

GABLE: GAMification for a Better Life

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Abstract. This paper presents the European H2020 project GAMification for a Better Life - GABLE¹. The project aims at the development of a web platform for the creation of exergames and non-exergames for patients with cerebral palsy (CP). Game development process takes under consideration the motor and cognitive constraints of people with CP. The input device used to interact with the games is a balance board. The design of the games and their features are being performed in real testing scenarios within a co-creation process under the supervision of experts in rehabilitation of CP. The focus of the games in this platform is on social inclusion, by means of improving the physical activity of CP patients and through the use of multiplayer technologies.

1 Introduction

Cerebral Palsy (CP) is one of the most frequent causes of disability in childhood, with an incidence of 2 per 1,000 live births. This neurological disorder affects body movement, balance and posture and often is accompanied by cognitive or sensory impairments like mental retardation, deafness and vision problems. The severity of these problems varies widely, from very mild and subtle to very profound. But what most is affected by this disease, from the youngest age, is the ability to play.

Play is probably the main activity for any child. Through play, children start exploring their world, and put the basis of their own system of values, which will be the cornerstone of their adult life. Play in children with CP becomes difficult due to the disability, and this in turn can affect child's self-esteem. In addition, the sensory and motor problems experienced by children with CP affect how they interact with their surroundings, including the environment and other people. Youth affected by CP have fewer opportunities to participate in traditional games and exercises such as playing basketball, riding a bike or playing ball with their friends. The lack of exercise contributes to a cycle of deconditioning as youth with CP grow into adulthood, resulting in deteriorating physical functions, which will also negatively impact their opportunities for social interaction. Youth with CP have already been reported to have fewer social

¹ <https://projectgable.eu/>

experiences with peers than youth without abilities, due to the special requirements for their access and transportation.

In this context, video games, and in particular exergames, represent a very promising way to enable youths with CP to perform the exercise they need to break the cycle of deconditioning, while allowing them to socialize with others in fun ways from the comfort of their homes [1, 2]. Exergames are a combination of exercise and video games. In particular, we refer to digital games that require actions of large body parts (like trunk or upper or lower extremity, as compared with finger or hand movements in non-exergames) or the whole body to control gameplay. Reviews of exergames indicate that they have positive effects both on motivation for active participation in rehabilitation and on impaired functions. However, the design of these games can be challenging, if our goal is to help them socialize with others. First of all, limitations in physical abilities of youth with CP make it difficult for them to play many of the existing exergames. Second of all, there are challenges to social play such as establishing player groups and playing with players with different abilities that need special consideration. Looking at these problems, and taking into account the extensive expertise of the project consortium, we believe we can help.

GABLE project aims to create the first online video games service for youths with CP, which will be the hosting platform of games (exergames and non-exergames) focused on improving motor skills and visual-motor coordination for youths with CP. These games will leverage the latest advances in order to improve accessibility. The platform will be constructed with social networking in mind, which will allow parents, care givers and patients to socialize in a common environment, to share experiences and advice, in an effort to provide the best care for CP patients. Caregivers would also be able to share best practices and lessons learned among themselves, which will help them provide a better service across Europe and beyond. The focus of the games in this platform is on social inclusion, by means of improving the physical activity of CP patients, through the use of multiplayer technologies [3, 4].

2 System Overview

There is no universal games for motor or cognitive rehabilitation that can cater to all ages and all levels of disability. Thus, a set of games must be designed and customized according to specific needs required by the patients. The games built within the GABLE project are being developed in a co-creative environment in order to develop useful games for the patients. It is important to guarantee that the developed games keep motivated the users through simple but interactive game scenarios also that can be adapted to the individual patient's progress.

Specifically, instead of single player games, this project creates several multi-player games in which many patients play the same game. Depending on the scenario of the game, the playing could be done at the same time or different times. Using these multi-player games, patients will collaborate and compete in the same game scenario. This increases the social engagement of the patients.

Furthermore, not only the statistical information will be shown by the GABLE project, it will also provide a tool for predicting the behavior of patients while they

are playing games. More importantly, the GABLE project is equipped with a recommender system in which new games will be recommended for patients/caregivers after their taste is learned by the system. This means that a unique model will be learned for each person based on their choice of game and progress.

