

# GlowAI - Automated Blemish Detection & Classification

## Why It's Important

- Skin conditions appear similar to non-experts
- Prevents incorrect self-treatment
- Facilitates early intervention

## Why It's Challenging

- Subtle color and texture differences
- Variable lighting and angles
- Skin tone diversity
- Multiple blemishes per face

## Current Solutions

- Manual dermatology inspection
- Low-accuracy mobile applications
- No reliable ML for segmentation + classification



# Project Task Description

Developing a robust two-stage pipeline for precise blemish analysis.

## The Problem:

Given a selfie image, detect all facial blemish regions and classify each into one of six predefined skin-condition classes

- **Acne** – pimples, inflamed bumps
- **Redness** – irritation or localized inflammation
- **Hyperpigmentation** – dark spots / discoloration
- **Dryness** – dry or flaky skin
- **Texture Issues** – uneven skin texture / enlarged pores
- **Scarring** – post-acne scars or indentations

## Input

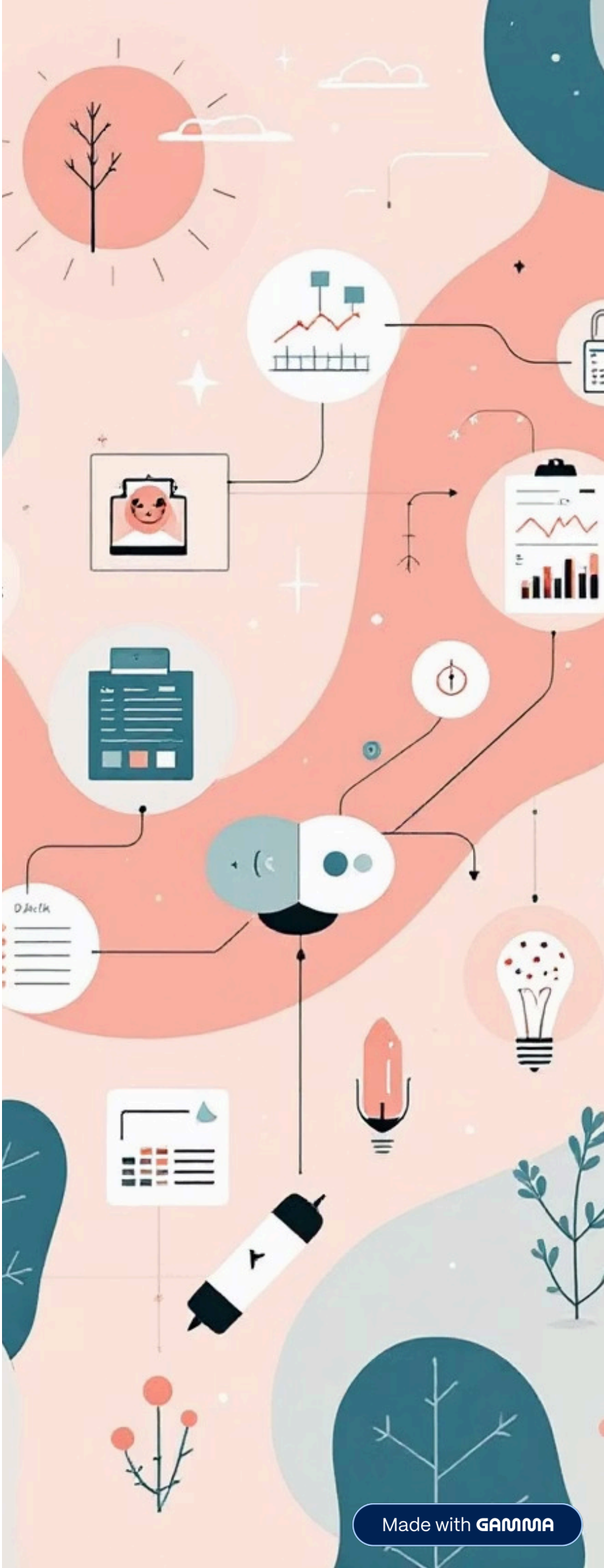
RGB selfie image

## Output

- Binary mask (blemish=1, normal skin=0)
- Extracted blemish regions
- Class label (6 classes)
- Facial location (forehead, cheeks, chin, nose)
- Short explanation + skincare suggestion

