ANALYZING THE COMPARATIVE METHODS OF PREWITT, ROBINSON, KRISCH AND ROBERTS IN DETECTING THE EDGES OF RICE LEAVES

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Abstract— *This research explores the vital role of rice in Indonesia as a staple food and primary source of income for farmers. Efforts are being made to increase rice production to meet the growing demand. The study focuses on object edge detection in image analysis, evaluating methods like Prewitt, Robinson, Krisch, and Roberts. Digital imaging plays a crucial part in visually presenting information, and image processing improves image quality for human and machine recognition. Detecting object edges, particularly in rice leaf images, is essential for computer inspection. The experiment on fifteen rice leaf images shows that the Krisch method performs better in edge detection, with a 52% average accuracy and smoothness. Other methods, such as Prewitt (6%), Robinson (11%), and Roberts (14%), have lower accuracy rates. These findings provide a foundation for enhancing edge detection in rice leaf image analysis. The study also emphasizes the need for refining classification models. Overall, this research provides insights into the effectiveness of edge detection methods in rice leaf image analysis.*

Keywords: *Krisch And Roberts, Prewitt, Robinson, , Rice Leaves.*

Intisari— *Penelitian ini membahasa peran penting beras di Indonesia sebagai makanan pokok dan sumber pendapatan utama bagi petani. Upaya dilakukan untuk meningkatkan produksi beras guna memenuhi permintaan yang terus meningkat. Studi ini berfokus pada deteksi tepi objek dalam analisis gambar, dengan mengevaluasi metode seperti Prewitt, Robinson, Krisch, dan Roberts. Imaging digital memainkan peran penting dalam menyajikan informasi secara visual, dan pengolahan gambar meningkatkan kualitas gambar agar dapat dikenali oleh manusia dan mesin. Mendeteksi tepi objek, terutama pada gambar daun padi, sangat penting dalam pemeriksaan komputer. Eksperimen dari lima belas citra daun padi menunjukkan bahwa metode Krisch memiliki performa yang lebih baik dalam deteksi tepi, dengan akurasi rata-rata dan kehalusan mencapai 52%. Metode lain, seperti Prewitt (6%), Robinson (11%), dan Roberts (14%), memiliki tingkat akurasi yang lebih rendah. Temuan ini menjadi dasar untuk meningkatkan deteksi tepi dalam analisis gambar daun padi. Studi ini juga menekankan perlunya penyempurnaan model klasifikasi. Secara keseluruhan, penelitian ini memberikan wawasan tentang efektivitas metode deteksi tepi dalam analisis gambar daun padi.*

Kata Kunci: *Krisch dan Roberts, Prewitt, Robinson, , Daun Padi.*

INTRODUCTION

Rice as a rice-producing crop is a very important commodity for Indonesia, apart from being a staple food producer, rice is also the main source of income for millions of farmers Every year the need for rice continues to increase, to meet domestic and export needs. Various efforts have been made to increase rice production (Adianto 2020). The edge or side of an object is an area where there is a fairly high change in color intensity. The edge detection process will convert this area into two types of values, namely low or high color intensity, for example zero or one. Edge detection will produce a high value if an edge is found and a low value otherwise (Sun et al. 2022). Digital images or popularly known as images are part of multimedia which have a role in presenting information and content visually. The image is a function in dimension space, f(x, y) where x and y are spatial

