Constructeer

"Construct something with the mindset of an engineer"

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Our game is an interactive web browser game, based on the interactive construction of objects: the user has to construct a building using a limited number of building blocks. The constructed building has then to withstand a test with simulated natural or artificial forces (such as snow, stones, rockets) acting on the building. Each level contains humans placed on a colorful background. These humans ought to be protected from the forces by constructing a suitable building for them. In order to successfully complete a level, it is necessary that neither human being is damaged by the forces. The game is supposed to convey the fundamentals of statics in a playful way and also addresses non-engineering students, who can playfully adapt the engineering mindset through the task of constructing a building and finding out what makes it stable and well-built with the "learning by doing" approach.

Contents

1 Overview

The game we develop is all about constructing. Actually it is about constructing buildings. But it is not a game about Bob the Builder. Our game is called "Constructeer - build something with the mindset of an engineer."

1.1 Main Concept

Our game features an educational, interactive construction of buildings. Even without an engineering background, the player can learn how to build robust and safe buildings which should withstand simulated forces such as snow, rain, stonefall or cars. Each level is set to a colorful background and has a maximum amount of building blocks the player can use to construct the building. First, the player has the task to construct a building in such a way that it can withstand a simulated test in the form of a natural or artificial force aimed at destroying the building. To do this, the player has to draw the building blocks (designed as steel beams) like beams over a canvas, with each drawn beam creating support anchors at their start and end points. After the player has finished constructing the building, it is being tested with a simulation of a physical force.

1.2 Unique Selling Point

The game is educational and social at the same time. For the social aspect, the topic of humanity is addressed by including human beings in the game. The game shows how crucial it is to have proper, safe buildings in order to protect humans around the world from being injured or killed. Regarding the educational aspect, the game teaches the basic laws of statics in a playful way by applying tests to each constructed building and showing the effects of these tests to the user through animations and simulations. These tests should follow the laws of physics as closely as possible and have the same or the similar impact as if they had been performed on real buildings in real life. While progressing through the game's levels, players should follow the "learning by doing" and "trial and error" approach - trying out different constructions, and correcting moves with the "undo" button. This helps them find out in a playful manner what makes a building stable and robust along the way.

2 References

Bridge Builder [1] is a game where the player has to construct a bridge built out of different materials with different Costs. Then the bridge has to withstand the impact of some cars or trucks rolling over the bridge. The main difference to our game is that in BridgeBuilder the main force is always coming from top down (e.g. a car rolling over it on the street, the weight of the material itself). In our game, the force may come from different directions, e.g. snow falling from top down, lateral movements from earth quakes or the wind, fire from the bottom up and so on.

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[1] https://en.wikipedia.org/wiki/Bridge_Builder

3 Specification

3.1 Player(s) / Target-group

Our target group is rather large - we want to address a diverse group of curious "tinkerers" and "makers" from all age groups and from all kinds of backgrounds, not necessarily only from engineering. People interested in constructing objects and observing their behavior according to the laws of physics should be naturally drawn to the game due to the technical challenges it offers.

3.2 Genre

The genre of the game can be classified as "Educational Simulation". The educational aspect is covered by the engineering mindset the player has to take on in order to construct different buildings; whereas the simulation aspect comes from the animated effects for natural forces or objects such as a driving car, which all follow real-world physics as closely as possible through the use of a Javascript physics engine called matter.js[1].

3.3 Art Style

The art style of the game is kept rather simple with contrasting, flat colors and few details, in order to not distract too much from the construction task at hand. For the objects contained in the game (such as humans, steel beam, car etc) we use different Bodies from matter.js to design their overall structure and the JavaScript library p5.js[2] for rendering Bodies onto the HTML canvas within the web browser. Animations for the simulated effects for forces such as water, fire, snow, earthquakes on the buildings are necessary to create a close-to-real user experience. Once again, the JavaScript framework matter.js is the framework providing us with their built-in underlying physics for the animations and simulations in our game.

3.4 Forms of Engagement

In our game, we want to focus on Challenge as a form of engagement. The game is designed as a sequential obstacle course on a level-to-level basis. The user is challenged to properly construct a robust and safe building which is being tested with different and increasingly difficult or stronger forces.

