



# SENSORDEVICES 2021 *Special*

## The Twelfth International Conference on Sensor Device Technologies and Applications

Paper Presentation:

### Tracking Suspicious Entities Using UAVs in Critical Urban Areas: A R-CNN Approach

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**Mathias Afonso Guedes de Menezes**

- **IME Master's Degree Candidate**
  
- **Research Interests:**
  - Computer Vision
  - Robotics Applications

**1 - Introduction**

**2 - Related Work**

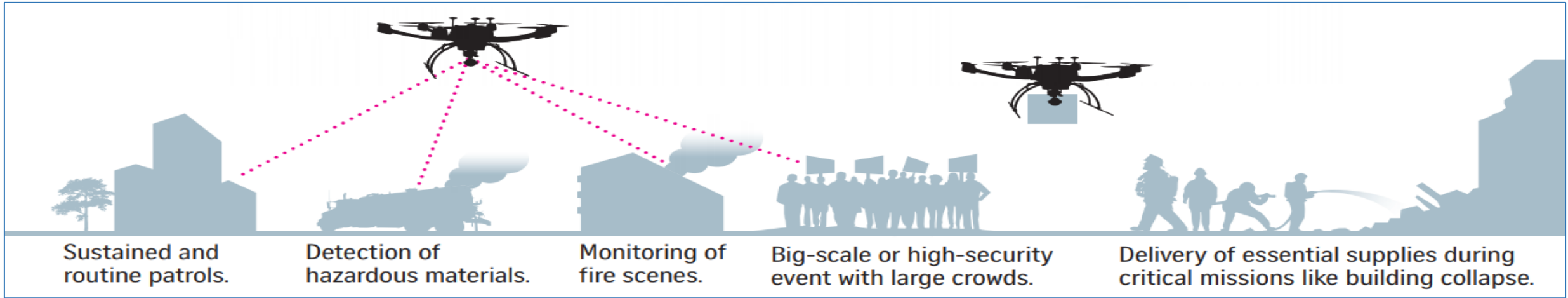
**3 - Proposed Tracking Method**

**4 - Experimental Results**

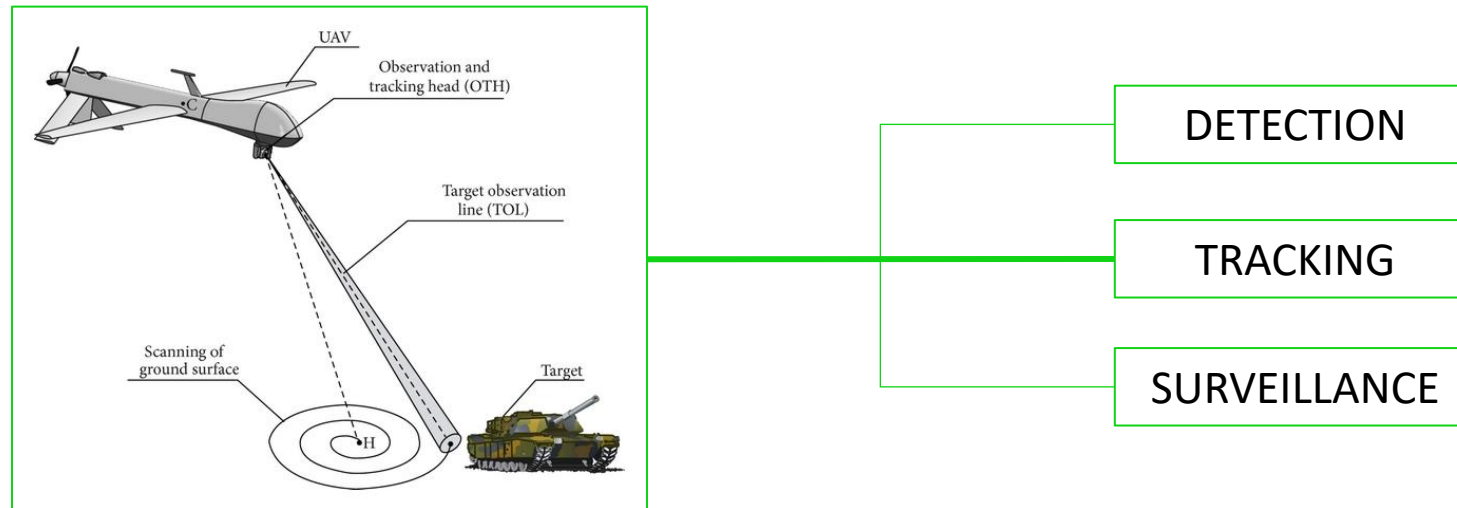
**5 - Conclusion**

Unmanned aerial vehicles (UAVs) are used for various tasks [1],[2],[3].