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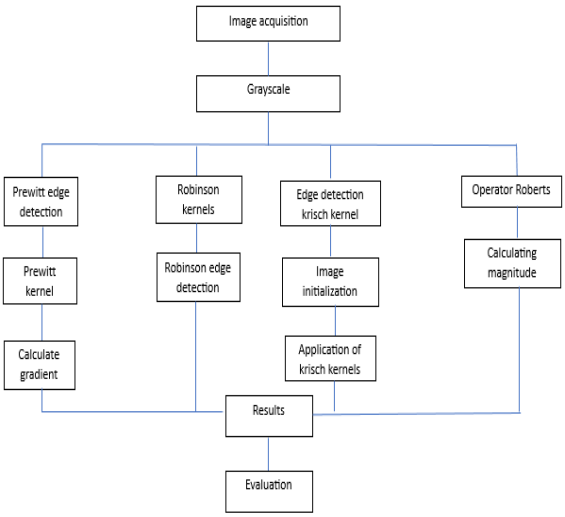
coordinates and the amplitude at certain coordinates (x, y) is called the image intensity value. Digital images can be obtained from various media or image acquisition tools with varying qualities. Each image has characteristics that are used to recognize an object. This recognition can be done through image processing, for example the image of rice leaves (Evsutin 2020). Image processing is a method for manipulating and improving image quality through various means. The main function of digital image processing is to improve image quality, so that it looks clearer and is easily recognized by humans or machines. Apart from that, image processing aims to interpret or extract image content, so as to find meaningful and significant information (Richards and Jia 2022). The edge of an object in an image can be defined as the boundary between two regions or two pixels that are close to each other and have a sharp or high difference in intensity, so that they will form the edge of the object. Detection in leaf images is an important step in computer leaf inspection (Harakannanavar et al. 2022). Edge detection is used in image analysis to be processed in object recognition using a computer. The algorithms for detecting edges analyzed are edge detection such as Prewitt, Robinson, Krisch, and Roberts. The observed experimental results show that Krisch edge detection works better than its counterpart edge detection methods(Shah et al. 2020). Iris recognition for security plays an important role in today's technological advancements. The segmentation process is carried out to group the right parts of the eye, for example. iris region, to extract the top and bottom textures, calculate the texture image, using the local entropy of the grayscale image (Mayangky 2023). Edges characterize the boundaries of an object in a digital mage and play an important role in image processing. Image edge detection reduces the data size and filters out unimportant information and preserves important structural properties of the image. Edge detection is the process of finding the boundaries of objects or textures in the image (Ranjan and Avasthi 2022). The goal of edge detection is to improve the appearance of the boundary lines of an object in the image. Therefore, it is possible to combine the level of edge line sharpness and edge detection shape accuracy into a convolution in one dimension with two different directions (vertical and horizontal) (Widiawati and Wulandari 2019).

MATERIALS AND METHODS

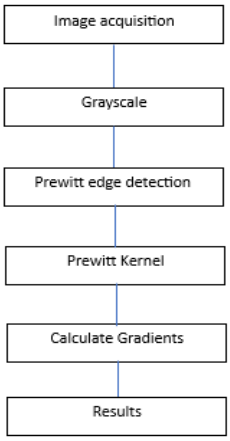
Edge Discovery is an image processing process to gain the edge boundaries of objects. The edge of an object in the image is characterized by a drastic change in the intensity value between two pixels that are close to each other. Edges can also be interpreted as a collection of pixels that are connected to each other, and are located at the boundaries between objects in the image. Edge discovery styles are divided into two orders, videlicet first- order edge discovery and alternate-order edge discovery. The first order, the edge discovery process is carried out using first order derivations or differentials, the edge discovery styles used are Prewitt, Robinson, Krisch, Roberts. Each edge discovery system uses drivers and has a different way of working, so it's necessary to experiment in certain cases. to find out the discovery system that produces the stylish object edges, by comparing the edge discovery results for the birth of four morphological features, videlicet; area, border, length and range (Makandar 2022). Can be seen in Figure 1. Edge Discovery system.



Source(Research Result, 2024)

Figure 1. Edge Detection Method

Method prewitt



Source(Ryu, 2023)

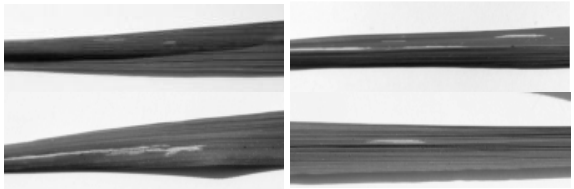
Figure 2. Prewitt method

a) Image acquisition:

Taking 15 images fromkaggle.com. By understanding image reclamation using the edge discovery system, we can explore the implicit and utility of this system in assaying illustrations and rooting features in images fluently. Then are some of the images used (Kaggle n.d.):

Source: (Research Results, 2024)
Figure 3. Rice Leaves

b) Grayscale :
Grayscale is a term used in the world of graphic computing and image processing to describe an image or picture that only has a argentine scale. In grayscale images, each pixel can be represented by a position of brilliance or argentine intensity, where these values range from 0(black) to 255(white), with values in between representing the argentine position (Viscaino et al. 2022). The following are grayscale exemplifications of several images taken:



