# IMAGE DETECTION ANALYSIS OF INTELLIGENT DIAGNOSTIC SYSTEM FOR THROAT RELATED SYMPTOM THROUGH FEATURE EXTRACTION VIA MATLAB

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**ABSTRACT:** In this paper, we propose the diagnosis of throat symptoms in children through image analysis using the marking of Regions of Interest (ROI) and feature extraction. By utilizing common endoscopic cameras, images of children's throats are captured and transferred to MATLAB software for analysis. The analysis consists of measuring contrast, RGB (Red, Green, and Blue) channels, and quality evaluations. These evaluations aim to identify the image quality for further analysis. ROIs are then marked to highlight throat conditions such as redness, and feature extraction is applied to identify abnormal patterns present in the throat. Real-life testing is compared with virtual throat images for performance evaluation. This paper aims to facilitate the diagnosis of throat-related symptoms, making it easier for physicians to interpret. The experiment also aims to evolve traditional methods by incorporating virtual analysis.

**KEYWORDS**: *Throat, Images Analysis, Children ,Regions of Interest (ROI) , Feature Extractions.*

## 1.0 INTRODUCTION

Throat infections are a significant health concern in children aged 1-10 years, often leading to discomfort and numerous healthcare visits. These infections are caused by various pathogens, including viruses, bacteria, and fungi, each presenting with distinct symptoms and throat findings. Common throat-related diseases in children include viral pharyngitis, strep throat, infectious mononucleosis, hand, foot, and mouth disease, croup, whooping cough, laryngitis, and tonsillitis [7] . These conditions manifest through symptoms such as sore throat, coughing, hoarseness, difficulty swallowing, and swollen glands, often accompanied by fever. Viral pharyngitis typically reveals redness and swollen tonsils, sometimes with white patches. Strep throat, caused by Streptococcus bacteria, is characterized by red, swollen tonsils with white patches or streaks of pus. Infectious mononucleosis, often caused by the Epstein-Barr virus, leads to swollen lymph nodes and is marked by red, swollen tonsils with a white or yellow coating and petechiae on the palate. Hand, foot, and mouth disease, commonly resulting from Coxsackievirus, presents with small red spots or ulcers in the throat and mouth [8,9] .

Advanced techniques in medical imaging and analysis are increasingly being applied to the diagnosis of throat infections in children. By analyzing the color intensity and specific features of throat images, such as the presence and pattern of redness, swelling, and white patches, it is possible to enhance the accuracy of diagnoses and monitor the progression of diseases. Studies have shown that color analysis can be an effective tool in identifying the severity and type of throat infection. For instance, [1] demonstrated that machine learning algorithms using color intensity metrics could differentiate between viral and bacterial infections with high accuracy. Other studies have explored the use of digital imaging and spectral analysis to identify characteristic features of various throat infections. For example, [2] utilized hyperspectral imaging to detect specific color patterns associated with different pathogens, enhancing the precision of diagnostic tools used in pediatric care. The integration of these advanced imaging techniques with clinical evaluations could significantly improve the early detection and management of throat infections in children, reducing the burden of these common ailments.

By focusing on the detection of color intensity and feature extraction from throat images, this research aims to develop more reliable and non-invasive diagnostic methods. Such advancements hold the potential to improve patient outcomes through quicker diagnosis, targeted treatments, and better monitoring of disease progression. In this paper, we propose an image detection method for pediatric cases that utilizes RGB color extraction to create Regions of Interest (ROIs), feature extraction to identify any abnormalities, and tonsil detection, all performed using MATLAB.

## 2.0 METHOD AND METHODOLOGY

Most of these diseases share common symptoms such as red spots, swollen tonsils, and ulcer patterns. In this paper, we use common endoscopic cameras for symptom detection. Test subjects include children and a virtual dataset of throat images. The analysis includes quality performance, contrast, and RGB extraction. Red and white Regions of Interest (ROIs) will be marked to highlight related symptoms, similar to the feature extraction process. Both sets of images will be analyzed using the same methods and compared for their performance.

