

### Dice Game (Chapter 22)

- The dice game in Chapter 22 is a good example of a Finite State Machine controlling a Datapath.
  - The combined FSM/Datapath implement a Dice Game.
- Dice Game Rules:
  - After 1st roll of dice, player wins if roll is 7 or 11. Player loses if roll is 2, 3 or 12. Anything else is saved as the players "POINT".
  - On subsequent rolls, player loses if roll is a 7. Player wins if the dice roll is equal to their "POINT". You must keep rolling until you win or lose.

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### What do we need: A Dice Roll

- Some way to simulate a dice roll. Dice have values of 1,2,3,4,5,6.
- We could generate a "random" number between 1-6.
  - Could use a psuedo random sequence generator in the form of a shift register for this.
  - Can be difficult to test if using psuedo random sequences
- An easier way is to use a counter whose count sequence is 1,2,3,4,5,6,1,2, etc.
  - Even though count sequence is NON-RANDOM, a high speed clock and a user pushing buttons to stop/start the roll will make the dice roll look random!!!

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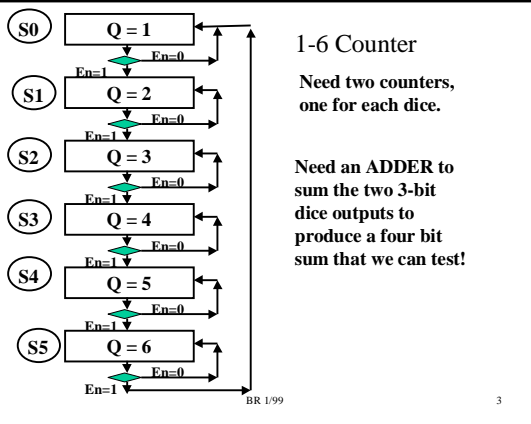
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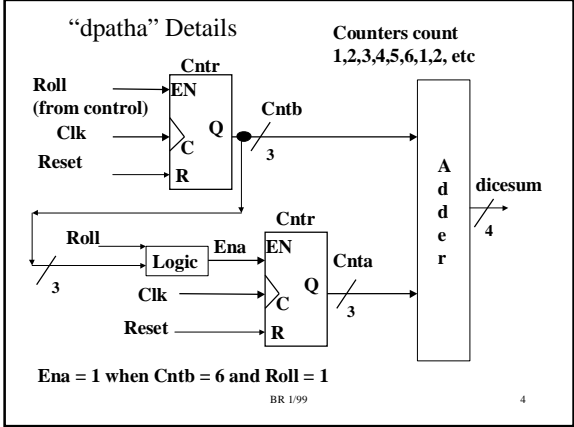
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- What else do we need???
- We need to save the “POINT” value from the first roll somewhere.
    - Use a Register!
  - We need to compare our POINT value and the current dice roll to several values
    - Compare Current dice roll to POINT value: Use a comparator
    - Compare Current dice roll to values of 7, 11, 2, 3, 12: Use comparator logic
  - Need inputs to start the dice roll, stop the dice roll.
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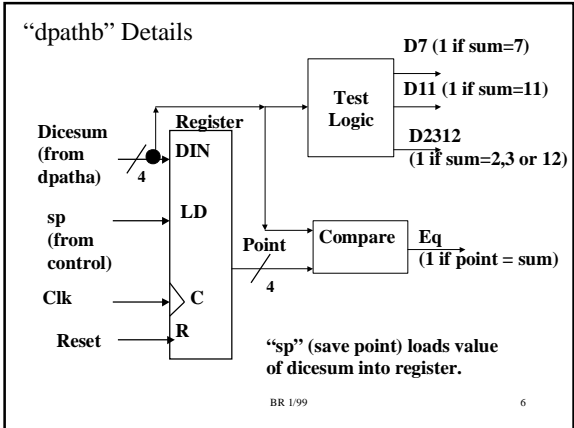
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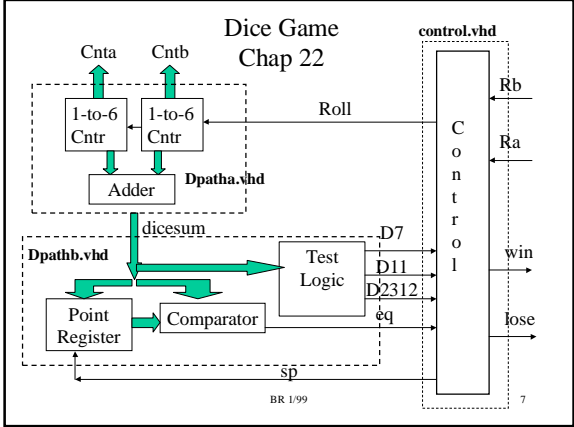
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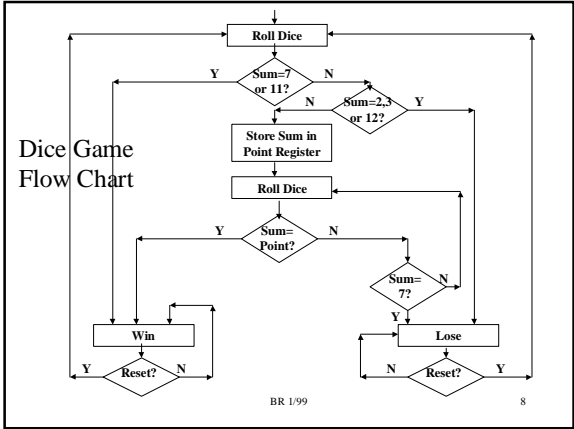
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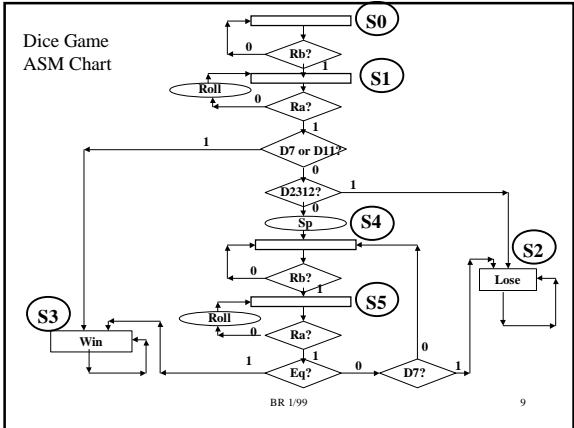
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## Dice Game Implementation

