HETZI - Jump and Run: Development and Evaluation of a Gesture Controlled Game

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Abstract

In this paper an interactive game is described, that has been developed for a company using new technologies for raising awareness at job fairs. An already existing framework of a game terminal for job fairs is used. The corporate identity, the content of the advertised job, but also the attraction of a young and technologically interested audience is combined in a game in order to develop an interactive experience that is easy to grasp, raises awareness for the company and is fun to play. Within the gesture controlled Jump and Run game, the audience accompanies the character "Hetzi" through the guts of a colocation centre, avoiding hazards and animating the player to move in order to win, the company's vision of a modern communication strategy became true. After describing the idea and implementation an evaluation of the game is presented. Due to the results and implemented improvements the company is convinced and the game will be used in future job fairs.

1 Introduction

At job fairs companies generally try to catch the attention of the visitor and want to be remembered by potential future apprentices. In order to achieve this goal for a company providing hosting solutions and being an experienced data centre operator a gesture controlled Jump and Run game was developed. It was implemented on an already existing terminal designed by Fliehr [Fli15], which consists of a Windows Computer running Max 7, a Full HD display in portrait orientation and some additional hardware. The Jump and Run game replaced a version of Tetris in the original terminal application and had to be integrated seamlessly into an existing Max 7 environment, guaranteeing that all other features of the application kept working.

The game was tested and evaluated against four hypotheses in order to be able to figure out weaknesses and strengths of the game and to be able to improve it with respect to the use at job fairs. The hypotheses were defined in a way allowing to figure out whether the game will contribute to the company's overall appearance at fairs. Subsequently final adjustments to further improve the game were made.

Especially in the context of a job fair it is important for a company to be remembered by the visitors. Past experience shows that usually exhibitors do not rely on Jump and Run games for marketing purposes. Therefore it should serve the purpose of becoming a more recognizable brand and helps to make the appearance more memorable. Thus hypothesis one focuses the question whether the player will associate the game with the company in case the game occurs within the company's working environment and the player becomes aware of that.

Hypothesis two: If the sound matches the events on the screen, the sound might contribute to the overall gaming experience and enjoyment.

Hypothesis three: If the controls of the game are simple and intuitive or at least easy to describe and comprehend, the player is able to play the game instantly and without time consuming explanations. This would contribute to making a fast impression on visitors, who usually only spend little time at each single stand of an exhibition.

Hypothesis four: If the complexity of the game is increasing in correlation with the amount of time the player is investing, it equally suits both new and more experienced players.

2 Related Work

Fliehr describes how the single components of the underlying terminal are arranged and function. Moreover, he suggests improving the integrated camera based tracking system and a further enhancement of the brick-based game [Fli15]. Since the version of Tetris and the camera based system were removed, there was no need to consider these improvements.

In: W. Aigner, G. Schmiedl, K. Blumenstein, M. Zeppelzauer (eds.): Proceedings of the 9th Forum Media Technology 2016, St. Pölten, Austria, 24-11-2016, published at http://ceur-ws.org

Lubitz and Krause [Lub12] proved that even if input methods for controlling a Jump and Run game character are considered easy by a very small group of persons, a large group of players may consider the controls too demanding. This emphasizes the importance of usability testing and the necessity of a very simple interaction.

Trepte et al. [Tre11] examined the relation of player performance, game-related self-efficacy experience and the enjoyment of the gaming within an equation. Their study reveals that player performance has a significant influence on game enjoyment. This relation has to be balanced accordingly in order to create an enjoyable experience for both beginners and advanced players.

3 Method

The Jump and Run game was developed in close collaboration with the company. Each step of the development process was shown to the company in order to guarantee the game is tailored according to the company's vision. After the game requirements had been specified, the game design, sound and controls were developed. Finally the game was implemented on the actual terminal and evaluated.

The evaluation practice consisted of a two step process. During and after the usability test, the participant took part in a narrative interview. Afterwards a questionnaire was filled in by the participant, ensuring the systematic survey of the overall impression of the game. .

The questionnaire was comprised of 19 questions, by which the participants were asked to either rate on a scale from one to five, fill in text or tick a checkbox.

Further insights were gained by the live feedback of the participants while playing the game and the statements they made without prior request.

Ten persons participated in the survey. Most of them were employees of the company the game was designed for. All other participants were been given a short outline of the company.

4 Implementation

The usability test was performed with each participant individually, during which the participants were standing roughly one meter in distance from a screen in front of a Leap Motion controller installed at hip height. After a short introduction to the terminal and how the test had to be performed, the start-screen of the game was presented to the participant.

