CÁTEDRA SANTANDER · UA
TRANSFORMACIÓN DIGITAL
UNIVERSIDAD DE ALICANTE

Universitat d'Alacant
Universidad de Alicante

Training socially responsible engineers by developing accessible video games

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University's active social responsibility

- The obligation to act for the benefit of society at large
- Two perspectives:
  - Acting responsibly as institution
  - **Transferring this ethical duty to the students**, for instance by ensuring the social inclusion of any individual, no matter his or her circumstances ➔ **inclusion of disabled people**

Degree of Multimedia Engineering

- Objective of the degree: train professionals in the ICT sector to be able to direct and develop projects in the field of multimedia
- Two specialties:
  - Digital Creation and Entertainment: video games
  - Content Management: content management and dissemination
- The concepts of accessibility, usability, ergonomics, equality and professional responsibility are present in every subject and area of the curriculum

Objectives of the experience

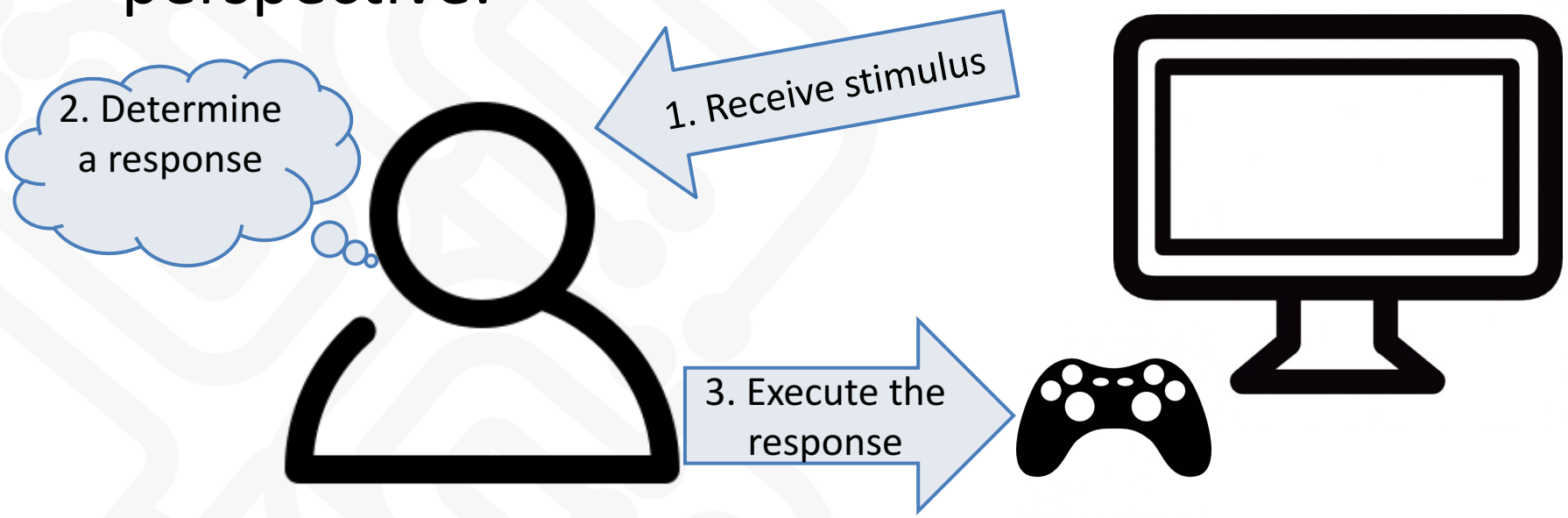
- Main objective: introducing social responsibility for achieving the social inclusion through the realization of the final degree project in collaboration with entities, institutions or associations of disabled users
- Particular objectives:
  - Training multimedia professionals in the social responsibility
  - Make disabled users participants in digital entertainment, since leisure is an essential human activity and an individual right
  - At the technical level, solving the interaction for users with cerebral palsy

