

# ASL Recognition: Supervised vs. Unsupervised

Group Number: B109 Group Member: Hengrui Li Yusen Fu Chenglong liu

## 1. INTRODUCTION

**Objective:** Develop a real-time computer vision system to translate static ASL alphabets (A-J) into text.

**Approach:** We evaluate **MediaPipe** landmark extraction using both Supervised (Classification) and Unsupervised (Clustering) learning to determine the most effective method.

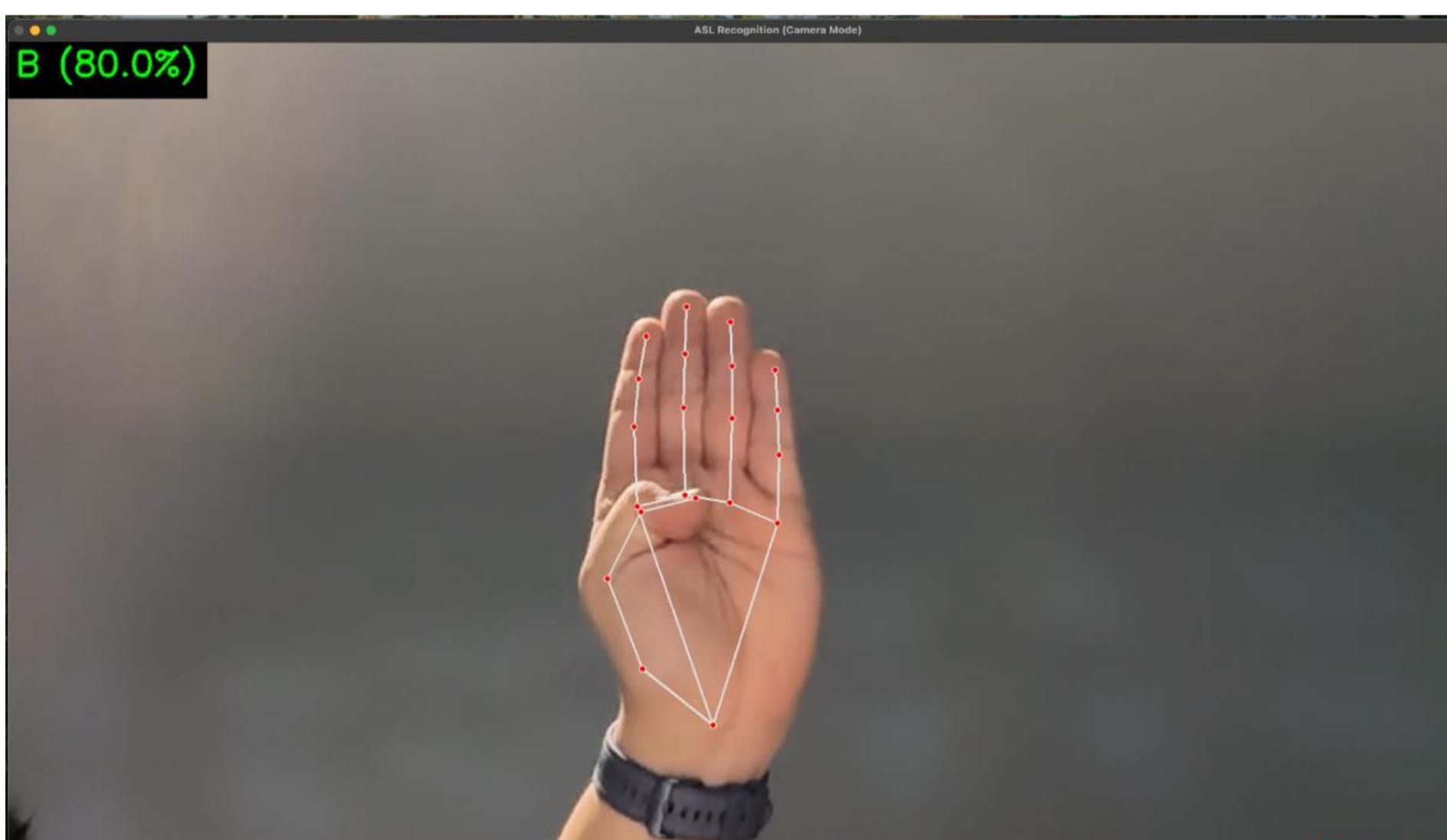
## 2. METHODOLOGY

### 1. Feature Extraction

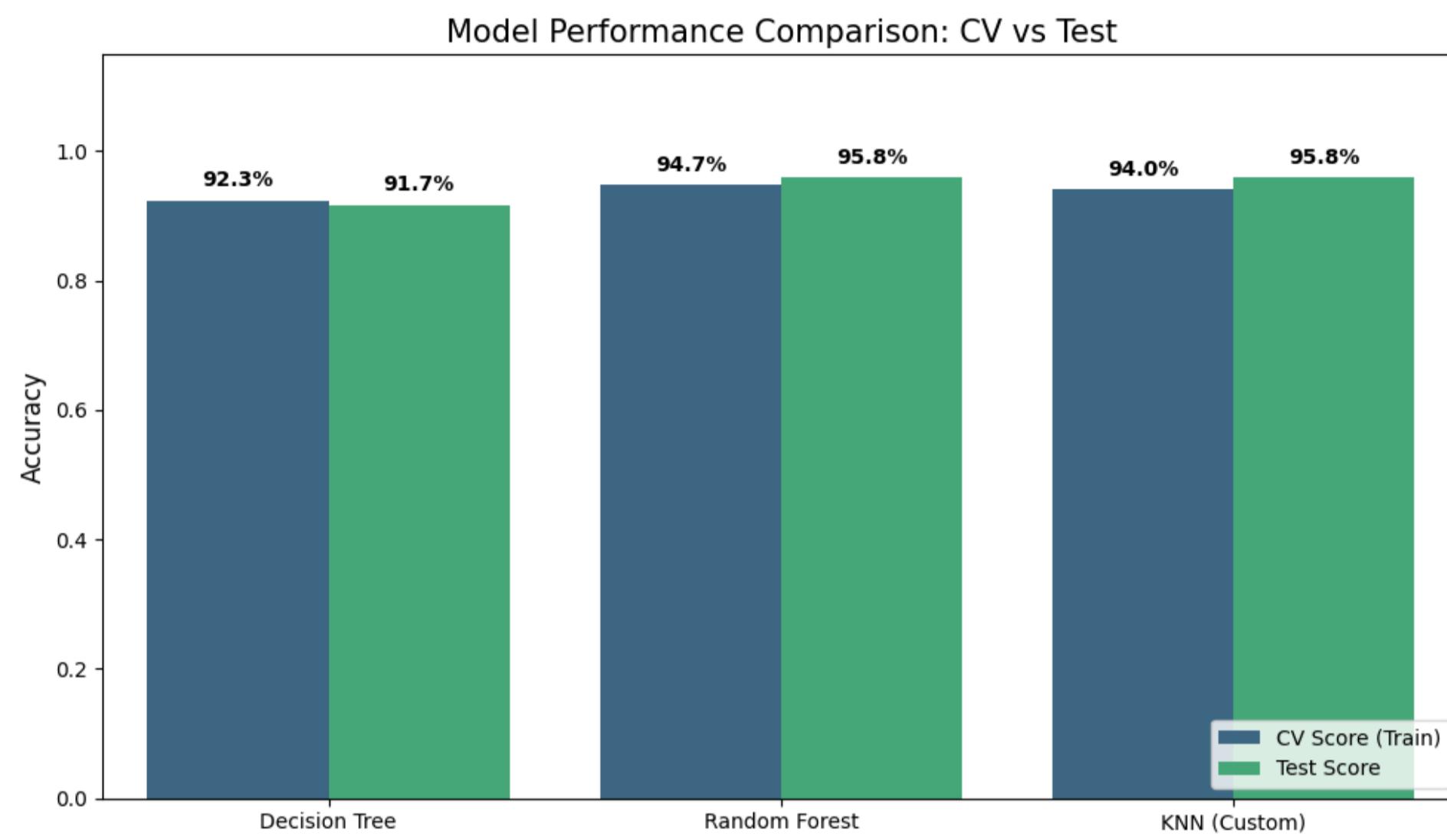
- **Input:** Webcam RGB frames.
- **MediaPipe:** Extracts 21 3D landmarks (x,y,z).
- **Pre-processing:** Wrist-relative normalization [-1, 1] for scale invariance.

