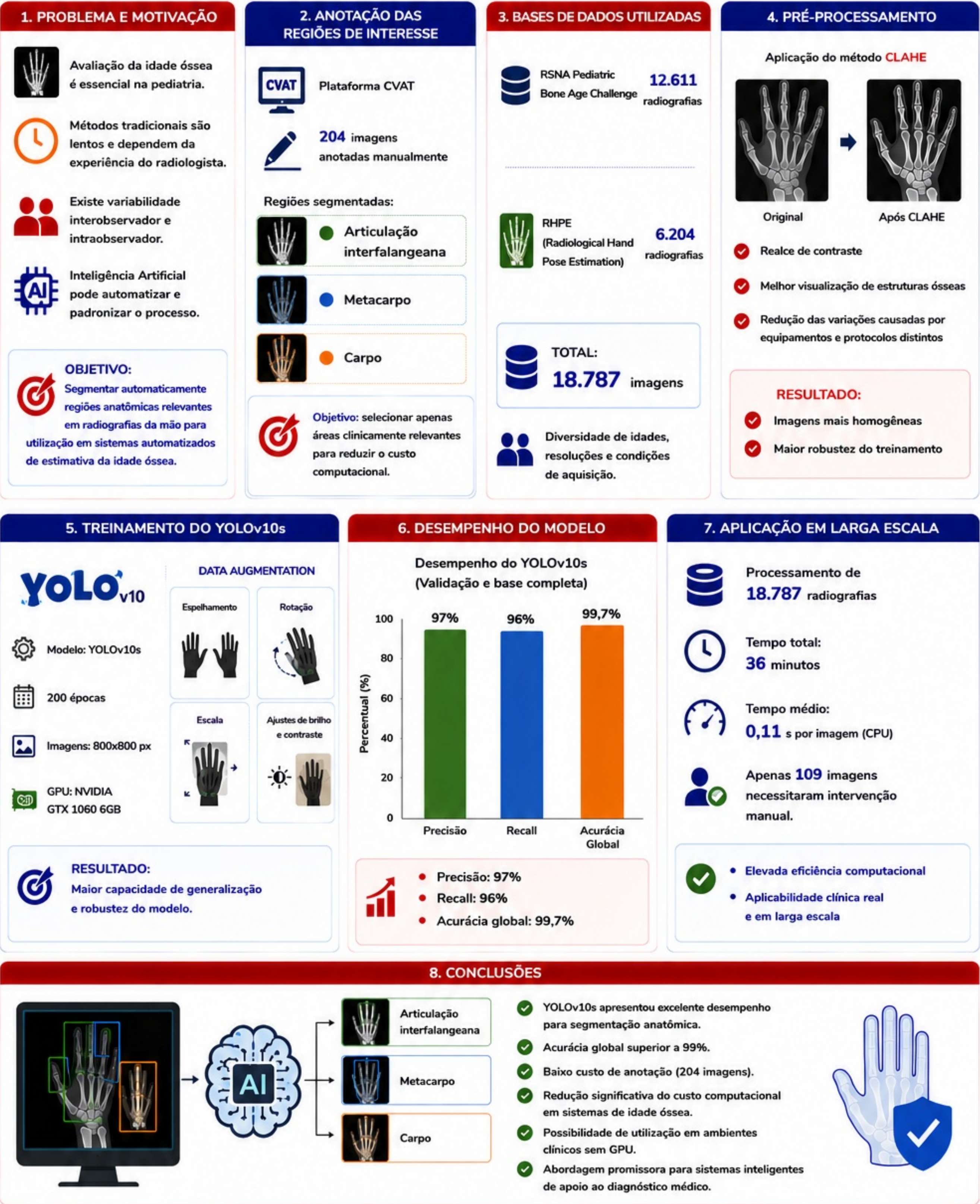


SEGMENTAÇÃO AUTOMÁTICA DE REGIÕES DE INTERESSE EM RADIOGRAFIAS DA MÃO UTILIZANDO YOLOv10



AUTOMATIC SEGMENTATION OF REGIONS OF INTEREST IN HAND RADIOGRAPHS USING YOLOv10

1. PROBLEM AND MOTIVATION



Bone age assessment is essential in pediatrics.



Traditional methods are slow and depend on the radiologist's experience.



There is significant interobserver and intraobserver variability.



Artificial Intelligence can automate and standardize the process.

