IDP EE3025

CALCULATOR

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Problem Statement

- **Implementation of Calculator with basic operations**
  - ADDITION
  - SUBTRACTION
  - MULTIPLICATION
  - DIVISION

Introduction

- Implementing a simple calculator in verilog using a icoBoard which is a FPGA based IO board for RaspberryPi which performs basic operations on the given 4-bit binary inputs.
- Arduino uno is used to interface between icoBoard and the keypad and the LCD display.

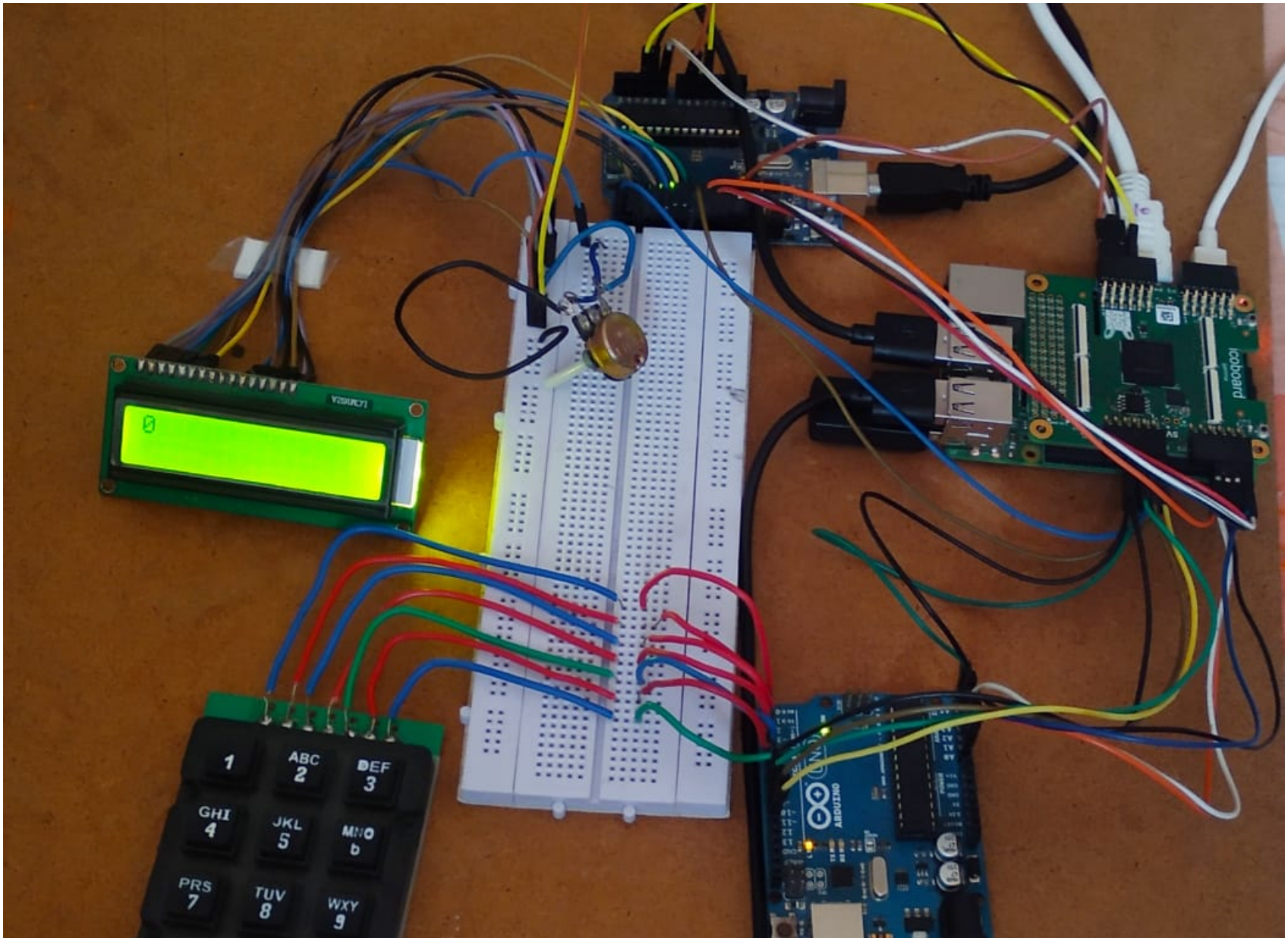
ALGORITHM

- Addition and Subtraction by realising a full adder.
- Multiplication is performed using the algorithm of a Vedic multiplier.
- Division by using the algorithm of shift and subtract.

