Smart Forest Fires Detection

Information Technology in Disaster Risk Reduction

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Collectif de protection de la forêt de Sidi Amor
APPROUVÉ
une initiative du GDA Sidi Amor

GDA المجمع البيئي للتنمية المستديمة
Sidi Amor سيدي عمر

UNIVERSITÉ LAVAL

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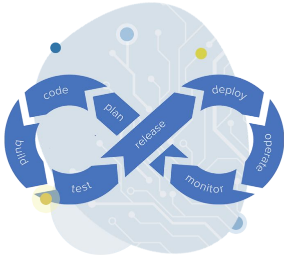
Comwork

A start-up born in the gardens of the GDA

Comwork is an IT services company founded in Tunisia by a team of dynamic and passionate people! Today, Comwork brings together professionals in several new branches in Paris and Saudi Arabia.

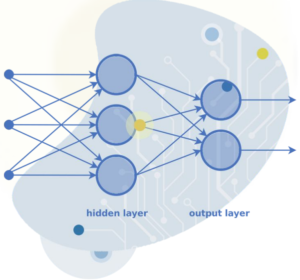
Our strong sustainable development culture also came from our training from the 2nd most eco-responsible university in the world



DevOps
administration & Infrastructure

Développement web
mobile & design UX/UI

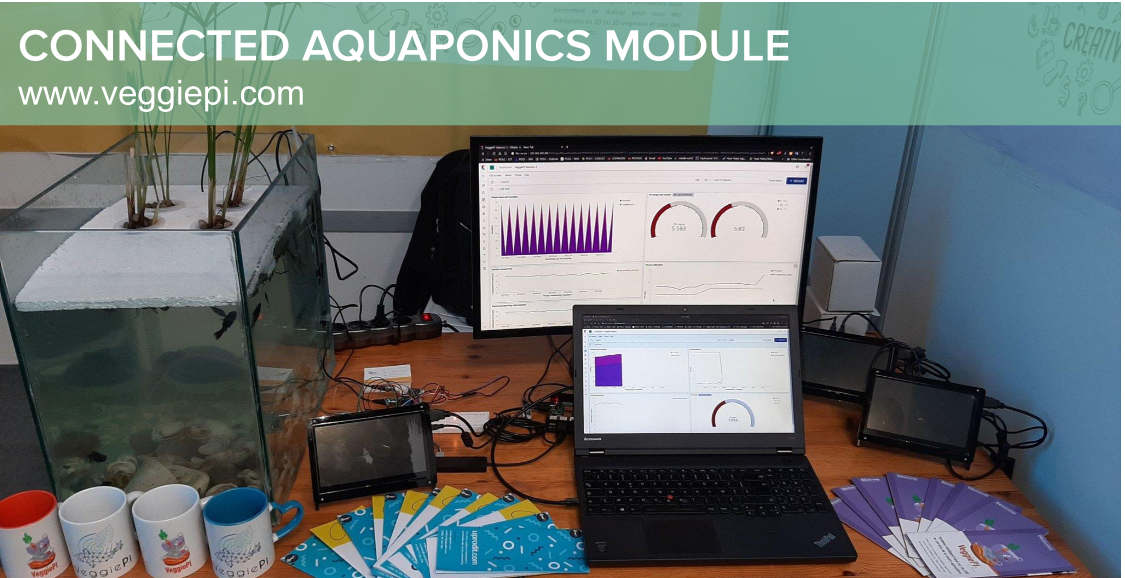
IoT & Big Data
embedded software and data analysis

