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Discrimination between Healthy and Unhealthy Mole Lesions using Artificial Swarm Intelligence

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Abstract-In recent years, occurrence rates of skin melanoma have shown a rapid increase, resulting in enhancements to death rates. Based on the difficulty and subjectivity of human clarification, computer examination of dermoscopy images has thus developed into a significant research field in this area. One the reasons for applying heuristic methods is that good solutions can be developed with only reasonable computational exertion. This paper thus presents an artificial swarm intelligence method with variations and suggestions. The proposed artificial bee colony (ABC) is a more suitable algorithm in comparison to other algorithms for detecting melanoma in the skin tumour lesions, being flexible, fast, and simple, and requiring fewer adjustments. These is characteristics are recognized assisting dermatologists to detect malignant melanoma (MM) at the lowest time and effort cost. Automatic classification of skin cancers by using segmenting the lesion's regions and selecting of the ABC technique for the values of the characteristic principles allows. Information to be fed into several well- known algorithms to obtain skin cancer categorization: in terms of whether the lesion is suspicious, malignant, benign (healthy and unhealthy nevi). This segmentation approach can further be utilized to develop handling and preventive approaches, thus decreasing the danger of skin cancer lesions. One of the most significant stages in dermoscopy image examination is the segmentation of the melanoma. Here, various PH2 dataset image were utilized along with their masks to estimate the accuracy, sensitivity, and specificity of various segmentation techniques. The results show that a modified automatic based on ABC images have the highest accuracy and specificity compares with the other algorithms. The results show that a modified automatic based on ABC images displayed the highest accuracy and specificity in such testing.

Keywords- Skin Cancer, Classification, Segmentation, Lesion, ASI.

1-Introduction

Various meta-heuristic models based on various natural swarm systems have been suggested for survey that have been successfully used in real-life applications. Examples of such meta-heuristics sampling technique include ABC, ant optimization, particle swarm optimization and glowworm swarm intelligence optimization methods [1]. The occurrence of malignant melanoma (MM; unhealthy nevi) in the USA has risen significantly in recent years from one per 100,000 persons per year in 1935 and twenty-three per 100,000 in 2012. Many different reasons for this observed rise spectacle have been suggested, including

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analytical deviation [2] decreasing of the ozone layer, the extensive usage of artificial Ultraviolet Rays (UVR) devices [3]. None of these clarifications is mainly favorable for the motive that none clarifies the steady rise in melanoma (unhealthy nevi) occurrence since 1935[4-6]. Indoor professions like professional, and service workers grew (from twenty-five to seventy-five) percent of full occupation between 1910 and 2000[7]. There are many types of melanoma including, BCC and SCC and evaluations of the spread of these skin tumours differ extensively. One set of investigators observed Medicare fee-for-service information, extrapolated to the full inhabitants, and evaluated that 2,152,500 people were cured for 3,507,693 NMSCs removed in the US in 2006[8]. Numerous of the same investigators assessed that 3,315,554 people were cured for 5,434,193 NMSCs in 2012 and studied the 2006 evaluates to 2,463,567people and 4,013,890 NMSCs [9]. These evaluates designated a fourteen percent raise in Medicare NMSCs over the 6-year interval from2006 to 2012and a forty four percent raise in non-Medicare NMSCs over the 6-year interval [10 ,11].
Among the different kinds of skin cancers, unhealthy nevi (Figure1) are the least visually coherent and yet among the most troublesome due to their capacity to metastasize to other parts of the body even while the initial lesion appears minor and untroublesome [12].

Figure1. Image of an early-level melanoma [12].

The many stages for lesion categorization can be carried out in a classification tree as shown in Figure 2. This tree allows for a better understanding of the lesion categorization designations.

