

گزارش سوال 8 میان‌ترم درس طراحی سیستم‌های دیجیتال

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```
module ParkingManagement(  
    input wire clk,  
    input wire reset,  
    input wire car_entered,  
    input wire is_uni_car_entered,  
    input wire car_exited,  
    input wire is_uni_car_exited,  
    output reg [9:0] uni_parked_car,  
    output reg [9:0] total_parked_car,  
    output reg [9:0] uni_vacated_space,  
    output reg [9:0] total_vacated_space  
);  
  
parameter TOTAL_CAPACITY = 700;  
parameter UNI_CAPACITY_LIMIT = 200;  
parameter INCREMENT_CAPACITY_PER_HOUR = 50;  
parameter TIME_LIMIT = 13;  
parameter TIME_INCREMENT_START = 13;  
parameter TIME_INCREMENT_END = 16;  
  
reg [9:0] current_capacity;  
reg [4:0] current_hour;  
  
always @(posedge clk or posedge reset) begin  
    if (reset) begin  
        uni_parked_car <= 0;  
        total_parked_car <= 0;  
        uni_vacated_space <= UNI_CAPACITY_LIMIT;  
        total_vacated_space <= TOTAL_CAPACITY;  
        current_hour <= 0;  
        current_capacity <= UNI_CAPACITY_LIMIT;  
    end else begin  
        if (car_entered) begin  
            if (is_uni_car_entered && (uni_parked_car < UNI_CAPACITY_LIMIT)) begin  
                uni_parked_car <= uni_parked_car + 1;  
            end  
            total_parked_car <= total_parked_car + 1;  
            total_vacated_space <= total_vacated_space - 1;  
            if (is_uni_car_entered) begin  
                uni_vacated_space <= uni_vacated_space - 1;  
            end  
        end  
    end  
end
```

```

end else begin
    if (car_entered) begin
        if (is_uni_car_entered && (uni_parked_car < UNI_CAPACITY_LIMIT)) begin
            uni_parked_car <= uni_parked_car + 1;
        end
        total_parked_car <= total_parked_car + 1;
        total_vacated_space <= total_vacated_space - 1;
        if (is_uni_car_entered) begin
            uni_vacated_space <= uni_vacated_space - 1;
        end
    end

    if (car_exited) begin
        if (is_uni_car_exited && (uni_parked_car > 0)) begin
            uni_parked_car <= uni_parked_car - 1;
        end
        total_parked_car <= total_parked_car - 1;
        total_vacated_space <= total_vacated_space + 1;
        if (is_uni_car_exited) begin
            uni_vacated_space <= uni_vacated_space + 1;
        end
    end

    if (current_hour >= TIME_INCREMENT_START && current_hour < TIME_INCREMENT_END) begin
        current_capacity <= current_capacity + INCREMENT_CAPACITY_PER_HOUR;
        total_vacated_space <= total_vacated_space + INCREMENT_CAPACITY_PER_HOUR;
    end

    if (current_hour < 23) begin
        current_hour <= current_hour + 1;
    end else begin
        current_hour <= 0;
    end
end
end
endmodule

```

توضیحات کد:

• ماژول: ParkingManagement

- این ماژول شامل ورودی‌ها و خروجی‌های مدار مدیریت پارکینگ است.
- از یک سیگنال کلاک و یک سیگنال ریست برای مدیریت زمان و وضعیت اولیه استفاده می‌کند.
- شمارشگرهایی برای تعداد خودروهای دانشگاه و کل خودروهای پارک شده دارد.
- ظرفیت خالی پارکینگ برای دانشگاه و کل پارکینگ را مدیریت می‌کند.
- در صورت ورود یا خروج خودرو، ظرفیت‌های مربوطه به‌روزرسانی می‌شوند.
- اگر خودرو متعلق به دانشگاه باشد، ظرفیت مربوط به دانشگاه نیز به‌روزرسانی می‌شود.
- افزایش ظرفیت در ساعات خاص مدیریت می‌شود.

کد تست بنچ:

```
module ParkingManagement_tb;

    reg clk;
    reg reset;
    reg car_entered;
    reg is_uni_car_entered;
    reg car_exited;
    reg is_uni_car_exited;
    wire [9:0] uni_parked_car;
    wire [9:0] total_parked_car;
    wire [9:0] uni_vacated_space;
    wire [9:0] total_vacated_space;

    ParkingManagement uut (
        .clk(clk),
        .reset(reset),
        .car_entered(car_entered),
        .is_uni_car_entered(is_uni_car_entered),
        .car_exited(car_exited),
        .is_uni_car_exited(is_uni_car_exited),
        .uni_parked_car(uni_parked_car),
        .total_parked_car(total_parked_car),
        .uni_vacated_space(uni_vacated_space),
        .total_vacated_space(total_vacated_space)
    );

    always begin
        #5 clk = ~clk;
    end

    initial begin
        clk = 0;
        reset = 1;
        car_entered = 0;
        is_uni_car_entered = 0;
        car_exited = 0;
        is_uni_car_exited = 0;

        $monitor("Time: %0t | uni_parked_car: %d | total_parked_car: %d | uni_vacated_space: %d | total_vacated_space: %d",
            | | | | $time, uni_parked_car, total_parked_car, uni_vacated_space, total_vacated_space);

        #10 reset = 0;

        #10 car_entered = 1; is_uni_car_entered = 1;
        #10 car_entered = 0; is_uni_car_entered = 0;

