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DETERMINATION OF INTESTINAL MASS BY REGION GROWING METHOD

ALI YASAR [1*], ISMAIL SARITAS [2] and HUSEYIN KORKMAZ [3]

[1] ComputerProgramming, Guneysinir Vocational School of Higher Education Selcuk University Guneysinir, Konya,Turkey, 42190, aliyasar@selcuk.edu.tr
[2] Faculty of Technology, Electrical and Electronics Engineering Selcuk University, Konya,Turkey, isaritas@selcuk.edu.tr
[3] Department of Gastroenterology, Faculty of Medicine, Selcuk University, Konya, 42031,Turkey, huseinkorkmaz68@hotmail.com

* Correspondence, aliyasar@selcuk.edu.tr,+905055204696Received: date; Accepted: date; Published: date

Abstract: Image processing is a field of which its popularity increases and continues and, that grows dynamically with new technologies. Nowadays, image processing finds itself in use in almost every field. One of these uses is undoubtedly in the field of medicine, where diagnosis and treatment planning are made from images and, which is constantly changing with newly developed techniques. Of course, the most important factor in using this so widely in the medical field is the acquisition of images on every medical field. With the help of these images, the complaints can be seen more easily and the doctor can follow a path in the treatment of the disease. In our study, we used the Region Growing segmentation method to detect the intestinal mass. This study compares the area determined by the specialist with the area obtained with the segmentation process and, it is seen that the created software system can be used as an auxiliary system to specialist doctors.

Keywords: Computer Aided Diagnosis (CAD); Image Processing; Region Growing Segmentation; Intestinal Mass

1. Introduction

Cancer is the most important problem for human life [1]. In addition to the high mortality rate, early detection and diagnosis are become crucial to understand cancer, but depending on the type of cancer, diagnostic procedures can be quite costly [2]. Image processing techniques have been used in the CAD system that was developed and image processing techniques used in this study were done through MATLAB software. This software provides data analysis, simultaneous data transfer, data processing and Matlab programming language support for special operations, while providing a powerful computing environment. In image processing to be performed in the medical field, the uncovering of the meaningful part of the image is one of the most important steps of the diagnosis process. Very different methods have been proposed for this process which is known as segmentation in the literature. In this study, it is aimed to segment the mass region in the intestine from the gastroscopy images by using the techniques in the literature, known as regional segmentation, with complete success. Recently, Computer-aided diagnosis (CAD) systems have been very common and generally, image processing methods and some different techniques are used in these systems [3, 4]. CAD systems have started to become common in recent years in order to diagnose and phase several types of cancer such as lung, brain and breast cancer in parallel with the developments of medical imaging and computer technologies [5]. In our study, computer-aided diagnosis system is recommended for detection and diagnosis of gastral cancer using gastroscopy images.

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2. Materials and Methods

The images taken from the patients were checked by a specialist doctor and based on these images image processing have started. GroundTruth pictures of the area designated as cancer by the specialist doctor were extracted[6]. Then, the segmentation processes have begun on the pictures. Figure 1. shows the user interface software of the proposed CAD system.

