# “Generic Shooter 3000”: A Realistic First Person Shooter Powered By Biofeedback

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## Abstract
“Generic Shooter 3000” is a First-Person shooter with semi-realistic interaction, where actions such as firing a gun or diving through underwater sections are performed with your own body- through the use of biofeedback technology. This prototype is the idealised version of a research game developed for a master's thesis project on “biofeedback interaction in video games”.

## Author Keywords
Biofeedback game design; direct multimodal biofeedback; physiological control.

## ACM Classification Keywords
K.8.0 [Personal Computing]: Games; H.5.2 [Information Interfaces and Presentation]: User Interfaces; H.1.2 [Models and Principles]: User/Machine Systems - *Human Factors*

## General Terms
Measurement, Design, Experimentation, Human Factors.

## Introduction
“Generic Shooter 3000” is a prototype of a first person shooter where all in-game actions are portrayed as closely as possible to reality, by using the player's entire body as input to the game.

Instead of relying solely on the well-known keyboard and mouse devices (used for movement, aiming and shooting), players are also connected to a biofeedback device which captures their body data over time. This allows the game to recognise even the smallest body movements of the player and to trigger appropriate actions inside the game, such as influencing gun recoil while firing, when players contract their arm or hold their breath. A second example is to simulate underwater diving when players hold their breath.

*Biofeedback interaction*
In the context of video games and Human-Computer Interaction, biofeedback is the process of capturing a player's physiological data and using it to modify the behaviour of a game. Here, we use direct biofeedback, where players manipulate *intentionally* their body to perform an action inside the game: for example, closing their hand to grab an object or to open a door.

This work is mostly inspired by the interaction potential demonstrated by previous research-based games using biofeedback [1, 3]. The idea was to bring the player as close as possible to the game, and making them "feel" what the game character is facing at the moment. We believe that biofeedback is the ideal technology to implement such design, and attempted to do so using the following equipment:

**Respiration sensor (RESP).** Worn by players around their chest, it is used to approximate the amount of air held in wearer's lungs.

**Temperature sensor (TEMP).** Attached to a headset worn by the player, it is activated in the game by blowing air on it.

**Electromyography sensors (EMG).** Used can be used to know if a muscle is contracted or relaxed.

**Glove tracker (GLOVE).** Monitors the position and bending of each finger, and can be used to detect different hand poses.

## Game Concept

In our test scenario, which takes place at a dungeon, the player has to make way through enemies inside the building and retrieve three gold keys in order to escape. Enemies are equipped with guns and have basic *shoot-and-pursuit* AI. The player can run, jump, crouch and use two combat guns, along with a Physics Gun to move heavy objects. All the remaining actions make use of the biofeedback interaction.

**Gun Recoil Control**. While players are firing at enemies, aim can be stabilised by contracting the arm and by breathing in a small amount of air - making for a close simulation of "good posture" while firing a gun. The RESP sensor and an EMG sensor placed on the player's arm are used here.

**Underwater Breathing**. To dive underwater, players will have to sustain breath as if diving in real life (using the RESP sensor). This is one of the mechanics that we wanted to test with real players, as it provides a great impact on the overall game experience.

**Sprinting**. Players can run for a short period of time by raising one of their heels (or both), activating the leg muscles both inside and outside of the game. These are connected to 2x EMG sensors.

**Invisibility**. This is activated by combining two actions. Players have to close their fist (using the GLOVE) to

gather magical power and breathe in using the RESP sensor, becoming instantly invisible to enemies. They will remain invisible as long as they sustain breath or until the power runs out.

**Possession**. Here, players are allowed to control an enemy while leaving their own body behind, and vulnerable to other enemies in the vicinity. This is activated by performing a special hand pose (using the GLOVE) and *whisper their soul out of their body* (using the TEMP sensor) - taking control of the enemy's body.

**Fire Blow**. Currently, the player can interact with fire objects by blowing out through the temperature sensor. Depending on the intensity/size of the fire object, they may need to gather air first using the RESP sensor.

