Digital Clock System

Shashank *(2204232, shashank.bhushan.22042@iitgoa.ac.in)*
Roshan (2204229, roshan.sharma.22042@iitgoa.ac.in)
Rushikesh2204230,*rushikesh.waghmare.22042@iitgoa.ac.in*
Sayan (2204231, sayan.dhara.22042@iitgoa.ac.in)

Introduction

In the realm of digital innovation, our project introduces a VHDL-powered digital clock system that harmoniously integrates a clock display, stopwatch, timer, and an alarm equipped with a buzzer. This endeavor transcends traditional timekeeping devices by leveraging the precision and versatility of VHDL, a hardware description language. The meticulous coding showcases technical prowess and highlights the seamless synergy between hardware and software components. The project not only offers a sleek and user-friendly design but also serves as a testament to the potential of VHDL in crafting sophisticated digital systems.

This multi-functional timekeeping device stands as a testament to the convergence of technology and time management. Beyond a mere clock, it embodies a comprehensive suite of features, including a stopwatch for accurate time tracking, a timer for countdown functionalities, and an alarm with a buzzer for timely reminders. As we navigate through the complexities of VHDL code, the project unfolds as a compelling exploration into the future of digital clocks, showcasing the adaptability and ingenuity achievable through the marriage of hardware and VHDL programming.

System Overview

A block diagram of the system is given in Fig. 1.

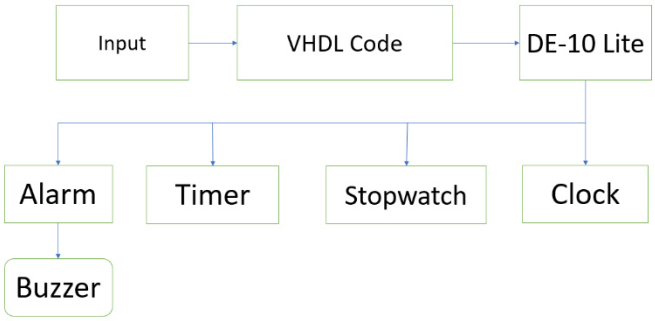


Fig. 1: Block Diagram.

Our digital clock system is an advanced timekeeping solution built on VHDL, offering a seamless integration of various time-related functionalities within a single device. The core components of the system include a clock display, stopwatch, timer, and an alarm system with a buzzer.

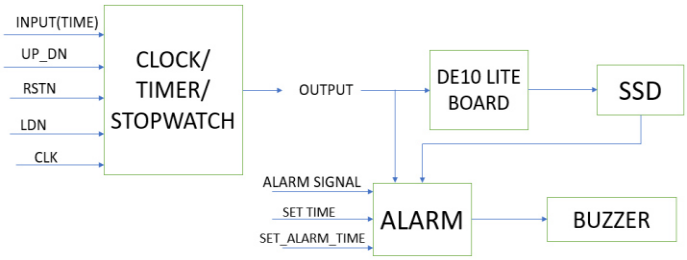
- **Clock Display:** The central feature of the system is a high-precision clock display, providing accurate real-time information. The VHDL code ensures the efficient functioning of the clock, delivering reliability and precision in timekeeping.

- **Stopwatch:** The system incorporates a stopwatch feature, allowing users to measure elapsed time with precision. Whether tracking sporting events or monitoring time intervals, the stopwatch functionality enhances the system's versatility.

- **Timer:** A countdown timer feature enables users to set specific time intervals, enhancing the practicality of the system for various applications. The VHDL code governs the timer, ensuring accurate countdowns and signaling upon completion.

- **Alarm with Buzzer:** The system includes an alarm feature accompanied by a buzzer for timely notifications. Users can set alarms for specific times, and the buzzer ensures attention-grabbing alerts. The VHDL-coded alarm system adds an additional layer of functionality to the device.