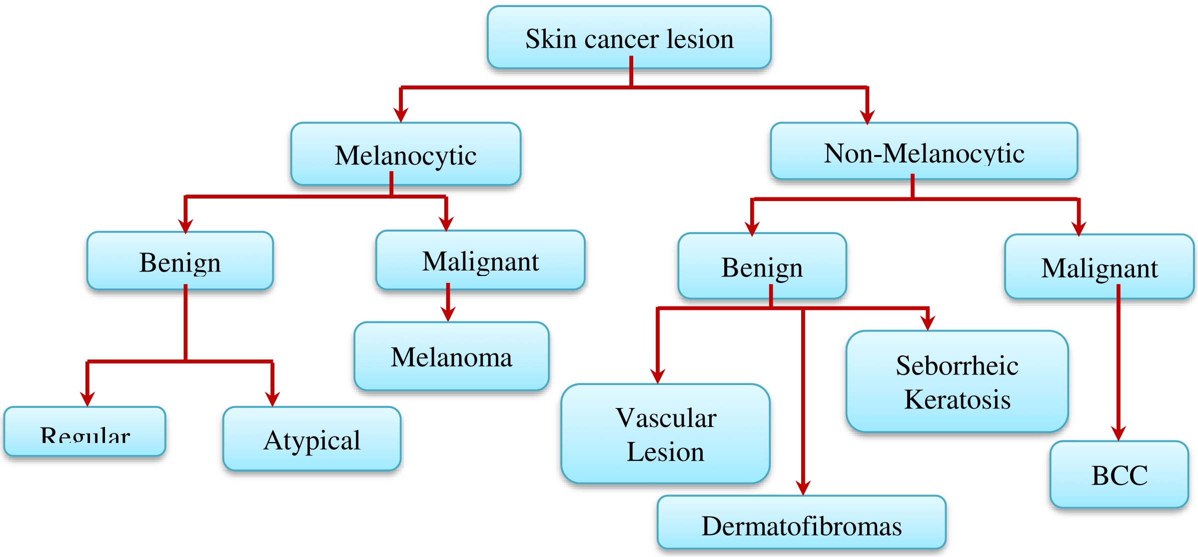

Figure2. Classification of the skin cancer lesions [13].

Digital image processing methods it is sought accuracy and speed quickness in the diagnosis by professionals through segmentation of MM and extraction of its features [14].

The American Cancer Society's (ACSs) evaluates for malignant melanoma in the USA for 2018 are about 91,270 new malignant cases will be detected (55,150 in males and 36,120 in females). The number 9,320 persons are predictable to die of MM (5.990 males and 3,330 females). The rates of MM have been increasing for the last thirty years [15,16]. Most of the researches were on healthy and non-healthy of nevi, which are the two significant kinds of skin cancer lesion.

In terms of NMSC, SCCs tend to be more threatening than BCCs, but the incidence for NMSC tends to combine the figures for BCC and SCC and the 5-year relative survival rate for both sexes [16,17]

Vestergaard et al. (2008) [18,19] further described inspection in their comparative study of detection of MM. modern, lighted digital images, and automated CAD based system work CAD systems perform automatic melanoma organization based on image processing methods as seen in Figure 3 [20].

