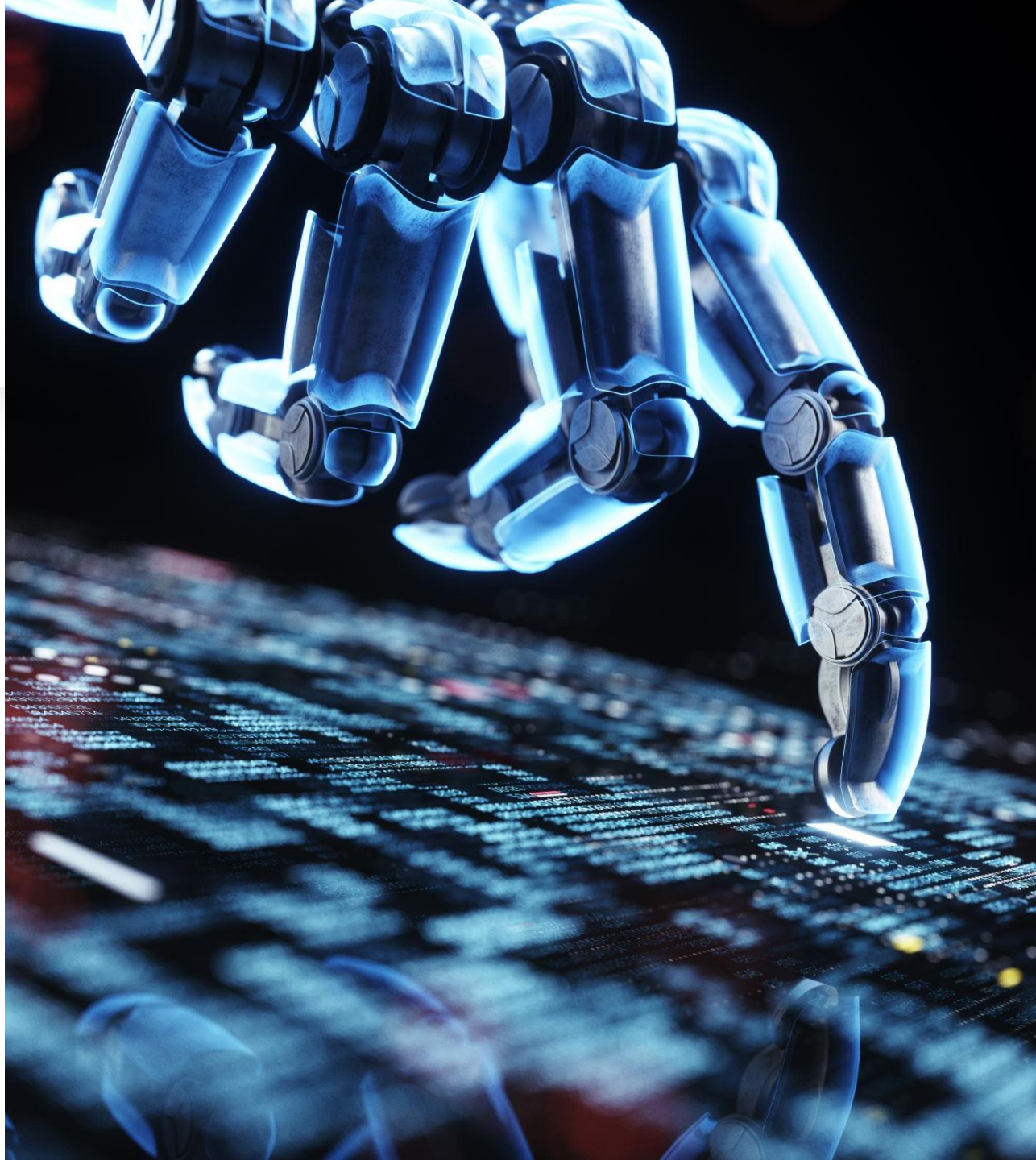
Introduction

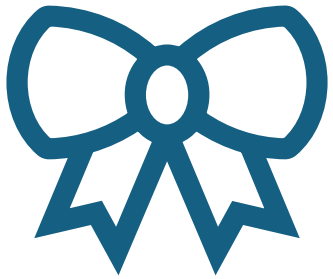
- **Project Title:** Interactive Gesture-Controlled Systems
- **Team Members: C**hakib El Bassam, Mike Yuriev

Project Overview

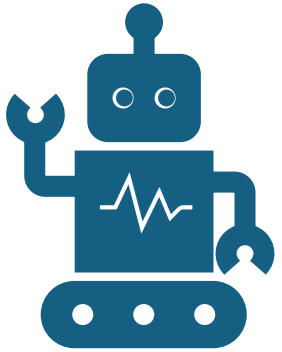
- **Main Idea:** Create an interactive system using supervised machine learning to control two hardware systems (bionic hand and RC car) through hand gesture recognition.
- **Project Goal:** Demonstrate how a single machine learning classifier can control multiple hardware devices simultaneously.
- Showcase the potential scalability and versatility of gesture recognition technology for various applications.



