# GROUP 5:
# NUCLEAR PANIC — A RADIOACTIVE PLATFORMING GAME

**Adrián Navarro Pérez**
University of Gothenburg
Spain
gusnavad@student.gu.se

**Alexia Dauvergne**
Chalmers University of Technology
France
alexia.dauvergne@edu.esiee.fr

**Christopher William Black**
University of Gothenburg
Germany
gusblackch@student.gu.se

**Jesper Jansson**
Chalmers University of Technology
Sweden
jespjan@student.chalmers.se

**Muhammad Ashar Imtiaz**
University of Gothenburg
Pakistan
gusimtiamu@student.gu.se

**Samuel Soutullo Sobral**
University of Gothenburg
Spain
gussoutsa@student.gu.se

## Abstract

As part of the Game Development Project course held during the academic 2019 Autumn term, a 2D scrolling platformer video game was developed for the Interaction Design and Game Design Exhibition (IDXPO) 2019 [1].

This game had to meet three main requirements in order to meet Universeum's expectations.

- The game should be designed to awake the interest in science of 12-16 years old children, even though everyone has to be able to enjoy the game.
- Showing the invisible: The game should be built around a topic which is not normally visible by using our 5 natural human senses.
- Scale: The size of the chosen topic should be either micro, human, or macro scale-based.

Meeting all 3 requirements, Nuclear Panic, a radioactive serious game experience was developed.

## Keywords

Platformer, Radiation, Game Design, Game Development, Video Game, Game, Unity, GarageBand, Visual Studio, C#, Paint.NET, GIMP, GitHub, ZenHub, Universeum, The Hub, IDXPO 2019, ISO 7010, Game Development Project, Invisible,

## 1 Introduction

Nuclear panic is a 2D endless runner scrolling platformer video game. In Nuclear Panic, players take control of a worker at a nuclear plant where a nuclear meltdown just occurred, which produced radioactive emissions. The character flees from this powerful, and lethal, source of radiation (Alpha radiation), while players have to avoid obstacles and hazardous elements, such as other kinds of radiation (Beta and Gamma), by jumping, or deciding not to jump, depending on each case.

Players will encounter 3 types of radiation throughout their escape, Alpha, Beta, and Gamma. Since radiation is invisible to human senses, the avatar has to put on a special pair of glasses which make radiation visible, at the cost of reducing their own eyesight of the surrounding environment, thereby showing the invisible.

Moreover, non-hazardous obstacles will be placed around the level that slow down the character and makes them be closer to the source of Alpha radiation which pursues the players at all times.

Finally, the goal of the game is to survive as much as possible to all these hazards, avoiding the worker's radiation personal levels to reach 10 Sv. The longer players survive, the better score they will get.

Parallel to the goal of the game, is the goal of the project, which aims to teach the children about some elements directly related to nuclear physics and its consequences in human's health:

- Warning signs and their meanings.
- How radiation is invisible and it can only be detected by using certain devices.
- How the consequences of radiation are not immediate and the danger associated to this: You can be exposed to radiation without knowing it, as radiation is invisible and their symptoms take a while to manifest.
- The real units that are used to measure the personal exposure to radiation (Sievert [Sv]) and the limit a standard human body can resist before it means their death (around 10 Sv). This is supported by a simplified representation of a dosimeter in the HUD, using a bar that is completely filled when it reaches the value of 10 Sv.
- The 3 types of different radiation and the comparison between them in terms of how dangerous they are for humans' health: Gamma < Beta < Alpha.

## 2 Project Management

The development used was based on some of the agile principles and tools such as:

- **Git & GitHub**: for version control, shared code on the cloud and backup.
- **Scrum board**: using ZenHub. To keep track of the tasks, their state (pending, in process, done, etc.) and their assignee.
- **Slack**: for communication, both among the group members and between group and supervisor (Mafalda).
- **Weekly meetings**: to keep track of the progress of the project in a more detailed way, plan the next steps, and make sure that all team members are working towards the same goals.
- **Supervisor meetings**: one meeting with Mafalda, one with Staffan, and another with Farshid. To get valuable feedback from experts.
- **User testing**: to make sure the overall gameplay experience on real players was the one intended during the design phase, and identify potential problems in this regard.
- **Brainstorming**: for ideation in early stages.

There are other techniques that were used during the development process, such as shared code ownership and pair programming, but this document is not intended to give an in-depth overview of such details.

