

RISC-V TALENT DEVELOPMENT PROGRAM - 2025

Powered by Samsung Semiconductor India Research(SSIR) along with VLSI System
Design(VSD)

TITLE OF PROJECT : Implementation of full
subtractor

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1.Overview

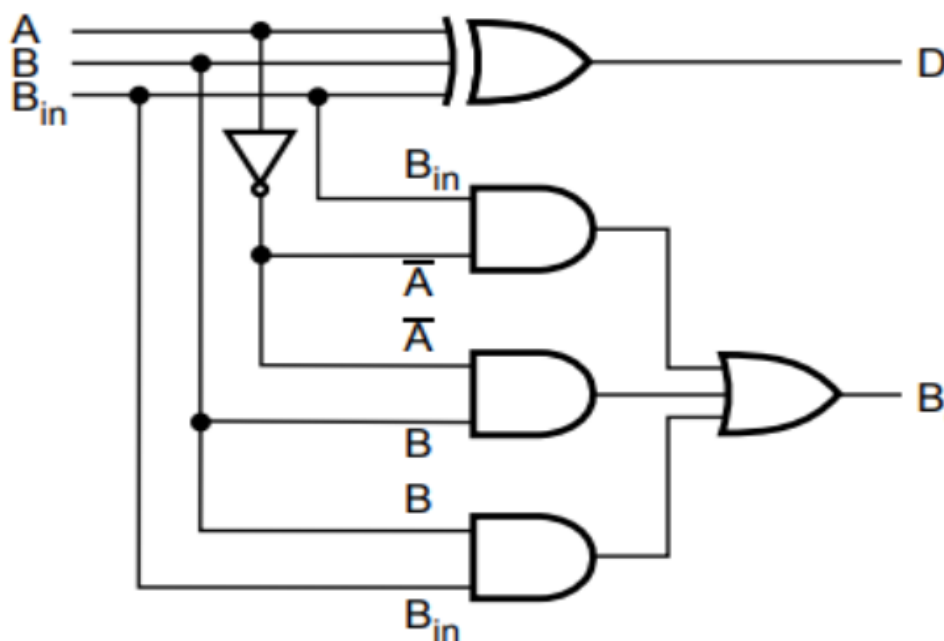
This project involves implementing a Full Subtractor combinational circuit using the VSD Squadron Mini, a development kit based on the RISC-V SoC architecture. The Full Subtractor is a vital component in digital electronics, frequently utilized in designing n-bit Subtractor circuits. This digital circuit subtracts two binary digits and incorporates a borrow-in digit to produce a difference and a borrow-out digit, making it an essential element for performing subtraction operations in digital circuits.

This project illustrates the practical application of digital logic and RISC-V architecture in executing arithmetic operations. It demonstrates the process of reading and writing binary data via GPIO pins, the implementation of the full subtractor using digital logic gates simulated in the PlatformIO IDE, and the display of outputs using LEDs.

2.Components Required to build Smart Door:

- VSDSquadron Mini board
- Push Buttons
- 2 LEDs
- Breadboard
- Jumper Wires
- VS Code ,Platformio

Logical Diagram of Full Subtractor and Expressions

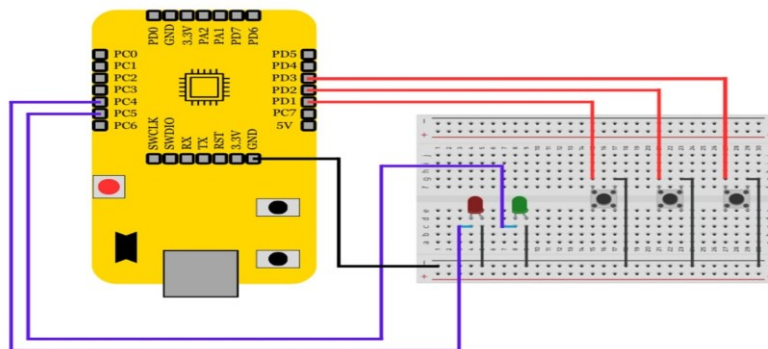


Difference output equation

$$\begin{aligned}
 D &= \overline{A} \overline{B} B_{in} + \overline{A} B \overline{B}_{in} + A \overline{B} \overline{B}_{in} + A B B_{in} \\
 &= B_{in} (\overline{A} \overline{B} + AB) + \overline{B}_{in} (\overline{A} B + A \overline{B}) \\
 &= B_{in} (A \odot B) + \overline{B}_{in} (A \oplus B) \\
 &= B_{in} (\overline{A \oplus B}) + \overline{B}_{in} (A \oplus B) \\
 &= B_{in} \oplus (A \oplus B)
 \end{aligned}$$

Borrow output Equation

$$\begin{aligned}
 B_{out} &= \overline{A} B_{in} + \overline{A} B + B B_{in} \\
 &= \overline{A} B_{in} (B + \overline{B}) + \overline{A} B + B B_{in} (A + \overline{A}) \\
 &= \overline{A} B B_{in} + \overline{A} \overline{B} B_{in} + \overline{A} B + AB B_{in} + \overline{A} B B_{in} \\
 &= \overline{A} B (B_{in} + 1 + B_{in}) + \overline{A} \overline{B} B_{in} + AB B_{in} \\
 &= \overline{A} B + \overline{A} \overline{B} B_{in} + AB B_{in} \\
 &= \overline{A} B + B_{in} (\overline{A} \overline{B} + AB) = \overline{A} B + B_{in} (\overline{A \oplus B})
 \end{aligned}$$



VSDSquadron mini board Hardware Connections	
GND	Led Anode ,Led anode, Switch(1,2,3) anode
PD1	Switch 1 Cathode
PD2	Switch 2 Cathode
PD3	Switch 3 Catode
PC4	Red led (Borrow)
PC5	Green Led (Difference)

Truth Table of Full Subtractor

Inputs			Outputs	
A	B	B _{in}	D	B _{out}
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

