

## Chapter 8

# Automating Pain Reduction Using Biosensors and Realtime Adaptive VR

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### ABSTRACT

*Recent years have seen digital game mediums taking conventional amusement, entertainment, and leisure industries by storm. They have revolutionized the system to the extent that the industry cannot now even dream of doing without this overwhelming reality. The same game mediums that have capitalized on intrinsic leisure aspects have simultaneously focused with equal vigour on other equally, if not more, important collateral objectives. This chapter builds on this concept and discusses work currently being carried out at the University of Malta. The research brings together various concepts synonymous with the field of artificial intelligence and automation to propose the use of games as a means of distraction therapy for individuals undergoing painful clinical treatment procedures.*

### INTRODUCTION

Pain is perhaps the most universal of medical complaints. However, it is the nature of pain that makes it both exciting and challenging to counter and handle. Many people deal with physical pain in their daily lives, and this pain can range from mild to excruciating, leaving significant marks on an individual's life. As of 2014, pain medications were the third most written prescriptions in the U.S alone, and few pain prescription drugs achieve acceptable pain relief in more than 50% of treated patients (Wiederhold et. al. 2014). Pain treatment, although necessary for survival, is often the cause of anxiety and severe distress. Also, painful procedures of treatment for any source of pain can make life difficult for patients who have to endure the recommended regimes.

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Treatment of pain in individuals has made significant strides forward. The shift away from opioid-based treatment has led researchers to look at other approaches to help people cope with pain. In 1983, Pearce (Pearce, 1983) discussed the potential of cognitive methods as a solution to the problem of managing pain. Pearce does so, given evidence from studies of experimental pain that cognitive factors such as predictability and control that influence the perceived intensity or distress of pain stimuli. Pearce's study was further corroborated by research into Distraction Therapy. Distraction is the process of shifting attention away from something. Distraction therapy, therefore, can be described as an interventional tool that is used to refocus attention from pain to a pleasant sensory stimulus (Siegele, 1974). The idea of refocusing attention from pain to a pleasant sensory stimulus has led recent research to highlighted digital games as a potential means of administering distraction therapy.

There is an ever-growing realization that the power games have to engage and motivate individuals to accomplish specific tasks is by far more attractive than that of any other medium previously explored. This ability to engage individuals provides a platform to gain experiences that go far beyond the expectation of what one had come to expect from games for decades. Furthermore, the introduction of new technologies such as Virtual Reality has continued to add to these engagement capabilities and in turn, established new areas where the application of such technologies can be beneficial.

This study aims to take what has been done already in the field of patient care, distraction therapy and virtual reality to the next level through Artificial Intelligence (AI). Through the addition of AI concepts such as Affective Computing, we envisage the creation of a game that can autonomously adapt itself to the affective state of the individual, and provide a personalized experience that distracts him or her from the pain symptoms resulting from painful treatment procedures.

The upcoming sections present research critical to the study and the methodology to reach the desired final objectives.

## **BACKGROUND**

The adoption of Virtual Reality as a coping mechanism for patients receiving painful treatment procedures is not new by any means. Researchers have looked at the adoption of VR based applications as coping mechanisms in burn wound care, physical therapy, chemotherapy, dental procedures and in cases of prolonged hospital visits. For example, the efficacy of VR distraction for reducing pain associated with burn wounds has been investigated amongst others by Hoffman et al. (Hoffman et. al, 2008). Burn wound care is considered to be among the most painful medical procedures. Treatment of severe burn injuries often includes repeated sessions during which bandages are removed, dead tissue is washed away, and new bandages put on. Hoffman et al. put eleven burn patients with burn severe enough to require hospitalization in a virtual environment called "SnowWorld". The "SnowWorld" virtual environment places individuals in a scenario where they are gliding down an icy canyon and could throw snowballs to snowmen, igloos, robots and penguins. Results showed that ratings of worst pain, pain unpleasantness and time spent thinking about pain were significantly lower for patients using the VR distraction tool.

The application of Virtual Reality as a pain reduction tool has also looked at helping patients during port access and intravenous placement procedures. The procedure of inserting an intravenous catheter is one of the most frequent acts for children in hospitals and is considered to be one of the most painful experiences. Children tend to refuse to cooperate in these situations, which result in both psychological and physical suffering due to a significant reduction in successful venipuncture. Although the port access

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