Automated monitoring of viral cassava disease

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Why is this important ?

- Cassava supports 75% of all farmers livelihoods in Uganda and is the number 1 food-security crop.
- Information about viral disease in cassava is extremely important to aid early intervention planning.


to stem devastating banana wilt

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Photo: Kate Holt/IRIN

Uganda: Banana Wilt to Cause $4 Billion Loss

BY GRACE AGABA, 5 OCTOBER 2006

Kampala — UGANDA risks losing about $4b (sh7.4 trillion) to the banana bacterial wilt by 2010 unless efforts to prevent the fast-spreading disease are put in place, banana experts have warned.

The banana bacterial wilt spreads by drying banana plants. Researchers have discovered that the


NEWS

New viral disease threatens region's cassava farming

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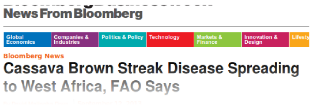
Commercial cassava growers. Uganda scientists are currently doing research to understand the virus, and how to develop resistant varieties. Photo/FILE

By HALIMA ABDALLAH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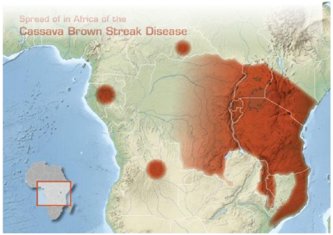
Cassava Brown Streak Disease Spreading to West Africa, FAO Says

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NEWS

Cassava farmers in Great Lakes facing double disease strike

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By ZAYNAB TURUKU

Posted Monday, November 23 2009 at 00:00

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Cassava farmers in the Great Lakes region are at risk of suffering losses following an outbreak of brown streak disease and cassava mosaic that are spread by white flies.

Where is the problem ?

Current methods involve experts from national agricultural research organisations visiting gardens throughout the country to do surveillance. This is sub-optimal because:

- There is a shortage of experts to perform this time-intensive task.
- Limited resources mean only small quantities of data can be collected which is not representative of the state of disease.

Automation of some of these expert tasks is hence critical. The ubiquity of mobile phones also means we can deploy these solutions quickly and have people with basic training facilitating these expert tasks.

Approach 1: Real-time disease surveillance using smart phones

Current methods are:

- Slow and error-prone.
- Require experts to visit and assess each crop.
- Have a 6 months cycle before a disease incidence map is produced from the data.

Approach 1: Real-time surveillance using smartphones

- Development of a smartphone data collection app for crop disease surveillance usable by surveyors at national research institute.
- Key improvement: 6 months $\rightarrow$ near real-time incidence map generation.
- Amount of expert time saved, closer or higher than 80%.
- Investigating crowd-sourcing disease surveillance data from farmers and extension workers running this app.

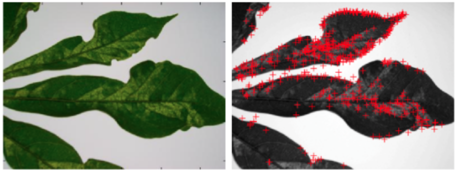
Approach 2: Automating disease diagnosis in the field

Current methods tend to be:

- Accuracy of method is highly dependent on the experience and training of expert.
- Limited resources (human and financial) has implications on the quality and quantity of field diagnosis.
- Determination of severity of disease is very subjective.

Approach 2: Automating disease diagnosis in the field

- Using machine learning techniques to automate diagnosis of crop disease on a smartphone or tablet offering rapid feedback to farmer or extension worker.
- We use a mixture of shape and color features from images of leaves to characterise different disease symptoms. Current accuracies we achieve for detecting Cassava Mosaic Disease are over 95% (AUC).
- Investigating specific algorithms detecting severity of disease.



Approach 3: Automating pest and symptom measurements

Current methods

Current methods used in surveillance include:

- Visually counting the numbers of whiteflies on leaves of a plant
- Visually scoring the percentage of necrotised root on a tuber of a cassava plant.

These methods tend to be highly subjective and expert training reliant.

