

HRI: Vision Control for Dexterous Robotics

GRASP: Intuitive Tele-Operation

Problem: Remote critical tasks (eg. medical, disaster relief) require natural dexterity, but current interfaces are complex and costly.

Solution & Goal

Goal: Achieve real-time, low-latency robotic control by directly translating natural human hand gestures using affordable, open-source methods.

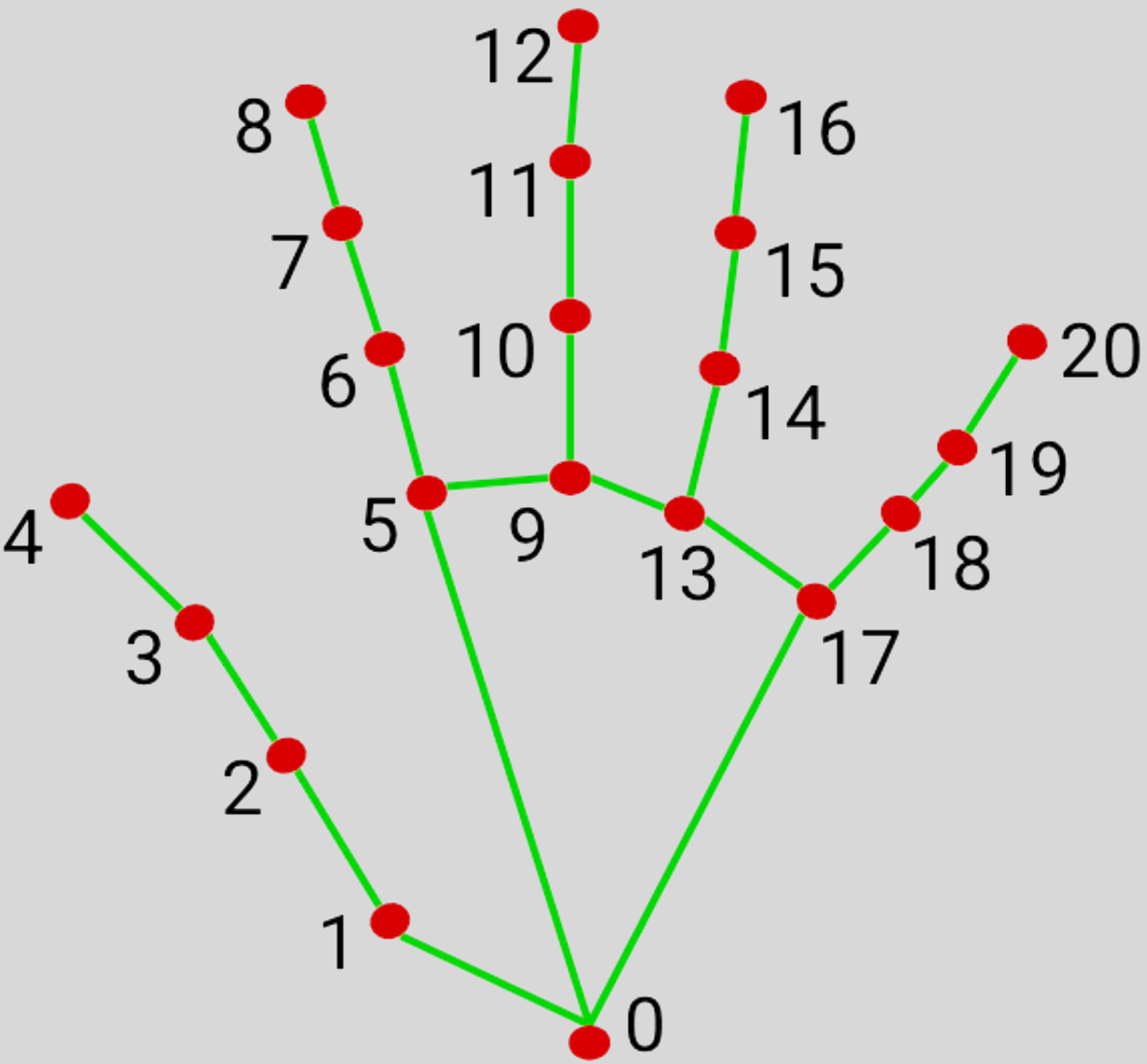
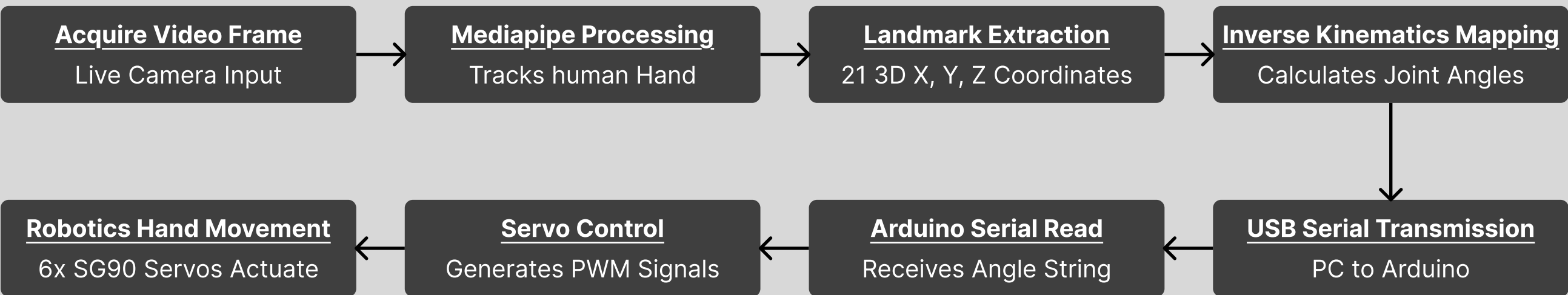
Technology Highlights

Core Tech: Vision-Based Inverse Kinematics
Input Model: Mediapipe Hand Tracking
Control Platform: Arduino Microcontroller
Key Feature: High-Fidelity Human-Robot Interaction (HRI)

Data Flow: From Lens To Limb

System Architecture:

1. Camera Input: Captures real-time video feed.
2. Vision Model: (Mediapipe) Processes the feed to identify the human hand.
3. Serial Data: Angular commands sent from Python/PC to the Arduino.
4. Servo Pulses: Arduino generates PWM signals for motor actuation.



Gesture Translation

A. 3D Tracking

The model tracks 21 key hand landmarks (X, Y, Z coordinates) on the human hand in real-time.

B. Angle Mapping

Calculated angles between specific joints (eg. PIP and DIP) are mapped directly to the robotic hand's angular range, ensuring 1:1 motion fidelity.

