Singapore: NTU's AI System Enhances Tree Management

Alita Sharon | November 18, 2024

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Scientists at Nanyang Technological University (NTU) Singapore, in partnership with the National Parks Board (NParks), are developing an AI-powered radar system to detect internal decay and cavities in tree trunks. This innovative technology aims to revolutionise urban tree management by enabling faster, more accurate health assessments, crucial for public safety in densely populated areas.

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In cities like Singapore, proper management of trees is vital as they offer for shade, cooling, and enhance biodiversity. However, as they age, trees become more prone to internal defects that can compromise their stability. If not detected early, these hidden flaws could lead to tree failures, posing risks to people and property, especially during severe weather events or unexpected storms, which can significantly increase the likelihood of tree collapses.

Currently, arborists use techniques like sonic tomography and electrical resistivity to assess tree health. While effective, these methods are time-consuming, labour-intensive, and require direct contact with the tree. NTU researchers have developed a faster, non-invasive solution using an AI-enabled radar system.

The system features a radar prototype that scans the interiors of tree trunks with microwaves. Unlike traditional ground-penetrating radar, which needs direct contact, NTU's radar uses a motorised slider that moves along a straight path 10 cm away from the trunk. This setup allows rapid scanning at regular intervals.

A unique antenna developed by NTU captures detailed internal images, which are processed using advanced signal techniques. These remove noise, enabling a deep learning model to identify 'defect signatures' – patterns indicating decay or cavities. The entire process takes only three to four minutes, significantly speeding up tree health assessments and allowing for more frequent monitoring.

The prototype was rigorously tested in NTU labs on Angsana tree trunks, a common species in Singapore, achieving a 96% accuracy rate in identifying internal defects. Encouraged by these results, researchers extended tests to living trees. A field test on a hoop pine tree, known to have internal cavities, showed a 75% accuracy rate. The lower accuracy was expected due to differences between cut samples and living trees, such as moisture content.

The NTU team, led by Assistant Professor Abdulkadir C. Yucel and Associate Professor Lee Yee Hui, is now focused on enhancing the technology. They are training the deep learning model on a more diverse dataset, including living trees of various shapes and sizes, to improve accuracy across different species and environmental conditions.

Additionally, researchers are working on making the radar system more portable, allowing it to scan trees of varying heights and diameters. This would enable arborists to conduct rapid, non-invasive checks during routine maintenance, boosting the efficiency of Singapore's tree management programme.

The AI-powered radar could significantly enhance urban tree management, potentially reducing tree failure rates further. Singapore has already seen a 65% reduction in such incidents due to its robust management programme. By integrating this new technology, authorities aim to detect defects earlier, with the goal of reducing tree falls to near zero. However, researchers acknowledge that tree failures cannot be entirely eliminated, especially due to external factors like extreme weather.

Beyond Singapore, this technology holds global potential, particularly in cities with dense tree populations. Its rapid detection capabilities could prevent property damage, minimise public transport disruptions, and enhance safety, especially in storm-prone regions where fallen trees can cause severe blockages.

The AI-enabled radar system developed by NTU represents a breakthrough in non-invasive tree health monitoring. Its ability to quickly detect internal defects, without direct contact or extensive manual labour, marks a significant advancement in arboriculture. As the technology is refined, it could become an essential tool for ensuring the safety and sustainability of urban green spaces worldwide and contribute to long-term environmental conservation efforts.

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