

SIT-ia User Manual

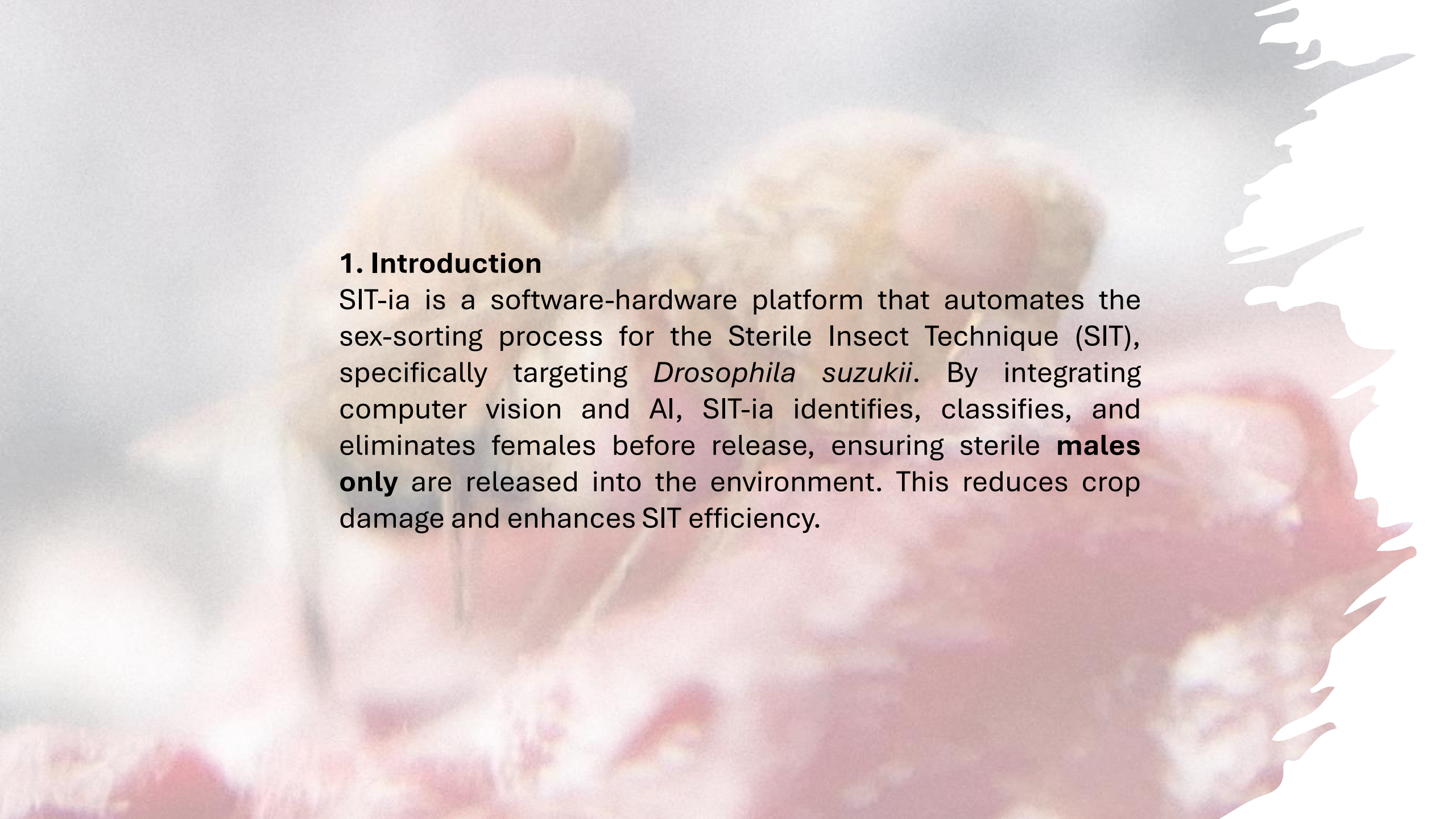
**Automated Sex-Sorting
System for *Drosophila*
*suzukii***

SIT-ia: A software-hardware system to improve efficacy of the Sterile Insect Technique for pest management

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Filiation:

- (1) IFAB (INTA-CONICET).
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- (3) CRUB (UNCOMA).
- (4) SENASA
- (5) Laboratorio de Ecología Química. Facultad de Química (Udelar).



