COL215 Assignment-3

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Entry No. - 2019CS10400

(1) Design Overview

Input:

1) Clock
2) Push-button to start filtering operation
3) Switch to toggle between the two different types of filtering: smoothening and sharpening

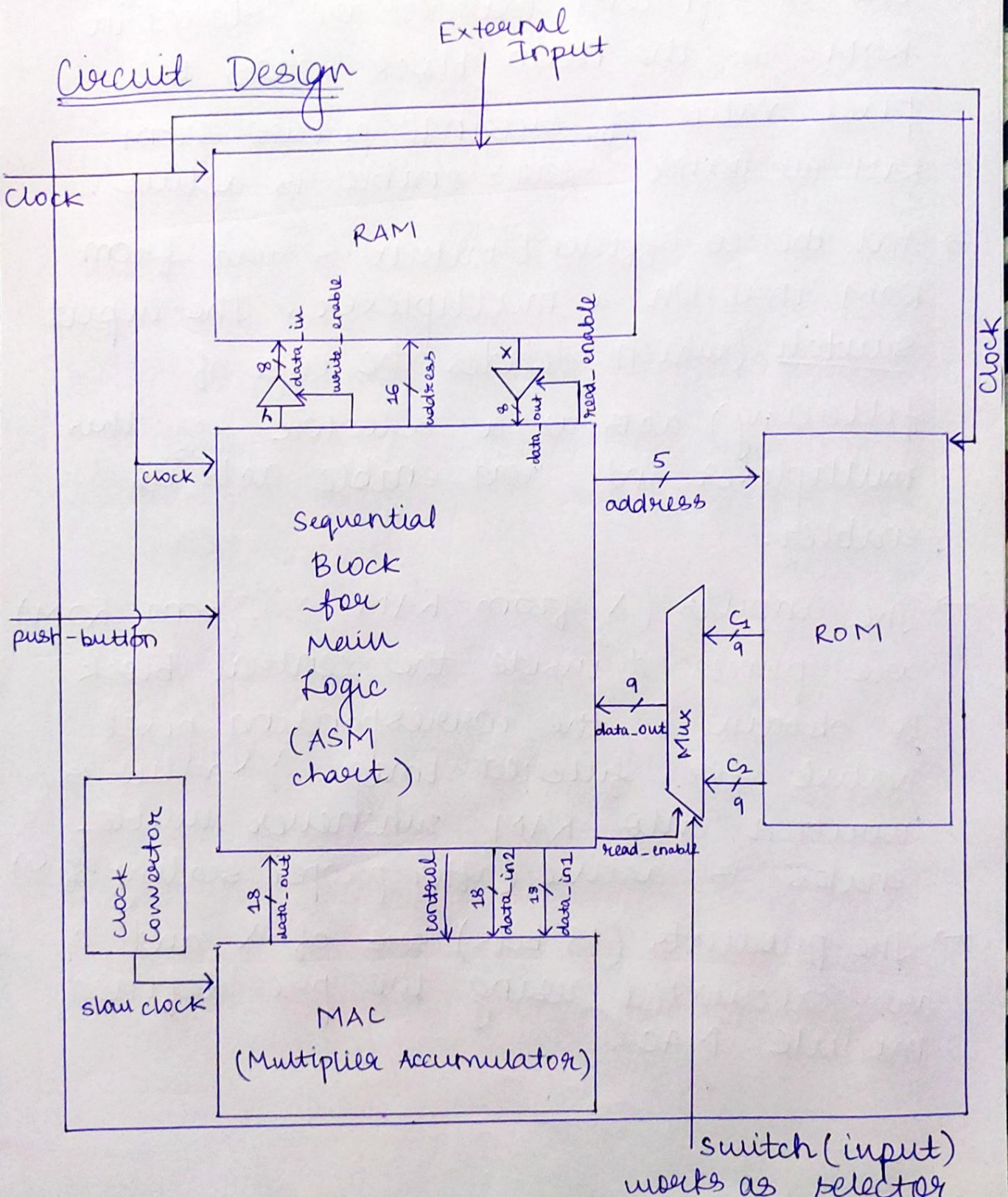
→ Another input is the pixel array (160x120) for the image which is to be filtered and the co-efficient arrays (3x3) required for both types of filtering.

→ But the input image is directly ~~written~~ read from ~~on~~ RAM while the co-efficient matrix is read from ROM. We are not bothered with their initialisation

Output

The pixel array (158 × 118) corresponding to the filtered image is written onto some unoccupied part of RAM.

Circuit Design



→ The main logic is contained in the central sequential block.

→ The input image is stored in RAM while the co-efficient matrices are stored in ROM. So, the main block reads the pixel value of original picture from RAM whenever read_enable is active.

→ And the co-efficient matrix is read from ROM through a multiplexer. The input switch (which decides the type of filtering) acts as a selector for this multiplexer and read_enable acts as its enabler.

→ The inputs (x from RAM, c from ROM) are processed inside the central block to obtain Y, the corresponding pixel value for filtered image. Y value is written onto RAM whenever write_enable is active (after proper scaling of Y)

→ The products (18 bits) ~~out~~ of x and c are calculated using the pre-defined module MAC.

→ Note that, RAM, ROM and central block are all triggered by the same master clock while MAC is synchronised with a slow clock, because the multiplier accumulator operation of two 18 bit inputs takes several cycles of master clock, precisely 9. So, we introduce a converted clock which is slower (9 times) than the master clock.

→ Various signals and their use:

X : 8-bit vector → stores pixel value of current pixel of original image

Y : 8-bit vector → stores pixel value of current pixel of filtered image

C : 9-bit vector → stores up-scaled co-efficient value of co-efficient matrix

clk_counter : 5 bit vector → Maintains a count of clock cycles

addr_counter : 16 bit vector → Maintains the address of current pixel