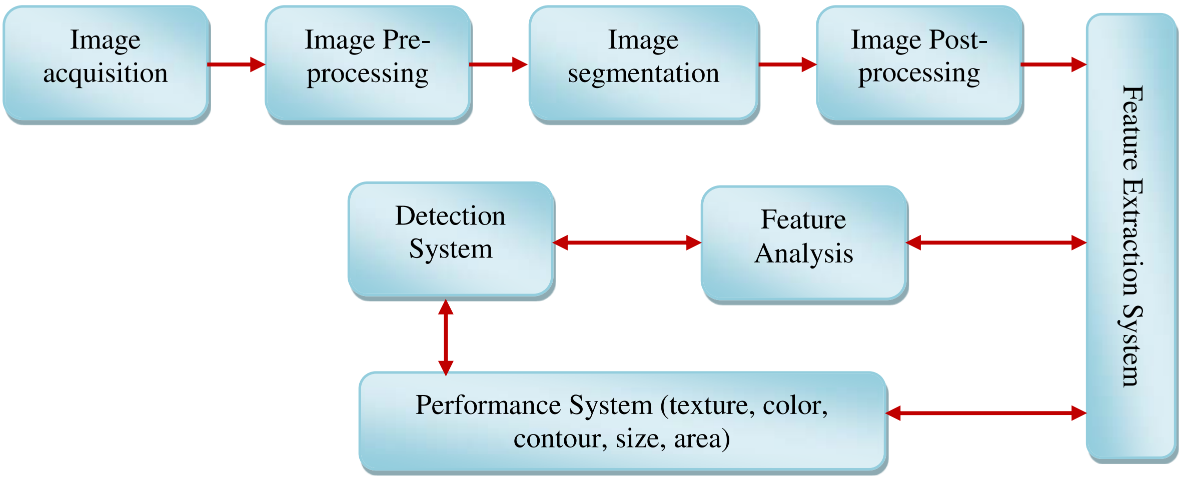

Figure 3. Computer aided detection stages [20,21].

This article was prearranged as follows: - The fundamentals Artifical swarm intelligence methods algorithm is presented in Section 1 together with the types of healthy and unhealthy moles of skin tumors lesion and comparison. Section 2 presents the methodology and meta-heuristics model used in this paper, along with the identification parameters and algorithms used. The estimated values of the predictions for survival rate in skin tumour lesion are offered in the results and discussion section in Section 3, and the conclusions are thus evaluated in Section 4, along with suggestions for future work.

2. Methodology

2-1 Improvements in the ABC Algorithm.

An Artificial Bee Colony may infrequently stop happening near the worldwide optimum level though the inhabitants have not congregated to a local optimum. Numerous educations [22] display that the resolution examines equation of Artificial Bee Colony algorithm is good at exploration but poor at exploitation.

Some authors improved the search model in which the resolution direction is prejudiced toward the best-so-far location [23].

2.2 ABC Method variables.

Karaboga designed ABC algorithms based on the intelligent foraging behaviour of honeybee swarms; this was used for resolving optimisation difficulties in [24], and comparisons with GA, PSO, and ASLM suggest that ABC offers enhanced analysis in comparison to other techniques. Karaboga and Basturk [25] effectively used group ABC to resolve several optimisation issues after comparing the analysis provided by ABC with that of algorithms such as DE, PSO, and EA and determining that ABC can more effectively resolve numerical problems.
The search besides pointed the colony dimensions of bees to support reasonable convergence speed and temperate value of limit (L) for the scout's bee. An enhanced ABC algorithm suggested by L i u et al [26] worked chaotic mapping having enough population randomness and enhanced periodicity during initialization. The improved study equation in scout bee phase supported better convergence. Kojima and Miy-auchi [27] further adjusted the ABC algorithm by reducing the utilization of scout bee stage and enhancing worker bee in addition to onlooker bees like this a method to conserve balance between resolution study speed and speed of convergence. Yu, Zhang and Chen [28] then introduced a new location update approach for onlooker bee to further develop the exploitation procedure and improve convergence.
Akay and Karaboga [29,30] adjusted the ABC algorithm by including Deb's 3 heuristic procedures. In first algorithm, study range is prepared extensive for enhanced exploration of worker bees however in second; sensibility substituted random number in screening of onlooker bees. To develop the study space to make new resolutions, several authors in presented the idea of multi-exchange neighborhood resulting in enhanced global search and better convergence. Sulaiman, Salah and Abro [31] suggested a novel model of ABC to improve the fitness of reduced resolutions by utilizing a modified mutation system. This method, the fitness of all probable resolution is improved and supported faster convergence and prevention of early convergence. Ga o, Liu and Huang [32] also, presented a novel search equation for the onlooker bee stage of ABC to develop study procedure.
Akay and Karaboga [33] later enhanced the modified ABC algorithm that considered the result of different factors for example perturbation rate, limit and scaling parameter however solving real factor optimization problems. An enhanced ABC algorithm for optimization problems is recommended in [34]. The algorithm includes the utilize of rank election mechanism for exploitation of food resources by onlooker bees. Figure 4 shows distribution of publications in the review of swarm intelligence (SI) using ABC method [35]. While, figure 5 is a flowchart methodologies of ABC models with variables of identification parameters used to evaluate and detect skin cancer lesions.