Problem Statement

- **Components used for hardware implementation of calculator**
  - icoBoard
  - RaspberryPi
  - Keypad
  - LCD display
  - Arduino Uno
  - Potentiometer

CIRCUIT

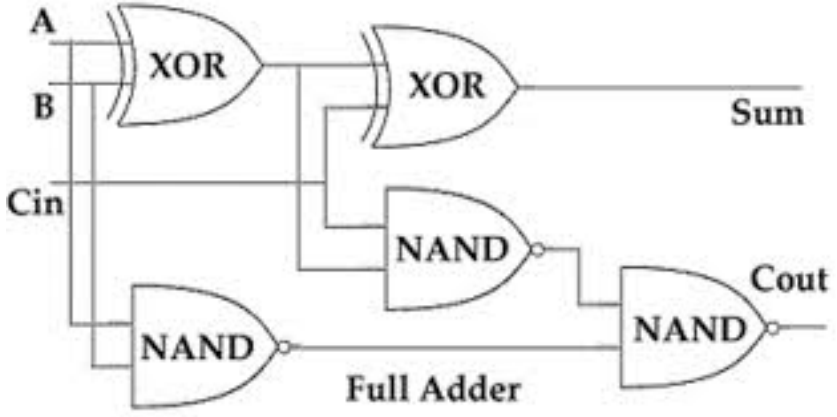


INPUT

- Input is given by a Keypad(4Rows x 3Cols) and transmitted to the icoBoard via a arduino.
- The arduino is programmed to convert the input from the keypad into binary format and transmit it to the icoBoard.
- The inputs given are two numbers(4 bit) on which the operation is to be performed and the operation which has to be performed.
- the arduino code to transmit the input is given in the link below
- https://github.com/hritikchavan/IDPEE3025/blob/master/idp3.ino

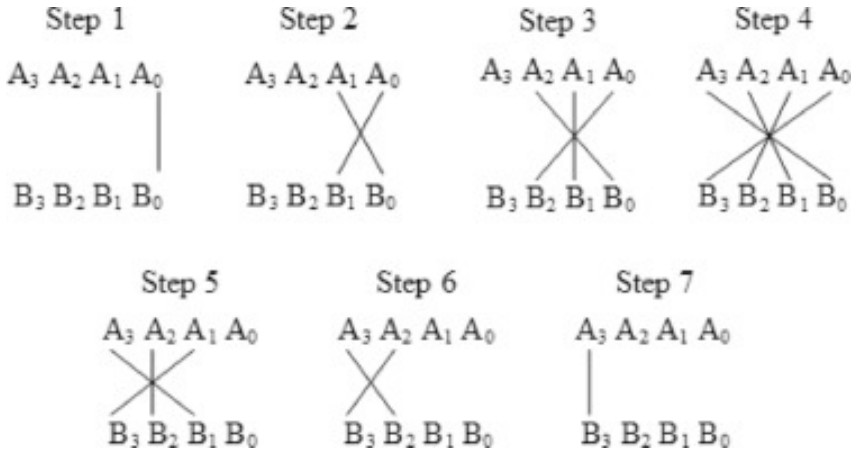
COMPUTATION

- The computational part involves 4-Bit Addition, Subtraction, Multiplication and Division.
- Here for performing Addition and subtraction we are using full adder. We are doing bit-wise addition in addition operation and in subtraction by taking 2s complement of second element we are again performing bit-wise addition.



COMPUTATION

- For performing multiplication we are using Vedic multiplier which works on the basis of weights of the bits. The numbers with equal weights are added at the end to get the output.



