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Real-Time
Hand Gesture Recognition

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PROJECT OVERVIEW

Team Worked on this project :

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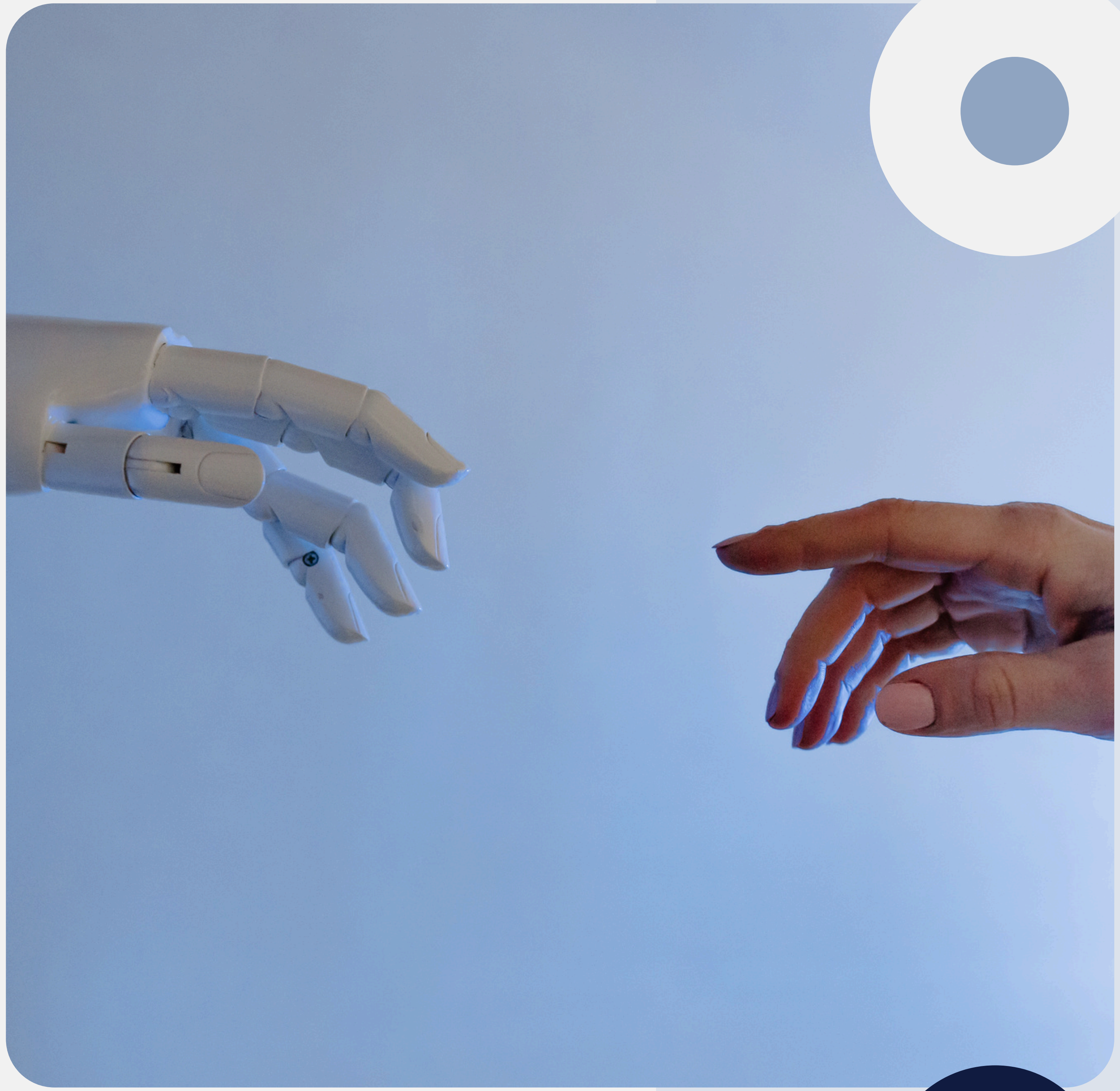
PROJECT **OVERVIEW**

THE PROJECT SHOWCASES THE INTEGRATION OF COMPUTER VISION, DEEP LEARNING, AND REAL-TIME PROCESSING INTO ONE SEAMLESS INTERACTION PIPELINE.

