PROJECT - I REPORT ON

AyuScan: An Intelligent System for Disease Detection via Facial Cues

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF

BACHELOR OF TECHNOLOGY IN COMPUTER SCIENCE & ENGINEERING

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Abstract

Healthcare has traditionally been reactive, treating diseases only after they manifest. This project introduces a novel **preventive healthcare system** that integrates **Ayurvedic diagnostic principles**—Varna Pariksha (skin tone), Mukha Pariksha (facial features), and Netra Pariksha (eyes)—with **Artificial Intelligence (AI)**. Using **Convolutional Neural Networks (CNNs)** and **image processing techniques**, the system analyzes real-time facial images to predict early signs of health imbalances.

A hybrid dataset consisting of **biomedical facial datasets** and **Ayurvedic annotations** was developed to train the CNN model. The system is capable of identifying dermatological issues, stress indicators, and neurological patterns. It then provides **personalized Ayurvedic recommendations** to prevent progression of disease.

The final product is a **real-time web/mobile application**, built with Python, OpenCV, TensorFlow/Keras, and Streamlit. Unlike existing AI systems that are disease-specific, this system delivers a **holistic, preventive healthcare analysis**.

Acknowledgement

We take this opportunity to extend our profound gratitude to our project guide,**Dr. Jasvinder Pal Singh**, whose expertise, encouragement, and unwavering support have been the cornerstone of this research work. His insightful feedback and constant motivation guided us not only in addressing technical challenges but also in refining our research perspective.

His emphasis on scientific rigor, innovation, and clarity of thought inspired us to explore the integration of **artificial intelligence and Ayurvedic knowledge systems** with greater depth and responsibility. This project would not have attained its present form without his critical observations and constructive suggestions at every stage of development.

We remain indebted to him for instilling in us the values of disciplined research, systematic exploration, and academic integrity, which will serve as guiding principles in our future endeavors.

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Chapter – 1
Introduction

1.1 Project Overview

This project is categorized as a Research-based Application Development project. It integrates Artificial Intelligence (AI), Convolutional Neural Networks (CNNs), and Ayurvedic diagnostic knowledge to build a novel facial health analysis system. By capturing facial cues such as complexion (Varna), eye condition (Netra), and facial structure (Mukha), the system predicts potential health conditions and suggests preventive healthcare insights based on Ayurvedic principles [1][2][4][6].

Unlike conventional medical diagnostic systems that rely on invasive tests, this project focuses on non-invasive, image-based analysis. The model leverages CNN architectures for facial recognition and feature extraction [2][3][9], maps these features to health categories, and integrates them with Ayurvedic interpretations. This hybrid approach allows the project to bridge modern AI capabilities with traditional holistic healthcare practices.

1.2 Objectives of Project

The objectives of this project are:

- To design and implement a CNN-based facial recognition system for extracting health-related features from facial images.
- To integrate Ayurvedic diagnostic principles with AI-based analysis for predicting possible health imbalances.
- To develop a real-time application capable of scanning faces through a camera and providing instant health insights.
- To generate a personalized preventive healthcare report, including Ayurvedic interpretations and lifestyle recommendations.

1.3 Problem Formulation

Healthcare systems today face challenges such as:

- Over-reliance on **invasive and costly diagnostic procedures**.
- Lack of **preventive healthcare awareness** among the general population.
- Insufficient integration of **traditional medical knowledge systems** like Ayurveda into modern health monitoring applications [6][7].

The formulated problem is:
"How can AI-driven facial recognition be integrated with Ayurvedic diagnostic knowledge to create a non-invasive, preventive healthcare system capable of real-time analysis and personalized recommendations?"

1.4 Existing System

Current facial recognition systems are primarily designed for security, biometrics, or emotion detection [2]. In the healthcare domain, existing AI applications focus mainly on disease detection through medical imaging, such as skin cancer classification [3] or Parkinson's detection [8].