Machine learning techniques will be employed as an automated/manual balancing technique, to adjust the challenge of the game based on the player's ability, or based on the player's performance in previous games. On the other side, the scenario design process will centrally involve medical professionals, game designers, computer scientists, physical therapists, social workers, social studies professionals, parents and youth with CP. Scenarios will be focused on the abilities and limitations of each individual with CP within a population group, and all will provide social accessibility in online games.

The 2 most impactful areas of development have been chosen:

1. Using game design for gameplay accessibility, in order to develop games that youth with CP can enjoy.
2. Using game design for social accessibility, we will allow youths with CP to socially interact with peers through video games.

3 GABLE Games

The aim of the developed games is to foster the patients entertainment and also to contribute to their rehabilitation and social interaction. Exergames are a good way to perform rehabilitation through a funnier way. There are three different modalities for some of the games developed currently: single player mode, player vs. player mode (PVP) and cooperative mode (CO-OP). The games developed during the project will be released and distributed through the GABLE platform, which will be the channel for accessing the games and also the other different functionalities provided by the platform.

These games provide authoring tools to customize some game parameters, for example, the objects speed, the number of objects displayed in the scenario, sensitivity of the input device, etc. These game authoring tools will provide a set of features that will allow the caregiver or the system to tune the game according to the required specifications for each patient. These tools can be used in order to increase or reduce the complexity of the game scenarios according to the user's evolution. Brief descriptions of the games developed by the project consortium are presented below.

3.1 Paddle Waddle

Paddle Waddle is an exciting action game, where your objective is to keep balls in play and reach a higher game level. It features a great selection of power-ups. You compete against all other players to reach the world high score, and you also get rewarded for beating your own high score. Each time you reach a new level, the game increases the ball speed. The game features simple child friendly artwork, sound effects and music. (Fig. 1 shows some screenshots of the game).

3.2 Paddle Waddle Level Editor

The Paddle Waddle level editor allows you to set your own parameters for the game. You can control various settings such as ball speed and speed increase when reaching a new level. You can share the newly created level with your friends.



Fig. 1. Screenshots of Paddle Waddle and its level editor.

3.3 Woo's Wonderful World Adventure

Woo's Wonderful World Adventure is an action puzzle adventure game, where your objective is to take 'Woo The Cat' around the world rescuing your animal friends. Woo travels the world in his plane, going from country to country. Each country features beautiful artwork from the local culture, and has a unique child friendly puzzle Woo needs to solve, including freeing his captured and caged animal friends, clearing the dark skies currently being present in the country and more. You can also activate power-ups that will help you during the gameplay.

The game features, among other (learning) elements, a world map where Woo is flying from country to country, enabling the players to learn names and location of countries in the world. The artwork, sound effects and music are child friendly. The end

goal is to pass all the levels and liberate the world. (Fig. 2 shows some screenshots of the game).

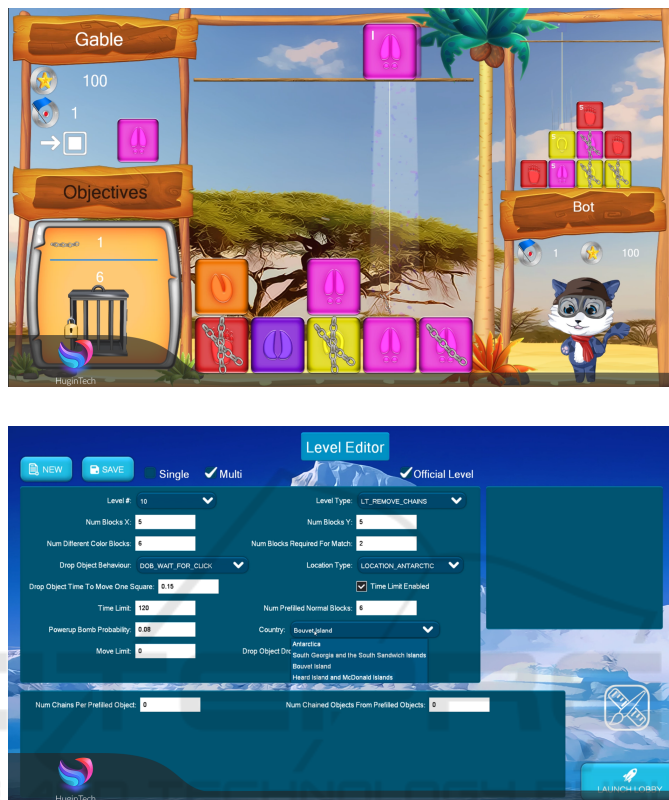


Fig. 2. Screenshots of Woo’s Wonderful World Adventure and its level editor.