Source: (Research Results, 2024)
Figure 4. Rice Leaves Grayscale

c) Prewitt edge detection:
Prewitt edge discovery is a system in image processing that's used to find edge lines or significant changes in pixel intensity in an image. This system uses complication operations with a Prewitt kernel, which consists of a 3x3 matrix to descry vertical and perpendicular changes in intensity (Yasir et al. 2022).

d) Kernel Prewitt :
The Prewitt kernel is generally used in matrix form with a size of 3x3. Each element in the matrix is a weight used in the complication operation to descry edges or silhouettes (Ryu 2023).

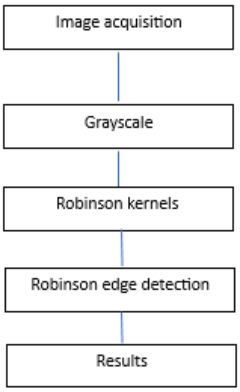
e) Calculate Gradient:
Prewitt gradient calculations are carried out by applying Prewitt kernels horizontally and vertically to the image. The horizontal gradient (Gx) and vertical gradient (Gy) are calculated using the following formula (Supriyatin 2020) :

$$Gx = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix} \quad (1)$$

$$Gy = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix} \quad (2)$$

$$GP = |Gx * 1| + |Gy * 1| \quad (3)$$

Methode Robinson

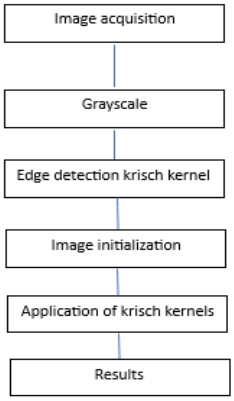


Source: (Armansyah, 2022)
Figure 5. Robinson method

f) Kernel robinson :
The Robinson kernel driver is used in image processing for edge discovery and has several kernel variants that are used for edge discovery in colorful directions. Generally, the Robinson kernel uses a 3x3 matrix like the Prewitt and Sobel kernels (Armansyah 2022).

h) Robinson edge detection:
The Robinson kernel driver is used in image processing for edge discovery and has several kernel variants that are used for edge discovery in colorful directions. Generally, the Robinson kernel uses a 3x3 matrix like the Prewitt and Sobel kernels.

Method Krisch



Source: (Shah, 2022)
Figure 6. Krisch method

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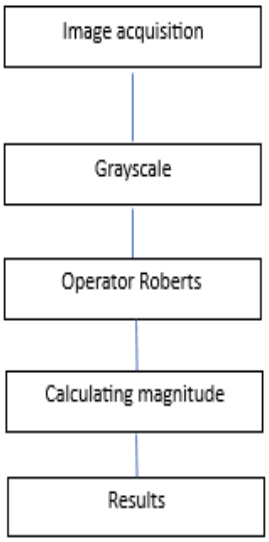
i) Edge detection kriscrnel:
The Krisch kernel, like other edge discovery drivers, is alsh keo used in complication operations to descry changes in intensity that indicate the presence of edges or silhouettes in the image. Krisch kernels generally have a size of 3x3, and correspond of weight values placed in a matrix arrangement.

j) Image initialization:
Image initialization using the Kirsch method is the first step in image processing that uses the Kirsch operator for edge detection. The Kirsch method involves the use of a Kirsch kernel that has eight different edge detection directions. This image initialization process prepares the image to then be processed with the Kirsch operator to detect edges in various orientations.

Metode Roberts



Source: (Widyawati, 2019)
Figure 7. Roberts method

j) Operator Roberts :
The Roberts operator is an edge detection method in image processing that is used to find sharp changes in pixel intensity in an image. This method uses two small kernels to detect edges diagonally.