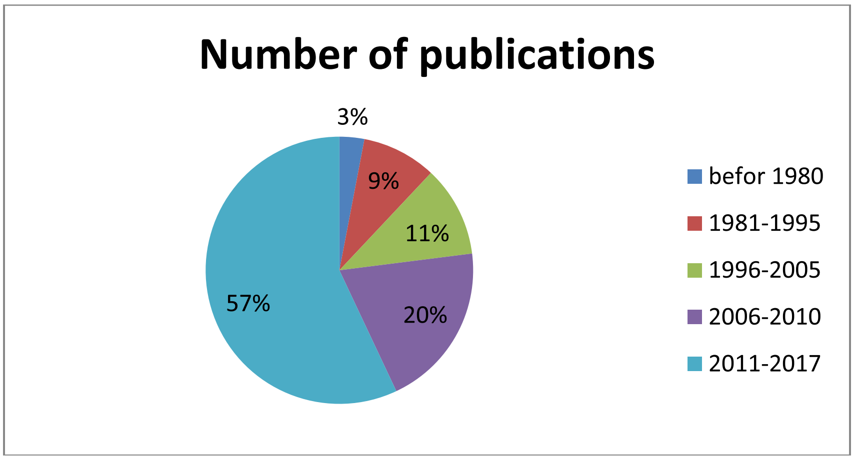

Figure4. Distribution of publications in swarm intelligence (SI) reviews [35].

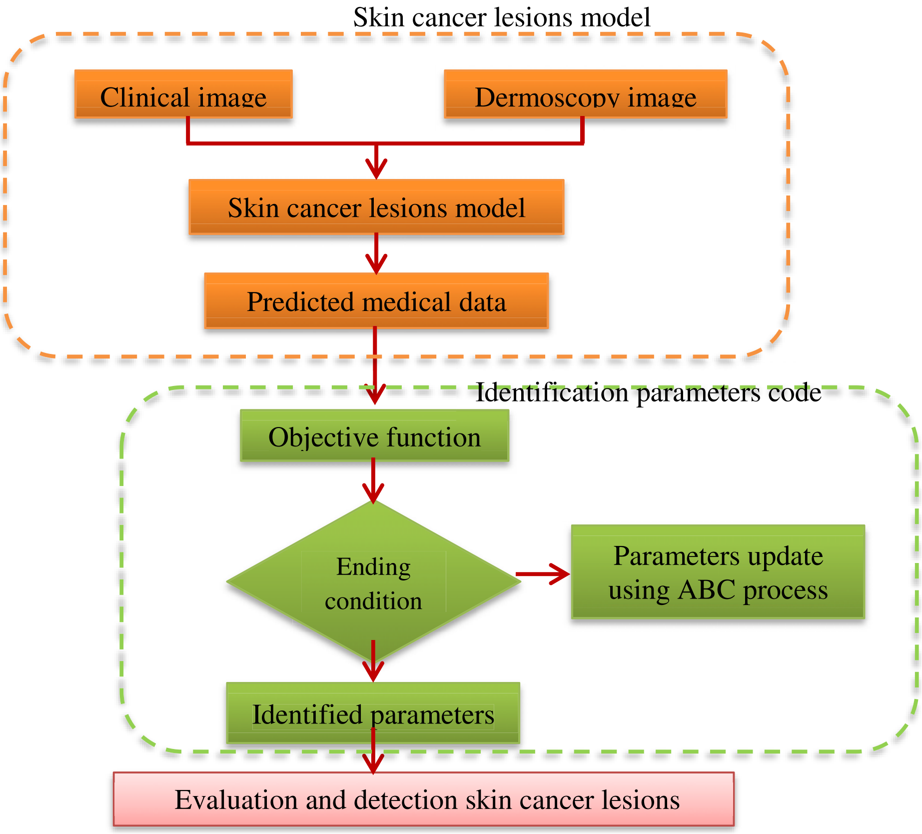

Figure5. Flowchart methodology of artificial bee colony models with identification parameters variables.

