

29 | EXERGAME CLOUD PLATFORM – DECOUPLING INPUT DEVICES FROM GAMES

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KEYWORDS

Exergaming, cloud, standardization, web-technology, health, sports

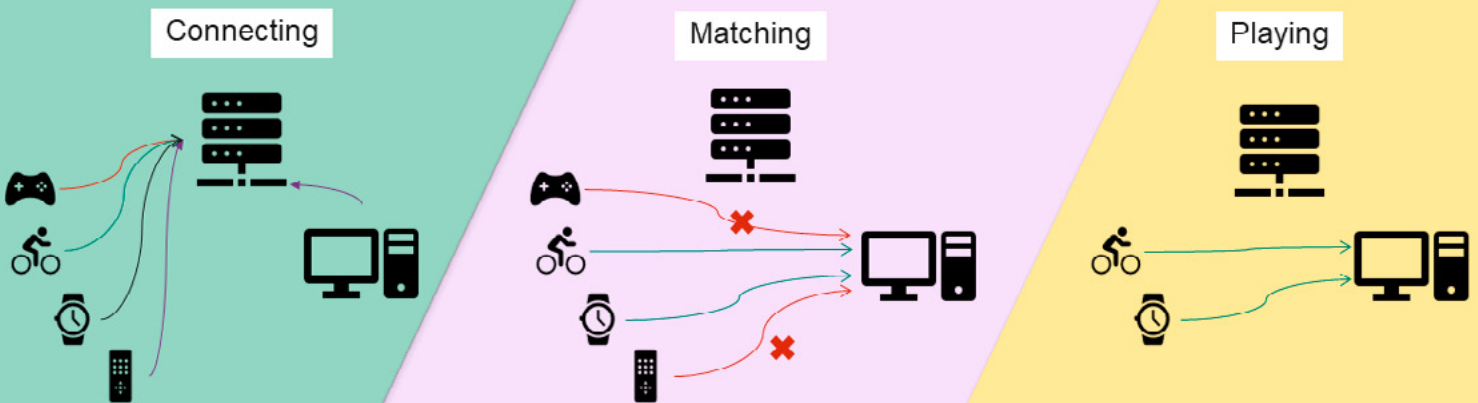
ABSTRACT

Exergames promote healthy behaviors by combining video games and physical exercise. Since such games and corresponding input devices are strongly interdependent, the development of exergames is challenging and costly.

We present an approach to abstract all actions of manifold input devices and to decouple exergames from devices. Three sophisticated games demonstrate the feasibility of our proposal. With our approach, developing exergames can be greatly democratized and expenses reduced.

“The Negotiator” has been primarily developed for future professional negotiators but also aims to bring these skills to the general public.

Device Server – Abstract





CONTEXT

Literature shows that exergaming can have a tremendous effect both at home and in therapeutic environments^[2]. However, the development of exergames today faces a fundamental hurdle: due to their nature, they are often coupled to a single (in many cases custom) input device, which makes their development, testing and operation expensive, and puts a limit on their availability, in therapeutic environments, sport facilities, and in homes.

Users need special hardware suitable for exergames, which explains this tight coupling between the devices and the games. This hardware is expensive and requires lengthy certification processes to be available in the market. At the same time, developing advanced games is a complicated and lengthy process. It takes vast knowledge and skills to develop compelling games and device manufacturers are not capable of following.

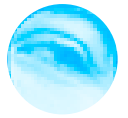
TARGETED ISSUE

The main barrier to developing exergames is the tight connection between the targeted devices and their games^[2]. This coupling requires developers to have access to (at least early) prototypes of the intended device to realistically test their game. In many cases, they need to implement auxiliary functions only for testing purposes which are later discarded.

This puts the device and game developers under pressure as they constantly must wait for progress of the other team. Both are required to work with assumptions, which may change later in the project.

Furthermore, tight coupling makes intercepting and collecting data for logging and analysis hard and sometimes ambiguous. It requires either the device or the game to have a special code to record data for later inspection.

By decoupling exergames from their input devices, we have really simplified developing exergames and custom devices.



PROPOSED SOLUTION

We propose a solution for decoupling exergames and their input devices. Our approach contains:

- a) an abstraction interface for all possible data from input devices
- b) a webserver, transparently managing connections between games and devices

The abstraction interface^[3] is an extension of the classification system developed by^[1]. The webserver uses industry standard technologies for an easy integration into existing projects.

When establishing a connection, a game announces its requirements, i.e. the types of data it needs to provide its services. Similarly, devices announce their capabilities, the kind of data they can provide. The server then performs a matching routine (either automatically or user-assisted) connecting the relevant requirements and capabilities. This is done through WebSockets following a publish/subscribe design pattern:

Notably, neither game nor device directly detect the other, they just send/receive data to/from a connection, allowing to easily replace and swap them with ease.

As neither game nor device are dependent on the other, teams can develop in isolation, should they wish to release a separate product, or team up and start development of both independently.

This greatly democratizes the development process for exergames and reduces expenses. Game developers can bring in their expertise without having to acquire expensive (and space-consuming) devices but can freely experiment with different game concepts.



RELEVANT INNOVATION

The common issue laid out previously show the need for an efficient, yet loose approach to connect various devices and games. We achieve by leveraging common Web-technologies and combining them with an interface specifically tailored to the needs of exergames.

While prior development approaches require tremendous efforts, our decoupling approach provides several advantages:

- › An exergame is longer restricted to one input device and can receive data from any number of devices through data channels. This allows enables games to be played simultaneously by multiple users simply by connecting several devices for different inputs.
- › Through the interface definition, communication between hardware and software teams becomes easier since the discussion between the teams is only about the interface type each component needs to implement. Specifics are left to the individual teams.
- › Input devices can be swapped even during runtime, which allows therapists to change the input-device on the fly, giving them enormous flexibility in their work.

PROJECT OUTCOMES & RESULTS

To demonstrate the feasibility of our concept, we implemented three device-independent games:

- › A kayak game designed to show tap inputs, where the user floats down a river.
- › A marble labyrinth where the player must direct a marble to a destination while avoiding holes in the ground.
- › A bike game where the user pedals through a semi-realistic environment.

These games were created to test the integration of the server infrastructure as well as to create better libraries to support game developers. They used various game engines and frameworks (namely Unity, Godot and MonoGame).

By using these self-implemented games, we have demonstrated the easy integration of different input devices and modalities:

- › Ant+ is a protocol developed by Garmin and used in a variety of devices such as sport watches, smart trainers and other wearables.
- › XInput, originally developed for the Xbox 360, is an API that has become the de-facto standard on all Windows devices.
- › A smartphone app transmitting several sensor values (gyro, accelerometer, buttons, etc.) for android.
- › Dance Pads, providing 8-directional input by stepping.

For these devices we wrote a separate gateway that showed how simple and quick the integration of new devices is. These gateways range from separate (windows) processes to native apps on smartphones.

A demonstrational video for this system can be found in [\[4\]](#).



CONCLUSION

By decoupling exergames from their input devices, we have really simplified developing exergames and custom devices. As neither game nor device are dependent on each other, we developed devices and games in isolation, simplifying testing and iterating.

Thanks to our decoupling approach, trying out new input devices requires only a minor reconfiguration instead of major code changes, making experimenting easier. We thus expect quicker iteration times for further exergame development.

PERSPECTIVES & NEEDS

The newly introduced decoupling interface needs to be promoted by allowing developers to engage and implement new games and devices that are compatible. We plan to encourage developers of exergames and corresponding input devices to further test and disseminate our platform.

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