PROJECT ABSTRACT

IoT Pneumatic Line Pressure Monitor using ESP32

An ESP32 pneumatic monitor: MPX5700 pressure sensor on a small air line, live gauge dashboard, compressor cycle counting, leak-watch detection and a solenoid safety vent. Delivered built-to-order with hardware, firmware, dashboard, report, PPT and viva kit.

01. Title

IoT Pneumatic Line Pressure Monitor using ESP32

02. Introduction / Background

Pneumatic lines run factory automation, and their health shows in one number: pressure. A slow leak wastes compressor energy and makes actuators sluggish; over-pressure risks burst fittings. Gauges don't log, don't alert and don't count compressor cycles. This project instruments a small air line properly: an MPX5700 sensor teed into the line, an ESP32 sampling every second, and a dashboard with a live gauge, 8-hour history, cycle counting, leak-watch flagging and a solenoid safety vent.

03. Problem Statement

Pneumatics is taught as symbols on a circuit diagram while pressure sensing, calibration and leak detection stay theoretical. This project provides a working instrumented line where the student plumbs the sensor, calibrates against a gauge, sets the working band, and verifies leak detection with a controlled leak.

04. Objectives

- Tee an MPX5700AP pressure sensor into a small air line with pneumatic fittings.
- Sample pressure at 1 Hz with the ESP32 12-bit ADC and publish over Wi-Fi.
- Render a live gauge dashboard with 8-hour pressure history.
- Count compressor cut-in/cut-out cycles per hour.
- Compute 10-minute pressure-drop leak-watch metric with dashboard flagging.
- Drive a solenoid vent valve on over-pressure as a safety interlock.
- Deliver a two-point gauge calibration procedure.
- Deliver the complete student kit: hardware, firmware, dashboard, report, PPT and viva Q&A.

05. Proposed Methodology

The sensor is plumbed into the line and wired to the ESP32; firmware covers sampling, calibration mapping, MQTT publishing and valve logic; the dashboard renders gauge, history, cycles and events. The student calibrates against the analog gauge, sets the working band, and runs the controlled-leak experiment to verify detection.

06. System Architecture / Working

The MPX5700 output feeds the ESP32 ADC; calibrated readings publish every second. The dashboard draws the live gauge and history; cut-in/cut-out crossings feed the cycle counter; the 10-minute drop metric raises the leak-watch flag above threshold; crossing the safety limit energizes the solenoid vent until pressure recovers.

07. Hardware / Software Requirements

- ESP32 development board (Wi-Fi)
- MPX5700AP pressure sensor (0-700 kPa)
- Small air receiver / compressor line with analog gauge
- Solenoid valve for safety vent
- Pneumatic tubing and tee fittings
- MQTT broker + web dashboard (HTML/JS)
- Arduino IDE (C/C++ firmware)

08. Expected Outcomes

- A working instrumented pneumatic line with live dashboard.
- A calibrated pressure reading verified against the analog gauge.
- Verified leak detection from the controlled-leak experiment.
- A complete report, PPT and viva Q&A on pressure sensing and pneumatics.

09. Applications

- Teaching pneumatics instrumentation in mechatronics labs.
- Demonstrating calibration, threshold logic and IoT telemetry.
- Energy-awareness demos on compressed-air waste.

10. Future Scope

- Flow-sensor addition for quantified leak rates.
- Multi-point monitoring along a longer line.
- Compressor run-time energy estimation.
- SMS/push alerts on leak-watch events.