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All the methods that mentioned above are effective at diagnosing melanoma, but all have some disadvantages that should also be considered.

Many of these algorithms are time-inefficient and require multiple factors to be exploited for each lesion, that all these algorithms and factors to be exploited for each lesion, so it's not a good method to apply them for a large scale of different lesions. Secondly, we can't access to dermatologists and specialists in all over the world like rural areas and in these places, please just go to check by a physician that doesn't have more knowledge about dermatology [36]. In addition, there are insufficient dermatologists and specialists globally, particularly in rural areas, and in such places local physicians may have little knowledge of dermatology and be unable to utilize the data produced [36]. Moreover, there are different opinions and ideas about assessment of the set parameters and different methods for recognizing skin lesions. According to all Based on these problems, there is a need to automate new algorithms to make them more flexible, faster, and more intelligence in terms of correctly diagnosing melanoma without additional expert input [37].

To create an automated algorithm to analyze the dermoscopy images of skin lesion several different stages are required. Figure 6 shows the block diagram for an automated skin cancer detection system [38].

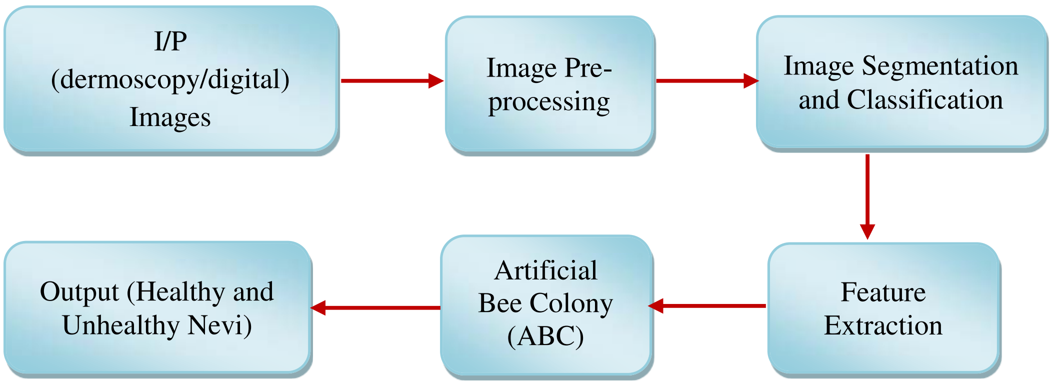


Figure6. Block diagram an automated healthy and unhealthy nevi early detection system [38].

3- Results and Discussion

One of key stages of such a system is the segmentation of the lesion skin tumour boundary, as this influences the accuracy of later feature extraction stages. Such, segmentation is problematic due to the wide variety of lesion colors, forms, and dimensions and various skin tumors. To address this problematic many algorithm have been proposed.
An application region of segmentation contains satisfactory base image retrieval, based on diagnosis of cancers, tissues in medical region and biological recognition.
The paper thus presents a proposal for the classification of skin cancer lesions of depend on designated characteristics of shape, color and texture. The main steps of this proposal are:
1. Select of a base of images;

2. Grey image extraction;
3. Segmentation;
4. Extraction of characteristics;
5. Use of an ABC algorithm for classification; Otsu's method is thus used to find the threshold studies that reduces the variance a in the form:

$$\sigma_x^2\ (t) = w_1\ (t)\sigma_1^2(\mathrm{t}) + w_2\ (t)\sigma_2^2(\mathrm{t}) \tag{1}$$

Where weights ω_1, ω_2 are the possibilities of the two modules of pixels in a picture, which is detached by a threshold t and σ_1^2, σ_2^2 are variances of these two categories. The purpose of this stage is to similarly allocate the color along the image and attempt to adjust any shadow and higher difference in images which can influence the segmentation procedure.