This project develops a real-time system capable of recognizing static hand gestures using a standard webcam. The system extracts hand landmarks, classifies gestures using a trained deep learning model, and displays predictions instantly enabling intuitive, device-free interaction.



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THE PROBLEM

WE ARE SOLVING

TRADITIONAL INTERFACES RELY HEAVILY ON PHYSICAL DEVICES

Physical input devices limit accessibility, reduce hygiene in shared environments, and restrict hands-free interaction.
There is a strong need for a more natural, effortless way to communicate with computers one that relies only on gestures and simple camera input

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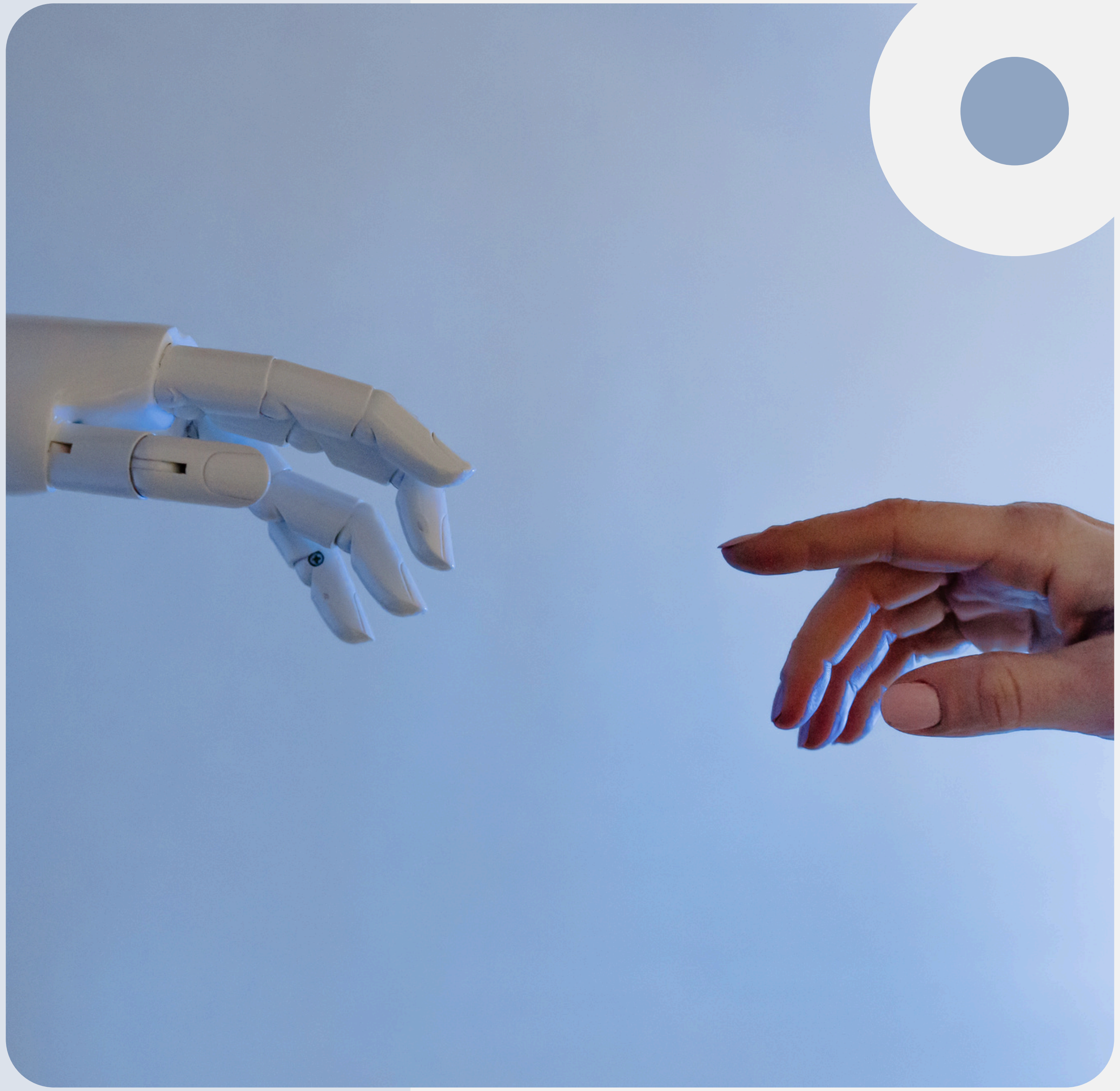