COMPUTATION

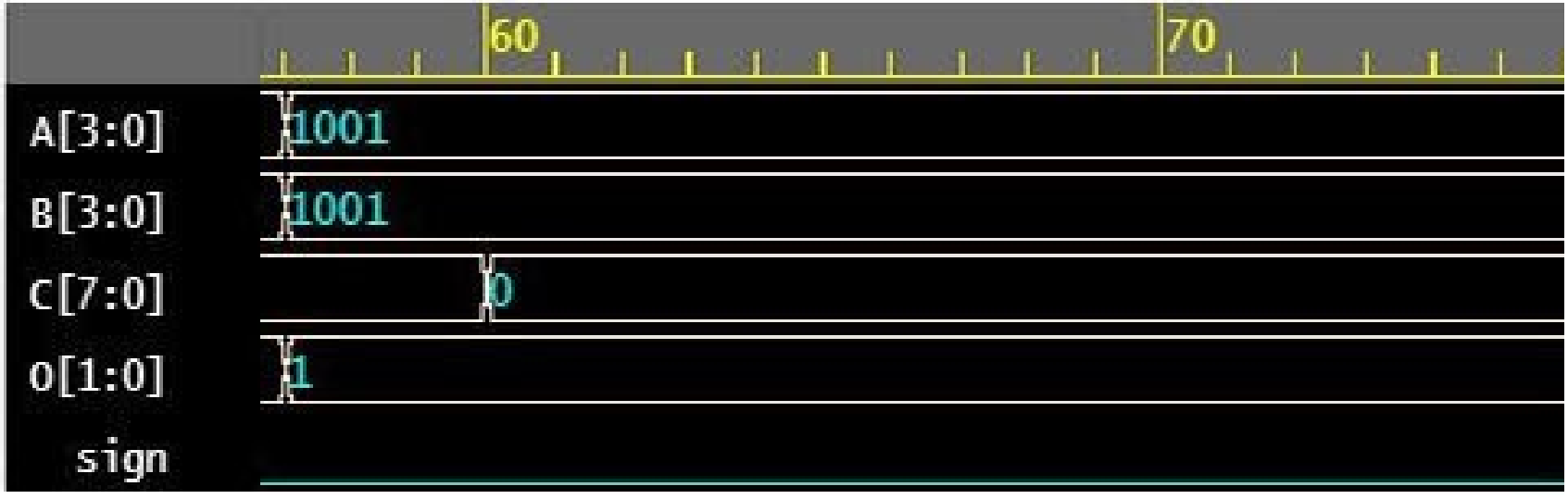
- Division is based on repeated bit shifting and subtraction. The second is bit shifted be certain amount and each time it is subtracted from the original number till it becomes zero.
- The opcode used in this is 2 bits wide. Opcode is used to decide which operation to perform. 00 stands for addition, 01 for subtraction, 10 for multiplication and 11 for division.
- This is the link to verilog code used for computation
- https://github.com/hritikchavan/IDPEE3025/blob/master/idp.v
- https://github.com/hritikchavan/IDPEE3025/blob/master/idp.pcf

OUTPUT

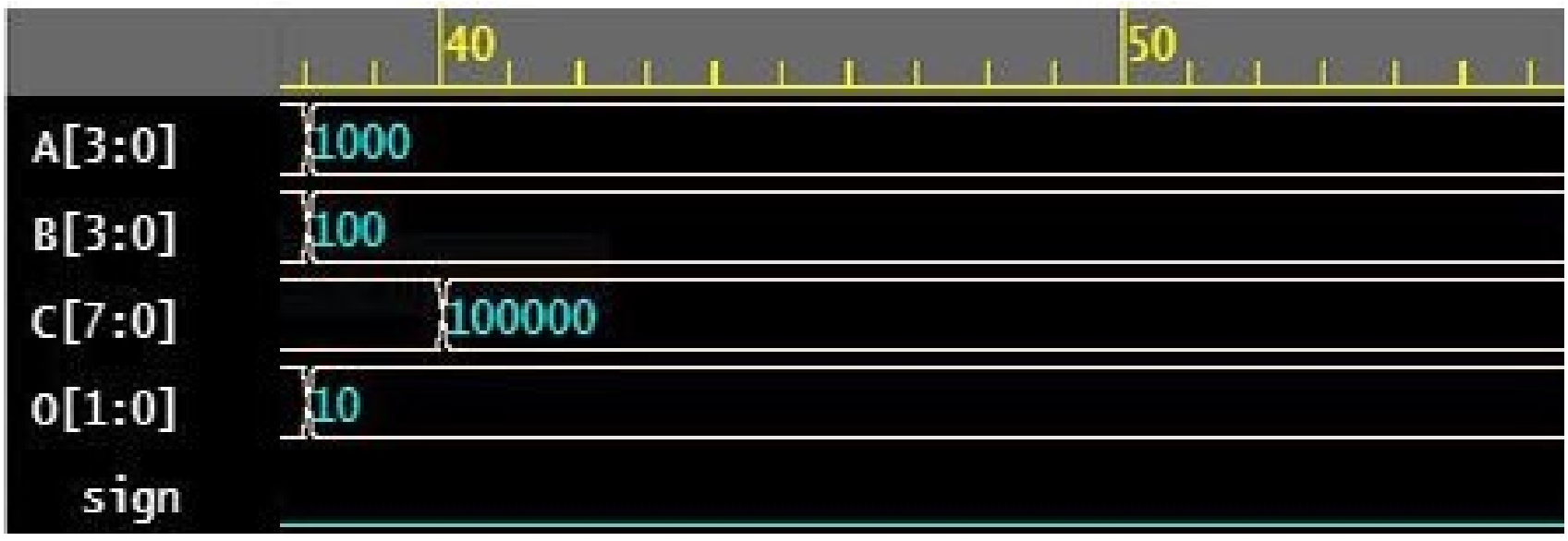
- The solution is transmitted to the LCD display where the output is displayed via a arduino.
- Output is of 8 bits from the icoBoard and 1 sign bit, the binary output is converted into decimal system in the arduino and displayed on the LCD display.
- Here we are using Potentiometer to control brightness of LCD display.
- the code to display the output on the screen is given in the link below.