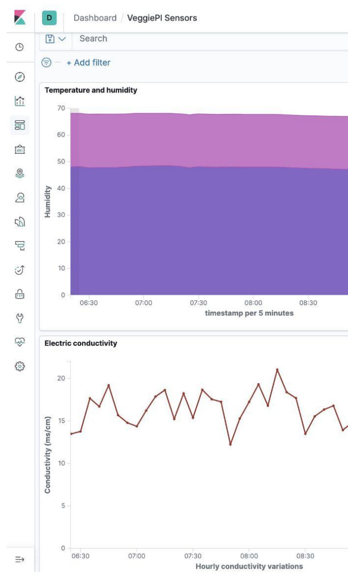


Intelligence Artificielle
machine learning & OR optimization

ILO International Labour Organization
SHIPPEO
DCAF Geneva Centre for Security Sector Governance
IACE
giz
LA POSTE
FAO FIAT PANIS
مدينة الثقافة Cité de la Culture


VeggiePI


CONNECTED AQUAPONICS MODULE
www.veggiepi.com


Dashboard / VeggiePI Sensors
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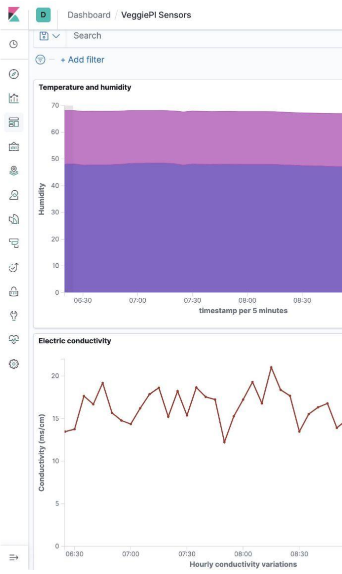
Humidity
timestamp per 5 minutes
Electric conductivity
Conductivity (ms/cm)
Hourly conductivity variations

TECHNICAL MODEL

- A RaspberryPi collects sensor logs in a so-called Time-series Database.
- Sensor units communicate with the RaspberryPi by different protocols depending on their distance: directly connected, by WiFi within a range of 800m maximum, LoRaWan, etc.
- The data is then sent to the cloud and analyzed to send alerts if abnormal thresholds are observed.

CONNECTED AQUAPONICS MODULE

www.veggiepi.com



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REMINDER OF THE SITUATION

The objective of this project is to implement a pilot project in GDA Sidi Amor.

The concerned area, surrounded in this map, consists of 5 hectares of forests and olive groves.

