Vision Assisted Pediatric Medication Verification: OCR vs End to End Classification

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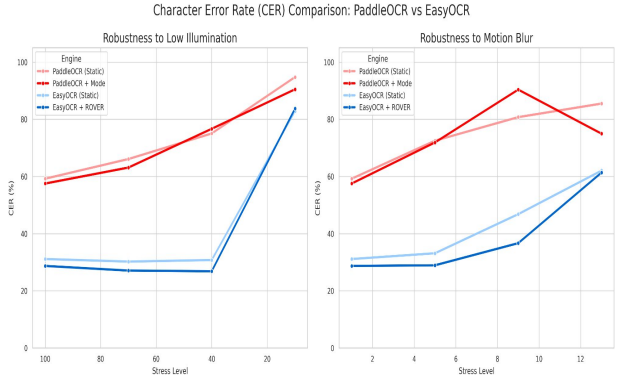
1. Motivation

- High-risk pediatric dosing requires precise verification.
- Cylindrical vials warp text during rotation.
- This geometric warp triggers 'stateless amnesia' in standard 2D OCR systems.

Can global visual recognition reliably identify medication type & concentration on dynamic cylindrical vials under clinical noise?

2. Methodology

- YOLOv8 + ByteTrack: Real-time spatiotemporal tracking.
- Pad-to-Square Transform: Prevents typography stretching.
- Classifiers: Vision Transformer (ViT-B/16) & ResNet-50.
- Baseline: Video OCR (EasyOCR + ROVER fuzzy consensus).



3. Results vs Clinical Noise

- Baseline OCR fails fundamentally: 27.4% error on clean frames.
- Global Classifiers succeed: 100% (Names) & 99.4% (Conc).
- ResNet-50: Highly robust to motion blur (natural low-pass filtering).
- ViT-B/16: Extremely resilient to localized occlusion.

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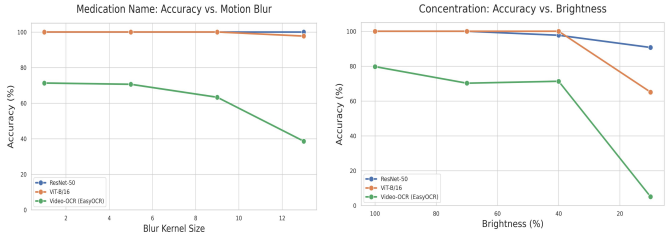

4. Explainability (Grad-CAM)

- ViT learns layout & color bands (scattered patch attention).
- ResNet-50 learns typographic density (smooth pooling blob).

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5. Limitations

- Illumination: ViT drops to 65% accuracy in 10% brightness (relies on contrast edges for attention correlation).
- Occlusion: ResNet-50 drops 30% accuracy when top-label bands are specifically occluded.
- Rotation: Both architectures fail under extreme 45° angular deformation without explicit data augmentation.

6. Conclusion

End-to-end global visual classification bypasses perspective warp entirely, achieving near-perfect identification where OCR fails.

- Feasibility: Pipeline sustains 22.2 FPS (45ms latency).
- Stability: 30-frame temporal voting smooths transient nurse occlusions effortlessly.
- Future Work: Edge-device profiling and ICU drug array expansion.

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