You are about to integrate all components that you have learned so far to form a mini system (*system*). The system will be the framework for your final design lab. The block diagram of system is as shown in Fig1.
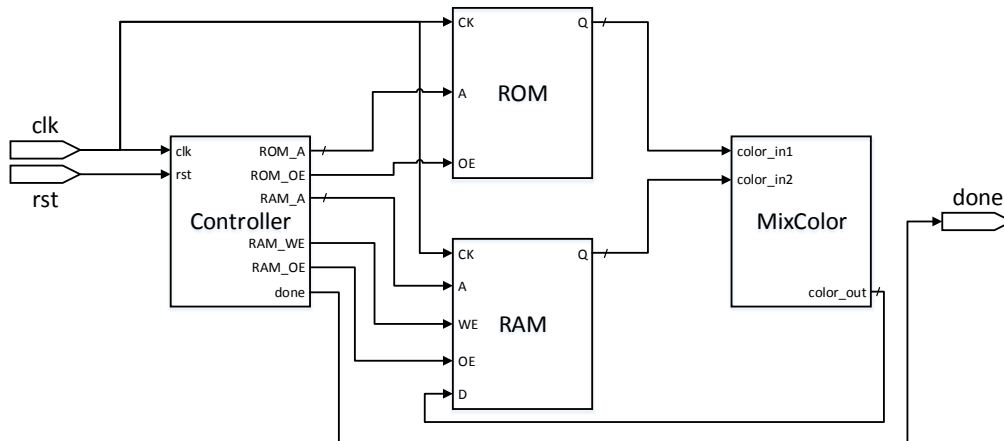

Fig1. The block diagram of system

➢ 系統 module 描述

Controller	The controller of this system
ROM	A read only memory (16384*24bits) 裡頭存放一張 128*128 的圖片，每個 pixel 值為 24bits
RAM	Randon access memory (65536*24bits) 裡頭存放一張 256*256 的圖片，每個 pixel 值為 24bits
MixColor	對兩個 input 做 XOR 運算後輸出

➢ Memory 運作模式

RAM

Data depth = 65536, Data width = 24,

Working at positive edge of clock

When *WE* is high, *D* is stored into the memory as pointed by *A*. When *OE* is high, the data will be put on *Q* as pointed by *A*.
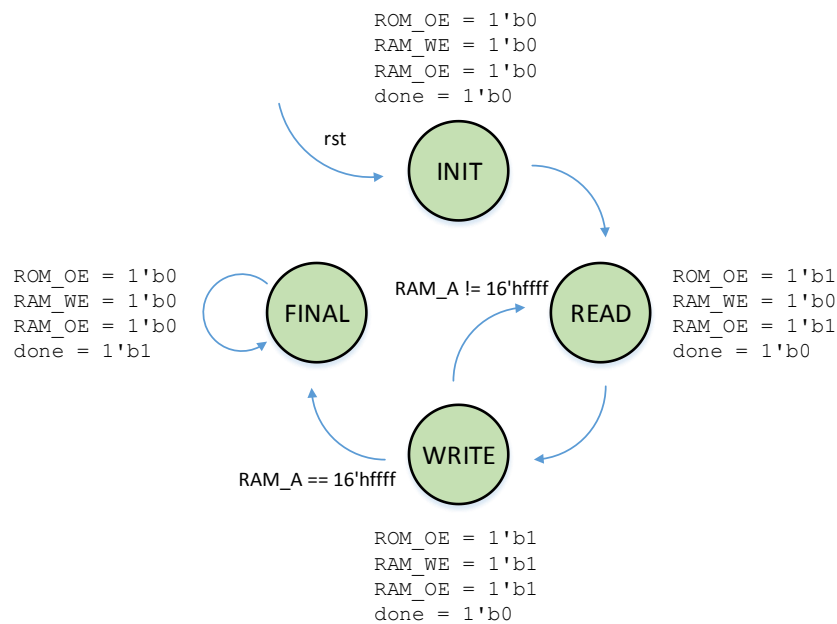
ROM

Data depth = 16384, Data width = 24,

Working at positive edge of clock

When *OE* is high, the data will be put on *Q* as pointed by *A*.

> ➢ Understanding the function:
>
> Once system is initialized, it
>   a) reads pixel from the ROM and RAM;
>   b) uses MixColor component to ==compute the new color of the pixel==;
>   c) writes the ==new color of the pixel== back to the RAM;
>   d) repeats the process step (a)-(c) until the last pixel of RAM is updated;
>   e) flags "done" when step (d) is completed
>
> ➢ Know the basic design rules
>   ● All operations initiated on the positive edge trigger of the clock
>   ● XOR the value of two colors to mix them
>   ● Be aware of the size difference of two images (memories)
>   ● Control signals:
>   ● *ROM_OE*: To read data from ROM
>   ● *RAM_WE*: To store the data to RAM
>   ● *RAM_OE*: To read data from RAM
>   ● *done*: Stop the process
> ➢ Observe the state diagram

```
                          ROM_OE = 1'b0
                          RAM_WE = 1'b0
                          RAM_OE = 1'b0
                          done = 1'b0

                    rst
                             ( INIT )

ROM_OE = 1'b0                                    ROM_OE = 1'b1
RAM_WE = 1'b0      (FINAL)  RAM_A != 16'hffff    RAM_WE = 1'b0
RAM_OE = 1'b0                          (READ)    RAM_OE = 1'b1
done = 1'b1                                      done = 1'b0

                             (WRITE)
              RAM_A == 16'hffff

                          ROM_OE = 1'b1
                          RAM_WE = 1'b1
                          RAM_OE = 1'b1
                          done = 1'b0
```

Complete all components in the system.