Acoustic Red Palm Weevil Detection

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A highly invasive pest, the red palm weevil (RPW), is posing a severe threat to date palm cultivation. The Larvae penetrates the palm trunks creating cavities and tunnels that weaken the tree structure. The Larvae can remain undetected until they cause severe damage. For early detection we propose an acoustic device to record the sound from the field and compare it with a previously recorded larvae sound under lab conditions to determine if there is an infestation.

Literature Review

This study focused on the deployment of the RPW bioacoustic sensors to form a wireless sensor network in palm tree orchards. This implies the development of network software that will allow a reliable communication of each sensor with the control station. Also, a control station software was developed. This software will receive the analysis reports from the installed sensors in order to process and conveniently store them with the corresponding side information, providing fast detection response, continuous monitoring activity and reducing the monitoring costs when compared to in-situ human-operated monitoring proposals.

Hardware:

-Sensing Node: consists of sound probe containing a microphone to be inserted in the Palm Tree, and a box containing amplifier + Arduino + SD card module + Wi-Fi module to receive the sounds from the probe and save them as wav files on the SD card before sending them to the Raspberry Pi. [1]

-Raspberry Pi: Receives the audio files and runs the Machine Learning classification algorithm to detect if the weevil infected the trees. [2]

Machine Learning Approaches:

-MFCC (mel-frequency coefficients): used to change the audio signal to Image-Like features. [3]

-Design and Implementation of ML Algorithms.

-Classification using CNN (Convolutional Neural Network). [4]

-Classification using Cross Correlation. [5]

-Both Classification approaches will be tested and the most suitable for the application will be chosen.
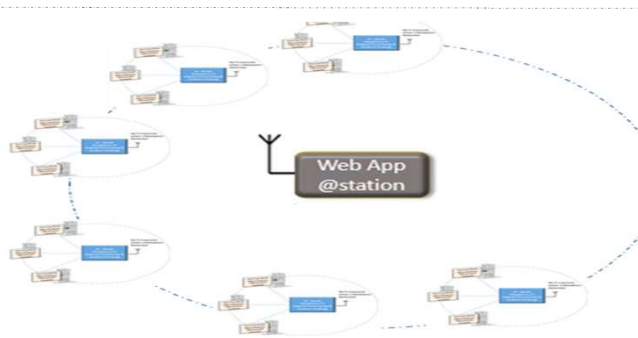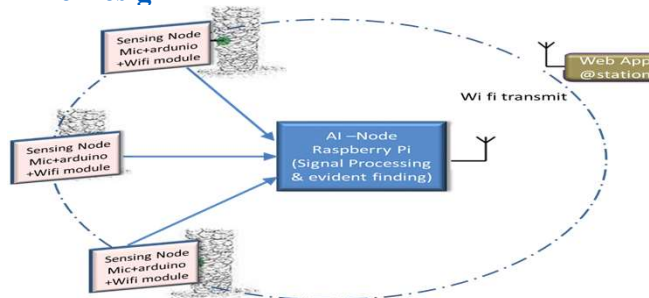
Methodology

An Algorithm based on Signal Processing and Artificial Intelligence is proposed to extract significant features of the acoustic signal to determine the presence of the weevil and estimate the current state.

Comparing signal features of the reference (Data Set) and field signals can be done either by Correlation or Machine learning.
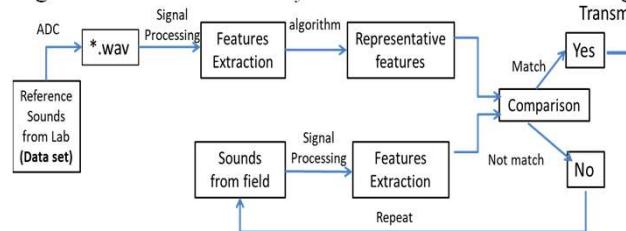
The Design

Conclusion

- The economic damage to palm crops due to RPW could be mitigated significantly by bioacoustic recognition in an earlier phase of infestation and applying the appropriate treatment.

- While their secretive behavior makes an early detection with traditional methods (e.g. pheromone traps) not applicable, it can be performed using bioacoustics recognition.

- Acoustic recordings from insects in trees often reveal sound waves with spectral and temporal features that make them distinctive and easily detectable.

- The acoustic device is a low cost solution to detect the red palm weevil

- It can detecct the weevil in earlier stages of infestation before it can cause severe damage to the tree

- Early detection allows for faster and less expensive treatment

References

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Further Info