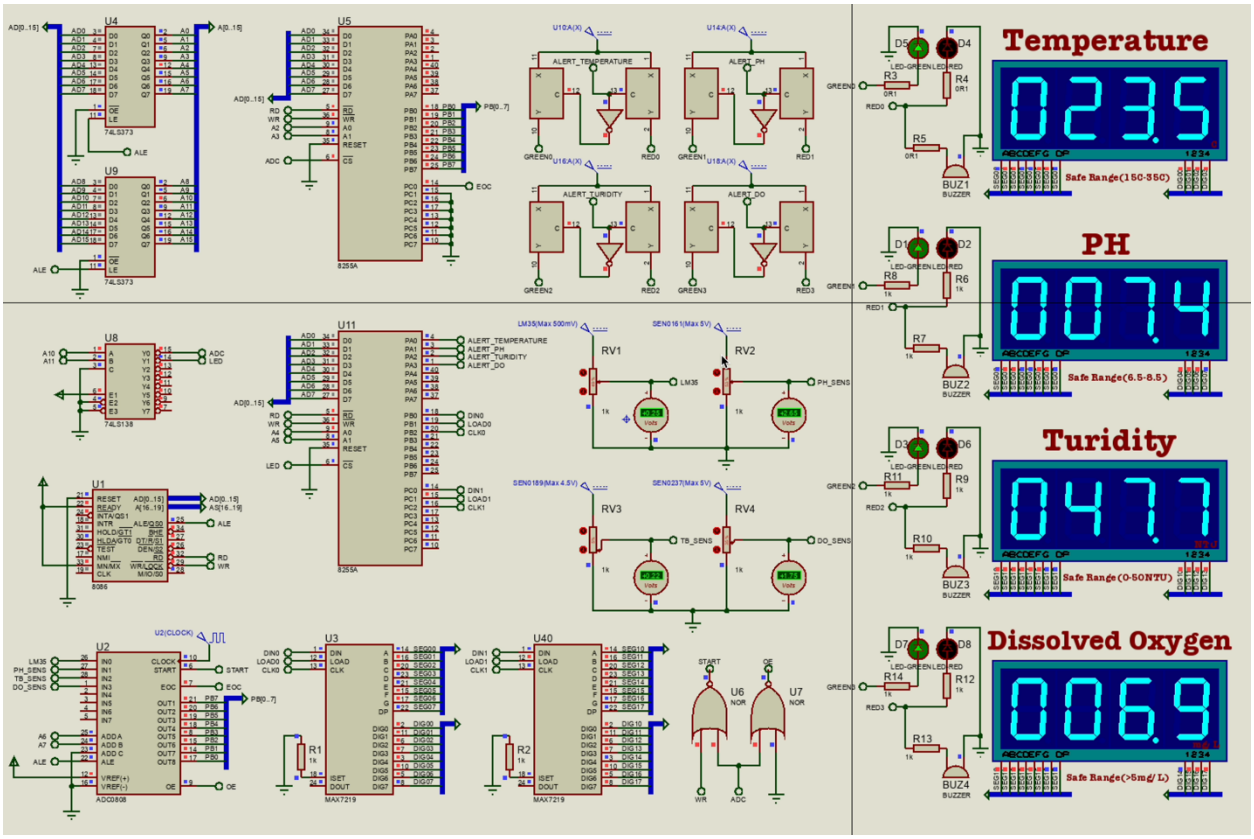
A Multi-Parameter Water Quality Monitoring System Using 8086 Microcontroller and ADC0808



System Architecture:

- Uses sensors (Temperature, pH, Turbidity, DO) to measure water quality.
- Employs an **ADC0808** to convert analog sensor signals to digital.
- Uses an **8051 microcontroller (AT89C51)** to process and display data.
- Drives **7-segment displays** using **MAX7219**.
- Triggers **alerts** using **comparators (LM339)**, LEDs, and buzzers if readings are out of safe range.

Detailed Flow

1. Sensors & Signal Conditioning

Each sensor is connected through a voltage divider (variable resistor for calibration):

- **RV1 + LM35** → Temperature sensor
- **RV2 + pH Sensor** → pH level
- **RV3 + Turbidity Sensor**
- **RV4 + DO Sensor**

These output analog voltages proportional to the measured parameters.

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2. Analog Multiplexer (U2 - ADC0808)

- Accepts 8 analog input channels (A0–A7).
- Converts selected analog signal to digital using 8-bit resolution.
- Controlled via select lines (A, B, C) from the microcontroller.
- **OE**, **START**, **EOC**, and **ALE** are control signals for synchronization.

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3. 8086 Microcontroller (U1)

- Central processor that:
    - Selects ADC channel.
    - Starts conversion.
    - Waits for **EOC** (End of Conversion).
    - Reads converted 8-bit value.
    - Sends data to display.
    - Checks thresholds and activates alarms.

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4. Display Driver (U3, U40 - MAX7219)

- **MAX7219** takes SPI input from 8051 and drives 7-segment displays.
- 4-digit 7-segment display used for each parameter.
- Each parameter has its own MAX7219 driving it (DIG0–DIG3).

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5. Alarms (Comparators + LEDs + Buzzers)

- **LM339 quad comparator** is used for each parameter.
- Receives:
    - One input from sensor signal (via voltage divider).
    - One input from reference voltage (threshold).
- If the sensor value exceeds the reference:
    - Comparator output goes HIGH.
    - Drives RED LED + BUZZER for that parameter.
    - Activates corresponding alert signal to microcontroller.
- Alerts:
    - ALERT_TEMPERATURE
    - ALERT_PH
    - ALERT_TURBIDITY
    - ALERT_DO

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6. Multiplexing & Control Logic

- 74LS373, 74LS573, 74LS138 (U4, U5, U8, U9, U11) handle:
    - Data/address multiplexing.
    - Output enable control.
    - Chip selection.
- Used to expand addressable memory/data lines for the 8051.

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7. Control Logic for Timing (U6, U7)

- NOR gates combine control signals:
    - Ensure correct timing between ADC **START**, **WR**, **ALE** signals.
    - Avoid data corruption during ADC reading.

Displays

7-Segment LEDs

- 4 separate sections showing:
  - **Temperature** – LM35 (display in °C)
  - **pH** – pH Sensor (0–14 scale)
  - **Turbidity** – in NTU (Nephelometric Turbidity Units)
  - **Dissolved Oxygen** – in mg/L
- Each has:
  - 4-digit display
  - Green/Red LED based on safety range
  - Buzzer for alert
  - Safe range labeled for reference

Threshold Values and Alert Conditions

Parameter	**Safe Range**	**Alert Condition**	**Signal**
Temperature	15–35°C	<15 or >35 triggers alert	ALERT_TEMPERATURE
pH	6.5–8.5	Outside this range	ALERT_PH
Turbidity	0–50 NTU	>50 triggers alert	ALERT_TURBIDITY
Dissolved Oxygen	>5 mg/L	<5 triggers alert	ALERT_DO