Followed by an initial instruction of how to play the game by the supervisor the participants were asked to play and explore the game by themselves for a period of at most ten minutes. If a user had any questions, during gameplay, they were answered and used to start a short conversation in order to gain further information.

Once the participants finished playing, they anonymously filled in the questionnaire.

5 Development

The following specifications were outlined at the beginning of the development process:

- The game consists of one endless level, dynamically and randomly put together.
- The speed of the game and of the character increases continuously throughout the game to increase the challenge (which is important to maintain motivation [Har10]).
- Different kinds of obstacles appear randomly.
- The game ends as soon as the character collides with an obstacle and can be restarted multiple times.
- The character is controllable via a simple hand gesture recognized by a Leap Motion controller.
- An 8-bit style melody is playing when the game has started.
- The game is running in an existing Max 7 environment of the terminal.

The storyline of the game follows an employee who has to fix a broken server at the other end of a colocation centre. On his way through the colocation centre he needs to avoid colliding with obstacles in his path.

5.1 Design

The overall design is kept very basic in a "flat" design in order to match with the existing design of the other terminal application and to create a modern, suitable and "clean" look. The game is kept two-dimensional, which lowers the barrier for people who only play occasionally as it creates a feeling of control. [Gan16]

After designing all the single visual components of the game, a sprite sheet was generated[1]. This helped to further reduce the needed resources, improve performances and allowed for quick and small adjustments of the design.

5.1.1 Game character

The game character ("Hetzi") shows a somewhat stereotypical employee of the company. "Hetzi" is wearing "nerdy" glasses, has an inconspicuous haircut, is wearing a black shirt with the company's logo, which is represented by the red "H" and carries a toolbox with the utensils he needs in order to repair a broken server. "Hetzi's" appearance wilfully plays with the widespread notion of the portrayal of an IT-technician (although many might disagree with this representation).

Figure 1: Game character - Hetzi

To make him look a little more innovative and futuristic he is surfing on a hoverboard instead of just running through the colocation centre.

5.1.2 Obstacles

There are three different kinds of obstacles inspired by real objects, which can be found in a data centre

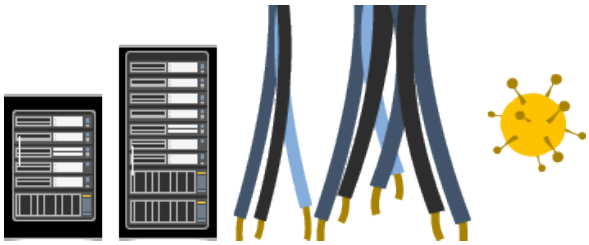


Figure 2: Obstacles

The first types are servers that are modelled in two different sizes. Both servers have the same width but differ in height. The servers are standing on the floor and the character has to avoid a collision with them by jumping.

The second types of obstacles are cables, which (in spite of the usual safety regulations) are hanging from the ceiling and creating a danger for "Hetzi", if he jumps into them.

The third type represents a hacker attack pictured symbolically as a virus. The virus obstacle spawns randomly at one of three predefined heights making it more difficult to avoid a collision with them and creates more diversion.

5.1.3 Setting

The scene of the game shows a colocation centre which is similar to one of the company's (most probably without the hazardous surrounding). One of the special features set in the background is a diagonal ceiling supporting an energy efficient air circulation which is why this feature is represented in the design of the setting. Furthermore there are servers, not too similar to the obstacles, standing in the background in addition with the company's logo on the wall.

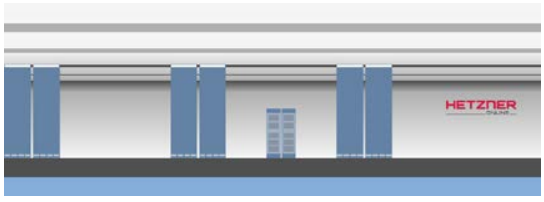


Figure 3: Setting

[1] Sprite sheet: An image containing all images used in the game

Obstacles are either standing on the grey floor (servers), hanging from the ceiling (cables) or flying somewhere in between (viruses).

The character has a fixed x-Position (horizontal) and a controllable y-Position (vertical) to allow him to jump. If the character is not jumping he is hovering in a sinusoidal movement above the floor.

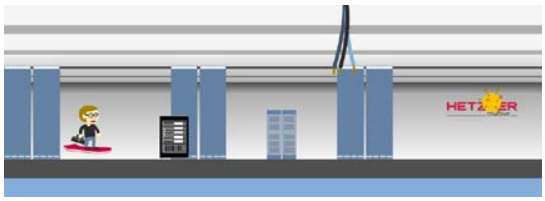


Figure 4: Character and obstacles in the setting

5.1.4 Score

The current score and the high score are displayed close to the top-right corner of the game's canvas. The high score is indicated by "HI" and the current score updates in real-time while playing.

