EE214 Music Synthesizer Thursday Batch

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1 Designing of a automated Synthesizer

In this experiment you will be playing a music using the notes which were introduced to you in the last class. The notes are given in a particular sequence like in a music. You need the FSM to automate such that note will be played one after another in the given sequence and for a particular duration. Please note that we will not be using the switches to play the notes. Switch will be used just to reset.

2 Notes to be played

Note	Pa	Pa	Dha	Pa	Ma	Ga	Ma	Ma	Pa	Ma	Ga	Re
Duration	0.5s	0.5s	0.25s	0.25s	0.25s	0.25s	0.5s	0.5s	0.25s	0.25s	0.25s	0.25s
Count	1, 2	3, 4	5									16
Note	Ga	Ga	Ma	Ga	Re	Sa	Ni	Re	Sa	Sa	Silent	Silent
Duration	0.5s	0.5s	0.25s	0.25s	0.25s	0.25s	0.5s	0.5s	0.25s	0.25s	0.25s	0.25s
Count												32

Table 1: Notes Table

Note: Here the frequency of Ni is 225Hz. It is the lower octave Ni. Rest of the notes have the same frequency as mentioned in the previous handout.
Hints: Here some notes are being played for 0.5s and some are for 0.25s. So for your convenience you can play the notes of 0.5s duration twice each of 0.25s duration. So for example Pa(the 1st note) will be played like *Pa Pa* each of 0.25s duration. Apply this division rule for other cases also.

3 Steps to perform this experiment

- Fill the table 1 by splitting all notes which are being played for 0.5s duration and keep 0.25s duration notes as it is. So for each 0.25s interval your count value will be incremented by 1.
- Count how many distinct notes are there and make a note(not music note) of that.
- Make a clock(clock_music) with frequency 4 Hz(1/0.25s) from the master clock of 50MHz.
- All the state transition and everything will happen happen at the rising edge of clock_music.
- Make the state diagram and state table and include the same in your report.
- This distinct notes will be the states of the FSM. There will be an initial state(reset) which is silent state.
- This means, at reset, count will be 0, thereafter, at the first rising edge of the clock_music, the count is incremented to 1 and the note Pa, will be played, for the second rising edge the count value gets incremented to 2, however, the corresponding note is again 'Pa'. At the fifth rising edge of the clock_music, when the count is incremented to 5, the note 'Dha' should be played..and this will be continued.
- Assign an LED for each state.

- After the last note machine will go to silent state.
- In the last class you were using switches to play the notes. Switches were played in one hot encoded manner(one at a time). Here in each state a vector will be generated(only one bit position will be on at a time depending upon the state) which will act as input switch to your last design.
- So use the toneGenerator as component here and pass the above vector as switch input to the toneGenerator.
- Write the VHDL code and then make the circuit as shown in the previous handout. And show it to your TA.
- Run the RTL simulation for 10s and show it to your TA.
  NOTE: Simulation will take long time
- Go to Tools → Netlist Viewer and → State machine viewer. Show it to your TA.
- Report should contain the following
  - Description of the experiment.
  - State transition graph (Both handwritten and that generated from Quartus).
  - State Table.
  - Notes Table(Table 1)
- Have fun playing the music :)