# PC-BASED DATA ACQUISITION SYSTEM WITH FAULT ALERTS

OBJECTIVE:

To design and implement a data acquisition system using the LPC2148 microcontroller that continuously monitors temperature using an LM35 sensor, timestamps the readings using a Real-Time Clock (RTC), and sends the data to a PC via UART. If the temperature crosses a defined threshold, a fault alert is generated and logged.

BLOCK DIAGRAM:
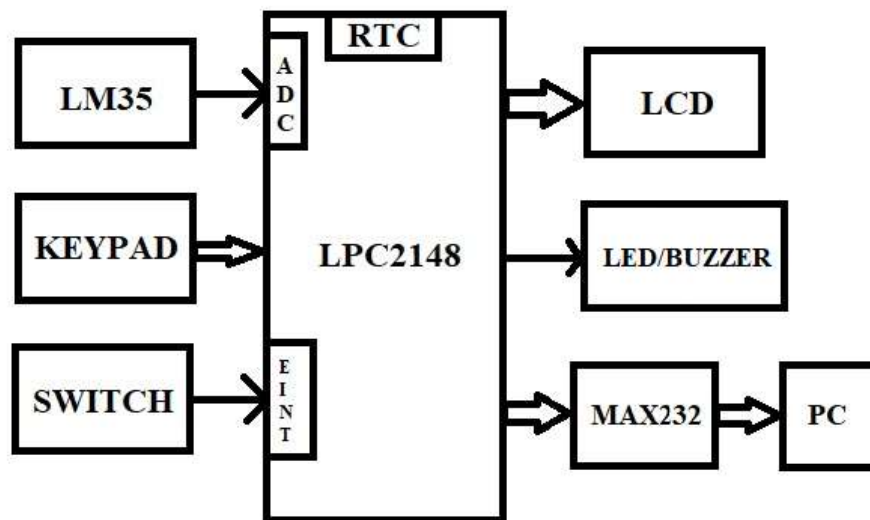
REQUIREMENTS:

HARDWARE REQUIREMENTS:

➢ LPC2148
➢ LM35
➢ LCD
➢ KEYPAD
➢ SWITCH
➢ LED
➢ MAX232

SOFTWARE REQUIREMENTS:

- ➢ PROGRAMMING IN EMBEDDED C
- ➢ KEIL C COMPILER
- ➢ FLASH MAGIC

PROJECT WORK FLOW:

The project is designed to continuously monitor temperature using the LM35 analog temperature sensor, and log this data with real-time timestamps using the LPC2148 microcontroller's on-chip RTC (Real-Time Clock). The system also includes a mechanism to edit the current time via a keypad, triggered by a button press using external interrupt.

When the system is powered on, the LPC2148 microcontroller begins by setting up all the essential components needed for the project to work properly. First, it configures the UART module to enable communication with a PC through a serial port. Then, it starts the on-chip Real-Time Clock (RTC) using either a default time or the last stored time. Next, it initializes the ADC (Analog-to-Digital Converter) so it can read temperature data from the LM35 sensor. It also initializes the required input/output devices such as the LCD for display, the keypad for user input, and the LED or buzzer for fault alerts. Finally, it enables an external interrupt, which is connected to a push button, allowing the user to enter time editing mode whenever needed.

During normal operation, the system continuously runs in an infinite loop, carrying out monitoring and data logging tasks. It begins by reading the current temperature from the LM35 sensor through the ADC, while also retrieving the current time and date from the on-chip RTC. These readings are then combined into a formatted message that includes both the temperature value and its corresponding timestamp. This message is transmitted to the Serial Terminal via UART at specified time intervals for logging or display. Additionally, the same data can be shown on a local 16x2 LCD screen for real-time monitoring. The system also checks whether the measured temperature exceeds a predefined threshold, such as 45°C. If the temperature is too high, a buzzer or LED is activated as a fault indicator, and the transmitted message to the Serial Terminal includes an "ALERT" status. If the temperature remains within normal limits, the alert is cleared and the buzzer or LED is turned off. This entire process continues indefinitely, ensuring real-time temperature tracking and immediate fault alerts.

When the user presses a push button connected to the interrupt pin, an external interrupt is triggered, signalling the system to enter time editing mode. Within the Interrupt Service Routine (ISR), a flag (such as edit_flag = 1) is set to indicate that the user intends to update the time. In the main program loop, this flag is checked, and once detected, the system switches to "Edit Mode." In this mode, a menu is displayed on the LCD, allowing the user to select the specific time or date field they wish to edit—such as hour, minute, second, day, month, or year. Based on the selected option, the system prompts the user to enter the new value using the keypad. The updated value is then written to the corresponding RTC Special Function Register (SFR). Once all desired changes are made, the user selects the "Exit" option from the menu. The system then exits Edit Mode and resumes its normal operation of monitoring temperature, logging data, and sending updates to the PC.

Reference information for Project code development:

LCD Display info:

1ˢᵗ line: HH:MM:SS   DAY

2ⁿᵈ line: DD/MM/YY   T: XX°C

Serial Terminal info:

Normal Operation (Temperature within safe limit):

[INFO] Temp: 32.5°C @ 13:45:20 13/05/2025

Over-Temperature Alert (Temperature exceeds set point (45°C)):

[ALERT] Temp: 47.3°C @ 14:10:55 13/05/2025 - OVER TEMP!

For Time Editing:

LCD Display Info:

1.H 2.M 3.S 4.D   --- 1ˢᵗ Line

5.M 6.Y 7.Day 8.E   --- 2ⁿᵈ Line

While Time editing UART Terminal Info:

*** Time Editing Mode Activated ***

Note: Provide the required display messages on LED as well as Serial Terminal for user better understanding.

**************************ALL THE BEST** ************************