Alarm Clock
Embedded Systems Project
Report

Monday 10:00 lab

Jakub Pawlak
234767@edu.p.lodz.pl

Artur Pietrzak
234768@edu.p.lodz.pl

Juliusz Szymajda
234769@edu.p.lodz.pl

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Devices used:

Eduboard LPC2148 v1.0

No external devices used

Interfaces used:

GPIO, I^2C, SPI

Devices used:

1. LCD display
2. RTC
3. Button
4. Joystick
5. Buzzer
6. Timer
7. EEPROM

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1 Project Description

1.1 General description

The project is an digital clock with the ability to set an alarm for a given hour. The device displays current time on the LCD display. Using button and joystick it is possible to set the current time, or set an alarm. If the alarm is set and the alarm time is the current time, the buzzer emits a sound until the alarm is turned off.

1.2 Project functionalities

Functionality	**Person Responsible**	**Implementation status**
Timer	Jakub Pawlak	Implemented
RTC	Artur Pietrzak	Partially implemented
SPI	Artur Pietrzak	Not implemented
LCD Display	Jakub Pawlak	Implemented
Buttons & Joystick	Artur Pietrzak	Implemented
Buzzer	Jakub Pawlak	Not implemented
EEPROM	Juliusz Szymajda	Not implemented
I2C	Juliusz Szymajda	Not implemented

Table 1: Project functionalities and responsible persons

1.3 Setting the alarm

The alarm setting mode it entered by pressing down the joystick center push-down switch. When in alarm setting mode, the user can change the alarm time by selecting the digit with left/right movement, and selecting the value with up/down movement. After the correct time is selected, alarm is set by pressing the button.

When alarm is turned on, it can be turned off by short press of the button.

1.4 Changing the current time

The time setting mode is entered by holding down the button. Then, the time is set with the joystick in the similar way, the alarm is set. After setting the time it is set by short press of the button.

1.5 Turning off the alarm

When the alarm clock starts emmiting sound, the user can turn it off by pressing the button.

2 Peripherals and interface configuration

2.1 GPIO

2.2 LCD Display

```
void DisplayInit(void) {
    IODIR1 |= (LCD_DATA | LCD_E | LCD_RS);
    IOCLR1  = (LCD_DATA | LCD_E | LCD_RS);

    IODIR0 |= LCD_RW;
    IOCLR0  = LCD_RW;

    IODIR0 |= LCD_BACKLIGHT;
    IOCLR0  = LCD_BACKLIGHT;

    LcdCommand(0x30);
    delay2ms();
    LcdCommand(0x30);
    delay37us();
    LcdCommand(0x30);
    delay37us();

    LcdCommand(0x38); // set 8-bit, 2 line mode
    delay37us();

    LcdCommand(0x08); // display off
    delay37us();

    clearDisplay();

    LcdCommand(0x06); // cursor direction - increment, no shift
    delay2ms();

    LcdCommand(0x0c); // display on, cursor off
    delay2ms();

    LcdCommand(0x02); // cursor to home position
    delay2ms();
}
```

Listing 1: LCD setup function

2.3 I²C

2.4 SPI

2.5 Debounce Timer

```
delayMs(uint16 delayLength, uint32 prescaler) {
    //initialize and start Timer #0
  T0TCR = 0x00000002;                          //disable and reset Timer1
  T0PC  = prescaler;                           //set prescale
  T0MR0 = delayLength *                        //calculate no of timer ticks
         ((CRYSTAL_FREQUENCY * 5) / (1000 * 1));
  T0MCR = 0x00000006;                          //reset counter and stop
      timer on MR0 match
  T0TCR = 0x00000001;
}
```

Listing 2: LCD setup function

3 Failure Mode and Effect Analysis

Component	Severity
Microcontroller	Critical
Power Supply	Critical[1]
RTC	Critical
LCD Display	High
Speaker	High
Button	High
Joystick	High

Table 2: Severity of component's failure

References

[1] Embedded Artists. *LPC2148 Education Board User's Guide*, 2006. EA2-USG-0601 v1.2 Rev B.

[2] Hitachi. *HD44780U (LCD-II) (Dot Matrix Liquid Crystal Display Controller/Driver)*. ADE-207-272(Z) '99.9 Rev. 0.0.

[1] Long-term power supply failures are of critical severity, but in case of short pause in power delivery, the system is able to recover using the RTC and the data stored in EEPROM