Smilage project Milestone 2

28 Aug : Multi-Model Research & Integration Foundation

Primary Focus: Multi-Model Integration & Comparison

1. **Research Additional Pretrained Models**
    - **Research 3-4 additional smile detection models:**
        - **FER2013-based emotion models from Hugging Face**
        - **MediaPipe Face Mesh with expression analysis**
        - **OpenCV DNN emotion detection alternatives**
    - **Research 2-3 additional age prediction models:**
        - **Different age_net variants (age_net_v2, age_net_v3)**
        - **ResNet-based age estimation models**
        - **VGG-Face age prediction models**
2. **Download & Organize Models**
    - **Download selected models and organize in structured folders**
    - **Create model registry/inventory with specifications**
    - **Test basic loading of each model**
    - **Document model input requirements and preprocessing needs**
3. **Design Model Comparison Framework**
    - **Design class structure for model management**
    - **Create abstract base classes for smile and age models**
    - **Plan performance metrics collection (accuracy, speed, memory)**

- Set up basic logging for model performance tracking

Deliverables:

- **Model inventory document with 6+ models**
- **Basic model loading verification**
- **Framework design document**

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29 Aug: Model Integration & Comparison System

Primary Focus: Multi-Model Integration & Comparison

1. **Implement Model Wrapper Classes**
   - **Create unified interface for smile detection models**
   - **Create unified interface for age prediction models**
   - **Implement model switching capabilities**
   - **Add consistent preprocessing for different models**
2. **Build Performance Analysis Framework**
   - **Implement performance metrics collection (FPS, accuracy, memory usage)**
   - **Create A/B testing infrastructure**
   - **Build model comparison utilities**
   - **Implement benchmark testing with sample images**
3. **Initial Model Performance Testing**
   - **Run preliminary performance tests on all models**
   - **Document initial findings**
   - **Create model selection logic based on metrics**

Deliverables:

- **Working model wrapper system**

- **Performance analysis framework**
- **Initial benchmark results**

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1 Sep : Advanced Face Processing Features

Primary Focus: Advanced Face Processing Implementation

1. **Multi-Face Detection & Tracking**
    - **Implement multi-face detection using improved algorithms**
    - **Add face tracking across frames**
    - **Create face ID assignment and management**
    - **Test with multiple people in frame**
2. **Face Quality Assessment**
    - **Implement blur detection using Laplacian variance**
    - **Add lighting condition assessment**
    - **Create face quality scoring system**
    - **Implement quality-based filtering**
3. **Face Alignment & Landmarks**
    - **Implement face landmark detection using dlib**
    - **Add face alignment based on eye positions**
    - **Create face pose correction utilities**
    - **Test alignment improvements on model accuracy**

Deliverables:

- **Multi-face detection and tracking system**
- **Face quality assessment module**
- **Face alignment and landmark detection**

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3 Sep : Emotion Detection & Enhanced Predictions

Primary Focus: Enhanced Prediction Features

1. **Extended Emotion Detection**
    - **Implement emotion detection beyond smile (happy, sad, neutral, angry, surprise, fear)**
    - **Create emotion classification using pretrained models**
    - **Add emotion confidence scoring**
    - **Test emotion detection accuracy**
2. **Enhanced Prediction Features**
    - **Implement age range prediction with confidence intervals**
    - **Add gender prediction using pretrained models**
    - **Create demographic analysis capabilities**
    - **Implement prediction confidence scoring**
3. **Prediction History & Trends**
    - **Create prediction history tracking**
    - **Implement trend analysis for predictions**
    - **Add calibration mechanisms for reliability**
    - **Design data structures for historical analysis**

Deliverables:

- **Multi-emotion detection system**
- **Enhanced age and gender prediction**
- **Prediction history and confidence scoring**

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5 Sep : Performance Optimization & Acceleration

Primary Focus: Performance Optimization Implementation

1. **Model Optimization**
    - **Convert models to TensorFlow Lite format**
    - **Implement ONNX model optimization where applicable**
    - **Add model quantization for faster inference**
    - **Test optimized model performance vs. original**
2. **Processing Optimization**
    - **Implement GPU acceleration for supported operations**
    - **Create batch processing for multiple faces**
    - **Add frame skipping and smart processing strategies**
    - **Implement memory optimization techniques**
3. **Resource Management**
    - **Add memory usage monitoring and optimization**
    - **Implement adaptive processing based on system resources**
    - **Create performance monitoring dashboard**
    - **Test optimization improvements**

Deliverables:

- **Optimized model inference pipeline**
- **GPU acceleration implementation**
- **Resource management system**

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8 Sep : Integration, Testing & Final Deliverables

Primary Focus: System Integration & Comprehensive Testing

1. **Complete System Integration**
    - **Integrate all new features into main application**
    - **Ensure compatibility between all components**

    - **Create unified interface for all advanced features**
    - **Test end-to-end workflow**
2. **Comprehensive Testing & Benchmarking**
    - **Conduct performance benchmarking of complete system**
    - **Test all features under various conditions**
    - **Create detailed performance comparison reports**
    - **Test system stability and error handling**
3. **Documentation & Presentation Prep**
    - **Document all implemented features**
    - **Create performance benchmark reports**
    - **Prepare demo materials for milestone review**
    - **Generate final deliverable package**

Deliverables:

- **Complete Milestone 2 implementation**
- **Performance benchmark reports**
- **Feature documentation**
- **Demo-ready application**