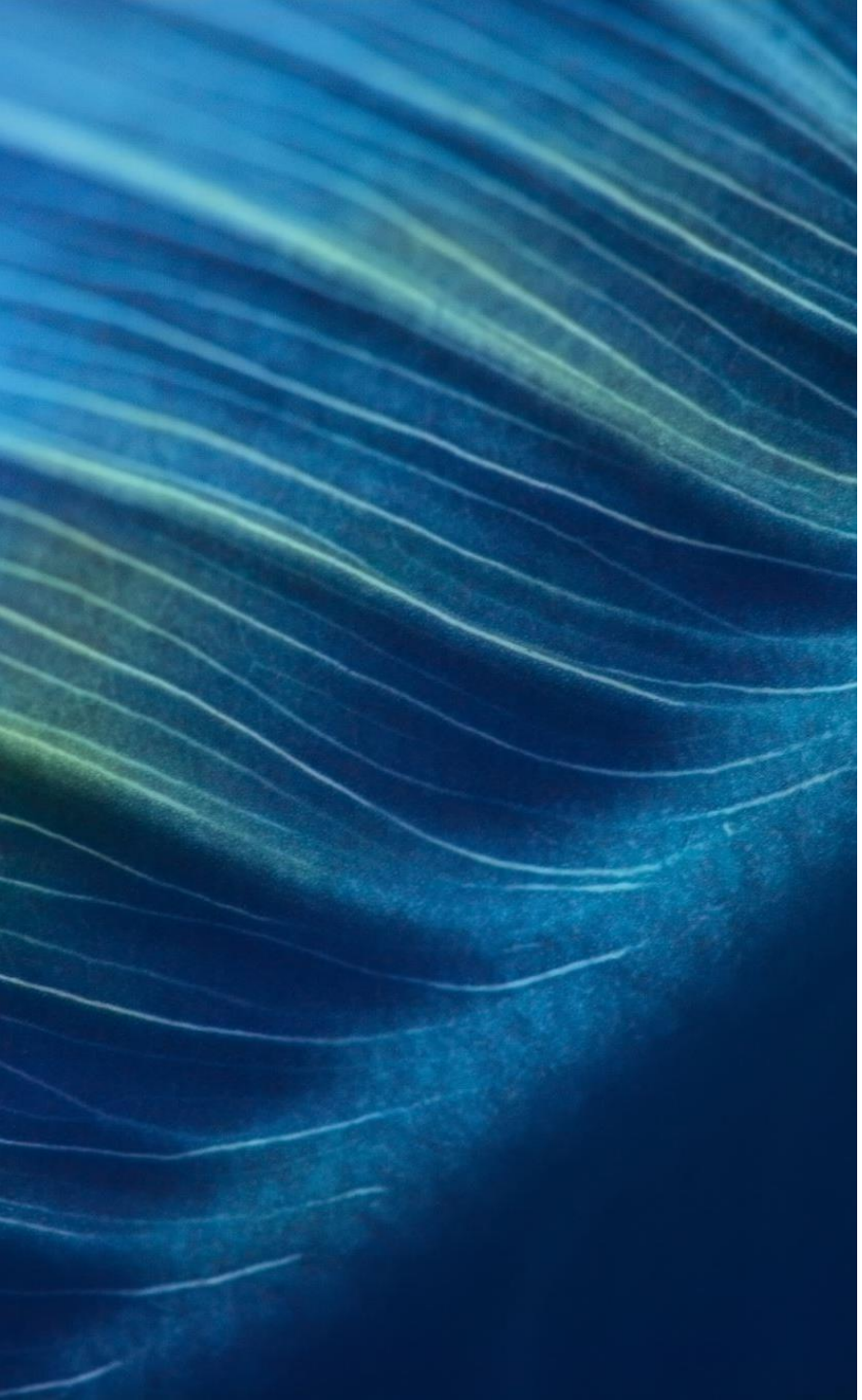
Research and Motivation



Interest in Gesture Recognition: Enhancing intuitive human-machine interaction.



