# Robinson Method For Edge Detection

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*Abstract*— **The field of Computer Vision consists of many advanced techniques and edge detection is the one of the fundamental bases for those techniques. Edges play an important role in helping for doing analysis and interpretation of any Image in the domain of computer image analysis. Robinson edge detection method is one of the simplest methods to quickly detect edges using predefined filters.**

**Keywords**– Edge detection,Robinson compass mask, Convolution, Computer Vision

## I. INTRODUCTION

Edges play an important role in helping for doing analysis and interpretation of any Image in the domain of computer image analysis. Edge detection is an image processing approach for detecting the boundaries of objects within images. Furthermore, There are three types of edges present in the image.i)Vertical edge, ii)Horizontal Edge iii)Diagonal edges. Edge detection performs a very crucial role in image segmentation, pattern recognition, image morphology, and feature extraction in the field of image processing, computer vision, and machine vision. It can identify discontinuities in an image. Edge detection can be performed by using various algorithms like Sobel operator, Canny edge detection, Prewitt operators, Roberts and fuzzy logic methods which are very frequently used methods. Moreover, some masking methods are also used for edge detection which are very primitive methods like Robinson compass mask, Krisch compass mask, etc. Among all of these, in this paper, we are going to use the Robinson Compass Masks method for edge detection. We have built this algorithm from scratch. This method is also known as direction mask because it detects eight major compass orientations and each of them will detect the edges with respect to its direction. Therefore, in this method, we take one mask and rotate it in all 8 directions so that we can detect the edges from all different angles.

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## II. MOTIVATION

Edge Detection process comprises of extracting edge line with orientation same as original image without changing the properties of original image. Major discrete values of image are brightness and contrast as mentioned in [1]. They generally corresponds to:

- Depth Discontinuities
- Surface orientation Discontinuities
- Changes in material properties
- Variations in scene brightness

## III. BACKGROUND

Historically, Edge detection has been used to detect low-level feature detection. There are several algorithms for edge detection. The Robinson compass mask is one of the simplest and the most primitive method among all of them. Robinson Detection method calculates an approximation of the first derivation of the image data and uses it as an edge detector. We take one mask and rotate it in all 8 directions. As a result, we can detect the edges from all different angles. In the following image 8 types of directional mask are depicted. As

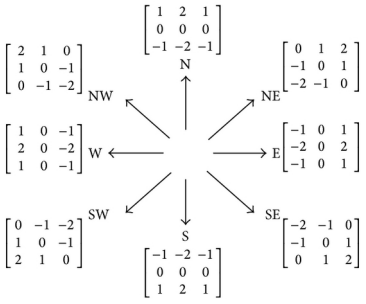


Fig. 1. Robinson compass masks or edge detection masks

we can observe here, all the masks contains only the values 0, 1, -1, 2, -2. Also, these masks are symmetrical. Therefore, we have to calculate only 4 masks and the other 4 marks are the negation of the first result. The convolution of the masks with an image will create a high-value output where there is a rapid change in pixel value in original image[3]. This way we can detect an edge.

## IV. DETAILED MATHEMATICAL ANALYSIS OF ROBINSON COMPASS MASK ALGORITHM

Robinson Detection method calculates an approximation of the first derivation of the image data and uses it as an edge detector. We take one mask and rotate it in all 8 directions. As a result, we can detect the edges from all different angles.To detect the edges,we use convolution operation between the gray-scale converted image and the 3x3 filter.The operation is as follows: Output I' will be the output of the robinson

$$I'(u,v) = \sum_{i=-\infty}^{\infty} \sum_{j=-\infty}^{\infty} I(u-i, v-j) \cdot H(i,j),$$

$$I' = I * H$$

Fig. 2. Convolution Operation

compass. This is the Robinson Compass Mask algorithm.

## V. EXPERIMENTS AND RESULTS

In this paper, we have used an image dataset from the Kodak Corporation for unrestricted research usage. In this dataset[2], there are total of 25 uncompressed PNG true-color images of size 768 × 512 pixels. After collecting the dataset we converted color images into grayscale for better analysis and visualization. After that, these images were passed into the different types of 8 directions kernel. More output results of this Algorithm performed on various types of images can be found here[4].