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[1]http://brm.io/matter-js/
[2]https://p5js.org/

4 Gameplay and Game Setting

The main goal of the gameplay is to save the humans placed in each level by constructing a helping barrier in the form of a building made out of steel beams, and to learn the basics of construction while doing so. The game contains a "Construct" mode and a "Run" mode. In the "Construct" mode, the player has to draw beams by dragging the mouse from joint to joint. Once finished, the player can test the completed construction by entering the "Run" mode.

4.1 Main Game Action

The main game action for the player consists of drawing beams; these beams should depict the steel joints making up the structure of a building.

Each of the ten game levels contains at least one human and at least two main anchor points - these are the points where the player must draw the first beams. Drawing beams is done by placing the mouse at one anchor (acting as starting point of a beam) and dragging it to the desired end point - upon release of the mouse, a new building joint (steel beam) with anchors is created. For each level, the player is challenged with a maximum amount of beams to be used for construction. The beams that can be drawn also have a minimum and maximum length. As helpful tool for the user, an "undo" button for construction as well as a helper grid overlaying the background picture for better positioning of beams, are provided.

Through the helper grid and the undo button as well as ability to switch between "Construct" and "Run" mode at any time within a level, we give the player the possibility to try out various constructions per level in a trial-and-error manner and thus understand certain metrics and mechanics necessary in order to construct a stable building.

4.2 Mood and Emotions

In general, the following mood and emotions could occur when playing our game:

- creativity (What kind of building should I construct?)

- technical questioning/reasoning (What to do to make my building stable enough?)

- curiosity (Let's try this out...What kind of test will happen?)

- sense of being in control as the creator (Cool, I have the power to construct something from scratch and see its reaction to different actions.)

- excitement (Will my building withstand this coming test?)

- sense of accomplishment and achievement upon passing the test and reaching the next level ("Yay, success - I did it..!")

- reflection and insight - upon failing a level's test, users should think about how to improve their construction ("Oh, I see what I did wrong here...need to improve this..")

- surprise ("Wow, I did better/worse than I had expected")

4.3 Story

Imagine that you're an engineer for an international construction company, with the task to build several safe homes and buildings for people in places all around the world. You travel from country to country, with each country presenting you with different constraints for construction (available space, limited number of material, number of humans to be protected by buildings) as well as a "stress test" for your finished building. This test comes in the form of a natural or artificial force, such as for example a meteorite, a landslide with rocks, or a car. Upon passing the test, you have successfully cleared the level and can thus proceed to the next level to build another building in a different setting. If you do not pass the test, you can always return to the level and improve your construction. With each level, the challenge of constructing buildings helps you to slowly discover the laws of statics and physics in a playful way. The game teaches you what it takes to make a building stable and resistant against various forces - and you'll slowly adapt the engineering mindset and be thinking like an engineer in no time!

4.4 World/Environment

We have designed a rather simple world with a static background and 2D game elements. The background environment reflects different environmental settings, such as a snowy region, a mountainous area or a vibrant city. The brilliant thing about our game idea is that its usage is possible in every kind of area. You as the engineer have to decide, which kind of building fits perfectly into each environment.

4.5 Objects in the Game

- per level: two main anchors as starting point for construction and one or more human beings (to be protected)

- different number of steel beams with anchor points drawn by the player, making up the building

- static background showing various colorful landscapes

- several UI elements within top menu bar (undo button, selection drop-down list to select level, construct mode button, run mode button)

4.6 Characters in the Game

Apart from the building the users create themselves out of steel beams, each level has one or more humans placed onto the ground plane, which should be protected from physical forces.

4.7 Main Objective

The main objective of the game is to enable users to try out real-world construction actions and see what consequences different forces can have on different buildings. At the same time, the game aims to implicitly educate users about physics laws and various natural forces that can be a danger to humanity.