While some studies have attempted Ayurvedic face diagnosis [4], these are limited in scope and lack real-time integration with modern AI models. Moreover, most available solutions are condition-specific, do not provide preventive health recommendations, and are not personalized for holistic healthcare.

1.5 Proposed System

The proposed system combines CNN-based AI models with Ayurvedic interpretative rules to build a real-time facial health analysis system. The camera captures the user's face, extracts features using MediaPipe + CNN, and classifies potential health conditions (e.g., dehydration, anemia, pitta imbalance). These conditions are then mapped to Ayurvedic interpretations with personalized recommendations such as dietary adjustments, lifestyle changes, and breathing exercises.

Key aspects include:

- Non-invasive analysis using only facial images.
- Integration of AI + Ayurveda, bridging modern and traditional knowledge systems.
- Real-time execution, allowing instant analysis via webcam.
- Personalized health recommendations, improving user engagement and preventive care.

1.6 Features of the Project

1.6.1 Real-time facial scanning using webcam integration.

1.6.2 CNN-powered feature extraction for accurate classification of health indicators.

1.6.3 Ayurvedic knowledge base mapping for holistic interpretations.

1.6.4 User-friendly interface with visual results (detected conditions, interpretations, and confidence scores).

1.6.5 Automated text report generation with personalized lifestyle recommendations.

1.6.6 Scalable design, enabling future expansion into broader healthcare applications.

Chapter – 2

Requirement Analysis

2.1 Feasibility Study

The feasibility study evaluates whether the proposed AI + Ayurveda-based facial health analysis system is technically, economically, and operationally viable.

2.1.1 Technical Feasibility:

The project leverages well-established technologies such as Convolutional Neural Networks (CNNs) for image classification, MediaPipe for facial landmark detection, and TensorFlow/Keras for model training. Hardware requirements are minimal, as the model can run on a standard laptop with GPU/CPU support. Real-time processing with a webcam is achievable, making the system technically feasible.

2.1.2 Economic Feasibility:

Traditional healthcare diagnostics often involve costly laboratory tests. In contrast, this system provides a low-cost, non-invasive alternative that requires only a camera-enabled device. The use of open-source libraries (TensorFlow, OpenCV, Mediapipe) reduces software licensing costs, making the project economically viable for both developers and end-users.

2.1.3 Operational Feasibility:

The system is designed to be user-friendly, requiring no medical expertise to operate. Users only need to face the camera, and the system automatically generates a health analysis with Ayurvedic interpretations. This ease of use ensures operational feasibility in home-based preventive healthcare as well as in clinical support systems.

2.1.4 Research Feasibility:

The project falls under Research-based Application Development. Given the growing global interest in AI-driven healthcare and integration of traditional medicine [6][7], this research direction is both relevant and feasible for academic and industry applications.

2.2 Software Requirement Specification Document (SRS)

The **Software Requirement Specification (SRS)** defines the functional and non-functional requirements of the system.

2.2.1. Functional Requirements

- The system must capture **facial images** through a camera in real time.
- The system must detect and extract **facial features** using MediaPipe.
- The CNN model must classify potential **health conditions** (e.g. anemia, dehydration, pitta imbalance).

- The system must generate **Ayurvedic interpretations** and **personalized recommendations**.
- The system must display **real-time results** with visualization (bounding box, confidence score).
- The system must create a **detailed text report** of the analysis.

2.2.2 Non-Functional Requirements

2.2.2.1 Performance: The system must provide results in real time (within 1–2 seconds of capturing an image).

2.2.2.2 Scalability: The framework should support expansion to more health conditions in the future.

2.2.2.3 Usability: The system should have an intuitive interface for non-technical users.

2.2.2.4 Portability: The software should run on different platforms (Windows, Linux, Colab).

2.2.2.5 Security: Captured images must not be stored permanently unless explicitly saved by the user, ensuring **data privacy**.

