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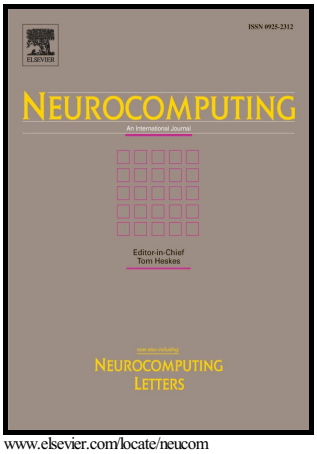

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Abstract Memristor is a nanoscale electronic device that exhibits the synaptic characteristics in artificial neural network. Some valuable memristor-based synaptic circuits have been presented. However, the circuitry implementations of some simple neural network are still rarely involved before. This paper contributes to construct a novel memristive Hopfield neural network circuit. On one hand, an improved memristor bridge circuit is employed to realize synaptic operation which better performs zero, positive and negative synaptic weights without requiring any switches and inverters, and Pspice implementation scheme is also considered. On the other hand, the proposed bridge circuit greatly simplifies the structure of neural network, and reduces the conversion process between current and voltage signal. Furthermore, the associative memory in binary and color images is demonstrated on the basis of the proposed memristive network. A series of numerical simulations are designed to verify associative memory capability, and experimental results demonstrate the effectiveness of the proposed neural network via the cases of single-associative memory and multi-associative memory.

Keywords: Memristor; Neural network; Associative memory; Memristor bridge circuit; Synaptic weight

1. Introduction

In recent years, neural networks and neuro-dynamics have been extensively investigated, which have a variety of applications in information processing, data storage and associative memory [1-6]. Especially, new network architectures are required to understand the biological brain and human memory. The Hopfield network has received significant attention in various fields since Hopfield proposed the model in 1980s [7-9]. It has a well-known demonstrated capability of solving the travelling salesman problem and the location allocation problem [10-11]. But the conventional Hopfield network was realized by constructing metal-oxide-semiconductor transistors as electronic synapses [12]. It was confronting several obstacles, especially in artificial neural synapses.

In 1971, Chua predicted the fourth basic circuit element and he theoretically postulated the definition of the memristor [13]. In 2008, William and his team at HP labs demonstrated the existence of the new nanoscale electronic component, so it immediately aroused people's great interest [14]. An increasing number of people have applied the characteristics of the memristor to some potential research fields [15-21].For instance, many researches demonstrated that the memristor and synapses shared extremely similar characteristics in the aspect that the memristance

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