Figure 1 : Healthy Throat

Figure 2 : Strep Throat

Figure 1 is an endoscopic image capture of healthy throat ( Real ) as no sign of related symptoms meanwhile Figure 2 is a strep throat ( Virtual ) from internet data set of strep throat that has redness.

### 2.1 Data Collection

A total of 20 children, aged 3-10, and 20 virtual throat images from internet datasets were collected. With the assistance of Hospital Besar Seremban (HTJ) and volunteers, additional data were acquired. Subjects included both genders, and only healthy throats were captured using real-time events. Therefore, virtual throat images focused on unhealthy throats. Using an endoscopic camera attached to smartphones, throat images were obtained. The captured images have a resolution of 720p (1280x720 pixels) and a field of view typically ranging from 60 to 70 degrees. Meanwhile, the virtual datasets varied in quality. Images were processed using MATLAB simulations.


Figure 3 : Endoscopic Camera attach to Smartphone

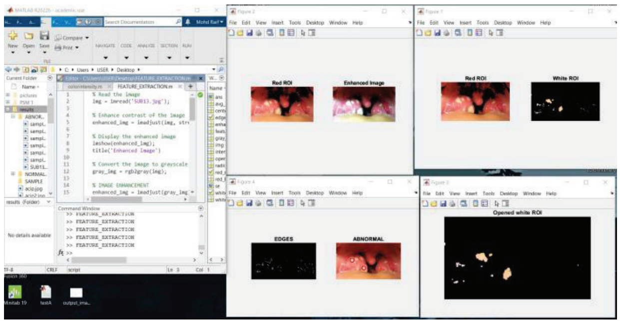



Figure 4 : MATLAB Simulations

### 2.2 Approach

After the images have been acquired, they need to be pre-processed to prepare them for analysis. One way to do this is by converting the images to grayscale format using a function in MATLAB. This reduces the number of dimensions in the image, making the analysis process faster. Secondly, extracting color intensity histograms captures the distribution of pixel intensities across different color channels before proceeding to feature extraction. This step helps identify the red and white Regions of Interest (ROIs) by undergoing RGB color extraction. The ROIs aim to highlight areas of infection or symptoms so that abnormalities can be detected and pointed out. During feature extraction, the throat images will undergo several steps of code to identify any abnormalities in the throat.

### 2.3 Grayscale Format

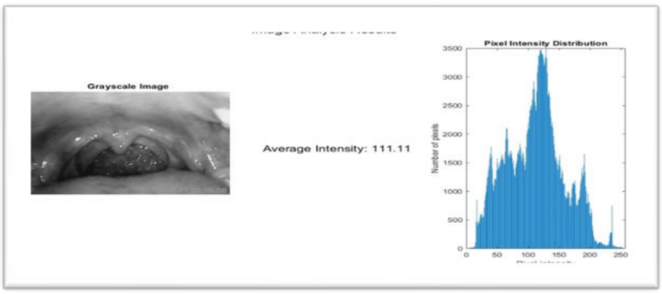



Figure 5: Calculated average grayscale and distribution of pixel intensity

This is the first step in the image processing. MATLAB successfully converts the image to grayscale format using standard image processing techniques, such as intensity averaging or color channel separation, without losing important details or introducing artifacts. Calculated average grayscale intensity and its distribution of pixel intensities are shown in Figure 5 . The results display the grayscale image, average grayscale intensity, and pixel distribution. The average intensity provides an overall measure of the brightness level, indicating how light or dark the image is on average. The pixel intensity distribution reveals the spread and concentration of pixel values, offering insights into the contrast and distribution of details in the image. These processes are helpful for identifying specific patterns or abnormalities in the image.

