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Nature Inspired Computing Machine

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Abstract- An alternate method of representation of number system is proposed. The alternate method is based on reflection (0) and inverted reflection (1). Using an inverted reflected plane, one can create consecutive places of a number system. The alternate method has the advantage of creating empowered system representation with all places of the same power of the base. Three axioms are identified and can be proved by the method of mathematical induction to complete the process. The three axioms are, a creation of number system using inverted reflection, unique non-repetitive inverted reflection count generates natural numbers and taking inverted reflection with sign bit generates two's complement representation of negative numbers. It enabled us to create any desired number system and explained with the help of two versions of the decimal system. Typically, powered system representation leads to random switching within the representation.

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Nature Inspired Computing Machine

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Abstract- An alternate method of representation of number system is proposed. The alternate method is based on reflection (0) and inverted reflection (1). Using an inverted reflected plane, one can create consecutive places of a number system. The alternate method has the advantage of creating empowered system representation with all places of the same power of the base. Three axioms are identified and can be proved by the method of mathematical induction to complete the process. The three axioms are, a creation of number system using inverted reflection, unique non-repetitive inverted reflection count generates natural numbers and taking inverted reflection with sign bit generates two's complement representation of negative numbers. It enabled us to create any desired number system and explained with the help of two versions of the decimal system. Typically, powered system representation leads to random switching within the representation. Contrary to that, new representation provides uniform switching and minimal uniform switching thus minimising glitch. Through this method, one proves that thermometer coding act as a number system so that all arithmetic operations are possible with thermometer coding. New representation brings out the fact that decimal representation confirms to dual form, in binary form is empowered representation and in decimal digit form powered representation. Uniform switching representation of decimal digit resembles the human finger digit, and its dual representation leads to exploiting symmetry.

Keywords: computing machine; number representation; decimal system; thermometer coding; dual and symmetry; minimal switching; glitch.

I. Introduction

For a long time, the number system (Behroohz Parhami, 2000) is considered to be obtained by the power of the base. This led to the dominance of the binary system as the basis of mechanisation even though humans are more comfortable with the decimal system (GorjiSinaki & Ercegovac, 1981) Moreover, one failed to understand the enormous amount of effort needed to maintain the binary-based system and live with the rigidity dictated by binary system and also a creation of artificial intelligence(Avron Barr, & et al., 1982) thus making humanity to forget the real value human intelligence and make the society machine dependent. After carefully going through the literature by experts like Alan Turing(Turing, 1950; Turing, 1937; Richard P Feynman, 1985; Herbert Simon, 1996; Simon, Herbert A, 1995) on various aspects of computation led to the thought process that a better representation (WU Ting, et al., 2010) of the number system needed.

The new method of representation of number system through the concept of reflection and inverted reflection explained. Inverted reflection leads to entanglement (Chris Bern Hardt, 2019) and the entire gamut of knowledge of mathematics addresses how to manage the entanglement and device methods to unentangle the system under consideration.

II. New Number System Representation

In nature, two phenomena can happen i.e. reflection and inverted reflection. If reflection (buffer) considered as 0 and inverted reflection (inverters) considered 1, the entire nature is composed of combinations of buffers and inverters. Based on this, define mathematics(Underwood Dudley, 2010) as a subject of study of managing inverted reflection and also considered as entanglement, which is of concern to us. Hence a representation of inverted reflection (not gate) and reflection without inversion (buffer) leads to the creation of number system.

Now a new way to represent the number system is proposed as an inverted reflection. For example, if you have 0 with inverted reflection, 1 gets generated. Thus, with single inverted reflection binary digits are generated. Now consider the two adjacent cells with 0's. Thus, we have 00, 01 and if we take an inverted reflection of this, the series 00 01 | 10 11. Where | denotes inverted reflector. Thus, we have created two-bit binary numbers. Now create three bits of two-bit combinations with the most significant bit as 0 to generate 000, 001, 010,011. Now putting an inverted reflection of this series, we generate000,001,010,011| 100,101,110,111.

