VIF: Virtual Interactive Fiction (with a twist)

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Figure 2: The Oculus Rift DK1 HMD[a] is combined with Neuroelecronics Enobio EEG cap[b] and OpenBCI amplifier[c] to both immerse and monitor user's brain activity.

[a] https://www.oculus.com/
[b] http://www.neuroelectrics.com/
[c] http://www.openbci.com/

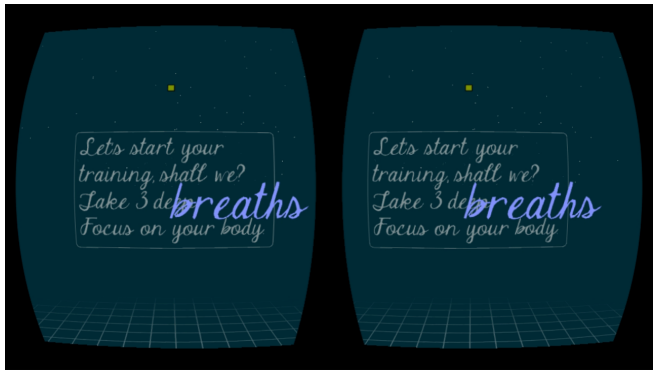

Figure 1: View of the virtual environment. Part of the text is dynamically mapped to player's physiology, such signals also influence the narrative.

Abstract
Nowadays computer science can create digital worlds that deeply immerse users; it can also process in real time brain activity to infer their inner states. What marvels can we achieve with such technologies? Go back to displaying text. And unfold a story that follows and molds users as never before.

Author Keywords
Storytelling; Physiological Computing; Brain-Computer Interface; Adaptive Systems; Virtual Reality

ACM Classification Keywords
H.1.2 [User/Machine Systems]: Human information processing; H.5.1 [Multimedia Information System]: Artificial, augmented, and virtual realities

Introduction
On the one hand, we have devices that are more than ever capable to create a variety of illusions and to draw attention up to the point that users will forget about the real world – the notion of virtual presence [12]. The paragons of such devices are probably at this moment head-mounted displays (HMD), that, *literally*, replace what people see with a virtual world – so called virtual reality (VR). Combined with headphones, the reality gets obliterated for most[1].

[1] Even though the focus is here on textual stories with (optional) ambient sounds, any other combination of input modalities – e.g. narrate a story and display (optional) colors – is of course suitable.

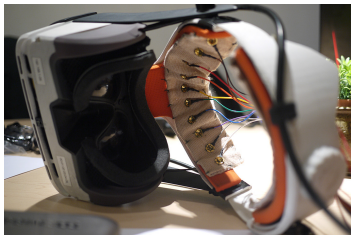

Figure 3: Prototype of a HMD device that directly embeds EEG electrodes – here a Vrvana Totem[a]. Picture © Alexandre Girardeau.

[a] http://www.vrvana.com/

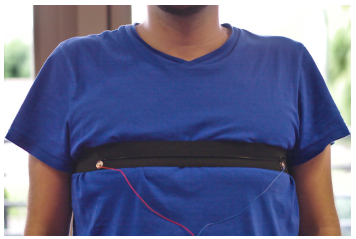

Figure 4: Various sensors could be integrated, e.g. a belt that measures breathing. From [5].

Figure 5: Users can interact with text elements in a more traditional way, using their gaze.

On the other hand, physiological computing is mature enough to asses mental states and emotions [3]. In particular, mobile brain imaging techniques alike electroencephalography (EEG) can be employed to measure a variety of constructs such as workload or attention; cognitive processes that were harder to monitor in the past [4]. Physiological sensors are not restricted to the laboratory, nowadays they can be used the field through carefully crafted wearables, e.g. [5]. These technologies make computers *comprehend* users [11].

On the *other* other hand, is lying interactive fiction (IF), stories that depend on the actions of the readers/players[2], a genre that is gaining increased attention from outside its original community [8]. The form of IF evolved from choice-based adventure games to complex generative systems that can narrate a living world [7]. Besides advances in natural language processing, IF attracted new game-makers thanks to writing tools – based on markup languages or graphical programming – easier to handle[3].

Putting hands back together, physiological sensors and brain computer interfaces could be added to the repertoire of IF makers in order to craft more resonating stories, that can both adapt and react to players. A narrative branch could be generated based on the (past) affect of the user, in order to favor or avoid an emotion. The events or the phrasing could be driven by the attentional state of the user to increase comprehension and seek a state of flow. Even more involving and pervasive, the user could be asked to perform breathing exercises and get actually relaxed before starting an adventure in a gloomy dungeon – a journey of initiation for the wannabe warrior that will echo within the reader.