1. Introduction

SIT-ia is a software-hardware platform that automates the sex-sorting process for the Sterile Insect Technique (SIT), specifically targeting *Drosophila suzukii*. By integrating computer vision and AI, SIT-ia identifies, classifies, and eliminates females before release, ensuring sterile **males only** are released into the environment. This reduces crop damage and enhances SIT efficiency.

2. System Overview

SIT-ia consists of three main components:

- **Hardware:** industrial camera, lighting system, CO₂ anesthetizing plate, and a 7W laser system.
- **Software:** AI models (CNN6), GUI-based control interface, classification and detection modules.
- **Control Algorithms:** image analysis, insect classification, and laser route optimization (ACO, Greedy, Local Search).

3. System Requirements

Hardware Requirements

- Industrial Camera (LapSun 12MP, 4000×3000 px) with fixed lens (HTENG VISHI HTFA1611A)
- Ring LED lighting system
- Anesthesia plate (Flypad) using CO₂
- Laser Module (Neje Master 2, 7W)
- Computer with Python 3.x environment, USB ports

Software Requirements

- Python 3.x with dependencies:
 - PyTorch
 - OpenCV
 - Pandas
 - SQLite
 - GCode Interpreter
- SIT-ia Application (GUI-based interface)

4. Operating Instructions

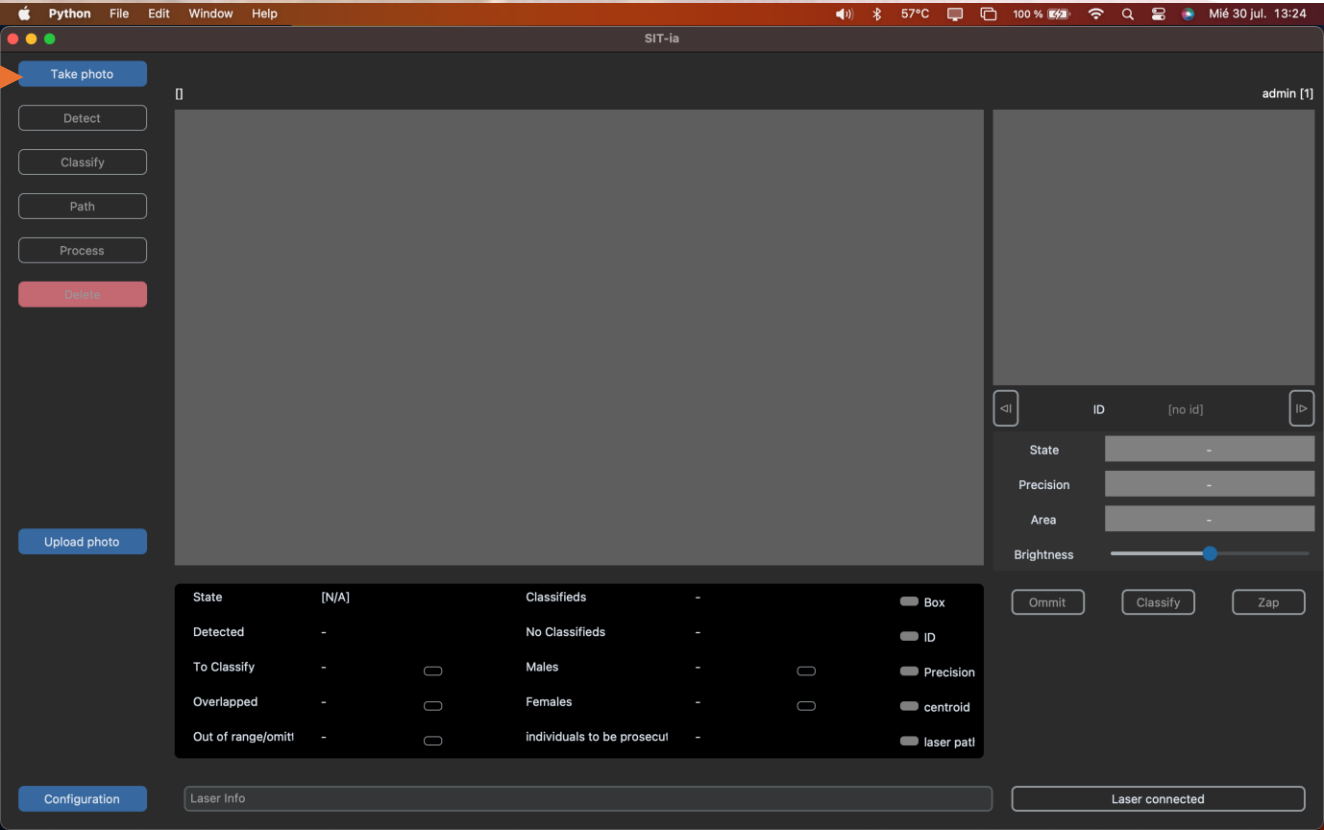
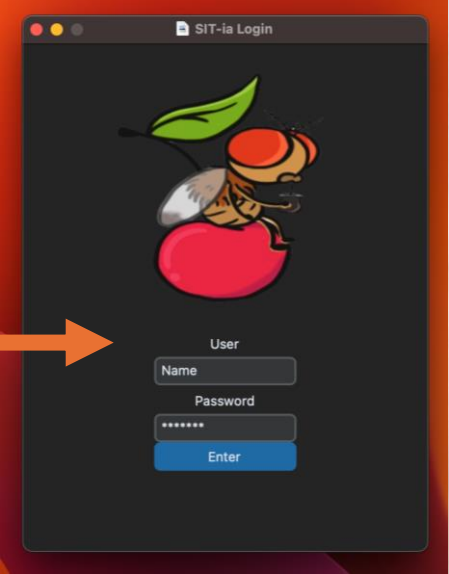
The SIT-is was thought for working as a sequential process. Follow the steps in order.

