An Embedded System for the Predictive Maintenance of Aerobic Digesters with Liquid Outputs

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Background

- 13% of the total food production is wasted in households, in the food service and in retail
- Aerobic Digesters with Liquid Outputs (ADLOs) can reduce the volume of food waste by 90% in a 24-hours period
- However, the grinding motor of ADLOs is highly susceptible to **mechanical failure** from repeated use and the use of non-biodegradable material in the bin of the digester

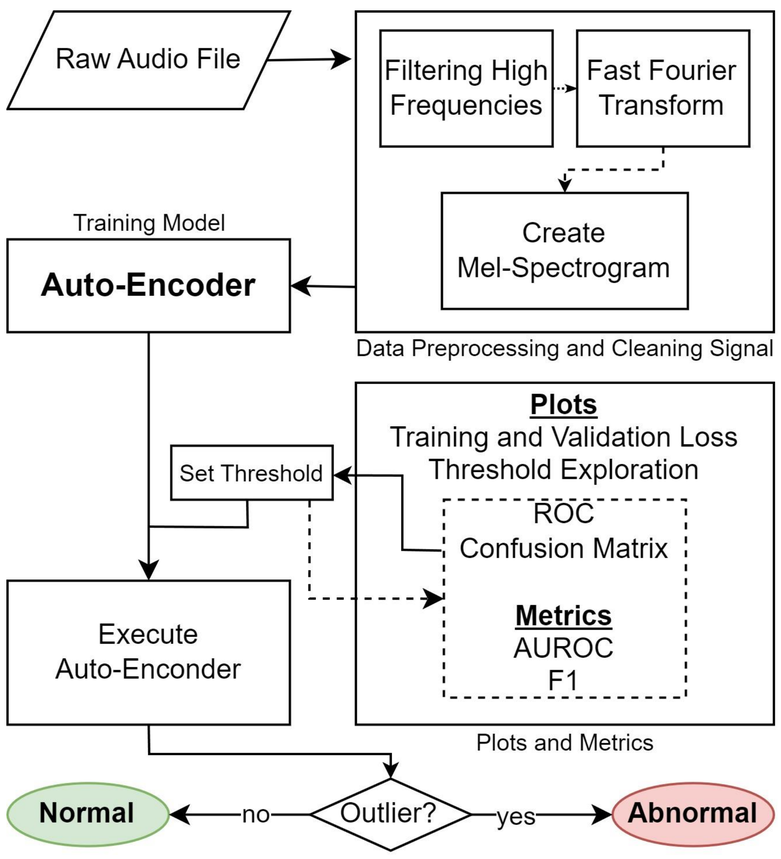
Our Approach

An embedded edge computing system for the Internet of Things (IoT), specifically designed and implemented for the **predictive maintenance** of the grinding motor of ADLOs.

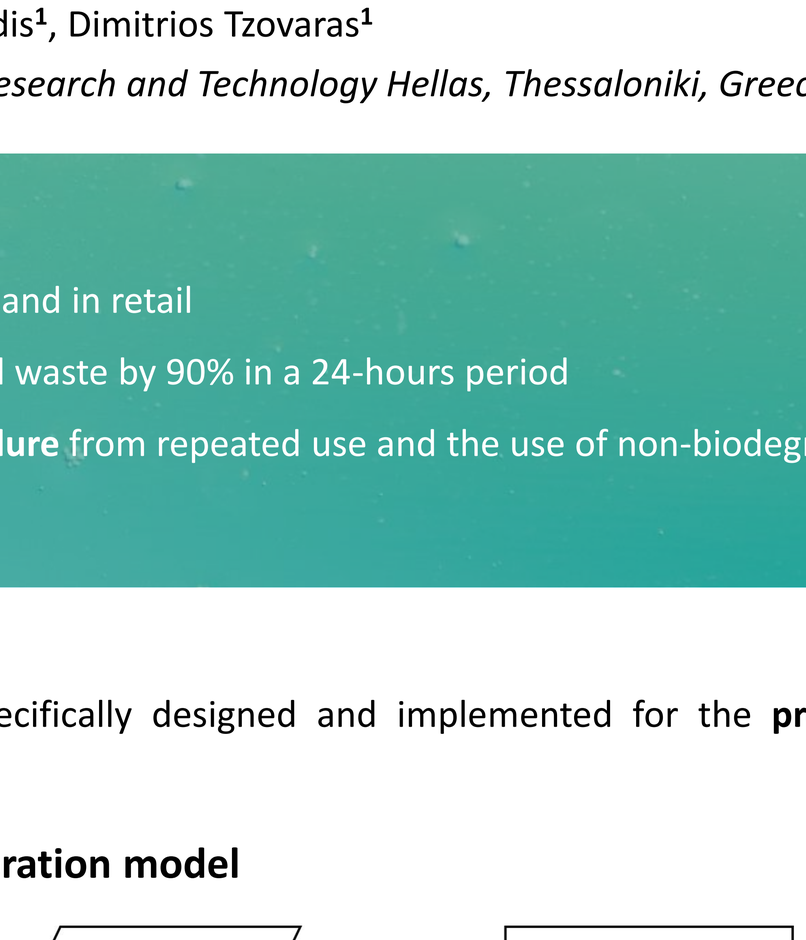
1. Hardware

- Raspberry Pi 4 B+ is the system's core
- Sensors collect vibration and sound data
- Machine Learning models are used to detect anomalies in the motor's behavior
- The outcome is sent via WiFi/LoRa to a server

2. Audio model



3. Vibration model



4. Performance

TABLE II
RESULTS

	Audio Data		Vibration Data	
	AUROC	**F1-Score**	**AUROC**	**F1-Score**
GMM	51.5%	73.6%	83%	83.2%
Isolation Forest	53.8%	80.9%	78.4%	67.6%
LOF	59.3%	71.2%	58.1%	51.9%
OCSVM	59.9%	83.4%	91.8%	83.3%
Auto-Encoder	**85.5%**	**90.2%**	**92.9%**	**97.5%**

Our Contribution

- Traditional compost bins lack autonomous surveillance process, which leads to extended periods of unavailability
- The proposed system ensures the **detection of abnormal operation**, leading to a reduced maintenance time
- Low-power sensors + ML algorithms enable **real-time monitoring** and early detection of abnormalities
- Audio-based model scored AUROC 85.5% and F1 90.2%, while Vibration-based model scored AUROC 92.9% and F1 97.5%
- In future research, more sensors will be utilized to achieve better performance

This research was carried out as part of the project "Intelligent System for the Assessment, Prevention and Intelligent Management and Utilization of Biowaste - AE3vAO" (Project code: KMP6-0082241) under the framework of the Action "Investment Plans of Innovation" of the Operational Program "Central Macedonia 2021-2027", that is co-funded by the European Regional Development Fund and Greece.