snakes & ladders
digital electronics

Innovative Assignment

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Aim	To create a functional snakes and ladders game with a little twist using Digital Electronics concepts and components
Components Used	AND Gates, OR Gates, NOT Gates, Adders, Subtractors, Multiplexers (MUX), Demultiplexers (DeMUX), Decoders, T Flip-Flops, Random Generator, Registers, 7-Segment Displays, LEDs, Buttons, Constants, Splitters and Probes

Game Rules (with a twist)

- This game can be played by 2-players.
- Firstly, Player-1 will roll the dice and then Player-2.
- The twist here being, instead of the numbers 1-6, the numbers 1-7 will appear on the dice. Also, the dice might even generate a 0, i.e. the Player's turn has been skipped.
- When a player encounters a ladder, they can ascend it to transition to the other block connected to the ladder, effectively upgrading their position.
- Similarly, when they'll encounter a snakes mouth, they will descend to the block located at the snake's tail.
- The first one to reach to the hundredth block (get to the score of hundred or more) will win the entire game.

Game Board

The game board is displayed using different LEDs (most of them of the color blue). Snakes are represented with red LEDs and Ladders with green ones. The snakes and ladders connections are used to connect the blocks using wires, respectively.

Methodology Followed

The game begins with pushing a button which is connected to a Random Generator. The output of this random generator is given as the input of a 3x8 Decoder. The outputs of this decoder are given as the input of a Seven Segment Display respectively. This display plays the role of the dice of the game, it displays the number on the dice.

When the button is pushed, it gives the input of clock pulse in T Flip Flop. This is to give alternate turns to the players. The output of this T Flip Flop is taken as the selection line of a demultiplexer and the input of the 1x2 Demultiplexer is the randomly generated number. Then two similar combinational & sequential circuits are constructed, one for each player. The two outputs of DeMUX are given one to each circuit.

The score of each player is passed as the input of an adder and the new dice score as the carry in of the adder. Adder's output is further used at two places. Firstly as the input of another 1x2 demultiplexer (this is explained later *). And secondly to check whether the player has encountered a ladder or a snake or none.

Further, a setup of gates is done to check for a ladder or a snake. If the player encountered a ladder, their position is reallocated to the respective block by adding the ladder points to the current score of the player using an adder. Similarly, if a snake is encountered, respective amount of score is deducted from the players' current destination by the use of a subtractor. The outputs of these (adder and subtractor) are then passed through two different 2x1 MUXs, each one to a different MUX. These MUXs are connected in series. * The outputs of the previous DeMUX are given one to the input of the first one of these MUXs and the other output is given to the adder for the ladder.

The output of the second MUX is passed as the input of a Register. In both the combinational circuits, a separate Register is connected to store the current block number of each player. Two probes, one to each, are attached to display the block on which the players are standing. These locations/scores are taken as the input of another 2x1 multiplexer. The output of this multiplexer is further passed to another combinational circuit which checks the winning condition and further clears the board.

NOTE: The scores are stored and used in 7-bit form in the registers as well as into the input for checking the winning condition.

Winning Condition

A separate combinational circuit is designed to declare the winner as soon as any of the players reaches or crosses 100. The last MUX's output is turned to 7-bits using splitter. These bits are further passed through a set of gates to check whether the player who has recently taken the chance has reached or crossed the 100th block or not. If so, the outputs are connected to another seven segment display which displays the winner player.

Circuit Screenshots