**OBJECTIVE:**

To automatically segment relevant anatomical regions in hand radiographs for use in automated bone age assessment systems.

2. ANNOTATION OF REGIONS OF INTEREST



CVAT platform



204 images manually annotated

Segmented regions:



Interphalangeal joints



Metacarpus



Carpus



Objective: select only clinically relevant areas to reduce computational cost.

3. DATASETS USED



RSNA Pediatric Bone Age Challenge 12,611 radiographs



RHPE (Radiological Hand Pose Estimation) 6,204 radiographs



TOTAL: 18,787 images



Diversity of ages, resolutions, and acquisition conditions.

4. PREPROCESSING

Application of CLAHE method



Original



After CLAHE

- ✓ Enhances contrast
- ✓ Improves visualization of bone structures
- ✓ Reduces variations caused by different equipment and protocols

RESULT:

- ✓ More homogeneous images
- ✓ Greater robustness for training

5. YOLOv10s TRAINING

YOLOv10

DATA AUGMENTATION

Horizontal flip



Rotation



Scaling



Brightness and contrast adjustment



Model: YOLOv10s



200 epochs



Image size: 800x800 px



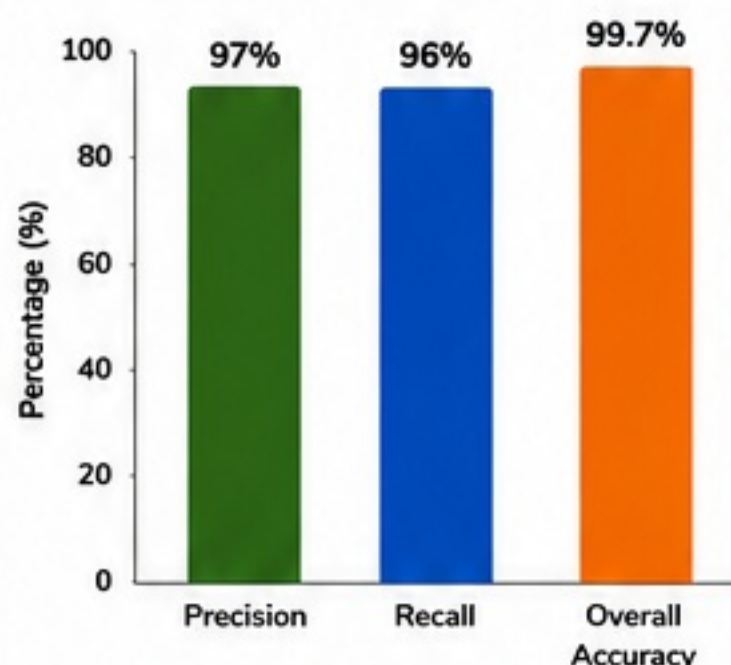
GPU: NVIDIA GTX 1060 6GB

**RESULT:**

High generalization capability and model robustness.

6. MODEL PERFORMANCE

YOLOv10s Performance (Validation set and full dataset)



- Precision: 97%
- Recall: 96%
- Overall accuracy: 99.7%

7. LARGE-SCALE APPLICATION



Processing of 18,787 radiographs



Total time: 36 minutes



Average time: 0.11 s per image (CPU)

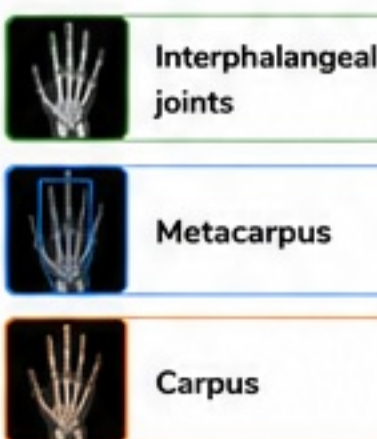


Only 109 images required manual intervention.



- High computational efficiency
- Real clinical applicability and scalability

8. CONCLUSIONS



- ✓ YOLOv10s achieved excellent performance for anatomical region segmentation.
- ✓ Overall accuracy above 99%.
- ✓ Low annotation cost (204 images).
- ✓ Significant reduction in computational cost in bone age systems.
- ✓ Usable in clinical environments without GPU.
- ✓ A promising approach for intelligent computer-aided diagnostic systems.



PREPRINTS

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CONFLICT OF INTEREST

The authors declare no conflict of interest.



DATA AVAILABILITY

The data are included in this article. All data supporting the results are available within the article.



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