

DIGITAL CLOCK

ASSIGNMENT 2- COL215

OVERVIEW AND DESIGN DECISIONS

This clock is a 24- hour digital clock. In this section, I have described the overview and major design decisions taken.

The features (relevant for a user) of this model are:

- It shows the time from 00:00:00 to 23:59:59 (HH:MM:SS).
- It allows the user to manually set the time if required.
- The user can update every digit separately.
- The increment button detects long presses. For short presses, it increases the digit selected by one whereas for long presses it increases the digit selected by 1 per 0.2 sec, i.e. 5 increments per second on average.
- If the time shown is in HH:MM format, then a decimal point keeps blinking every second to give an indication of time.
- It has total 5 push buttons- reset button, set_time button, plus button, change_digit button, mode button.
- User can restart the system by pressing the reset button.
- If the user wants to manually set the time, he/she would have to select the set_time button. Then, he would have to select the digit he wants to change by using change_digit button. The default value that is ready to be incremented is tens digit of hour. Pushing the change_digit button changes the digit in the order:
H(tens digit) -> H(ones digit)-> M(tens digit)->M(ones digit)->S(tens digit)->S(ones digit).

Overview of the working of the model:

The model designed has total 10 components that work together to accomplish different tasks.

master_clock : clk250Hz- The clock provided by the basys board has frequency 10 MHz. Master clock gives a clock of frequency 250 Hz. It uses a counter to count the no. of cycles. One cycle of output signal is equal to $10\text{MHz}/250\text{Hz}=40000$ cycles of input signal.

manual_normal : manual- This component allows the user to set the time manually. It is connected to the master clock and thus it updates the requests every 4 ms. The push button needs to be pressed to change from manual setting mode to normal working.

select_digit : setting- This works based on the FSM model shown in Fig.2 . The button is pressed asynchronously but the effect on output is visible only at the rising clock edge of master clock.

increment: incrementer- This helps in the increasing the digit selected by the select_digit component while manually setting the time. It can detect long and short presses. The push detects long press if it has been pressed for last 0.8 sec. Note that this may also detect longer than 0.6 sec press as a long press in extreme case since the system looks for presses only after every 0.2 sec and 4 rising edges may be counted in 0.6 sec in extreme case. The FSM for this component is shown in Fig.3.

tik_tik: clock- This is the main part of the clock. It is connected to the master clock of 250 Hz. It updates the time after every second. To measure one second, it counts the 250 cycles of the master clock. Also, it has input terminals from manual_normal and increment components to manually set the time. If the signal from manual_normal is '1', it takes the time given by increment as the user input; else it works as a normal clock.

set_mode: mode- This helps to change the output mode from HH:MM format to MM:SS format. It has a input signal from a push button that is pressed to change the mode.

multiplex: multiplexer- This selects the digit that is to shown on the output. This changes every 4 ms as controlled by the display_manager component. This is very fast. Thus, when shown on the 4 seven-segments display, the human even cannot detect this change.

display-manager: clk_display- This gives the output to the anodes and only one anode is active(high voltage) at a time. Also, this sends signal to the multiplexer to select the digit that is to be shown for that cycle. This changes at a frequency of 250Hz, i.e. updated every 4 ms. Thus, the refresh time is 16 ms.

decimal_control: deci- This maintains the output to the decimal-digit that will blink every second when the clock works in HH:MM mode.

