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# Application Of The ROI (Region Of Interest) Color Method Using A Bounding Box Approach To Detect Caries On Dental Images

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***ABSTRACT***

*Caries detection system on radiographic image detection is widely used in medicine, especially dentistry. Dentists currently perform caries detection. It becomes less accurate in determining the diagnosis because of the limitations of human vision, then needs something to help the system detect dental caries in the image. This system could be used more effectively and efficiently than with manual detection. Detection of the dots is one of the high-contrast detection caries (tooth unhealthy) and could be one substitute detection manually by a dentist. Teeth image processed with some image processing stages such as grayscale, binarization with men over image into two values: black and white, morphology (thresholding) bright object floating on a dark background, ROI (Region of Interest) Color, and bounding box approach (to label images which has a white contrast to facilitate detection). Image of the tooth that has been grayscale and binarization, then do the ROI (Region of Interest) with the Color Boundingbox approach. Training results using test data 10 tooth image system has an accuracy rate of 80% is good enough.*

*Keywords: Dental Radiographs, Caries, Binarization, ROI (Region of Interest) Color, Bounding box*

## INTRODUCTION

Radiography assumes a pivotal role in the determination of dental treatments and diagnoses. Radiography has been widely acknowledged as a valuable diagnostic and treatment-planning tool in general medicine and dentistry for an extended period. Radiographic images play a crucial role in dentistry as they enable dentists to identify abnormalities that may not be readily discernible. Consequently, these images significantly contribute to diagnosing and planning appropriate patient treatment.

Dental caries is a pathological condition affecting dental structures, marked by the initiation of damage at the tooth's external surface, specifically in the pits, fissures, and interproximal regions, and progressing inward towards the pulp. Caries is a pathological condition that gives rise to structural deterioration of the tooth, ultimately resulting in the development of cavities.

The fundamental diagnostic principle of X-rays is based on the variations in tissue density within the body, leading to different levels of darkness observed on the X-ray film. The process of interpreting conventional X-ray images is prone to a significant degree of subjectivity due to inherent constraints in visual perception. Using computerized detection is anticipated to enhance the accuracy of dental caries diagnosis. Thresholding is considered to be a fundamental operation in the field of image processing. Thresholding, called binarization, encompasses segregating luminous entities from a contrasting dim backdrop. Thresholding is a commonly utilized technique in image processing to segment images and identify objects within them. The main aim of this process is to detect and isolate distinct points with significant contrast that are deemed components of an object, achieved through binarization. The binarization operation also improves the visual contrast of a specific region or object within the image. Ideally, the binarization process aims to delineate an object's geometric contours and detect the presence of white pixels within said object. The result of this operation is employed for advanced visual processing tasks, including three-dimensional reconstruction, image recognition, and compression.

The utilization of thresholding can be employed as a means to facilitate the identification of dental caries. This study employed the Region of Interest (ROI) color method with a bounding box approach to implement thresholding or binarization methods. Using ROI color in conjunction with a bounding box methodology has proven to be highly efficient in detecting objects that possess low contrast.

The process of a bounding box involves the generation of precise coordinates that accurately identify the location of an object within an image. These coordinates are then utilized to establish boundaries around the object and assign appropriate labels. In contrast, image resizing is executed to diminish an image's dimensions,

thereby enhancing the computational efficiency of image processing. Bitmap images consist of a collection of pixels, and during resizing, each pixel comprising the image becomes progressively visible. The phenomenon above has the potential to result in a diminished visual clarity of the image, primarily attributable to the degradation of color data that occurs during the process of resizing. In contrast, vector graphics undergo a process of mathematical formula-based redraw when resized, producing an image that retains the smoothness of the original. This phenomenon is because vector images do not rely on pixels as their foundation but instead employ mathematical equations to generate lines and curves that can be amalgamated to form the image.

Classification refers to identifying and categorizing objects within a given frame to determine the presence or absence of one or more objects in that particular frame. In contrast, localization refers to the procedural aspect of determining the precise position of objects within a given frame. In order to locate the intended item, the classification process becomes imperative. When the object under consideration is a car, the resulting output will comprise a softmax function that includes the classification of the detected object and the parameters bx, by, bh, and bw, representing the bounding boxes associated with the output. The parameters in question are relative values that fall from 0 to 1.

