Hand Landmarks

MODEL DETAILS

This model estimates 10 hand landmarks and validates hand presence. It operates on hand ROIs extracted from a hand detector.

Figure 1: Hand Landmark Model Output.

MODEL SPECIFICATIONS

Inputs

- a 96×96×1 grayscale hand ROI obtained from a hand detector

Outputs

- 10-landmark coordinates estimation
- Hand validation confidence

Architecture

- YOLO-like architecture

Parameters

- 450,171 (446,131 trainable, 4,040 non-trainable)

AUTHORS	Lattice Semiconductor	**SOURCE CODE**	Training Source Code
VERSION	hl-nx33-8.2.0	**TOOLCHAIN**	LATTE
RELEASE	2025-12-18		LSCQuant

PERFORMANCE EVALUATION

Live Evaluation

Evaluations were performed on Lattice CLNX-33 FPGA and IMX219 camera, under a controlled, standardized environment to ensure consistency and reproducibility of results. While these conditions shaped the reported metrics, the model architecture is designed for flexibility, supporting potential deployment across a wide range of platforms, including non-FPGA environments.

- **Detection Range:** The model has been evaluated across distances from 40 cm to 2 m, maintaining optimal stability up to 1 m.
- **Illumination:** Performance was tested under lighting conditions ranging from 10 lux to 1000 lux. Noticeable degradation occurs in low-light environments beyond 1 m.

Offline Evaluation

The KPIs for the evaluation data are reported in Table 1. Categorical metadata for quantitative analysis were generated using Gender Classifier, Age Classifier, and Deep Face. Figure 2 illustrates the false negative rate by age, ethnicity and gender categories.

Table 1: Hand Landmark Estimation and Validation Metrics.

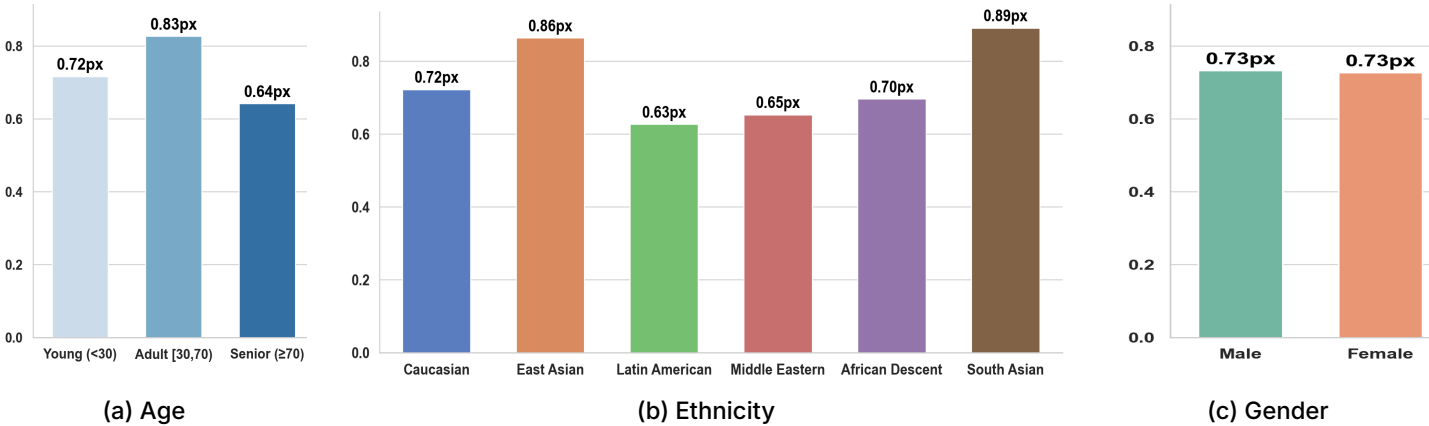| Dataset	Metric Category	Metric Name	Value	Comments
IPN	Landmark Estimation	MAE	1.3 pixels	10k images
HaGrid	Validation	Accuracy	99.94%	15k images
Lattice in-house				22k images

(a) Age   (b) Ethnicity   (c) Gender

Figure 2: False Negative Rate by age, ethnicity, and gender categories.