        #10 car_entered = 1; is_uni_car_entered = 0;
        #10 car_entered = 0; is_uni_car_entered = 0;

        #10 car_exited = 1; is_uni_car_exited = 1;
        #10 car_exited = 0; is_uni_car_exited = 0;

        #10 car_exited = 1; is_uni_car_exited = 0;
        #10 car_exited = 0; is_uni_car_exited = 0;

        #10 car_entered = 1; is_uni_car_entered = 1;
        #10 car_entered = 1; is_uni_car_entered = 1;
        #10 car_entered = 1; is_uni_car_entered = 1;
        #10 car_entered = 1; is_uni_car_entered = 1;
        #10 car_entered = 0; is_uni_car_entered = 0;

        #10 car_exited = 1; is_uni_car_exited = 1;
        #10 car_exited = 1; is_uni_car_exited = 1;
        #10 car_exited = 1; is_uni_car_exited = 1;
        #10 car_exited = 0; is_uni_car_exited = 0;

        #10 car_entered = 1; is_uni_car_entered = 0;
        #10 car_entered = 1; is_uni_car_entered = 0;
        #10 car_exited = 1; is_uni_car_exited = 0;
        #10 car_exited = 1; is_uni_car_exited = 0;
        #10 car_exited = 0; is_uni_car_exited = 0;

        #100 $stop;
    end

endmodule
```

توضیحات کد:

• مازول: ParkingManagement

- این مازول شامل ورودی‌ها و خروجی‌های مدار مدیریت پارکینگ است.
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- افزایش ظرفیت در ساعات خاص مدیریت می‌شود.

نتیجه تست:

```
# Time: 0 | uni_parked_car: 0 | total_parked_car: 0 | uni_vacated_space: 200 | total_vacated_space: 700
# Time: 25 | uni_parked_car: 1 | total_parked_car: 1 | uni_vacated_space: 199 | total_vacated_space: 699
# Time: 45 | uni_parked_car: 1 | total_parked_car: 2 | uni_vacated_space: 199 | total_vacated_space: 698
# Time: 65 | uni_parked_car: 0 | total_parked_car: 1 | uni_vacated_space: 200 | total_vacated_space: 699
# Time: 85 | uni_parked_car: 0 | total_parked_car: 0 | uni_vacated_space: 200 | total_vacated_space: 700
# Time: 105 | uni_parked_car: 1 | total_parked_car: 1 | uni_vacated_space: 199 | total_vacated_space: 699
# Time: 115 | uni_parked_car: 2 | total_parked_car: 2 | uni_vacated_space: 198 | total_vacated_space: 698
# Time: 125 | uni_parked_car: 3 | total_parked_car: 3 | uni_vacated_space: 197 | total_vacated_space: 697
# Time: 135 | uni_parked_car: 4 | total_parked_car: 4 | uni_vacated_space: 196 | total_vacated_space: 696
# Time: 145 | uni_parked_car: 4 | total_parked_car: 4 | uni_vacated_space: 196 | total_vacated_space: 746
# Time: 155 | uni_parked_car: 3 | total_parked_car: 3 | uni_vacated_space: 197 | total_vacated_space: 796
# Time: 165 | uni_parked_car: 2 | total_parked_car: 2 | uni_vacated_space: 198 | total_vacated_space: 846
# Time: 175 | uni_parked_car: 1 | total_parked_car: 1 | uni_vacated_space: 199 | total_vacated_space: 847
# Time: 195 | uni_parked_car: 1 | total_parked_car: 2 | uni_vacated_space: 199 | total_vacated_space: 846
# Time: 205 | uni_parked_car: 1 | total_parked_car: 3 | uni_vacated_space: 199 | total_vacated_space: 845
# Time: 215 | uni_parked_car: 1 | total_parked_car: 2 | uni_vacated_space: 199 | total_vacated_space: 846
# Time: 225 | uni_parked_car: 1 | total_parked_car: 1 | uni_vacated_space: 199 | total_vacated_space: 847
# Time: 235 | uni_parked_car: 1 | total_parked_car: 2 | uni_vacated_space: 199 | total_vacated_space: 846
# Time: 245 | uni_parked_car: 1 | total_parked_car: 3 | uni_vacated_space: 199 | total_vacated_space: 845
# Time: 255 | uni_parked_car: 1 | total_parked_car: 4 | uni_vacated_space: 199 | total_vacated_space: 844
# Time: 265 | uni_parked_car: 1 | total_parked_car: 5 | uni_vacated_space: 199 | total_vacated_space: 843
# Time: 275 | uni_parked_car: 1 | total_parked_car: 6 | uni_vacated_space: 199 | total_vacated_space: 842
# Time: 285 | uni_parked_car: 1 | total_parked_car: 7 | uni_vacated_space: 199 | total_vacated_space: 841
# Time: 295 | uni_parked_car: 1 | total_parked_car: 8 | uni_vacated_space: 199 | total_vacated_space: 840
# Time: 305 | uni_parked_car: 1 | total_parked_car: 9 | uni_vacated_space: 199 | total_vacated_space: 839
# Time: 315 | uni_parked_car: 1 | total_parked_car: 10 | uni_vacated_space: 199 | total_vacated_space: 838
# Time: 325 | uni_parked_car: 1 | total_parked_car: 11 | uni_vacated_space: 199 | total_vacated_space: 837
# Break in Module ParkingManagement_tb at C:/Users/AmShZ/UNI/DSD/Q8/ParkingManagement_tb.v line 73
```