Crowd-generated Outdoor Fitness Exercises

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Abstract
Doing sports on a regular basis is beneficial for personal health and well-being. This paper introduces the idea for crowd-generated outdoor fitness exercises with the goal to assist people already keen on doing sports. Based on idea, people can create and do outdoor exercises at everyday locations, e.g. stairs or benches. In this paper, we present our concept as well as results of an initial user study. With a mobile prototype, we investigated people's ability to identify exercise spots outdoors and whether they are able to enhance existing spots.

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, 8]. Nonetheless, it is in general difficult to encourage people to do so [8]. A possible strategy to overcome this problem is the use of persuasive computing systems [5]. The work already done in the domain of encouraging healthy behavior often focuses on

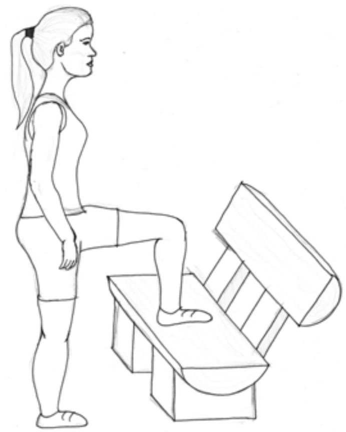


Figure 1: Outdoor exercise at a standard bench.

specific groups of people (e.g. office workers [7] or social circles [4]). Within this work, we target the group of people who are already keen on doing sports. Providing a system which encourages people to do exercises outside the gym in their daily lives (comparable to exercises on fitness trails, see Figure 1) might not only enhance the enjoyment of doing sports, but also improve the overall fitness levels even further. For creating and maintaining these exercises, we aim at utilizing a crowd-based approach. 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 a user study we carried out during our user-centered design process and give a short outlook on the next steps we plan.

Scenario

Bob is jogging and listening to music with his smartphone. The music gets interrupted by an auditive notification to inform Bob about suitable spots for outdoor fitness activities nearby. Bob checks the map in our app to see details, e.g. the exercises he can carry out at the spots and the community's rating. 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 explain how the exercise can be done. Bob watches the best-rated video and carries out the exercise. 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.

Related work

For our app, we utilize the concept of virtual fitness trails that provide exercise spots at certain locations. 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. The authors do not offer a solution for how to create new trails. By using a crowd-based approach, we hope to solve this, which might also 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 to convey how the exercises are done. Regarding the quality of the spots, we think that the crowd approach is suitable: Already in 1907, Galton reported that the weight of an ox could better be estimated by averaging judgements of many observers than by asking experts [6] – a phenomenon called "the wisdom of crowds" [9] . We will therefore offer rating mechanisms for the contents in our app. The averaged judgements of the users can then serve as indicator of a spot's quality, and users will be able to contribute to already existing spots. Chuah and Sample [3] present a system targeting obesity in children by creating random tours with exercises. While users do exercises, the heart rate and the calories burnt are measured. 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 [4], we will integrate a ranking and achievement system from the beginning. Another 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

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. The muscle sample selection was done 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 1: Study: Investigation of spot usage and creation.

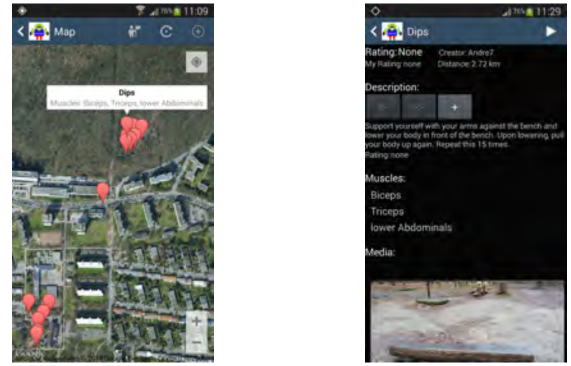
accordingly. To simplify this, in addition to visual information auditive instructions are also provided; we also see these as a necessity in our scenario. In contrast to the work presented here, we additionally aim at better integration in the users' everyday lives, e.g. by providing notifications if a user approaches a spot that could be of interest for his goals and preferences.

User study on spot usage and creation

We follow a user-centered design process and conducted a user study with an early prototype. Our goal was to learn whether users are able to find spots, which variances in the creation process exist, whether errors in spot descriptions are found and in general, which requirements users have for such an application outdoors. Therefore, the collected results are not only restricted to our application but can also be used for other sport applications. With this study the following hypotheses should be validated:

- **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.

To validate our concept, we conducted the study as closely as possible to the proposed use case. We defined three tasks (see Table 1) at which the individual participants were each accompanied by an experimenter who observed them and took notes. The participants were encouraged to think aloud. For the second and the third task, we used the prototype of our app (see Figure 2). After their trial, participants filled out a post-session questionnaire.



(a) Map view **(b)** Exercise view

Figure 2: Prototype version of the mobile 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. 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 route used and the amount of spots created were found. Regarding the level of sportiness, a Fisher's exact test showed that the level of detail for the spot descriptions (e.g. potential errors, correct posture) differs significantly ($p < 0.05$). 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 rank of sporting and non-sporting participants was 5.9 and 11.5, respectively; $U = 4, Z = -2.27, p < 0.05, r = 0.61$. Nonetheless, the high error numbers show, that we need a mechanism for detecting errors in spots descriptions. We see a solution 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 exercise as erroneous (R=3.62) and all reported the present 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 corrected or the corresponding spots are rated lower. In the post-session questionnaire, 93% of the participants reported liking the idea of digital fitness trails. However, because of the experimental situation, we could not draw any definite conclusions for **H4**.

Conclusion

The results of the user study were encouraging, as they show that the community-based approach for this app has a high chance of working: Participants could not only find exercise spots outdoors, but were also able to identify bad spots. Based on these results, we can expect a reasonable number of exercise spots that provide high-quality content. As the next step, we will finish the prototype implementation, paying special attention to creating an appealing user interface, and will focus on persuasive components to motivate the user to participate. Later on, we plan to conduct an in-the-wild study to assess 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 the app.

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