### 2.4 Image Enhance and Colour Extraction ( ROIs )

This step involves extracting color intensity histograms to capture the distribution of pixel intensities across different color channels. This process provides valuable insights into the color characteristics of the throat image, enhancing the understanding of the visual information present and potentially aiding in the detection and assessment of abnormalities or changes. By highlighting these Regions of Interest (ROIs), the analysis becomes more focused, reducing computational complexity and enabling targeted analysis of potential abnormalities.

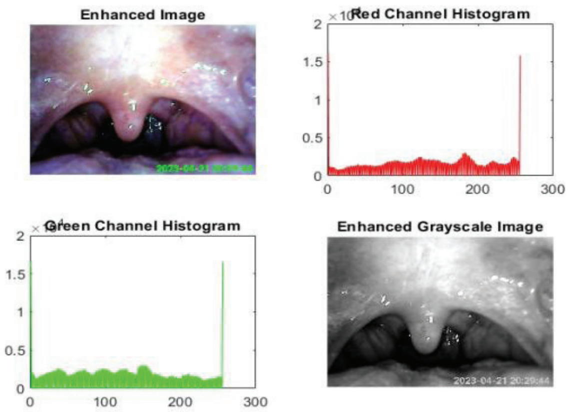



Figure 6 : Enhance images and Channel Histogram

Figure 6 shows the results of the process.


Figure 7 : ROIs Red and White results.

Performance of image segmentation based on intensity thresholds. It first creates a binary mask (red_mask) by comparing the grayscale image (gray_img) with a threshold value of for example 50. Pixels with intensities greater than 50 are set to 1, indicating potential regions of interest for red objects. Similarly, a higher threshold value of 200 is used to create a binary mask (white_mask) for potential white objects. The masks are then applied to the original image (img) using element-wise multiplication to isolate the regions of interest. The resulting red and white regions of interest in Figure 7 retain the pixels from the original image that passed the respective intensity thresholds. Using the [1 1 3] value in the repmat function replicates the binary mask along the third dimension, representing the RGB channels of the image. This ensures that the resulting ROI has the same size and channel information as the original image.

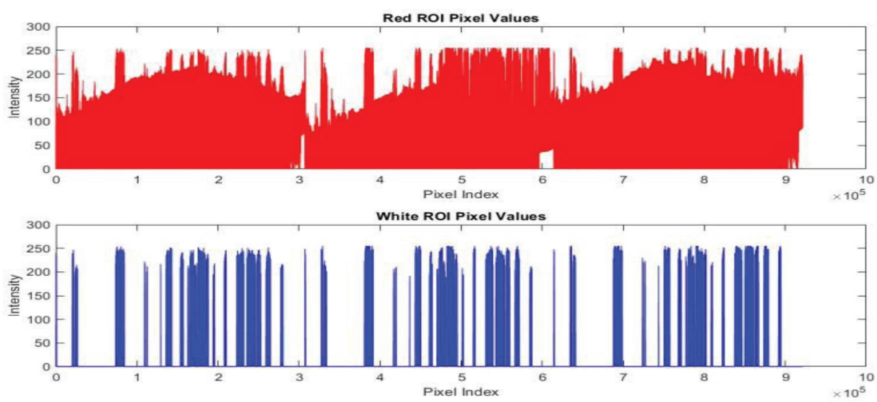



Figure 8: Red and White ROIs pixel values.

In Figure 8, it is evident why the red ROI is larger than the white ROI. The pixels in the red ROI have higher intensity values within the image, resulting in a larger, clearer ROI plot. This is also because, as shown in Figure 9 of the code, the red ROI is plotted when pixel intensities are above 50. In contrast, the white ROI only includes pixels with intensities above 200, resulting in fewer pixels and gaps in the plot. Consequently, this affects the results as shown in Figure 10 (White ROI).