GOALS &
CORE FEATURES

- Real-time gesture recognition with minimal latency
- High accuracy across multiple gesture classes
- User-friendly interface for testing and demos
- Lightweight, landmark-based inference for fast processing
- Scalable design for future cloud deployment and MLOps integration

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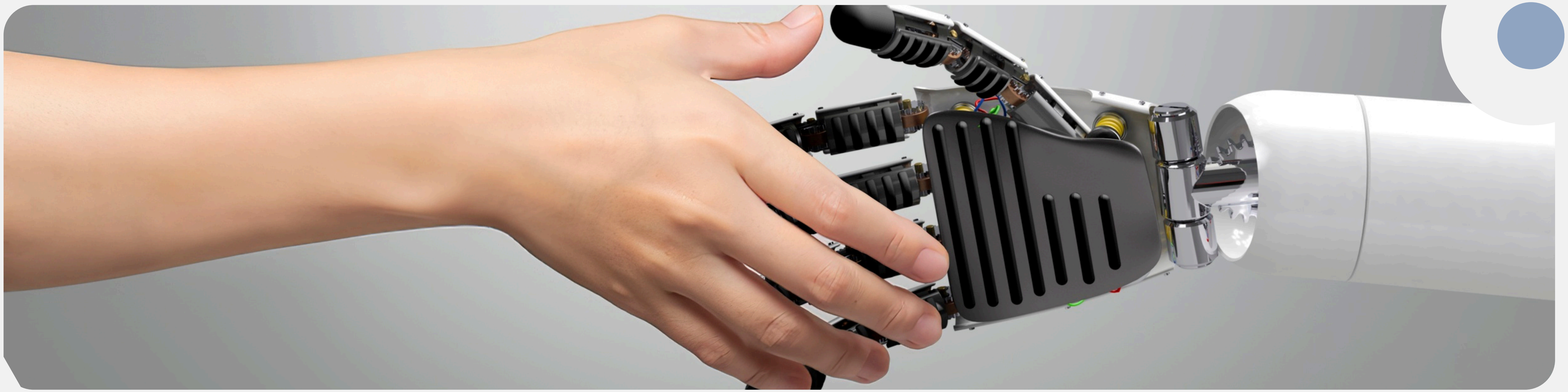

TECHNOLOGY **STACK**

AI & Modeling: TensorFlow, Keras
Vision & Landmarks: MediaPipe
Processing: OpenCV
Interface: Streamlit
Future Deployment: Microsoft Azure
Each tool plays a specific role in enabling accurate, fast, and scalable gesture recognition.

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DATA COLLECTION & PREPROCESSING

A custom dataset was created due to the limitations of public datasets.

Steps included:

- Capturing gestures under consistent lighting
- Performing EDA to ensure balanced classes
- Applying segmentation to isolate hands
- Enhancing data with augmentation
- This produced clean, diverse data for robust model training.

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MODEL DEVELOPMENT

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MODEL
DEVELOPMENT

Hand landmarks (21 points) were extracted for each gesture, forming the model's input.
A fully connected neural network was built with:

The final model achieved strong accuracy and consistency across different users.

