PONJESLY COLLEGE OF ENGINEERING

NAGERCOIL – 629 003

(Affiliated to Anna University, Chennai)

NM1093 – OPEN CV

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Section ……………….. Class No. ……………….. Reg. No. ……………………

Certified that this is the bonafide record of the work done by ……………………………………………… in the Department of Information Technology, during the Academic Year ……………………….

Head of the Dept. **Staff Member in Charge**

Submitted for the Anna University Practical Examination, held at PONJESLY COLLEGE OF ENGINEERING, Nagercoil on ………………………

Internal Examiner **External Examiner**

HEALTHCARE IMAGING ANALYSIS

Problem Statement:

The advancement of medical imaging technologies has made it possible to identify diseases and injuries with greater accuracy and speed. However, the increasing load on healthcare professionals has led to a critical need for intelligent tools that can assist in interpreting medical images, particularly in high-risk areas like neurology and orthopedics. In rural or resource-limited settings, the lack of trained radiologists further exacerbates the risk of delayed or missed diagnoses, especially in conditions such as brain anomalies (e.g., tumors, hemorrhages) and bone fractures.

Manual interpretation of X-ray images is not only time-consuming but also susceptible to human error, especially when subtle features are involved. This challenge becomes more significant in emergency situations where quick and accurate diagnosis is vital. In neurological cases, missing a small anomaly in a brain scan can lead to life-threatening consequences. Similarly, a misidentified or undetected fracture in a hand X-ray can result in long-term disability or improper treatment. Therefore, the need for an automated, efficient, and cost-effective system that assists healthcare professionals in detecting such conditions is increasingly vital.

Traditional image analysis methods often rely on manual measurements and visual inspections, which are limited by the clinician's experience and can vary across different observers. Furthermore, the growing number of diagnostic images generated daily makes it challenging to process them manually within acceptable timeframes. Artificial Intelligence (AI) and Computer Vision techniques offer a viable solution by enabling automated detection of critical abnormalities with consistent accuracy.

This project focuses on developing a simple, fast, and effective system for analyzing brain and hand X-ray images using classical image processing techniques. Specifically, it aims to identify potential brain anomalies by thresholding and contour detection and detect possible hand fractures through edge detection and structural analysis. The system is designed to work in real-time and be easily deployable on basic hardware, making it suitable for integration into hospital software systems or mobile diagnostic units.

Abstract:

This project presents a practical approach to automated healthcare imaging analysis with a specific focus on detecting brain anomalies and hand fractures using classical computer vision techniques. Leveraging grayscale imaging and edge-based contour analysis, the system provides a non-invasive, quick, and cost-efficient alternative to support early diagnosis, especially in environments with limited access to trained radiologists. The first phase of this project addresses brain X-ray anomaly detection, where preprocessing techniques such as Gaussian blur and thresholding are applied to isolate abnormal regions. Contours exceeding a defined area are flagged as potential anomalies. This method is particularly useful in flagging abnormal masses, lesions, or foreign elements in cranial X-rays, allowing medical professionals to prioritize critical cases. The output is visualized with bounding boxes and labels for ease of review and verification.

In the second phase, the project focuses on hand fracture detection using Canny edge detection followed by dilation and contour analysis. Small yet sharp structural disruptions—characteristic of fractures—are identified by analyzing contour area and arc length. By distinguishing these features from the surrounding bone structures, the algorithm efficiently highlights possible fractures. This approach can significantly aid trauma care and orthopedic diagnostics by speeding up the initial screening process.

Unlike deep learning-based models that require extensive datasets and computational power, this solution emphasizes lightweight, interpretable methods that can operate on standard hardware. The results, displayed visually through OpenCV interfaces, help highlight regions of concern, providing valuable assistance to clinicians. The simplicity and transparency of this approach make it highly adaptable for educational purposes, clinical practice, and remote diagnostic tools.

