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Addition of two large numbers entered from keyboard using Stack and its application in maintaining a Parking Register

Priyam S Shah[1*], Shivani D Desai[2], Dwisha R Kulkarni [3]

[1*]Department of Computer Engineering, Institute of Technology, Nirma University, Ahmedabad, India
[2] Department of Computer Engineering, Institute of Technology, Nirma University, Ahmedabad, India
[3] Department of Computer Engineering, Institute of Technology, Nirma University, Ahmedabad, India

[*]*Corresponding Author: shivani.desai@nirmauni.ac.in, Tel.: +91-9824069443*

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***Abstract*—** This paper shows how to input two numbers using a keyboard component available in Logisim. The addition is performed using a special data structure called "Stack". We have used the concept of ASCII input. Addition is done in a digit by digit fashion using the ideology of BCD addition. Also, we have applied this logic to design a circuit for maintaining a parking register of a housing society. A special emphasis has been done to allocate parking for the guest members.

***Keywords*—**Clock cycle, BCD adder, Stack

I. INTRODUCTION

We have designed an efficient addition [1] circuit which computes addition of two numbers. It uses minimum possible clock cycles to generate an appropriate summation of two numbers. This logic is applied to create a parking [2] register for a society. The circuit will allocate the parking space. The motivation behind this paper is finding a most effective way to perform the basic addition operation by minimizing clock cycles of CPU. This logic circuit can be used to perform addition and other operations involving intermediate addition with minimum possible clock cycles. This will contribute to minimize the clock cycles. Hence, the computational speed will increase and we can get faster results.

Section I contains the introduction to the paper. Section II describes the related work. Section III contains the procedure to perform Push operation, Pop operation and BCD addition as described in [3]. Section IV discusses the application of the circuit.

II. RELATED WORK

The addition algorithm in [1] couldn't be implemented in circuit. We have presented an efficient circuitry for addition. We got the idea for Parking Register from [2]. The Stack Implementation is described in [3].

III. IMPLEMENTATION OF CIRCUIT

The main components of the circuit are RAM, BCD adder, Key Board input, clock cycles, logical gates, multiplexers and wire splitters [4]. There are 64 bits in the memory available so the input for the addition can contain maximum of 64 digits each. The input is entered using the keyboard component [5] available in Logisim. One of the outputs available in the keyboard gives the ASCII value of the character present at the first position. There is another control output from the keyboard which is 1 if there is some input available in the keyboard. If there is no input, the value is 0. This control is used to synchronize the Stacks which are used to store the digits.

Push Operation

Once the input is entered through the keyboard, the digits are stored one at a time during each clock cycle. The numbers of input clock cycles are equal to the highest number of digits of the inputs. The Pop operation is performed only after all the digits have been pushed into the Stack. This is achieved using proper synchronization using the keyboard controls [6].

Pop Operation

After all the digits have been pushed, the keyboard control will be 0. Hence the Pop operation will start automatically. With every clock cycle, the digits which were stored inside the Stack are Popped and passed through a BCD adder. This process is continued until all the digits are popped from the Stack.

BCD Addition

With every Pop Operation, the digits of both Stacks are added. The sum (which is in binary) is converted into BCD. The Most Significant Bit is stored in a flip flop which will be used as an input in next addition operation. One important thing to understand is the fact that the addition is not a normal addition [1] but a BCD adder. For example- If one digit is 9 and another digit is 8, the binary addition gives 17 in binary form. But the BCD addition will give output as