Data Normalization

BATCH NORMALIZATION FOR STABLE TRAINING

Dense layers

DENSE LAYERS FOR SPATIAL PATTERN LEARNING

Dropout

DROPOUT FOR GENERALIZATION

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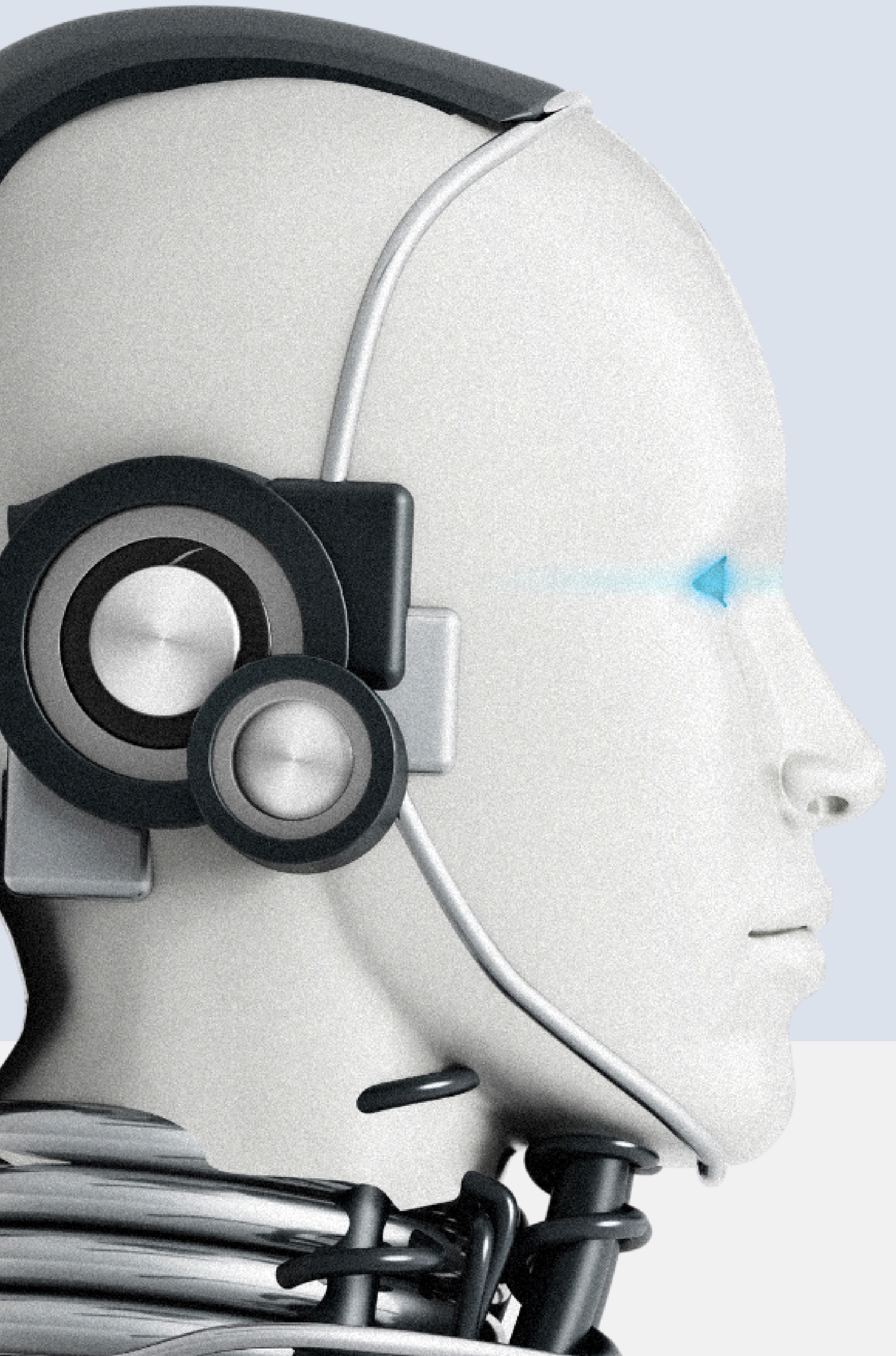

REAL-TIME **APPLICATION**

USING OPENCV AND MEDIAPIPE, THE SYSTEM PROCESSES VIDEO FRAMES CONTINUOUSLY:

- Detect hand
- Extract landmarks
- Run inference through the trained model
- Display gesture prediction + confidence percentage
- A Streamlit interface makes the system accessible with a single click.

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DEPLOYMENT &
MLOps PLAN

With Azure, the system can support:

- Cloud-hosted inference for cross-device access
- Automated retraining pipelines
- Version control for models and data
- Performance monitoring (latency, accuracy, drift)
- This ensures long-term reliability and easy scalability.

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RESULTS, IMPACT &
FUTURE WORK

