Palm Guard

AI Multi-SENSING WIRELESS DEVICE for Early Detection of Red Palm Weevil (RPW) using Edge AI & ML

Presented by:
ABDULLA ALJENAIBI (PH.D)

INTRODUCTION

According to the Food and Agriculture Organization (FAO), the world's USD 13-billion date sector, which includes both large farms and countless smallholders, is at risk from this destructive pest, the Red Palm Weevil (RPW). They cause billions of dollars of damage each year. The Near East, which is characterized by its large date-growing sector, remains the region most affected by the infestation of the red palm weevil. FAO estimates that the insects has burned an estimated half a billion US dollars in date palm trees and left millions of farmers in fear of bankruptcy in the region. (https://www.fao.org/fao-stories/article/en/c/1271032/)

Early detection is vital to control and eliminate the RPW spread which is till now unpresented to the palm trees to defeat and destroy the hidden enemy (RPW). However, most detection systems are not practical enough, they are very expensive, incomplete and without sufficient network IOT alert connectivity in terms of hardware and software.

What is more, sensor nodes are typically just a data collection device, mindlessly sending data to detection algorithms running on servers far from the point of data generation. This increases both energy consumption, response time and lack of un-manned detection system.

To tackle these issues, I designed and deposited for patent Palm Guard, a solution for early detection of RPW, using multi-sensor MEMS, AI & ML, that can harvest, store, and run on solar energy. It detects RPW larvae sound at an early stage from the 1st and 2nd week of newborn larvae while boring and infesting the Palm Trees and the odor sensing even earlier starting from the eggs and new born larvae odor. And the temperature sensing will be detected once the Palm Trees temperature raised after being strongly affected. Early detection is key to target biological controls that halt multiplying of RPW.

The Micro-Electromechanical System (MEMS) digital device is an instrument having an array of gas, sound, temperature and humidity sensors coupled to a system with Artificial Intelligence (AI) and Machine Learning (ML) that can determine odors and sound data analysis simultaneously. The methodology used for identification is through the odorous volatile organic compounds (VOC) and the sound pattern that the Red Palm Weevil (RPW) and its larvae at the early stage makes. The system detects the odor and sound digitally through AI & ML, and this feature makes the gas and sound sensor MEMS technology suitable and perfect for real time monitoring.

PALM GUARD DEVICE

The Palm Guard supports Artificial Intelligence (AI) with Machine Learning (ML) providing the backbone and algorithm that can process Machine Learning firmware in a small form factor Hardware.