### 2. Algorithms

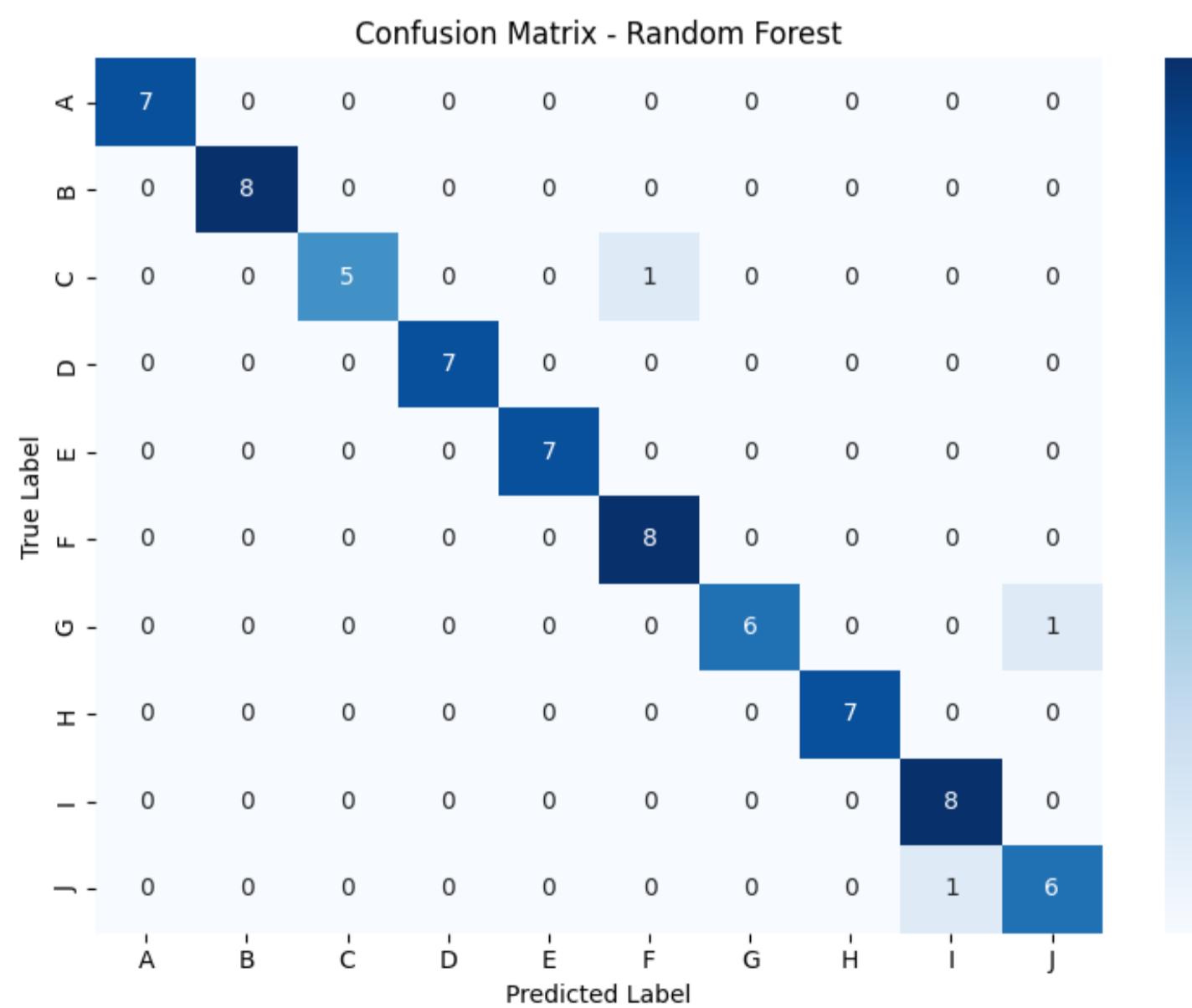
- **Supervised:** Random Forest, Decision Tree, Custom KNN.
- **Unsupervised:** K-Means Clustering (K=10).