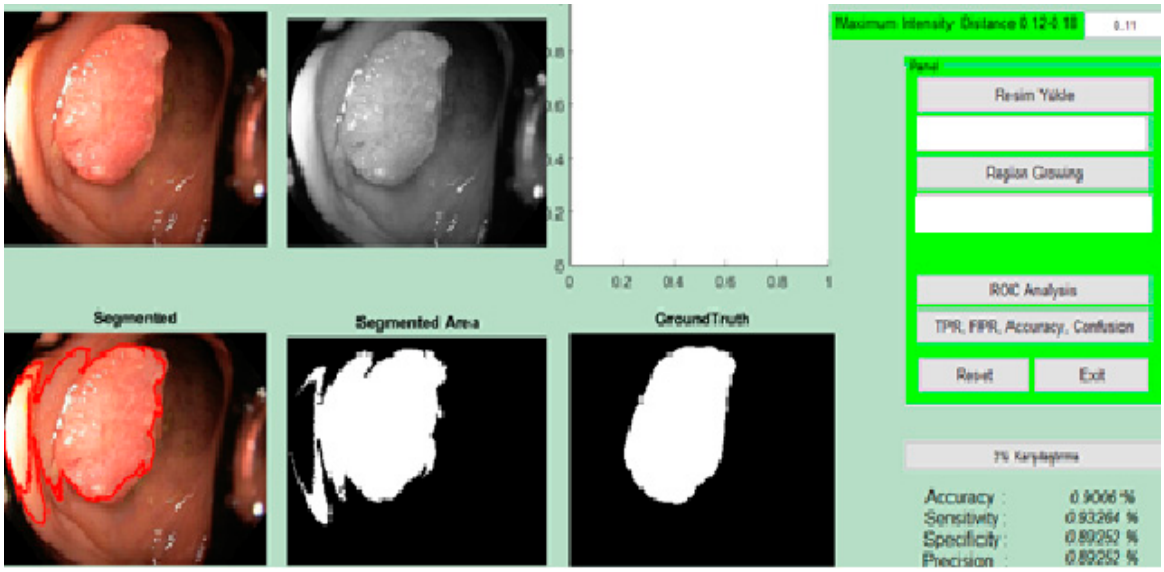

Figure 1. Designed CAD System

2.1. Image Segmentation

The segmentation is used to divide the region and objects that make up the image into subdivisions[7]. For the implemented subdivisions, the detail level is dependent on the problems to be solved. Namely; Depending on the application, segmentation can be terminated when the region or objects of interest in the image are detected. For example, there may be similar luminosities in the image, and these luminosities may represent objects in different regions of the scene. If the image is made up of complex views, then image segmentation is one of the most difficult operations in image processing[8]. The more accurate the segmentation process, the more likely it will affect the latest success in computer analysis in a positive way. Due to this reason, efforts should be made to keep the accuracy of the segmentation operations as high as possible. The most important thing to know here is that there is no universal segmentation method that can be applied to all images and no segmentation method is perfect.

2.2. Region Growing

Region growing algorithm is one of the preferred segmentation techniques in image processing applications. Region growing technique is a zone based technique[9]. First, the initial seed is determined. Statistical calculations are carried out between the identified initial seed and neighboring points. During calculations parameters like average density, color and variance values are determined. Segments which are similar with respect to these values are clustered and segmented. The starting seed is generally selected by the user and the segmentation process is started according to this point. We can sort the operations as follows[10]: First, we need to select a seed pixel as a starting point for each of the required partitions. In the second stage, the same or similar properties of the pixel are combined in the SEED field with similar feature areas around the seed pixel area. This new pixel will continue the above process as a new seed pixel and it will continue until there are no pixels to satisfy the situation. [11].

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The region growing approach is exactly the opposite of the partitioning and merging approach: For this, the following algorithm is executed.

- The initial small-area clusters are repeatedly combined according to similarity constraints.
- Start by selecting a random seed pixel and compare it with neighboring pixels (Figure 2).
- The region is enlarged from the seed pixel by increasing the size of the region by adding neighboring pixels of similar size.
- When a region stops growing, we select another seed pixel that does not belong to any region yet and start again.
- All the processes continue until all the pixels belong to any region.
- It is a method that works in the sense of induction.

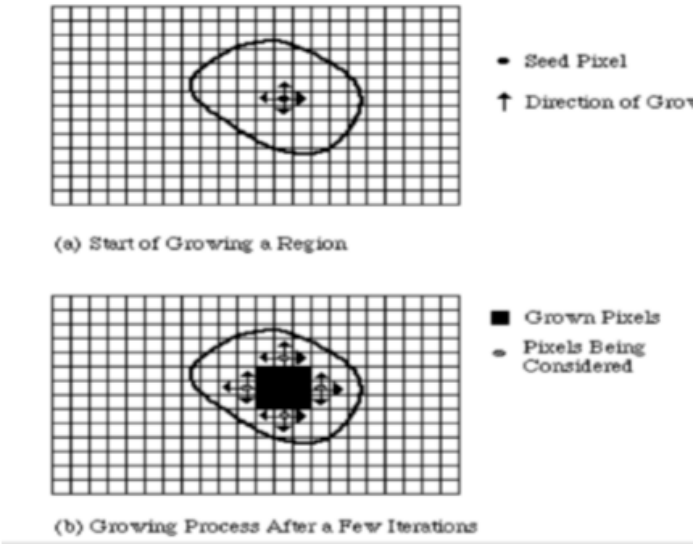

Figure 2. Region Growing Seed and Growth Process

Region Growing methods often give very good segmentation results to specified edges. However, it starts with a certain seed pixel and ensures that this region grows completely before the other seeds try to prejudice, and gives good segmentation results in regions that are segmented first. This may have several unwanted effects:

- The current region dominates the growth process, but the uncertainties at the edges of adjacent regions may not be resolved correctly.
- Different seed selections can give different segmentation results.
- Problems may arise if the seed point is near an edge region.