2.2.3 Hardware Requirements

Component	Specification
Processor	Intel i5 or higher / Equivalent AMD
RAM	Minimum 8 GB
GPU	NVIDIA GPU (optional, for faster model inference)
Camera	Integrated or external webcam

Table 2.1 Hardware Requirements

2.2.4 Software Requirements

Category	Details
Programming Language	Python 3.10+
Frameworks / Libraries	TensorFlow / Keras, OpenCV, MediaPipe, Matplotlib, NumPy, Pandas
Operating System	Windows / Linux / macOS
Development Environment	Jupyter Notebook, Google Colab, or VS Code

Table 2.2 Software Requirements

2.3 SDLC Model Used

The **Software Development Life Cycle (SDLC)** model selected for this project is the **Iterative and Incremental Model**.

2.3.1 Reason for Selection:

- This project is **research-based** and requires continuous refinement of the CNN model, Ayurvedic mappings, and real-time accuracy.
- The Iterative model allows for **progressive development**, where each version of the system improves upon the previous one.
- It provides flexibility to **incorporate new findings from research**, user feedback, and performance results at each stage.

2.3.2 Phases of SDLC Applied:

2.3.2.1 Requirement Analysis: Identification of system objectives, feasibility, and user expectations.

2.3.2.2 Design: Development of architecture integrating CNN, MediaPipe, and Ayurvedic knowledge base.

2.3.2.3 Implementation: Building modules for face detection, health condition classification, and report generation.

2.3.2.4 Testing: Evaluating the accuracy of CNN predictions and system performance in real-time conditions.

2.3.2.5 Deployment: Running the application in real time (Colab or local machine).

2.3.2.6 Maintenance: Updating the model with new datasets, improving Ayurvedic mappings, and enhancing usability.

[Chapter – 3]
System Design

3.1 Product Perspective

The system is a **standalone AI-based health application** that integrates **real-time facial analysis** with **Ayurvedic principles**. It leverages **Convolutional Neural Networks (CNNs)** for classification and **MediaPipe** for face landmark detection. The system provides **preventive health insights** and recommendations without invasive procedures.

It is a **research-based application development project**, designed to bridge the gap between **traditional Ayurvedic diagnostics** and **modern AI-based image processing**. The product can work as:

- A **desktop-based application** (using Python and OpenCV),
- A **cloud/Colab-based prototype**,
- Or be extended into a **mobile/web application** for broader usage.

3.2 Product Functions

3.2.1 The main functions of the system are:

- Capture real-time **facial images** via camera.
- Detect and extract **facial landmarks** using MediaPipe.
- Preprocess and feed the image to a trained **CNN model**.
- Classify possible **health conditions** (e.g., anemia, dehydration, dosha imbalance).
- Generate **Ayurvedic interpretations** of results.
- Provide **personalized health recommendations**.
- Create a **detailed health report** (text-based).

3.3 User Characteristics

3.3.1 Primary Users:

Individuals interested in **preventive health analysis**.

Ayurvedic practitioners seeking AI assistance.

Researchers in **AI & traditional medicine integration**.

3.3.2 User Expertise Level:

Non-technical users: only need to operate the camera and view results.

Technical/Research users: may retrain models, test accuracy, or integrate into new systems.

3.4 Constraints

3.4.1 Technical Constraints:

- Requires a **working camera** with good lighting.
- Accuracy depends on dataset quality and CNN performance.

3.4.2 Operational Constraints:

- Cannot replace certified medical diagnosis – intended only for **preventive and educational use**.

3.4.3 Data Constraints:

- Currently relies on **synthetic datasets** and small-scale facial datasets; needs larger real-world datasets for better accuracy.

3.4.4 Ethical Constraints:

- Must ensure **data privacy** and avoid misuse of health predictions.

