TrampTroller

Using a trampoline as an input device.

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WS 2017 / 2018
Hochschule Augsburg
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1 Abstract

The goal of the research project "TrampTroller" is to create a prototype for a trampoline controller, a trampoline which measures the user's bounce and outputs it as a value to be used in various media. We propose to build this because it hasn't been done before and we think that a trampoline could be a fun way to interact with e.g. video games. To find out if users enjoy using this, we will conduct a user study, where we have users test the system in various applications and then ask them questions about their experience.

2 Motivation

Never before has a trampoline been used as input device. And that, although it's so intuitive, for example for Jump 'n' Run games. Using a button or a touch surface to make a virtual character jump is not very intuitive. With our trampoline interaction, we increase the feeling of immersion, the physical activity and the fun factor. Additionally, gamification is increasingly used in gyms. With our interaction we encourage the user to work out. We can optimize the flow of the users movement with visual representations.

3 Related Work

Fig. 1: Wii Balance Board

Fig. 2: eGym

While we couldn't find any work about using a trampoline as an input device for an application, there is precedence of combining games with sports in Nintendo's Wii Balance Board and eGym's eGym Zirkel .

The Wii Balance Board is an accessory for Nintendo's Wii and Wii U consoles, that looks like a body scale (see fig.1) and is used to measure the user's weight and center of balance. This information is used as input values in various games that promote fitness, such as the mini games found in Wii Fit U.

eGym's eGym Zirkel is a series of electronic gym equipment. The series uses gamification by showing the user a representation of themselves on a screen. The goal in these games is to train in an ideal rhythm and with the ideal amount of strength to keep a circle on the screen in a certain area (see fig.2). In a playful way this makes sure, that the user is training in the best and healthiest way possible.

4 Concept

Fig. 3: Fitness application

Our main two interaction techniques both take place on the trampoline. The first technique is simple jumping on the trampoline. The motion sequence can be seen in fig. 4. This interaction technique is used in both of our applications, the first of which is the fitness application (see fig. 3). In it the user jumps in the rhythm of a sine wave displayed on the screen to collect coins distributed on the wave.

Fig. 4: Jumping motion sequence

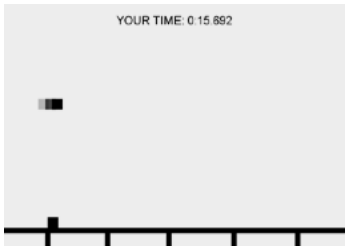

Fig. 5: Game application

The second technique is only used in the second application, the game. It consists of an up and down motion in the hip while lightly squatting. See fig. 6 for the technique's motion sequence. In the game (see fig. 5) the user jumps over obstacles to get to the goal in the smallest amount of time. To increase their speed between obstacles, the user can use the squatting motion.

Fig. 6: Light squatting motion sequence

Fig. 7: Hand raise gesture

Additionally, there is a third interaction technique that is specific to our prototype. Because we use a Kinect sensor to track the user, the use starts the game themselves by raising a hand (see fig. 7). This fulfils two purposes. The first one is to make the user feel more in control by enabling them to decide when to start the game. The second purpose is to correctly identify the tracked skeleton belonging to the user and save their current position as a zero used in the applications.

5 Implementation

To implement a prototype we used a small one person trampoline, a Kinect sensor, and a PC running an application displayed on a TV monitor and written in the Processing programming language using the SimpleOpenNI library (see fig. 8). We decided to use a Kinect sensor for our prototype because, after researching force gauges and similar equipment, it seemed like the quickest way to implement a prototype to test our idea.

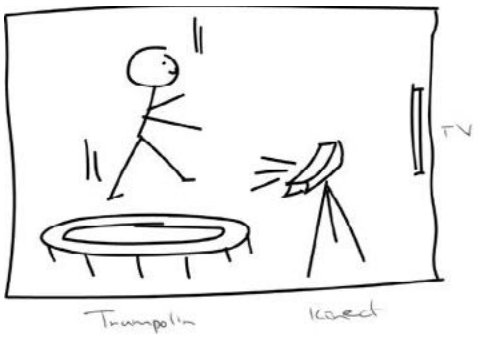

Fig. 8: Prototype setup

The SimpleOpenNI library by Max Rheiner allows easy access to Kinect data in Processing, while also providing the ability to track user skeletons. When tracking a skeleton, the library allows to access the location of different joints on the skeleton. While we initially thought about using the location of the feet as input data, they proved to be the least stable and most jittery joints. After reviewing test data we recorded, we decided to use the torso joint (see fig. 9), as it was most stable.

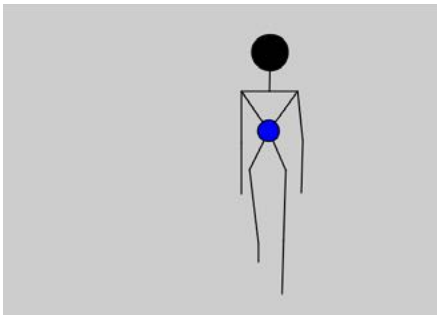

Fig. 9: Tracking the user's torso

To use the torso data in the applications we converted it into 2D space. Using a hand raising gesture the library can recognize natively as a calibration gesture, we saved a torso position point as a zero. We then used the difference from this zero on the y-axis as input for our applications. For the fitness application we used the positive and negative difference equally, directly translating it to motion of the user avatar in the application. In the game application the positive difference, above a certain threshold to avoid a jittery avatar, was used as the jump ascend. Because users tended to drop too fast to clear even very slim obstacles, the descent of the jump is linear instead of using real position data. Negative difference was used in the game to detect the speeding up motion. The motion was recognized by observing local minima and maxima in the difference on the y-axis. Furthermore strategies for re-adjusting the zero were used, in case the user changed their location forward or backwards, which results in higher or lower y-axis data in 2D projection.