Figure 5: Score and high score

5.2 Sound

Three events result in a sound aiming to create a more interactive gaming experience:

- The start of a jump of the character.
- Reaching a multiple of 100 points.
- A collision of the character and an obstacle.

Moreover a background soundtrack starts every time the game begins. The soundtrack is an 8-bit sound file, which is supposed to be reminiscent of the sound design of older 8-bit-platform games such as Super Mario Bros. ®.

5.3 Controls

In order to keep the control as easy as possible only one action can be triggered by the player: The jump. This jump of the character is triggered by a swipe-up with either the right or left hand of the player within the interaction area of the Leap Motion controller.

If the Leap Motion recognizes a swipe-up the y-axis variable increases. If a certain threshold is reached the jump starts. The threshold guarantees that the jump isn't triggered by accident, allowing the player to slightly move their hand without affecting the game. Since the learning curve appears to be very gentle, the game offers entertainment for all possible user groups.

5.4 Software development

The software development process started with the analysis and the adjustment of the pre-existing terminal application. The new game logic was then implemented in JavaScript and integrated in the Max 7 environment, followed by the integration of the Leap Motion Controller into Max 7.

5.4.1 Initial situation

The initial application consisted of:

- The start screen,
- A menu to choose one of two games,
- The Tetris-clone,
- Numberquiz (a game where you have to convert decimal into binary numbers and plug the number with network-cables in a switch with the upper row representing ones and the lower row zeros as fast as possible),
- A photograph of the player, taken by an attached webcam and printed together with the time from the Numberquiz

The navigation of the application was achieved by holding physical Tetris-bricks with a fiducial mark into the field of view of the installed camera. The camera then tracked the fiducial mark and translated the information into the desired output.

5.4.2 Programming Environment Max 7

The Jump and Run game was added to the pre-existing software whilst all other features had to remain working. The navigation links were adjusted accordingly.

To navigate through the application the Leap Motion was introduced. As there is a maximum of two navigational options on each screen one option is triggered by clenching a fist with the left hand for a

short amount of time while the other option is triggered by holding a fist with the right hand.

The layout of all the screens has been adjusted to take advantage of the full resolution of the terminal's screen (1080*1920px).

5.4.3 JavaScript in Max 7

For a Jump and Run game the "JSUI-object" fits best which is the equivalent within the Max framework to the Canvas-element in HTML (Cyc16). The JavaScript code updates the position of the background, the character and the obstacles every frame. Then all the elements on the canvas are cleared and redrawn with their new positions.

The character has a fixed x-Position creating the illusion of a forward movement by decreasing the x-Position of all other elements. The hovering of the character is created by updating its y-Position. It increases until it reaches an upper threshold and then decreases until it reaches the lower threshold. When a jump is triggered the y-Position is updated in regard to the existing thresholds.

Initially six random obstacles are created. If an obstacle's x-Position is lower than zero minus the obstacle's width, it is removed and a new obstacle is created. The x-Position becomes then the x-Position of the prior obstacle plus its width and an additional random gap. The virus obstacle can only be created if the speed, which increases throughout the game, has exceeded a certain limit, since it is the most difficult obstacle to avoid a collision with.

The collision detection validates if:

- the character's x-position is smaller than the obstacle's x-position plus its width
  and
- the character's x-position plus its width is greater than the obstacle's x-position
  and
- the character's y-position is smaller than the obstacle's y-position plus its height
  and
- the character's y-position plus its height is greater than the obstacle's y-position

If all conditions are met, it returns a collision and the game state is set to game over.

The background consists of two parts. If the first part's x-position is smaller than zero minus its width, it receives a new x-position which is the second background's x-position plus its width.

The current score is constantly increasing. If the current score modulo 100 is zero the achievement sound is played. If the game state is set to game over and the current score is higher than the high score, the high score gets updated.

If the game state is set to game over, the game frames and the update cycles stop. If the game is then restarted everything besides the high score is set to the initial values and the game begins again.

If you are using "this." in JavaScript as you usually would, problems can occur as Max sometimes falsely seems to relate "this." to the JSUI-object in your patch. This can lead to errors in the code, shown by the console or to unexpected behaviours of the game. Therefore you should avoid using "this." or you would have to double-check each occurrence of "this." to make sure it is working the way you need it to.

5.4.4 Leap Motion integration in Max 7

Using the "leapmotion-object" by Jules Francoise [Fran14] the integration of the Leap Motion Controller is straightforward. The object extracts all the tracking data from the Leap Motion and utilizes it in the relevant Max-Patch.