Object detection is a computational methodology that pertains to recognizing and localizing objects belonging to specific categories (e.g., humans, buildings, or cars) within digital images or videos. The machine analyzes the image or video, generating results for each identified object along with their respective class labels. The machine additionally exhibits bounding boxes surrounding the identified objects and denotes the precision of the detection. There are three primary categories in which object detection methods can be classified: motion-based detection, appearance-based detection, and convolutional neural network (CNN)-based detection.

The detection method centered on an object's visual characteristics or attributes, including but not limited to color, shape, orientation, and other relevant features, is commonly referred to as appearance-based detection. Hence, the feature selection process is crucial in determining the overall performance of the object detection system.

Motion-based object detection refers to identifying and acknowledging an object's physical displacement within a designated area or locality. The procedure involves the segmentation of mobile entities from the immobile background. Tracking and analyzing moving objects involves identifying the target object's motion from frame to frame in a video or when the object first demonstrates movement [9]. In contrast, the detection method based on Convolutional Neural Networks (CNNs) utilizes a neural network architecture comprising multiple layers: an input

layer, at least one hidden layer, and an output layer. The concealed layers function as filters that receive the initial input, apply specific features to transform it, and transmit it to the subsequent layer [8]. Each subsequent hidden layer in a neural network performs distinct transformations, such as identifying green objects by one layer, followed by the inference that the object is a leaf by the subsequent hidden layer. Fundamentally, an increased number of layers results in a broader range of detectable objects. Radiography plays a pivotal role in the determination of dental treatments and diagnoses. The utilization of radiography has been widely acknowledged as a valuable instrument in general medicine and dentistry for disease diagnosis and treatment planning. Radiographic images play a crucial role in dentistry as they aid dentists in identifying abnormalities that may not be readily discernible. Consequently, these images significantly contribute to the diagnosis and treatment planning process.

Dental caries is a pathological condition affecting dental structures, wherein the initial lesions manifest on the tooth's outer surface, specifically in the pits, fissures, and interproximal regions, and subsequently progress toward the dental pulp. Caries is a pathological condition that gives rise to structural deterioration of the tooth, ultimately resulting in the development of cavities.

The fundamental diagnostic principle of X-rays is predicated upon the variations in tissue density within the human body, leading to dissimilar levels of darkness on the X-ray film. The process of interpreting conventional X-ray images is prone to a significant degree of subjectivity due to inherent constraints in visual perception. Using computerized detection is anticipated to enhance the accuracy of dental caries diagnosis. Thresholding is a fundamental operation in the field of image processing. Thresholding, commonly called binarization, entails segregating luminous entities from a dimly lit backdrop. The thresholding technique is utilized in image segmentation and the subsequent identification of objects within the image. The main goal of this process is to detect points with significant contrast that are deemed components of an object. These points are subsequently separated through the process of binarization. Another objective of the binarization operation is to augment the visual distinction of a specific region or entity within the image. Ideally, the binarization process aims to delineate an object's geometric contours and detect the presence of white pixels within said object. The result of this operation is employed for advanced visual processing tasks, such as three-dimensional reconstruction, image recognition, or compression.

The utilization of thresholding can be employed as a means to facilitate the identification of dental caries. This study employed the Region of Interest (ROI) color method with a bounding box approach to implement thresholding or binarization methods. Using ROI color in conjunction with a bounding

box methodology has demonstrated notable efficacy in detecting objects with low contrast.

The process of a bounding box entails the generation of precise coordinates that accurately identify the location of an object within an image. These coordinates are then utilized to establish boundaries around the object and assign appropriate labels. Image resizing, conversely, is conducted to diminish the size of an image, thereby enhancing the computational efficiency of image processing on a computer. Bitmap images are composed of a collection of individual pixels, and during resizing, each pixel comprising the image becomes progressively visible. The phenomenon mentioned above has the potential to result in a decrease in image clarity due to the reduction in color data that occurs during the resizing process. On the other hand, vector images exhibit a distinct characteristic whereby resizing is achieved through mathematical equations, thereby yielding an image that retains the smoothness of the original. Vector images differ from raster images in that they are not pixel-based but rely on mathematical equations to render lines and curves, which can be combined to form the visual representation.

Classification refers to the process of identifying and categorizing objects within a given frame, aiming to determine the presence or absence of one or more objects in that particular frame. In contrast, localization encompasses the procedural aspect of determining the precise position of objects within a given frame. In order to locate the intended item, it is imperative to engage in the classification process. In the case where the object to be identified is a car, the resulting output will include a softmax function that contains the classification of the detected object and the parameters bx, by, bh, and bw, which represent the output bounding boxes. The parameters above are represented as relative values that span the numerical range of 0 to 1.