- Dice game implemented in three 22V10 PLDs
  - control.vhd (Finite State Machine)
  - dpatha.vhd (two 1-6 counters, adder)
  - dpathb.vhd (point register, comparator, test logic)
- The Control FSM is implemented using one-hot encoding.
  - Outputs q0, q1, q5 are states S0, S1, S5. Output “win” is state S2, output “lose” is state S3. Outputs q0,q1,q5 are available just for debugging purposes.

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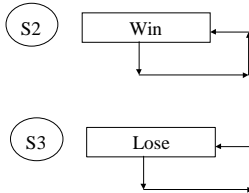
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## Finite State Machine Changes

Asynchronous Reset now use to exit states S2, S3. Resets back to State S0.



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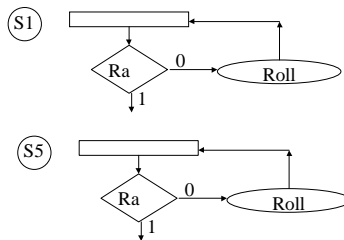
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## Finite State Machine Changes (cont).

Because we don't have debounced switches, added extra “roll” input called “Ra”. Changed States S1, S5 to use Ra, not Rb.



This means that to roll the dice, you use flip switch Rb up, then down. This starts the dice rolling. To stop the dice, Flip Ra switch up then down.

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