Approach 3: Automating pest and symptom measurements

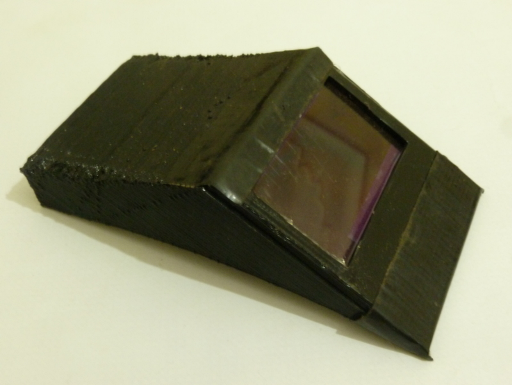
- Using computer vision techniques, we automate the count of whiteflies, the vectors that transmit viral disease in cassava.
- We employ a combination of Haar classifier cascades and image pre and post-processing to achieve accuracies of upto 89 %.
- Improvement from the current methods is envisaged to be closer to 200 % (savings in time with more consistent readings)

Approach 3: Automating pest and symptom measurements

- Using computer vision techniques, we automate the scoring of the percentage of necrotised root, a phenomenon caused by Cassava Brown Streak disease.
- Current methods provide a score that relates to a percentage threshold of necrosis i.e. Score 1 - $<5\%$ necrosis, Score 2 - 5% - 20% necrosis, ..., Score 5 - $>80\%$ necrosis.
- Our method provides the actual percentage in a more consistent manner.

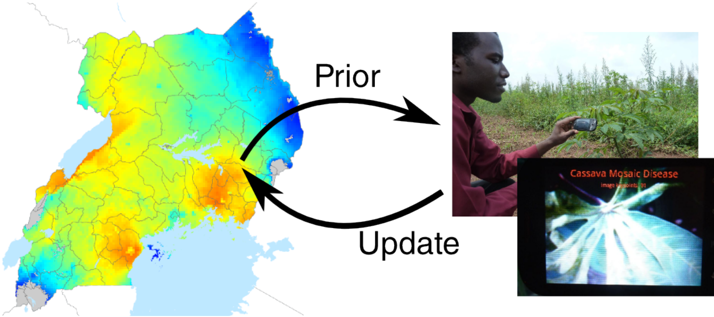
Approach 4: Use of spectrometry for non-invasive field diagnosis

- Investigating the use of low-cost spectrometry mobile phone add-on for doing non-invasive crop disease diagnosis in the field.
- Works by characterising the absorption and reflection properties of plant material.
- Extend spectrometry-based methods to determine health of cassava planting materials.
- Goal is to combine these methods into a holistic diagnostic tool box.



Approach 5: Spatio-temporal modeling of disease

- Coupling mobile survey technology with the use of spatio-temporal techniques to monitor and predic the spread of disease.
- Use of spatio models to optimize survey resources e.g. determing optimal routes.



Current successes

- Created prototype smartphone app for disease diagnosis, for Cassava Mosaic Disease only.
- Developed first version of web and smartphone app for whitefly count, currently being tested in the field with national agricultural research organisation collaborators.
- Used smartphone datacollection tools alongside team from national research organisation to collect over 14,000 images of diseased cassava plants, over 1000 images of whitefly infested leaves, over 500 images of necrotised roots.

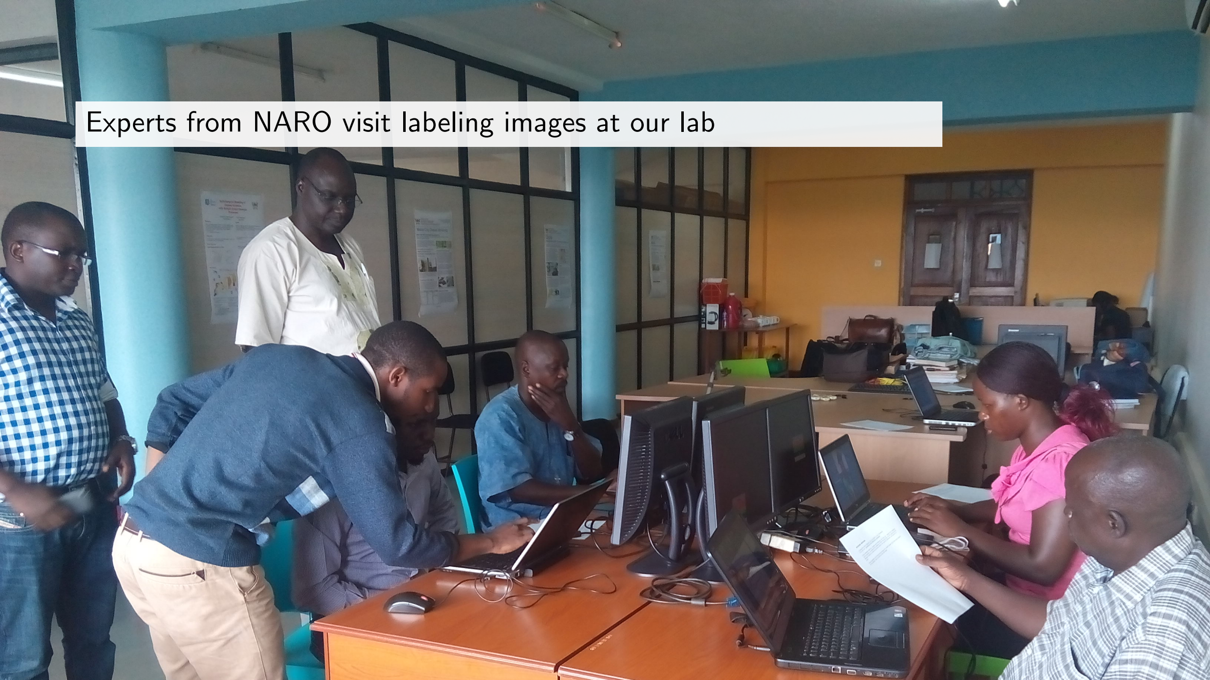
Field data collection
Shadowed experts from National Agric Research Org (NARO)

