MEMRISTOR.... SAY GOOD BYE TO BACKUP
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Abstract: Just think a situation, when you are doing some urgent work on your laptop which has no backup and one of your friend suddenly comes and shut down your power supply right now - no saving, no quitting, nothing. You'd to lose your work, of course. But if your laptop were built using a memory based on Memristor, your screen would return to life with everything exactly as you left it: no lengthy reboot, no half-dozen auto-recovered files. The device about which I am talking, is to build the memristor which Instead of storing data as charge, stores it as resistance and Whose interstitial material is titanium dioxide.

Keywords: D-RAM, R-RAM, FPGA, NVRAM, RAM

I. Introduction

This paper presents a brief review about the recent advanced technology concepts in the field of the 4th element, called as the memristor, which has the properties of R, L & C. Traditionally, there have been three different basic components to circuits, namely capacitors, resistors, and inducers. However, a new basic element to a circuit has been developed. This element is known as the memristor. A memristor is essentially a resistor with memory. The resistance of a memristor is dependent upon the amount of voltage which has been applied to it and the length of time this voltage was applied. The concept of a memristor was first developed in 1971. However, it was not until recently that researchers at HP Labs were able to build the first working one. This is due mostly to the size dependence of the memristor. The changes in resistance of a memristor are not detectable until the memristor is in the nanometer range. When the thickness of the memristor is larger than this, it is indistinguishable from a standard resistor. The main advantage of the memristor in modern computing is that it retains its resistance even when no voltage is applied. This would allow a computer to retain its saved state while off and would require less power to run when it is on.

Memristor is a simple word derived from “memory resistor,” because that is exactly its function: to remember its history.

Figure 1 Memristor

Computers using conventional D-RAM lack the ability to retain information once they are turned off. When power is restored to a D-RAM-based computer, a slow, energy-consuming "boot-up" process is necessary to retrieve data stored on a magnetic disk required to run the system. Memristor-based computers wouldn't require that process, using less power and possibly increasing system resiliency and reliability. But here's the really interesting thing about a memristor: Whatever its past state, or resistance, it freezes that state until another voltage is applied to
change it. Maintaining that state requires no power. That's different from a dynamic RAM cell, which requires regular charge to maintain its state.

II. PAST:

Prof. Chua proved a number of theorems to show that there was a ‘missing’ two-terminal circuit element from the family of “fundamental” passive devices: resistor, capacitor and inductor, for e.g., elements that do not add energy to a circuit.

Figure 2 Discovery of memristor

He discovered a missing link in the pair wise mathematical equations that relate the four circuit quantities - charge, current, voltage, and magnetic flux - to one another.

III. GENERAL FUNCTION

The crucial issue for memristance is that the device' atoms need to change location when voltage is applied, and that happens much more easily at the nanoscale. Think of a resistor as a pipe through which water flows. The water is electric charge. If charge flows in one direction through a circuit, the resistance of that component of the circuit will increase, and if charge flows in the opposite direction in the circuit, the resistance will decrease. If the flow of charge is stopped by turning off the applied voltage, the component will ‘remember’ the last resistance that it had, and when the flow of charge starts again the resistance of the circuit will be what it was when it was last active.

IV. CONSTRUCTION

Physically, a memristor is just an oxide junction between two perpendicular metal wires. The generic memristor can be thought of as a nanosize sandwich—the bread is the intersection of the two crossing wires. Between the "bread" slices is an oxide; charge-carrying bubbles of oxygen move through that oxide and can be pushed up and down through the material to determine the state—the last resistance—across the memristor. This resistance state is what freezes when the power is cut the important thing to recall is that the memristor "state". Memristor typically contain metal oxide sandwiched between metal wires. An applied voltage makes the normally resistive material more conductive, an effect that can be reversed by flipping the voltage bias. The architecture of memristor circuit may be a hash of perpendicular wires known as a crossbar array, in which the Memristor is sandwiched between the crossing points. In memristor, the interstitial material is titanium dioxide. The crossbar is an array of perpendicular wires. Anywhere two wires cross, they are connected by a switch. To connect a horizontal wire to a vertical wire at any point on the grid; you must close the switch between them. The idea was to open and close these switches by applying voltages to the ends of the wires.

