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Abstract

The neuroregulator system in humans controls organ and system functioning. This system comprises a set of neural centres that are distributed along the spinal cord and act independently together with their nerve interconnections. The centres involved in this task were isolated in previous studies through investigations of the functioning and composition of the neuroregulator system of the lower urinary tract to elucidate their individual performances and enable the creation of a general neuroregulator system model capable of operating at the neuronal level. Although the long-term goal of our research is the development of a system on chip (SoC) capable of behaving as a fully programmable neuroregulator system, this work is another step in which we test the viability of the hardware design of one of these neuroregulator centres (specifically the cortical-diencephalic centre) to achieve a first prototype and architectural proposal. To this end, the behaviour of this centre has been isolated, a hardware design implemented on FPGA has been proposed to create a prototype, a simulation environment has been built for the evaluation, and finally, the results have been analysed. This system verified that the functional behaviour corresponded to the expected behaviour in humans and that the operational requirements for the implementation were technically and architecturally viable.

Keywords

Neuroregulator system, Hardware Design, FPGA, Cortical Diencephalic Centre

1. Introduction

Currently, there are many diseases for which innovated solutions using technological systems are adopted to resolve, monitor, correct or modulate organ or subsystem dysfunctions. At present, one of the strategies adopted to solve these problems is the creation of embedded hardware devices that can be implanted into humans to correct dysfunctions [1, 2]. This strategy has already yielded promising results for a wide variety of problems [3, 4, 5].

In the human body, one of the most complex and sensitive systems is the neuroregulator system because its operation is not yet fully understood and it is difficult to study while it is working without causing damage. However, there are studies that address this subsystem and its dysfunctions, such as [4], in which the author describes the design and implementation of a reconfigurable hardware with an architecture capable of emulating cellular neural networks in real time to correct any disorders of the nervous system, or [6], in which the development of an