[2] In the present document I consider a broad definition of IF, that encompasses both Choose-Your-Own-Adventure (CYOA) games and games where users have to actually type text to interact.

[3] One could find a variety of commented IF works on https://emshort.wordpress.com/.

While rich inputs derived from physiology are already investigated with traditional video games [10, 9], the “form factor” of IF should ease the integration of these modalities to the fabric of the story. Indeed, readers are used to filling the gaps between ellipses or suggested details; through their imagination they seize the content and make it their own. To change the mood of a scene, whereas a AAA video game will have to smoothly adapt assets that where expensive to build in the first place, a writer will lightly tune the right adjective. Simple and seamless.

Far from being a trendy gimmick, the use of HMD and VR let readers focus entirely on the text, preventing stimuli external to the narrative to reach them and distract them from the story[4]. The simplicity of the scene will hopefully reduce perceptual load, freeing more cognitive resources to let them build their own representations, increasing engagement. At the same time, HMD could be used to design simple game mechanisms based on gaze and head tracking, yet another input modality for readers to *physically* interact with IF (see System Description below).

First and foremost, this technology is really a mean to put upfront one medium that shaped for ages humanity [1]. If the word is mightier than the tools, now it shall be exalted by computer science to help twist our minds for the better.

Description of the system

This section describes a proof of concept that implements a basic set of features to support the ideas discussed previously. The program and its source code are available on https://github.com/jfrey-xx/vif.

[4] Resulting in an *immersive* book indeed.

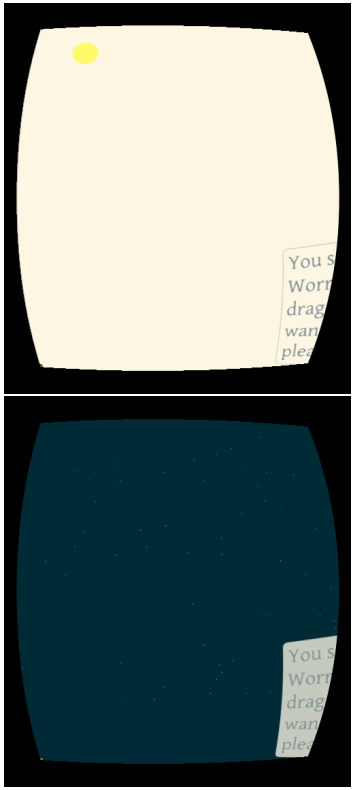

Figure 6: Besides text, graphical elements are kept minimal. The environment serves purposes, e.g. to give a sense of time or a sense of orientation.

```
#+ACTIVATE: start

* Narrator                                  :@north:#default:%medium:

  * start
    # This is a comment. No actual sensors plugged for video recording
    (sorry!), instead we fake stress.
    timer:1000:goto-stress
    Howdy, Adventurer!

  * no stress
    You look good! Ready to begin your journey?

  * stress
    You seem tensed. Worried about the dragons, maybe... Do you want to
    relax? pick:goto-send_to_bob:Yes, please. pick:goto-no_stress:No I'm
    good.

  * send to bob
    timer:2000:goto-bob_awaits
    I'll leave you in Mr. Zen's hands. He's just /behind/.

* Bob Zen                                   :@south:#bob:%medium:

  * bob awaits
    visible:goto-training
    I'm Bob.

  * training
    eq-breathVar,3:goto-heart
    Let's start your training, shall we? Take 3 deep
    bind-breath-breathstyle:inc-breathVar:breaths. Focus on your body.

  * heart
    Good. Now try to feel your bind-heart-heartstyle::heartbeat.
```

Figure 7: Game-makers / writers can use their favorite text editor and a markup language to create new content.

Rendering
The graphics are kept simple on purpose. As an emanation of IF – even in 3D and in stereoscopy – the virtual world is mostly composed of text blocks. Generative typography and colors can impersonate the narrator or characters. They can also be used to give a biofeedback – e.g. “your heart *beat*” could pulse toward the camera and change color along each heartbeat (Figure 1) – depending on the control or awareness given to users (see also [5]).

Other graphical elements are present, but only to fulfill particular functions. A grid on the floor gives a sense of position in space. The day/night cycle has two purposes: to give a sense of orientation (the trajectory of the sun gives cardinal directions) and to give a sense of time (Figure 6).