Context: cerebral palsy

- Group of permanent non-progressive disorders of movement and posture, occurred during fetal or infant development
- Characterized by abnormal muscle tone, reflexes, or motor development and coordination
- Frequent symptoms of CP: spasticity, spasms, other involuntary movements, unsteady gait, balance problems, or decreased muscle mass

Context: Video games and disability

- Basic flow of a video game from the player's perspective:



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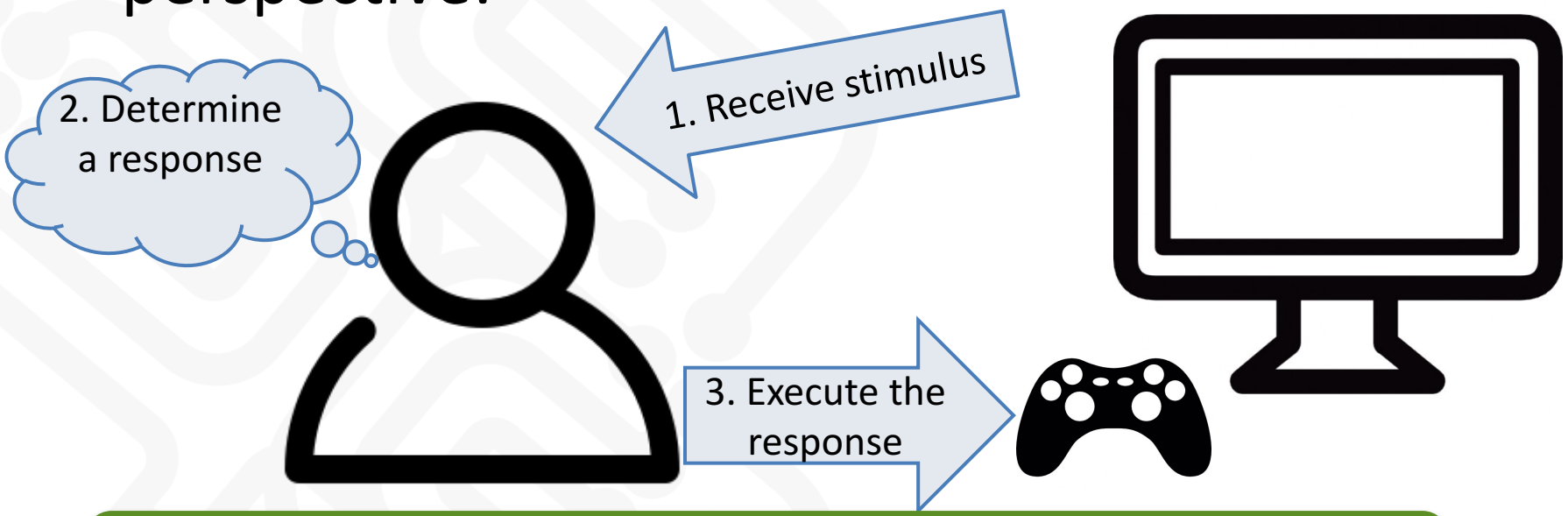


Making accessible a video game: giving support and offering options to allow this flow to run correctly to players with any limitation

