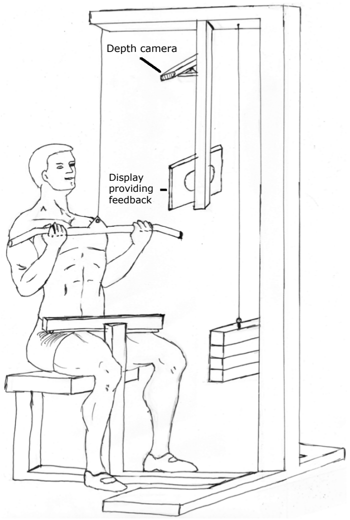


Figure 1: Augmented indoor exercise.

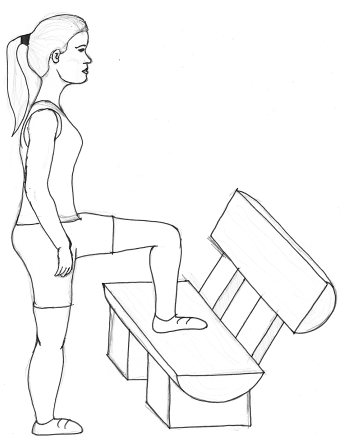


Figure 2: Outdoor exercise at a standard bench.

domain of encouraging healthy behavior often focuses on specific groups of people (e.g. office workers [8] or social circles [6]). Within this work, we target the group of people who are already keen on doing sports. Providing a system which helps them to optimize their daily (or weekly) training cycle and to encourage them to also do exercises outside the gym enhances the enjoyment of doing sports by adding more variety to the workout process[1]. We want to provide a system that helps this group of people in three ways: First, analog training schedules (as provided in fitness centers) will be replaced by a digital version utilizing the user's smartphone. Second, we support instrumented fitness centers, in which the execution of exercises is supervised and the user provided with helpful advice and error corrections (for an example, see Figure 1). Third, by utilizing a crowd-based approach we want to collect information about outdoor places in which exercises can be done and thereby encourage users to do exercises in their daily lives (comparable to exercises on fitness trails; see Figure 2). The digital training schedule is the connecting link between the indoor and the outdoor part and is adjusted accordingly from both of them. Exercises finished outdoors influence the indoor activities and vice-versa. The remainder of this paper is organized as follows: We start with a description of a sample scenario and present related work. We continue by elaborating on two studies we carried out during our user-centered design process. Within the first study, we analyzed training schedules in terms of their structure. In the second study, we investigated whether a crowd-based approach is feasible and people are able to provide exercise spots outdoors. We end this paper with an overview on the next steps.

[1] Some sources report diversification as an option to prevent boredom; see e.g. `http://goo.gl/PZ3cRD`, Retrieved: 16/02/2014

Scenario

Bob is jogging and listening to music from his smartphone. The music gets interrupted by an auditive notification to inform Bob about suitable spots for outdoor fitness activities according to his training schedule. Bob checks the map in our mobile app to see details, e.g. the exercises he can carry out at the spots, and the community's ratings. Bob decides to target the best-rated spot and continues his jogging while being guided by auditive messages. Upon arrival, Bob inspects the spot's details. Along with other multimedia content, videos showing how the exercise can be done are presented. Bob watches the best-rated video, carries out the exercise and marks it as complete. He rates the spot and continues to jog. Later, he comes across a bench which he finds suitable for doing an exercise and creates this spot within our app.

Bob visits an instrumented fitness center in which every station is equipped with sensors, enabling the monitoring of exercises as they are done. Bob checks his digital training schedule which was suggested by our app the week before to account for Bob's progress. The schedule has been continuously updated, including earlier when Bob completed the exercise outdoors. As the corresponding muscles have already been trained, one of the indoor exercises is designated to be skipped. After finishing an exercise, the digital training schedule is updated automatically. As a consequence, outdoor spots are always suggested based on the latest training information.

