

## Licensing and Technology Transfer Opportunity: Manipal University

### **Title of Technology Available:**

A SYSTEM FOR PERFORMING A BINARY DIVISION

### **Brief Description of Invention:**

The first stage of the proposed architecture which determines the type of input performs the following operations.

- Checks if the dividend and divisor are in the same range and if inputs are in same range, then it enables “one range” block.
- Checks if the divisor is onehot (i.e., only one bit in the input is one) and if divisor is “onehot” number, then enable onehot block.
- Checks if the divisor is between 0 to 15, if the divisor is in the given size, then it enables “2-part-dividend” block.
- If above conditions are not satisfied, then enable the divide and conquer block.

Only one of the four blocks in second stage will be enabled and other blocks are disabled, such that the total power consumption can be reduced.

**One Range:** The “Type Determinant” blocks checks the range of both divisor and dividend, if both inputs are in same range, then the “One Range” block is enabled. The range of divisor and dividend can be determined by getting the position of first one from MSB. If the positions of first one from MSB are same, then the quotient is one.

**Onehot:** The “Type Determinant” blocks checks if the divisor is a onehot number. If divisor is onehot, the quotient will be generated by right shifting the dividend by bit position. A barrel shifter can be used to shift the dividend.

**Divide and Conquer:** In this block, the range of the divisor is determined. For example, if the divisor is 21, then the range of the divisor is [16, 32]. Then the mid value of the range is determined by calculating the average of the minimum and maximum value in the range. If the divisor is less than or equal to mid value, then the dividend is divided by minimum value in the range. If the divisor is greater than mid value, then the dividend is divided by the maximum value. If the remainder is greater than the divisor, then the above procedure is repeated.

### **Divide and Conquer based Divider with Shifting of Even Numbers**

In current proposed architecture, divisor is checked to determine whether it is even number or odd number. If the divisor is even number, then number of trailing zeros is determined. Then both divisor and dividend are shifted right by number of trailing zeros. Once the divisor and dividend are shifted right, the range of both will be reduced. Division can be performed on the reduced dividend and divisor. 2-part dividend or divide and conquer can be used to perform the

division. As the range of both dividend and divisor are reduced, the power consumption can be reduced while performing the division operation.

**Brief Background of Invention:**

Arithmetic unit is a component in embedded computer systems. Typically, the arithmetic unit is used in Central Processing Units (CPUs) and Graphics Processing Units (GPUs). The arithmetic unit performs arithmetic operations like multiplication, division, addition, subtraction and others. Example of the arithmetic unit comprises multipliers, dividers and other hardware structures for performing various arithmetic operations. There are mainly two parameters i.e. delay and power consumption which are considered while selecting the hardware structures for performing the arithmetic operations. The delay specifies a total time taken by the hardware structure to complete the arithmetic operation. The power consumption specifies a total power consumed by the hardware structure. It is to be noted that the current systems and methodologies introduces the delay in performing complex arithmetic operations due to the hardware structure leading to increase in the power consumption.

**Describe the final product:**

The proposed invention performs the division operation at high speed and consumes less power.

**Technological Domain (Keywords):**

Binary Divider, Divide and Conquer, Modified Booths, High speed, Low Power, Power Delay Product, Range Detection (Determining the range of given value on-the-go)

**Proof of Concept:**

NA

**Stage of Development:**

Advanced Prototype

Provide Information on Competitors who manufacture and/or sell similar products: NA

**What are the unique advantages your innovation has compared to the competition:**

The current invention reduces the total power consumption and delay to perform division

A few potential companies who might be interested in this technology: Nvidia, Intel, Qualcomm, Synopsys

Intellectual Property Status: **Application#: 201941023752** and **Date of Filing: June 14, 2019**