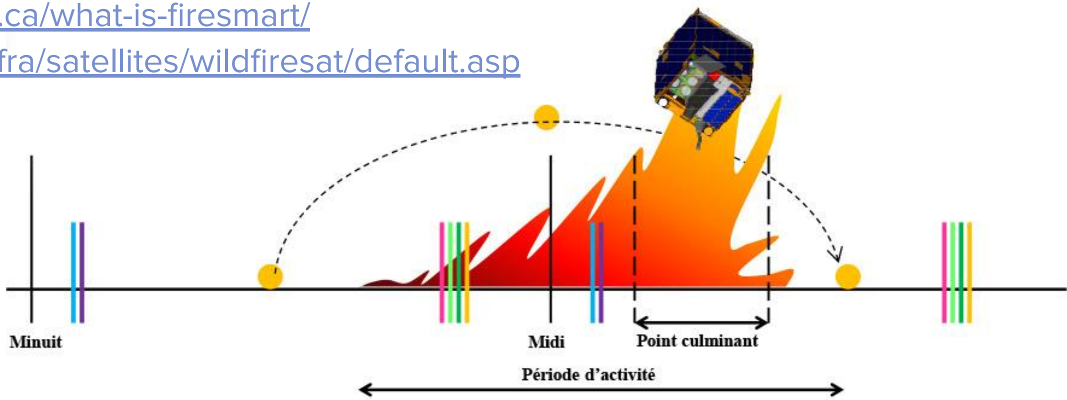
STATE OF THE ART

Canadian Fire Forest Strategy

Simulation Software: https://d1ied5g1xfgpx8.cloudfront.net/pdfs/32530.pdf

Firesmart: https://www.firesmartcanada.ca/what-is-firesmart/

WildFireSat: https://www.asc-csa.gc.ca/fra/satellites/wildfiresat/default.asp



Californian Projects

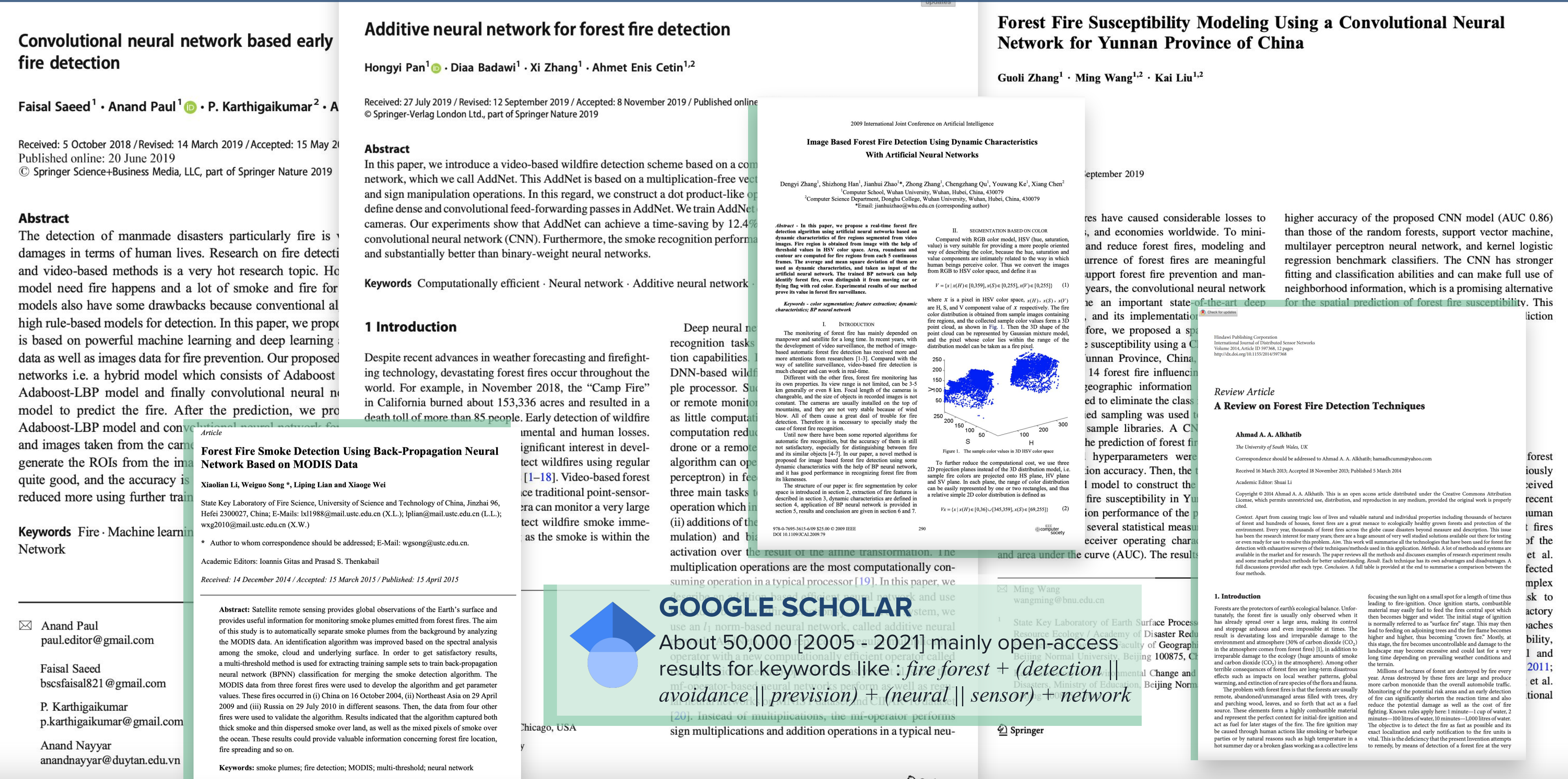
IA Video Recognition: https://www.azocleantech.com/news.aspx?newsID=29087

