



Smart Lime Farm Management System: Robotics, IoT, Computer Vision, Multispectral Imaging

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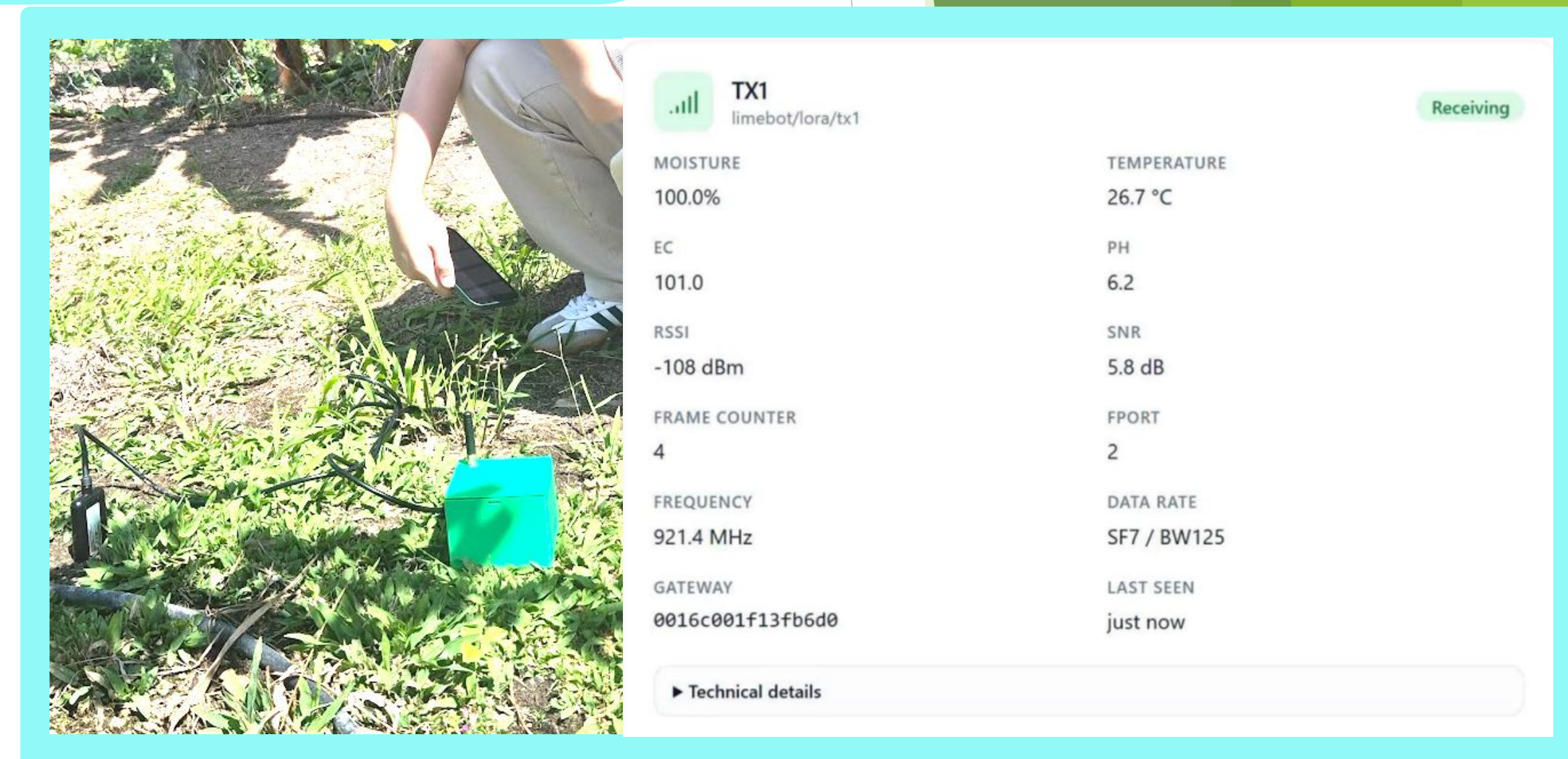
Did you know ?

Despite population growth and climate change,

- Insects, diseases, and processing lose over **40%** of citrus ?
- Citrus market value will increase **15%** in 2035 ?
- Technology supports reducing fertilizer usage by **20%**, pesticides by **50%**, and increasing **25%** of organic farmland ?