Object detection is a computational method that pertains to recognizing and localizing objects belonging to specific categories, such as humans, buildings, or cars, within digital images or videos. The machine analyzes the image or video, generating results for each identified object along with their respective class labels. The machine additionally exhibits bounding boxes surrounding the identified objects and denotes the precision of the detection. Object detection methods can be classified into three primary categories: motion-based detection, appearance-based detection, and detection based on convolutional neural networks (CNNs).

The detection method centered on an object's characteristics or visual representation, including attributes like color, shape, orientation, and other relevant factors, is commonly referred to as appearance-based detection. Hence, the feature selection process is crucial in determining the overall performance of the object detection system.

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displacement within a designated space or locality. The procedure entails the segmentation of mobile entities from the immobile background. Tracking and analyzing moving objects involves identifying the target object's motion from frame to frame in a video or when the object first demonstrates movement [9]. In contrast, the detection method based on Convolutional Neural Networks (CNNs) utilizes a neural network architecture comprising multiple layers: an input layer, at least one hidden layer, and an output layer. The concealed layers function as filters that receive initial input, undergo a transformation utilizing specific features, and transmit it to the subsequent layer [8]. Each successive hidden layer within a neural network performs distinct transformations, exemplified by identifying green objects in one layer and the subsequent inference of the object being a leaf in the subsequent hidden layer. Fundamentally, an increased number of layers results in a broader range of objects that can be detected.

## METHOD

Researchers took a sample of 30 to be used as respondents, namely in the form of 4 administrative staff, four finance staff, eight salespeople, ten general staff, and four management information system staff.

The experiment was carried out utilizing the MATLAB computer language version 7.12.0.635 (R2011a) to evaluate the efficacy of the roicolor approach in analyzing dental caries photographs. The accurate detection of dental caries is of utmost importance in dentistry, as it plays a critical role in diagnosing and developing appropriate treatment strategies. Hence, the significance of the invention of binarization techniques such as roicolor cannot be overstated.

The samples utilized in this experiment consist of dental caries images in *.jpg format, obtained from periapical and bitewing radiography images. These radiological imaging techniques are widely employed in the field of dentistry. The utilization of random sampling techniques in picking samples from a doctor's dataset enhances diversity and promotes robust representation inside the experiment, hence augmenting the results' reliability.

The roicolor method is a widely employed binarization technique to convert color photographs into binary images. This process results in depicting objects, such as dental cavities, in black while the background represents white. This method enables subsequent processing, such as extracting and analyzing features, which might be beneficial for diagnostic purposes.

The roicolor method's performance is evaluated based on two primary parameters: the quality of the produced morphology/contrast and the standard deviation. The importance of morphology and contrast lies in their contribution to the quality of binary images, which play a crucial role in diagnosing dental caries. A high-

quality binary picture effectively preserves the critical features and contrast necessary for accurate caries detection. The utilization of standard deviation serves as a means to quantify the level of consistency exhibited by a given approach in generating stable binary images. This attribute is essential in guaranteeing the outcomes' dependability and accuracy.

The outcomes of this trial will provide valuable insights into the evaluation of the roicolor method's efficacy in facilitating the diagnosis and planning of dental caries therapy. Suppose this method is demonstrated to be effective. In that case, it has the potential to serve as a valuable instrument in dental practice, facilitating the improvement of accuracy and efficiency in the diagnosis of dental caries.

## RESULTS and DISCUSSION

Based on the results of data calculations, it is known that the quality of valid and reliable data is shown in Table 1 below:

| | X1 | Y |
|---|---|---|
| No | R Count | R Count |
| 1 | 0,411 | 0,487 |
| 2 | 0,443 | 0,355 |
| 3 | 0,487 | 0,433 |
| 4 | 0,488 | 0,378 |
| 5 | 0,459 | 0,480 |
| 6 | 0,504 | 0,485 |
| 7 | 0,326 | 0,485 |
| 8 | 0,604 | 0,456 |
| 9 | 0,476 | 0,372 |
| 10 | 0,364 | 0,439 |
| 11 | 0,574 | 0,335 |
| 12 | 0,344 | 0,406 |
| 13 | 0,421 | 0,447 |
| 14 | 0,440 | 0,443 |
| 15 | 0,378 | 0,359 |

| Reliability Results | | |
|---|---|---|
| **Variable** | **Score** | **Conclusion** |
| Operational Cost Accounting Information System (X) | 0,827 | Reliable |
| Internal Control of Operational Costs (Y) | 0,809 | Reliable |