Related work

The supervision of exercises has already been investigated by other authors. Therefore, we focus on the outdoor part. Nonetheless, we will provide a short overview on possible realizations for the indoor part. The option to automatically supervise the execution of a fitness exercise

Study design:
We collected 41 paper-based training schedules (4 from local gyms, 37 from online websites) for analysis. Three of the authors analyzed each of them with respect to three pre-defined dimensions:

1. **Customization possibilities**: We wanted to explore the given customization options in training schedules and analyzed how they are utilized by the members of fitness centers.
2. **Included exercise information**: The training schedule is a tool for helping people not to forget which exercises they should do and in what way (e.g. number of repetitions, weights used). Hence, we were especially interested in how exactly the exercises are represented.
3. **Layout and graphical appearance**: Not only is the content of interest, but also how the graphical layout is implemented (e.g. page orientation, exercise arrangement, color scheme).

Table 1: Study 1: Analysis of training schedules.

and providing feedback is investigated in [9]. A balance board is used as training device and the execution is processed and assessed within a smartphone app. Another approach is the usage of depth cameras: the Kinerehab system [4] for example uses a Kinect to assist people with disabilities in their physical rehabilitation. Other work uses further sensors to monitor the users' bio signals while doing exercises. For example Chandra et al. [3] use an electromyograph within their application to assist physiotherapists with monitoring patients' exercises at home, and heart rate sensors are also used (e.g. [10]).

The outdoor part of our app utilizes the concept of virtual fitness trails. Buttussi et al. [2] target runners and present exercises on their trail. Upon arrival at a spot, an embodied virtual agent explains the exercise. An evaluation showed that fewer execution errors occurred and that the users perceived the system as useful. However, the authors do not offer a solution for how to create new trails. By utilizing a crowd-based approach, we hope to receive more exercise spots which will potentially add value and lead to a broader base of users. We therefore focus on user-generated content that can easily be added (e.g. photos or videos) instead of using an embodied virtual agent. Another approach [5] targeting obesity in children creates random tours with exercises. While users do these exercises, the heart rate is measured as well as the calories burned. To motivate and persuade the users, various technologies are utilized (e.g. group challenges, reminders and social media), which we also aim to use in our system after validating the utility of the basic scenario. By following the requirements for encouraging physical activities stated in [6], we will integrate a ranking and achievement system from the beginning. Another interesting gamification approach is presented in [1]. Here, the runner is monitored with a pulse oximeter and a game is shown on a mobile device. With the help of GPS, information on the runner's individual characteristics (e.g. fitness level) and the current data from the pulse oximeter, the game pace is adapted. If the runner wants to win the game, he needs to adapt his running behavior accordingly. To simplify this, in addition to visual information auditive instructions are also provided; we also see these as a necessity in our scenario. In contrast to the work presented here, we additionally aim at better integration in the users' everyday lives by automatically adapting their training schedules based on the exercise that are done outdoors.

Training schedule analysis and user study

We follow a user-centered design process and prior to developing the app itself, we conducted two studies. It seems reasonable to investigate training schedules used in fitness centers, as our approach will use digital counterparts. We have focused on paper-based training schedules so far, but equipped with the results, extending the analysis to digital versions will be a next step. Within this first study, we analyzed these paper-based training schedules to learn the important aspects that our system should integrate, and in particular, which aspects can be improved. The study should be the basis for generating questions we will use for conducting interviews with trainers and members of fitness centers to better understand the training schedule usage. In a second study, the outdoor part was investigated by giving participants tasks during a walk and observing the situation.

Study I – Analysis of training schedules

In this first study, we wanted to learn how paper-based training schedules are used nowadays. To do this, we collected and analyzed 41 training schedules. A detailed description of the study is given in Table 1.

Classification of different training levels (e.g. beginner, advanced)
Training goal and detailed training program for weeks (e.g. cardio)
Overall workout duration in minutes
Weight gradation per set
Specific instructions

Table 2: Uncommon features.