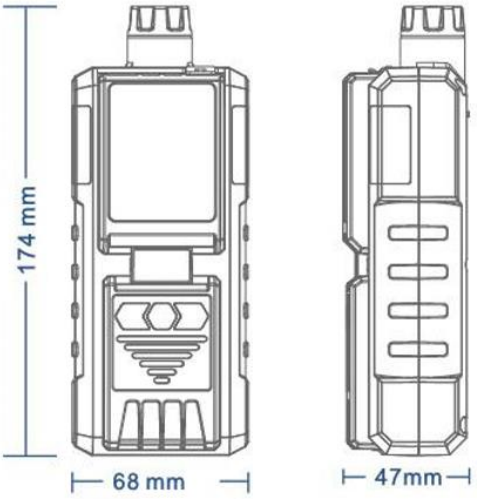
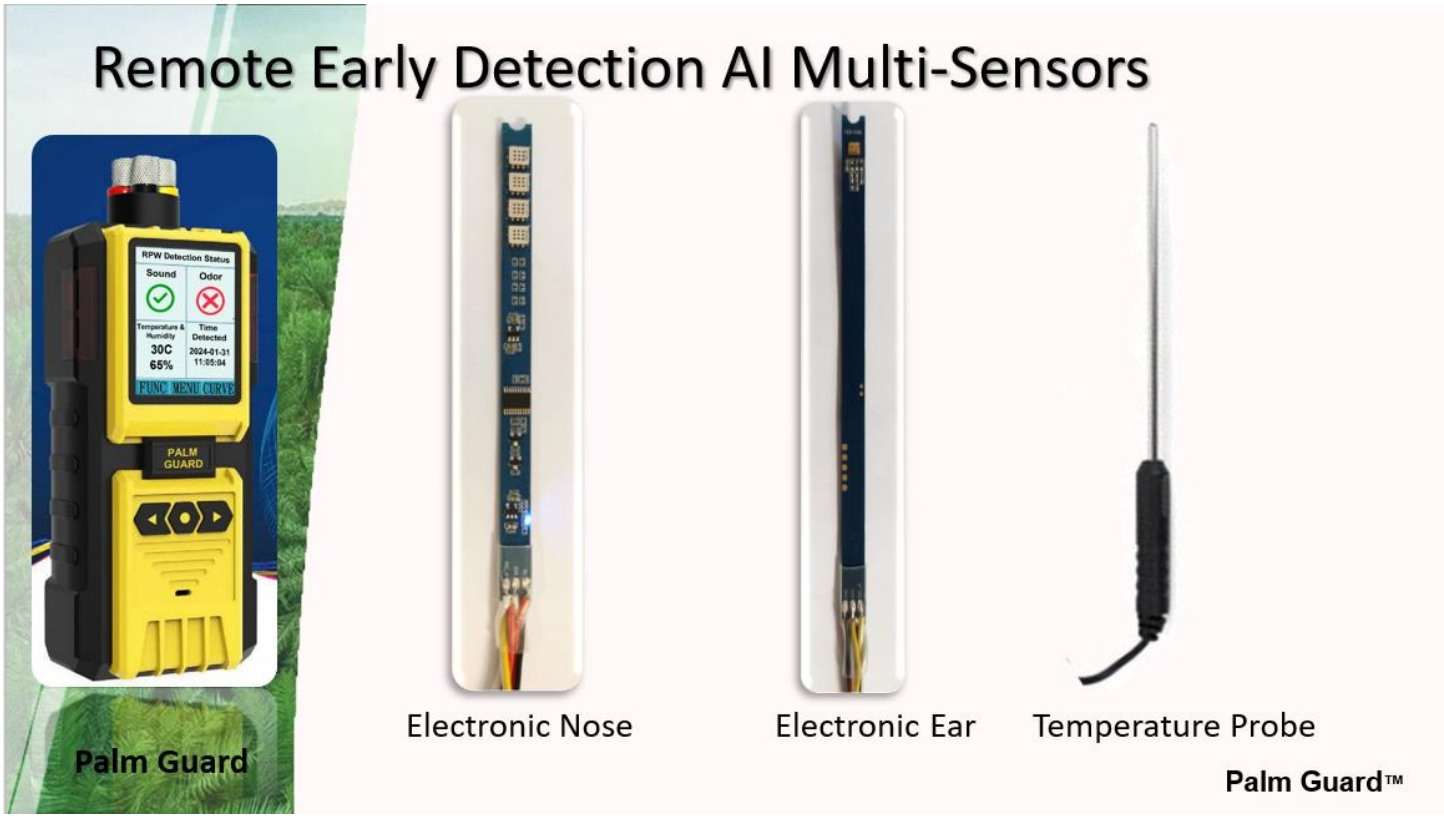


Fig.1: Palm Guard

The 4-in-1 technology digital MEMS device has Gas, Sound Temperature & Humidity Sensors. The Gas Sensor has 4 measuring units and each of them is sensitive to various kinds of gases, which means it will be able to get four sets of data at the same