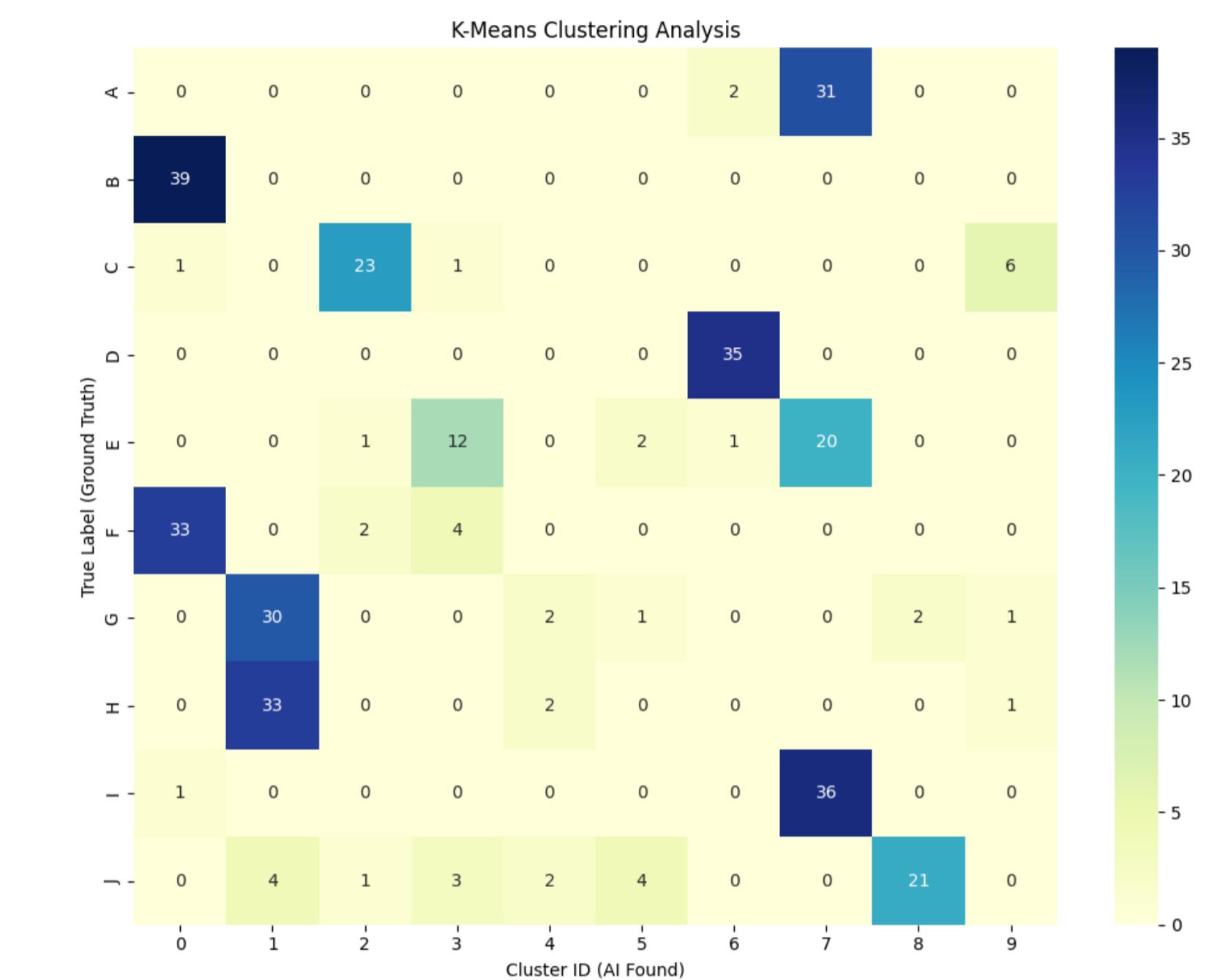
## 3. RESULTS: MODEL PERFORMANCE



- **Random Forest & Custom KNN:** Highest accuracy (**95.8%**).
- **Decision Tree:** 91.7% accuracy.
- **Stability:** Minimal gap between CV and Test scores suggests no overfitting.



## 4. UNSUPERVISED ANALYSIS



- **Clustering:** K-Means separated data into clusters matching Ground Truth labels.
- **Insight:** Geometric feature extraction creates a naturally separable feature space without labels.

## 5. CONCLUSIONS

- **Features:** Geometric landmarks ensure high accuracy.
- **Best Model:** Random Forest (High accuracy & stability).
- **Real-Time:** Efficient webcam performance.

**Future:** Support dynamic gestures via LSTM.