6 Evaluation

In the user study we wanted to find out about these questions:

- Do users prefer jumping on the trampoline over jumping from the ground?
- Do users enjoy the trampoline input device overall?
- Do users find it to be to exhausting to use it regularly?

We placed the trampoline in front of a TV monitor at the eye level of the user, so the user can confortably see te application even while jumping. The Kinect was placed on a table below the monitor. Before the evaluation, we briefly introduced each user to our project and what they would have to expect during the test. Starting and changing the applications was done from the laptop. We took care to change the order in which users tested the application. We alternated between starting with the fitness application and starting with the game and when testing the game we alternated between starting on the trampoline and starting from the floor. A questionnaire was completed after testing both applications. The results can be found on the next page.

6.1 Results

A total of 8 participants, 4 female, 4 male, aged 23-27 participated in our evaluation.

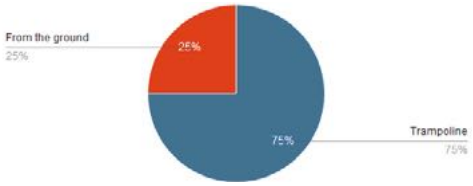

Fig. 10: Preference Trampoline / Ground

75% preferred the trampoline as an input device over jumping from the ground (see fig. 10). This is mainly due to the fact that jumping is softer and more cushioned. Users also said that it was easier on the joints, reactions would be faster and thus the fun factor was higher.

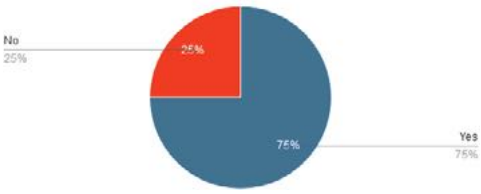

Fig. 11: Home usage answers

Also, 75% of users can imagine using our interaction method from home, or in the gym (see fig. 11).

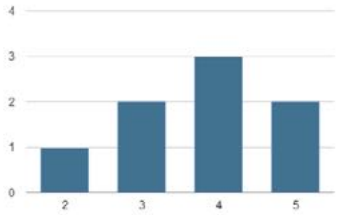

Fig. 12: Level of exhaustion

On a scale of 1 to 5, where 1 is not at all tiring and 5 is extremely exhausting, the average is 3.75 (see fig. 12). Our interaction is thus to be seen as a sporting activity which limits the usage duration. Most users can not imagine interacting with the trampoline over a long period of time. Although the physical effort involved in our interaction

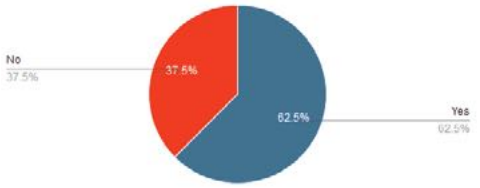

Fig. 13: Regular usage

is high, 62.5% of users can imagine using it regularly (see fig. 13). Especially an additional offer in the gym with our application would be gladly accepted by the users. On a scale of 1 to 5, the fun factor is 4.13, which is very high (see fig. 14). The users

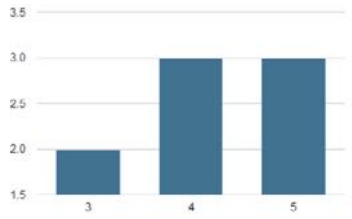

Fig. 14: Level of enjoyment

had a lot of fun while testing and even though they did not reach the end of the level in the game application they were motivated to try it over and over again. Overall, we had a representative mix of different genders and ages. 4 subjects already had previous experience with tracking-based interactions of, for example, the Nintendo Wii, HTC Vive, or other Kinect applications. For 4 users, however, interactions with via motion tracking were novel.

7 Conclusion

TrampTroller is a novel approach to use a trampoline as input device. More than 75% of the tested users found the possible interactions entertaining and more fun than interacting without a trampoline. One point that needs to be taken into account is that users exhaust very quickly. Besides the fact that our physical activity is healthy and good for the joints, it`s very strenuous in the long term. It is therefore advisable to use our interaction in a sporting environment, or to design shorter levels.

In conclusion, users were positively surprised and 62.5%, the majority, can also imagine a regular usage, both at home and in the gym.

In the future, we would visually and technically improve our applications to make them even more appealing. For example, users mentioned the introduction of a ranking system that makes it possible to compare each other. In addition to improve our current prototype, more gestures could be introduced. In the fitness application, users would then be able to determine the tempo and amplitude of the sinusoid itself by applying hand movements. Thus, an application could be created that could be consistently controlled from the trampoline offering an even more fluid user experience without breaks when switching modes or tweaking settings.

8 Image Source

Fig. 1 By Dddeco - Own work, CC BY 2.5, https://commons.wikimedia.org/w/index.php?curid=3168572

TrampTroller...

...for gamers
and gym rats.

Video Documentation