4.8 Core Mechanics

The main components of the mechanics are gravity, frictional forces and leverage. Another critical point is the simulation of destructive natural and artificial forces such as earthquakes, storms, fire etc. A building block is simultaneously exposed to many different forces and has to react accordingly. With *matter.js*, a powerful JavaScript physics engine has been used to handle all mechanics in this game.

4.9 Controls

Our game mainly needs the mouse for "drag and release" to draw the building blocks (steel beams) onto the background canvas which displays the the construction site. In addition, various UI elements are accessed via mouse clicks and holding down the SHIFT key shows the helper grid overlaying the background picture with squared cells, which should aid the player in deciding where to place the next steel beam.

5 Front End

The front end and overall theme are rather sparse, but still mostly colorful. While the top menu bar is kept in a classic black-and-white theme, the background picture of each level shows beautifully colored landscapes to delight the player. It should reflect the simplicity of geometry forms and the liveliness of nature's colors, similar to the Google Material style. Each screen contains an background image and a top menu bar with the same items (listed below in 5.1. When the game is loaded for the first time, the "tutorial level" is presented - it is a regular playable level with the addition of an animated text overlay to the standard screen, explaining how the game is to be played.

5.1 Standard screen

The main area of the screen is dedicated to construction purposes. The standard screen consists of a background image and a top menu bar with the following items :

- game logo

- game name

- level selector drop-down menu

- undo button with countdown of remaining beams (maximum allowed number of beams is different for each level)

- "Construct" button to build your construction

- "Run" button to test your construction

5.2 Level end pop-up

When the player switches to "Run" and the construction withstands the simulated test, the level is successfully completed and a pop-up with a "Success!" message and the option to proceed to the next level or return to the current level appears. If the construction breaks down and does not withstand the simulated test, a pop-up with a "Fail!" message and the option to return to the current level (and improve the construction) is presented to the user.

6 Technology

We use **HTML5, CSS (Bootstrap**[1]**)** and the following JavaScript frameworks: **matter.js**[2] as a physics engine and **p5.js**[3] as a rendering engine.

6.1 Target Systems

The game runs on any up-to-date browser; it has been tested on the latest versions Chrome and Firefox as of March 2018. A mobile device support with responsive design is not within the scope of this game project.

6.2 Hardware

No special hardware is required to run the game, a regular PC or laptop running an up-to-date web browser such as Firefox or Chrome should do just fine.

6.3 Development Systems/Tools

We used the TU Graz Git repository[4] to host our code repository and collaborate during development. Since our game runs in a web browser, no special build tools were necessary. We regularly tested the game in Firefox and Chrome browsers and communicated via Facebook Messenger throughout the development process.

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[1]https://getbootstrap.com/
[2]http://brm.io/matter-js/
[3]https://p5js.org/
[4]https://git.tugraz.at/

7 Topic and Inclusion

The decision which topic we finally chose was not easy for us. Both possible topics had interesting points. But after some group assessments, we have decided to focus on the topic "Trust Me I'm An Engineer". This topic was not only interesting but also quite challenging, because you have to care about certain implementation issues such as the computational methods mentioned above.

7.1 Main Theme

As an ordinary user, the topic "Trust Me I'm An Engineer" probably does not seem very interesting. However, this certain phrase is known all around the world and a lot of people can associate this phrase to a popular meme and superb engineering skills. For our team, it gave us a lot of possibilities how we finally would decide to build our game. All of us are software developers, therefore the most common thing would be to address a certain topic of our computer science field. Nevertheless, we decided to think out of the box and design a game which is suitable for a broader group of people. This fact also increases the diversity factor which will be described later on.

7.2 Inclusion

Not all of our team members are able to understand certain physics which is necessary for implementing our game beforehand. Therefore we, ourself, had to acquire knowledge in this certain area - but luckily, we came across matter.js, a physics engine that already handles all physics behavior required for the gameplay. Even though all of our team members are studying Computer Science or Software Engineering and Management, some of us are also more refined experts in fields important to our game development process such as graphics, JavaScript, and project management. With diversified team members in our team we were able to implement a game for each kind of user: the engineer studying at a university as well as ordinary users without an engineering background, who like gain knowledge and understand certain processes.