- https://github.com/hritikchavan/IDPEE3025/blob/master/idp$_d$*isplay*.*inc*

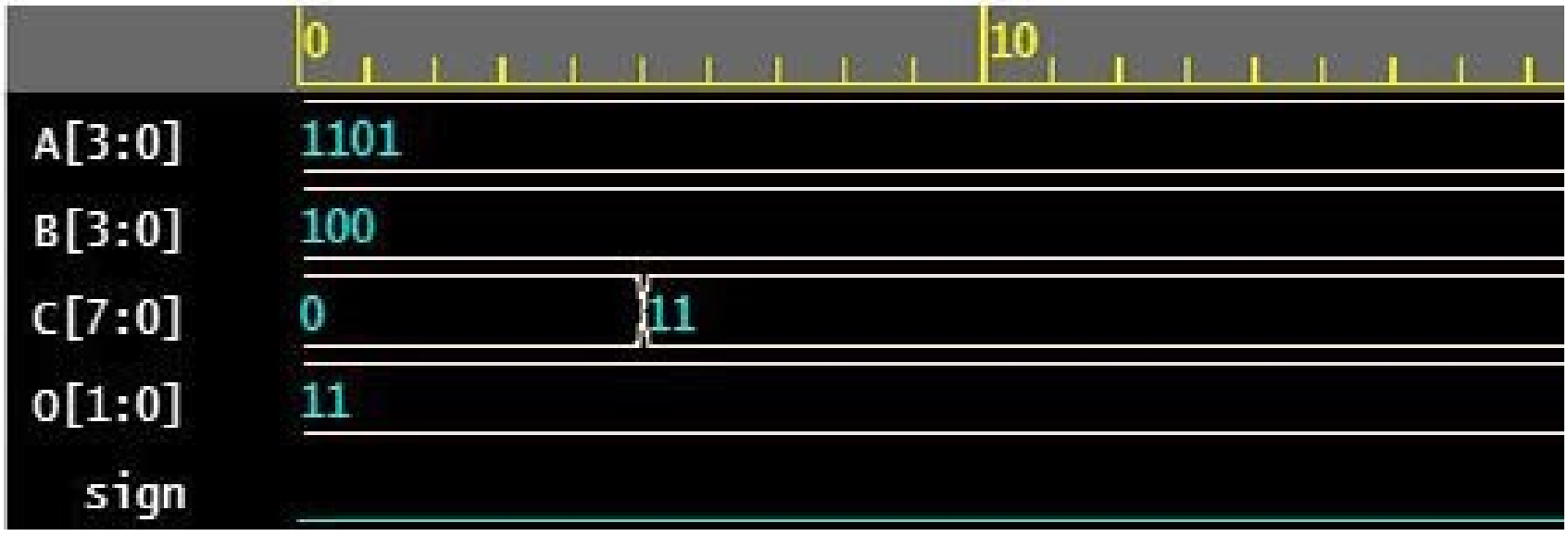
- A AND B ARE THE INPUTS
- C IS THE OUTPUT(addition)
- O IS THE OP CODE



- A AND B ARE THE INPUTS
- C IS THE OUTPUT(subtraction)
- O IS THE OP CODE



- A AND B ARE THE INPUTS
- C IS THE OUTPUT(multiplication)
- O IS THE OP CODE



- A AND B ARE THE INPUTS
- C IS THE OUTPUT(division)
- O IS THE OP CODE

THANK YOU

- **THANK YOU**
- **END**