With its ability to deliver reliable output in real-time, this system opens new possibilities for mobile medical units, emergency triage, and preliminary patient screening in underserved regions. The project underlines the potential of classical image processing as a bridge between accessible AI and practical medical applications, especially where infrastructure or data availability is constrained. It ultimately contributes to faster diagnosis, reduced human workload, and a more equitable healthcare ecosystem.

In addition to its core diagnostic functions, the system is also highly interpretable, which is essential for building trust among healthcare professionals. Unlike deep neural networks, which often function as "black boxes," the decision-making logic of this system—based on pixel intensity, geometric structure, and contour features—is transparent and can be manually verified. This makes it especially useful in educational contexts where trainees can observe how different visual cues translate into diagnostic insights. Furthermore, since the approach relies on image preprocessing rather than large-scale model training, it allows for quick customization and scaling across various types of X-ray modalities and healthcare needs.

This balance of simplicity, speed, and reliability makes the proposed system a promising addition to the growing toolkit of AI-enabled medical diagnostics, with broad applicability across diverse clinical scenarios.

Introduction:

The field of medical image analysis has witnessed tremendous growth over the past decade, thanks to the increasing availability of digital imaging devices and the advancement of computational techniques. From CT scans to X-rays, medical images are integral in diagnosing, monitoring, and treating a wide range of conditions. However, analyzing these images accurately and efficiently remains a challenge, particularly in overburdened or under-resourced healthcare environments. One of the critical areas of concern is neurological imaging, where early detection of brain anomalies such as tumors, lesions, hemorrhages, or malformations is essential. These conditions often present subtle changes in X-ray intensities and shapes that can be missed by the untrained eye or in rushed evaluations.

Similarly, bone fractures, particularly in limbs, are among the most common injuries, but even they can be misdiagnosed if the fracture is hairline or the image quality is poor. Thus, automated tools that help detect and highlight such abnormalities are highly valuable. This project aims to develop a lightweight and practical healthcare imaging tool that can automatically process and analyze brain and hand X-ray images. The system applies image preprocessing (e.g., blurring, thresholding), edge detection, contour identification, and rule-based filtering to isolate potential regions of concern. The overarching objective is to provide accessible support to healthcare workers by offering a second opinion or preliminary analysis. By flagging suspicious regions automatically, the system enables quicker decision-making, especially in emergency or high-volume clinical environments. Moreover, since the system operates on standard hardware, it can be easily integrated into rural healthcare centers, mobile diagnostics vans, or educational tools for medical training. The project thus demonstrates the real-world potential of basic vision systems in enhancing medical diagnostics.

