Handheld Augmented Reality for Collaborative Boulder Training

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Figure 1: Collaborative boulder training scenario.

Abstract

In this work we address the question how mobile technology can be used for collaborative boulder training. More specifically, we present a mobile augmented reality application to support various parts of boulder training. The proposed approach also incorporates sharing and other social features. Thus our solution supports collaborative training by providing an intuitive way to create, share and define goals and challenges together with friends. We present of a user study with climbers that used the application in a climbing gym.

Figure 2: Supporting collaborative boulder training with mobile augmented reality.

Author Keywords

Augmented Reality; Gestural Interaction; Collaboration

ACM Classification Keywords

H5.1 [Information interfaces and presentation]: Multimedia Information Systems. - Artificial, augmented, and virtual realities

Introduction

Bouldering is a special variant of climbing near to the ground without a rope that emphasizes on few but difficult moves [2]. Although Bouldering was defined as a special discipline of climbing half a century ago it grews in popularity only recently. Due to this trend even specialized boulder gyms have newly been opened. Boulder training is often performed in groups and solving boulder problems can be perceived as a collaborative group experience as the following scenario shows.

Scenario

As usual Michael meets his friends in the climbing gym on Wednesday evening. After warming up they decide to focus on a special part of the wall and do some systematic training to improve certain skills. Therefore they define special sequences by pointing at holds that are "allowed" and then attempting to perform the defined problem sequence (see Figure 1). This kind of training is very helpful because individual strength, favorite movements and climbing styles will be avoided [3]. This leads to a much more varied training since every group member contributes his ideas, preferences and styles. Michael is very busy so he often misses the weekly training session with his friends. He tries to compensate this by doing individual training sessions on another day. Unfortunately, in these sessions Michael is usually not able to perform such a diverse training as in the group setting. He has problems to motivate himself and he often is dissatisfied with his training progress afterwards. It even gets worse when his friends tell him that they had on the fly defined interesting new problems during their last workout.

Systemboard Bouldertraining

One possibility for focused training in climbing and bouldering is systemboard training. A systemboard is a special kind of climbing wall that has a standardized layout (size, slant, grid based hold structure, etc.) and hold sets. This layout allows an easy definition and documentation of different exercises, moves and problems by referencing the holds in a coordinate system. A systemboard allows a varied training from simple holding exercises to complex boulder problems. The Moonboard[1] is a systemboard that already provides a small database of problems. In this work we focus on the Moonboard since it can be seen as a de facto standard for systemboards.

Ubiquitous games and computer augmented sports

The use of technology in sports training is nowadays a general practice to measure, analyze and document performance and progress especially in professional environments. Non- or semi-professionals also use training plans and diaries. To some extent mobile technology is already used to achieve this, e.g. runners or bikers who track their trips with gps-enabled smartphones. Computer Supported Collaborative Sports [6] as a research field in ubiquitous games and computer augmented sports is mainly driven by computer gaming research. From that perspective Reilly proposed a taxonomy for Computer-Augmented Sports Systems [5]. To our knowledge only few work on augmented reality (AR) has been done so far in sports technologies (e.g. the augemented ping-pong table *PingPongPlus* [4]).

[1] http://www.moonclimbing.com/moonboard/

Figure 3: Screenshots: problem list (top), marked holds in AR view (bottom).

Computer Supported Collaborative Training

The main goal for such a system is to create an intuitive and easy-to-use editor for boulder problems as well as a system that enables climbers to share their achievements and ideas on new boulder problems. By using AR it is possible to superimpose markers around specific holds over the camera display (see Figure 2). The viewport can be easily controlled by moving the mobile in front of the wall without the need of additional interface elements. In contrast to most other computer vision based AR approaches, the solution proposed in this paper uses huge portions of the environment as trackable markers, i.e. big parts or even the whole climbing wall. The system is designed to achieve three main requirements: (1) defining problems and goals, (2) managing a training diary and (3) collaboration and sharing of problems.

To define a new problem certain holds are simply marked by touching and selecting them in the AR view. To compensate for the lack of precision on the small display the raster-based hold setup is used. If the user missed the intended hold she can quickly adjust the position of the marker by simple flicking gestures in each cardinal direction.

