



FPGA-Based Parking Monitoring System

Hardware Engineering
Team F

Introduction:

Objective:

- Implement a parking monitoring system using FPGA
- Use ultrasonic and infrared sensors for real-time status updates

Key Benefits:

- High efficiency and accuracy in parking management
- Real-time updates and collision prevention

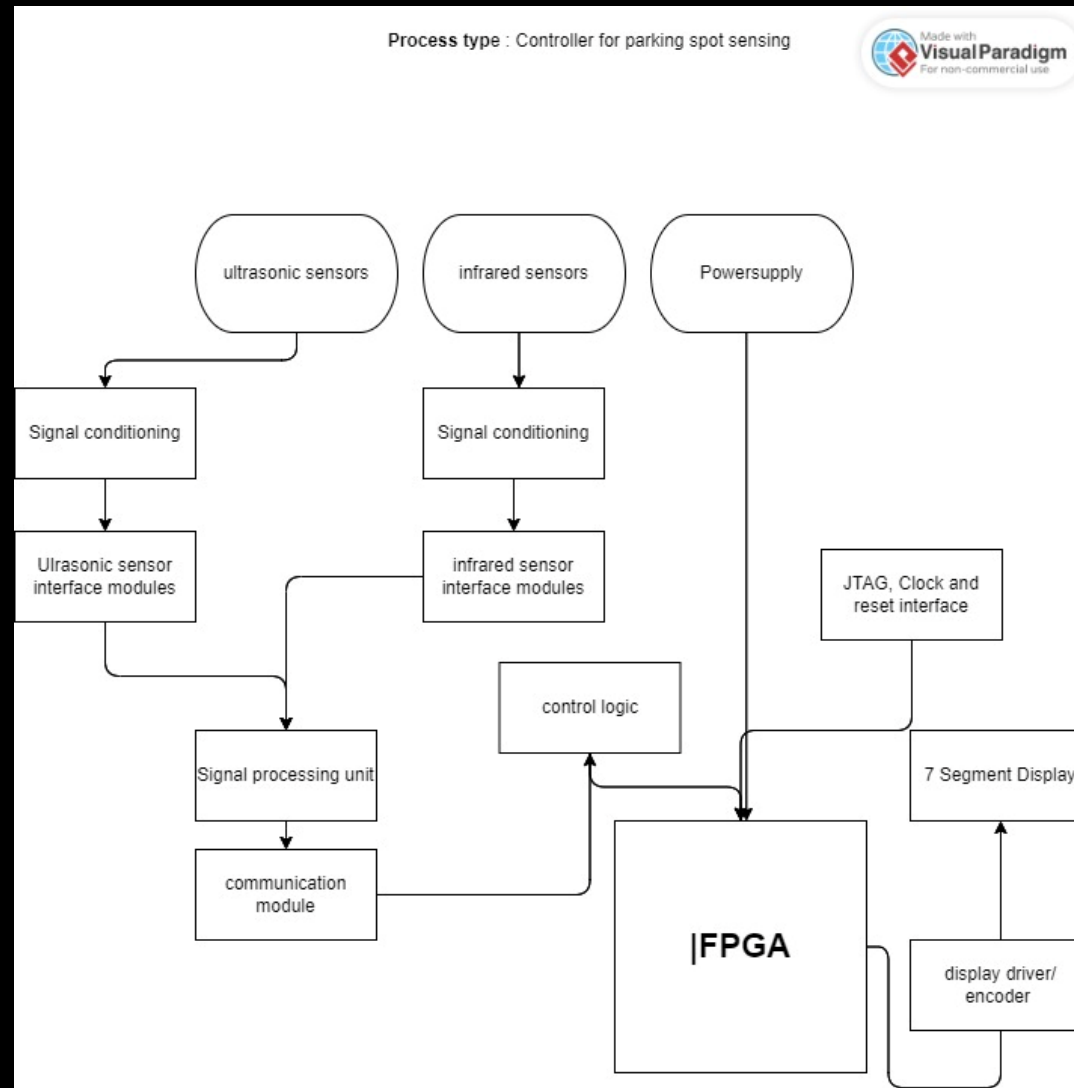
Project Concept:

Description:

- Real-time monitoring of parking spaces using sensors
- FPGA processes sensor data to determine parking space status

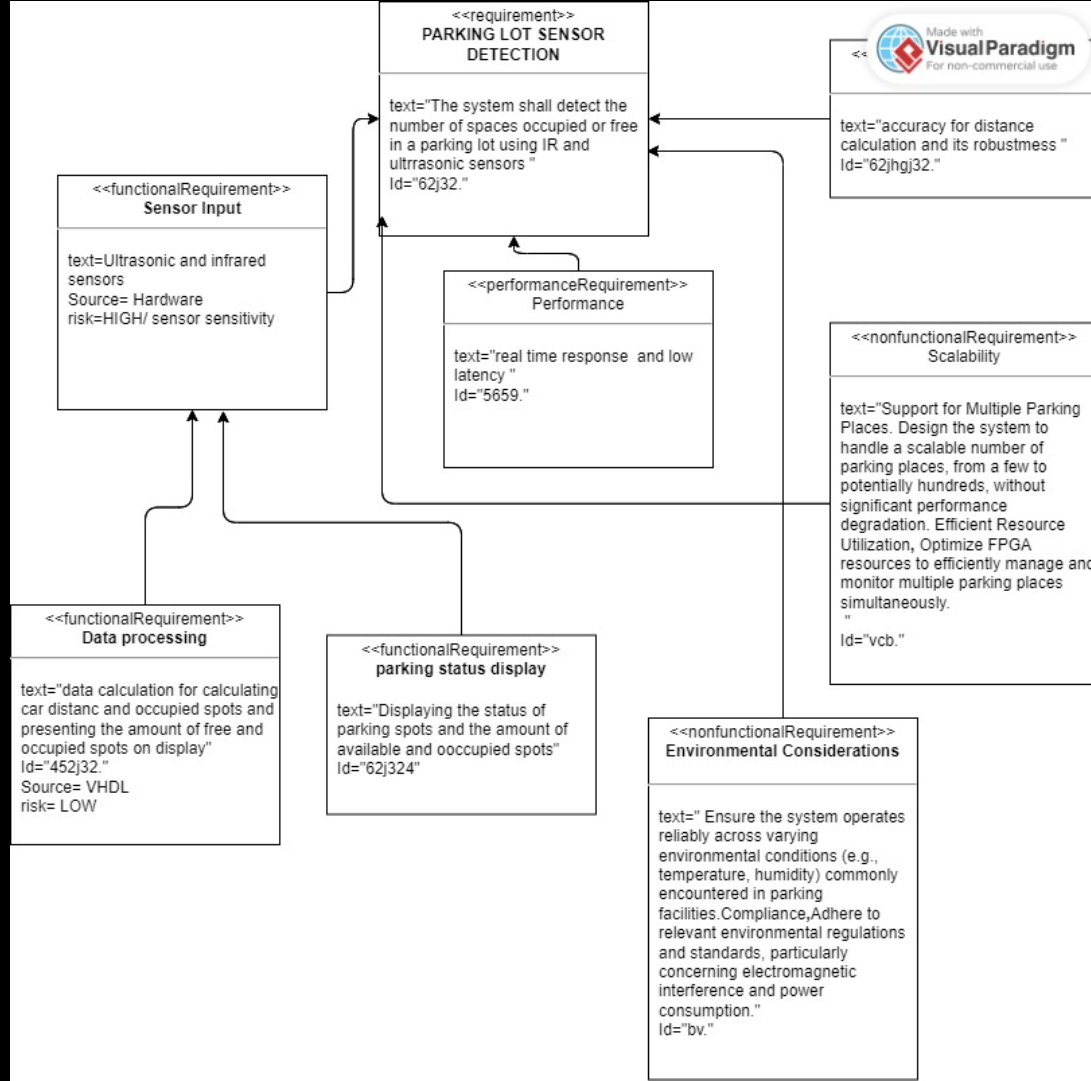
Technologies Used:

- Field-Programmable Gate Arrays (FPGAs)
- VHSIC Hardware Description Language (VHDL)
- KiCAD for PCB design