## 2.5 Feature Extraction


Figure 9 : Results for Edges and Abnormal

The feature extraction process involves identifying distinctive features from the image that characterize and identify specific elements or patterns. In this project, abnormalities are identified using RGB data and ROI pixel values displayed in the image. Two feature extraction techniques are applied: edge detection and circle detection. The 'Canny' edge detection algorithm identifies edges in the white ROI mask, representing significant changes in intensity or color useful for identifying boundaries or regions of interest. The resulting edges are shown in the first subplot of the figure. Usage of 'imfindcircles' function detects circular shapes within the white ROI mask using the Hough transform, with a specified radius example of range (10 to 50 pixels). Detected circles are represented by their center coordinates and radii. These circles are overlaid on the original image using the 'viscircles' function, displayed in the second subplot of the figure. Figure 9 shows result of the feature extraction techniques and image analysis, providing insights into edges and circular patterns within the white ROI. The edge detection aims to identify patterns such as streptococcal pharyngitis, while abnormal extraction targets the detection of tonsil forms or other foreign objects.

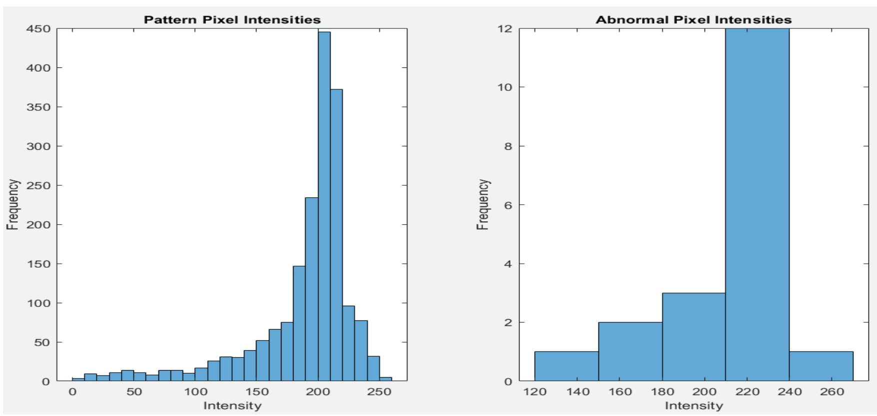


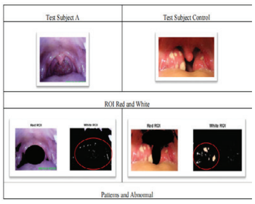
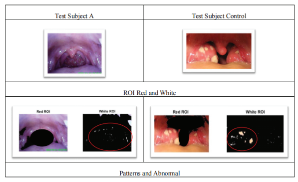
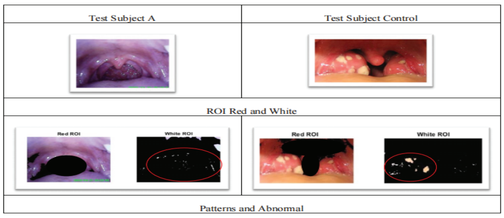
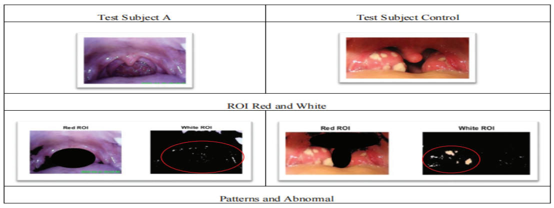
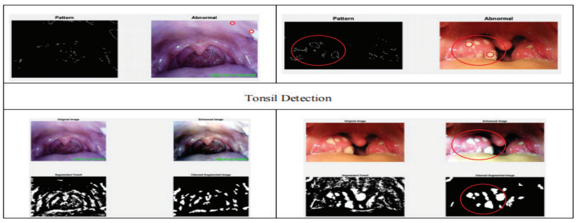
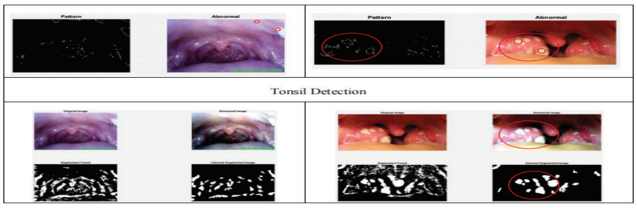