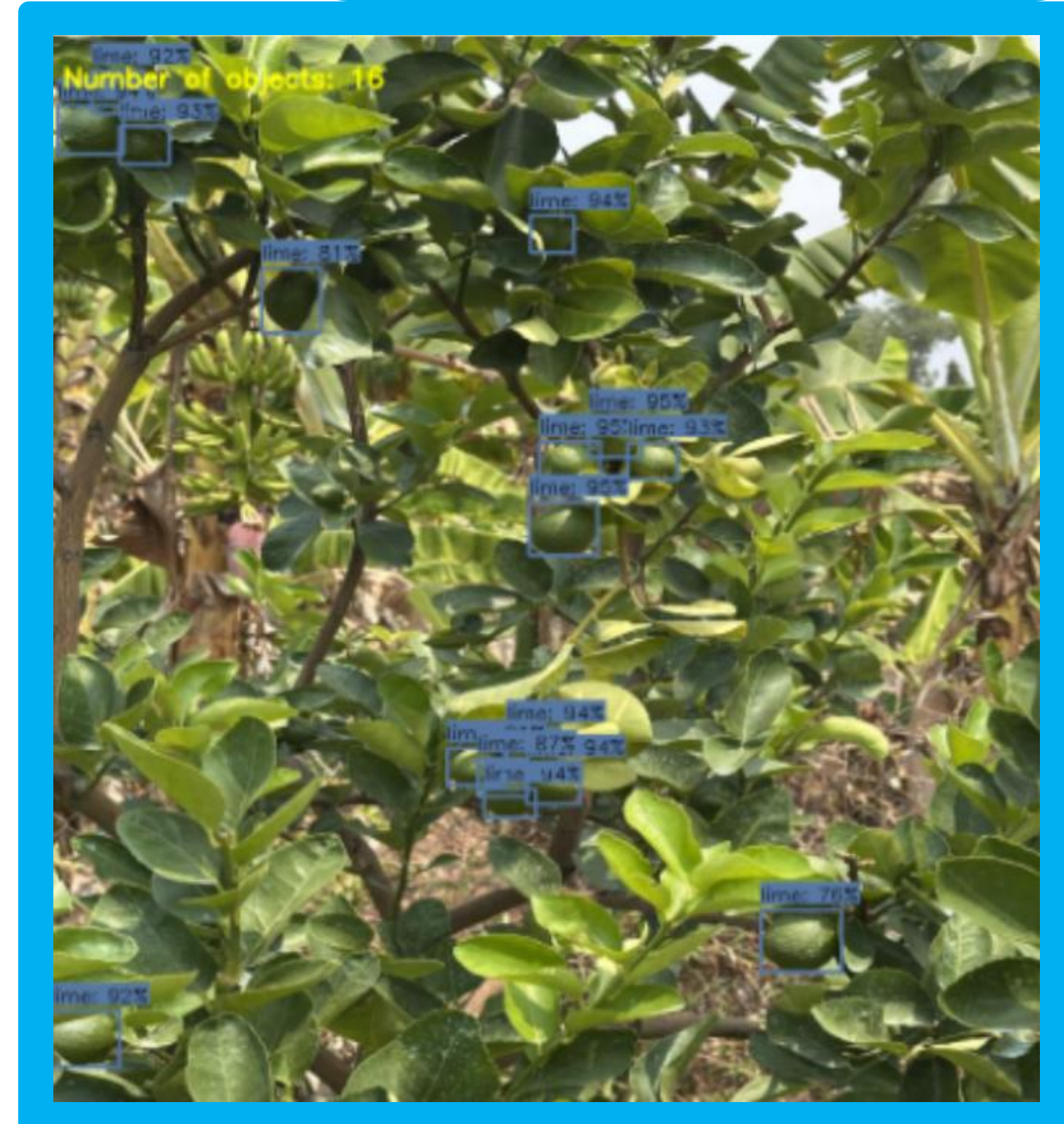
Node overview

- Air, soil quality
- LoRaWAN transmission protocol



CV overview

- Detect, count lime
- On-board processing
- 15 frames-per-second speed



Computer vision (CV)

Sensor nodes

WebApp:
Display,
alert,
control

Multi-spectral camera

Camera overview

- Find tree stress
- Early disease alert
- Farm health



Robot



Robot overview

- 45-minute autonomous patrol
- Collect data, avoid obstacles
- Zenoh transmission protocol

Achievements and future work

- Fruit detection accuracy **above 70%** consistently. Retraining with more data helps increasing accuracy. An algorithm can be developed to estimate yield.
- Robot navigates to goals with **0** collision. Extra tests in highly dynamic environments are helpful to improve localization, mapping, and navigation.
- The multispectral camera and sensors correctly reflect farm status in real-time. A maintenance plan should be developed as nodes scale up.