To navigate through the application the grab strength of both hands is evaluated. If it is found to be higher than a threshold, a variable is increased; if it is lower the value of the variable is set to zero. The navigational option is triggered if the variable reaches a threshold. Additionally, the confidence (a probability value of the placement of an object) of each hand must be evaluated, since the "leapmotion-object" keeps the last known value of the grab strength stored and does not reset it when the tracked object is moved out of the interaction area. While the user moves his hand to the edges of the interaction area, the confidence decreases allowing the program to detect the possible leave of the users hand and therefore is able to set the value of the relevant variable to zero.

To provide a visual feedback to the user a loading bar beneath the navigational option continues to fill while the user is holding a fist. By that way the user is able to experience how long to hold the fist and when to open the hand again.

6 Evaluation

The results of the evaluation were split into four parts:

- Design.
- Gameplay.
- Overall.
- Improvements.

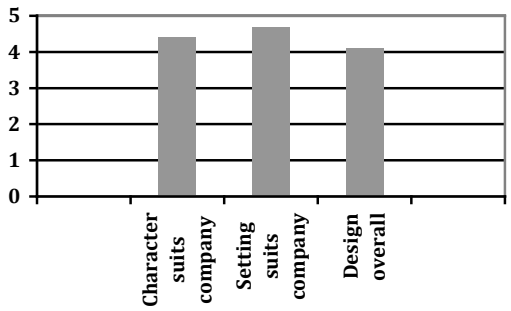
The participants surveyed helped in identifying major bugs as well as receiving an overall first impression from the users. The study was not designed with the goal to generate statistically exact measurement results on an overall user experience but to see tendencies in the user experience with respect to the hypotheses and the aims of the development. Thus the graphs in the following represent the results according to the answers of the participants and are used here as a means of users tendencies in the perception of the game.

Eight out of the ten participants were male. The average age throughout the group was 24.4 years. Two of them had prior experience with a Leap Motion controller. Only one person had never played a Jump and Run game before. At the time of the survey, eight of the ten participants were working at the company the game was designed for.

6.1 Design

Being asked what the character represented, 90% recognized the character as a stereotypical employee of the company. 60% identified his means of transportation as a hoverboard. Even though 40% did not, only one participant wondered why the character was hovering over the floor and thought it to be a "carpet-like thing" out of Aladdin's tales. All participants identified the background as a colocation centre. With all above mentioned characteristics the participants were asked to fill in the blank text. Rating on a scale from 0 (not at all) to 5 (fully agreed) the participants agreed that the character as well as the setting suited the company's conception and image.

Table 1: Design



The overall design was rated 4.1 out of 5 points.

Some of the participants were not sure if the servers in the background of the game were obstacles. At first they had trouble distinguishing the obstacle servers from the background servers. However, after a short period of playing the game this problem disappeared. Nevertheless, the background was adjusted in order to address this problem.

6.2 Gameplay

6.2.1 Sound

The sound was perceived as either supporting or disturbing. The participants, who perceived the sound as disturbing, agreed on the fact, that the game should contain sound, but they were displeased with the chosen song.

All participants agreed that the sounds for jumping and a collision were fitting and enhanced the quality of feedback.

6.2.2 Controls

On a scale where 3 represented "just right" the swipe up was considered neither as very simple nor as complicated. Most participants said it was rather intuitive and fast to learn.

Table 2: Controls

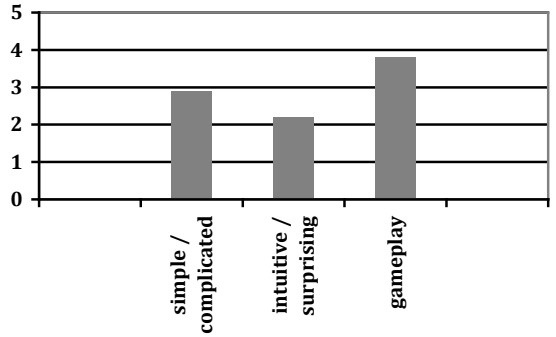
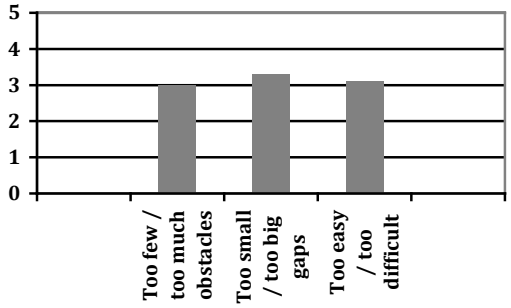


Table 3: Obstacles



At first the results were quite surprising, because a swipe up did not seem to be challenging at all. The problem most participants experienced resulted from the narrow tolerance range of the Leap Motion controller, which often failed to recognize the movement as a swipe up. Several reasons could be identified. In case the movement was carried out too slow, the participants were able to quickly adapt the movement. However, in case the participants hand had left the interaction area, the participants were not able to realise this and therefore could not adjust their motions accordingly. For that reason further adjustments had to be made to the game (6.4 Improvements).