Swaying of tree: https://www.science.org/content/article/self-powered-wildfire-detector-could-help-prevent-deadly-blazes

AlertWildfire Camera Network: http://www.alertwildfire.org/

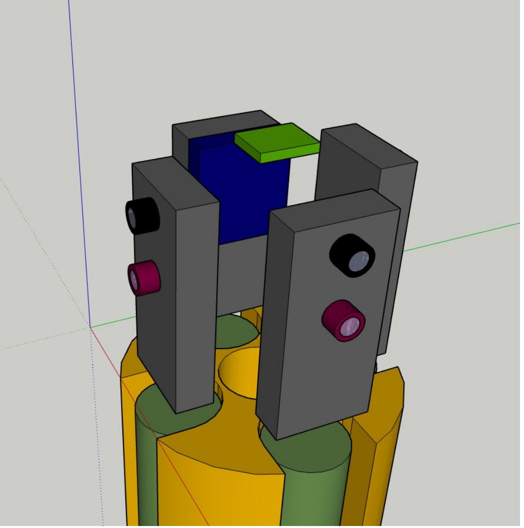
https://www.govtech.com/products/artificial-intelligence-is-helping-to-spot-california-wildfires.html

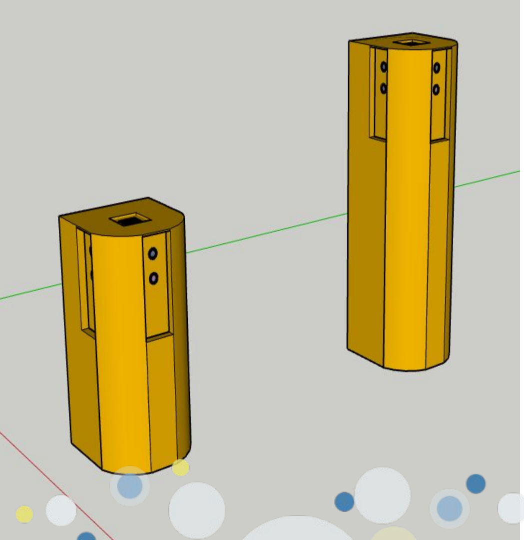
A TOPIC ALSO INCREASINGLY STUDIED IN THE LITERATURE



GOOGLE SCHOLAR

About 50,000 [2005 - 2021] mainly open-access results for keywords like : *fire forest* + *(detection* || *avoidance* || *prevision)* + *(neural* || *sensor)* + *network*





FIRST APPROACH

A network of connected sensors and activators (IoT)

TECHNICAL MODEL

Small-profile, self-contained, fire detection units with:

- 2/3 thermal cameras and 3 traditional cameras and 200° of visibility
- Temperature, Humidity, CO_2 combination sensor on top
- 4 to 8, 18650 batteries which will allow them to have between 12000mAh and 24000mAh of battery storage. (given a 3v system, and 3000mAh per battery)

TERRAIN COVERAGE

- Minimum of 56 units covering 900m^2 each (30m of coverage in each direction)
- Minimum of 80 units covering 625m^2 each (25m of coverage in each direction)
- Minimum of 125 units covering 400m^2 each (20m of coverage in each direction)
- Each configuration will require a minimum of 2 Gateway Nodes to ensure redundancy