Components:

- Ultrasonic Sensor
- Infrared Sensor
- Piezo-Buzzer
- FPGA Board Nexys A7



Functionalities:

- Real-time surveying of parking spaces
- Immediate display updates
- Sensor data processing
- Status display on 7-segment displays
- Safe Distance alert via Piezo-buzzer

VHDL Coding and Simulation:

Coding:

- Use of Finite State Machine (FSM) approach
- Modules: Sensor check, status update, warning

RTL Simulation:

- Test benches for simulation
- Verification of design specifications

```
process(clk)
begin
    if rising_edge(clk) then
        if ir_sensor_input = '1' then
            parking_status <= "1"; -- occupied
        else
            parking_status <= "0"; -- available
        end if;
        seven_segment_display <= parking_status;
    end if;
end process;
```

```
process(clk)
begin
    if rising_edge(clk) then
        distance <= ultrasonic_sensor_reading;
        if distance < threshold then
            buzzer <= '1'; -- activate buzzer
        else
            buzzer <= '0'; -- deactivate buzzer
        end if;
    end if;
end process;
```

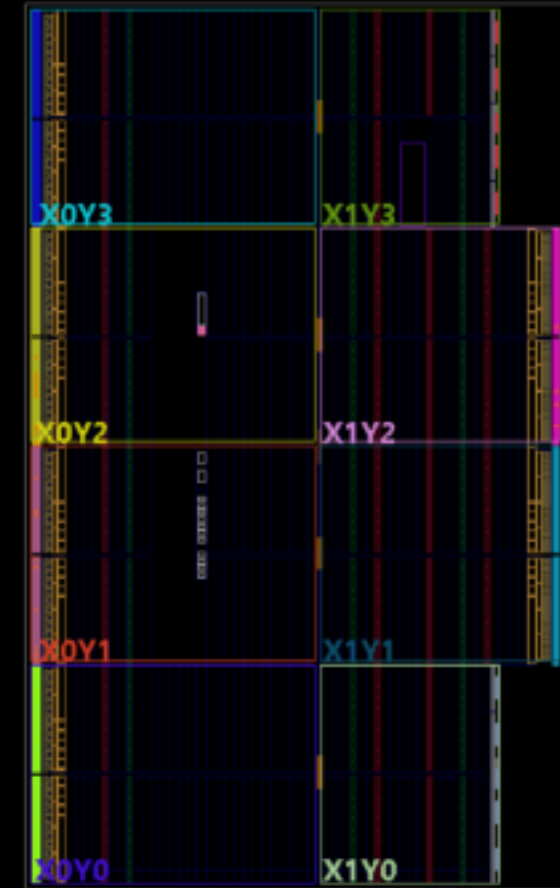
Synthesis Design and Implementation:

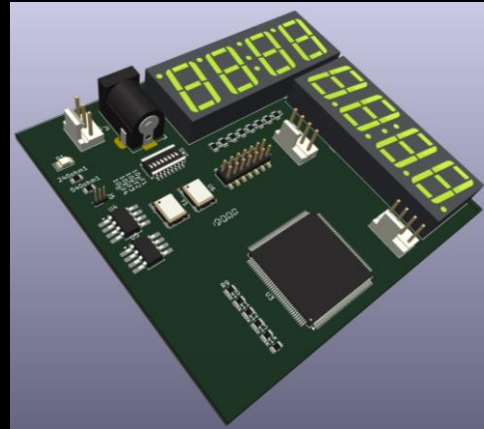
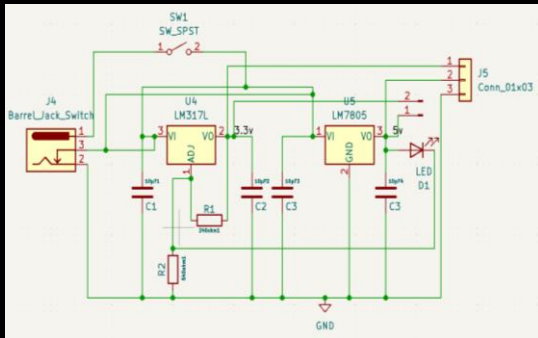
Implementation:

- Successful implementation on Artix 7 FPGA
- FSM-based control of system behaviour

Results:

- Accurate status updates and collision warnings
- Efficient and safe parking management system





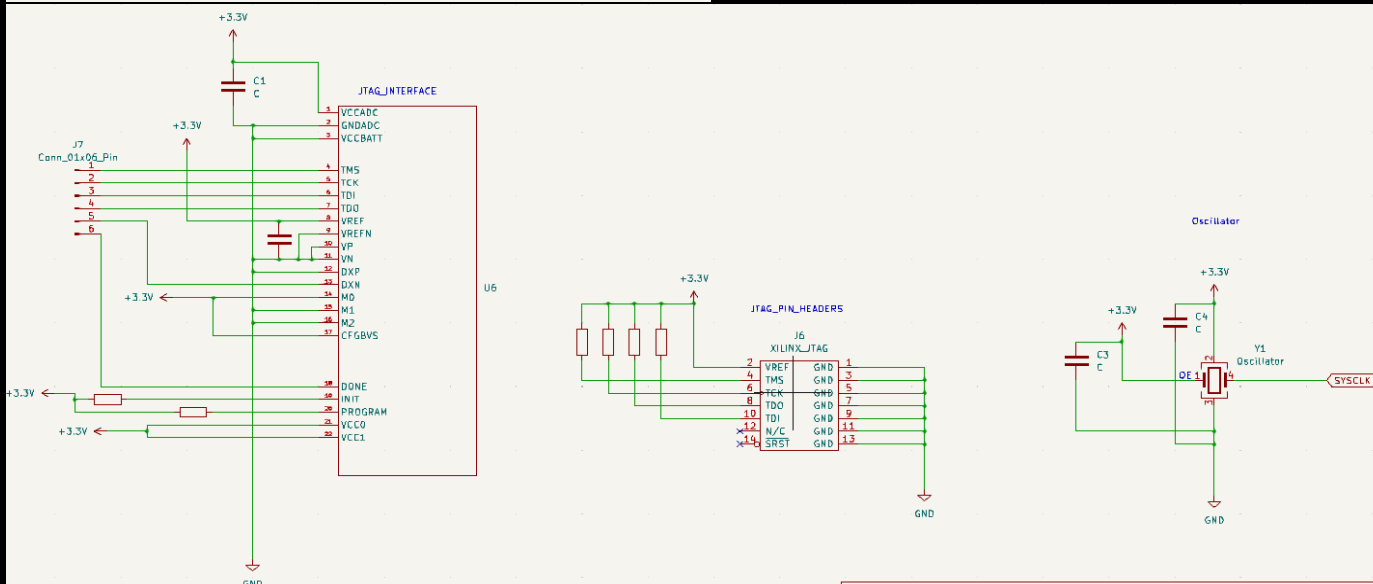
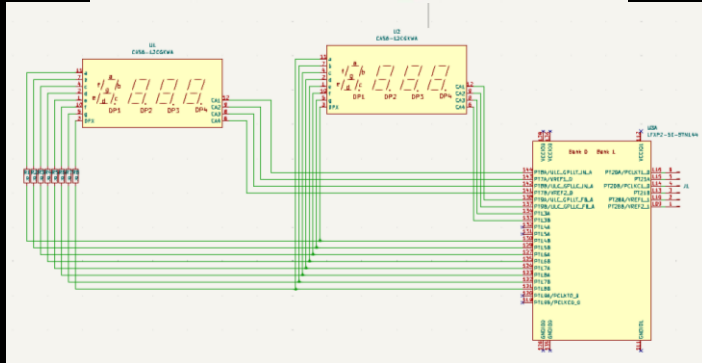
PCB Design:

Design Process:

- Schematics development and component
- ERC checks and corrections

Components:

- Power Supply Circuit
- Clock Circuit
- JTAG Interface
- 7-Segment Displays



Conclusion and Future Work:

Conclusion:

- High efficiency and accuracy in monitoring parking spaces
- Real-time collision prevention

Future Work:

- Integration with IoT applications
- Scalability for larger parking lots

THANKS...