**CIVIL TASKS**



**MILITARY TASKS**



## Contextualization



**Assaults by the Military Police using helicopters can result in casualties for the troops.**



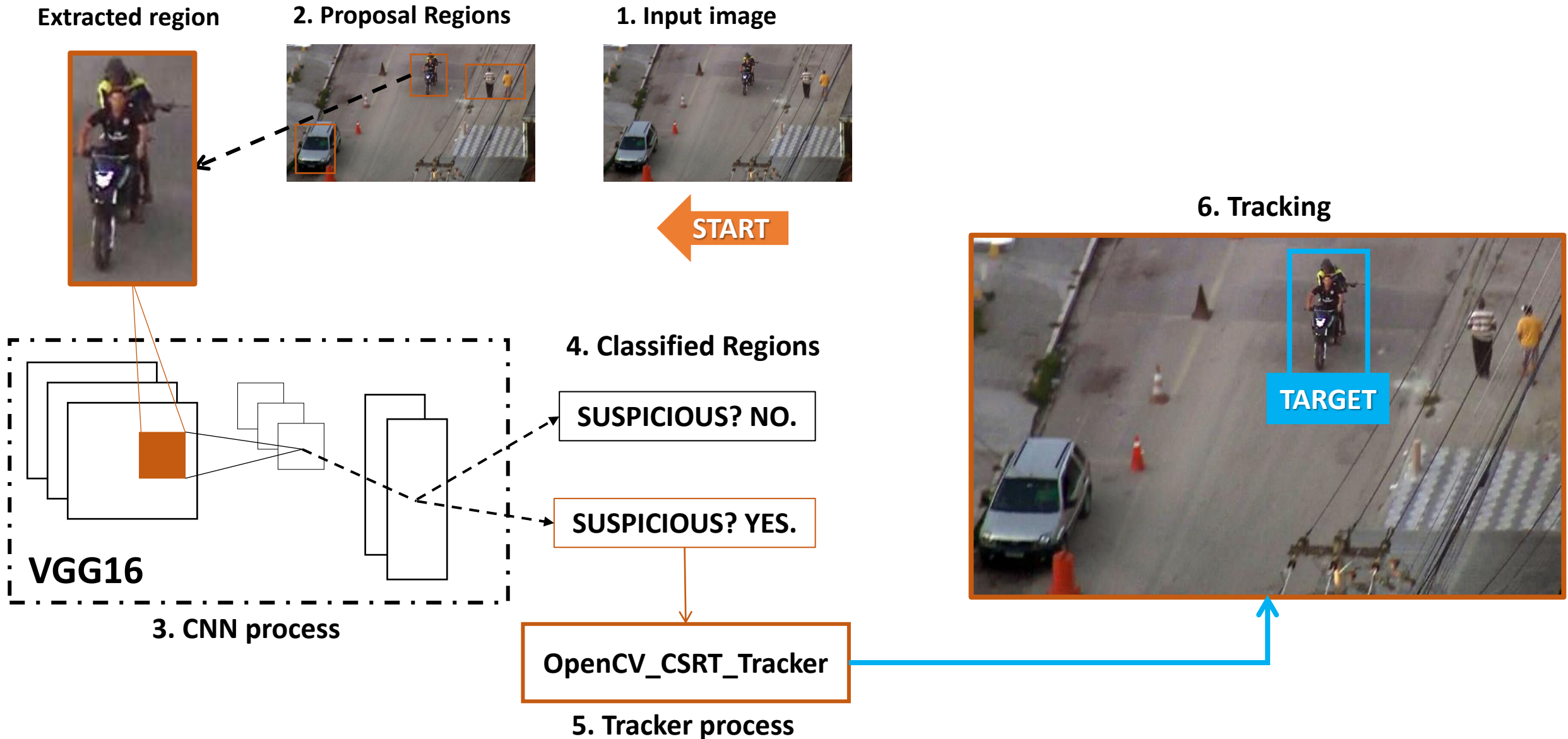
**SOLUTION: employ UAVs for terrain reconnaissance, surveillance and identification of suspicious entities.**