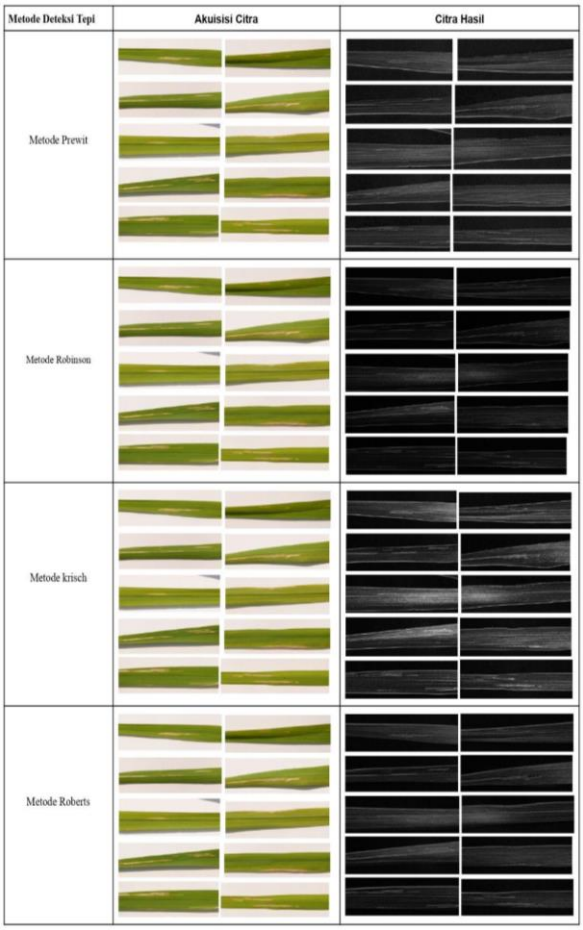
k) Calculating magnitude:
Magnitude (magnitude response) dari operator Roberts calculated by combining the results of horizontal and vertical edge detection. The following is the formula for calculating magnitude using the Roberts operator:

$$G = \sqrt{G\frac{2}{x} + G\frac{2}{y}} \quad (4)$$

Where:
- GG is the magnitude of the response,
- GxGx is the result of horizontal edge detection,
- GyGy is the result of vertical edge detection

RESULTS AND DISCUSSION

Comparison of the intensity of edge detection in rice leaf images indicates variations in the response of edge detection operators, with each operator (Prewitt, Robinson, Kirsch, and Roberts) showing unique characteristics in responding to changes in intensity at the leaf edge. This intensity comparison analysis provides sapience into each driver's capability to punctuate and depict edge structures in images, and allows the identification of certain preferences or advantages in dealing with intensity changes in these visual objects. Seen in Figure 8. Comparison of Edge Detection styles.



Source: (Research Results, 2024)
Figure 8. Comparison of Edge Detection Methods

The comparison results of edge discovery using the Prewitt, Robinson, Kirsch, and Roberts drivers show variations in edge repression and robustness to noise in colorful types of images. The Prewitt driver emphasizes perpendicular and vertical edges in rice splint images and Prewitt also tends to be effective in landing vertically or horizontally acquainted

outlines. The advantage is the simplicity of perpetration.

The Robinson driver highlights edges in eight different directions on a rice splint image. Robinson is more flexible because it can capture intensity changes in multiple directions. This can be useful if the image structure has varying exposures. The Prewitt and Robinson drivers tend to produce smoother edges.

The Kirsch driver highlights edges in eight directions like Robinson, while the Roberts driver highlights edges by emphasizing intensity changes in two slant directions. Indeed though it's simple, Roberts can give good results for slant edge discovery, the results are better applied to grayscale images than color images. still, it's lower effective at landing pure perpendicular or vertical outlines. Kirsch and Robinson drivers can also give a sharper response to depth changes in intensity.

Evaluation

These tables 1 show the performance evaluation results of an edge detection method on fifteen different images. Evaluation is carried out using Confusion Matrix and Accuracy.