Figure 10 : Edge Intensity histogram contrast and Intensity characteristics

Figure 10 displays the histogram of edge intensity contrast and intensity characteristics. The circle radius histogram illustrates the size distribution of detected circles, while the circle count quantifies their number, assisting in object counting and assessing the density of circular elements. Consequently, this explains why the edge patterns appear random and inaccurate, influenced by reflected light that affects contrast intensity in the area. In contrast, abnormalities in circles tend to be more accurate when no foreign objects are detected. The low count and small radius of circles may be influenced by unclear image processing.

## 3.0 RESULTS

### 3.1 Performance Evaluations

Table 1 Test Subject Image Analysis (a),(b),(c) and Infection Throat Image Analysis (d) ,(e), (f)

<table>
<tr><th>Test Subject</th><th>Infection Throat</th></tr>
<tr><td><br>(a)</td><td><br>(d)</td></tr>
<tr><td colspan="2">Red and White ROI</td></tr>
<tr><td>
<br>(b)</td><td>
<br>(e)</td></tr>
<tr><td colspan="2">Patterns and Abnormalites</td></tr>
<tr><td>
<br>(c)</td><td>
<br>(f)</td></tr>
</table>

For this part, both test subjects were evaluated manually through side-by-side observation. This approach was chosen because the methods used aim to detect abnormalities, ROIs, and tonsils in throat images, all of which can be observed with the naked eye. Performance evaluation was conducted by comparing the results of Table 1 both images: Test Subject (a) and Infected Throat (b), which underwent feature extraction and tonsil detection methods. The purpose of this testing was to analyze the effectiveness of the image detection method on specific images containing all testing inputs, elucidating the working mechanism of the image analysis method.

In both cases (a) and (b), the analysis yielded satisfactory results. The regions of interest (ROIs) were accurately identified, allowing focused examination of specific areas in both cases (b) and (e). However, edge and abnormality detection in case (c) was unsuccessful, whereas in case (f), the edges and abnormalities followed the tonsil pattern, thereby highlighting the abnormality. Conversely, analysis of the Infected Throat image in Table 1 (d) demonstrated smoother performance. Both the red and white ROIs were accurately detected, enabling targeted examination of specific throat regions. Edge and abnormality detection in the image was partially successful, showing the approximate area. This indicates the software's capability to identify potential issues or anomalies with slight accuracy.

## 4.0 DISCUSSIONS AND CONCLUSIONS

The quality of an image, including factors such as resolution and lighting conditions, significantly impacts the accuracy of tonsil detection. High-quality images with clear RGB information provide better input for image processing algorithms [5] . Conversely, low-quality images may have degraded RGB information, making it more challenging to accurately detect tonsils and identify abnormalities or patterns [1,3].

The threshold value used in image processing algorithms is a critical parameter for accurate detection [4]. Careful selection of an appropriate threshold value is essential to avoid false positives and false negatives. A threshold set too low may include unnecessary regions, leading to false positives and vice versa. Adaptive thresholding techniques, which consider local image characteristics, show promise in improving ROIs detection accuracy [6] .

Achieving better detection accuracy requires consideration of both the quality of the input image, particularly its RGB information [5] , and the selection of an appropriate threshold value. Advances in adaptive thresholding techniques and ongoing research in medical imaging analysis contribute to developing more accurate detection algorithms .

In conclusion, to enhance the efficiency and effectiveness of software system, focus on improving image quality, determining precise threshold values, optimizing computational efficiency, and enhancing the user-friendly graphical interface. Addressing these areas will advance the system's capabilities, enabling accurate pediatric throat image analysis, efficient diagnosis, and facilitating ease of use for healthcare professionals.

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