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Research Article

Using the Binary Logistic Regression Analysis Function for Image Processing

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ABSTRACT

Binary logistic regression analysis is a statistical method used to predict a set of quantitative and monotonic variables. The logistic regression function is also used in data classification because it does not impose any conditions on the independent variables, so it is a flexible mathematical formula for interpretation that is used to study the relationship between a dependent variable and an explanatory variable. The regression equation is also used to predict the value of the dependent variable at a certain value of the independent variable. In this research, it was proposed to employ the binary logistic linear regression function in image processing as a statistical tool. The purpose is not to analyze the relationship between the dependent variable and the explanatory variable, but rather to develop a tool that works on image segmentation using the threshold technique by considering the highest value of the binary logistic regression vector estimated from the image data as the threshold limit for segmentation. The images were given segmented images containing the most important areas with features that benefit the study, with the removal of non-useful or important areas. And proved its efficiency in extracting all the features of interest in the images.

Keywords: Binary Logistic Regression, Maximum Likelihood Estimation (MLE), Image Processing, Images, Image Segmentation, Threshold

INTRODUCTION

The logistic regression model is one of the most important statistical models that studies and analyzes the influence of several independent variables on a nominal or categorical dependent variable consisting of two or more distinct groups.

The logistic regression model is divided into two types, called the binary logistic regression model, in which the dependent variable is descriptive and divided into two categories. The second type, multiple logistic regressions, extends from binary logistic regression when the dependent variable has more than two categories. The main purpose of the logistic regression model is to obtain the best description for harmonizing the relationship between the dependent variable and the independent variables. The main purpose of using the logistic regression function is to study the relationship between the dependents of two or more classes and the independent variables. It is also useful to predict the value of a dependent variable at a given value of the independent variable, and all of these studies using a logistic regression function assume that there is a relationship between the dependent variable and the independent variables. The binary logistic regression function can be used in the area of image processing, which often uses statistical tools such as mean and variance in the image segmentation [1] that give satisfactory results for image segmentation, finding areas that are objects, or finding the important areas of pixels in the image. Pixels are classified according to their color image values to cluster into areas representing these objects.

In this paper, the binary logistic regression function was used in image segmentation using the threshold technique, where the binary logistic regression function was estimated from the image data.

The goal of the research is to use the binary logistic linear regression function in image fragmentation in image processing by estimating the parameters of the logistic regression model from images in the way of maximum likelihood and making the highest value vector to be the hash threshold. The paper examined the binary logistic regression function, which was considered in theory, and then the practical aspect of applying what was stated in theory, where the binary logistic regression function was estimated and arrived at the most important conclusions.

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In the most important studies that dealt with this topic in 2011, researchers Jiangye Yuan, DeLiang Wang, and Rongxing Li [6] used the linear regression method with a new method to segment images using histological and non-tissue regions. And in 2012, researchers [7] Pekka Ruusuvuori, Tapio Manninen, and Heikki Huttunen used the sparse logistic regression method in image segmentation using sparse logistic constraints with prior spatial. In 2017, researchers V. Vanlalhruaia, Y. K. Singh, and N. Debachandra Singh [10] proposed using the binary logistic regression function and the neural network in the face recognition technique.

THE BINARY LOGISTIC REGRESSION MODEL

The binary logistic regression function [4] is as follows:

$$y_i \sim \text{bernoulli}(\pi_i) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

$$\pi_i = \text{pr}(y_i = 1 / x_{i1}, x_{i2}, \dots, x_{ip})$$

$$\pi_i = \frac{e^{x\beta}}{1 - e^{x\beta}} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2)$$

The probability is $0 \leq \pi_i \leq 1$, while the ratio $\frac{\pi_i}{1-\pi_i}$ is a positive value confined between $(0, \infty)$ and when entering the natural logarithm, the estimated is $-\infty \leq \ln \frac{\pi_i}{1-\pi_i} \leq \infty$Therefore, the model can be written as follows:

$$\ln \frac{\pi_i}{1 - \pi_i} = x\beta \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3)$$

$$x\beta = \beta_0 + \beta_1 x_{i1} + \cdots + \beta_p x_{ip} \dots\dots\dots\dots\dots\dots\dots\dots\dots (4)$$

The y_i of the response variable and β_j represent the parameters of the model that are estimated. x_{ip} the illustrative variables represent $i = 1, \dots, n, j = 1, \dots, p$.

Simple linear regression function used

$$x\beta = \beta_0 + \beta_1 x_i \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5)$$

The binary regression model's maximum likelihood is estimated to be the most likely view outcome to be selected, and the milestone requires the use of the iterative algorithm. The most important advantage of estimating the symptom is that its distribution follows the symptom size distribution.

The difference between maximum likelihood and estimation methods is that the square of the difference between the observation values and the predictive values of the dependent variable is lower [8]. The significance of parameters estimated using the Wald-Statistic test is tested for each parameter of the logistic regression model corresponding to each independent variable.