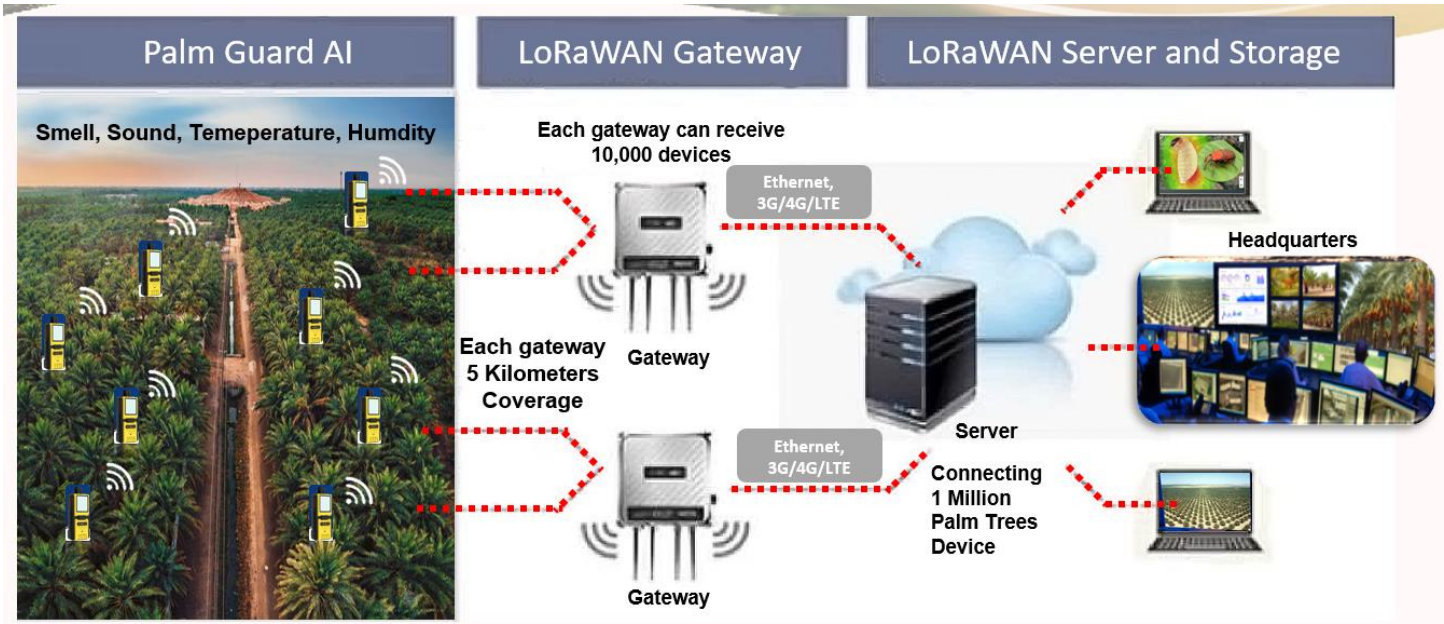
time. And different sorts of gases can also be judged by these four sets of data. The gas sensor used in this module is based on MEMS technology and has the advantage of being in a small size (7.5mm x 127mm x 1.5mm) with considerable measurement stability and is more suitable for qualitative than quantitative measurement.

The Sound Sensor in the device is based on high-performance microphone MEMS technology, offering an extremely-low-noise (filtering background noise), low-current, reliable, and small microphone to open source hardware industry, and it has improved performance under severe conditions. It is an ideal choice of sound sensors where excellent audio performance is required. It can provide up to 20dB of gain and it also features low current, max RF protection, which makes it a perfect microphone.



The system also includes Temperature and Humidity digital MEMS that works with odor and sound sensors which presents a comprehensive check-up to the Palm Tree. An infected palm has a different temperature and humidity inside the palm tree body which is learned by AI and ML.

Multi Wireless Connectivity between Palm Guard device, Gateways and Servers to Farmer Device and Headquarters



The Palm Guard System protects each Palm Trees from early stage larvae attack and consider as a total early detection solution to defeat and eliminate the RPW. The device will send immediate message to the Control Room or to the Farmer once larvae is detected by noise or smell or temperature MEMS sensor and will send the farm and palm tree number and location to the concerned Authority to be treated immediately and control one of the important food security in the region.