Thus, three-bit binary numbers are created. In this way, one can create a number system using the inverted reflection, which is much more fundamental than the powered system. It becomes evident that binary representation is the fundamental way to represent any number system to utilise the inverted reflection concept. The second axiom to be satisfied by this concept is that this generated number system creates natural numbers through new inverted reflection but not repeated inversions. Take, for example, two-bit combinations we see that we have natural numbers 0,1 with fresh inverted reflection, 2 with a count two new inverted reflection and 3 with one more new inverted reflection. One more axiom to be needed by inverted

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reflection to complete the number system generation in creating negative numbers. To create negative numbers if you do inverted reflection with the most significant bit has sign bit then two's complement numbers are generated. In the above explanation if third-bit acts as a sign bit, then the inverted reflection of three bits are two's complement of the two-bit numbers. As seen 000,001,010,011,100,101,110,111 represent 0,1,2,3,0, -3, -2, -1.

III. Axioms of Representation

To summarise the definition of creation of number system needs to obey three axioms:

1. Number systems are generated using inverted reflection of binary equivalent. 2. Natural numbers are generated by counting fresh inverted reflections leading to generation of 1 up to that point.
2. Affixing a sign bit and taking inverted reflection with respect that creates negative numbers in two's complement form.

IV. Advantages of New Representation

Let us now analyse what special advantages one gets out of this new way representation of number system.

1. It is possible to create arbitrary number systems. For example, thermometer coding (Rasit Onur Topalogulu, 2007; Toru Nakura,& Kunihiro Asada, 2013; Fereshteh Jafarzadehpour et al., 2019) can be proved as a number system.
2. One can create empowered number systems in which all binary digits have same power. Thus, first the time, a representation for empowered systems accomplished.
3. Particular representations having uniform switching (all switching with the same level of switching), minimal uniform switching (all switching with uniformly one switching only) can be generated that cannot be achieved by powered number system representation.
4. Unlike binary representation decimal representation follows dual (Williams, 1996; Girvin, 1996) system of binary empowered and decimal powered system. Thus symmetry (De Haro, Butterfield, 2019; Ruben Aldrovandi et al., 2013; Dr. Ivan Fernandoz-Corbaton, 2019) can be exploited
5. A new system satisfies the concept in field of Mathematics(Givant, Steven & HalmosPaul, 2009)as addition, multiplication, subtraction and division is possible and mechanisation realised through Boolean algebra(George Boole, 2011; Foster, 1991) and CMOS technology (Lee, 2019; Rohit Sharma, 2018).

V. Example of New Representation

To illustrate advantages mentioned above decimal representation taken as example.

Consider thermometer coding with nine binary digits of power 2^0as shown in Figure 1

		2^0	2^0	2^0	2^0	2^0	2^0	2^0	2^0	2^0
000000000	0	0	0	0	0	0	0	0	0	0
000000001	1	0	0	0	0	0	0	0	0	1
000000011	2	0	0	0	0	0	0	0	1	1
000000111	3	0	0	0	0	0	0	1	1	1
000001111	4	0	0	0	0	0	1	1	1	1
000011111	5	0	0	0	0	1	1	1	1	1
000111111	6	0	0	0	1	1	1	1	1	1
001111111	7	0	0	1	1	1	1	1	1	1
011111111	8	0	1	1	1	1	1	1	1	1
111111111	9	1	1	1	1	1	1	1	1	1

Inverted reflection enabled cell

Figure 1: A decimal system based on thermometer coding using Inverted Reflection

Thus, the above decimal numbers are generated using inverted reflection satisfying the first axiom, natural numbers are generated using afresh inverted reflection that leads to the generation of 1 and if a sign bit appended and inverted reflection taken produce negative numbers in two's complement form. Thus, with the new concept, a decimal number system is generated. Inherently this representation satisfies uniform and minimal switching (Jaakko Astola & Radomir S. Stankovic, 2006) from one digit to the other. Many advantages of the thermometer coding are already available in the literature and exploited in the hardware (Stanley Wolf, 2002; Sung Kyu Lim, 2008; Holdsworth & Woods, 2003) development as well.

But if one tries to generate addition and multiplication circuits using this representation, it needs huge logic and consumes lot of area. To overcome this and also to illustrate the generation of arbitrary number system consider uniform switching but not minimal. In this representation, we take five bits with four 2^1bits as Most significant bits and the least significant bit with power 2^0. Then our new decimal numbers are generated using inverted reflection as given in Figure 2.