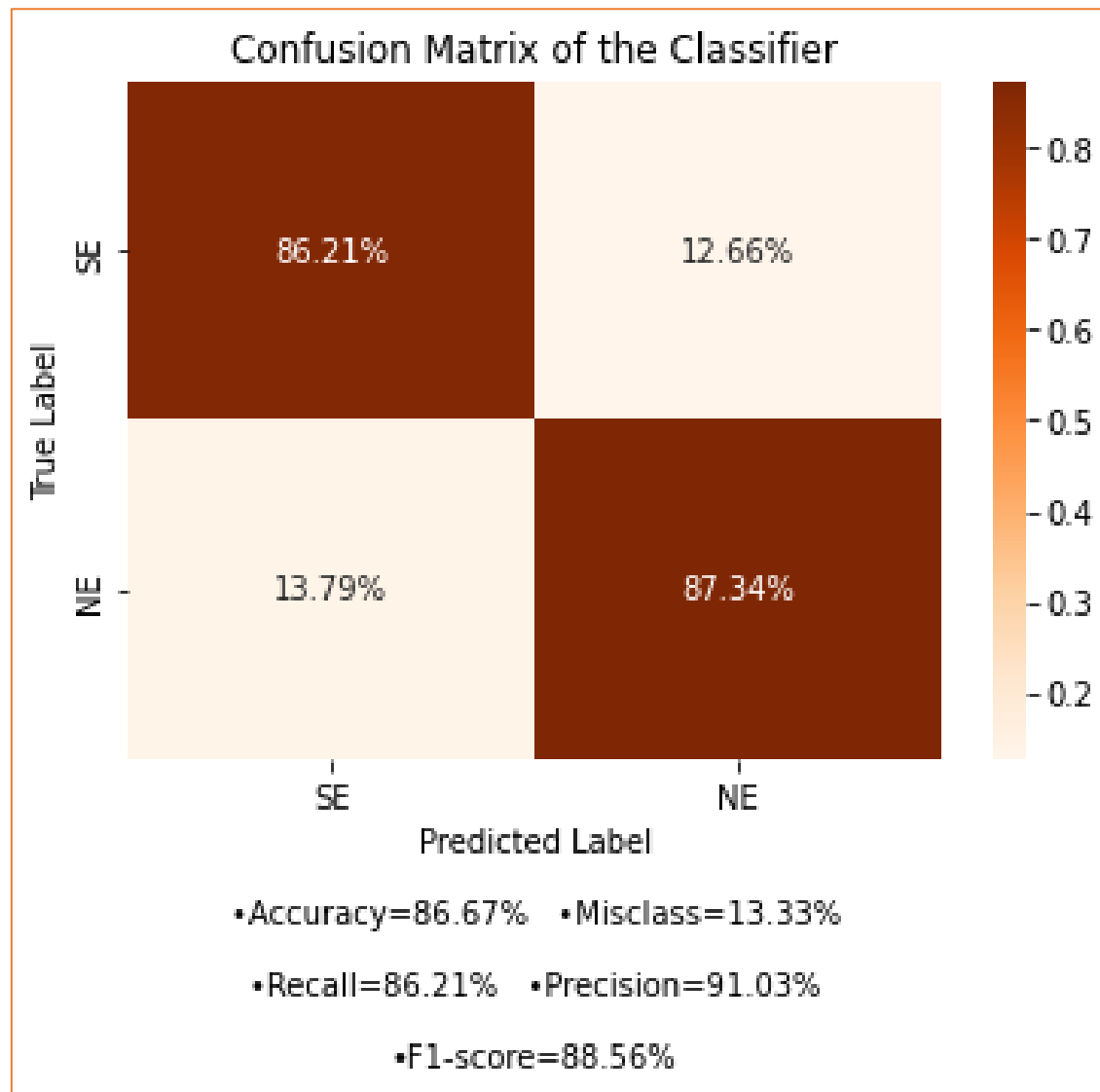
## Detection and Tracking of Moving Objects