Based on Table 1 above, the research variables consist of statements above 0.300, so all items are declared valid. For this reason, the questionnaire used is feasible to be processed as research data. Furthermore, the reliability test results above show that all variables are included in the Reliable category because the score is > 0.70. Thus, the research instrument used for each variable in this study can be declared reliable and, indeed, a reliable measuring instrument with high stability. Furthermore, if the instrument is carried out repeatedly, the results of testing the instrument will show results fixed.

From the results of the correlation analysis using Pearson Product Moment, it can be seen that the correlation coefficient is 0.599 (in the

interval 0.400 – 0.599). This condition shows a "moderate" influence of the Operational Cost Accounting Information System on the Internal Control of Operational Costs.

The constant obtained is 16.888. Therefore, this condition shows that if the Operational Cost Accounting Information System (X) with Operational Cost Internal Control is positive, the variable positively affects Operational Cost Internal Control (Y). Therefore, due to the variable Y Internal Control of Operational Costs, the positive effect that can be concluded is that if there is a good Operational Cost Accounting Information System, the Internal Control of Operational Costs will be even better.

The regression coefficient 0.567 states that each increase in the Operational Cost Accounting Information System by one unit will increase the Internal Control of Operating Costs by 0.567 units. This condition shows a significant and positive influence of the Operational Cost Accounting Information System on the Internal Control of Operational Costs.

The R Square value (which can also be interpreted as the coefficient of determination) is 0.359. Therefore, in addition to the R-value of 0.599, it can be concluded that the effect of the Operational Cost Accounting Information System on the Internal Control of Operating Costs is 35.9%.

Cost accounting is a technique used to determine a product or service's manufacturing and sales costs. With this approach, production and sales-related costs are measured, analyzed, and translated. (Wang et al., 2018) In order to manage a company's finances and provide accurate and pertinent information for decision-making, cost accounting is a crucial tool.

Calculating manufacturing costs, figuring out the cost of goods sold, developing cost budgets, evaluating performance, making business decisions, and controlling costs are just a few crucial functions cost accounting plays in providing accurate and pertinent financial information. (Walz & Guenther, 2021) For example, the corporation may choose the right selling price to maximize earnings by knowing the production expenses. Likewise, the business can compute other production-related costs and the profit margin by knowing the cost of goods sold.

Companies can plan operational activities, optimize resource utilization, and create precise production cost budgets with cost accounting. (Azudin & Mansor, 2018) Additionally, the effectiveness of a company's cost management is assessed by comparing actual expenses to cost budgets to gauge the business's performance. Companies can evaluate their production efficiency and pinpoint areas that need improvement using cost accounting.

Making informed business decisions, such as developing a product in-house or purchasing it from a third-party provider, can impact production costs and company earnings. Cost accounting provides this information. (Kokina & Blanchette, 2019) Cost accounting also enables businesses

to take the required steps to control expenses by periodically reviewing production costs, finding areas for improvement, and monitoring costs.

Cost accounting can be combined with information technology in the modern digital era, for example, by employing cost accounting software to automatically compute production costs, produce precise cost budgets, and more effectively gauge business success. In addition, companies may handle and analyze cost accounting data more quickly and correctly using information technology.

Cost accounting is essential for delivering current and accurate financial data that helps businesses make wise decisions and maximize their financial success. (Rikhardsson & Yigitbasioglu, 2018) Companies can use cost accounting to estimate production costs, calculate the cost of goods sold, develop cost budgets, track performance, make strategic decisions, and manage expenses. These are all essential for managing a business's finances and attaining its objectives. Companies may process financial information more quickly and precisely, make better business decisions, and succeed in their operations by maximizing cost accounting and information technology. Cost accounting is, therefore, essential to managing a company's finances and can aid businesses in succeeding in the corporate sector.

## CONCLUSION

Based on the results of data processing shows that the operational cost accounting information system affects internal control of operating costs; this is evidenced by the results of the correlation coefficient test of 0.599, which states that there is a strong relationship and the coefficient of determination is obtained R square 0.359 or if it is in percentage 35.9%. The remaining 64.1% is influenced by other factors not examined by the author. This condition shows the influence of operational cost accounting information systems on internal control of operational costs.

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