Context: Video games and disability

- Adapting a video game to functional diversity in mobility

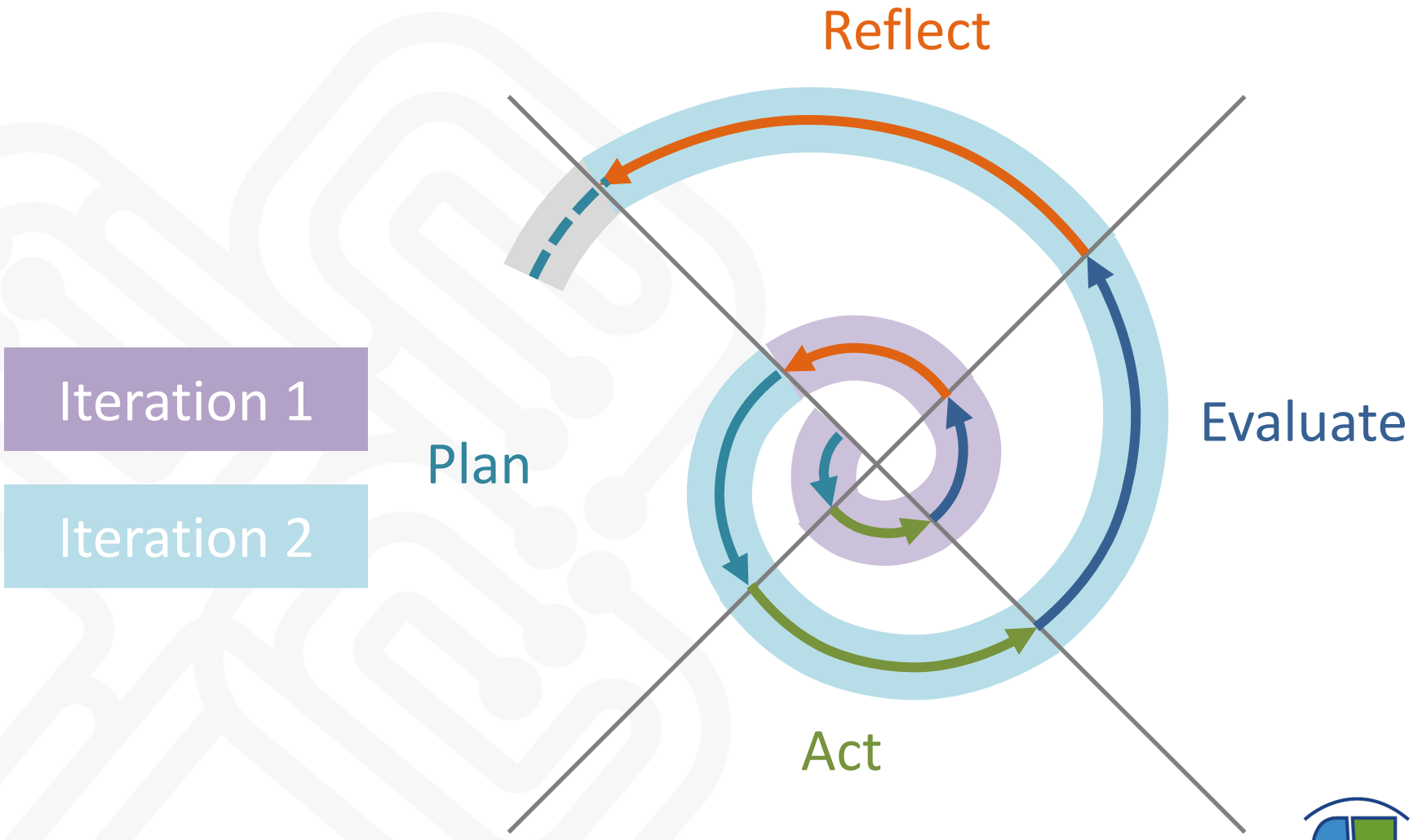
Access technologies

Mechanical switches
Infrared sensing
Microphones
Electromyography
Oculography
Computer vision
Brain-Computer Interfaces

Adaptation strategies

Control with one button
Control with one hand
Non-simultaneous buttons
Configurable control sensitivity
Configurable game speed
Various levels of difficulty
Control by voice or sounds

Methodology: Action Research



Results

- Collaboration with APCA (Association of Cerebral Palsy of Alicante)
- APCA offers care, advice, education, training and leisure to its associates
- Collaboration since 2013 to develop final degree projects for designing and developing accessible video games, adapted for users with cerebral palsy

First iteration: Footb-all

Plan

- Requirements
  - simple design
  - configurable (user profiles)
  - possibility to cancel an action
  - use of sweeps for navigation
  - emphasis when the action succeeds or fails
  - graphic support for textual elements
- Conceptual design
  - a series of football penalties
  - interaction using a mechanical switch (just to click)
  - selection of the parameters (direction and speed) using bar meters (sliders), with configurable speed
  - random variable representing the nervousness
  - ranking
  - extras: choosing teams, players and avatars

First iteration: Footb-all

- Implementation of the video game
- Iterative refinement of the prototype
- Three main parts in the game:
  - Configuration (player's profile, team and avatar)
  - Game (direction and speed of the ball)
  - Results (ranking)