Tabel 1. Evaluation of the Prewitt Edge Detection Method

Prewitt Edge Detection	Confusion Matrix	Accuracy
Image 1	[[7 4] [2593065 170581]]	6%
Image 2	[[36450 9][2599503 127695]]	6%
Image 3	[[0 0] [2697703 65954]]	2%
Image 4	[[0 0] [2617059 146598]]	5%
Image 5	[[0 0] [2472693 290964]]	11%
...	...	...
Image 13	[[37 0] [2559598 204022]]	7%
Image 14	[[0 0] [2581435 182222]]	7%
Image 15	[[64 13] [2517500 246080]]	9%

Source: (Research Results, 2024)

Each row represents information from one image, including the confusion matrix and delicacy values. All images have a low position of delicacy, with average accuracy values 6%, indicating that the bracket model used tends to be ineffective in prognosticating rightly. Refinement or improvement of the model may be necessary to ameliorate bracket performance. It can be seen in tabel 1. Evaluation of the Prewitt Edge Detection Method.

Tabel 2. Evaluation of the Robinson Edge Detection Method

Robinson Edge Detection	Confusion Matrix	Accuracy
Image 1	[[3 8] [2462464 301182]]	11%
Image 2	[[36404 55][2472176 255022]]	11%
Image 3	[[0 0] [2645046 118611]]	4%
Image 4	[[0 0] [2484656 279001]]	10%
Image 5	[[0 0] [2285189 478468]]	17%
...	...	...
Image 13	[[36 1] [2367455 396165]]	14%
Image 14	[[0 0] [2425576 338081]]	12%
Image 15	[[51 26] [2374310 389270]]	14%

Source: (Research Results, 2024)

The Robinson edge detection method applied to these images has a low level of accuracy, with average accuracy values 11%, indicating that this edge detection model is not effective in separating objects and background satisfactorily. Improvements or improvements to the detection method may be required to achieve better performance. It can be seen in tabel 2. Evaluation of the Robinson Edge Detection Method

Tabel 3. Evaluation of the Krisch Edge Detection Method

Krisch Edge Detection	Confusion Matrix	Accuracy
Image 1	[[0 11] [0 2763646]]	100%
Image 2	[[0 36459] [0 2727198]]	99%
Image 3	[[2763657]]	4%
Image 4	[[2763657]]	4%
Image 5	[[2763657]]	4%
...	...	...
Image 13	[[0 37] [0 2763620]]	100%
Image 14	[[2763657]]	4%
Image 15	[[0 169] [0 2763488]]	100%

Source: (Research Results, 2024)

The Krisch edge discovery system shows excellent performance on utmost images with a high position of delicacy, with average accuracy values 52%, The confusion matrix results give a more detailed picture of the model's performance, and in general, the model seems to have succeeded in relating edges veritably well in utmost of the images tested. It can be seen in Table 3. Evaluation of the Krisch Edge Detection Method.

Tabel 4. Evaluation of the Roberts Edge Detection Method

Roberts Edge Detection	Confusion Matrix	Accuracy
Image 1	[[11 0] [2763646 0]]	39%
Image 2	[[36459 0] [2727198 0]]	1%
Image 3	[[0 0] [2763657 0]]	0%
Image 4	[[0 0] [2763657 0]]	0%
Image 5	[[0 0] [2763657 0]]	0%
...	...	...
Image 13	[[37 0] [2763620 0]]	13%
Image 14	[[0 0] [2763657 0]]	0%
Image 15	[[77 0] [2763580 0]]	27%

Source: (Research Results, 2024)

The Roberts edge discovery model used for these images performed inadequately, with average accuracy values 14% indicated by veritably low delicacy values. This model seems to have difficulty feting edges well in all the images estimated. It can be seen in Table 4. Evaluation of the Roberts Edge Detection Method

CONCLUSION

Based on the experimental results, the Krisch method performs better in detecting edges in rice leaf images with an average accuracy of 52% and a high level of smoothness. However, the performance evaluation on fifteen rice leaf images shows low accuracy rates for other methods such as Prewitt (6%), Robinson (11%), and Roberts (14%). These findings provide a basis for improving edge detection in rice leaf image analysis. The study also emphasizes the importance of refining the classification model. Overall, this research provides insights into the effectiveness of edge detection methods in rice leaf image analysis.

REFERENCE

Adianto, Indra Yanuareza. 2020. *RICE POLICIES IN INDONESIA, FROM RICE SELF-SUFFICIENCY TO RICE SECURITY by Indra Yanuareza Adianto In7446ad-S@student.Lu.Se*.