Again, the above decimal system satisfies all three axioms put forward for inverted reflection method of generation of a new number system. Here if you observe the switching is not minimal but uniform. Since only five bits are used, combinations needed to generate arithmetic circuits (LaMeres, 2019; Jiang et al., 2019)will be much less compared to thermometer coding. Here also since there is empowerment for higher-order bits it has the advantages of thermometer coding. Coincidently, human finger systems have such an arrangement and hence form the basis for an analysis of the human digit system.

		2^1	2^1	2^1	2^1	2^0
000000000	0	0	0	0	0	0
000000001	1	0	0	0	0	1
000000011	2	0	0	0	1	0
000000111	3	0	0	0	1	1
000001111	4	0	0	1	1	0
000011111	5	0	0	1	1	1
000111111	6	0	1	1	1	0
001111111	7	0	1	1	1	1
011111111	8	1	1	1	1	0
111111111	9	1	1	1	1	1

Inverted Reflection Enabled Cell

Figure 2: Decimal system generation with uniform switching with 5 bits

The number system generation depicted as a machine consisting of inverters and buffers illustrated in Figure 3 and Figure 4 for the decimal systems discussed earlier.

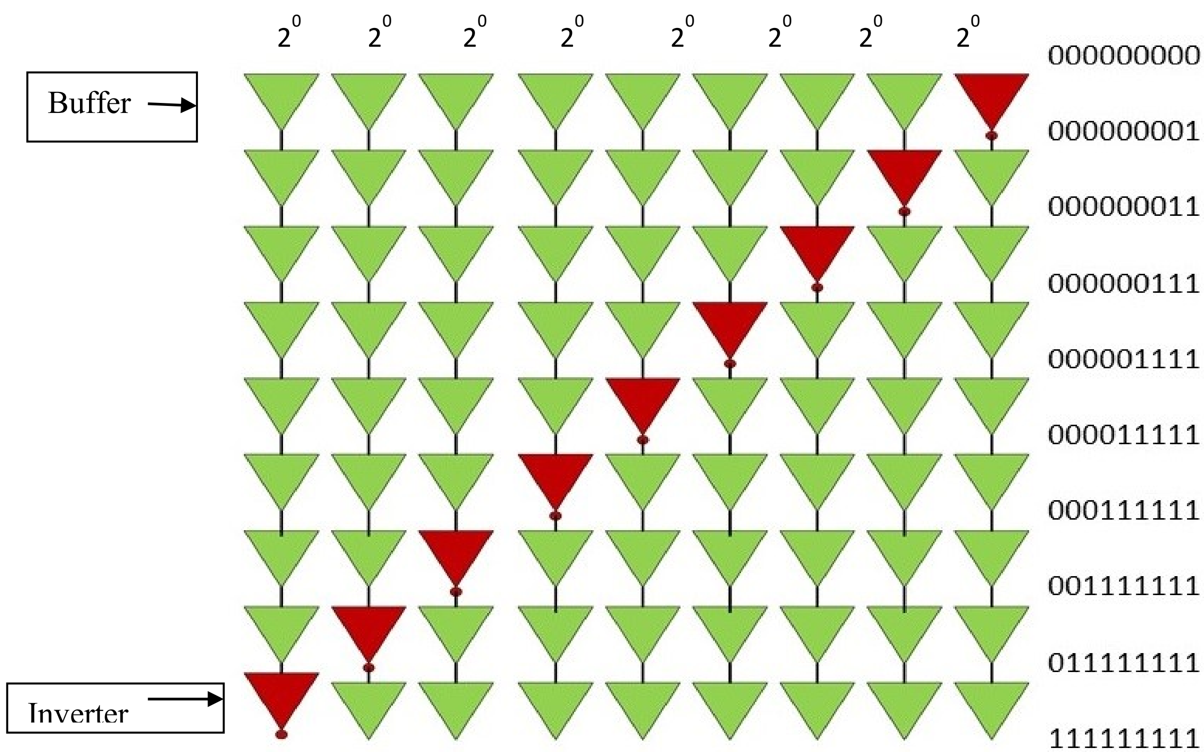

Figure 3: Natural Inverted Reflection based representation of 9 bit decimal with 2^0 as weight

