FinEst Centre
for Smart Cities

SMART CITY CHALLENGE 2024
Solution idea for the city challenges

Max 3 pages
send to smartcity@taltech.ee by Nov 30, 2025

Solution Idea Title - Smart Tree Pit Sensors
Planned pilot project duration – 24 months
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1. Which urban challenge or problem are you planning to provide a solution to?

- Which city challenge/-s proposed by the cities / counties you are targeting? NB! Please choose one from the list of urban challenges chosen for the Smart City Challenge 2025, i.e. Round 5.

City challenge: Tree Pits for Challenging Urban Conditions, proposed by the City of Milton Keynes, UK.

Description: Urban trees are crucial for resilient, liveable cities, but current tree pit designs often fail to support long-term tree health and proper stormwater management, sometimes causing costly damage to infrastructure.

2. The solution you are proposing

- What is the solution you are proposing for the challenge above?

Our TreeSense Pulse sensors, developed by our Munich-based startup, monitor water status and tree health in real-time. This data allows optimized irrigation, prevents tree stress, and ensures sustainable growth in challenging urban conditions.

It has been tested in over one hundred client locations, including London, and deployed in major German and European cities. It combines sensor technology with adaptive tree pit management design to support root expansion, nutrient and water access, and stormwater absorption.

- How does it solve the city challenge you target?

Our minimally invasive TreeSense Pulse sensors are mounted directly on trees and wirelessly monitor, using LoRaWAN or NB-IoT, water levels in the xylem in real time through the electrical resistance between two electrodes placed in the xylem. The system alerts users to critical conditions, allowing timely intervention before trees suffer permanent damage. It is ideal for trees in precarious conditions, such as limited root space, where delayed irrigation could cause death. This solution ensures tree health in urban tree pits, optimizes water use, and reduces damage to surrounding infrastructure.

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3. Innovation and piloting of your pilot solution.

- What are the best solutions available now that solve the challenge you target? (There are some solutions there for sure) How will your solution be better? What is the innovation in it?

Existing solutions monitor only limited aspects of tree health, often indirectly. For example, they may measure soil moisture or environmental conditions rather than the tree's internal water status, which risks failing to capture its real-time physiological needs. Additionally, many sensors, such as xylem tensiometers (Scholander pressure chamber) or sap flow sensors (Granier probe), require expert installation, calibration, and interpretation, making them difficult to use and integrate into solutions that are universally applicable across different urban contexts. TreeSense Pulse sensors, based on IoT, directly monitor vital parameters on the tree. They are innovative, precise, easy to install and use, and provide data that can be easily interpreted through a traffic-light system developed by our algorithm, as well as raw data suitable for research. The complete system, combining hardware and software, enables effective and sustainable urban tree management.

- What do the cities need for piloting the proposed solution? How the piloting could work?

Cities need only to allow collaboration with urban greenery managers. The pilot involves installing sensors on trees in tree pits and collecting data to optimize care and maintenance. Users can access real-time tree health information via an account and receive alerts if vital parameters approach critical levels.

- Please provide short information about the capabilities of the research and development proposed team. Your team should have members from TalTech as well for sure. In case you do not have them yet, which skills would you need from TalTech.

We aim to combine **high-resolution sensor data** with **satellite-based remote sensing indicators (e.g., NDVI, NDMI, EVI, thermal indices)** to identify correlations and, in the long term, enable the approximation or replacement of on-tree sensors with satellite-derived metrics. This requires interdisciplinary expertise. We currently do not yet have TalTech members on the team. For a successful joint R&D effort, we would benefit from TalTech competencies in the following areas:

- **Earth Observation and Remote Sensing:** Expertise in satellite image processing, vegetation indices, and calibration/validation workflows to correlate ground sensor data with space-based observations.
- **Geoinformatics & Urban Data Platforms:** Competence in spatial data integration, GIS analytics, and building interoperable digital layers for urban tree management.
- **Environmental Modelling & Climate-Resilience Analysis:** Skills in modelling drought stress, heat dynamics, and ecosystem responses to connect physiological sensor data with broader climatic patterns.
- **IoT, Wireless Systems & Edge Computing:** Support for optimizing communication protocols, improving data reliability at scale, and integrating sensor networks with digital platforms used by cities.
- **Machine Learning for Environmental Systems:** TalTech's expertise would strengthen the development of predictive models that translate satellite data into reliable proxies for sensor-measured physiological signals.

These complementary skill sets would significantly enhance the **scalability, scientific validation, and long-term feasibility** of transitioning from sensor-based to satellite-supported tree health monitoring within the Smart City Challenge 2024.

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4. Expected impact of your pilot solution.

- What is the potential impact for city environments, sustainability and citizens?

Our solution enhances the health and longevity of urban trees, improving green infrastructure and climate resilience. It optimizes water use, supporting sustainable resource management. Citizens enjoy greener, more livable urban spaces, and community engagement is fostered through passive and user-supported tree care. Overall, it strengthens urban resilience, sustainability, and quality of life.

Disclaimer: by submitting this form you will give the FinEst Centre for Smart Cities the right to share this idea with cities and other researchers, companies through FinEst Centre homepage. If this idea is selected, the FinEst Centre for Smart Cities has the right to implement this idea with offering you an active role in conducting the pilot. If this pilot is selected then the financing is an investment by the FinEst Centre for Smart Cities.