Lab Report Project 2

Digital Design 1

Under the Supervision of Dr.Mohamed Shalan

Names: Janna Osama and Youssef Badawy

Implementation Report: Digital Clock

This report provides an overview of the implementation of the `DigitalClock` module. The module is designed to function as a digital clock with features like time adjustment and alarm setting.

The `**DigitalClock**` module is the main module for our design which consists of several submodules responsible for different functionalities of the digital clock system. These submodules include clock dividers, push-button detectors, counters for tracking time and functioning the clock, BCD converters, state machine conditions for controlling clock operations, and LED and sound output controllers.

The following modules have been implemented for different functions to be used in the `DigitalClock` module:

1. **Clock Divider:** Divides the input clock signal to generate a 1 Hz clock signal (`clk1hz`) and a 200 Hz clock signal (`clkout200`).

2. **PushButtonDetecto**r: Detects button presses and generates corresponding output and uses a **rising edge detector,** a **synchronizer** and a **debounce**r modules .

3. **Counter Bits**: A binary counter for selecting anodes for multiplexing display segments.

4. **AlarmCounter**: Tracks alarm time in seconds, minutes, and hours.

5. **SecMinHourCounter**:Tracks current time in seconds, minutes, and hours.

6. **BCD**: Converts binary values to BCD format for display on 7-segment displays.

The functionality and the features

Clock Generation:

The clock generation feature is crucial for the functionality of the digital clock. In this module, two clock signals are generated: a 1 Hz signal (`clk1hz`) which is the fundamental base counter for tracking the time and a 200 Hz signal (`clkout200`) which is needed for the button debouncing .

Time Tracking:

. It is implemented by counters to keep track of each unit of time, incrementing them accordingly. These counters are synchronized with the 1 Hz clock signal to ensure accurate timekeeping.

Alarm implementation:

The alarm functionality allows users to set alarms for specific times. The module includes components to set and compare alarm times with the current time. When the current time matches the set alarm time, the system triggers an alarm, which triggers a buzzer and a LED.

Button Inputs:

We have 5 buttons **BTNR**, **BTNL, BTNL, BTNU,** and **BTNR.**

BTNU increments the the hours and the minutes in either the adjust Time or adjustAlarm mode.

BTND decrements the the hours and the minutes in either the adjust Time or adjustAlarm mode.
BTNC exits the “adjust” mode to the “clock/alarm” mode and also enters the adjust mode.
BTNL or **BTNR** selects what to adjust: “time hour”, “time minute”, “alarm hour”, and “alarm minute” (in sequence).

Display:
The 7-segment displays to represent the current time and alarm time.

State Machine:
The state machine manages different states of the clock based on input signals such as button presses and alarm activation. The state machine transitions between states to enable functionalities such as **time adjustment**, **alarm setting**, and **normal clock operation.**

Implementation Issues

1. **7-Segment Display Configuration**

Issue: Configuring the 7-segment display to properly represent the hours and minutes digits.
Resolution: Implementing logic to map the binary-coded time values to the appropriate segments of the display, ensuring correct representation of hours and minutes.

2. **Mode Switching Logic**

Issue: Implementing the logic for switching between the "clock/alarm" mode and the "adjust" mode based on button presses.
Resolution: Designing a robust state machine to handle mode transitions and ensuring proper synchronization between display modes and button inputs.

3. **Blinking Decimal Point**

Issue: Implementing the blinking of the second decimal point from the left in the "clock/alarm" mode with a frequency of 1Hz.

Resolution: Developing a timer-based mechanism to toggle the state of the decimal point at the desired frequency while maintaining accurate timekeeping.

4. **Alarm Functionality**

Issue: Ensuring proper comparison between current time and set alarm time to trigger the LD0 blinking when they match.

Resolution: Implementing a reliable comparison mechanism and synchronization between the clock and alarm counters to accurately detect matching times and trigger the appropriate visual indication.

Validation Activities

1. **Functional Testing**

Description: Testing each submodule individually to ensure they perform their designated functions correctly.

Validation: Verifying that the clock divider generates accurate 1 Hz and 200 Hz signals, button inputs are detected and processed correctly, counters track time accurately, and alarm functionalities trigger alarms appropriately.

2. **Integration Testing**

Description: Testing the integration of all submodules within the DigitalClock module to ensure proper communication and synchronization.

Validation: Verifying that all submodules interact correctly with each other, data flows smoothly between components, and the system functions as expected when all modules are working together.

Contributions

Youssef Badawy

1. **Design and Implementation of Clock Divider:** responsible for dividing the input clock signal into a 1 Hz signal (`clk1hz`) and a 200 Hz signal (`clkout200`).

2. **Design and Implementation of State Machine:** responsible for controlling the different states of the digital clock system, including normal operation, time adjustment mode, and alarm setting mode.
3. **Designing the overall architecture of the `DigitalClock` module**, including the interconnection of submodules, data flow between components, and synchronization of clock signals.
4. **Testing of their implemented modules** to ensure proper functionality and integration within the `DigitalClock` module.
5. **Creating the block diagram** illustrating the structure of the `DigitalClock` module, depicting the relationships between clock dividers, button detectors, counters, converters, state machines, and output controller.

Janna Osama

1. **Design and Implementation of AlarmCounter and SecMinHourCounter,** for tracking alarm time in seconds, minutes, and hours, and the SecMinHourCounter submodule for tracking current time in seconds, minutes, and hours.
2. **Design and Implementation of Button Inputs Handling,**including detecting button presses and interpreting them based on the current state of the system.
3. Design and Implementation of **Button Inputs Handling.**
4. **Created the Logicism Structure** used for the implementation of the design.
5. Testing of their implemented modules to ensure proper functionality and integration within the `DigitalClock` module.
6. **Documentation of writing the report.**