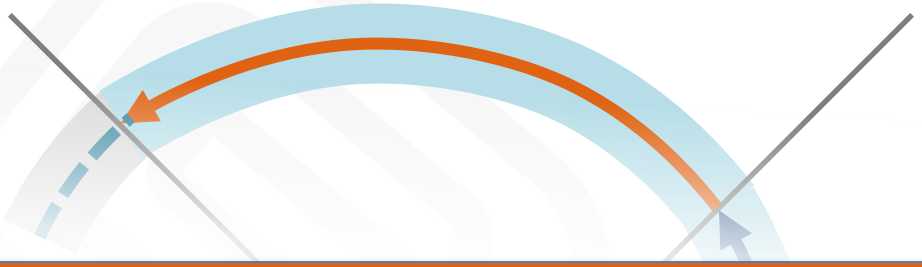
First iteration: Footb-all

- Determine the progress and make the necessary adjustments. Data from users, therapists, and implementation
- Opinion of final users and therapists:
  - game enhances the emotional well-being and the motivation for personal improvement
  - playing in a continued way favours strategic planning and perceptual abilities (spatio-temporal organization and physical response speed)
  - access to new technologies and competition is very attractive

Evaluate

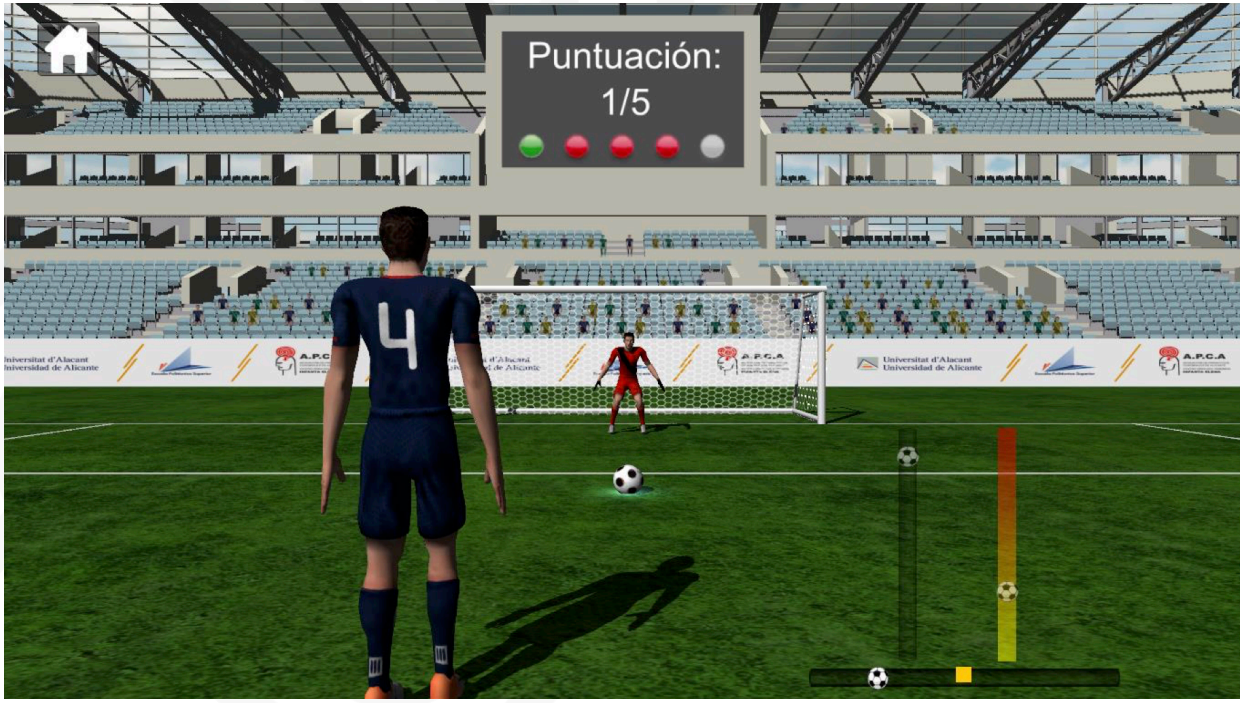
First iteration: Footb-all

Reflect



- The first iteration allowed us to
  - understand the problem of making video games accessible to users with cerebral palsy
  - identify the main strategies to reduce and adapt interaction
  - use simple interaction devices such as mechanical switches
- Improvement plan with two main objectives:
  - Explore new ways of interaction
  - Introduce characters which the player could identify with

