Digital Clock Project

Project Report

EE1003: Scientific Programming

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Contents

Digital Clock

Design Objectives

The digital clock displays time accurately in 24-hour format (HH:MM:SS).

Hardware Components

The digital clock implementation utilizes the following components:

- **Microcontroller:** AVR microcontroller for processing, time calculations, and display control
- **7447 BCD-to-Seven-Segment Decoder:** Converts Binary Coded Decimal (BCD) inputs to drive seven-segment displays
- **Six 7-Segment Displays:** Shows hours, minutes, and seconds in 24-hour format (HH:MM:SS)
- **Multiplexing Circuit:** Controls all six displays using a single set of segment outputs

Connection Details

BCD Input Connections

- 7447 Input A (Pin 7) → AVR Pin D2
- 7447 Input B (Pin 1) → AVR Pin D3
- 7447 Input C (Pin 2) → AVR Pin D4
- 7447 Input D (Pin 6) → AVR Pin D5

7-Segment Display Controls

- Segment 'a' (Pin 13) → Connected to segment 'a' of all displays
- Segment 'b' (Pin 12) → Connected to segment 'b' of all displays
- Segment 'c' (Pin 11) → Connected to segment 'c' of all displays
- Segment 'd' (Pin 10) → Connected to segment 'd' of all displays
- Segment 'e' (Pin 9) → Connected to segment 'e' of all displays
- Segment 'f' (Pin 15) → Connected to segment 'f' of all displays
- Segment 'g' (Pin 14) → Connected to segment 'g' of all displays

Display Selection

- Tens of Hours (TH) → AVR Pin D6
- Units of Hours (UH) → AVR Pin D7
- Tens of Minutes (TM) → AVR Pin D8
- Units of Minutes (UM) → AVR Pin D9
- Tens of Seconds (TS) → AVR Pin D10
- Units of Seconds (US) → AVR Pin D11

The multiplexing technique activates only one display at a time. Persistence of vision makes it appear as if all displays are simultaneously illuminated, reducing required microcontroller pins while maintaining display quality.

User Interface

The digital clock incorporates buttons connected to the AVR microcontroller's analog input pins:

- **A0 (PC0):** Increase Hours (H+)
- **A1 (PC1):** Decrease Hours (H-)
- **A2 (PC2):** Increase Minutes (M+)
- **A3 (PC3):** Decrease Minutes (M-)
- **A4 (PC4):** Reset Clock (00:00:00)
- **A5 (PC5):** Start/Stop Clock

All buttons use software debouncing and pull-up resistors for reliable operation.

Testing and Validation

Functional Testing

- **Time Accuracy:** Long-term tests against reference clock
- **Button Response:** Verification of reliable debounced operation
- **Display Quality:** Assessment of readability and refresh rate
- **Edge Case Handling:** Testing time rollover at 24-hour boundaries

Reliability Testing

- **Long-term Operation:** Continuous running for extended periods
- **Button Durability:** Repeated button press testing
- **Power Cycle:** Multiple power-on/power-off cycles to ensure consistent operation

Note

I modified **J. Kedarananda's (EE24BTECH11030)** code according to my connections and button functions.