## 3 Game Design

### 3.1 Gameplay Style and Genre

Out of the ideas generated, it was decided to develop the radiation platformer, which was then further developed to be an endless runner. This decision was made based on the restriction of the setting being an exhibition, where the visitors would not want to spend too much time on a single experience. Many people, especially the ones of our primary target audience, are familiar with the concepts of endless runner and platformer games, due to the mobile gaming market. This made it possible to build special features on top of the fundamentals, as most players would already be familiar with the basics.

### 3.2 MDA

The MDA model was used to design the game. [2]

#### 3.2.1 Mechanics
The main mechanics of the game are:

- **Jump**: jump allows to avoid obstacles and radiation, as well as reaching high platforms in the level.
- **Put/Remove glasses**: the special glasses that make radiation visible can be turned on or off willingly by the players
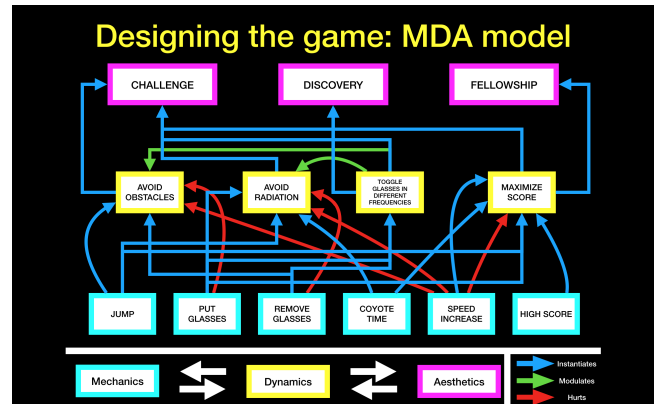


Figure 1: MDA Graph

However, there are other, not so obvious mechanics, that were implemented to create a more fair or satisfying gameplay:

- **Coyote time**: the player is able to jump 200 milliseconds after they leave a platform. Without this mechanic, players might sometimes feel that their input is lost when they jump near to edges of platforms.
- **Speed increase**: the character speed gradually increases during the gameplay, resulting on a game suitable for different skill levels.
  This speed increase consists of two parts. The first part is applied while the player score is lower than 100. During this period, the character moves slowly, and the speed is not increased. Then, the second part is applied, in which the velocity is linearly increased.
  Therefore, the player has enough time to learn the basics of the game before facing challenging situations. Then, just after they learnt and just before the gameplay becomes repetitive and boring, they start noticing an obvious increase on the speed of the character, and they realise that challenge is building up.
- **High Score**: one problem with infinite runner games is the lack of goals that ultimately the player has to reach. To palliate this problem, a high score system was implemented. With this, players would have a purpose for playing: trying to beat the current high score. Also, it makes the game more satisfying for competitive players.

#### 3.2.2 Dynamics

- **Avoid obstacles**: obstacles are parts of the level with which the player can collide. To avoid them properly, the player needs to remove the glasses to be able to see enough to react in time, and then jump.
- **Avoid radiation**: to avoid radiation, the player needs to put the glasses to be able to see it and then jump in some situations.

- **Toggle glasses in different frequencies**: since having the glasses off all the time does not allow the player to see the radiation, and having them on all the time prevents them from seeing all the environment, the player must toggle them in order to perform better in the game.
- **Maximize score**: given the fact that score measures how well the player performed in the game, and that there is a high-score counter, some players will try to maximize their score.

### 3.2.3  Aesthetics

- **Challenge** (game as obstacle course): as the character speed increases, and given the fact that they have to avoid obstacles and radiation, while toggling the glasses, with the goal of getting the maximum possible score, the game will become a challenge for some players.
- **Discovery** (game as uncharted territory): the player needs to find out where the radiation is. Initially, it is hidden. However using the glasses, it can be discovered.
- **Fellowship** (game as social framework): considering fellowship as having a community to which the player belongs and interacts with, having a high-score creates a competition among players, who try to beat each other.

## 3.3  Gameplay Design Patterns

During the design process gameplay design patterns as defined by Staffan Björk, Sus Lundgren and Jussi Holopainen [3] were also used. The gameplay design patterns used are marked as *italics* and are referenced on the Gameplay Design Patterns Wiki [4].

Nuclear Panic was designed as an *unwinnable single-player real-time game*. The player controls an *avatar*, *maneuvering* it through an endless progression of *levels*. Doing so the player accumulates a *score*.