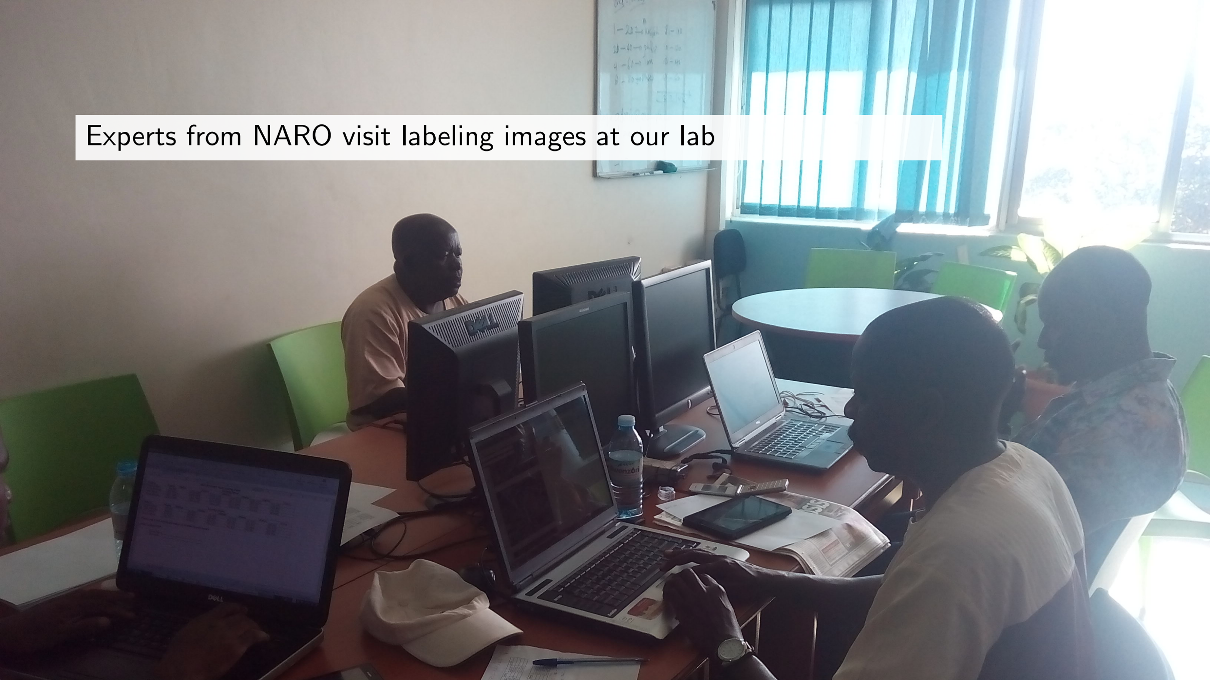
Field data collection
Shadowed experts from National Agric Research Org (NARO)

Collecting root necrosis data

Collected 14K images

Experts from NARO visit labeling images at our lab





Experts from NARO visit labeling images at our lab

Thank You ! When in Kampala visit with the AI-Research lab *(http://www.air.ug)*