Sonification Mappings for Sensing Tree Stress: A DIY Approach

Centre for Digital Music, Queen Mary University of London

Tug F. O'Flaherty, Mahmoud B. Elmokadem, Xinyue Xu, Krishna Nama Manjunatha, Gerard Roma, Georgios Xenakis, Anna Xambó Sedó

{t.f.oflaherty, x.xu}@se24.qmul.ac.uk, {mahmoud.elmokadem, krishna.namamanjunatha}@dmu.ac.uk, gerard.roma@uwl.ac.uk, georgios.xenakis@forestresearch.gov.uk, a.xambosedo@qmul.ac.uk

School of Electronic Engineering and Computer Science

Research Question

What are suitable mappings (data-to-sound associations) from weather data to sound data that can raise awareness about climate change?

Sensing the Forest

Sensing the Forest (StF) aims to raise awareness among forest visitors, artists, scientists, and the general public about the connection between forests and climate change.

Our vision is to emphasise listening as a method to engage with the forest ecosystem.

System Hardware

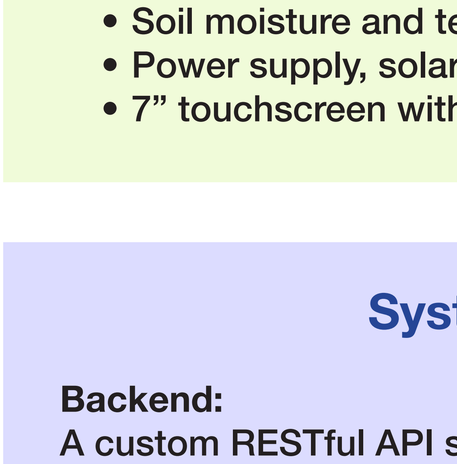
A custom tree talker prototype offers affordability and ease of use for monitoring a tree and its climate. Sensors connected to a Raspberry Pi, for processing, include:

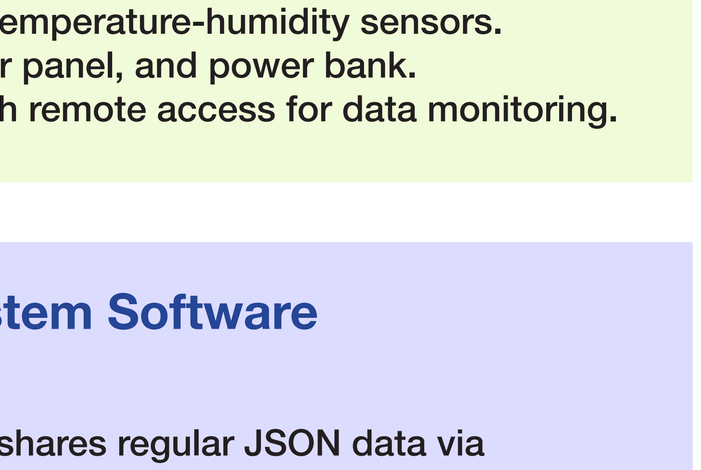
- Custom low-cost 3D-printed non-invasive magnet-based dendrometer (to measure tree trunk diameter changes).
- Soil moisture and temperature-humidity sensors.
- Power supply, solar panel, and power bank.
- 7" touchscreen with remote access for data monitoring.

System Software

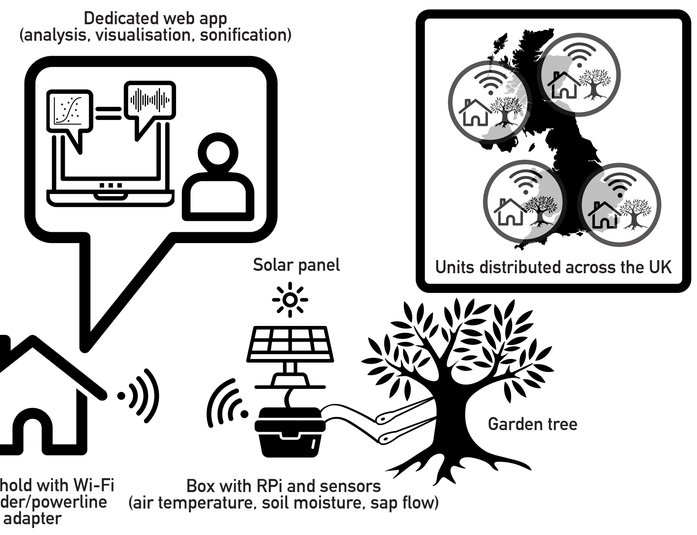
Backend:
A custom RESTful API shares regular JSON data via endpoints corresponding to URLs. Sensor data is received from the tree-talker hardware unit, and saved separately on the web server.

Frontend:
Directly accessible REST endpoints are available to:
•View unit's latest record.
•View unit's historical records.
•Interact with visualisations and sonification of unit's data.





A real-world deployment of the hardware unit (left) and interactive software (right)



Project vision: our low-cost DIY tree-talker prototype's hardware and software workflow.

Basic Mappings

Two simple one-to-one mapping sonifications are proposed, mapping sensor data to separate drone sounds or frequency modulation (FM) synthesiser parameters, accompanied by a line graph visualisation.

- **Drone Mapping:** tone frequency changes with respect to corresponding value using natural mapping (high values -> high tones).
- **FM Synthesis Parameter Mapping:** carrier frequency (temperature), modulator frequency (humidity), modulation index (dendrometer), and carrier gain (soil moisture) calculated using suitably rescaled values with natural mapping.

Complex Mappings

Users may create custom sonifications from the data, or sonify data inferred from the sensor readings, optionally accompanied by graph or animated visualisations.

- **Custom Sonification:** users design their own sonifications, selecting instruments for each data variable, tempo, rhythm and note duration preferences, and a starting pitch or scale for the tool to use to map the sensor data. Chords, drums, instrument track volumes, spatial location, and audio effects may be selected using the dropdown list-based tool, with the final piece able to be played back or saved.
- **Inference:** Performing calculations using the sensor reading values provides further insights into tree stress, including daily tree shrinkage and expansion, a tree's response to climate, its mean growth, and tree canopy air dryness. These inferred values may be sonified using a drone soundscape, FM synthesis parameter, or custom sonification mapping method.

Dendrostream

StF Code

StF Website

Web Audio Conference (WAC '25), 19-21 November 2025, Paris, France
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