The player is encouraged to play multiple runs, as the game is designed around *replayability*. As it is an *unwinnable game*, the player can never finish it and is always able to improve their *score*, with the highest score achieved displayed in a *high score list*. This promotes a feeling of competition between players, although it is just a *single-player game*. Another way *replayability* is increased is by facilitating *randomness* to create variety in the progression of *level* segments. The game provides constant *player agency* as the player can always use the *avatar's abilities*. These are used to *evade obstacles* and hazards to avoid *life penalties*. When taking too much *damage* or failing to *evade* lethal hazards, the player will face *death consequences* in form of a *game over* and in term a *setback penalty*, as the game has to be restarted.

Other patterns taken into consideration are *tension*, which increases as the game progresses and the speed picks up, *difficulty levels* to make the game more enjoyable for players with different experience levels and the *spectators*, as the quick gameplay should be appealing to watch and *spectators* can pick up information for their own run, in case they plan to play themselves.

## 3.4  Narrative Design

A worker of a nuclear plant is calmly working on their everyday job when suddenly a nuclear meltdown occurs due to a big explosion. Next, all the alarms start to ring as loud as they have never rung before. As soon as the worker realizes the current hazardous situation, they let everyone know about it, and when everyone has been alarmed, the former worker heads to an emergency exit. It is now when they start to run as fast as they can, as some radiation is already spreading due the nuclear meltdown.

## 3.5  Art Design

A cartoon-like style was used. The avatar of the game is based on an asset from the Unity Asset Store [5], but sprites and animations were adjusted to fit the setting and gameplay. Originally designed to be a man, the avatar was later modified to be more gender neutral so that more people can identify with it. The metallic platform sprites have been designed to create an urban industrial environment. Some details such as the warning tape, scratches or greenish spots have been added to create a dangerous dimension. The warning signs are replicas of the ISO 7010[6] signaling to add a real element the players can take away from the experience and recognise in the real world.

## 3.6  Level Design

When designing levels two challenges have been addressed:

- Players should not be able to memorize the levels. Otherwise, they would know where radiation is without using the glasses.
- The game should be suitable for everyone. Thus, the levels must not be frustrating for novice players, while at the same time not boring for experienced ones.

A possible solution for the first issue would be implementing a fully procedural level generator. However, it would be a task too complex considering the given development time. Consequently, an hybrid approach was used: a semi-procedural level generator. With this approach, level designers just need to create small mini-levels that are randomly arranged by the level generator to create a semi-random, infinite level. This level, is different on each gameplay session.

To tackle the second issue, the main philosophy was to keep the mini-levels simple. Also, a lot of these mini-levels are designed in such a way that making a mistake is not lethal, but just punishing. With this approach, the challenging gameplay would arise with the speed increase: the levels are easy when moving slowly, but hard when moving fast.

### 3.7 Sound design

A main theme an sound effects were composed.

(1) Background music (BGM):
  (a) Nuclear Panic main theme: by making use of synthesizers, some beats, and post-processing effects, an electronic-punk song was composed to match perfectly the experience the game provides.
(2) Sound effects (SFX):
  (a) Jumping sound: played every time the character jumps.
  (b) Landing sound: played every time the character lands.
  (c) Geiger counter Gamma sound: similar to a Geiger counter, this sound effect is reproduced when the character is under the influence of Gamma radiation.
  (d) Geiger counter Beta sound: close to the sound a Geiger counter emits but with more pitch than the aforementioned described, this sound effect is reproduced when the character is under the influence of Beta radiation.

## 4 Implementation

The implementation of this project required several steps. First, the base mechanics such as jumping and running were programmed. Then, the rest of the programming, the graphical assets creation and the sound design were made in parallel. Finally, when all scripts of the mechanics worked as intended and all graphical assets were created, the last part was to design the different levels.

The game was developed with the Unity[7] game engine with C# scripts written in Microsoft's Visual Studio[8]. Programming was the most time-consuming part of the project, thus it was essential to be able to work together on this part. Therefore, the use of a versioning tool, namely GitHub[9], was imperative.

The character comes from the Unity Asset store and it has been modified with GIMP[10], the platforms assets with Paint. NET[11] and the background, from the Unity Asset Store.

The sound design has been realized using GarageBand[12].

## 5 User Testing

User testing was conducted before the final session at Universeum. A class of students within our target audience were arranged to visit Universeum to test the different group's projects and provide feedback on them.

