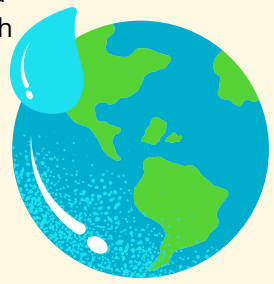
EVERY DROP MATTERS, (EDM) ROBOT

Entry to the Stockholm Junior Water Prize 2025

Problem:
Water is a vital resource facing growing challenges due to population growth, urbanization, and climate change. In Palestine, water losses reach 30–35% in the West Bank and up to 45% in Gaza, mainly due to aging infrastructure and economic pressures

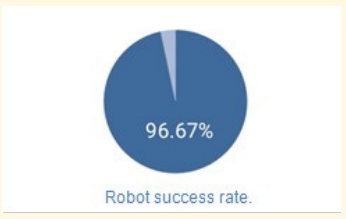
Globally, similar issues persist: Iran lost 2.3 billion m³ of water in 2020 due to system leaks (Iran Water and Wastewater Company, 2023); Malaysia's non-revenue water ranges between 35–45% (See & Ma, 2018); and in California, studies link water loss to network length and leak frequency (Güngör-Demirci et al., 2018)

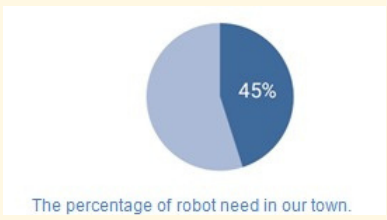
This experiment aims to show how robots can effectively detect leaks, reduce waste, and enhance water management both locally and globally

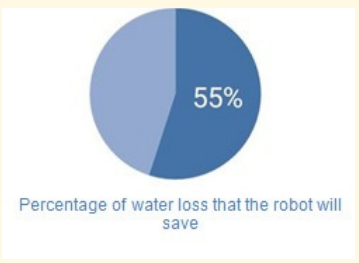


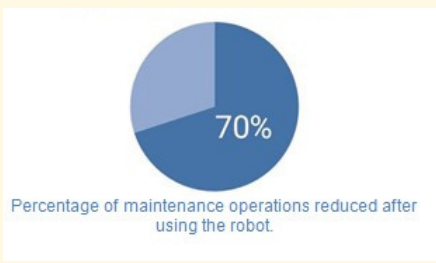
Objective:
• Accurately identify leakage locations using sensors connected to the robot and reduce water loss by detecting leaks immediately upon occurrence, accelerating the detection process compared to traditional methods.
• Provide accurate data to support maintenance decision-making, reduce repair and maintenance costs in the long term by preventing water leaks from worsening.

Data Analysis:



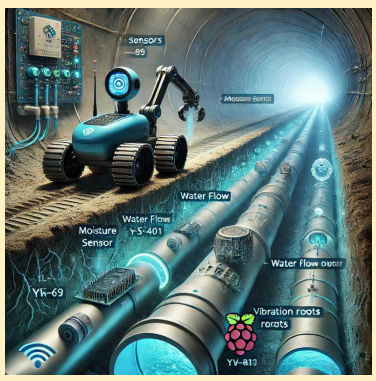






Methodology:
Our robot, EDM, is a system consisting of sensors controlled by an Arduino WeMos D1, distributed at specific points along underground water pipelines. A mobile robot controlled by a Raspberry Pi 4 Model B moves along a path to detect harmful plant roots using a Raspberry Pi Camera Module, then removes them using a TowerPro MG946R Servo. Both the Raspberry Pi and Arduino are connected to the same network. The Arduino sends data via the Raspberry Pi's IPv4 address to the relevant authorities. If a leak is detected, the pump (the water source) is .automatically shut off to prevent further water loss

Future work:
The project envisions future implementation with institutional and municipal support, ensuring access to upgraded tools and sensors for efficient water conservation. It proposes replacing traditional energy sources with renewables—using solar power and energy from plant root–microorganism interactions to power the surface robot. The underground robot may be powered by electricity generated from the water flow sensor (YF-S401). The project also plans to integrate AI and modern leak detection technologies while prioritizing eco-friendly water treatment solutions and cleaner, more advanced components.



Results:

Our project positively impacts humans, animals, plants, and the climate. Key benefits include:

• Resource conservation: Quickly detects and stops leaks, reducing water waste.
• Environmental protection: Prevents damage like erosion and mold.
• Cost reduction: Minimizes repair expenses by addressing leaks early.
• Safety and convenience: Works automatically without supervision.
• Public health improvement: Prevents conditions that foster mold and bact
eria.

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