**Hand Gesture Recognition Using Machine Learning**

**Abstract**

In recent years, hand gesture recognition has emerged as a significant technology in human-computer interaction (HCI). This project aims to develop a **real-time hand gesture recognition system** using deep learning techniques. The system utilizes a webcam to capture hand movements, processes the images using **OpenCV** and **cvzone**, and classifies gestures using a trained **TensorFlow model**.

The proposed model detects **multiple hand gestures** and identifies them in real time with high accuracy. The project incorporates **Flask** to create a web-based front-end, allowing users to interact with the system through a simple interface. The model architecture is stored in **JSON format**, ensuring flexibility and efficient deployment.

Our approach involves the following key steps:

1. **Hand Detection:** Utilizing the **cvzone HandTrackingModule** to locate hands in the video stream.
2. **Preprocessing:** Extracting and resizing the hand region for classification.
3. **Gesture Classification:** Using a deep learning model trained on various hand gestures.
4. **User Interface:** A web-based interface that displays the detected gesture in real time.

The system can be applied in various fields, such as **sign language interpretation, virtual gaming, robotics control, and contactless user interfaces**. The project demonstrates the effectiveness of deep learning in gesture recognition and highlights its potential for enhancing human-computer interaction.

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