

GymSkill: Mobile Exercise Skill Assessment to Support Personal Health and Fitness

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Abstract. We present GymSkill, a personal trainer for the smartphone, contributing to regular physical activity and a healthier lifestyle. GymSkill incorporates automated exercise skill assessment, allowing to track training success as well as the need for improvement. Precise and targeted feedback can increase satisfaction through more efficient training, thereby addressing the important and often neglected aspect of intrinsic motivation. In a first 5-day study, users attested GymSkill the potential to reach training goals faster and to support maintaining long-term motivation. The video shows the app, its features, and the training.

Key words: Skill Assessment, Health, Fitness, Sports

1 Introduction

Regular physical activity is important to personal health and well-being. Meanwhile being daily companions, smartphones can support exercising, e.g. by apps that record running tracks. However, continuity is important for significant effects of training, requiring long-term motivation [1] – an aspect not yet addressed by smartphone fitness apps. Performance evaluation and targeted feedback based on sensor data could be a way to maintain especially one’s intrinsic motivation and make training more effective. The computational power and multitude of sensors of today’s smartphones are currently not exhausted and can be employed for automated exercise analysis and assessment. While research uses sensors for sports-related activities even in everyday objects [4], more recently, sports manufacturers have included algorithms in their systems to automatically detect the activity performed by the wearer, such as speed walking, jogging and others.

However, the automatic, expert-like judgment of the performance remains an open research topic. We present GymSkill, a personal fitness trainer for balance board exercises (see Fig. 1), a system *assessing the quality* of an activity. We situate our approach on top of raw sensor data acquisition, data processing and activity detection.

2 GymSkill – A Mobile Personal Trainer

GymSkill is a mobile personal trainer for balance board exercises, which train e.g. ankles, body posture and the equilibrium sense, and are beneficial to likewise young people [3] and elderly [5]. Unlike existing fitness or workout applications available e.g. in the iTunes App Store or the Android Market, the GymSkill application combines a comprehensive exercise database with illustrated descriptions and video demos with the ability to assess the exercise performance.

The smartphone is therefore placed on the balance board, and the board’s movement is recorded by the phone’s accelerometer during the training. Based on e.g. equality in movement and other parameters, the skill level for a particular exercise is calculated. GymSkill has the following benefits:

- Training is more effective and faster improvement is possible, as the user knows whether (and which) individual exercises need particular practice.
- GymSkill contributes to maintaining long-term motivation, as the user is aware of his or her training progress. Through skill assessment right after each exercise, improvements, or the lack thereof, become immediately visible.
- By detecting correct exercise execution, GymSkill omits the need for permanent supervision. GymSkill not only supports leisure time exercising, but is also a valuable complement for physiotherapy or rehabilitation.
- GymSkill supports autonomous training through comprehensive exercise descriptions and medical background information.
- Training feedback has already been presented with external sensors [2], but GymSkill does not require the connection of additional hardware. Recording and computation is performed entirely by the smartphone, enabling true, zero-setup ‘ubiquitous training’.

2.1 Functionality

GymSkill is implemented as Android application and consists of three main parts: an exercise database, the sensor recording functionality, and an evaluation component. The user can either work through a 20-exercise training plan composed by a sports medicine specialist, or focus on individual exercises. Prior to the first training, GymSkill needs once to be calibrated before the phone is placed on the balance board. The correct execution is explained by text, illustrations and video footage. Accelerometer data is recorded upon the press of the start button. During actual exercise performance, the application gives visual and auditive feedback. The number of repetitions is shown on the display and