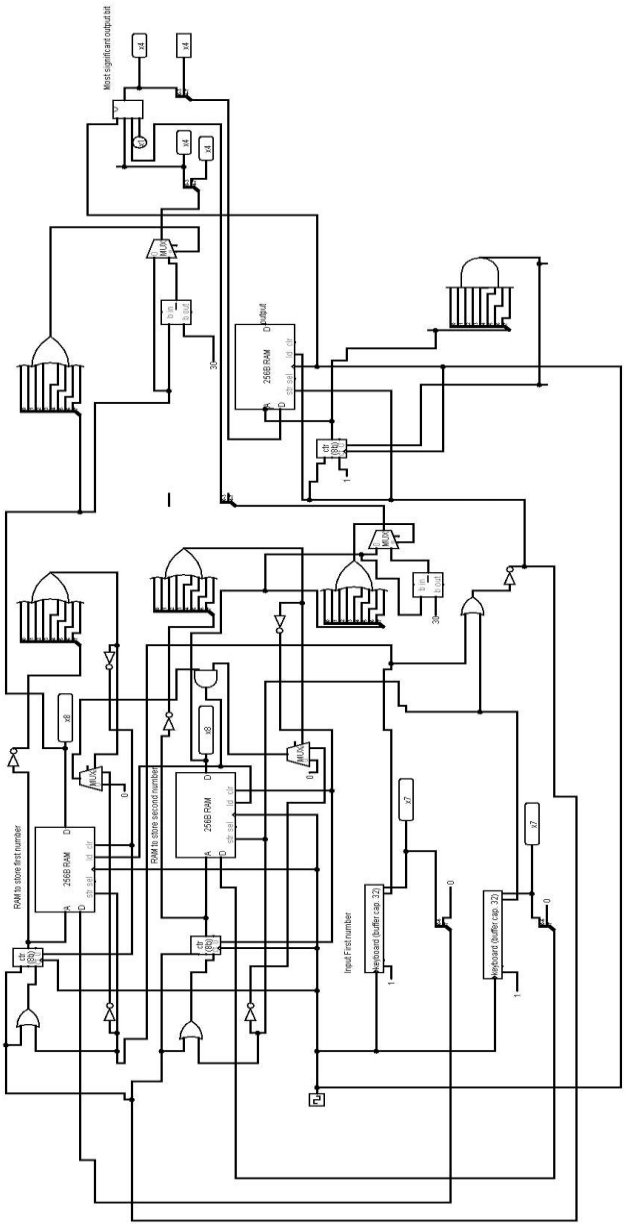

Figure 1. Addition of numbers using stack

BCD of 7 and 1 will be the carry which will be used as input in the next addition. This process is continued until all the digits are popped from the Stack. The BCD addition of the digits is stored in the Output Stack. The Output Stack is synchronized in such a way that the outputs of digits (which are popped in reverse order) are stored in reverse order. The entire circuit is simulated properly using Logisim [7].

Output Stack

The Output Stack is used to store the final answer of the addition of two numbers. While the digits are being pushed inside the Stack, 0 is stored in the Output Stack. While popping the digits, the Output Stack is popped and the output value of BCD adder is stored in the Output Stack.