Surprisingly, we found out that the majority (61%) of our sample did not offer any editable features and thus was not adaptable to the user's progress. Concerning the editable schedules, we learned that all (if they offer this feature; see below) allow for a customization of the pace, weight used, progress and notes. For our interviews, we will therefore focus on the user's current behavior patterns regarding the adaption of the schedule according to their progress, and we will investigate why only little information is editable as we see room for improvement here. Concerning the second dimension, we learned that there are only a few features that are present in the majority of all analyzed training schedules. In total, we identified ten common features. The summed up frequencies are shown in Figure 3.

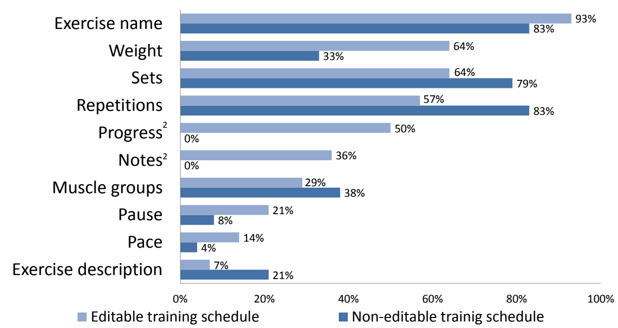


Figure 3: Common features and their frequency

These results show that in general there is no significant difference between editable and non-editable training schedules. Notably, we discovered that the level of detail information varies widely between the individual schedules. Besides these ten features which occurred several times, we identified features which appeared only once or twice (see Table 2). These findings open up room for further investigation in our structured interviews.

Regarding the third dimension, we found that 95% of the training schedules utilize a table layout; the remaining 5% are offered in a list layout. For the orientation, we found a nearly uniform distribution with respect to portrait and landscape. Only one of the online training schedules provides images to describe the exercises; two additional ones from local fitness centers use images taken on site. Four training schedules introduce the trainer who developed the training schedule with an image and a short description. For our app, we conclude that we will support both portrait and landscape orientation and for the initial version, we will adopt the idea of a table-based layout. However, we will have to evaluate whether the concept is easily transferable to mobile devices.

Study II – Investigation of spot usage and creation

The overall goal of the second study was to learn whether people in general are able to participate in our system; i.e. is a crowd-based approach possible? We want to validate the following hypotheses:

H1 Sporting people are in general able to identify spots at which they can carry out exercises and can add valuable information to already existing spots.

H2 Even non-sporting people can find spots, but they can only provide higher-level descriptions.

H3 People are able to recognize errors in descriptions.

H4 People would integrate this application into their everyday training behavior.

[2]Fisher's exact test reveals that the presence of the feature differs significantly by editability ($p < 0.01$).

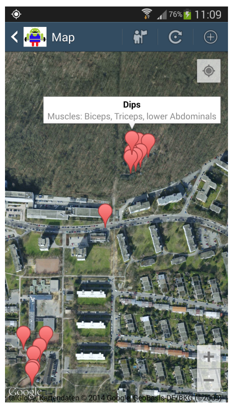
We recruited 14 subjects (8 women, 13-58 years, M=34.14) with different backgrounds. We assessed their sportiness with a short questionnaire and categorized them into sporting (71.4%) and non-sporting (28.6%) depending on their sport activities. Furthermore, they answered questions on health status and mood.

Tasks:

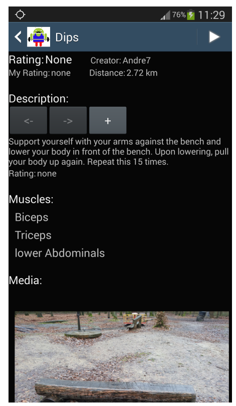
1. **Muscle selection**: Participants were given three exercises (push-ups, sit-ups, knee-bends) and had to select affected muscles from a list of 26 muscles in 5 categories. Correct muscles were selected through internet research and a discussion with an orthopedist.
2. **Spot usage**: We prepared two routes of equal length (one in an urban, the other in a rural setting, 7 subjects per route) for which we ensured that suitable points for exercises existed: a handrail, stairs, a playground and a bench. The average route duration per participant was 44 minutes. Four predefined spots with varying quality were created on each route: (1) a well-described stepping exercise, (2) a sit-up exercise with minor errors (i.e. wrong muscles given), (3) an inapplicable pull-up exercise (i.e. at possibly suitable spot, but unsuitable for this exercise) and (4) a push-up exercise at an unsuitable location (i.e. on a busy street). The spots were visited in random order.
3. **Spot creation**: The participants were encouraged to create spots whenever they found a suitable location. The spots could be created by giving a short description, taking a picture and stating the affected muscles (optional).