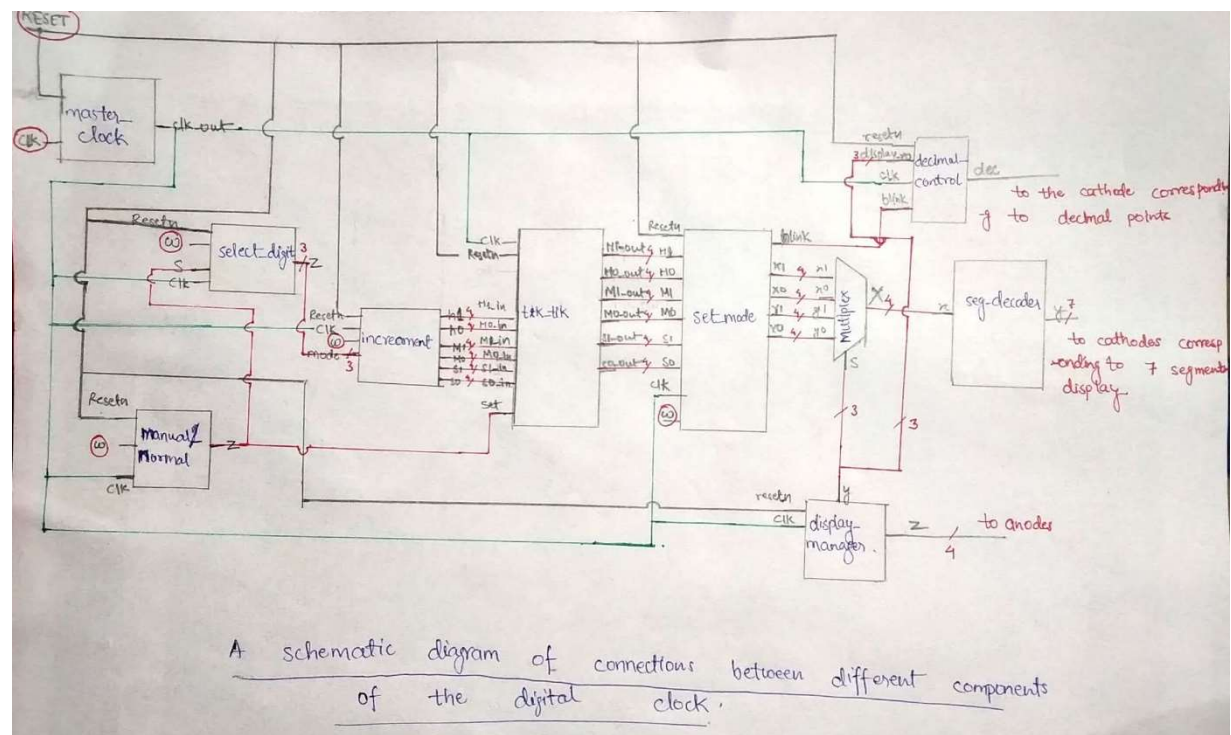


Fig.1: connection of different components

seg_7_decoder: seg_decoder:- The binary outputs for each digit is changed into proper output that should be given to the anodes of 7 segments-display. '1' implies high voltage and '0' implies low voltage.

NOTE: In fig.1 the signals circled red are the inputs provided by the basys board. There are 5 push buttons and 1 clock.