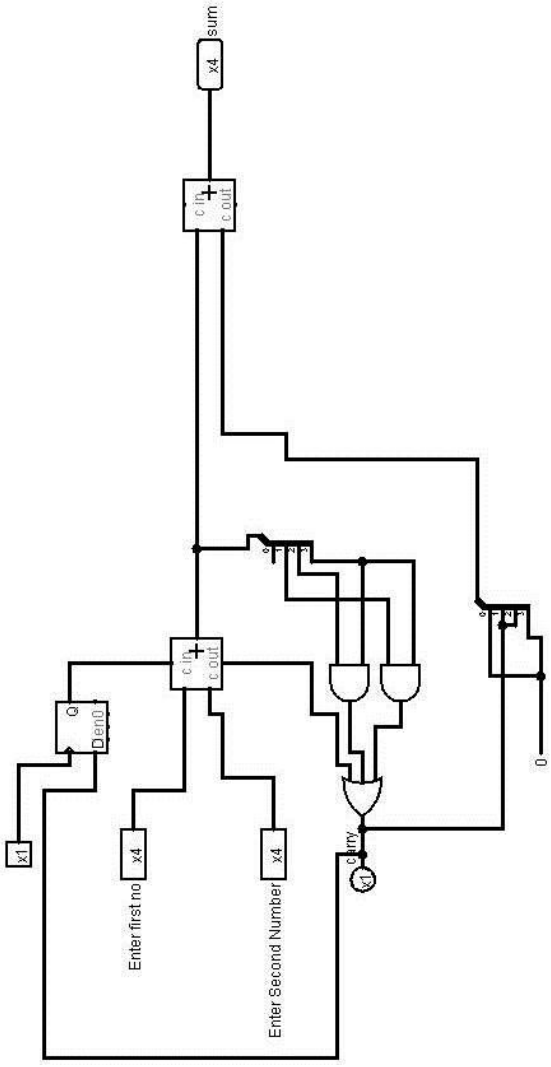

Figure 2. BCD Adder

IV. APPLICATION OF MAIN CIRCUIT

Consider a society having 10 houses and each house has a parking [2] space and there are 4 parking spaces extra for the guest members. Based on figure 3, we will analyze and maintain a register of the number of parking spaces which are free and which are occupied. A keyboard [5] is used by the members or the guests to enter a house number. The result will be displayed in the Output Register.

A. Entering the parking area

- For the member of the society, to check for the available parking space the member has to enter the number of their house ranging from 01 to 10.
- For the guest who wants to park in the society, they have to enter – 'a' followed by the last digit of house number. Also, the selection line should be 1 for the guest.

B. Inside the circuit

There are 2 selection inputs. One input determines whether the user wants to park the car or remove the car from the parking area. Other selection determines whether the user is a society member or guest. If first selection input is 0, it means that the user wants to park car. If first selection is 1, the user wants to remove the car from the parking area. When the 2nd selection input is zero, the circuit in figure 4 is activated and a comparator is used so that only values of the digits 01 to 10 can be used. If any other value is entered by the member, the entered data will be invalid and no operation will be performed.

When the 2nd selection input is 1, the circuit in figure 5will be activated. The guest member is required to enter a special character 'a' followed by the last digit of the house number where the guest wants to go. The range of values for the guests is from a0 to a9. The comparator is used to check whether the data entered by the guest is proper or not. Comparator [8] is a tool which will take ASCII value as input and check with a predefined value. We have used 2 comparators, one for checking the lower range and one for checking the upper range. When both the conditions are satisfied, only then the user is a valid user and he/she can either park car or take the car away from the parking area.

C. Output

After the user has been correctly verified by the circuitry logic, 1st selection condition is checked. If it is 0, identified society member/guest is allowed to enter the parking space and park the car. The Counter at the output is incremented. If the value exceeds 10 (4 for guest), full condition is reached and counter stops incrementing. If it is 1, identified member/guest is allowed to take his/her car away and the value of the counter decrements by 1. If there is no car in parking area, then user will not be allowed to select 1 in 1st selection input and hence counter remains 0.