Real-world Applications: Robotics, assistive technology, interactive gaming, and accessibility solutions.



System Components

Hardware:

RC Car controlled via ESP32-CAM

Bionic Hand via Raspberry pi 4B

Software:

Gesture pattern recognition via OpenCV and Mediapipe

Hardware Details – rc car

- **Controller:** ESP32-CAM
- **Key Features:**
  - Wi-Fi connectivity for wireless communication
  - Built-in camera for live streaming and interaction
- **Construction:**
  - Lightweight, durable 3D-printed chassis
  - Efficient TT motors for precise movement

Hardware Details – A.C.R.A.

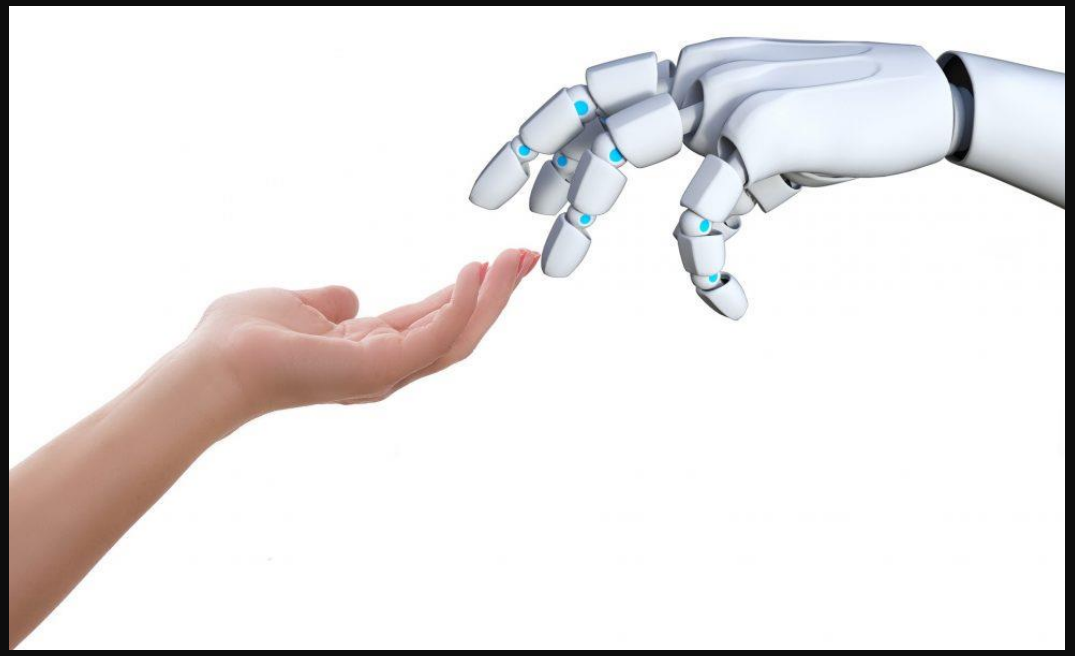
- Controller: **Broadcom BCM2711** (Raspberry Pi 4B 8gb)
- Key Features and Body Structure:
  - Built-in high resolution camera;
  - 10 SG-90 Servomotors, connected to Waveshare servomotor shield
  - Unique shell structure of the forearm, which makes it more durable and also flexible due to the specific type of the plastic (ePLA)
  - Flexible and precise design of the finger joints allows the hand to accurately mimic the elegant movement of human's hand, it's also a nice alternative to bearings due to it's low cost.

Interaction Between RC Car and Software

- **Workflow:**
  - Laptop webcam captures real-time hand gestures.
  - Classifier identifies gestures and translates them into commands.
  - Commands transmitted wirelessly to ESP32-CAM.
  - ESP32-CAM processes signals and directs RC car accordingly.
- **Communication:** Reliable and responsive Wi-Fi-based interaction.

Interaction Between A.C.R.A. and Software

- A.C.R.A. gently mimics the move
- ment of each finger by capturing
- any movement of our fingers’ join
- ts.



Machine Learning Approach

- **Technique Used:** Supervised Classification
- **Data Collection:**
  - Video recordings of distinct hand gestures
  - Associated labels corresponding to vehicle movements
- **Feature Extraction:** teammate’s detailed explanation]

Future Directions

Potential Enhancements:	Increase accuracy and robustness of the gesture classifier Expand the range of controllable hardware with minimal additional software changes Implement outdoor functionality for real-world usage
Applications Beyond the Project:	Interactive gaming Advanced assistive technologies Educational robotics platforms