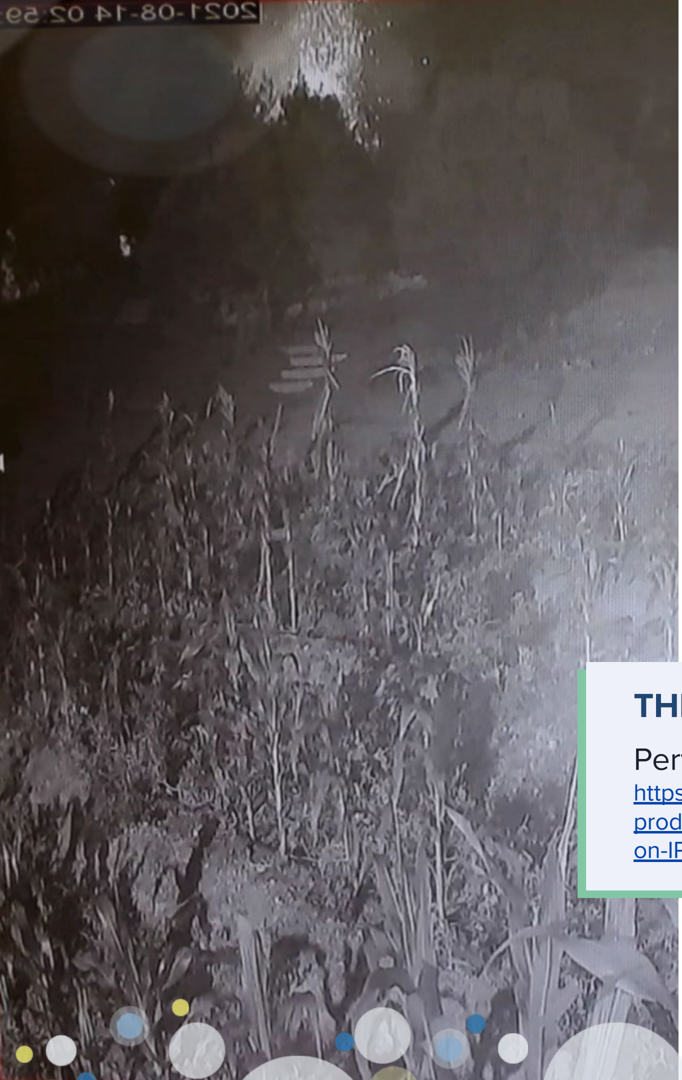
Article	Quantity	Unit Price	Total Price
Cost breakdown of components per Gateway			
RaspberryPi 4 8Gb	1	€169.99	€169.99
LoRa Hat	1	€35.68	€35.68
GSM Hat	1	€31.99	€31.99
Gateway Units	2	€237.66	€475.32
Cost breakdown of components per unit			
18650 3000mAh Batteries	4	€9.25	€37
100mA 3v Solar Panel	4	€3.5	€14
Optical Cameras	2	€8.04	€16.08
Thermal Cameras	2	€62.96	€125.92
ESP32 LoRa Gateway	1	€36.73	€36.73
DHT22 Temperature and Humidity sensors	1	€13.29	€13.29
Co2 concentration sensor	1	€19.59	€19.59
Plastic Injection Housing	1	€3	€3
Fire Detection Units	56	€265.61	€14,874.16

FIRST APPROACH
A network of connected sensors

Sensor cost calculator: https://fire-detection.comwork.io

ISSUES

The prices do not take into account (i) the engineers' allocation time for development and set-up, (ii) the assembly of parts into a finished product (resistance to water and heat, etc.) or (iii) the amount of material needed to test the product, etc.



SECOND APPROACH

Machine Learning - Video Analysis

Machine learning

Only requires knowledge and engineer development time, little or no material to import

Require only already finished and industrially objects

Conventional cameras + Computers to train the neural network model and apply detection in the image stream

THERMAL CAMERA (*China*)

Performant but expensive:
https://shandongsheenrun.en.made-in-china.com/product/pBKxRJivVaUz/China-Forest-Fire-Detection-IP-Thermal-Imaging-PTZ-CCTV-Camera.html

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Thank you for your attention !