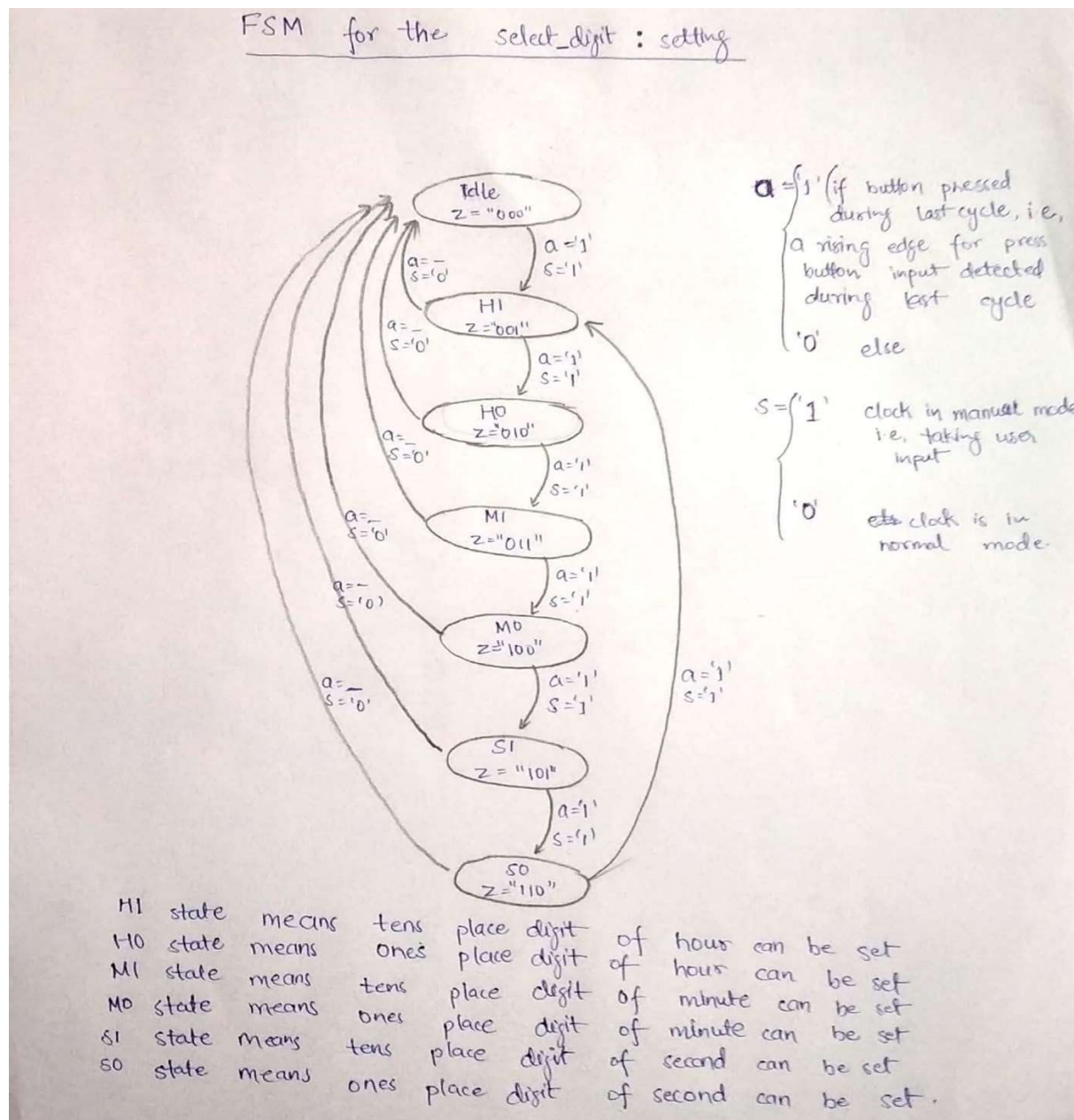


Fig.2 – FSM for the digit selector

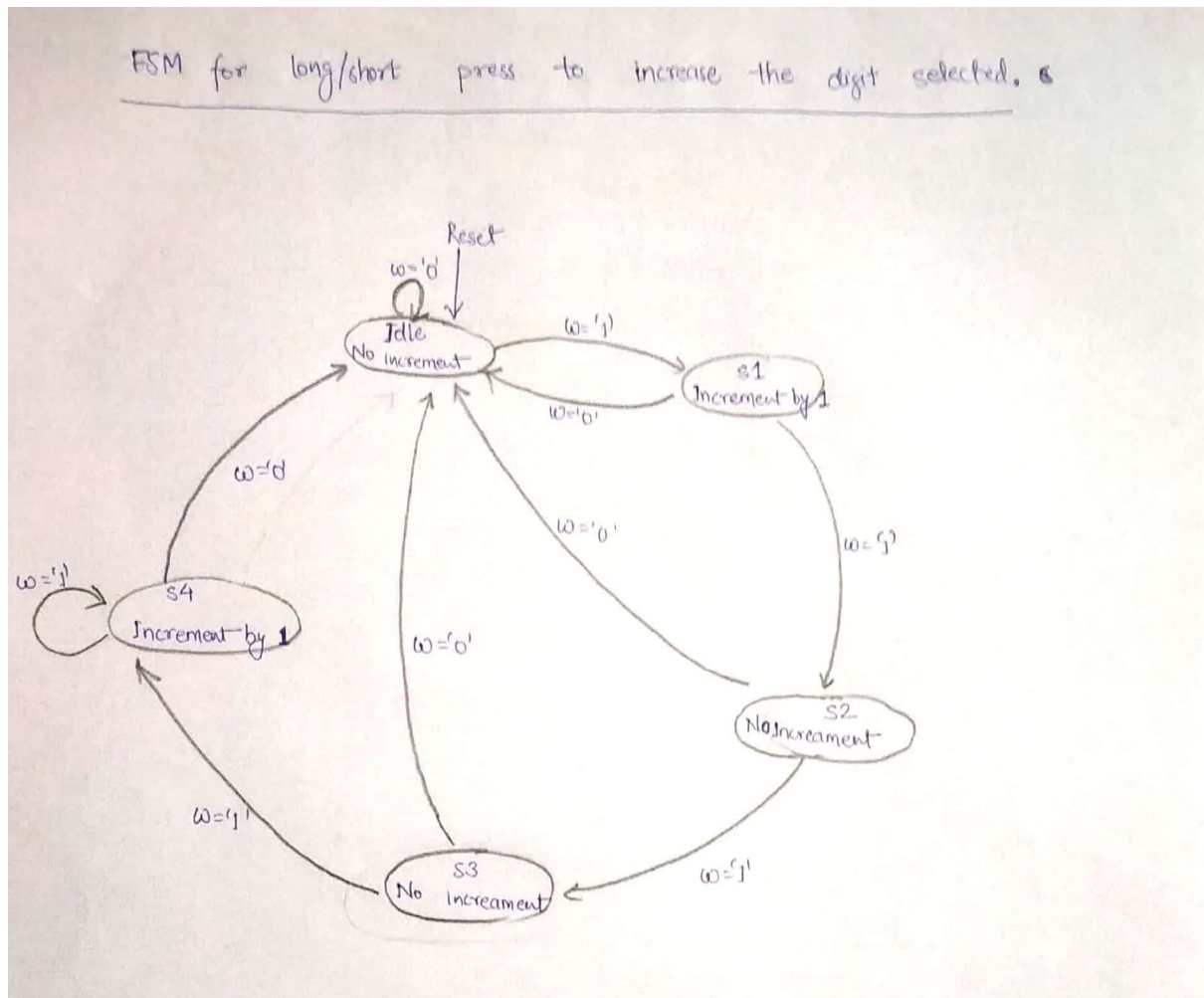


Fig. 3- FSM for the long/short push