First iteration: Footb-all



Second iteration: Formula Chair

- Objectives:
  - Maintain the main successful elements: sweep, profiles and ranking
  - Introduce a character and a context which the users could identify with
  - Incorporate a new interaction device to increase the range and variety of movements
- Conceptual design
  - A character infinitely moving in a three lanes scene
  - Coins and obstacles to be collected or avoided
  - Configurable extremity to interact : head, right arm, left arm, right leg or left leg
  - Capture of movement using Microsoft Kinect

Second iteration: Formula Chair

- Implementation of the video game
- Iterative refinement of the prototype
- Main milestones:
  - Start up and configure the interaction using the Kinect
  - Determine interaction: user profile and select extremity for interaction
  - Define the ranges of movement of the extremities

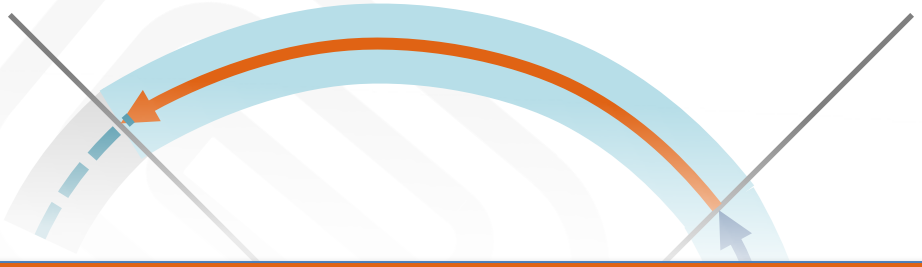
Second iteration: Formula Chair

- Opinion of therapists:
  - Possible method of physiotherapy to work with an extremity
  - It improves motivation
  - Configuration (speed, extremity and movement range) improves therapy possibilities
  - Capture to be improved (users in wheelchair)
- Opinion of users
  - They all liked it (a good tool for physiotherapy sessions)
  - Good opinion about APCA-UA collaboration
  - Some difficulties of use (limited movements)