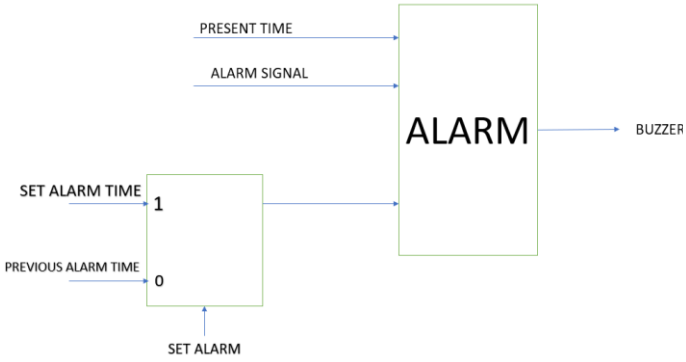
Implementation Details



Clock: Our clock works on up counters, down counters and muxes. First, the user needs to upload the initial real-time in the DE10 lite board. The VHDL logic will then start counting from 0 to 9 and from 0 to 6 in the second part. A similar thing will happen in minutes and hours will be adjusted respectively.

Stopwatch: When the user starts the start button, the VHDL logic will use a counter that will start counting from 0 to 9,0 to 5,0 to 4 in the needed part. More precisely, the second has a 0 to 9 counter in the unit place and a 0 to 5 counter at the tens place. Minute has a 0 to 9 counter at the unit place and a 0 to 5 counter at the tens place. The hour has a 0 to 9 counter at the unit place and a 0 to 2 counter at the tens place. These counters continue to work till you press stop. If you reset it, everything goes to zeros.

Timer: The user sets a time in the timer. The timer checks the real time which we have from our clock part and continues to check if it's equal to the input. Once the set time matches real time, the alarm will send a high signal to the buzzer and it will create a sound till you shut it down.



Alarm: Our alarm has given you the facility to set a time. Time will come from the clock. Once you set a time, an alarm signal will be sent to confirm system that alarm that you are willing to start the alarm. After that, once the time matches your set alarm time, the alarm will send a high signal to a buzzer and the buzzer will make some sound to tell you that time is over.

Results

The implementation of our VHDL-based digital clock system has yielded compelling outcomes, showcasing the successful integration of diverse timekeeping functionalities. Here are the key results:

- **Clock Display Accuracy:** The clock display, powered by VHDL precision coding, demonstrates exceptional accuracy in real-time tracking. The system reliably maintains synchronization with the underlying hardware, ensuring precise timekeeping.
- **Stopwatch Precision:** The stopwatch functionality proves to be a valuable asset, providing users with an accurate and responsive tool for measuring elapsed time. Whether used for sports events or time-sensitive tasks, the stopwatch enhances the system's utility.
- **Timer Functionality:** The countdown timer feature operates seamlessly, allowing users to set specific time intervals. The VHDL code governing the timer ensures accurate countdowns, and the system provides timely alerts upon completion.
- **Alarm and Buzzer Integration:** The alarm system, coupled with a buzzer, delivers effective and attention-grabbing notifications. Users can set alarms for designated times, and the buzzer ensures that alerts are promptly acknowledged, adding a practical dimension to the system.
- **Synergy Between Hardware and VHDL:** The project successfully exemplifies the harmonious collaboration between hardware components and VHDL programming. The system's architecture underscores the adaptability and ingenuity achievable through this integration, showcasing the potential of VHDL in crafting sophisticated digital systems.

Overall, the results attest to the project's success in creating a versatile, reliable, and user-friendly digital clock system, enriching the landscape of timekeeping solutions through innovative VHDL implementation.

Conclusion

In conclusion, our VHDL-powered digital clock system has successfully combined precision engineering with advanced programming, presenting a comprehensive and versatile timekeeping solution. The integration of a clock display, stopwatch, timer, and alarm system with a buzzer showcases the depth of functionalities achievable through VHDL coding.

The system not only meets the fundamental goal of accurate timekeeping but extends its utility with features like a stopwatch for precise time measurements, a countdown timer for diverse applications, and an alarm system for timely reminders. The VHDL code governing these features ensures reliability and responsiveness, highlighting the potential of VHDL in crafting intricate digital systems.

Furthermore, the project underscores the seamless synergy between hardware components and VHDL programming. This collaboration goes beyond mere functionality, serving as an educational exploration into the adaptable and ingenious possibilities achievable through the integration of VHDL.

References

[1] Course Lecture Notes

[2] Some YouTube videos