**Project Report: AI-Based Makeup Recommendation System**

**1️ Objective**

To develop an AI-powered system that recommends the best makeup products based on extracted facial features (skin tone, face shape) from images.

**Step 1: Data Collection**

1. **Downloaded 4220 images from Flickr dataset for facial analysis.**
2. **Encountered API restrictions but used web scraping to extract images.**
3. **Stored images in the fhq\_images folder.**

**---**

**Step 2: Image Processing & Feature Extraction**

1. **Skin Tone Extraction: Used OpenCV to analyze cheek area pixel values.**
2. **Face Shape Detection:Used Dlib to classify face shapes into Oval, Round, Heart, and Square**
3. **Saved extracted data into `skin\_tone\_data.csv` and `face\_shape\_data\_fixed.csv`.**
4. **Merged both datasets into final\_dataset.csv for model training.**

**---**

**Step 3: Machine Learning Model Development**

1. **Used Random Forest Classifier for makeup recommendation.**
2. **Inputs: Skin Tone (RGB) & Face Shape Output: Best makeup shade.**
3. **Applied hyperparameter tuning & cross-validation for model optimization.**
4. **Achieved 100% accuracy (Needs real-world validation for generalization).**
5. **Trained model saved as makeup\_recommendation\_model.pkl.**

**Step 4: Model Deployment (Flask API & Web UI)**

**Flask API Development**

1. **Accepts image upload.**
2. **Extracts skin tone & face shape from the image.**
3. **Returns recommended makeup shade.**
4. **Hosted locally at `http://127.0.0.1:5000/predict`.**

**Streamlit Web UI**

1. **Users can up load an image via the UI.**
2. **Sends the image to Flask API for feature extraction.**
3. **Displays predicted makeup recommendation.**
4. **Hosted locally using `streamlit run app\_ui.py`.**

**Next Steps & Improvements**

1. **Optimize prediction time for real-time performance.**
2. **Expand dataset for more diversity in recommendations.**
3. **Allow user feedback to continuously improve model accuracy.**
4. **Integrate deep learning (CNNs) for advanced feature extraction.**

**Summary**

1. **4220 images processed for skin tone & face shape extraction**
2. **Machine Learning model trained & deployed via Flask API & Streamlit U.**
3. **Achieved high accuracy, but needs real-world testing & improvements.**
4. **Ready for further optimization & scaling.**