The odds ratio (OR) $\frac{\pi_i}{1-\pi_i}$ of success $(y_i = 1)$ is estimated using the following formula:

$$\text{OR} = e^{x\hat{\beta}} = \frac{\hat{\pi}_i}{1 - \hat{\pi}_i} \dots\dots\dots\dots\dots (6)$$

The individual number i must be classified to failure, y=1 if $\text{OR} > 1$

The individual number i must be classified to success, $y = 0$ if < 1

The binary logistic regression function was used in the process of image segmentation [8] as a tool that works to divide the image into parts or objects that make it up. It is based on the properties of discontinuity and similarity, and most similarity algorithms are based on thresholding [2]. In addition to algorithms for expanding (magnification) areas and splitting and merging areas. The fragmentation algorithms are based on the basic assumption that objects and backgrounds in the image have distributions that are gray levels. Selecting the threshold is one way to separate objects from the background by identifying areas with lower gray levels than the threshold and identifying areas with higher gray levels than the threshold value with the objects, or vice versa. Using the local threshold technique, which is a method of threshold fragmentation using the binary logistic regression function, the rating

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value of y is based on image fragmentation, and the local threshold is effective when the gradient effect is small for the selected subimage size [3].

The following algorithm shows the image segmentation based on the regression function:

1. Enter the image and convert it to gray.
2. Through the histogram, the dependent variable and the independent variable are calculated from the gray images.
3. Estimating the parameters of the model in terms of the maximum likelihood.
4. Finding the Estimated Binary Logistic Regression Function $\hat{\pi}_i = \frac{e^{x\hat{\beta}}}{1-e^{x\hat{\beta}}}$.
5. Use $\hat{\pi}$ as the local threshold for image segmentation.
6. If x(i,j)> $\hat{\pi}$ then $y(i,j) = 1$, and if $x(i,j) < \hat{\pi}$ then $y(i,j) = 0$.
7. Display the segmentation image.

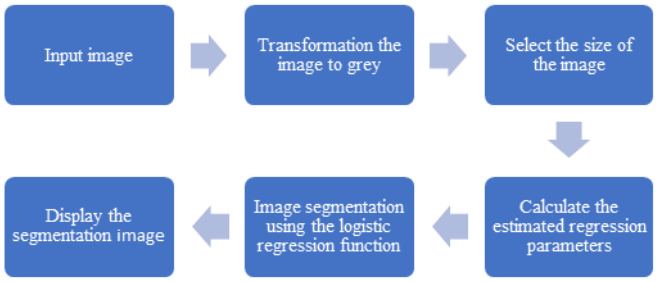

Figure 1. Flow chart of the process of segmentation the image

PRACTICAL ASPECT

The practical aspect is a satellite image of Marsh Hamrin observed on the Kermap platform with Nimbo Maps and a computer, where the above is applied theoretically using MATLAB and shows the importance of the binary logistic regression function in the image segmentation. This function was applied by taking the highest value of the function's scope and considering the threshold. The algorithm is performed on two images, as shown in the results listed below.

The above table shows the estimation values and test measurements extracted from the image segmentation. It is known that the images contain image points (pixels), which will be the vocabulary of the sample, and since the image is of n×m size, the more image units in the image, the greater the resolution of the image and the more features and clarity, so it will produce a high-resolution image. On the practical side, the image was converted to a gray image, so the number of image units is determined between 0 and 255, so we note in the first image of Marsh Hamrin with a size of 355×357, that it contains features that differ from the second image with a size of 768×1024, so the number of image units will differ between the two images, which makes the values of the feature estimators differ between the two images and thus the different values of the scales, i.e. each image is an independent sample from the other.

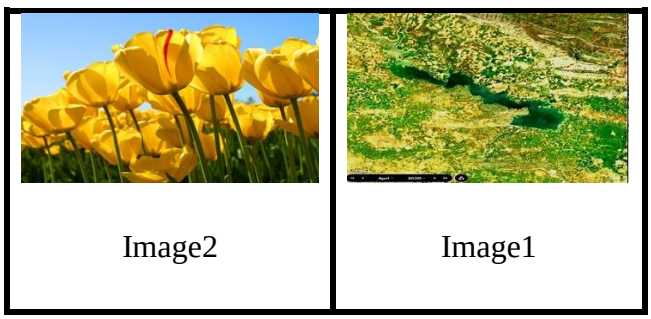

Figure 2: Shows the original images

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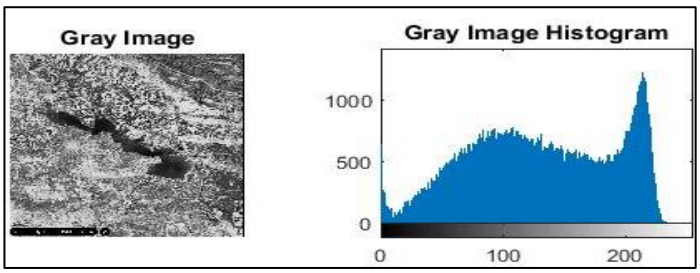
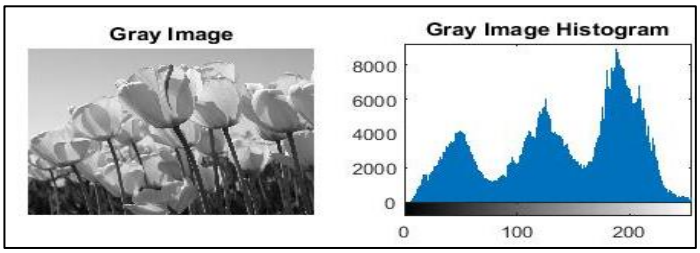
Figure 2, shows the two original images and that the size of image 1 is 355×357, which is a satellite image, while image 2 has a size of 768×1024, and this image is in the calculator.



