FROM SENSOR TO SOLUTION: EMBEDEDD WASTEWATER SPILL MONITORING SYSTEM

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1. INTRODUCTION

Background

Wastewater overflow events have become an increasing environmental concern across the United Kingdom. Existing monitoring systems often fail during critical conditions such as power outages, storms and extreme inflow events, resulting in unrecorded pollution incidents and delayed operational response.

This project developed a resilient embedded wastewater monitoring system capable of maintaining continuous monitoring during adverse conditions.

Key Issues

1. Existing systems vulnerable to power failure
2. Data gaps during overflow events
3. Lack of monitoring resilience
4. Environmental and regulatory concerns

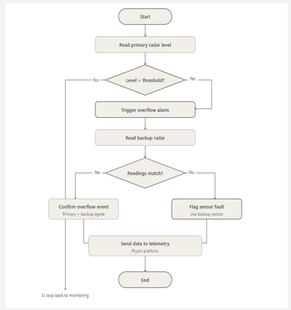
2. AIMS & OBJECTIVES

Aim

To design and develop a reliable embedded wastewater monitoring system capable of continuously detecting and recording overflow events during power failure and extreme inflow conditions.

Objectives

- Analyse limitations of existing monitoring systems
- Design a radar-based embedded monitoring system
- Integrate UPS backup power and telemetry systems
- Implement redundant radar sensing
- Test under simulated and real-world conditions
- Evaluate reliability and operational performance



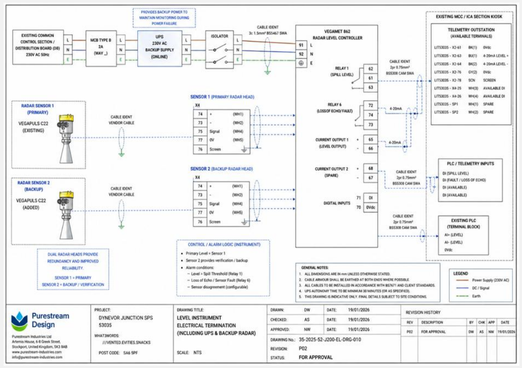
3. SYSTEM DESIGN & ARCHITECTURE

Embedded Monitoring System

The proposed system integrates radar level sensing, telemetry interfacing, redundant sensing and UPS backup power to provide continuous wastewater overflow monitoring.

Main Components

- Primary radar sensor
- Backup radar sensor
- PIC microcontroller
- Telemetry outstation
- Prysm monitoring platform
- 230V UPS backup system



4. IMPLEMENTATION & INSTALLATION

The monitoring system was physically installed and commissioned at Dynevor Junction SPS within a live Welsh Water operational environment.

Implementation Included

- Radar sensor installation
- UPS integration
- Telemetry configuration
- Real-time Prysm monitoring
- Overflow simulation testing
- Power failure testing

Engineering Challenges

- Sensor calibration
- Signal integration
- Dynamic wastewater conditions
- Environmental interference

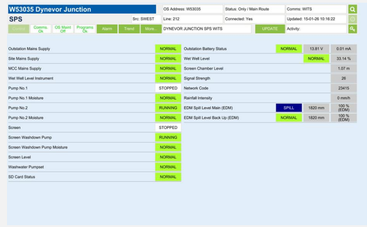
5. TESTING & RESULTS

Overflow Detection Performance

The system successfully detected overflow events in real time under simulated testing conditions.

Results

- High detection accuracy
- Near real-time response (<1 second)
- No false positives observed
- Stable telemetry communication

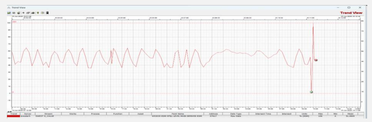


Power Failure Performance

A major objective of the project was to maintain monitoring continuity during power interruption.

UPS Performance

- Continuous operation maintained
- No data loss observed
- Zero system downtime
- Automatic UPS switchover successful

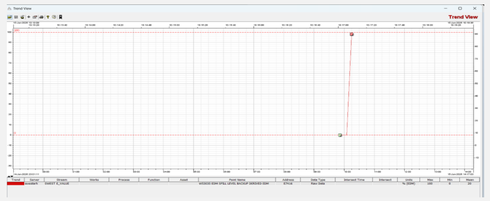


Sensor Redundancy

A secondary radar sensor was implemented to improve reliability and fault tolerance.

Benefits of Redundancy

- Improved measurement reliability
- Reduced risk of missed events
- Improved signal stability
- Enhanced operational resilience



Real-World Deployment

The system operated successfully within a live wastewater environment at Dynevor Junction SPS.

6. COMPARISON WITH EXISTING SYSTEMS

Feature	Traditional Systems	Proposed System
Continuous Monitoring	Limited	Yes
Power Failure Resilience	No	Yes (UPS)
Real-time Detection	Limited	Yes
Sensor Reliability	Variable	High
System Resilience	Low	High

7. CONCLUSION

Project Outcomes

The project successfully demonstrated that integrating radar sensing, embedded systems, UPS backup power and redundant sensing significantly improves wastewater overflow monitoring reliability.

The live deployment confirmed the practical feasibility of resilient embedded monitoring systems within operational wastewater infrastructure.

Key Achievements

✓ Continuous monitoring during power failure
✓ Real-time overflow detection
✓ Improved reliability through redundancy
✓ Successful industrial deployment
✓ Enhanced environmental monitoring resilience

8. FUTURE WORK

Potential Improvements

- IoT remote communication
- Wireless monitoring integration
- Renewable energy backup systems
- Improved filtering algorithms
- Multi-site deployment
- Long-term field evaluation

REFRENCES

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