

Implementation of a Digital Time Display System¹

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OVERVIEW

This project focuses on the development of a digital time display system using an ATmega328P microcontroller. The system supports three functionalities: clock, stopwatch, and countdown timer. Time management is handled via Timer1 interrupts, and user input is managed through push-button switches. The output is displayed on a multiplexed seven-segment display.

COMPONENTS USED

The project utilizes the following hardware components:

- ATmega328P microcontroller
- Six seven-segment common-anode displays
- Three push buttons for mode selection
- Resistors and interconnecting wires

SOFTWARE IMPLEMENTATION

The firmware is developed in C using AVR-GCC libraries, following a structured programming approach:

A. System Initialization

The setup function configures the microcontroller's GPIO pins and initializes Timer1 to generate periodic interrupts for timekeeping. Additionally, internal pull-up resistors are enabled for the buttons.

B. Timer Interrupt Handling

A dedicated Timer1 interrupt service routine (ISR) executes every second to update time values across different modes and handle day transitions where necessary.

C. Mode Control

User input is processed through three buttons, each corresponding to a specific functionality:

- Button 1: Activates standard clock mode
- Button 2: Starts or resets the stopwatch mode
- Button 3: Initiates or resets the countdown timer mode

D. Multiplexing of Seven-Segment Display

To efficiently utilize microcontroller pins, display multiplexing is implemented, allowing one digit to be displayed at a time while cycling through the digits at high speed to create a continuous display effect.

RESULTS AND ANALYSIS

The system was successfully built and tested. It accurately updates and displays time across all three operational modes. The multiplexing technique ensures efficient power consumption and GPIO utilization.

POTENTIAL ENHANCEMENTS

Future improvements could include:

- Integration of an RTC (Real-Time Clock) module for enhanced accuracy
- Adding an alarm function
- Implementing an OLED display for better readability and additional features

CONCLUSION

This project successfully demonstrates the implementation of a digital clock, stopwatch, and timer using an ATmega328P microcontroller. By leveraging Timer1 interrupts, the system achieves precise timekeeping, and multiplexing minimizes hardware complexity.

REFERENCES

This assignment was developed with reference to open-source AVR-GCC documentation and discussions with peers, including contributions from Dhawal (EE24BTECH11015).