**Results:**

Fig. 3. Original Image


Fig. 4. Output: Robinson Compass Mask

Fig. 5. Original Image

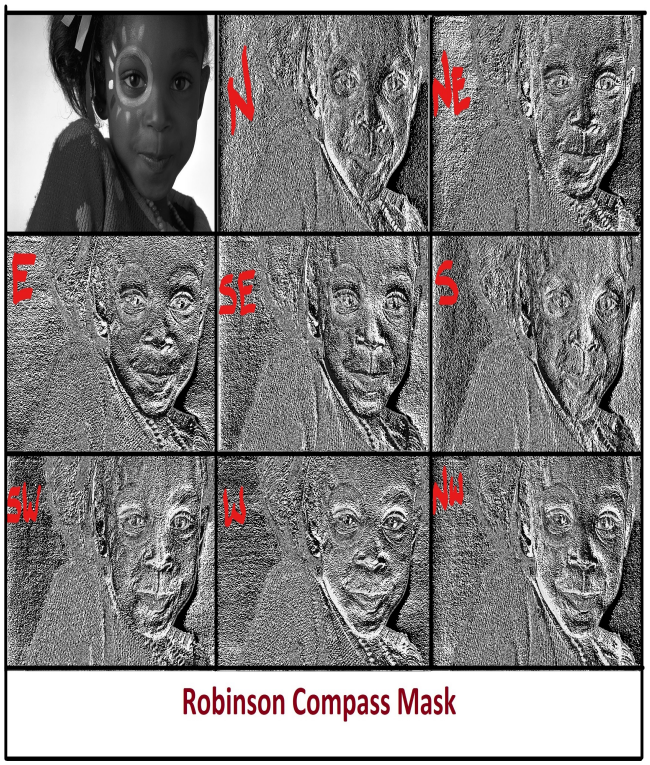


Fig. 6. Output: Robinson Compass Mask

## VI. Comparison

### *A. Comparison between our Robinson Compass Mask and In-built Function*

We get smoother output with inbuilt function as compared to our algorithm as we have not used any special function for smoothing.

### *B. Comparison between Robinson Compass Mask And Other Algorithm*

There are several algorithm for edge detection.We compare some of the algorithm like krisch Opertor,Canny Edge detection,Prewitt Edge detection below.

Below shows a concise comparison:

| | Time Complexity | Space Complexity | Sensitivity to noise | Drawback of algorithm |
|---|---|---|---|---|
| Robinson Edge Detection | M X N | M X N | High | • Extremely prone to noise<br>• More time for calculation |
| Kirsch Edge Detection | M X N | M X N | High | • Sensitivity to noise<br>• Inaccurate |
| Prewitt Edge Detection | M X N | M X N | Low | • Sensitivity to noise<br>• Inaccurate |
| Canny Edge Detection | MNlog(MN) | M X N | Comparatively low | • Complex Computation<br>• False Zero Crossing<br>• Time consuming |

Fig. 7. Comparison of Edge Detection Algorithm

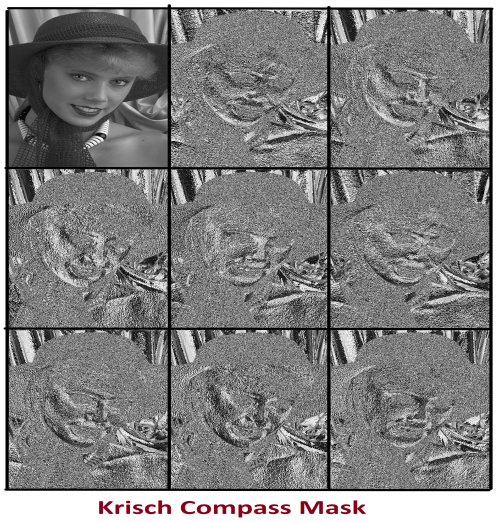


Fig. 8. Comparison of Edge Detection Algorithm


Fig. 9. Comparison of Edge Detection Algorithm


Fig. 10. Comparison of Edge Detection Algorithm

## VII. CONCLUSION

The experiments conducted in the report show us how effective the Robinson compass method is at highlighting the edges in a given image. This method gives clear representations of the edges as well as provides flexibility of detecting edges in a particular direction only. This simplicity and flexibility renders the Robinson method as one of the top choices for low-level feature detection. The experiment also observed the need of smoothing to better the results of filter based edge detectors. In the end, the Robinson compass method provides a simple, quick as well as flexible method for edge detection.

## REFERENCES

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