

DESIGN PROJECT - SIE 2025

REMOTE SENSING OF BUSHFIRES IN THE REPUBLIC OF GUINEA

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1 CONTEXT & AIM

Arborise is a non-profit organization leading an **eco-participative reforestation project** in Guinea since 2021. The model relies on community involvement and is partly financed by external investors who receive **carbon credits** in return for supporting tree growth as a means to offset their emissions.

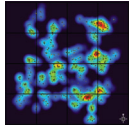
However, to ensure the long-term viability of the project, **young trees must be protected from a major threat: bushfires**. These fires, often uncontrolled and recurrent during the dry season, pose a serious risk to reforested plots.

While Arborise is currently subscribed to global satellite-based fire alert systems, these are often too slow or imprecise to trigger effective local responses. Local authorities and communities have expressed a clear need: they **want to be alerted as soon as a fire ignites**, so they can act rapidly and contain it before it spreads.

OBJECTIVE: To propose a remote sensing mechanism capable of detecting and locating fires in real time in order to improve containment efforts.

4 PRIORITY AREAS

Monitoring the entire set of plots appears unrealistic given the vast area they cover. A prioritization strategy is thus essential. To this end, data on plot density and historical fire recurrence were combined to target areas with both high plantation density and frequent fire events, ensuring a focused and efficient deployment of resources.

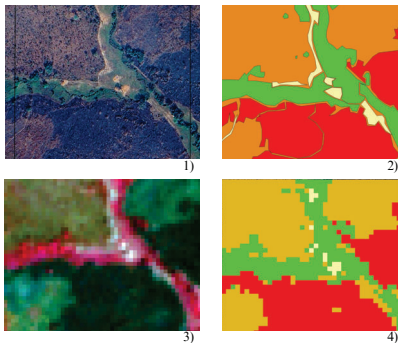


840 plots
1'807 ha

Fig.1: Heatmap of plot density

5 IDENTIFICATION OF BURNT AREAS

A raster-based image classification was performed using false color filtering to train a model capable of distinguishing three land cover types. This allowed analyzing spatio-temporal fire trends and identifying priority zones where early fire detection efforts should be focused.



Classe	Précision	Rappel	F-mesure (F1)
1	0.824	0.275	0.412
2	0.750	0.653	0.698
3 et 4	0.921	0.973	0.946

Tab.1 : Performance indicators of the model for each class on the training zone B.

6 RESULTS

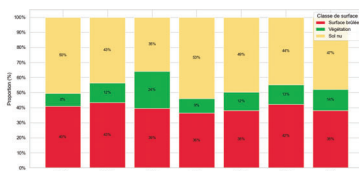


Fig.3: Histogram of land cover evolution

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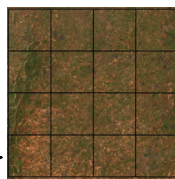


Fig.4: Research Area - True Color Raster Image

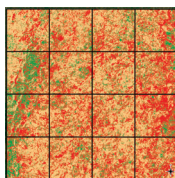


Fig.5: Research Area - Classified

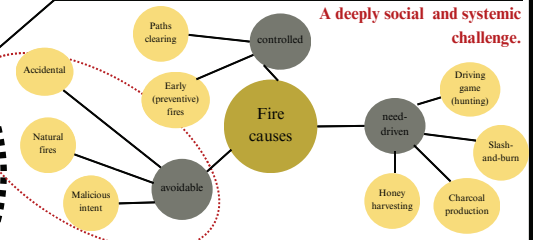
1km-range Arducam
monochrome camera

Infrared projector for
night vision

Performs lightweight
onboard image processing
through Raspberry-Pi

2 CAUSES OF FIRES

A deeply social and systemic challenge.



3 DESIGN CONSTRAINTS

High Spatial Coverage
Monitor a wide area with minimal blind spots

Continuous & Reactive Detection
Ensure near-real-time alerts with fire localization

Local Integration & Autonomy
Deploy a non-intrusive, self-sustaining system

Respecting the annual budget of
10,000 CHF

7 SOLUTION

AUTONOMOUS VISUAL FIRE DETECTION UNIT

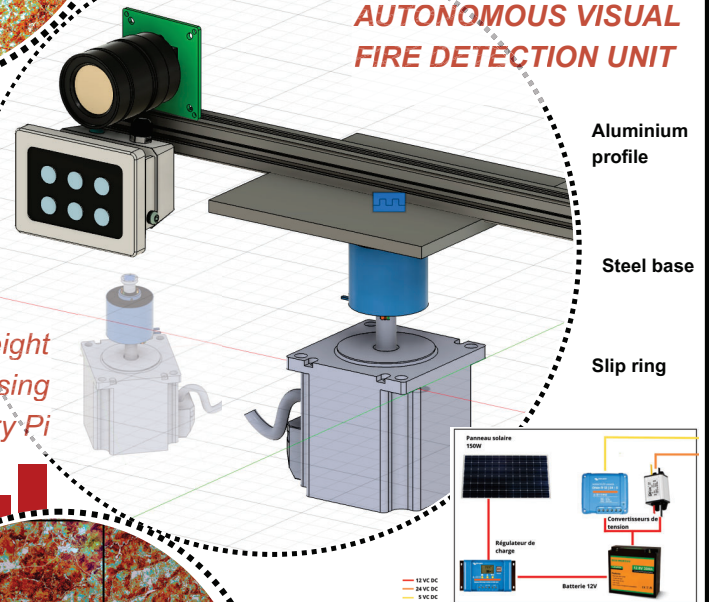


Fig.7: Power System Schematic

8 PROPOSED IMPLEMENTATION

- ~€1000 per unit
- Progressive deployment of ~10 detection units/year
- Target areas selected by overlapping fire recurrence and parcel density maps
- First phase focuses on local deployment
- Total monitored area: ~8km² (10 units with 1 km diameter coverage each)

Fig.6: Overlapping of fire recurrence and parcel density maps