Project Title: ML based Windows Controlling using Hand Gestures.

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Objective: Develop a real-time hand gesture recognition system using Convolutional Neural Networks to enable precise and effortless control of Windows commands.
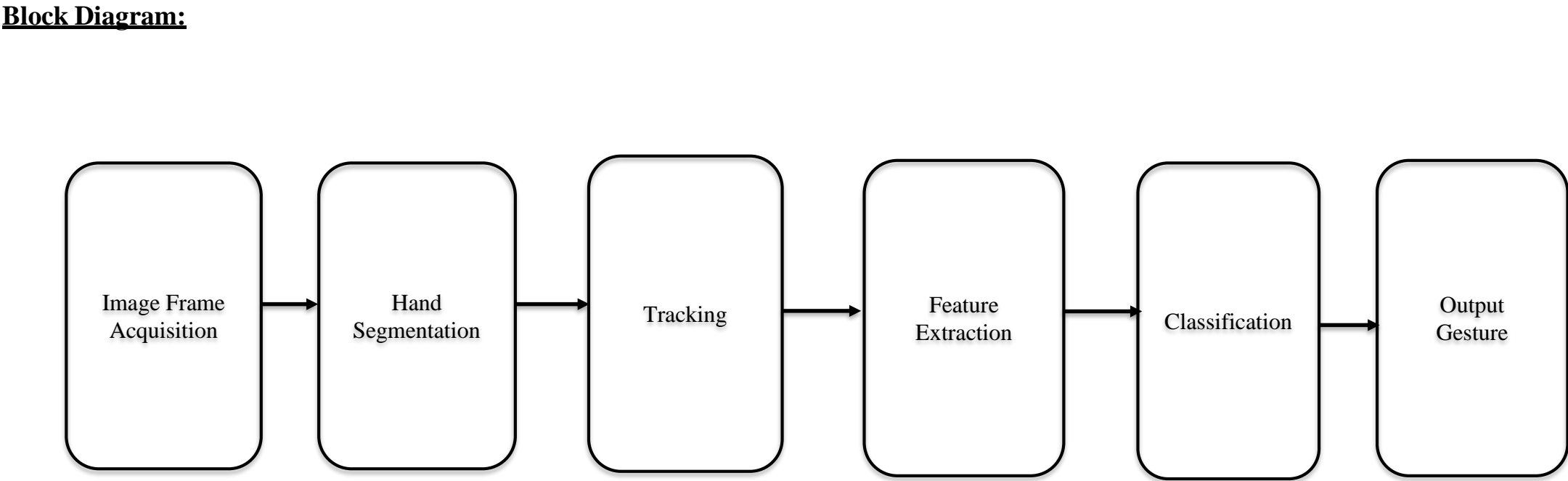
Methodology:

1) The real-time virtual mouse system utilizes webcam frames processed through OpenCV to detect hand gestures.

2) It converts fingertip coordinates to control the mouse within the computer window, discerning gestures through MediaPipe.

3) Mouse functions are executed based on finger positions, enabling actions such as cursor movement, left and right clicks, volume control, and drag-and-drop operations.

4) Additionally, a custom hand gesture recognition model was developed using a proprietary dataset comprising six distinct gestures.

5) This dataset, carefully curated to address overfitting issues, consists of 3000 images for testing, 2000 for training, and 500 for validation, ensuring accurate and reliable Windows control.

Block Diagram:

Image Frame Acquisition → Hand Segmentation → Tracking → Feature Extraction → Classification → Output Gesture

Testing & Debugging:

1. Classification Report:-

	precision	recall	f1-score	support
0	0.30	0.73	0.43	84
1	1.00	1.00	1.00	200
2	1.00	0.87	0.93	229
3	0.99	0.96	0.98	206
4	1.00	1.00	1.00	200
5	0.86	1.00	0.93	173
6	1.00	1.00	1.00	200
7	1.00	0.47	0.64	422
8	0.47	1.00	0.64	94
9	0.96	1.00	0.98	192
accuracy			0.86	2000
macro avg	0.86	0.90	0.85	2000
weighted avg	0.93	0.86	0.87	2000

2. Classification Accuracy of 89.50 %.

Specifications / Features:

1) Gesture Control:
   Open CV - python 4.9.0.80
   MediaPipe 0.10.9
   PyAutoGUI 0.9.54
   ScreenBrightnessControl 0.22.1
   PyCAW 20230407
   COMTypes 1.2.1
   contourPy 1.2.0

2) ML Model:
   Training:
     TenserFlow 2.2.0
     Keras 2.3.1 - python 3.8
     NumPy 1.26.3
     Pandas 2.2.1
     MatPlotLib 3.8.3
   Testing:
     Open CV python 4.9.0.80
     NumPy 1.26.3
     Keras 2.3.1
     PyAutoGUI 0.9.54

Results:

Conclusion:

1) This project highlights the potential of deep learning for hand gesture recognition in HCI, achieving an 89.50% accuracy in real-world testing.

2) It underscores the importance of ongoing development to overcome challenges and optimize performance across various hand gestures, ensuring a more intuitive and user-friendly HCI system based on gesture recognition.