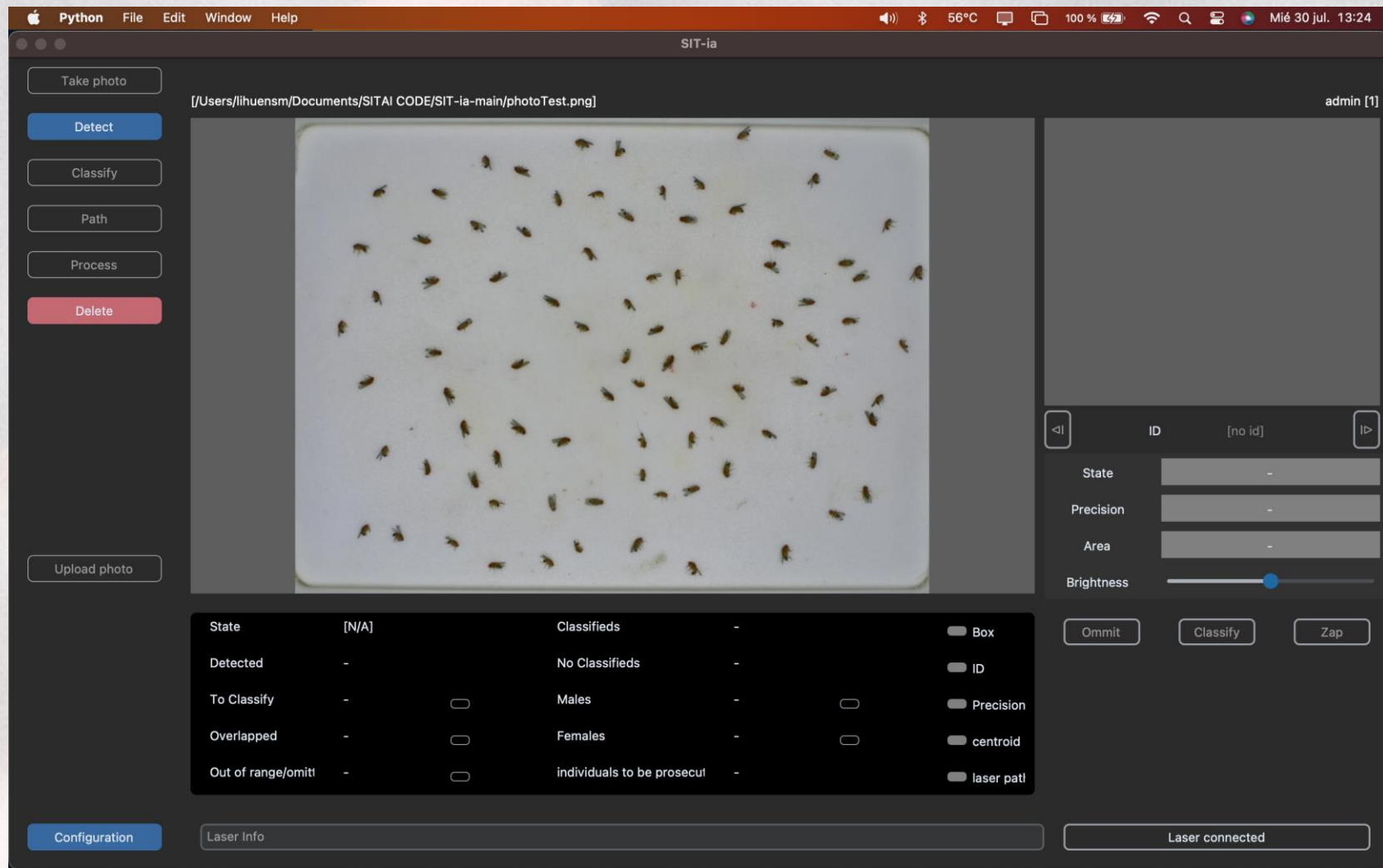
Step 1: System Setup

1. Connect the industrial camera and laser module to the computer via USB.
2. Place the anesthesia plate with the flies under the camera lens.
3. Ensure proper lighting around the lens for consistent image quality.

Step 2: Image Capture

- 1. Launch the SIT-ia GUI.
- 2. Log in using your credentials.
- 3. Select “Take Photo” from the left panel.