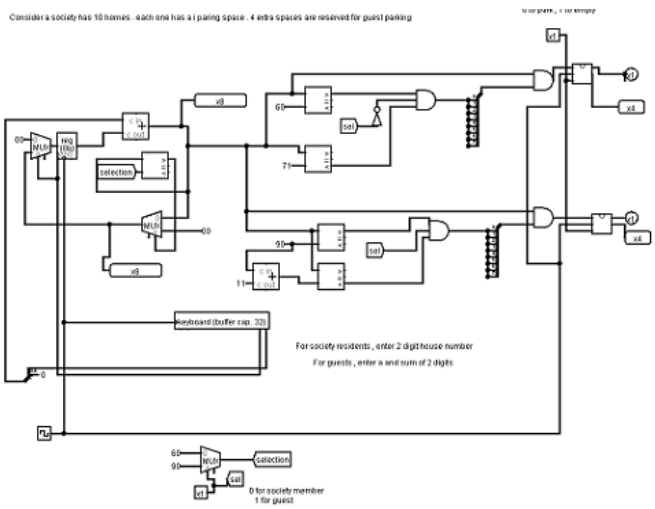

Figure 3. Parking Register

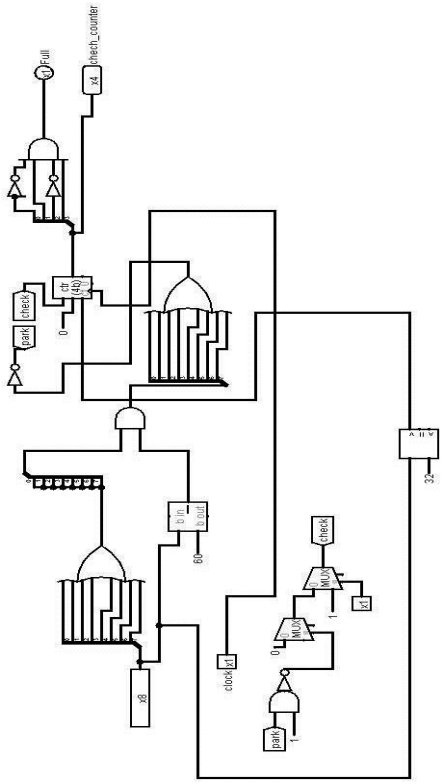

Figure 4. Parking society member

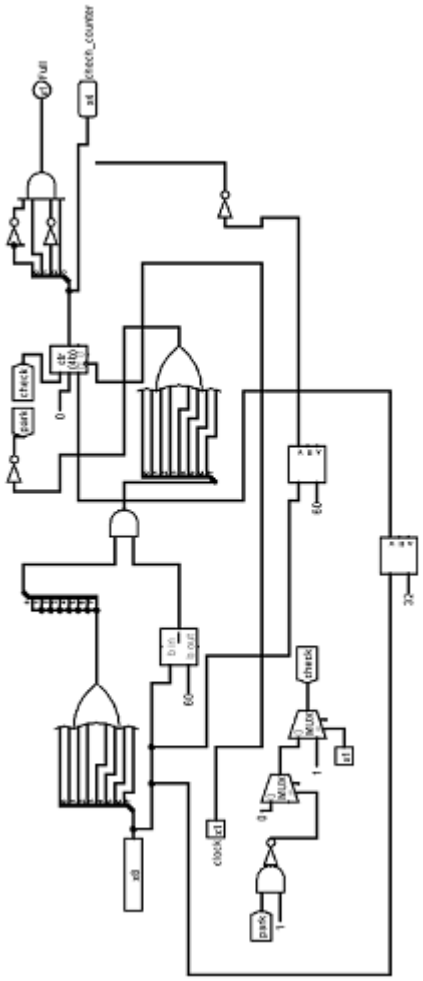

Figure 5. Parking of guest member

V. CONCLUSION AND FUTURE SCOPE

We have presented a proper circuitry to perform addition of two numbers. It uses minimum clock cycles. This will help manufacturers to design a modified version with faster computational speed. The Parking Register helps the user to get the status of parking. We are expecting to develop logic of carrying out addition of multiple numbers simultaneously. Also, with similar approach, we can develop circuits for faster and efficient subtraction, multiplication, division and other mathematical operations.

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Authors Profile

Mr. P S Shah is persuing Bachelor of Technology from Institute of Technology, Nirma University, Ahmedabad. He is currently studying Computer Engineering from Institute of Technology, Nirma University, Ahmedabad since 2016. His main research work focuses on Computer Hardware, Smart Parking Space Management System, Computer Architecture, Developing Circuits using Logisim and Designing Algorithm for faster Addition inside the CPU.

Mrs S D Desai pursed Bachelor of Technology from Gujarat University and Master of Technology from Institute of Technology, Nirma University, Ahmedabad. She is currently working as an Assistant Professor in Department of Computer Enginnering, Institute of Technology, Nirma University, Ahmedabad, India since 2012. Her main research work focuses on Wireless Sensor Network, Computer Architecture, Data Communication, Opeating System, and Digital Systems.

Mrs. D R Kulkarni is persuing Bachelor of Technology from Institute of Technology, Nirma University, Ahmedabad. She is currently studying Computer Engineering from Institute of Technology, Nirma University, Ahmedabad since 2016. Her main research work focuses on Computer Hardware, Computer Architecture and Developing Circuits using Logisim.

