CHAMELEON

mandrIAno

Artificial Intelligence-empowered stockman

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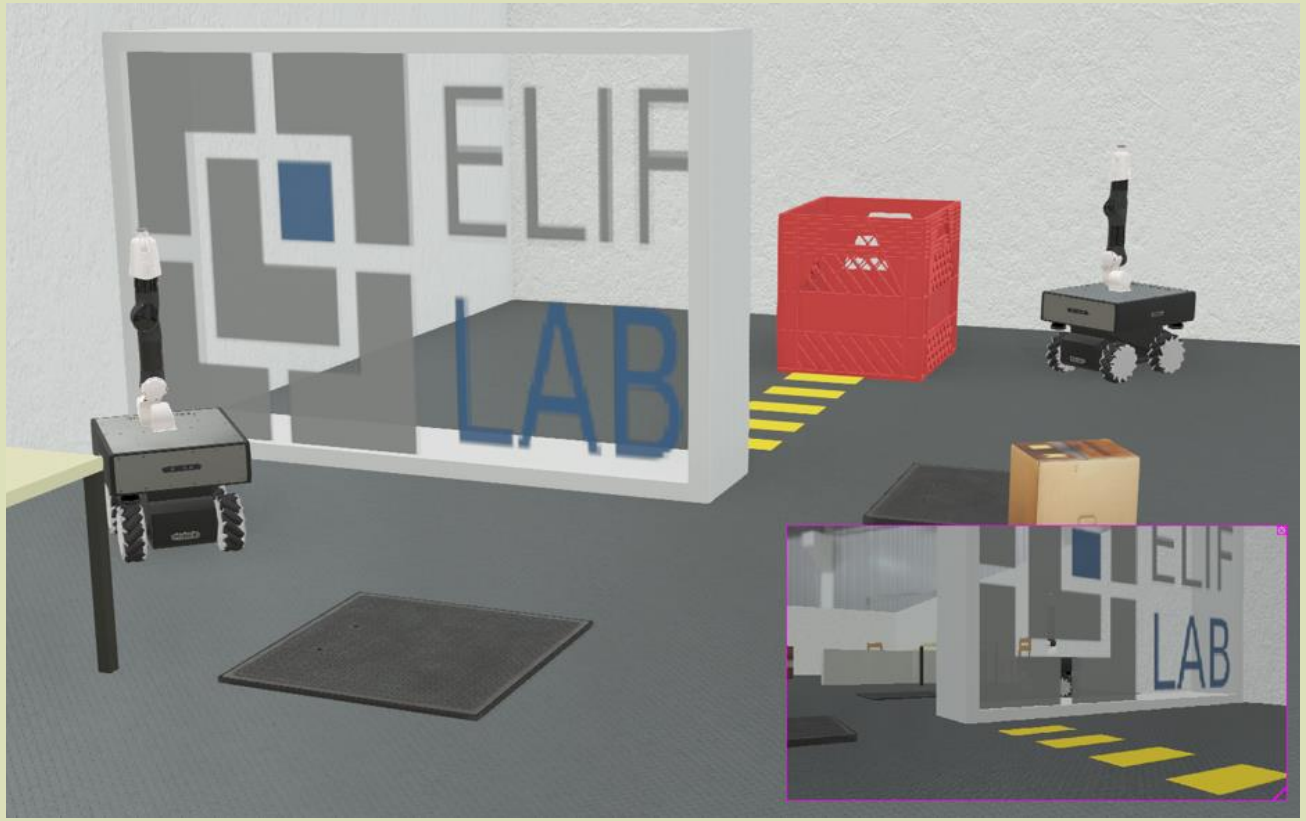
About us

ELIF LAB



Established in 2016, **Elif Lab** is an **Italian innovative company** specializing in developing **data science and artificial intelligence** solutions.

We solve complex problems, automating operations for private and public organizations through **mathematical models**, **artificial intelligence** and **robotics**.

Introducing mandrIAno

Artificial Intelligence-empowered stockman

01 Problem

Livestock monitoring using drones

Monitoring the movement and positioning of livestock and individual animals is crucial:

- track their journeys,
- check their health,
- assess their behaviour,
- verify their access to water and food, and
- report any unexpected or dangerous events.

Direct human visual intervention may not be feasible: drones can be a powerful alternative to direct monitoring by operators (complete replacement or as a preliminary tool to assess situations).

02 Solution

Introducing mandrIAno

Using **Artificial Intelligence**, **natural language generation** and **computer vision** to **reduce flight time** and **provide clear information to the operator.**

- **Eliminate the need for the operator to stop the drone** to perform inspection tasks and interpret the footage.
- Use algorithms to **extract information automatically** from the video
- **Reduce the time and expertise required** for analysing the collected videos
- Provide **readable information**

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How?