Armansyah, Muhammad Albi. 2022. "Aplikasi Pengolahan Image Mri Untuk Deteksi Area Kanker Otak Dengan Menggunakan Metode Robinson." *Journal of Informatics, Electrical and Electronics Engineering* 1(3): 91–96.

Evsutin, Oleg. 2020. "Digital Steganography and Watermarking for Digital Images: A Review of Current Research Directions." *IEEE Access* 8: 166589–611. doi:10.1109/ACCESS.2020.3022779.

Harakannanavar, Sunil S., Jayashri M. Rudagi, Veena I Puranikmath, Ayesha Siddiqua, and R Pramodhini. 2022. "Plant Leaf Disease Detection Using Computer Vision and Machine Learning Algorithms." *Global Transitions Proceedings* 3(1): 305–10. doi:10.1016/j.gltp.2022.03.016.

Kaggle. "Rice Leaf." https://www.kaggle.com/datasets.

Makandar, Aziz. 2022. "Impact of Edge Detection Algorithms on Different Types of Images Using PSNR and MSE." *LC International Journal of STEM (ISSN: 2708-7123)* 3(4): 1–11. doi:10.5281/zenodo.7607059.

Mayangky, Nissa Almira. 2023. "Eye Pupil Image Segmentation Conducted with Intensity Adjustment Method and Active Contour Method." https://pubs.aip.org/aip/acp/article-abstract/2714/1/030007/2889756/Eye-pupil-image-segmentation-conducted-with?redirectedFrom=fulltext.

Ranjan, Rakesh, and Dr. Vinay Avasthi. 2022. "Enhanced Edge Detection Technique in Digital Images Using Optimised Fuzzy Operation." *Webology* 19(1): 5402–16. doi:10.14704/web/v19i1/web19362.

Richards, John A., and Xiuping Jia. 2022. Remote Sensing Digital Image Analysis *Remote Sensing Digital Image Analysis*. doi:10.1007/3-540-29711-1.

Ryu, Jihyoung. 2023. "Adaptive Feature Fusion and Kernel-Based Regression Modeling to Improve Blind Image Quality Assessment." *Applied Sciences (Switzerland)* 13(13). doi:10.3390/app13137522.

Shah, Bickey Kumar, Vansh Kedia, Rohan Raut, Sakil Ansari, and Anshul Shroff. 2020. "Evaluation and Comparative Study of Edge Detection Techniques." *IOSR Journal of Computer Engineering* 22(5): 6–15. doi:10.9790/0661-2205030615.

Sun, Rui, Tao Lei, Qi Chen, Zexuan Wang, Xiaogang Du, Weiqiang Zhao, and Asoke K. Nandi. 2022. "Survey of Image Edge Detection." *Frontiers in Signal Processing* 2(March): 1–13. doi:10.3389/frsip.2022.826967.

Supriyatin, Wahyu. 2020. "Perbandingan Metode Sobel, Prewitt, Robert Dan Canny Pada Deteksi Tepi Objek Bergerak." *ILKOM Jurnal Ilmiah* 12(2): 112–20. doi:10.33096/ilkom.v12i2.541.112-120.

Viscaino, Michelle, Matias Talamilla, Juan Cristóbal Maass, Pablo Henríquez, Paul H. Délano, Cecilia Auat Cheein, and Fernando Auat Cheein. 2022. "Color Dependence Analysis in a CNN-Based Computer-Aided Diagnosis System for Middle and External Ear Diseases."

Diagnostics 12(4): 1–13. doi:10.3390/diagnostics12040917.

Widiawati, Linda, and Novi Wulandari. 2019. "Akurasi Deteksi Tepi Wajah Dengan Metode Robert, Metode Prewitt Dan Metode Sobel." *Jurnal Ilmiah MIKA AMIK Al Muslim* 3: 9. https://journal.almuslim.ac.id/index.php/mika/article/download/24/34/39.

Yasir, Muhammad, Sakaouth Hossain, Shah Nazir, Sulaiman Khan, Md Sakaouth Hossain, Rahul Thapa, Shah Hossain, Sulaiman Nazir, and Rahul Thapa Khan. 2022. "Object Identification Using Manipulated Edge Detection Techniques." *Science Development* 3(1): 1–6. doi:10.11648/j.scidev.20220301.11.