Despite the difficulties, the participants rated the gameplay 3.8 out of 5 points. This result was used to slightly adjust the game-controls in order to strengthen the gameplay.

6.2.3 Obstacles

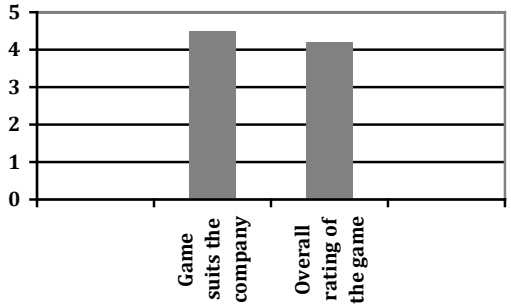
Regarding the obstacles, the results of the survey showed, that the participants were content with the amount of obstacles in the game and the positioning of these obstacles as well as the level of challenge for beginners and experienced players. They were asked to rate on a scale from 0 (too few / small / easy) to 3 (just right) to 5 (too many / big / difficult).

We found that it is rewarding to conduct small adjustments to the individual proportions of the visual elements. The ratio between the character's height, the possible jump height, the obstacle's width and height as well as the period of appearance of the obstacles and the speed of the game have to be treated carefully.

6.3 Overall

The participants of the study expressed that the game suited the company very well. Despite some weaknesses they rated the overall game 4.2 out of 5 points.

Table 4: Overall



Considering the difficulties some of the users experienced, this appeared to be a surprisingly high rating, which indicates a possible potential of the game.

6.4 Improvements

After the evaluation, the following improvements were made. The difference between foreground and background was emphasized by slightly desaturating and blurring the background.

The threshold for triggering a jump was lowered. Therefore a jump is triggered faster and easier.

A small green box was included to indicate if the left, right or both hands are within the interaction area of the Leap Motion controller. This should serve as a permanent feedback for the user and makes it easier to avoid mistakes.

Not yet implemented but possible improvements:

- Building a physical boundary for the interaction area of the Leap Motion.
- Replacing the 8-bit song with a more popular melody.

For further adjustments the game would need to be retested by a broader audience at an exhibition where the terminal shall be displayed.

7 Conclusion

Hypothesis one: The participants did associate the game with the company and responded that it was a "very good" suit for the company. We believe that this is mostly the result of the design of the character, the obstacles and the environment the game plays in.

Hypothesis two: For the participants of the study sound played an important role in making the game enjoyable. Even if the sound does not match with the player's idea of a suitable music, participants indicated that it contributes to the overall gaming experience and enjoyment.

Hypothesis three: If the controls of the game are simple and intuitive, participants were able to instantly play the game. Two of the participants came back after the usability test and still remembered the gesture. We conclude that once an intuitive gesture is performed a few times, it will not be forgotten quickly and the game can be enjoyed more easily.

Hypothesis four: As the game becomes more difficult the longer it runs, newbies as well as more experienced participants enjoyed the game. The only difference seemed to be that more experienced participants made faster progress in the game and reached a higher speed in fewer attempts.

8 Prospect

As mentioned in section 6.4. a retest within the framework of an exhibition or ideally a job fair including a bigger number of participants of the target group is a future project to be undertaken.

According to our experience the most important part of making a gesture-controlled Jump and Run game enjoyable is to give the user constant feedback about the precision of the applied gesture. This should be done through the interface the user sees on the screen rather than a person who constantly has to correct the player's movement.

Especially building a physical boundary to indicate the interaction area of the Leap Motion controller would be a great benefit for any gesture controlled application.

As the Jump and Run game is mostly written in JavaScript it could be adapted to be used on the company's website or implemented as a smartphone app – which three participants of the usability test also suggested.

Developing a lightweight casual game with easy controls can be a great benefit for a company. It increases the attractiveness of an exhibition stand and can be used as a giveaway in the form of a smartphone app enhancing a company's impact on future applicants and raising memorability.

A possible future improvement on the overall experience would be the implementation of a persistent high score list.

Furthermore it would be interesting to implement different input methods for the jump like a Wii balance board or a Kinect camera recognising a jumping user or just a simple enter key.

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