In proposed work, model matrices are used for the qualitative analysis and comparison. These three metrics are: ATDR, AFPR, and AEP can be explained mathematically as: -

$$Average\ \ Ture\ of DetectionRate(ATDR) = \frac{numbers\ of\ \ (Segmented\ Image\ Results\ \ \cap Ground\ Truth\ Table)}{Numbers\ of\ Ground\ Truth\ Table} \tag{2}$$

$$Average\ \ False\ of Postive\ Rate(AFPR) = \frac{numbers\ of\ \ (Segmented\ Image\ Results\ \ \cap Ground\ Truth\ Table\ of\ skin\ lesions\ )}{Numbers\ of\ Ground\ Truth\ Tabble} \tag{3}$$

$$\text{Error Probability } (EP)\ = \frac{FPR + FNR}{TPR + FPR + TNR + FNR} \tag{4}$$

$$\text{False Negative Rate}(FNR) = \frac{numbers\ of\ \ (Autmated\ system\ Image\ Results\ \ of\ skin\ lesion\ \ \cap Ground\ Truth\ Table\ of\ \text{skin lesion})}{Numbers\ of\ Ground\ Truth\ Table} \tag{5}$$

$$Ture\ Positive\ Rate(TPR) = \frac{numbers\ of\ \ (Segmented\ Autmated\ and\ manual\ Results\ \ \ \cap Ground\ Truth\ Table\ of\ skin\ lesions)}{Numbers\ of\ Ground\ Truth\ Table\ of\ skin\ lesions} \tag{6}$$

$$Ture\ of DetectionRate(ATDR) = \frac{numbers\ of\ \ (SegmentedAutmated\ and\ manual\ Image\ Results\ \ \cap Ground\ Truth\ Table)}{Numbers\ of\ Ground\ Truth\ Table} \tag{7}$$

Tables 1, 2 and 3 show the comparisons between the proposed technique and other methods of assessing images based on the 200 PH2 dataset; the ABC method achieves better performance than all additional segmentation methods based on the assessment parameters selected to assess accuracy and specificity.

TABLE 1. Results of segmentation on eighty common moles and skin dye from PH2 database pictures.

Segmentation Method %	**Parameters**		
	Accuracy	**Sensitivity**	**Specificity**
SRM	72.50	7.51	93.32
Level Set	79.96	70.69	82.62
JSEG	93.70	69.77	97.83
ASLM	94.77	**87.17**	97.60
Method (ABC)	**94.88**	70.42	**98.40**

TABLE 2. Results of segmentation on eighty nonstandard moles and skin dye from PH2 database pictures.

Segmentation Method %	**Parameters**		
	Accuracy	**Sensitivity**	**Specificity**
SRM	68.12	10.42	89.54
Level Set	79.85	73.64	82.37
JSEG	92.36	74.35	97.08
ASLM	92.71	**86.40**	97.33
Proposed Method (ABC)	**93.94**	66.77	**98.75**

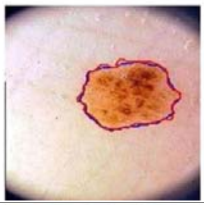
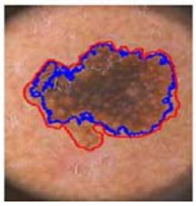
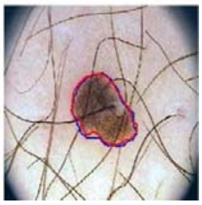
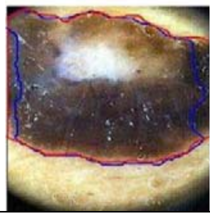
TABLE 3. Results of segmentation on forty malignant lesions and skin dye from PH2 database pictures.

