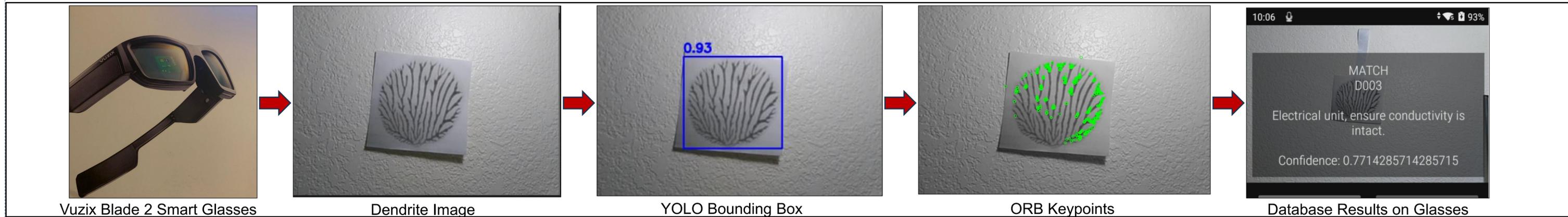# Group 22: Dendritic Identifiers and Augmented Reality/Extended Reality in Assembly and Maintenance Operations

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Vuzix Blade 2 Smart Glasses → Dendrite Image → YOLO Bounding Box → ORB Keypoints → Database Results on Glasses

Introduction

Counterfeit parts threaten safety-critical sectors like aviation, automotive, and medical devices, where failures can cost lives and money. Authenticating components has grown harder with globalized supply chains, and traditional marks such as bar codes are easily copied or tampered with. This project proposes a secure identification workflow that leverages dendritic identifiers—naturally formed patterns that are nearly impossible to replicate.

Theory

The pipeline uses a two-stage computer-vision approach for detection and verification. First, YOLOv8 localizes the dendritic identifier on the full image and outputs a bounding box. Next, ORB extracts and encodes distinctive keypoints from the detected region and matches them against a Google Cloud database of enrolled dendrites. The best match, or no-match, decision is returned with associated metadata and displayed on the glasses. This enables secure on-site authentication.

Results

The system consistently detects the dendritic region with YOLO, but verification with the current system is unreliable. ORB often returns few keypoints on far away or blurry images, leading to weak matches and frequent misidentifications. Techniques like binarization and skeletonization aided the process but background, distance, and lighting changes reduced repeatability, so results were not consistent. A multi-view database improved stability, but overall accuracy remained below a usable threshold.

Conclusion

In controlled tests with high-resolution still images, the system achieved 100% identification, confirming that dendritic patterns are sufficiently distinctive when captured clearly. Performance drops on lower-resolution images where few keypoints are found and background competes with the signal. Considerations for improvements will be to expand the database, and establish a capture protocol that standardizes stand-off distance, field-of-view, and minimum size of the dendrite.