# INTEL ONE API HACKATHON
# Aug 5, 2023 - Aug 12, 2023

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# Abstract


## Problem Statement

The task involves developing a comprehensive AI-based system for Hair Type and Characteristics Analysis that accurately identifies and categorizes individual hair types (curly, straight, wavy) and hair characteristics (oily, frizzy, dry) based on input images.

## What we Offer

Our project is built around the innovative Hair Type and Characteristics Analysis (HTCA) methodology, which transforms conventional hair assessment techniques. Our solution offers a thorough and precise study of a person's hair features by utilising the power of cutting-edge image technologies and machine learning algorithms. We provide detailed hair type evaluations, thorough character assessments, real-time accessibility, and data-driven personalization that can result in tailored hair routines and product suggestions. In essence, our service turns taking care of your hair into a customised, data-backed experience. By fusing technical innovation with the field of hair analysis, we enable people to make knowledgeable decisions and maximise the natural beauty of their hair.

## Beneficiaries

Our project has the potential to be advantageous to a variety of people and organisations in many industries. Here are some of the key beneficiaries:

1. Individuals
   From our project, people of all ages and hair kinds stand to benefit. People can get precise evaluations of the types and qualities of their hair, which results in customised hair care regimens. This gives consumers the power to decide for themselves which practices and products work best for their hair, leading to healthier, brighter hair.

2. Salons and Hair Care Professionals
   Our approach can improve the services provided by hair care specialists and salons. Professionals can offer highly individualised advice to their clients by adding our analysis into their sessions. As a result, client loyalty is increased and the customer experience is improved.

3. Beauty and Cosmetic Industry
   Businesses in the cosmetics and beauty industry might use our study as a springboard to develop specialised solutions that cater to certain hair demands. Companies may create more appropriate and effective hair care solutions and boost customer satisfaction and brand loyalty by learning about their consumers' hair kinds and characteristics.

4. E-Commerce Platforms
   Our technology can be included by online retailers of hair care items to offer a customised purchasing experience. Based on the findings of their hair analysis, customers can obtain product recommendations, enabling more informed purchases.

5. Diverse Hair Communities
   Our project may help varied hair communities foster a sense of inclusivity. We encourage a more all-encompassing and considerate approach to hair care by identifying and taking into account the particular requirements of various hair types and characteristics.

6. Research and Development
   The data gathering and analysis capabilities of our study could increase knowledge of various hair forms and qualities. In the area of hair science, researchers could use this information to create fresh insights and solutions.

7. Education and Training
   Our technology can be incorporated into the curricula of institutions that provide cosmetology and hair care education. Students can broaden their practical knowledge by learning about various hair kinds and how to handle diverse hair characteristics.

8. Sustainability Initiatives
   Individuals may choose more environmentally friendly hair care procedures and products as they become more aware of their hair's needs.

9. Health and Wellness Industry
   The condition of your hair may reflect your general health and happiness. Our research may help with health evaluations and suggestions for dietary changes, stress reduction techniques, and lifestyle modifications.

In conclusion, a wide range of people will benefit from our research, from those looking for customised hair care to companies looking to offer niche solutions and the larger ecosystem focusing on expanding the science of hair care.

## Features

Below are some of the features of our project:

1. Image Upload and Analysis
   - Allow users to upload images of their hair.
   - Apply image processing techniques to detect hair strands and attributes.

2. Hair Typing
   - Employ machine learning models to accurately classify hair types as curly, straight, wavy, etc.
   - Display the hair type classification along with a description.

3. Hair Characteristics Assessment
   - Utilize AI algorithms to evaluate hair attributes such as dryness, friskiness, and oiliness.

- Provide a detailed analysis of these characteristics.

4. Real-time results
    - Provide instant analysis results to users after uploading their images.
    - Allow users to see their hair's attributes in real-time.

5. Comparison over time
    - Enable users to track changes in their hair attributes over multiple sessions.
    - Offer insights into the effectiveness of their hair care routines.

6. User Engagement
    - Gamify the experience by awarding achievements or badges based on consistent care routines or improvement in hair health.
    - Encourage users to stay engaged with their hair care journey.

7. Data Insights and Analytics
    - Collect anonymized data to gain insights into broader trends in hair types and characteristics.
    - Use analytics to improve the accuracy of the analysis algorithms.

8. Enhanced User Experience
    - Design a user-friendly interface that is easy to navigate and understand.
    - Use clear labels, icons, and visual cues to guide users through the process.

## List of oneAPI Toolkit/Libraries used

1. scikit-learn-intelex:

   The scikit-learn-intelex package is an optimized version of the popular scikit-learn machine learning library. It is designed to take advantage of Intel's hardware acceleration and optimizations, including those provided by the oneAPI toolkit.

   When you use this package, scikit-learn operations will be accelerated on Intel CPUs and hardware accelerators, potentially leading to faster execution and better resource utilization.