Simultaneous region growing techniques have been developed to counteract the problems above.

- The similarities of neighboring regions are taken into consideration during the enlargement of the area.
- A single territory is not allowed to have complete domination.
- A number of zones are allowed at the same time.
- Similar regions will gradually turn into expanding regions.
- The control of these methods can be quite complex, but effective methods have been developed.
- Easy and efficient application is ensured in parallel computers.

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2.3. Grafik user interface (GUI)

GUI, a computer program that enables a person to communicate with a computer through the use of symbols, visual metaphors, and pointing devices[12-13-14-15]. We think of it as a software application that only accepts commands typed on the keyboard with fairly ordinary, even primordial. We prefer to point some aspects of the application, to click on it (to invoke some events), and to continue working with the application with interactive hints on a graphical level. We are also familiar with windows, popup menus, slider controls and checkboxes. It is known how slow and tedious the software world is without the GUI[16-17]. Because of these reasons, the GUI structure is at the forefront and is constantly used.

3. The application of RG methods

The algorithm is implemented in MATLAB R2016a and is run on Intel(R) Core(TM)_i7-3630QM_CPU_ @_2.40GHz PC with 8 GB RAM and Windows10 operating system. In our study, segmentation was performed on stomach gastroscopy images using region growing algorithm. The target image is not used in the region growing segmentation algorithm. The target image is used only for the calculation of the accuracy, i.e. the error between the obtained segmentation result and the desired result. The image that use in our work, is shown in Figure 3. The gray level image that use in our work, is shown in Figure 4.

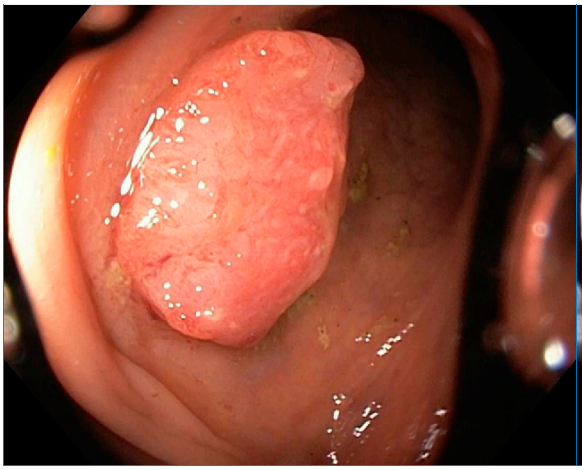

Figure 3. Intestinal mass

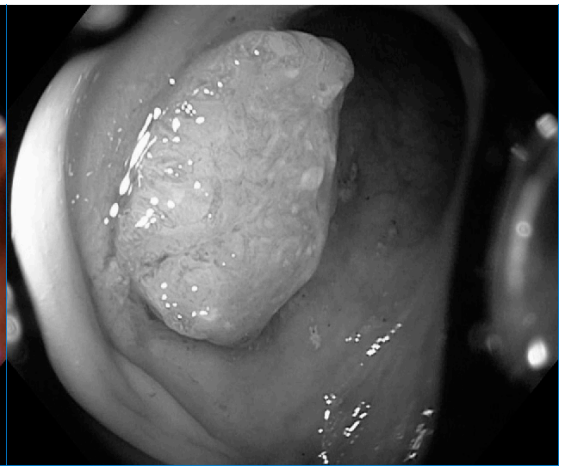

Figure 4. Gray Level Intestinal mass

In our system, we have our interface screen which works according to the region growing method and we see the obtained results of the segmentation in Figure 5.