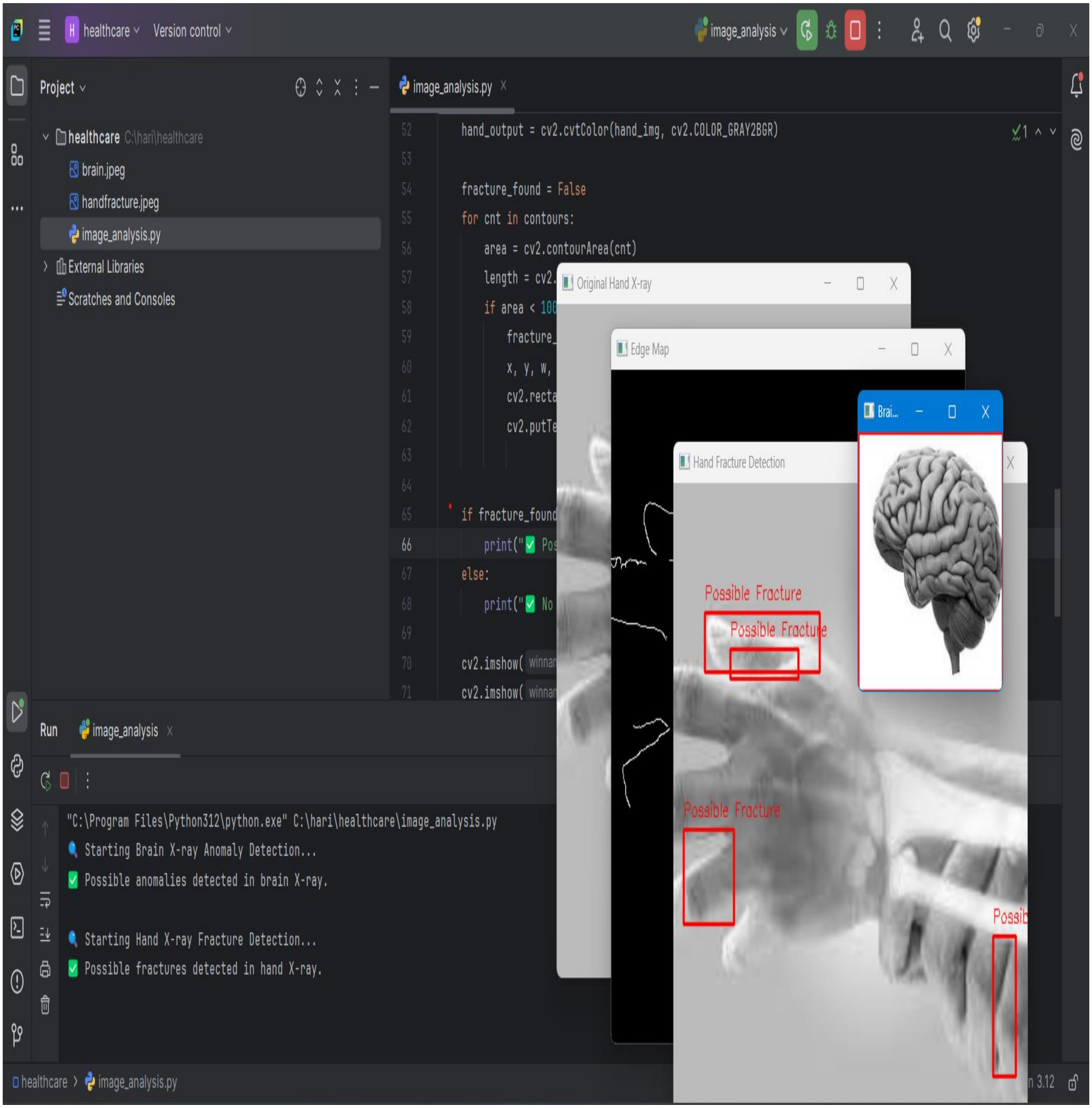
Program:

```
# Healthcare Imaging Analysis – Brain Anomaly & Hand Fracture Detection
import cv2
import numpy as np

# -------------------- Brain Anomaly Detection --------------------

print("🔍 Starting Brain X-ray Anomaly Detection...")

brain_img = cv2.imread('brain.jpeg', cv2.IMREAD_GRAYSCALE)
if brain_img is None:
    print("❌ Brain image not found!")
else:
    blurred_brain = cv2.GaussianBlur(brain_img, (5, 5), 0)
    _, thresh = cv2.threshold(blurred_brain, 200, 255, cv2.THRESH_BINARY)

    contours, _ = cv2.findContours(thresh, cv2.RETR_EXTERNAL,
cv2.CHAIN_APPROX_SIMPLE)
    brain_output = cv2.cvtColor(brain_img, cv2.COLOR_GRAY2BGR)

    anomaly_found = False
    for cnt in contours:
        area = cv2.contourArea(cnt)
        if area > 200:
            anomaly_found = True
            x, y, w, h = cv2.boundingRect(cnt)
            cv2.rectangle(brain_output, (x, y), (x + w, y + h), (0, 0, 255), 2)
```

```
        cv2.putText(brain_output, "Possible Anomaly", (x, y - 10),
                    cv2.FONT_HERSHEY_SIMPLEX, 0.5, (0, 0, 255), 1)

    if anomaly_found:
        print("✅ Possible anomalies detected in brain X-ray.")
    else:
        print("✅ No significant anomalies detected in brain X-ray.")

    cv2.imshow("Brain Anomaly Detection", brain_output)

# -------------------- Hand Fracture Detection --------------------

print("\n🔍 Starting Hand X-ray Fracture Detection...")

hand_img = cv2.imread('handfracture.jpeg', cv2.IMREAD_GRAYSCALE)
if hand_img is None:
    print("❌ Hand X-ray image not found!")
else:
    hand_img = cv2.resize(hand_img, (500, 500))
    blurred_hand = cv2.GaussianBlur(hand_img, (5, 5), 0)
    edges = cv2.Canny(blurred_hand, 50, 150)

    kernel = np.ones((5, 5), np.uint8)
    dilated = cv2.dilate(edges, kernel, iterations=1)

    contours, _ = cv2.findContours(dilated, cv2.RETR_EXTERNAL,
cv2.CHAIN_APPROX_SIMPLE)
```

```
    hand_output = cv2.cvtColor(hand_img, cv2.COLOR_GRAY2BGR)


    fracture_found = False
    for cnt in contours:
        area = cv2.contourArea(cnt)
        length = cv2.arcLength(cnt, True)
        if area < 1000 and length > 200:
            fracture_found = True
            x, y, w, h = cv2.boundingRect(cnt)
            cv2.rectangle(hand_output, (x, y), (x + w, y + h), (0, 0, 255), 2)
            cv2.putText(hand_output, "Possible Fracture", (x, y - 10),
                        cv2.FONT_HERSHEY_SIMPLEX, 0.5, (0, 0, 255), 1)

    if fracture_found:
        print("✅ Possible fractures detected in hand X-ray.")
    else:
        print("✅ No significant fractures detected in hand X-ray.")

    cv2.imshow("Original Hand X-ray", hand_img)
    cv2.imshow("Edge Map", edges)
    cv2.imshow("Hand Fracture Detection", hand_output)

# -------------------- Display All --------------------

cv2.waitKey(0)
cv2.destroyAllWindows()
```