2. intel-tensorflow:

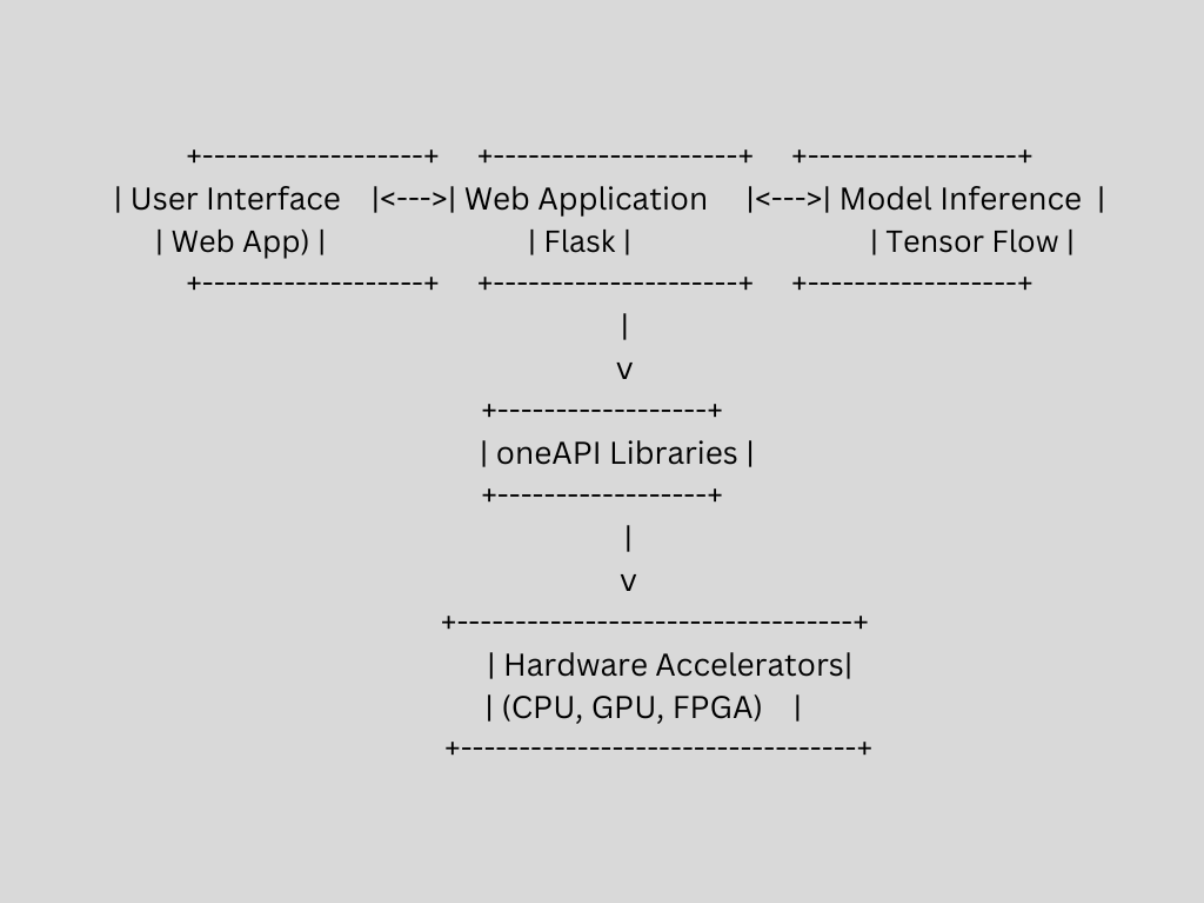
   The intel-tensorflow package is an optimized distribution of TensorFlow that is optimized to run efficiently on Intel hardware.

   It includes Intel's optimizations for deep learning operations, allowing your TensorFlow models to take advantage of Intel-specific performance improvements.

   This version of TensorFlow is designed to deliver better performance on Intel CPUs, making it a good choice if you're working with Intel hardware.

By installing these packages, we're essentially enhancing the performance of both scikit-learn and TensorFlow in our hair analysis project when running on Intel hardware. These optimized versions leverage Intel's hardware acceleration capabilities and optimizations, which can result in improved execution times and more efficient resource utilization.

## Architecture Diagram




# Technologies Used

1. TensorFlow and scikit-learn with Optimizations:
    - We've used TensorFlow and scikit-learn libraries for machine learning tasks.
    - We've utilized optimized versions of these libraries (scikit-learn-intelex and intel-tensorflow) to leverage Intel's hardware acceleration and performance optimizations.
    - TensorFlow is used for deep learning model development, and scikit-learn is used for various machine learning tasks.

2. Front-End Development:
    - We've developed the user interface using front-end technologies like HTML, CSS, and JavaScript.
    - HTML is used for structuring the content, CSS for styling, and JavaScript for interactive elements on the web page.

3. Flask:
    - Flask is used as the web framework for building the backend of your application.
    - It handles user requests, communicates with the model inference component, and serves the web pages.

4. Image Processing Libraries:
    - We've utilized various image processing libraries like cv2 (OpenCV) for image manipulation tasks.
    - These libraries help with tasks like loading, preprocessing, and transforming images for analysis.

5. PyTorch:
    - We've used PyTorch, a popular deep learning framework, for various tasks related to image analysis and neural network development.
    - PyTorch provides a flexible and dynamic computation graph suitable for research and development.

6. Data Handling and Transformation:
    - We've used data handling and transformation libraries like torchvision and transforms for managing datasets and applying transformations to images.

7. Data Loading and Preprocessing:
    - DataLoader from PyTorch is used for efficient data loading and batching during training and inference.
    - We've employed ImageFolder to manage image datasets and their labels.

8. Neural Network Architecture:
    - We've defined a neural network architecture using nn.Module and used various layers and activation functions from nn and F (functional) modules.

9. Visualization:
    - matplotlib is used for data visualization, showing images, plots, and graphs.
    - We've used it to visualize image data, model training progress, and analysis results.