3.4 Woo’s Wonderful World Adventure Level Editor

Woo’s Wonderful World Adventure Level Editor allows a user to create their own journey through the world. They can edit existing levels, or create brand new ones. The user can set up, among other things, which countries to travel to, which puzzles to complete, the goals that must be reached to complete a level. The user can then share their ‘world story’ with other users and have them play a game of their own making.

3.5 Hungry Woo

Hungry Woo is a game where the objective is to feed Hungry Woo. Woo travels the world eating his way through various countries and capitals. Woo must eat all the food and avoid things that are not edible. The game features a selection of power-ups, goals and a great selection of child friendly artwork related to the cultures that Woo is visiting. The sound effects and music has been created to be a good fit for children. The end goal

is to finish all levels, having eaten your way around the world. (Fig. 3 shows some screenshots of the game).

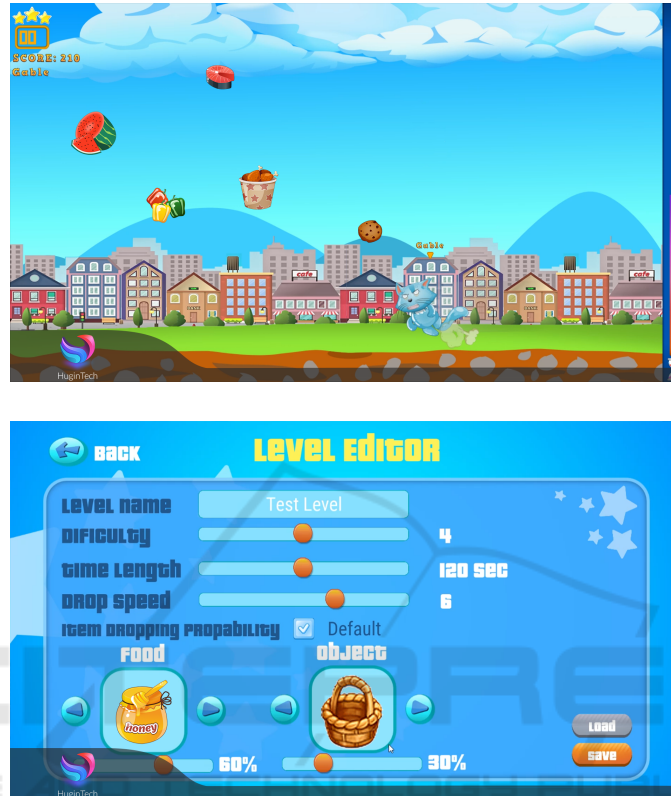


Fig. 3. Screenshots of Hungry Woo and its level editor.

3.6 Crazy Racing

The crazy racing game is a 3D-Racing game, where the objective is to race to the end of the track before the timer runs out. The development for Crazy Racing includes a Single Player Game, PvP Game and a Level Editor. (Fig. 4 shows a screenshot of the game).

3.7 Dynamic Balance Test Game

The Dynamic Balance Test Game allows to measure the possibility of the patient to shift his/her body weight (bend to the right – left) in a controlled manner. During the test patient stands on the balance board and has to bend to one side for a certain degree and keep this position for 3 second according to on screen instructions. After each successful attempt the next task is slightly more difficult, requiring more precise balancing. After each session the testing score is calculated representing patients balancing performance.



Fig. 4. Crazy Racing screenshot.



Fig. 5. Dynamic Balance Test Game.

3.8 Static Balance Test Game

The static balance game allows a user/caretaker/doctor to measure standing stability of a user. It is based on the “classical” measurement known as Stabilometry [5] or Posturography. The patient is standing still on the balance board for 20 seconds trying not to move. During this period the displacement of the center of pressure is measured and certain parameters are calculated.

4 GABLE Data Analysis

The system provides basic analysis to the caregivers and parents, who will be able to track the progress of the patients using games. The module analyses all data collected, and display statistical data on the types of games a patient has played, the progress s/he has made while playing a certain game repeatedly, etc. It will give an overall view of all the activity of the player, including game time, preference to a certain type of game, and will assist the caregiver in the active monitoring of a patient.