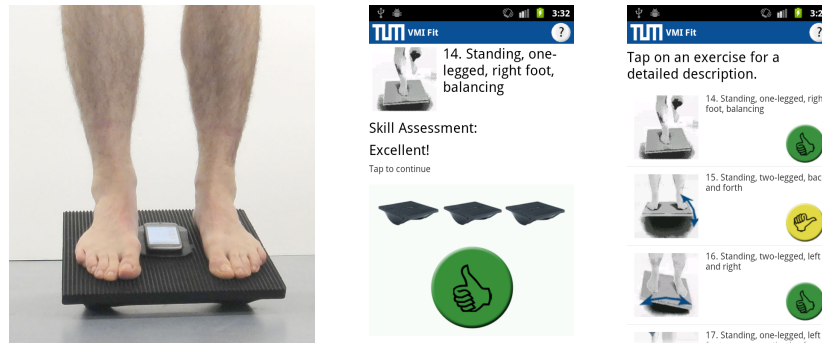


Fig. 1. *Left:* Balance board training with GymSkill with the smartphone capturing accelerometer data. *Middle:* Skill assessment after exercising, based on the evaluated sensor information. *Right:* Indicators which exercises need further training.

a sound notification signals exercise completion (particularly useful for exercise types where glancing at the phone is difficult). Incorrect movements (e.g. a too high board deflection) are signaled visually and optionally by a warning sound.

After exercise completion, the general skill assessment is calculated based on multiple factors (see Fig. 1, middle image). For balancing exercises, e.g. the number of deflections from the base level is incorporated, while for tilting exercises, the uniformity of movements plays a significant role. The assessment is classified into three levels from one point (poor) over two points (fair) to max. three points (excellent). In case of a poor result, the user can either immediately repeat the exercise to improve, or first complete the entire training program. The assessments are stored and can afterwards be reviewed in the exercise list, so that the user can track which exercises need particular training, and address them directly (see Fig. 1, right image).

2.2 User Feedback

GymSkill's potential to make regular training more effective and to maintain long-term motivation was evaluated in a 5-day study by 6 participants, aged from 25 to 33 years (average: 29). On each day, the complete set of exercises was performed twice (morning and afternoon).

After the study, participants answered that GymSkill could help to reach a defined training goal faster with an average of 4.2 (SD=1.3) on a 5-step Likert scale (1=fully disagree, 5=fully agree). The potential to motivate regular training in a long-term perspective was evaluated with an average of 3.7 (SD=1.0) (see left diagram in Fig. 2). Asked for most attractive potential features of a personal fitness trainer like GymSkill, individual exercise feedback was evaluated with 5.0 (SD=0.0), followed by suitable exercise suggestions (4.8, SD=0.4) for faster improvements (see right diagram in Fig. 2).

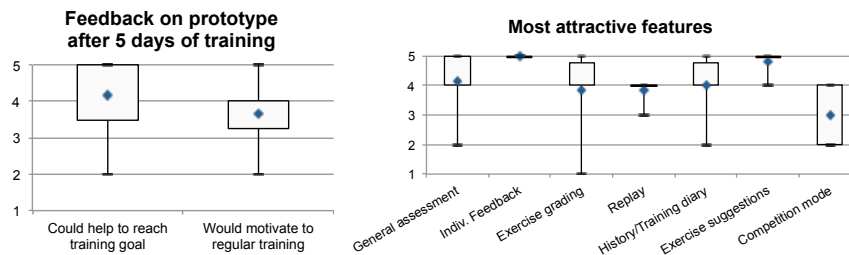


Fig. 2. *Left:* User feedback on the GymSkill prototype after 5 days of use. Study participants believe that the application could help to reach training goals faster and see a high potential for long-term motivation. *Right:* Individual feedback and suggestions of suitable exercises were particularly attractive to users. Answers were given on a Likert scale (1=fully disagree; 5=fully agree). The box indicates the interquartile range (middle 50%), the dot the mean value, and the bars minima and maxima.

3 Conclusion

We have presented GymSkill, a mobile personal trainer to support regular exercising. The idea of evaluating phone sensor data to assess exercise performance can contribute to more effective training and faster improvement, thereby addressing the important aspect of long-term motivation maintenance. This potential of GymSkill was confirmed in a first one-week user study. Our system inspires the future of personal health and fitness applications and can foster research on support regular physical activity through mobile devices.

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