Evaluate

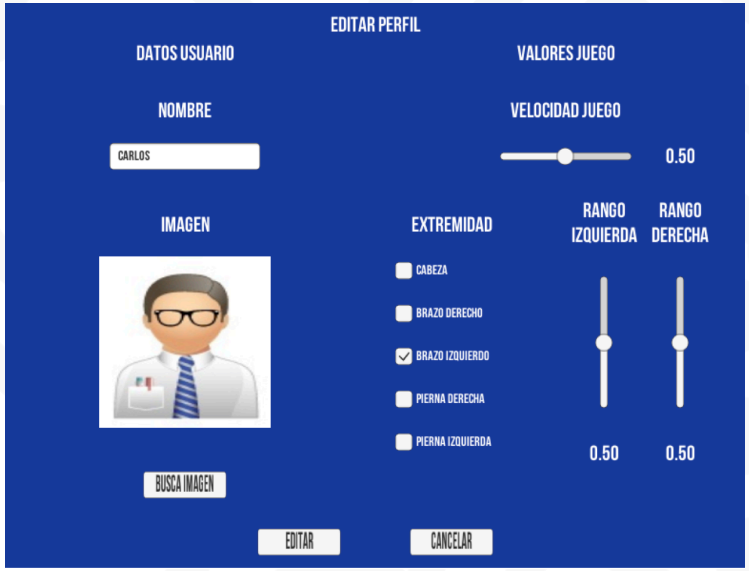
Second iteration: Formula Chair

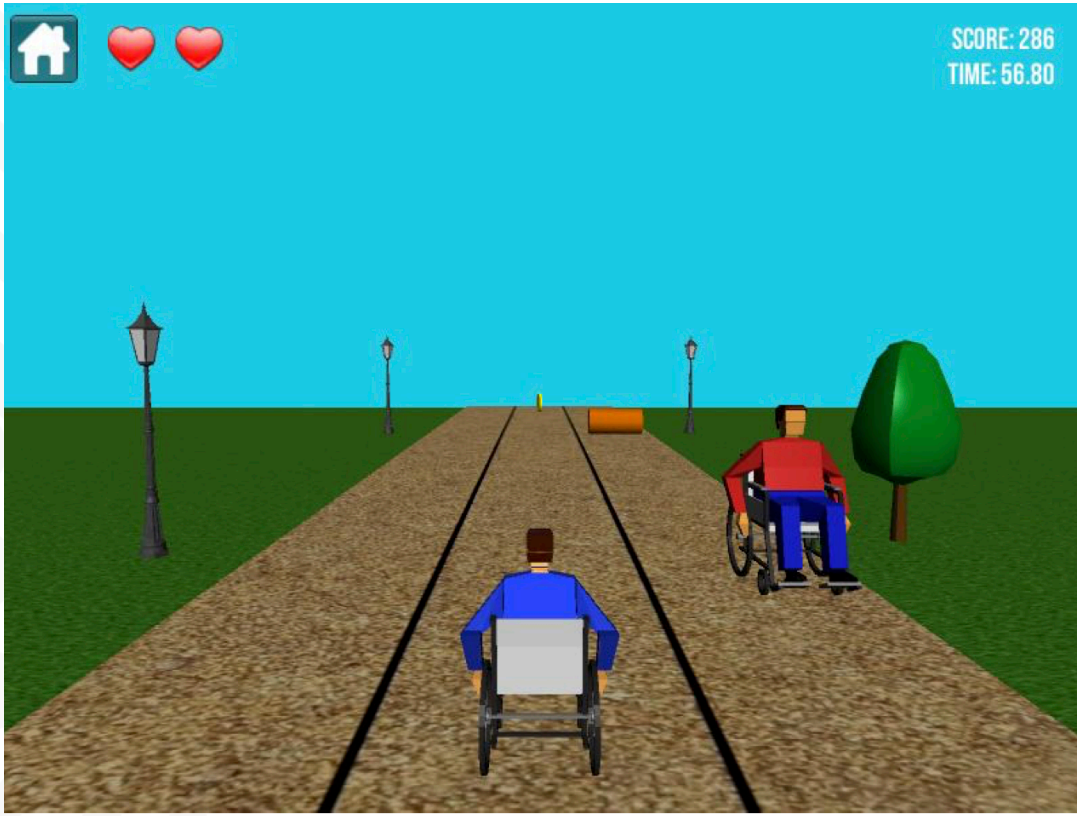
Reflect



- The second iteration allowed us to
  - Explore new interaction devices
  - Use the games as therapy tools
- Improvement plan with two main objectives:
  - Place the requirements of the physiotherapists in the centre of the design process
  - Balance fun and utility of the game as a physiotherapy tool

Second iteration: Formula Chair





Third iteration: Fisio Run

Plan

- Objectives:
  - Maintain the main successful elements: sweep, profiles, ranking, Kinect
  - Develop a video game that, besides being fun, has a therapeutic purpose
  - Include more complex movements
- Conceptual design
  - A character running while jumping and ducking to avoid the obstacles
  - Movement controlled by different parts of the player's body

Third iteration: Fisio Run

- Implementation of the video game
- Iterative refinement of the prototype
- Main features:
  - Scenario automatically created, infinite, with two types of random obstacles to avoid, by jumping or crouching
  - Two game modes: one and two players (competition)
  - Profile to configure: speed, extremities to interact and movement
  - Three types of actions: running, jumping and crouching