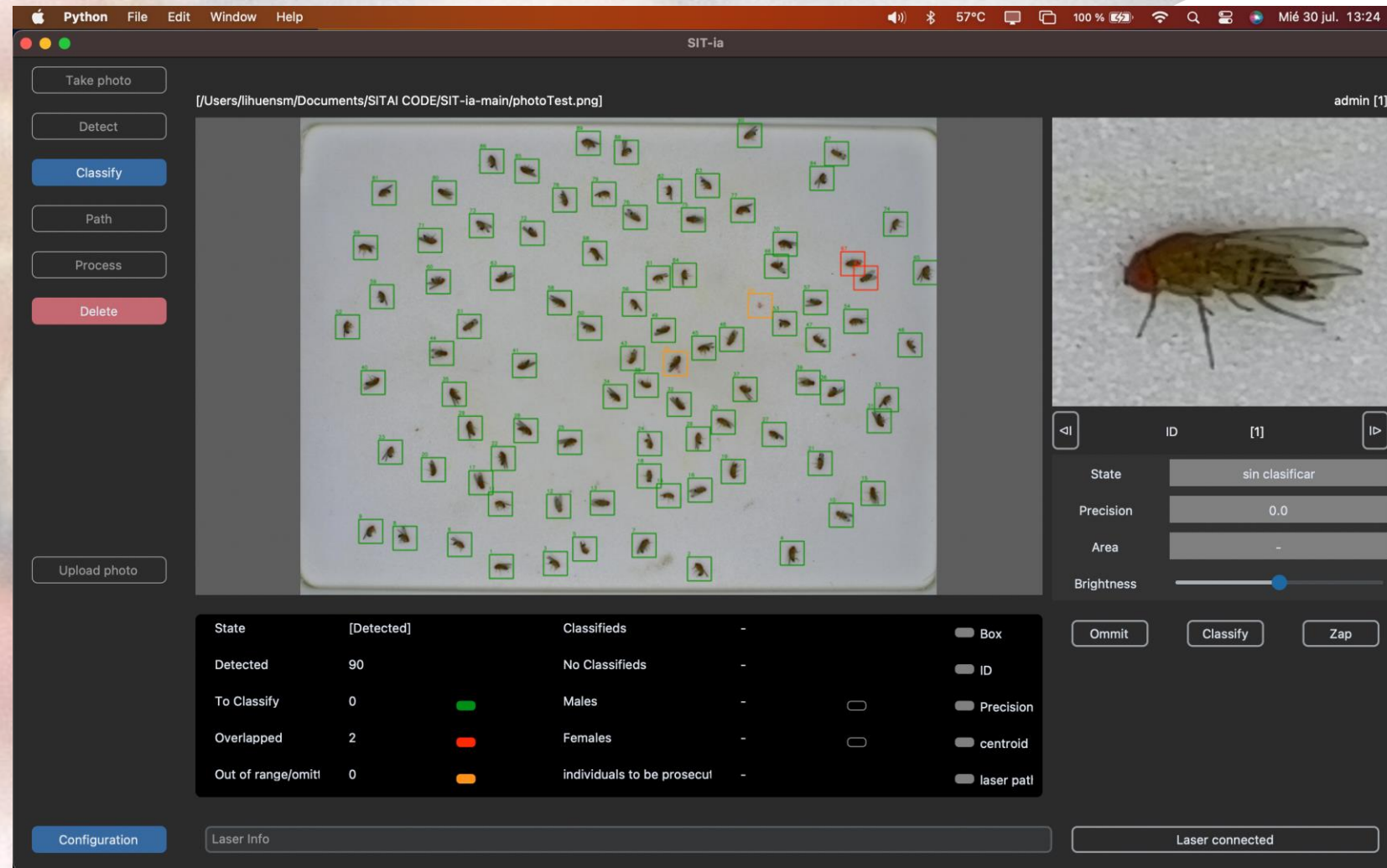




4. Review the image for clarity. If unclear, recapture.

Step 3: Detection & Classification

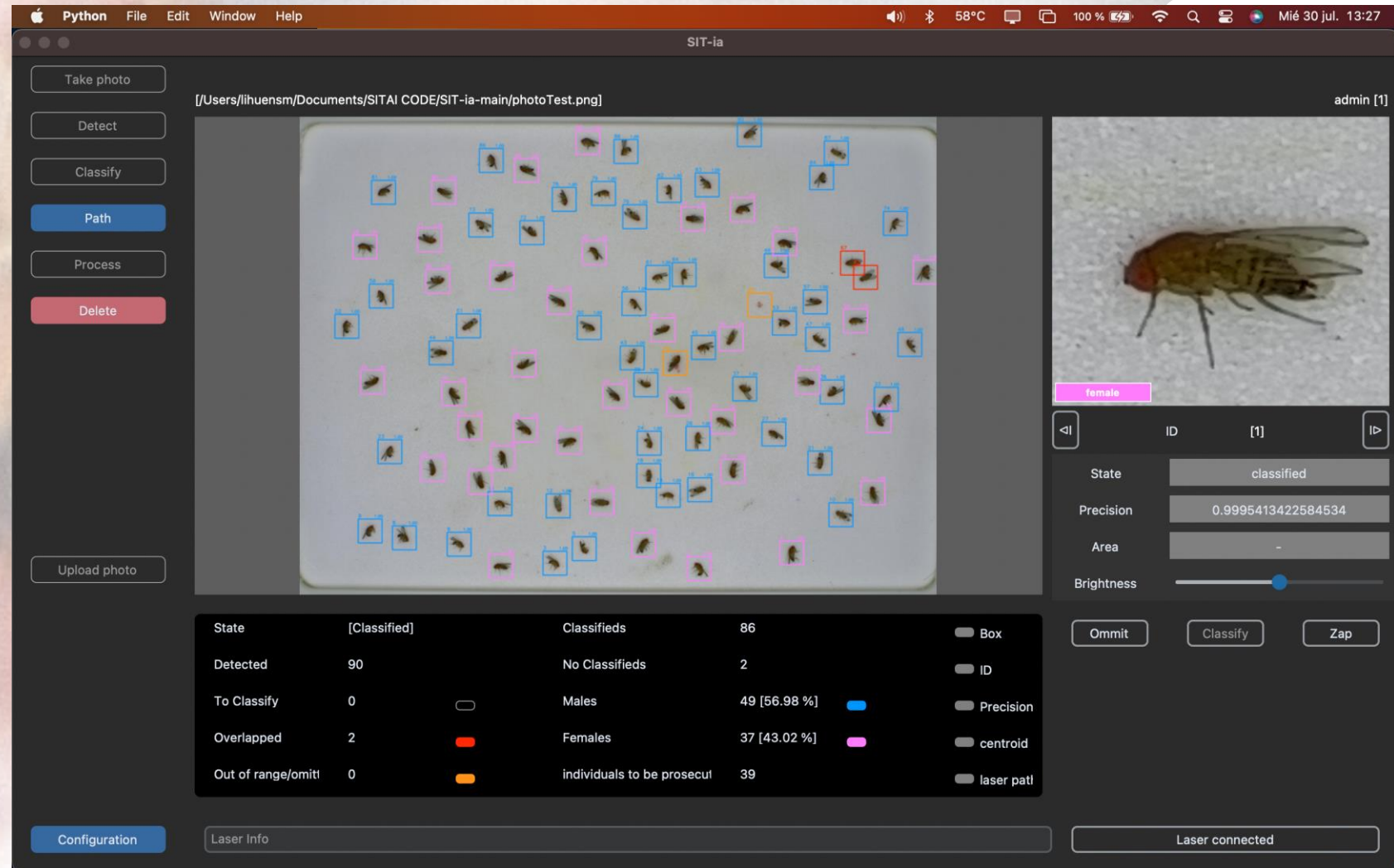
1. Run the **detection module** to identify all insects in the image.
 - Green: insect ready for classification.
 - Orange/Red: overlapping or threshold errors.
 - If you correct or move the flies, delete the photo and take another one until satisfaction.