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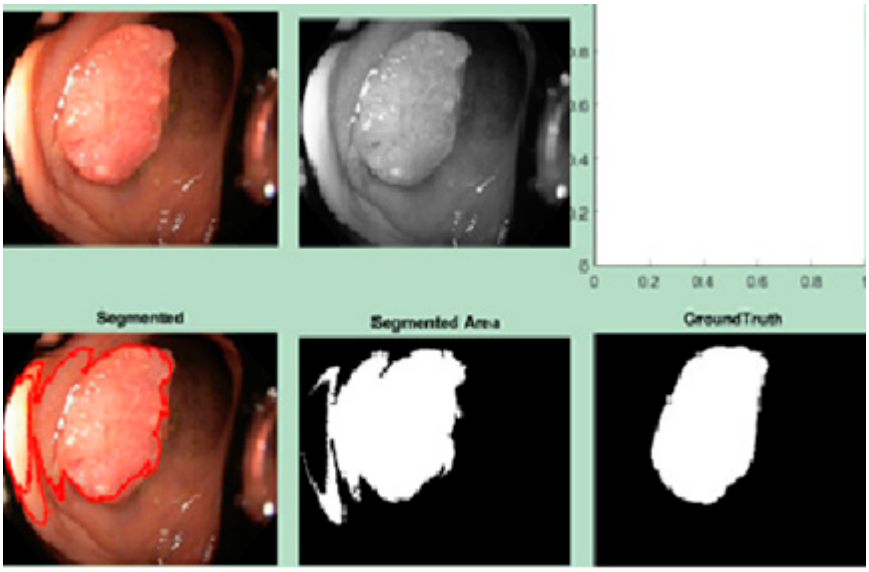

Figure 5. Matlab Software GUI Interface

4. Result and Discussion

Here, the image of 720 × 576 pixels size is segmented by the region growing segmentation algorithm, and the segmentation result is again an image of 720x576 pixel size. The image to be segmented and the maximum intensity distance are given as the input value to the algorithm. There is no training procedure for the algorithm. The region growing segmentation algorithm calculates the accuracy by comparing the image obtained with the desired image. Thus, it is determined how close we are to the desired result.

4.1. Diagnostic Test

Sensitivity and Specificity: Scientifically one of the main purposes of the measurement process is to help the diagnosis. For example, it may be possible to identify one of several possible diagnoses in a patient, or to find people with a specific illness in a seemingly healthy population [18]. Generally used indicators; accuracy, sensitivity and specificity coefficients are given as follows.

		Assigned class	
		Positive	Negative
Actual class	Positive	TP	FN
	Negative	FP	TN

Figure 6. Confusion matrix: The outcomes of classification into positive and negative classes

In Figure 6: A special case of the confusion matrix is often utilized with two classes, one designated the positive class and the other the negative class. In this context, the four cells of the matrix are designated as true positives (TP), false positives (FP), true negatives (TN), and false negatives (FN), as indicated in Figure 6. A number of measures of classification performance are defined in terms of these four classifi- cation outcomes[19]: Confusion Matrix, is a classification system developed by Drew, the performance of such systems can be assessed using the data from matrix.

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN} \quad (1)$$

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$$Specificity = \frac{TN}{TN + FP} \quad (2)$$

$$Sensitivity = \frac{TP}{TP + FN} \quad (3)$$

4.2. *Medical decision making methods*

ROC (Receiver Operating Characteristics Curves) is defined as the receiver operating characteristic ROC or ROC curve in the signal detection theory[20]. ROC can also be expressed as the ratio of the true positives to the false positives. The widespread use in medicine is due to the evaluation and comparison of the performances of diagnostic tests. If the clinically measured variable is continuous, separation of the patients as sick and healthy is difficult. Depending on the conditions of clinical trials, the optimum effect point of the diagnostic test varies. ROC were established by selecting intermediate options depending on the different sensitivity-specificity properties which were found for the different threshold values. ROC curve method can be used to determine the discriminatory power of the test, to compare the activities of the tests, to determine the appropriate positivity threshold, and to monitor the quality of the laboratory results[21]. Confusion matrix and ROC analysis graph of the study are given in Figure 7.