V. ACTUAL FUNCTIONING

The exotic molecule monolayer in the middle of the sandwich had nothing to do with the actual switching. Instead, what it did was control the flow of oxygen from the platinum dioxide into the titanium to produce the fairly uniform layers of TiO2 and TiO2-x.
The key to the switching was this bilayer of the two different titanium dioxides. The TiO2 is electrically insulating (actually a semiconductor), but the TiO2-x is conductive, because its oxygen vacancies are donors of electrons, which makes the vacancies themselves positively charged, they can be pushed up and down at will in the titanium dioxide material because they are electrically charged. If a positive voltage is applied to the top electrode of the device, it will repel the (also positive) oxygen vacancies in the TiO2-x layer down into the pure TiO2 layer. That turns the TiO2 layer into TiO2-x and makes it conductive, thus turning the device on. A negative voltage has the opposite effect: the vacancies are attracted upward and back out of the TiO2 and thus the thickness of the TiO2 layer increases and the device turns off. This switching polarity is what we had been seeing for years but had been unable to explain. The memristance did not actually involve magnetism in this case; the integral over the voltage reflected how far the dopants had moved and thus how much the resistance of the device had changed.

VI. APPLICATION

NVRAM: It stands for non-volatile random access memory. In its initial state, a crossbar memory has only open switches, and no information is stored. But once you start closing switches, you can store vast amounts of information compactly and efficiently.

FPGA’s: Memristor could vastly improve one type of processing circuit, called a field-programmable gate array, or FPGA. By replacing several specific transistors with a crossbar of Memristor, we showed that the circuit could be shrunk by nearly a factor of 10 in area and improved in terms of its speed relative to power-consumption performance.

ANALOG PARALLEL COMPS: Low-cost, low-energy-consuming computers that are much better suited to parallel processing are required to analyze, model, and diagnose many of the toughest problems — like global warming. These Memristor can be turned into “integrated circuits that remember information, consume far less power than existing devices, and may someday learn from past behavior. An analog computer is a computational device in which the problem variables are represented as continuous, varying physical quantities.

VII. EXPECTATIONS

So our coming generation seeks to eventually replace both flash and DRAM with the new device called Memristor or RRAM (resistors random access memory). The problem is that DRAM makers have been cramming more memory onto less real estate. So our new concern is about using Memristor which instead of storing data as charge, RRAM stores it as resistance. RRAM, in which an amount of resistance represents a bit, is a promising alternative to flash and DRAM. It relies that Memristor devices that switch their resistance depending on the direction of voltage applied and hold this resistance when the power is off. They are also faster and consume less energy by a factor of hundreds when switching a bit. Some time these Memristor can also be called zero-capacitor RAM, or Z-RAM. Z-RAM, unlike DRAM, doesn’t require a capacitor, so the we can estimates that the new design will be 25 to 30 percent cheaper.
Our goal is to have a product that will have at least twice as many bytes as a flash memory with the same chip size. Right now, about half of the total power used by DRAM is static power. But memristor which is a competitor to DRAM would not dissipate static power just to keep the bits refreshed. So we should have a factor of two total power advantages. This is because it roughly doubles the storage capacity of those storage mediums, while keeping the price the same Memristor memory chips promise to run at least 10 times faster and use 10 times less power than an equivalent Flash memory chip.

VIII. DRAWBACKS

Because of its size of nano range it is little difficult to manufacture.

IX. CONCLUSIONS

This paper presented a brief review of the recent advanced technologies that lead to the development of the element, viz., the memristor & its wide-spread applications which has the potential to shake up the technological industry.

X. References