- Approach to target pursuit [4];
- A CNN-based object tracking [5];
- A tracking framework employing classification label information from a deep learning detection approach [6];
- Approach to increase the operating time for complete coverage of the environment [7];
- Presents a two-phase strategy to solve the UAVs recognition problem with a specified altitude [8];
- Proposed an approach to detect moving objects in wide area motion imagery [9].

R-CNN: The Object Classifier; and, CSR-DCF: The Tracking Algorithm.



## R-CNN Trained Model Statistics



**Suspicious Entity (SE)**

**Not suspicious Entity (NE)**



## R-CNN Trained Model Applied in Images



a)



b)



c)



d)

- Object detection results of the trained R-CNN object classifier: images from our dataset.

- We can see the remarkable results of the object detection model, where it is detecting all objects (labels) in each frame.

## R-CNN\_CSRT\_tracker Applied in a Video Sequence

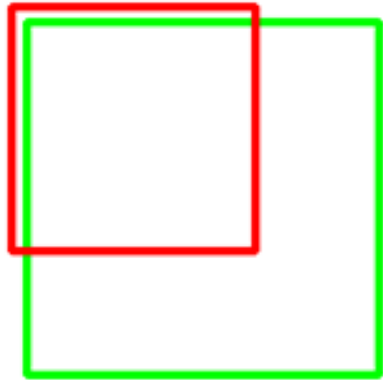


- Even if the shape or appearance of the tracking object changes, the tracker can track the object properly.

## Intersection over Union (IoU)

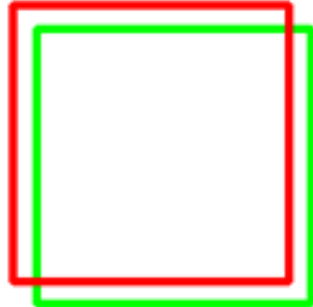
$$(IoU) = \frac{S_{\text{DetectionResult}} \cap S_{\text{GroundTruth}}}{S_{\text{DetectionResult}} \cup S_{\text{GroundTruth}}}$$

IoU: 0.4034



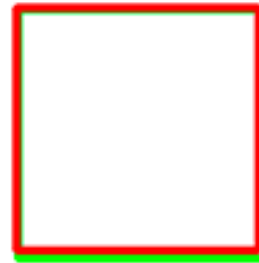
Poor

IoU: 0.7330



Good

IoU: 0.9264



Excellent

 Ground Truth Bounding Box Predicted Bounding Box

- Tracker Accuracy Rate  
- 74.83%

When applied to video sequences with images captured by helicopters, the tracker performed below expectations. These images need to be in good resolution, with a greater amount of angulation, detailing the position and shape of the entities present.

**In future works:**

- Improve the Digital Processing of Images
- Use a Faster R-CNN approach

## Referencies

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- [3] Y. Wu, S. Wu and X. Hu, "Cooperative Path Planning of UAVs & UGVs for a Persistent Surveillance Task in Urban Environments," in IEEE Internet of Things Journal, vol. 8, no. 6, pp. 4906-4919, 15 March 2021, doi: 10.1109/JIOT.2020.3030240.
- [4] S. Bhagat and P. B. Sujit, "UAV Target Tracking in Urban Environments Using Deep Reinforcement Learning," 2020 International Conference on Unmanned Aircraft Systems (ICUAS), 2020, pp. 694-701, doi: 10.1109/ICUAS48674.2020.9213856.
- [5] S. Mane and S. Mangale, "Moving Object Detection and Tracking Using Convolutional Neural Networks," 2018 Second International Conference on Intelligent Computing and Control Systems (ICICCS), 2018, pp. 1809-1813, doi: 10.1109/ICCONS.2018.8662921.

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# SENSORDEVICES 2021

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# Thank You!

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