A **semantic computer vision system** that uses videos collected by a drone **to generate a report in natural language**.

The artificial intelligence component provides information on:

- the **positioning** of monitored animals (in association with GPS data),
- the **count** of animals in a group, and
- the **environment** in which the animals are detected.

Scene description is achieved through the use of a **transformer-based visual question answering model and a language model component**, which highlight the context and environmental features of the scene.

The output**: a natural language and geolocalised description** (which can also be visualised on a map) of what was detected in the video and logged by **mandrIAno**, related to the features, elements and events significant to the use case.

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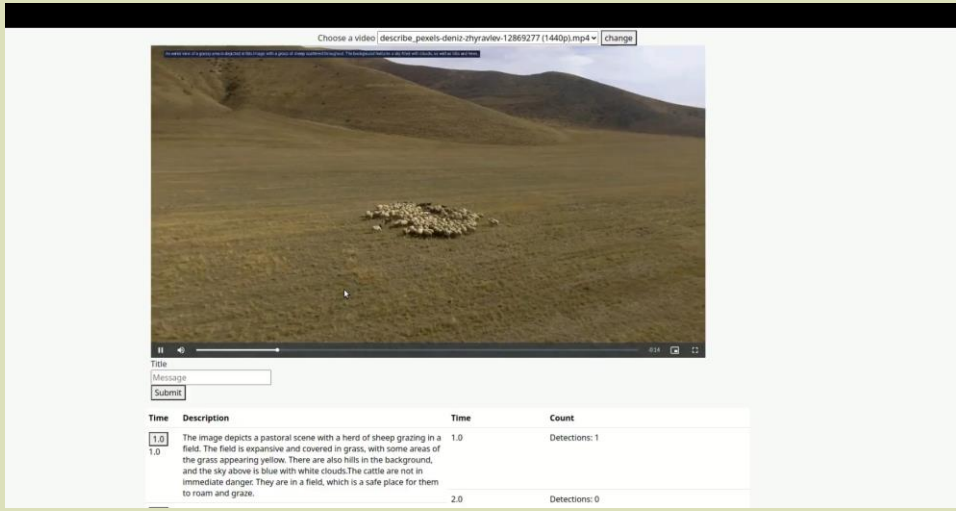
How?



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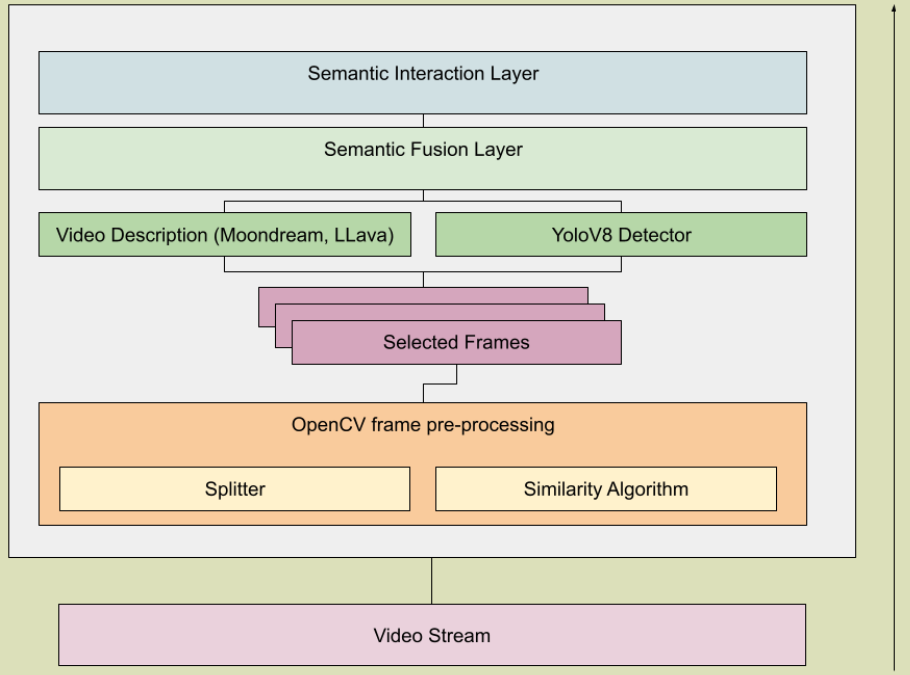
The Artificial Intelligence pipeline

1. Firstly, **drone footage is captured and preprocessed** to extract **individual frames** for analysis.
2. Then, utilizing **Moondream2** or **NanoLLava**, descriptive captions are generated for each frame, providing a **semantic understanding** of the scene.
3. Subsequently, the **YOLOv8 model detects and counts cattle** within each frame, ensuring accurate and efficient object detection.
4. The generated image descriptions undergo **NLP**, allowing us to extract relevant information through searches within the captions.
5. Finally, our **proprietary semantic-graph algorithm** is applied to maintain **temporal stability and smoothness** in the interpreted data, ensuring consistency in the semantic representation.