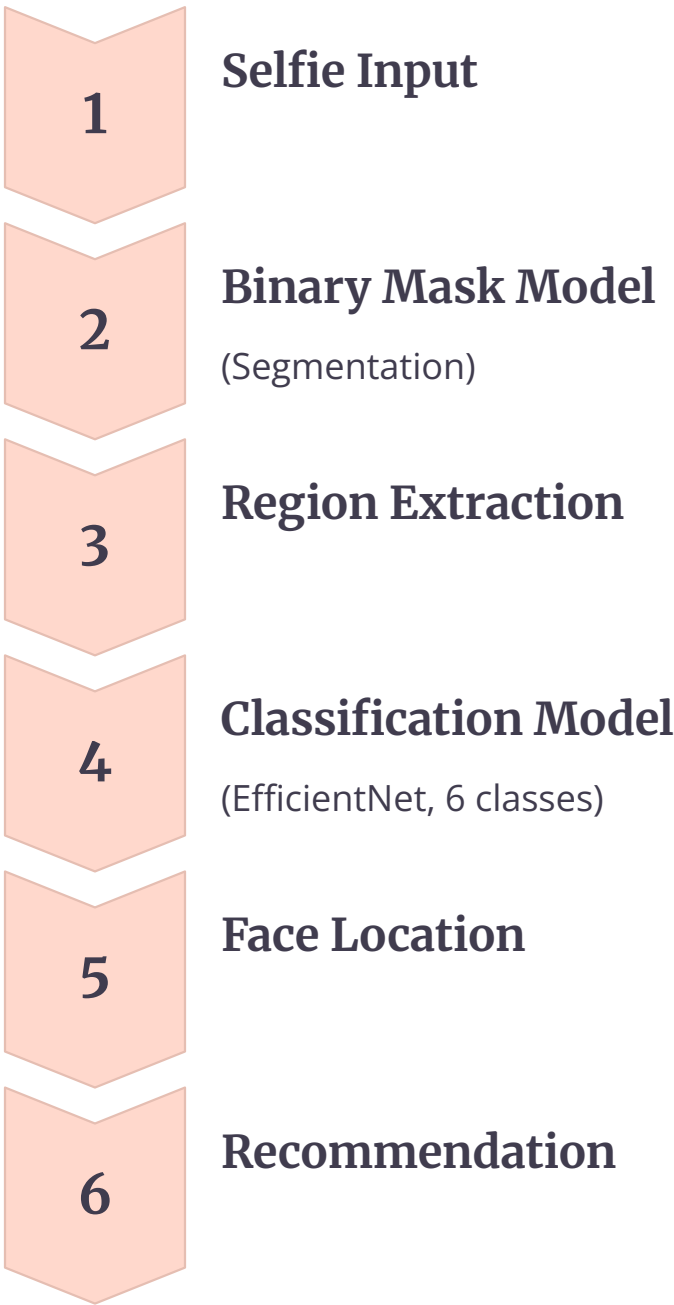
## Novelty

- Two-stage pipeline (mask → region classification)
- Region-level predictions
- Synthetic data for balanced training



# Models & Methods

A cascaded approach integrating segmentation and classification for enhanced accuracy.



**Segmentation Model**  
Generates the initial binary mask.

**EfficientNet Classifier**  
Specialized for 6 distinct skin condition classes.

Fine-tuning and adjustments:

- Adaptive threshold tuning
- Extensive data augmentation
- Hybrid training: synthetic + real data
- Validation exclusively on real-world data

# Data Specification & Generation

Constructing a robust dataset through real-world collection and synthetic expansion.

## Real Seed Data

~20 clean faces per class. Provides foundational real-world examples for model training.