**Usable Objects**. Players can use levers, buttons or items can be used or equipped by closing their fist (using the tracker glove).

**Grab/Move Objects**. Occasionally, players will find obstacles represented by physics-based objects. These are meant to be moved with the Physics Gun. Players move them by closing their fist (the same as "Use objects"). Depending on the weight of the object, they may need to use more strength by contracting the arm equipped with the EMG sensor.

## Biofeedback Interaction - Empirical Study

It is our belief that direct biofeedback games can leverage multimodal biofeedback - the use of multiple sensors contributing to one game mechanic - and open up the possibilities to combine different inputs in creative ways, rather than constraining game designers too much when attempting to give "meaning" to a single input sensor. In the scope of the original master's thesis project [2], it was our initial intention to introduce this concept in research, as well as to study the pros and cons of placing this design into practice (versus standard games and unimodal biofeedback games).

32 players who play games regularly were recruited to test three distinct versions of our game (no biofeedback, unimodal, multimodal biofeedback) and to evaluate each one using both objective (Fun, Ease of Use, Originality) and subjective measures (associating keywords with each version and open-ended commentaries). A repeated-measures experimental design was employed using the three versions as the within subjects factor. From the entire set of results presented in the full study [2], we discuss here those which we consider most relevant to the current state of the game: Fun, Ease of Use, and a reflection on the different game experiences provided by the three interaction types.

Overall in terms of Fun, both biofeedback versions were considered more fun than the "no biofeedback" version. Informally, a good game presents challenges to the player and allows he/she to master new abilities in order to overcome those challenges. In this case, players can effectively enjoy the challenge of experimenting with new technologies and dominating them in a game. The obtained results confirm the potential to use of this technology in video games.

Regarding Ease of Use, the "no biofeedback version" was considered the easier to use when compared to its biofeedback counterparts (the latter were still rated positively in the "easy" range). This poses no surprise as despite very simplistic, the current devices produce great satisfaction in players by allowing them to express themselves with little effort. Instead, Ease of Use was measured to ensure that the biofeedback controls were

not an obstacle for players and allowed them to enjoy the game and positively express themselves. Steve Swink describes this as part of the larger concept of *Game Feel* [4]. For immersion and a positive game feel to exist, the game needs to have quality controls that are able to deliver fun to players.

Although the idea of direct multimodal biofeedback did not exist previously in research, we consider that multimodal biofeedback is not the definitive solution to the problem of creating engaging games using this technology. Instead, the key is to balance both unimodal and multimodal types to achieve a strong design.

## Target Audience

Based on the feedback that we got from the players and the data that we collected [2], we believe that **this game is best targeted at players who enjoy games focused on exploration and interaction with the surrounding environment**. With the current technology, players are able to see and hear aesthetically pleasant environments in games - and also manipulate them, to a certain degree, using the traditional gamepads and mouse/keyboards. Using biofeedback, players have the chance to experience the same environments using an unexplored dimension, where their physiological characteristics can play a role in the game as well.

Lastly, based on the feedback provided by two of our players, direct biofeedback might not be appropriate for highly competitive games. This is because although easy to use after a while, may prove difficult to be fully mastered, as there are more input variables to be controlled. Current shooter games require from players a certain degree of eye-hand coordination to aim perfectly, and "game intelligence" so they know exactly when and where they should take action in order to win. The added dimension of physical control can make this task more difficult and become a source of frustration for some players. Additionally, they may feel tired due to the repeated use of their body.

## Credits and Acknowledgements

The gameplay footage demonstrating our game can be seen at https://vimeo.com/104439652. All credits regarding the original map design and 3D modelled objects of the dungeon map goes to Chris Holden.[1] The biofeedback prototype was developed using Unreal Development Kit. With the exception of the pre-made scripting code that ships with the engine, all code was written by our development team.

## References

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[4] Swink, S. *Game Feel*. Morgan Kaufmann, 2009.

[1] Permission was given by the author to use the map in both the original master's thesis project and to submit this biofeedback prototype to the "Student Game Design Competition". The original map can be accessed at http://www.chrisholden.net/05.htm.