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Budget friendly!

Our tests included **Full HD (1080p, recommended for the use case) and 720p resolutions (minimal for the use case), with frame rates varying between 30 and 60 fps**. This range of settings is widely available in affordable devices, making it pertinent for our focus on budget-friendly technology.

To reduce computational costs, we **calculate the similarity between consecutive frames using a combination of histogram comparison and structural similarity index (SSIM**).

By comparing the histograms of the YUV channels and the SSIM of the frames, we can determine if the frames are significantly different or not. A configurable threshold is used to decide if further processing is required.

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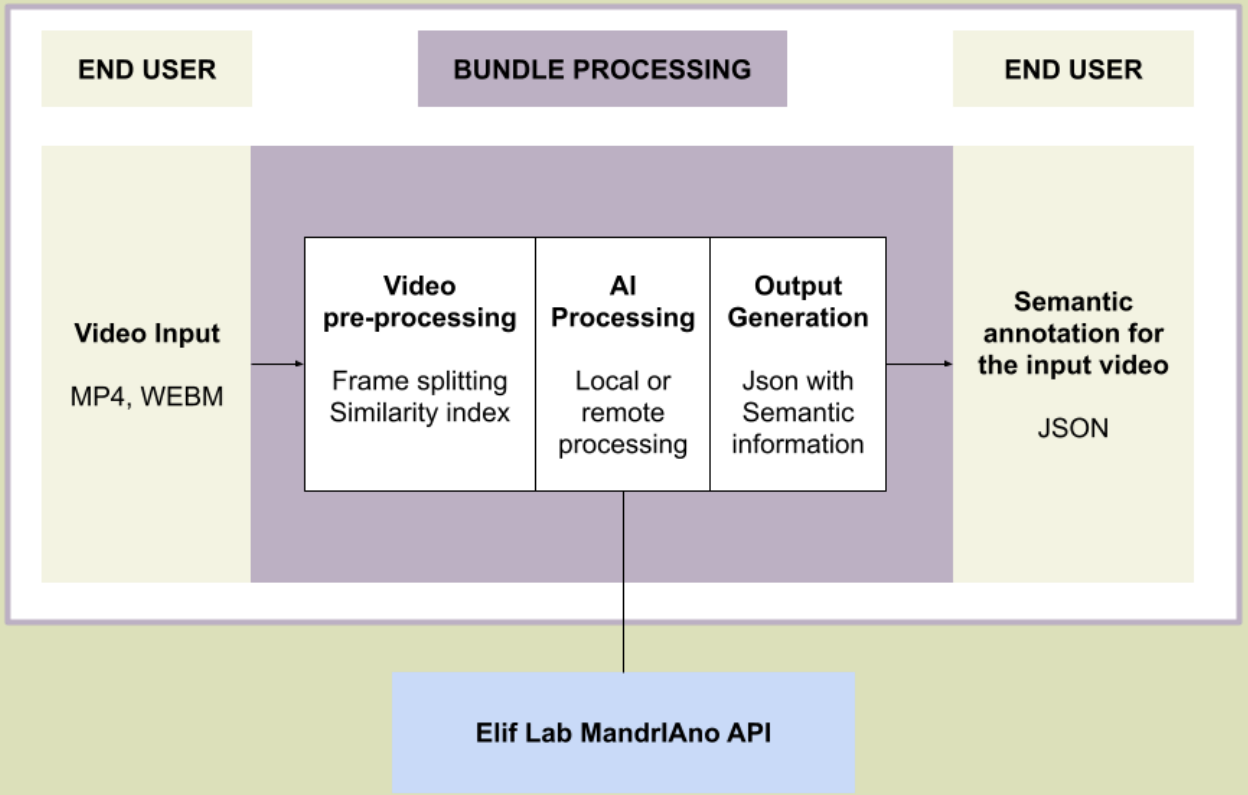
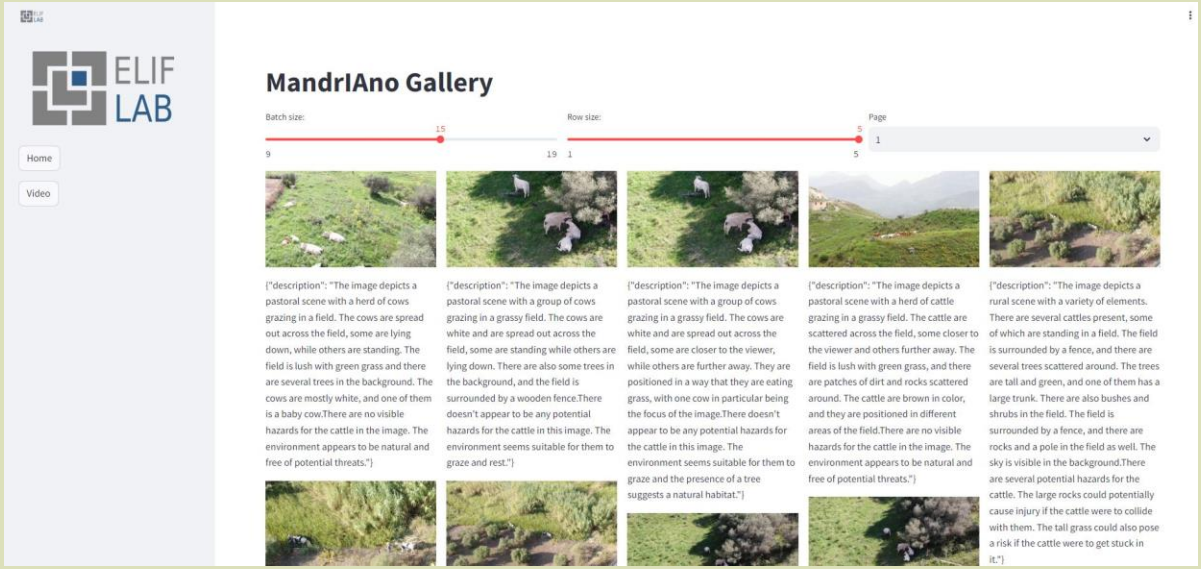
The bundle