## Synthetic Data

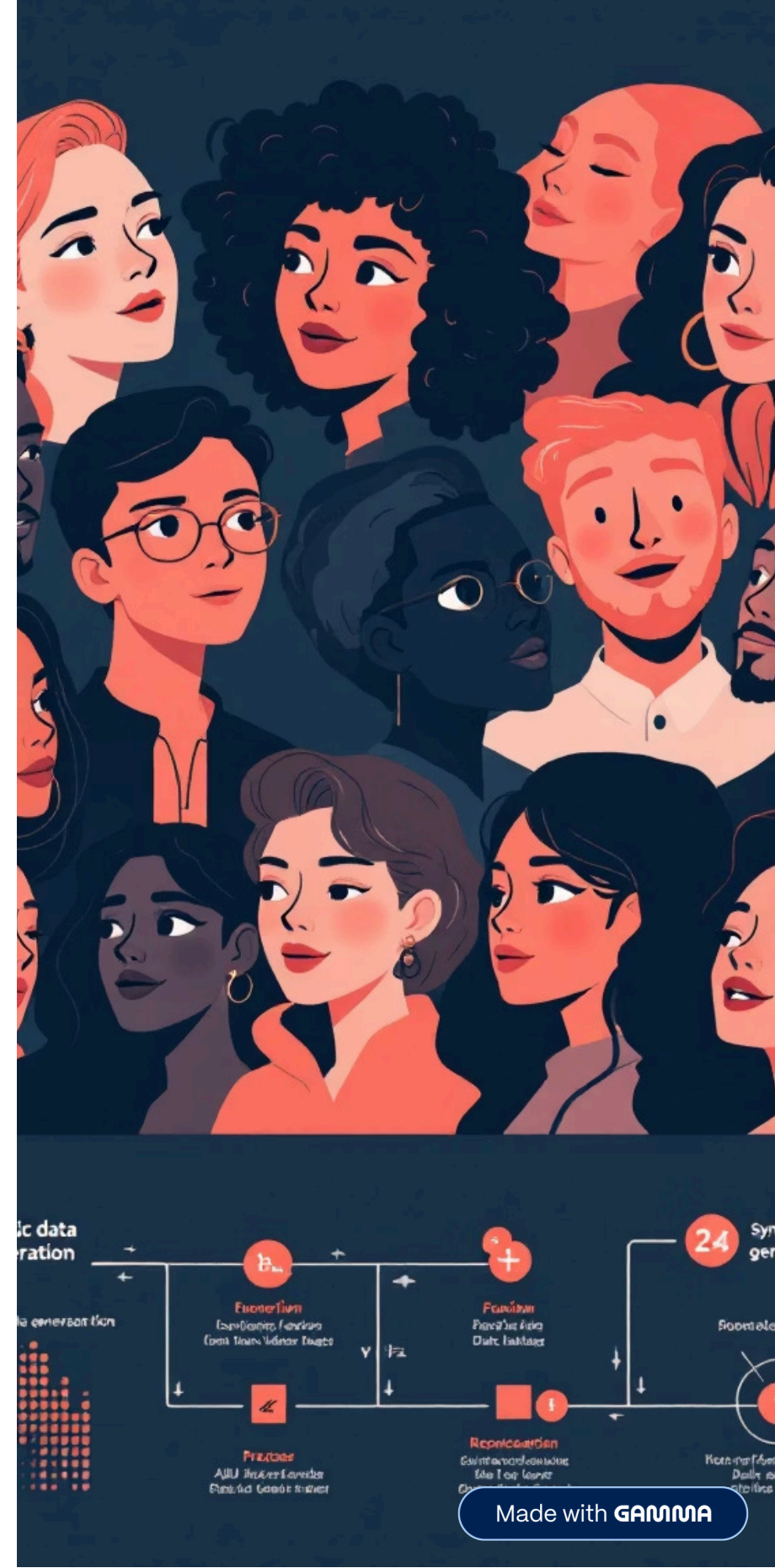
~1000 samples per class. Generated via inpainting and full-image generation to ensure class balance and diversity.

## Real Evaluation Set

100% real images, meticulously annotated with masks and class labels. Used for unbiased performance assessment.

### Dataset Requirements:

- Balanced class distribution
- High variation in lighting, skin tone, angle, and severity





# Metrics & KPIs

Rigorous evaluation to ensure model efficacy and reliability.

## Detection Metrics

- Intersection over Union (IoU)
- Dice Score
- Pixel Accuracy

## Classification Metrics

- Accuracy
- Precision / Recall / F1-Score
- Confusion Matrix analysis

## End-to-End Metrics

- Correct detection + correct classification per region
- Percentage of blemishes correctly identified per face

## Evaluation Protocol

- 80/20 Train/Validation Split
- Testing exclusively on real images
- Ground truth: manually annotated masks and labels