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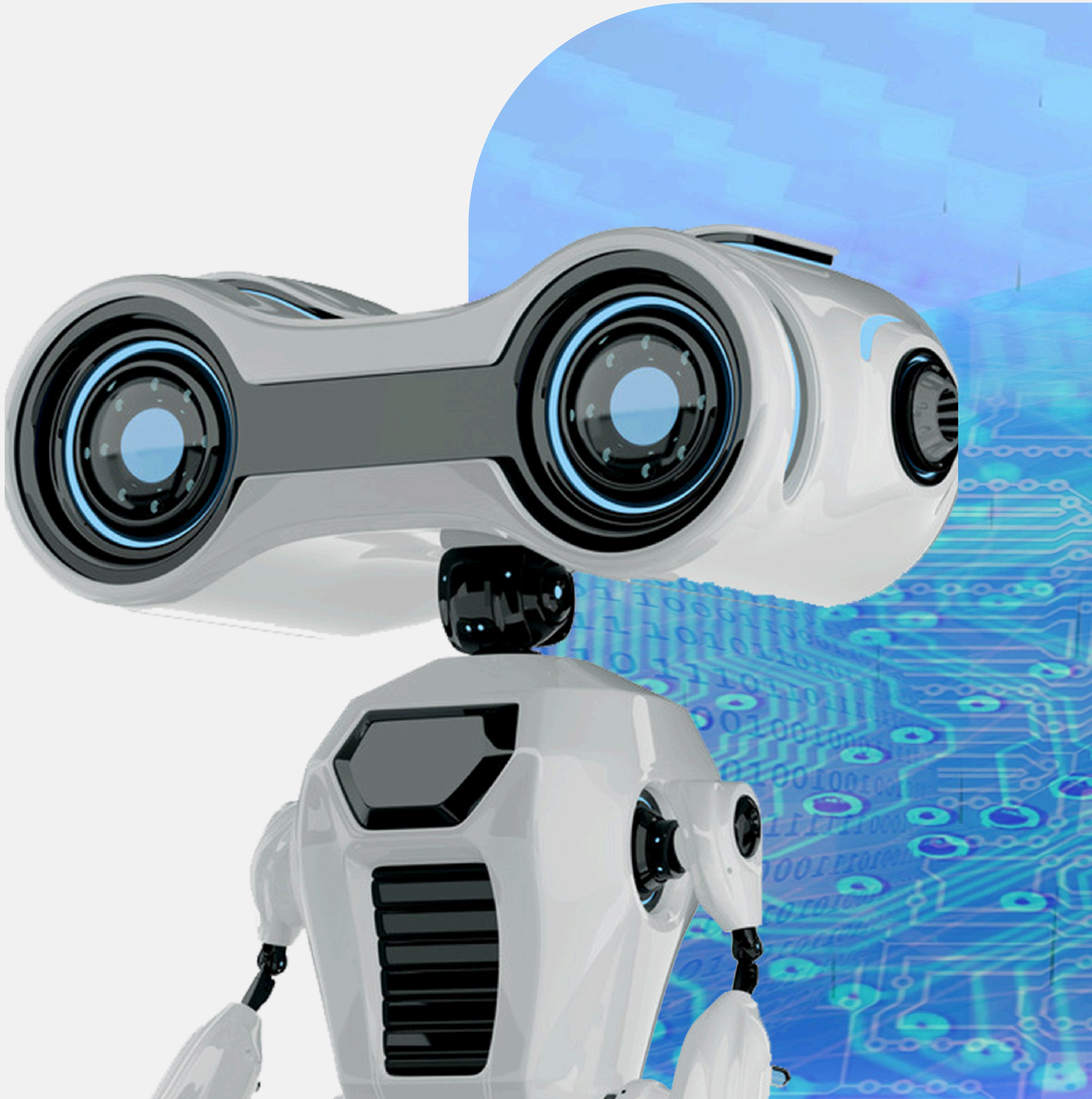
Gesture-Based
Control System

We extended the gesture-recognition model by building a control program that translates detected gestures into computer actions.
The system maps each gesture to a specific command, allowing users to interact with their device without touching the keyboard or mouse.

Staying ahead in a dynamic threat landscape



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Gesture-Based
Navigation& Media Control

The program provides a set of intuitive, hands-free controls, including:

- Moving the mouse cursor using hand movement
- Scrolling vertically through pages or content
- Triggering next and previous track actions in media apps like Spotify
- Using directional gestures to simulate arrow-key navigation

These features create a smooth, touch-free experience for browsing, media control, and general computer interaction.

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RESULTS, IMPACT & FUTURE WORK

Results:

- Smooth real-time gesture recognition
- Accurate classification across multiple static gestures
- Fully functional demo interface

Future Enhancements:

- Dynamic gesture recognition
- Larger gesture vocabulary
- Mobile + IoT deployment
- Integration with smart devices and AR/VR

THIS PROJECT DEMONSTRATES HOW AI CAN CREATE MORE INTUITIVE, ACCESSIBLE, AND HUMAN-CENTERED INTERACTION EXPERIENCES.

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Thank
YOU