Segmentation Method %	**Parameters**		
	Accuracy	**Sensitivity**	**Specificity**
SRM	41.48	22.34	75.12
Level Set	72.49	70.73	70.15
JSEG	75.91	67.46	95.93
ASLM	66.15	54.04	95.97
Proposed Method (ABC)	**95.18**	**64.16**	**98.97**

Table 1 shows the results of segmentation on eighty common mole and skin dye fromPH2 dataset. Using for the ABC method, an accuracy increases from 93.01- 94.88, a specificity increases from98.00 – 98.40, and the sensitivity reduces from 72.85to 70.42. The results of segmentation on 80 nonstandard moles and skin dyes from the database are seen in Table2; again, the ABC algorithm is superior to the other four methods. In this case, the accuracy for the ABC technique increases from 93.01 to 93.94, specificity increases from 98.00 to 98.75, and sensitivity moves to 66.77 from 72.85. In this case, the accuracy for

ABC technique increases from 93.01 – 93.94, specificity increases from 98.00 - 98.75 and sensitivity develops 66.77 from72.85. From Table 3 can be showing the results of segmentation on 40 MM lesions of the skin dyes from dataset pictures. Especially, ABC algorithm presents the value of the sensitivity reduces from 64.16 to 72.85, Table 1 shows the value of the accuracy and specificity have been increased compared with Tables (2and 3), (i.e. in the skin cancer lesions detection is easy stages for this procedure). The segmentation outcomes from figure (7) demonstrate the efficiency of the method is used in the existence segmentation.

TABLE 4. Identification of Malignant Melanoma (MM) with segmentation using the ABC algorithm

Number of Image	Original Image	Segmented Output
IMD405		
IMD058		
IMD101		
IMD437		

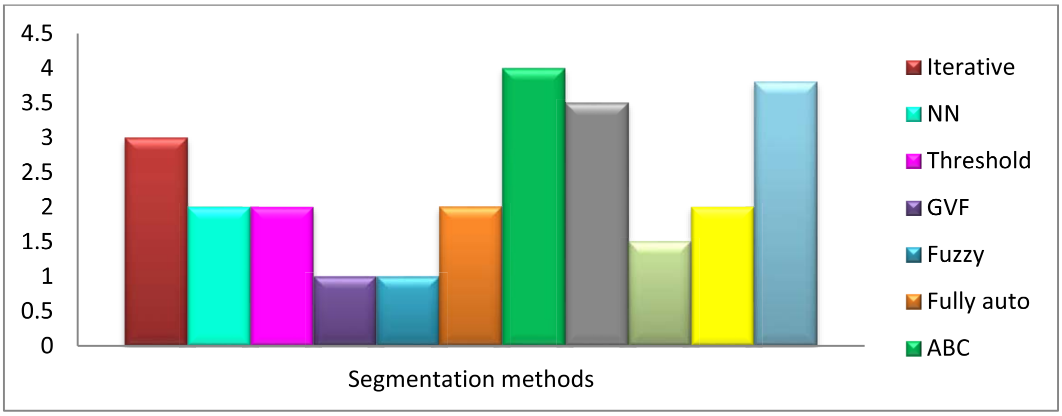


Figure7. Comparison chart methods of segmentation [39].

Benign and malignant skin tumours were more common in men than in women. After reviewing the anatomical distribution of skin tumours, it was noticed that no body portion was excluded, though the majority, and equal numbers, of skin cancers were found in the head and neck area (44.8 percent) and the extremities (44.8 percent) [40,41].

4.Conclusions

Segmentation is a significant development supporting the categorization of extracted lesions as healthy or unhealthy nevi [Benign and Malignant]. Malignancy maintains the requirement for examination and then medical checking. Accurate categorization needs to be captured after careful division.
The results show that a modified automatic system based on ABC algorithms has the highest accuracy and specificity compares with the other algorithms. In particular, ABC becomes a highest accuracy with melanoma skin cancers, although the accuracy is smaller than for the benign lesions.
For the efficiency of the proposed method, it is compared with already obtainable melanoma recognition methods.
The efficiency of the proposed method is comparable with current melanoma recognition methods, offering a 10-year survival rate of 80 percent such that 80 out of 100 people diagnosed as having MM tumours will still be alive 10 years after the tumour is identified.
In future work, new algorithms with different medical imaging of skin cancer lesions (healthy and non-healthy) should be developed and subject to analysis. The earlier skin tumours can be identified and addressed, the more life spans should rise in the future [42].

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