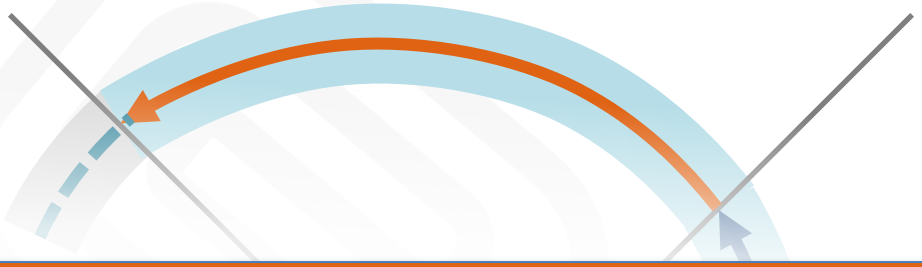
Third iteration: Fisio Run

- Data from users, therapists, and implementation
- Main conclusions about Kinect as interaction device:
  - Reduced cost and quite acceptable results
  - It leaves out certain users with a very low level of mobility
  - It has some problems when detecting users in a wheelchair
- Main conclusions about APCA-UA collaboration:
  - There is a need to establish stronger ties between APCA and UA to carry out new joint actions

Evaluate

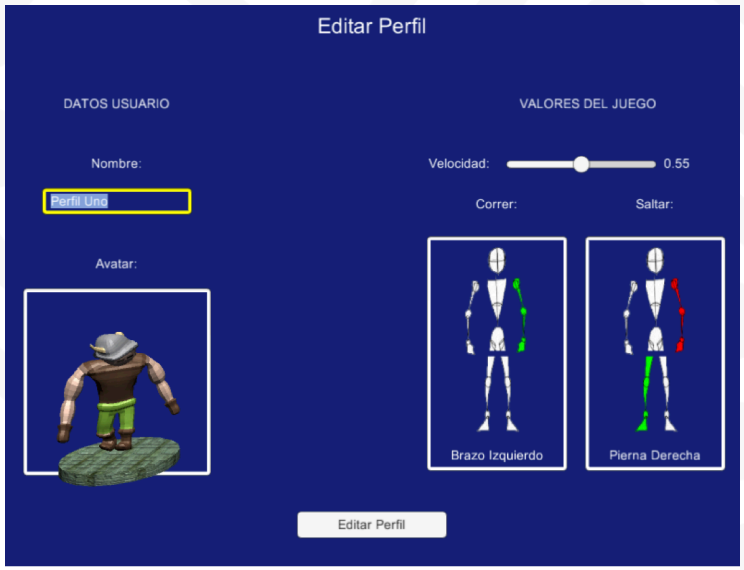
Third iteration: Fisio Run

Reflect



- The third iteration allowed us to
  - Strengthen the collaboration APCA-UA. However, a formal framework of collaboration is needed
  - Detect that Kinect must be complemented with other interaction devices
- Improvement plan with two main objectives:
  - Sign a formal agreement between APCA and UA
  - Explore the use of other interaction devices

Third iteration: Fisio Run



Fourth iteration: in process

- Sign a formal agreement between the institutions (done)
- Develop new games, exploring the new interaction devices
- Improve our dissemination actions by letting every development at the disposal of any other institution through the institutional platform of the university

Guide for adapting video games

- Strategies to improve adaptation:
  - Interaction reduction
  - Sweeping
  - Sliders and circular meters
  - Speed configuration
  - Special interaction devices
  - Simple game interface and graphics

Conclusions

- Social responsibility is effectively introduced in the curricula of engineers
- The incremental and agile methodology has been proved to be very suitable for this type of projects
- A preliminary guide for designing and developing adapted games has been obtained
- The collaboration with APCA allows the students to:
  - Know the problems of users affected with cerebral palsy
  - Strengthen the bonds with final users
  - Be aware of the need to give all people, regardless of their conditions, access to digital platforms and digital leisure
  - Study and design new ways of making video games accessible to disabled people

Future work

- Widen and strengthen the links UA-APCA and other associations of disabled users
- Introduce this iterative and incremental methodology of work in other curricula of IT Engineering
- Improve the diffusion of the results
- Explore other interaction devices
- Explore new ways of adapting the interaction to complete the guide and lessons learned about adapting video games to disabled users

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