Input: a video stream (up to 4k, 60fps. Formats: mp4, webm)

Parameters: similarity threshold, YOLOv8 threshold

Output: database with video information (scene description, metadata) (default: .json)

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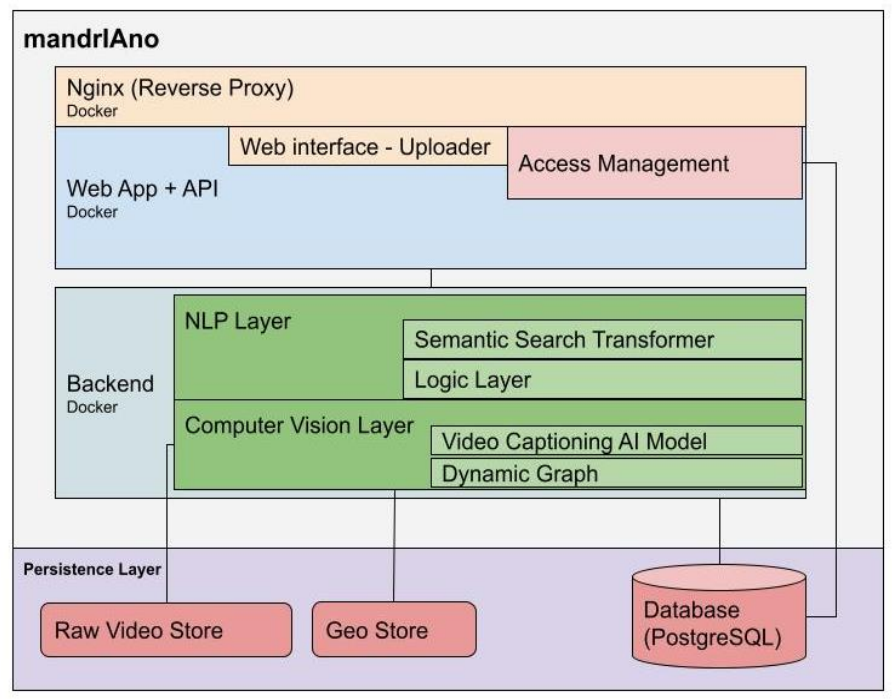
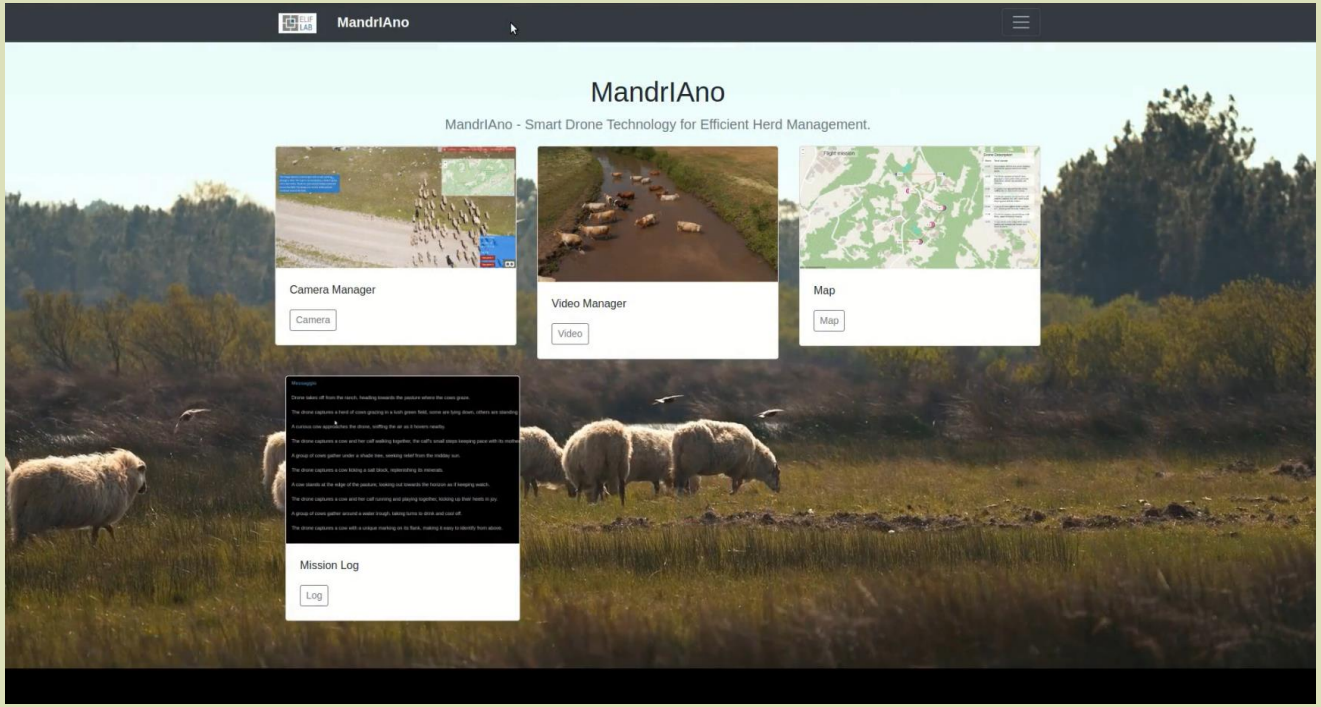
Elif Lab's complete application

Works on tablets and PCs and includes different **web interfaces**

Camera Manager; Video Manager; Map; Mission Log

A video showcasing the solution also available [on our YouTube channel]





09 Results

Testing mandrIAno

Tests in simulated environments and with

open datasets and videos collected with DJI Mavic Mini 2 SE

in Trentino and Sicily (Italy)

Animal count

YOLOv8 – Average Accuracy 92%

(drone altitude and lower thresholds can impact accuracy)

Semantic-Graph Algorithm

Reduced false detections by 71%

Successfully filling gaps in missing detections with 78% recovery rate

10 Results

Scene description

5 human observers evaluated a set of 20 frames with associated generated descriptions with a score from 1 to 10.

Average score 8.25

In some cases the generated description is correct, it may be somewhat generic (on the other hand, this also appears to be a sign of the absence of significant events/alerts in the situation captured by the camera).

Fine tuning of the LLM on specific use cases to have further improvements.

11 Results

Live testing

The live test allowed for **real-time calls for on-demand scene description and object detection on individual frames**.

Response times of under 1 second when executing the algorithms directly on the test PC.

The hardware configuration used for these tests included

- CPU: i7 12th gen
- RAM: 16GB
- GPU: Nvidia GeForce RTX 4050 Laptop GPU - 6GB Vram

With this hardware setup, it was possible to run all the algorithms and models concurrently, demonstrating the system's capability to handle the computational demands of the task.

12 Exploitation

Market segments

- **Drone operators**
- **Agritech** companies, agricultural service providers and marketplaces
- Drone **manufacturers**
- Livestock **farmers** and ranchers
- Agricultural **research institutions** and government agencies focused on rural development

Extension of the technology to other use cases (animal rescue, infrastructure inspection..)

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Thank you for your attention!
Do you have any questions?

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