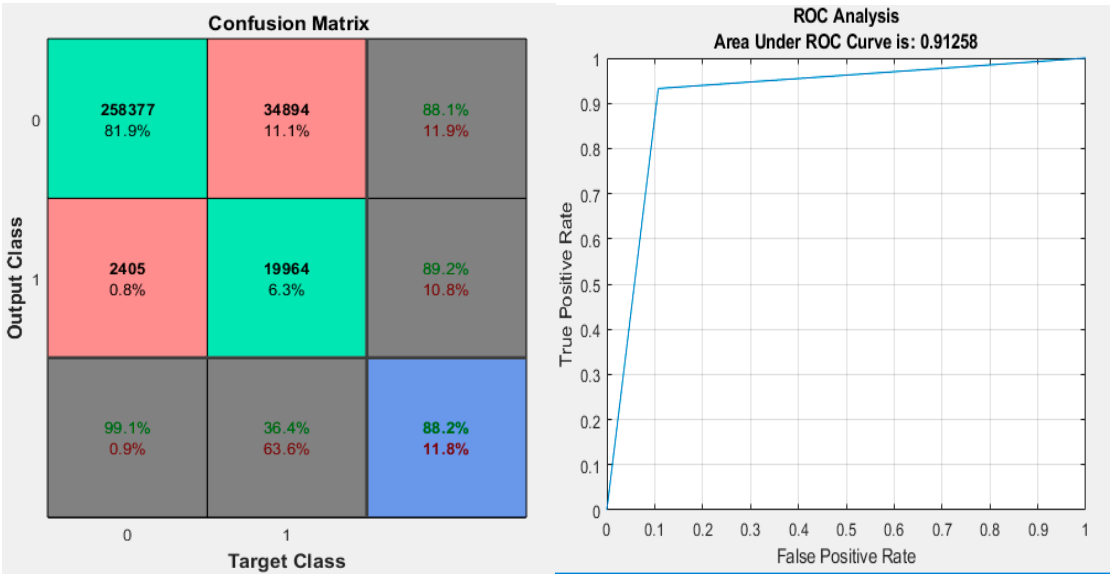

Figure 7. Confusion Matrix and ROC analysis

5. Conclusions

In conclusion, the Ground Truth images of the determined area are considered in evaluating the performance. The Ground Truth images are prepared with the help of a specialist doctor Accuracy[22], Sensitivity and Specificity are calculated with the Equation 1-3. ROC curve and the values[23] are given in table 1.

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Table 1. Result of Diagnostic Tests

Accuracy	Sensitivity	Specificity	ROC curve
0.882	0.892	0.991	0.913

This system shows promise in medicine as a useful application for detecting the mass in the intestine. Accuracy and speed of detection proposed method is very high and has a significant coefficient value accurate diagnosis compared with a human detection method.

Ethics Approval And Consent To Participate: The whole study was approved by the local research ethics committee of Faculty of Medicine Affiliated to Selcuk University (Selçuklu, Konya Province, Turkey).

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Conflicts of Interest: The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results