3.5 Use Case Model / Flow Chart / DFD

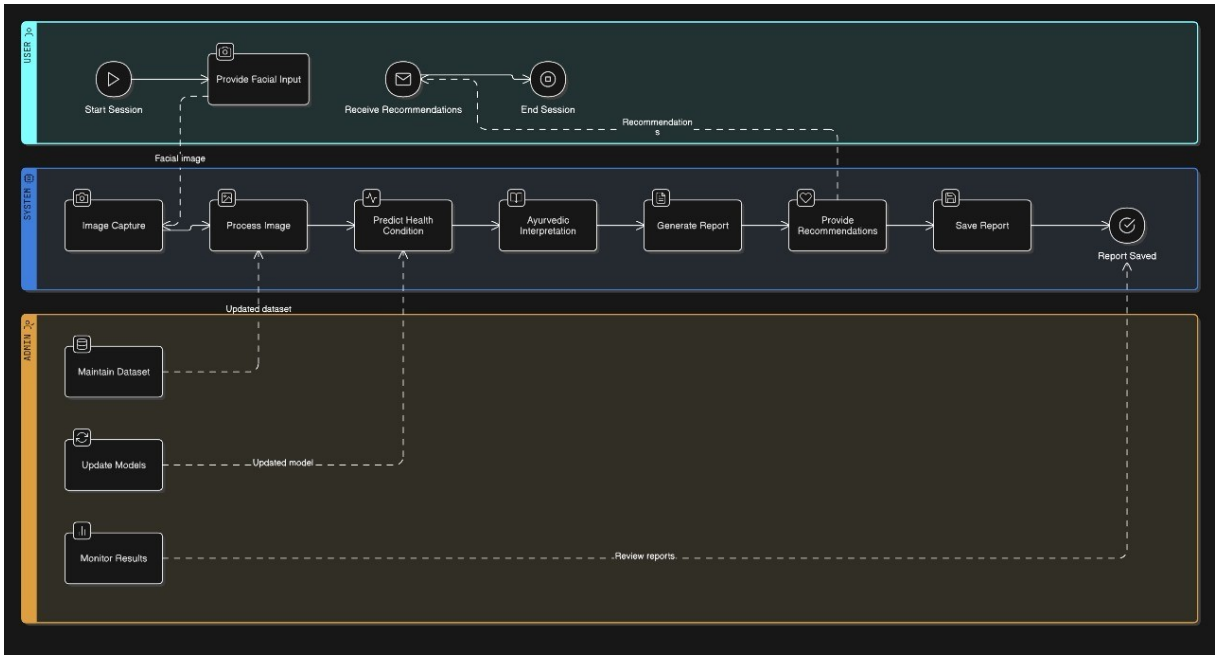

Fig. 3.1 Use Case Diagram of the System

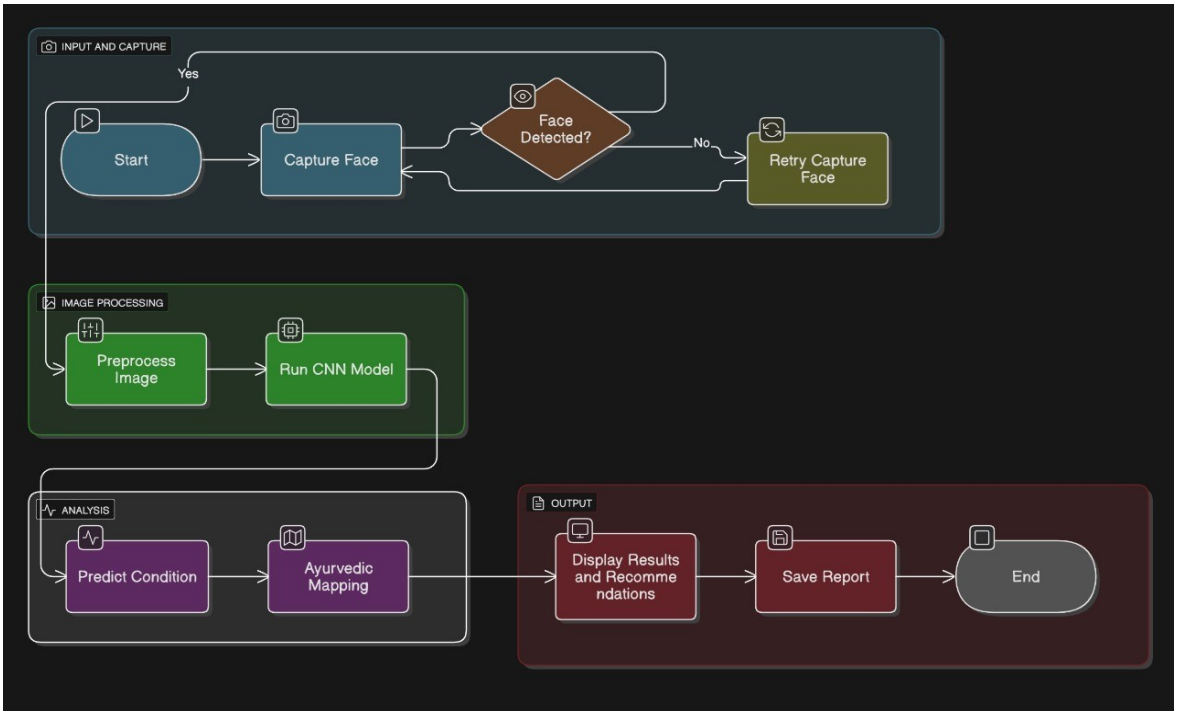

Fig. 3.2 Flowchart of Facial Image Processing

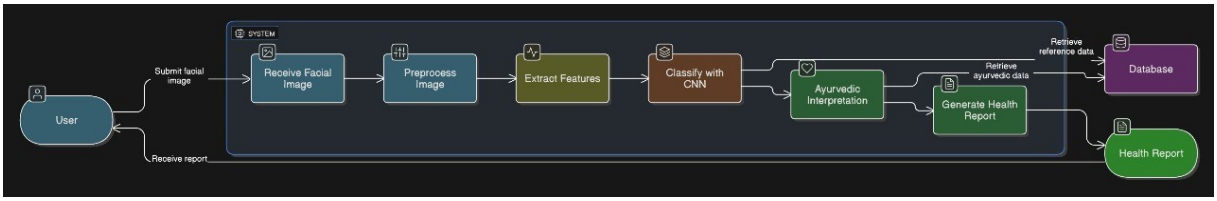

Fig. 3.3 Data Flow Diagram

3.6 Database Design

Since this prototype is lightweight, it does not require a complex relational database. Instead, it uses:

- **JSON file** (`class_names.json`) for class labels.
- **Dictionary (Python-based)** for **Ayurvedic interpretations & recommendations**.
- **Text file** (`ayurvedic_health_report.txt`) to store user reports.

However, in an extended version, a database (e.g., MySQL/PostgreSQL) can be used to:

Store user history,

Save facial analysis results,

Maintain Ayurvedic health recommendation datasets.

3.7 Table Structure

Table Name	Attribute	Description
Users	user_id (PK), name, age, gender, photo	Stores user details
Facial_Features	feature_id (PK), user_id (FK), landmark_data	Stores extracted facial landmarks
Predictions	prediction_id (PK), user_id (FK), condition, confidence	Stores CNN predictions
Ayurveda_Mapping	condition (PK), interpretation, recommendations	Knowledge base for Ayurvedic insights
Reports	report_id (PK), user_id (FK), report_text, date_time	Stores generated reports