Table 3: Study 2: Investigation of spot usage and creation.

To validate the concept for the outdoor part, we ran the study as closely as possible to the proposed use case. We defined three tasks (see Table 3) at which the individual participants were each accompanied by an experimenter who observed the situation and took notes. The participants were encouraged to think aloud. For the second and the third task, we used a prototypical version of our app (see Figure 4). After their trial, participants filled out a post-session questionnaire.



(a) Map view



(b) Exercise view

Figure 4: Prototype version of the outdoor app.

As expected, only a minority of our participants have used a fitness trail before (35.7%) whereas 57.1% visit a fitness center, go jogging or do both. In total, 33 exercises (only one being a duplicate) were created by the participants (min=1, max=3, M=2.36). No significant differences with respect to the routes used and the number of spots created were found. Nevertheless, a Fisher's exact test showed that the level of detail (e.g. potential errors, correct posture) for the spot descriptions significantly differs by the user's level of sportiness ($p < 0.05$). These findings provide evidence for **H1** and **H2**. We further analyzed the results of the muscle selection task by counting the number of wrong (either forgotten or falsely added) muscles. The median error count of sporting and non-sporting participants was 8 and 16.5, respectively. We ran a Mann-Whitney U test to evaluate the difference in the error number. We found a significant difference between groups. The mean ranks of sporting and non-sporting participants were 5.9 and 11.5, respectively; $U = 4, Z = -2.27, p < 0.05, r = 0.61$. Nonetheless, the generally high error numbers show, that we need a mechanism for detecting errors in spot descriptions. We see a solution for this in our crowd-based approach (cf. **H3**). To acquire evidence for this, we checked the performance of the participants in detecting errors for the predefined spots and looked at the given ratings (R) on a 5-point scale. None of the participants reported the accurate stepping exercises as erroneous (R=3.62) and all reported the correct error at the push-ups spot (R=0.75). 79% reported the minor muscle error in the sit-up exercise (R=2.79) and 93% found the problem in the pull-ups exercise (R=0.82). We reason that with a solid base of users the quality of spots will be high in the long-run, as errors are detected and the corresponding spots are rated lower. In the post-session questionnaire 93% of the participants reported liking the idea of digital fitness trails. Nonetheless, because of the experimental situation, we could not draw any definite conclusions for **H4**. Therefore, we plan to conduct an in-the-wild study.

Discussion and Outlook

The analysis of the paper-based training schedules revealed no general solution regarding the feature set that should be provided by a digital training schedule. Furthermore, no clear results regarding the required level of editability could be gained. Next, we will analyze digital training schedules used in fitness centers and other available sport apps, such as Concept2 Logbook[3]. However, the analysis equipped us with a better overview of the available dimensions and based on this, we can generate questions for our structured interviews. We will conduct these with members of fitness centers and trainers to get a deeper insight on how the training schedules are used, what users think about analog vs. digital training schedules, which features are essential and, especially, which are missing or could be improved. The results of the outdoor study were encouraging, as they show that our community-based approach has a high chance of working: Participants could not only find exercise spots, but were also able to identify bad spots. This will lead to better content quality in the long run. An aspect we are also going to investigate will be how we can motivate the crowd. An in-the-wild study, which is planned as the next step after the prototype implementation is finished, will provide us with an idea for this and show the acceptance of our app in a natural setting: Measurements of app usage, the number of created spots and direct feedback might help us to evaluate OmniSports.

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