Project Proposal

1 Project Title

Air Drawing: Real-time Sketch Recognition and Enhancement System

2 Team Members

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3 Project Details

3.1 Project Objective

This project aims to develop an innovative air drawing recognition system that can accurately interpret hand movements in real-time and match them to known drawing patterns.

- **Project Objective:** Create a real-time system that can recognize and enhance sketches drawn in air using hand movements, with the ability to match them to known patterns and provide immediate visual feedback.
- **Problem to Solve:** Current air drawing systems lack accuracy in pattern recognition and real-time feedback. The challenge is to accurately interpret hand movements as drawings and match them to intended patterns while providing immediate visual feedback.
- **Importance:** This problem is significant because:
  - It advances human-computer interaction in 3D space
  - Has applications in education, accessibility, and interactive systems
  - Addresses challenges in real-time pattern recognition
  - Can improve touchless interaction systems
- **Why Machine Learning:** Machine learning is crucial because:
  - Pattern recognition at this scale requires deep learning approaches
  - Real-time processing needs efficient ML models
  - The system must adapt to variations in drawing styles and speeds
  - Traditional computer vision approaches cannot handle the complexity of 3D gesture recognition

3.2 Datasets

We will utilize Quick Draw Dataset for this project:

- **Quick Draw Dataset:**
  - Source: `https://quickdraw.withgoogle.com/data`
  - Contains 50 million drawings across 345 categories

  - We will focus on 10 specific categories including basic shapes (circle, square, triangle), common objects (car, house), and simple symbols (star, heart)
  - Format: Raw stroke data with x,y coordinates and timing information
  - Training split: 70% (approximately 1.4GB)
  - Validation split: 15% (approximately 300MB)
  - Testing split: 15% (approximately 300MB)

- **Selected Categories:**
  - Basic shapes: circle, square, triangle
  - Common objects: car, house, tree
  - Simple symbols: star, heart, arrow
  - Each category contains approximately 100,000 samples

- **Data Format:**
  - Raw stroke data with x,y coordinates
  - Timing information for each stroke
  - Sequence of points representing drawing trajectory
  - Available in multiple formats (raw, simplified, binary)

- **Data Splits:**
  - Training: 70% (approximately 700,000 samples)
  - Validation: 15% (approximately 150,000 samples)
  - Testing: 15% (approximately 150,000 samples)

3.3 Machine Learning Algorithm

We will implement a hybrid deep learning approach combining multiple techniques:

- **Pattern Recognition Network:**
  - CNN architecture for feature extraction from movement sequences
  - LSTM layers for temporal sequence processing
  - Trained on Quick Draw dataset for pattern matching

- **Real-time Processing Components:**
  - OpenCV for efficient hand tracking
  - Kalman filtering for motion smoothing
  - Real-time pattern matching algorithm

This combination is chosen because:

- CNNs excel at spatial pattern recognition
- LSTMs can handle variable-length drawing sequences
- Real-time processing requires efficient algorithms
- The hybrid approach can handle both spatial and temporal aspects of air drawing

3.4 Expected Outcomes

The project aims to deliver the following.

- A functional air drawing system with:
  - Recognition accuracy greater than 85% for completed drawings
  - Real-time response (less than 100ms latency)
  - Support for 10 different sketch categories
  - Pattern completion suggestions
- Technical contributions:
  - Novel real-time sketch recognition architecture
  - Efficient pattern matching algorithm
  - New methods for air-drawing enhancement
  - Improved accuracy in 3D gesture recognition