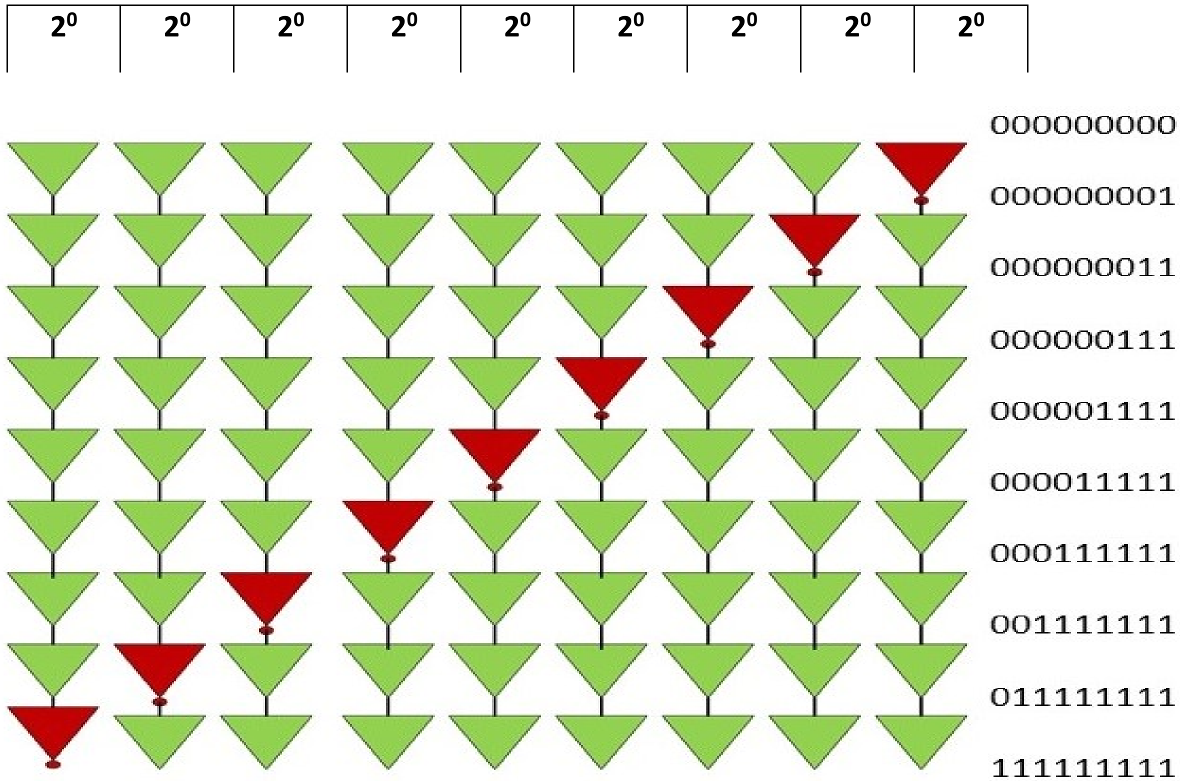

Figure 4: Natural Inverted Reflection Based Machine with uniform switching with weight $2^1 2^1 2^1 2^1 2^0$

VI. Scope of New Representation

This Nature Inspired Machine capable of generation of various number systems. They are considered Natural as it uses various natural aspects like reflection and inverted reflection, new cell generation and existing cell. This brings out the natural generation numbers as a unique count of inverted reflection leading to the generation of new 1's. Any number system consists of a field of buffers and inverters arranged in a matrix of the size based on the weight age given to each element and number of bits taken into consideration.

New decimal representation obeys dual system. At binary level bits are empowered and at digit level digits are powered. This unique advantage gives many applications and mainly manages power and glitch (Ki-Seok Chung et al., 2002) in a better way. This dual nature of empowered and powered enable to create various innovative applications if carefully researched. One immediate observation in human digits applying this dual concept brings out a better understanding of the human system. These pave the way for many in-depth studies of the human digits system and bring better understanding. Glitch free circuits become possible through a representation of any number system with equivalent thermometer coding before mechanisation. These become feasible through our new number system representation.

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