(1) It was noted that the first student to try the game faced difficulties to grasp the some of the mechanics. The next students did not experience this problem, as they observed their partner before playing. From this it was concluded that for first time players, the game might be a bit ambiguous to understand.
(2) It was noticed that while the students were playing, the less 'gaming experienced' students were facing trouble in keeping up with the level than the more skilled counter parts.
(3) It was observed that certain students were either very good at adapting to the mechanic of switching between the glasses or not. Others, did not familiarize with this mechanic and opted to either always play the game with the glasses on or off.
(4) On a positive note it was noted that the students reluctant to try within the group would certainly give the prototype a chance once they saw their classmates enjoying.
(5) From the game sessions of the students we concurred that there were certain points at the game that they did not understand how to utilize the controls provided, to them to maneuver through the level. For e.g when not to jump or jumping continuously.
(6) The detection was made that the area of visibility with the glasses equipped was very narrow and most of the students had trouble in operating within that.
(7) It was also noted that with a few students a recurring theme of them returning and trying out the prototype repeatedly. We think it was because of the challenge and competition we intended to provide the students.

### 5.1 Exhibition at Universeum

The final playtesting sessions were conducted at Universeum and the visiting public were to be the intended audience. The prototype presented during this session had been polished, addressing most if not all the points raised during user testing. An 'easy' mode was introduced to make players more familiar with the game mechanics, particularly the glasses. Visual aids were added to supplement and educate the players on when to equip the glasses and when to jump or not. Different types of radiations were labelled at the beginning of the level so the players could learn to distinguish between them. In order to test the more challenging players we added two more features. First, the running speed of the player was increased as the distance covered grew longer. Second, a high score system was implemented where the highest of scores would be displayed at all times providing bragging rights to the player who achieved that. This features certainly provided a challenge with the participants,

Furthermore, the game was supported by the construction of a booth at the exhibition. This included hazard tape as decoration and the people in charge wearing lab coats. This was done to attract attention, introduce the players to the theme of the game, and make the people in charge easily identifiable, to be addressed by people who might have questions. Additionally, a poster was displayed, which would give more detailed information about the setting and scientific facts.

However, there were some challenges also encountered. With our younger audience it was hard to relay to them the concept and point of the game as most of them were there to merely play a game. However, explanation of the aim of the game was provided to them while they were playing by us or sometimes with the help of their parents. It was noticed that most parents appreciated the theme and actively participated or encouraged the educational aim of the game either by explaining or observing the poster.

With the more older audience it was noted that they felt the game was not that much descriptive. They felt the game should have contained more details than just the basics. However, the intention was to provide the most basic fundamental points on radiation so that a seed of curiosity could be planted in the children's mind and they would be free to explore with renewed interest.

## 6   Ethical and Social Implications

The development of a game leaves the developers a responsibility of upholding certain ethical and social standards. In this project, most of these questions were handled at the start but inevitable new ones came up as time progressed. In the start it was clear that children were going to be using the product and therefore precautions regarding violence and potential horror experiences had to be made. This was made by excluding violent visual graphics as well as including more fictional sound effects while for example still using the realistic sound of the Geiger counter when exposed to radiation. The issue of the player experience the death of the character was deemed to fulfill the goal of showing the danger of radiation. The death of the character was regardless of the goal still brutal and was made to be more gentle by letting the character leave the screen and telling the player they lost the game.

When discussing whether the game should be supporting nuclear energy, it was decided that it would not. To make sure this was the case, the game is played out in an accident where a power plant has defected and the character is trying to escape the radiation. This lets the players get an insight of the experience of bad things happening if one would break. The way to get a high score in the game is to avoid radiation because it hurts the character and makes the player lose. This was partially done to give a negative view of radiation in the sense of it being dangerous for the health of the one in contact with it. According to the seventh Global Goal [13], it is important to produce clean and affordable energy. Nuclear power is cheap in connection to how much energy it produce and if it is clean or not is a big debate. It does produce waste that needs to be taken care of, yet it has less environmental impact than some other ways of producing energy. It was important to showcase the worst case scenario to spread awareness but let the users form their own opinions.

The game is made for single player only and is therefore impacting the players by isolating them from the real world and their peers. This can affect players who spend a lot of time on the game, since it reduce their time spent on social interaction. It is to some extend dismissed by the fact of the product being going to be used as an exhibition and not be played for more than a couple of minutes. The implementation to reduce time spent was to gradually increase the speed of the game to make it more difficult over time. This lead to players getting bored of the low speed in the start of the game after having a high speed in the end of the last run.

## 7   Conclusion

To conclude this report, the main objectives of the game were to raise awareness of radiation, to learn something new in the area and to have fun. This was achieved by putting the players in a situation dominated by radiation and where survival is pivotal. By doing this, the game provides the knowledge of radiation being dangerous and potentially even lethal. To improve the learning outcome, the game has several signs that do exist in real life. The signs are supposed to educate the players about what they mean, by showing them in similar situations. To make it easier for the players to learn anything at all, the game is designed to be "fun" by using various designing methods.

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