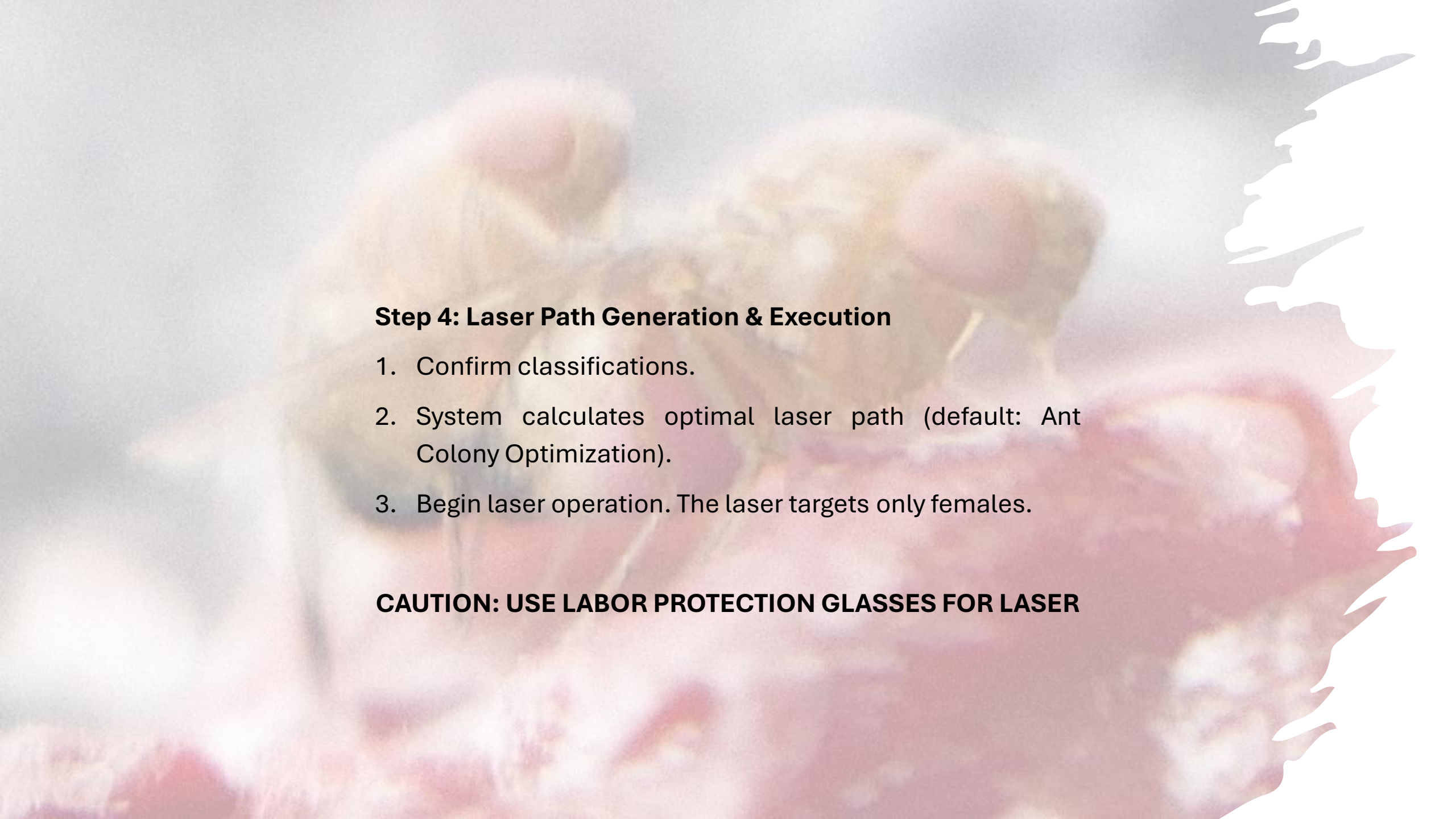


1. Run the **classification module**:

- Pink: female (to be eliminated).
- Blue: male (to be kept).

2. Manually correct any errors using the GUI tools.





Step 4: Laser Path Generation & Execution

1. Confirm classifications.
2. System calculates optimal laser path (default: Ant Colony Optimization).
3. Begin laser operation. The laser targets only females.

CAUTION: USE LABOR PROTECTION GLASSES FOR LASER

Step 4: Laser Path Generation & Execution

1. Confirm classifications.



2. System calculates optimal laser path.

3. Begin laser operation.

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5. Configuration Panel

Accessible via the main menu:

- Threshold settings for detection (advanced users).
- Lighting and image resolution controls.
- Algorithm selection for path optimization.
- Colors changes for detection and classification.

6. Maintenance & Best Practices

- Clean anesthesia plate regularly to prevent detection errors.
- Avoid glare or reflections during imaging.
- Update AI model with new corrected data periodically.
- Inspect the laser system regularly for dust or damage.

7. Troubleshooting

<u>Issue</u>	<u>Cause</u>	<u>Solution</u>
<ul style="list-style-type: none">• False detection• Misclassification	<ul style="list-style-type: none">• Plate stain or artifact• Overlapping insects	<ul style="list-style-type: none">• Clean plate, adjust thresholds• Use smaller batches
<ul style="list-style-type: none">• Laser not firing	<ul style="list-style-type: none">• Hardware fault	<ul style="list-style-type: none">• Check GCode connection and power
<ul style="list-style-type: none">• App freezing	<ul style="list-style-type: none">• Memory overload	<ul style="list-style-type: none">• restart software

8. Contact & Support

For bug reports, feature requests, or assistance, contact:

Dr. Gerardo de la Vega

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Git-hub repository: <https://github.com/Gdlv/SIT-ia>

Download site: Spanish Version:

<https://drive.google.com/file/d/1kkolkEUL49uVzMY9RfqgrWOyH52gNXM0/view?usp=sharing>

