Project Proposal Report

Acne Detection & Classification

Survey & Plan

Course	영상처리 (Image Processing)
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1 About Our Team

Our team, Team 08 – **[Team GLOPIX]** - blend of Global + Pixels, meaning diverse people analyzing pixels together, is a global group consisting of four members: three Korean students (김성민, 류수정, and 전지민) and 태아카, an international student serving as the team leader.

Despite our diverse backgrounds, we maintain a strong spirit of open communication and mutual respect, ensuring smooth collaboration across different ideas and perspectives. Our teamwork is grounded in clear task division, consistent progress sharing through Notion, and regular discussions to refine our approach. By combining technical expertise and creative problem-solving, we aim to build an inclusive and well-organized environment where every member contributes meaningfully to the project's success.

2 About Our Topic

The program we propose detects acne in photographs of human skin. Acne is a key indicator with uses that extend beyond simple skin concerns in modern contexts. Accurate detection and analysis of acne regions serves as an essential preprocessing step for dermatological diagnosis, skin-whitening effects in Photoshop workflows, cosmetic recommendations, and beauty-tech services. However, conventional face-detection models generally fail to distinguish fine skin textures such as acne. To address this limitation, we develop an acne-detection program.

In brief, the implementation relies on YCrCb and HSV rather than RGB, which is poorly suited to acne detection. While human skin is broadly similar, its appearance in RGB varies with brightness, lighting, and shadows. Processing in RGB therefore becomes cumbersome, whereas YCrCb mitigates this by separating luminance (Y) from chrominance (Cr, Cb). As a result, Cr and Cb remain stable even when brightness changes, enabling reliable separation of skin and reddish areas.

We then detect acne by identifying red peaks in HSV, which is better for isolating specific colors. By separating color information through the H (hue) channel, HSV improves color selectivity. Finally, candidate regions are judged as acne or not based on their approximate circularity.

These core functions support multiple applications. In Photoshop-style workflows, the system can reduce or correct the appearance of acne. In clinical settings, it can assist as a medical tool to estimate lesion size and track progression. More broadly, it can be extended to identify not only acne but other skin problems as well.

3 Development Plan

Our implementation plan is based on a color-space and shape-based approach that allows acne regions to be precisely isolated without relying on deep learning models. The system is implemented entirely in OpenCV (Python) and proceeds through the following pipeline:

(1) BGR → YCrCb Conversion (Skin Mask Generation): We first convert the input image from the standard BGR color space to YCrCb, which separates brightness (Y) from chrominance (Cr, Cb). By applying a threshold range to the Cr and Cb channels, we can generate a skin mask that filters out non-skin regions such as hair or background. This step ensures that later processing focuses only on skin areas.

(2) BGR → HSV Conversion (Red Peak Detection): Within the extracted skin area, we convert the image to HSV color space to analyze hue distribution. Acne typically appears as reddish peaks in the Hue histogram. By locating and thresholding these peaks, we create a candidate acne mask that highlights areas of potential acne lesions.

(3) Morphological Processing and Gaussian Blur: To eliminate isolated noise pixels and refine the acne candidate regions, we apply morphological opening/closing operations followed by a Gaussian Blur. This step smooths the mask boundaries and enhances continuity in the detected regions.

(4) Contour Analysis – Area, Circularity, and Boundary Contrast (Lab): Each connected region (contour) in the mask is analyzed by: **Area filtering**: removing overly small or large blobs. **Circularity index**: ensuring lesions are roughly circular, consistent with acne morphology. **Boundary contrast (Δa^*) analysis**: comparing color difference between inner and outer rings in L*a*b* space to verify redness intensity and lesion edge clarity. Only regions meeting these conditions are classified as acne.

(5) Overlay Visualization and Final Scoring: Finally, we overlay the detected acne contours on the original image for intuitive visualization. A quantitative acne score is computed using metrics such as lesion count, average redness intensity, and total affected area. These outputs are displayed to the user and can later be used for progress tracking or integration with auxiliary classifiers.

4 Future Development Direction

Our object is to integrate Auxiliary skin disease classifiers into the acne-detection pipeline as extensively as possible in order to achieve various necessary goals such as,

A. Clinical Decision Support: Add an "Auxiliary disease classifier (acne vs folliculitis vs contact dermatitis vs seborrheic dermatitis, .. etc)" that outputs per-class probabilities alongside acne detection, so individuals can obtain medical reference information without visiting a hospital. (This module is for only and not a diagnostic device.)

B. Severity and Progress Tracking: Track lesion count, mean score, and max score over time for the same subject and visualize trends. When worsening exceeds a threshold, display a consult-dermatologist cue. This can provide self care guidance

C. Application Integration and Reporting: Generate before/after reports for skincare routines, product A/B trials, JSON for research, and a concise PDF for users.

5 Project Timeline & Process

Our team follows a structured and hybrid collaboration approach to maintain steady progress and effective communication. We combine in-person meetings after class with online Zoom sessions on weekends, enabling both convenience and inclusivity for all members, including the international student. To manage work efficiently, we utilize Notion for task planning and progress documentation, and GitHub for source code management and version control.

A. Communication Tools and Workflow – (1) Notion: Used for task assignment, scheduling, and weekly progress tracking. Each milestone is documented with assigned responsibilities and completion notes. **(2) GitHub:** Serves as the main platform for collaborative coding, version control, and issue tracking. **(3) Hybrid Meetings: In-person:** Held immediately after class for quick discussions and weekly reviews. **Online (Zoom):** Conducted during weekends to coordinate tasks and resolve implementation issues. Through this mixed approach, we ensure consistent communication, efficient decision-making, and accessibility for all team members.

B. Project Timeline.

Phase	Period	Objectives
Planning & Topic Selection	Oct 28 – Nov 4	Team formation, brainstorming, and submission of Survey & Plan report
Research & Initial Design	Nov 5 – Nov 18	Literature review and prototype design using color space and morphology methods
Implementation & Testing	Nov 19 – Nov 29	Code development, debugging, and source code submission
Finalization & Presentation	Nov 30 – Dec 6	Report writing, slide preparation, and presentation rehearsal
Final Presentation	Dec 11	In-class demonstration and evaluation

Figure 1: Project timeline and milestones.

C. Progress Tracking and Collaboration: Each week, progress is reviewed through Notion updates and brief after-class check-ins. While the team leader organizes the summary of tasks and upcoming goals, all team members actively remind and support one another to stay on track and maintain consistent progress. This mutual accountability helps the team identify challenges early, distribute workload fairly, and ensure that every milestone is achieved on time. Through this collaborative workflow, Team GLOPIX maintains clear communication, regular updates, and cooperative problem-solving, ensuring steady progress toward the final deliverables.

Acknowledgments

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