References

1. White, F. H., Gohari, K., & Smith, C. J. (1981). Histological and ultrastructural morphology of 7, 12 dimethylbenz (alpha)-anthracene carcinogenesis in hamster cheek pouch epithelium. Diagnostic histopathology, 4(4), 307-333.
2. Alpert, M. A., Terry, B. E., Mulekar, M., Cohen, M. V., Massey, C. V., Fan, T. M., ... & Mukerji, V. (1997). Cardiac morphology and left ventricular function in normotensive morbidly obese patients with and without congestive heart failure, and effect of weight loss. The American journal of cardiology, 80(6), 736-740.
3. Akbari, H., Kosugi, Y., Kojima, K., & Tanaka, N. (2009). Hyperspectral image segmentation and its application in abdominal surgery. International Journal of Functional Informatics and Personalised Medicine, 2(2), 201-216.
4. Richardson, A.D., Duigan, S.P., andBerlyn, G.P., An evaluation of noninvasive methods to estimate foliar chlorophyll content. New Phytol. 153:185–194, 2002.
5. Dandıl, E., Ekşi, Z., & Çakıroğlu, M. Mamogram Görüntülerinden Bilgisayar Destekli Kitle Teşhisi Sistemi.
6. Dreizin, D., Bodanapally, U. K., Neerchal, N., Tirada, N., Patlas, M., & Herskovits, E. (2016). Volumetric analysis of pelvic hematomas after blunt trauma using semi-automated seeded region growing segmentation: a method validation study. Abdominal Radiology, 41(11), 2203-2208.
7. Zheng, Y., Jeon, B., Xu, D., Wu, Q. M., & Zhang, H. (2015). Image segmentation by generalized hierarchical fuzzy C-means algorithm. Journal of Intelligent & Fuzzy Systems, 28(2), 961-973.
8. Graham Leedham, C. Y., Takru, K., Tan, J. H. N., & Mian, L. (2003, August). Comparison of some thresholding algorithms for text/background segmentation in difficult document images. In Proceedings of the seventh international conference on document analysis and recognition (Vol. 2, pp. 859-864).
9. Adams, R., & Bischof, L. (1994). Seeded region growing. IEEE Transactions on pattern analysis and machine intelligence, 16(6), 641-647.
10. Yang, B., Xiang, D., Yu, F., & Chen, X. (2018, March). Lung tumor segmentation based on multi-scale template matching and region growing. In Medical Imaging 2018: Biomedical Applications in Molecular, Structural, and Functional Imaging (Vol. 10578, p. 105782Q). International Society for Optics and Photonics.
11. Sofu, M., Er, O., Kayacan, C., Cetişli, B. (2013). Elmaların Görüntü İşleme Yöntemi ile Sınıflandırılması ve Leke Tespiti. Gıda Teknolojileri Elektronik Dergisi, 12-25.

12. Forstall, S., Herz, S., Anzures, F. A., Christie, G., Chaudhri, I., & Van Os, M. (2015). *U.S. Patent No. 9,049,302*. Washington, DC: U.S. Patent and Trademark Office.
13. Lemay, S. O., Matas, M., Omernick, T. P., Williamson, R., Chaudhri, I., Pisula, C. J., & Van Os, M. (2018). U.S. Patent No. 9,933,937. Washington, DC: U.S. Patent and Trademark Office.
14. McDonald, L., Jacobsen, J. J., Pombo, S. A., & Parkinson, C. (2015). U.S. Patent No. 9,134,793. Washington, DC: U.S. Patent and Trademark Office.
15. Saxena, A., Sudarshan, M., Jasola, S., Barik, K., Joshi, A., Dubey, A., & Jauhari, M. (2017). Unit-10 Software Tools for Educational Computing.
16. Singh, R. K. (2014). *Web-based interactive editing and analytics for supervised segmentation of biomedical images* (Doctoral dissertation, University of Missouri--Columbia).
17. Meng, X., Zhao, S., Huang, Y., Zhang, Z., Eagan, J., & Subramanian, R. (2014, April). WADE: simplified GUI add-on development for third-party software. In Proceedings of the 32nd annual ACM conference on Human factors in computing systems (pp. 2221-2230). ACM.
18. Çelik, M. Y. (2013-2014). Halk Sağlığı-Adli Tıp-Biyoistatistik-Tıp Tarihi Ve Etik.
19. Masethe, H. D., & Masethe, M. A. (2014, October). Prediction of heart disease using classification algorithms. In *Proceedings of the world congress on Engineering and Computer Science* (Vol. 2, pp. 22-24).
20. Hanley, J. A., & McNeil, B. J. (1982). The meaning and use of the area under a receiver operating characteristic (ROC) curve. Radiology, 143(1), 29-36.
21. Balasubramanian, R., Xu, H., Whitcomb, B. W., Hankinson, S. E., Paynter, N., Rexrode, K. M., & Qian, J. (2017). Abstract P200: Estimating the Receiver Operating Characteristics (ROC) Curve and its Associated AUC in Matched Case Control Studies.
22. Ab Ghani, N. L., Abidin, S. Z. Z., & Khalid, N. E. A. (2015, September). Accuracy assessment of urban growth pattern classification methods using confusion matrix and ROC analysis. In *International Conference on Soft Computing in Data Science*(pp. 255-264). Springer, Singapore.
23. Kaytez, F., Taplamacioglu, M. C., Cam, E., & Hardalac, F. (2015). Forecasting electricity consumption: A comparison of regression analysis, neural networks and least squares support vector machines. *International Journal of Electrical Power & Energy Systems*, *67*, 431-438.