In order to keep track of the training progress a diary module is provided. First, one can simply log all unsuccessfully tried and successfully climbed problems in a training session. The user can share the completed training units with friends to inspire, compare, and motivate each other. Another useful functionality is the option to comment and subjectively judge on training units, session, and distinct boulder problems.

Users can get together in groups and share problems, achievements and climbing logs among each other. An achievement can be a predefined (hard) problem or a set of routes that needs to be completed within a particular timespan. The popular training technique "send me" [3] can be directly adopted in the proposed mobile augmented reality scenario. In this random skill practice a teammate is pointing the climber to random holds and thus forcing her to do unusual and unfamiliar movements. With this approach it is also possible to motivate (and control) climbing partners through online social interaction. Users can not only keep track of their own solved problems but also the ones of the climbing partners by sharing and discussing them online.

The proposed concept of Computer Supported Collaborative Training uses a multi-dimensional approach of computer supported collaborations. On the one hand individual training that was remotely created in asynchronous collaboration with others and on the other hand co-located collaboration in synchronous training sessions when an advisor guides the climber using the application. While the diary functionality primarily focuses on individual training the problem and goal definition feature is optimally suited for sharing.

User Study

A user study in a climbing gym has been conducted to evaluate our implementation. Six climbers (three female, age: $M = 25$, $SD = 4.14$) participated in a half an hour long trial session. Their average boulder experience was 16.17 month ($SD = 12.14$) and most of them preferred the gym over outside locations for bouldering. The majority of the subjects fell themselves confident in using a smartphone whereas two persons did state the opposite. Four participants stated that they have already seen or used a smartphone application which used augmented reality. Except for two subjects, none of them owns a smartphone.

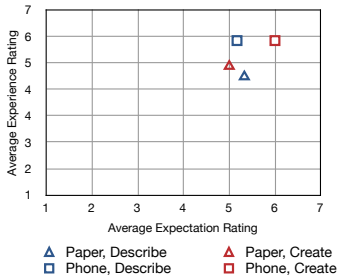

Figure 4: Scatterplot: Average expectation and experience ratings.

The participants were required to perform two tasks. In the first task the participants were asked to describe three problems to the interviewer. This task was performed by using a printout of the problem and afterwards the smartphone was used to identify the holds on the board. To complete the second task, the participants had to note a route as the interviewer described. Again, this was performed by marking the holds on a provided paper based template and by creating the route with the smartphone. Expectation Measure [1] was used to gather subjective feedback from the participants. Before and after each task the participants were asked to answer questions concerning the expected and experienced difficulty respectively on a 7-point scale (1 = Very Difficult, 7 = Very Easy).

Results

In the study subjective feedback was assessed with the Expectation Measure approach [1]. The rating scores for each task are shown in Figure 4. Each quadrant of the plot provides insights of possible improvements of the system. All tasks were expected and experienced as easy to perform. The scores of the tasks are located in the upper right quadrant and thus were expected to be easy and actually were easy. These tasks in the "Don't touch it" quadrant should not be modified to avoid a decrease of usability. In both tasks the average experience was perceived better in the phone condition. Anyhow, in the description task the participants expected the paper version easier than the phone version. During the two tasks four subjects stated that they did not lost the focus to the wall using the smartphone application. Two participants claimed that they lost the focus while using the paper based version. Overall, five out of six people would prefer the smartphone application over the paper based solution.

Conclusions and Outlook

In this work we investigated a mobile augmented reality application for collaborative boulder training. In order to support collaborative climbing training we developed a mobile augmented reality application to define, document and share boulder problems. With this approach we aim to support a more collaborative training by providing and intuitive way to create, share and define goals and challenges together with friends. The proposed technical solution makes use of synthetic images that are used as trackables. This approach allows a flexible and robust solution that is very well suited in a climbing gym scenario. The user feedback is promising. Nevertheless the concepts of collaborative training needs to be explored more in detail in future work. Currently, this work is focused on the Moonboard but it can be easily extended to every systemboard as well as arbitrary boulder walls.

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