Interaction
The main contribution comes from the events that can be triggered depending on the physiology and on the mental state of the players – e.g. three deep breaths, getting relaxed, . . . However, alike choice-based adventures, players can also select explicitly interactive chunks of words – e.g. “open the box” / “feed the box to my pony”. They use their gaze to do so (Figure 5).

Time passing by can be measured to drive the narration and the text could change accordingly to the time of the day – e.g. wolves are obviously out at night.

The virtual world surrounding players, the text can be positioned at various places, both related to the orientation of the player or to cardinal directions (e.g. “behind”, “North”). Then the field of view of the player can be taken into account in order to show or hide text blocks based on what is seen (Figure 8). Sentences that could creep from behind: ideal for an horror novel.

Sensors
Wearables such as belts measuring breathing (Figure 4) or smartwatches measuring heart rate can be plugged to the system. However, since players are already equipped with HMD, this latter piece of hardware can be used at the same time to embed sensors. For instance, thanks to affordable hardware coming from the DIY movement, a (very) early prototype of a HMD with integrated EEG electrodes was crafted to measure brain activity (Figure 3). Regular EEG caps could also be combined with HMD (Figure 2). Eventually, a whole array of physiological measures may be inferred directly from a device placed on the head – see, e.g. [6].

Writing 101
Game-makers with a background in programming can suit the engine behind VIF to their needs, for example add new typographic effects. However, for regular users that simply wish to create new content, a text parser based on a markup language has been implemented (Figure 7).

Beyond: going social
Since communications between the game engine and physiological measures rely on a network protocol, it would be trivial to share and sync data between multiple instances of the system. Doing so would extend the system with multiplayer elements. Several in-game characters could then be personified by others users – the states and choices of everyone influencing the overall story –; direct or intimate interactions that could deeply connect players, help them share an experience.

Inspirations

The idea of using processed physiological signals as a pervasive element roots to the affective computing movement [11], even though since these debuts the spectrum of available measures has widened beyond emotions through physiological computing [3] and neuroadaptive technologies [13].

Figure 8: Events can occur depending on what players see and on texts' position, resulting in emerging game mechanisms that are physically involving.

My personal (re)discovery of the IF genre comes from the productions of the Inkle Studios[5]. Whereas I could not achieve a CYOA book when I was a child, their clever games designs kept me engaged throughout the stories, giving a clue on how to hook readers. Later on I found interesting perspectives on the whys and hows we may rely so much on stories within the preliminary chapters of [1], Bruno Bettelheim's book describing how significant fairy tales could be during child development.

However, these cornerstones are a mere *retcon* of what aroused my interest for interactive and adaptive fictions in the first place. All started as it should, with a story within a story. In Ender's Game[2], Orson Scott Card describes how a RPG-like video game used by the military to monitor young recruits' mental health is "hijacked" by an alien race in order to reach out for the hero and plead for empathy[6].

Superpowers

As per workshop requirement, few lines about my abilities. During my PhD I started to explore how physiological computing can contribute to human-computer interaction and foster new communication channels among people. In particular, I have been using EEG and machine learning to measure constructs such as workload, comfort or attention – dimensions of the user experience that I was able to grasp thanks to my background in cognitive science. With hacking spells, I helped to craft sensors more practical to use in the field, an opportunity to investigate multi-users scenarios and playful contexts. I also participated in the development of novel physiological feedback, that could be integrated seamlessly to the physical surroundings through spatial augmented reality and tangible user interfaces. Science-fiction reader at night to fetch ideas, daydreamer to create new ones, I am not afraid to get my hands dirty to implement them, more eager to do so when they sound crazy or stupid, even when I have already too many projects running for my own good. In the end I seek to use computer science as a mean to enhance well-being and facilitate human relationships on the whole. Mandatory website: http://phd.jfrey.info/.

[5] http://www.inklestudios.com/

[6] Note that novel's background is itself a (too) serious game.

Acknowledgements

After months toying with the idea, I finally had the opportunity (and the liberty!) to implement a first version of this project while I was visiting the MuSAE Lab in late 2015, under the kind supervision of Tiago H. Falk. During my stay in Montreal, the HMD+EEG cocktail would never have come to life without the vivid Breathe@Work crew that gathered during the Hacking Health event, and for *that* to happen, I was lucky to meet two wonderful communities there, namely NeuroTechX and Highway 101. Since VIF is but a spin-off of the Tobe toolkit, I shall not to forget my usual co-authors [5]. Finally, Joan Sol Roo is the one who made me realize the connection with Ender's Game, that explained it all.

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