7.2.1 Diversity

As mentioned above, the diversity factor will be given by the fact that all kinds of person should be addressed by our game, not only engineers. Although engineering is a very men-dominated field of science, we will also try to motivate and inspire women.

7.2.2 Accessibility

We do not specially plan to address accessibility in our game.

7.2.3 Humanity

By including simulations of natural and artificial forces such as landslides or snow avalanches, our game makes users aware of the various challenges humanity is facing in different parts of the world.

8 Marketing and Publishing Strategy

We plan to publish our game on the itch.io site[1] of the TU Graz Game Dev course, once it has been presented to the public at the final presentation day. Due to time constraints during game development, all marketing efforts described in this chapter will be conducted after the final presentation of our game on March 12, 2018.

Since our game is provided free of charge, we do not plan to spend any money on advertising, which limits the possibilities of gaining a high paid reach. Nevertheless, some options remain open such as posting through our own accounts on (social) media networks such as Facebook, Twitter, Instagram, Reddit, or YouTube. Our strategies for marketing in these media are as follows:

Social media: Given the short attention span on social media, a short video (uploaded onto YouTube) showcasing our game briefly in an exciting game phase is probably best suited. The link to video should be shared through all our personal social media accounts, with the post using appropriate hashtags (such as #GameDev #IndieDev #tugamedev) and a good preview of the video to attract the attention of users.

Youtube: Apart from uploading our short game teaser video onto YouTube, we hope to get in contact with some of the lesser-known gaming YouTube channels and ask them to produce a video reviewing our game or even doing a "Let's Play" of our game.

What we will not do:

1. TV advertising

2. Advertising in apps / games

3. (Paid) advertising on Facebook etc.

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[1] https://itch.io/jam/tugamedev17

9 Timeline

A detailed timeline is always hard to define, therefore we only used a rough timeline to help us plan our development. We focused on certain milestones during our implementation. First, we designed and defined our game specifics as detailed as possible in several further group sessions, by also trying out different physics frameworks and possibilities for designing blocks, before finally deciding on matter.js as a physics engine suitable for rather fast prototyping. Then we set out to build the first rudimentary prototype of our game, which only included the main functionality with three levels in a different art style (without humans, tutorial level, helper grid, selector box, background levels, fail/success message). After submitting our first prototype, we decided to add various background pictures to the levels to make them more colorful and interesting to look at. Once we had received the feedback from another group's QA playtesting, we started bugfixing and decided to work on implementing several further useful features (mentioned above as missing from the first prototype). Along the way, we added seven additional levels with different tests as challenges. Furthermore, a slight redesign with new graphics changed the user menu to a more classic, black-and white look with new icons for buttons. The final step was to polish the game, clean up the code and produce a short game video, which is presented along with the final game in March 2018.

Milestone	Description	Deadline
1	Hand-in of Design Document	08.12.2017
2	Set-up of Development environment	15.12.2017
3	First playable prototype	05.01.2018
5	Submission of first prototype (3 levels only)	12.01.2018
6	Implementation of further levels and features	08.03.2018
8	Finalization of Game and Production of Game Video	10.03.2018
9	Submission and presentation of final game	12.03.2018

Table 9.1: Project Schedule.

10 Team and Credits

10.1 Team

Project Management: Isabel
Programming: Stefan, Heinz, Mathias, Patrick, Isabel
Art, Design, Sound: Mathias, Markus

10.2 Credits

Levels "select" box: http://unlockcampus.org/code/tutoring/select-boxes
Icons: https://fontawesome.com/icons
Background pictures (Google/Android wallpapers) obtained from various sources:
https://wallpaperstudio10.com/wallpaper-abstract-71425.html
https://wallpaperscraft.com/download/minimalism_sky_clouds_sun_mountains_lake_landscape_95458/1920x1080
https://wallpapertag.com/wallpaper/full/b/4/1/654825-free-download-google-backgrounds-1920-jpg
https://protiumdesign.com/downloads/background/flat-mountains-landscape/
https://www.desktopbackground.org/wallpaper/google-wallpapers-890866
http://www.berga-tech.com/2018/02/free-template-game-android-2d.html