04/2023 (12)

ISSN: 2395-1680 (ONLINE)
DOI: 10.21917/ijme.2023.0260

AN IMPROVISED METHOD TO SECURE SENSE AMPLIFIER USING MACHINE LEARNING ASSISTED MEMRISTORS

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Abstract

The rapid development of memristor technology gives hope for a solution to both issues since it promises to enhance the capabilities of electronics beyond what CMOS technology can provide on its own and makes it possible to implement unconventional computer designs. In this paper, we present a novel sensing amplifier that possesses unwavering consistency. The proposed sensory amplifier makes use of a Machine Learning Assisted Memristor (MLAM) circuit to reliably recreate the same values as the original randomly generated keys, despite variations in noise, supply voltage, and temperature. When compared to the other available topologies, the recommended sensory amplifier uses an amplifier structure to provide a quick response time and good traits of originality and unpredictability.

Keywords:

Amplifier, Machine Learning, Memristors, Sense, CMOS

1. INTRODUCTION

The current CMOS technology could one day approach its physical limit, it has been proposed that additional devices should be incorporated into the technology. Research into alternative computing paradigms such as neuromorphic computing has been sparked in part by the requirement to circumvent the data scalability restrictions imposed by traditional von Neumann systems. The rapid development of memristor technology gives hope for a solution to both issues since it promises to enhance the capabilities of electronics beyond what CMOS can provide on its own and makes it possible to implement unconventional computer designs [1].

A non-volatile solid-state device that uses copper-tungsten oxide and can modify its resistance in response to an applied writing current is a typical example of this type of memory. The HP lab was the first in 2008 to connect the concept of a memristor to a non-volatile resistive switching device with a layered structure consisting of Pt-TiO2-Pt [2].

Since that time, interest in memristors among the scientific community has only increased, and there have been reports of memristors based on a very wide variety of materials. Memristors offer intriguing prospects for usage in a wide variety of applications [3] due to their nonvolatility, minuscule feature size (down to 2nm), low power consumption, and compatibility with CMOS technology, enabling monolithic integration.

The memristor possesses several fascinating advantages, one of the most intriguing of which is the ability to switch between a variety of states. Because a single memristor has the potential to replace many transistors while still carrying out the same logic function [4], exploiting the multi-state property of memristors in next-generation electronics has emerged as a key focus of research since 2008 logic function [5], exploiting the multi-state property of memristors in next-generation electronics has emerged as a key focus of research since 2008.

The challenges that multi-state memristors still face include, but are not limited to, retention deterioration, vulnerability, device-to-device variations, cycle-to-cycle changes, process voltage temperature (PVT) variations, inaccurate modelling, complex control logic and excitation circuits, and many more.

1.1 MEMRISTOR

In recent years, a wide variety of nanodevices have been successfully manufactured and distributed. These brand new nanodevices include carbon nanotubes, graphene, quantum dots, spin-torque transfer devices, phase-change electronics, and metal-oxide memristors [6].

As a result of the unique qualities they possess, metal-oxide memristors will serve as the key building blocks for our security primitives in this undertaking. In [7], Leon Chua was the first to suggest the idea of a memristor, sometimes known as a memory resistor.

This ground-breaking work by Chua demonstrated the link $M(q)$ between charge q and flux φ, which made it possible for the device resistance to vary with time and the electric field.

The value of a memristor memristance is denoted by the parameter $M(q)$, which is measured in ohms. Memristance is calculated by taking the integrals of the current and voltage as they pass through the device from the beginning of time to the present. The memristor behaves in the same manner as a conventional resistor at any given time, with the exception that its memristance is defined by its complete history [8].

Memristors can be created by stacking a layer of TiO2X that has oxygen vacancies on top of a layer of TiO2 that does not have such vacancies and then sandwiching the stack between two metallic electrodes. This creates the conditions necessary for the memristor to function.

In memristors, there is the possibility of either a high resistance state (HRS) or a low resistance state (LRS). To carry out a SET operation, in which a memristor is switched from the HRS to the LRS, it is necessary to supply a voltage bias that has the appropriate polarity and magnitude, denoted by the notation VSET. A device that is in the LRS can be reset and brought back into the HRS by giving a lower voltage, which is referred to as VRESET [9].

If the voltage or current that is being supplied is lowered, then different resistance states will become accessible. Some recently manufactured memristors behave more like resistors than they do like toggle switches when subjected to the normal toggle voltages.