A new computer theory

Jian Sun, *Member, IEEE,*

Abstract

In the current development of computers, the underlying principle of traditional binary computers—which recognize only two states, 0 and 1—lags behind that of quantum computers in terms of basic computational logic. This paper proposes a computer storage and computation method in which each unit can theoretically recognize and store an infinite number of values, and presents a technically feasible solution for practical implementation.

Index Terms

Computer, Computer System, Calculation Method

I. Introduction

The paper proposes a theoretically novel computational and storage method at the hardware level, aimed at improving computational speed and reducing operational complexity.

II. Principles of mathematics

In computer computation, the fundamental operations are based on binary calculations and binary storage, utilizing high and low voltage levels for both storage and computation. In this paper, both storage enhancement and computation speed improvement rely on the absolute precise control of voltage. Theoretically, by dividing a voltage range of 0-5V into numerous intervals to represent computational numbers for use in computers, each interval represents a specific value. The more precisely these intervals can be divided, the more values can be represented. This approach can exponentially enhance both the computational speed and storage capacity of traditional computer systems. If such voltage control can be absolutely precise, any complex basic operation can be reduced to a single computation. Additionally, storage capacity can be transformed into a single storage unit capable of holding arbitrary values. Data can be stored by precisely charging and discharging the storage unit's capacitor to store voltage values. The division of intervals depends on two factors: the precision of voltage control and the stability of voltage signal transmission, which involves signal integrity.

III. Principle of computer

A. Adder

The basic architecture of a computer system consists of adders and other supporting logic circuits for arithmetic operations. To realize the underlying computation of the proposed method, redesigning a full-adder logic circuit is of paramount importance. In theory, precise voltage control is essential; we assume that such precise control is achievable. Then the voltage value no longer represents '1' as a high level and '0' as a low level. Instead, each voltage within a set of divided voltage intervals represents a distinct numeric value. The design of addition becomes simpler: two voltages are equivalent to two voltage sources; connecting them in series in the same direction yields addition, while connecting them in opposite directions yields subtraction. Multiplication is also convenient. By mimicking the underlying computation logic of existing computers, we replicate the voltage (the number of replications equals the multiplier) and connect the replicas in series in the same direction. Of course, each time we replicate and connect, the voltage representing the multiplier should be reduced by one unit until it reaches zero. For division, we adopt its essence—repeated subtraction. In a division operation, the value to be repeatedly subtracted is the dividend. The process stops when the dividend becomes zero or less than the divisor. The number of subtractions gives the quotient, and the remaining voltage of the dividend after the final subtraction is the remainder.

For fractional arithmetic, each number is represented by two such voltages: one for the integer part and the other for the fractional part. The precision is determined by the granularity of the divided voltage intervals, which is directly related to the achievable precision of voltage control.

B. Storage

Regarding the storage of computations, each computed value and result must be stored and retrieved within the computer's internal memory. The use of capacitors for precise storage is essential. The capacitor charges to accurately store the computed result, and during discharge, the voltage scale of the stored value is precisely retrieved.

Engaged in research on information theory and wireless communication. E-mail: 18816269268@163.com.

C. Discussion on signal integrity

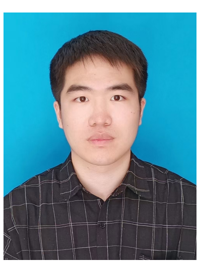
The computational method proposed in this paper requires extremely fast computation speeds. To achieve this, the precision of voltage control must be significantly enhanced on high integration platforms. The more precise the control over a voltage, the larger the range of values it can represent, resulting in greater computational speed—essentially a reduction in the number of computations. This imposes stringent requirements on the integrity of the signal transmission process. The better the signal integrity, the finer the scale can be—because there is no need to expand the scale to ensure that the voltage, despite interference or attenuation, remains within its designated range.

IV. Conclusion

In this paper, a theoretical method for the underlying operation of computers is proposed, which, in theory, can reduce infinitely complex computations from an extremely large number of binary operations to a minimal set of calculations. This approach has the potential to significantly enhance the computational capabilities of computers.

V. Discussion

In this paper, a novel method for underlying computation and storage in computers is proposed, aiming to increase computational speed and reduce the number of operations. However, the most significant practical challenge lies in achieving precise voltage control to realize the required granularity of divisions. If extreme precision can be achieved, the range of values representable by a single voltage can theoretically be unbounded, thereby drastically reducing the computational complexity and expanding the operational range. Moreover, signal integrity requirements are equally stringent: the integrity of signal transmission must be synchronously precise, without deviating beyond the defined intervals. Under such conditions, it is theoretically possible that the computational speed of traditional electronic computers could surpass that of quantum computers.



Jian Sun Graduated from the Department of Information and Communication Engineering of Nantong University. The main research fields are wireless communication and stochastic processes.