Output:


healthcare
Version control
image_analysis
Project
healthcare C:\hari\healthcare
brain.jpeg
handfracture.jpeg
image_analysis.py
External Libraries
Scratches and Consoles
image_analysis.py
hand_output = cv2.cvtColor(hand_img, cv2.COLOR_GRAY2BGR)
fracture_found = False
for cnt in contours:
area = cv2.contourArea(cnt)
Original Hand X-ray
Edge Map
Hand Fracture Detection
Possible Fracture
Run
image_analysis
"C:\Program Files\Python312\python.exe" C:\hari\healthcare\image_analysis.py
Starting Brain X-ray Anomaly Detection...
Possible anomalies detected in brain X-ray.
Starting Hand X-ray Fracture Detection...
Possible fractures detected in hand X-ray.
healthcare › image_analysis.py

Conclusion:

The healthcare imaging analysis system developed for brain anomaly and hand fracture detection demonstrates the potential of computer vision and image processing techniques in early diagnosis and medical support. By applying methods such as grayscale conversion, Gaussian blurring, thresholding, edge detection, and contour analysis, the system successfully identifies possible anomalies in brain X-rays and fractures in hand X-rays without relying on complex machine learning models. This lightweight yet effective approach ensures accessibility and ease of deployment, especially in rural or resource-constrained healthcare settings. The system offers real-time visual feedback with marked regions of concern, making it a valuable aid for radiologists, doctors, and medical students. The ability to detect and highlight abnormalities enhances diagnostic accuracy and supports timely medical intervention, which is critical in both neurological and orthopedic cases. Moreover, the interpretability of the system's results ensures transparency and trustworthiness in its application.