Table 3.1 Dataset Table Structure

3.8 ER Diagram

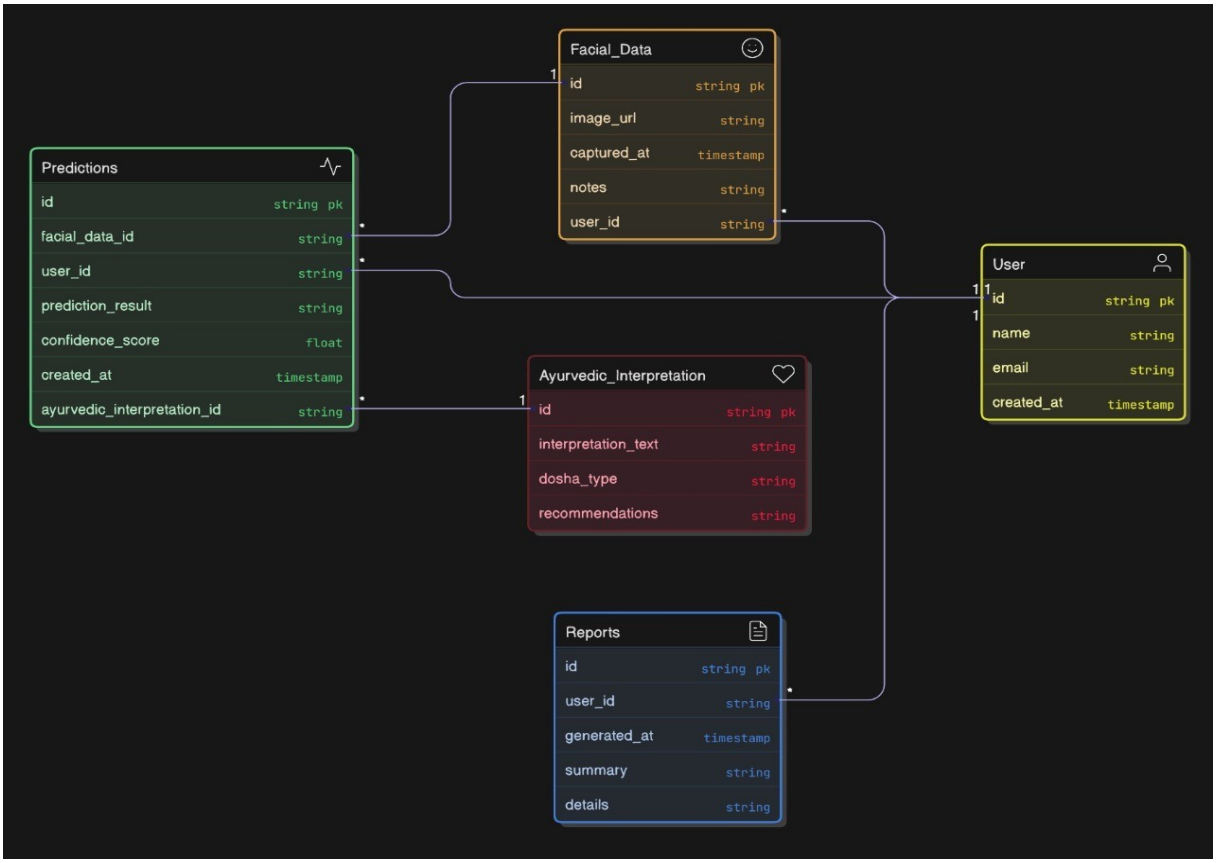

Fig. 3.4 ER Diagram of the System Database

3.9 Assumptions and Dependencies

- Assumes users will have a **camera-enabled device**.
- Assumes **lighting and positioning** are sufficient for accurate face detection.
- Depends on the **quality and diversity of training dataset**.
- Depends on **open-source libraries (TensorFlow, MediaPipe, OpenCV)** for model execution.

3.10 Specific Requirements

- Real-time processing with **minimum delay (<2 sec)**.
- Support for **multi-platform execution** (Windows/Linux/Colab).
- Expandability to new health conditions and Ayurvedic interpretations.
- User-friendly interface with both **visual and text-based results**.
- Compliance with **data privacy and ethical AI usage**.

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