The GABLE platform collects information about users and their activities on every

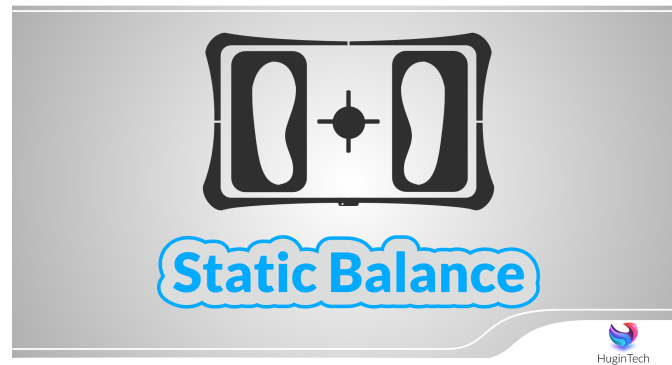


Fig. 6. Static Balance Test Game.

game. From a statistics perspective, social inclusion and education are latent variables of the data that are related to the game score. For example, a game that is mainly played using the body motions teaches the patients to improve their motor functions. Consequently, the game score of a patient is improved during time by playing this game, we can imply that the motor function of the patient is improved as well.

The data gathered from the games played by the patients and their progress within a game provide to the care givers recommendations on changing the difficulty level of a certain game, or recommend more challenging games.

A predictive module provides rating for each game, as a measure of how many patients are playing this game, or how high it was scored by the patients and other caregivers and parents. Using this rating system, the module can then recommend a certain game for a patient, or for the caregiver/parent. For instance, collaborative filtering [6, 7] can be used for this purpose.

5 Game Testing and Validation in a Real Environment

Currently, the GABLE system is being tested in real environments including the participation of people with CP, caregivers, etc., with the purpose of improving the games according to the feedback provided by them. GABLE consortium is engaged with the development of a useful exergaming platform that can be used by the patients to improve their quality of life. Experts health professionals contacted by the consortium are advising continuously the decisions in order to assure the development of useful games for the patient's rehabilitation.

6 Conclusion

Exergames have shown to be a good tool for the rehabilitation of patients with CP by taking advantage that most of the people enjoy playing interactive games with their peers. Thus, the adequate design of games for people with disabilities is a promising

way to improve the patient's quality of life and impact directly their wellness. Furthermore, the continuous co-creation process among all the stakeholders is a key element to achieve the final project objectives and hence its social impact.

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References

1. Burke, J., McNeill, M., Charles, D., and Morrow, P. Designing engaging, playable games for rehabilitation. *Proceedings of the 8th International Conference on Disability, Virtual Reality & Associated Technologies*, (2010), 195–201.
2. Göbel, S., Hardy, S., Wendel, V., Mehm, F., and Steinmetz, R. Serious games for health: personalized exergames. *Proceedings of the International Conference on Multimedia*, ACM (2010), 1663–1666
3. Howcroft, J., Fehlings, D., Wright, V., Zabjek, K., Andrysek, J., and Biddiss, E. A comparison of solo and multiplayer active videogame play in children with unilateral cerebral palsy. *Games for Health Journal* 1, 4 (2012), 287–293.
4. H. Cole, M.D. Griffiths, "Social Interactions in Massively Multiplayer Online Role-Playing Gamers", *Cyberpsychology & Behaviour*, vol. 10, no. 4 (2007)
5. The calculations of Stabilometry indicators been done according to the article Bonnechere, B., Jansen, B., Omelina, L., Sholukha, V., & Van Sint Jan, S. (2016). Validation of the balance board for clinical evaluation of balance during serious gaming rehabilitation exercises. *Telemedicine and e-Health*, 22(9), 709-717.
6. Xiaoyuan Su and Taghi M. Khoshgoftaar, "A Survey of Collaborative Filtering Techniques," *Advances in Artificial Intelligence*, vol. 2009, Article ID 421425, 19 pages, Hindawi, 2009. doi:10.1155/2009/421425
7. Christian Desrosiers and George Karypis, "A Comprehensive Survey of Neighborhood-based Recommendation Methods", *Recommender Systems Hand- book*, pp. 107-144, Springer, 2010, doi:10.1007/978-0-387-85820-34