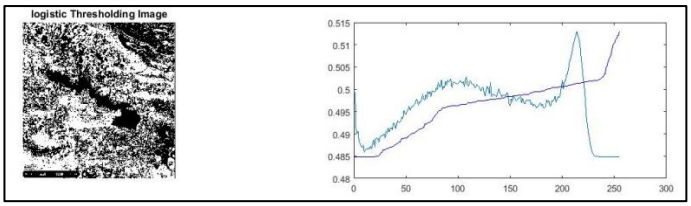
(a)



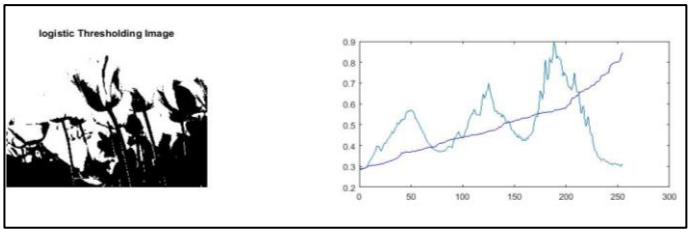
(b)

Figure 3: Two gray pictures on the left and on the right show the frequency distribution of the pictures

Figure 3, images a and b, are grayed to the left, and to the right is the histogram, which shows the axis units between zero and 255.



(a)



(b)

Figure 4: Shows the fragmented images of the threshold process using the logistic regression function on the left, while the right side represents the spread of data

In Figure 4, the segmented images by the threshold process using the binary logistic regression function are shown, where it is best to give a segmented image containing the most important features and properties while removing insignificant ones.

The values for abilities and for the Chi2-statistic were extracted from the segmented image as follows:

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Table 1: Shows milestone rating values for both images

		Estimate	wald	t-Stat	p-Value	Chi2-statistic	p-Value
Image1	β_0	-0.060812	0.25533	0.23817 -	0.81175		
	β_1	9.1271e-05	0.00044965	0.20298	0.83915	0.0412	0.839
Image2	β_0	-0.9049	0.24187	-3.7413	0.00018304		
	β_1	0.00029259	6.8439e-05	4.2751	1.8025e-0	20.5	5.86e-06

CONCLUSION

In this paper, the binary logistic regression function was used as a tool for image processing rather than as a measure for analyzing the results and studying the relationship between variables. It was used for image segmentation using the threshold technology of image processing, as the highest value of the binary logistic regression function was a local threshold. The technique has proven to be efficient at giving a snapshot of the most important landmarks, removing unimportant landmarks, and extracting all the landmarks.

REFERENCE

[1] A. M. Eesa and H. Raaid Talib," Comparison of the Methods of ImageSlicing After Initial Image Processing Using the Statistical Confidenc Limits Technique ", (2021),Annals of Pure and Applied Mathematics Vol. 24, No. 1, 2021, 53-64 ISSN: 2279-087X (P), 2279- 0888(online).
[2] C.Ashutosh Kumar , " Comparison of The Local and Global Thresholding Methods in Image Segmentation", World Journal of Research and Review (WJRR) ISSN:2455-3956, Volume-2, Issue-1, January 2016 Pages 01-04.
[3] D. Barten " Contrast Sensitivity OF Human Eye and its Effect on Image Quality" , SPIE –The International Society For Optical Engineering Belling Ham , 1999.
[4] J. Yuan, D. Wang, and Rongxing Li,(2011),"Image Segmentation Based Local Spectral Histograms and Linear Regression", Proceedings of International Joint Conference on Neural Networks, San Jose, California, USA.
[5] P.Ruusuvuori, T. Manninen and H. Huttunen," mage segmentation using sparse logistic regression with spatial prior", 20th European Signal Processing Conference, 2012 - ISSN 2076-1465.
[6] K. Bhargavi and S. Jyothi,(2014)," A Survey on Threshold Based Segmentation Technique in Image Processing", International Journal of Innovative Research & Development, November, (Special Issue) Vol 3, Issue 12.
[7] R.C. Gonzalez, R.E. Woods (2008), Digital Image Processing, Prentice Hall, Englewood Cliffs, Nj.
[8] V. Vanlalhruaia, Y. K. Singh and N. Debachandra Singh, "Binary face image recognition using logistic regression and neural network",978-1-5386-1887-5/17/$31.00 ©2017 IEEE.

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