WaterLeak.AI — AI-Powered Smart Leakage Detection for Buildings & Infrastructure

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🏠 Prevent leaks before they destroy what you've built.

Introduction | Overview

Water leakage in walls or pipelines often goes unnoticed until visible damage appears , resulting in costly repairs, health risks from damp walls, and long-term structural harm.

WaterLeak.AI solves this using **real-time sensor monitoring**, **ML-based leakage prediction**, and **automated alerts**to detect issues *early* and prevent disaster.

Audience
Beginner–Intermediate developers in IoT, ML, and smart infrastructure solutions.

What you'll learn by the end:
✔ How IoT + Cloud + AI detect leakage
✔ How severity & location are analyzed
✔ How predictive maintenance insights are delivered in real-time

Design

WaterLeak.AI combines **hardware sensing** with **cloud-driven intelligence**:

🔷 Architecture Highlights

- **IoT Sensor Layer**
  Moisture + pressure signals collected from embedded strips in walls/pipes
- **LeakGuard API** (Cloud Run)
  ML model predicting leakage vs non-leakage
- **BigQuery**
  Logs pipeline health + historical events
- **AI Agent (Gemini)**
  Answers queries like:
- "Which floor is highly susceptible to leakage this week?"
- **Dashboard UI**
  Real-time status, alerts, zone-wise heat maps & severity graphs

💡 Why this design?

- ✔ Real-time reliability
- ✔ Cloud scalability for large buildings
- ✔ ML enables proactive maintenance
- ✔ Natural language for non-technical operators

Prerequisites

Before starting, ensure you have:

- Basic IoT sensor knowledge
- **Google Cloud account**
- Python environment setup
- Fundamentals of **BigQuery** + **Cloud Run**
- Introductory ML classification knowledge

Step-by-Step Instructions

1️⃣ Hardware Setup

- Install wire-based moisture sensing strip on wall surface
- Interface with **ESP32 / Arduino Nano**
- Send sensor events → Cloud API via Wi-Fi

2️⃣ Build & Deploy the ML Model

- Features: Pressure, Flow, Temp, Humidity, Vibration, RPM
- Labels: *Leakage / Non-Leakage*
- Train in **Vertex AI Notebook**
- Deploy as **LeakGuard API** (Cloud

Run)

3️⃣ Store & Analyze Data

- Log each prediction into **BigQuery**
- Track:
- Zone ID
- Time/Duration of leakage
- Severity probability

4️⃣ Conversational AI Interface

Gemini agent interprets queries like:

> "Leak detected in Zone C for 15 minutes — severity rising."

→ Provides summaries + maintenance recommendations

5️⃣ Build the Real-Time Dashboard

- Live leakage indicator
- Duration counter
- Distance & location estimate
- Historical charts + alerts

Result / Demo

What the working prototype delivers:

⚠️ **Instant alerts** when leakage starts
📍 **Leakage localization** support
⏱️ **Event duration** to estimate severity
📈 **Visual analytics** of pipeline health
🧠 **AI-powered insights** for operators

What's Next?

Future development directions:

- LoRaWAN support for long-range underground pipeline monitoring
- Predictive burst analysis
- Automated repair ticketing workflows
- Enhanced mobile alerts + offline mode

Closing Notes

WaterLeak.AI demonstrates how digital infrastructure can prevent hidden threats before they escalate into emergencies. By integrating IoT sensing, machine learning, and conversational intelligence, the system promotes **sustainable water usage** and **proactive facility protection** — improving safety, saving money, and preserving structural integrity.

Google Cloud Platform | Vertex AI | Water Leakage Detection

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