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Plant Disease Image Segmentation applying the K-Means Algorithm, Firefly, and Particle Swarm Optimisation

Mandeep Kaur
Dept of Computer Science & Engineering, CT University, Ludhiana, Punjab India

Abstract: The process of dividing an image to several pieces with comparable features is known as segmentation of images. A difficult phase in the image segmentation process is to extract the information from the image. Clustering is used to segment photos of a similar type or to assess the relevance of data. In essence, clustering is an unsupervised learning process. The data elements that make up one cluster share the same kinds of characteristics. In other words, each cluster has a minimum difference between its points and a maximum difference from the data points of other clusters. The suggested approach clusters image pixels by combining Particle Swarm Optimization with K-Means. Since combined techniques produce the best results, K-means should be thanked. K-means combined with Particle Swarm Optimization performs better than firefly combined with K-means. The firefly algorithm is used to tackle optimization issues and has a variety of uses. The Firefly method has been utilized in numerous research and optimization fields. Firefly algorithm and Firefly have been effectively utilized to solve a variety of issues. The firefly algorithm needs to be altered or combined with other algorithms in order to be used to a wide range of problems. Due to their metaheuristic nature, contemporary algorithms are crucial for solving NP-Hard problems.
Keywords: Particle swarm optimizations, K-means, Firefly, and the clustering technique for images

I. INTRODUCTION

A. Introduction of Image Segmentation

Image segmentation is one of the essential phases in the study and interpretation of images. The process of breaking down a digital image into several subsets is known as image segmentation. The image is divided into several parts with constant properties due to varied textures, shapes, boundaries, and colours. Four key picture segmentation techniques include threshold segmentation, edge detection, region extraction, and clustering. The process of breaking down a digital image into several subsets is known as image segmentation. https://www.sic.ici.ro168 Romana Capor Hrosik, Eva Tuba, Edin Dolicanin, Raka Jovanovic, and Milan Tuba are divided into numerous discontinuous segments, each of which contains elements that are related to yet distinct from those found in the other segments depending on factors such as intensity level, textural features, frequency components, etc. When brain tumour identification is the focus of segmentation

is to clearly distinguish the anomaly, in this case the tumors, from the rest of the image. Different methods were put forth for image segmentation. The most popular techniques include thresholding, edge detection, histogram-based techniques, clustering-based techniques, and others. In this article, we suggest a method for medical image segmentation based on the clustering algorithm. Romana Captor Hrosik, Eva Tuba, Edin Dolicanin, Raka Jovanovic, and Milan Tuba into numerous discontinuous parts, with elements in one segment being similar to, but different from, elements in other segments based on various criteria, such as intensity level, textural aspects, frequency components, etc. When brain tumor detection is taken into consideration, segmentation's purpose is to distinguish the anomaly—in this case, the tumor—clearly from the surrounding area of the image.

Thresholding, histogram-based approaches, clustering-based techniques, region-growing methods, edge detection, etc. are some of the most used methods. In this study, we offer a clustering-based approach for segmenting medical images. Different methods for image segmentation have been suggested. Thresholding, histogram-based approaches, clustering-based methods, region-growing methods, edge detection, etc. are some of the most used techniques.

Using segmentation based on the clustering technique, we offer a method in this study for identifying illnesses in plant images. A method of unsupervised classification is clustering. Data handling, thickness, centroids, and other factors can all be used to group data into clusters. In this research the K-means algorithm among other clustering techniques.

However, determining the initial centroids for the k-mean is a significant issue K-means can be used to create centroids for the original cluster, but it becomes trapped in local optimum [9]. It **is** challenging to match the time restrictions and complexity of the standard approach when optimizing centroids' effectiveness through picture analysis. Many academics plan to apply swarm intelligence to improve the K-means algorithm. The cuckoo algorithm, artificial bee colony optimization, and differential algorithm are currently used successfully optimization algorithms for image processing. Swarm intelligence-based algorithms are developed from applications of the firefly method and are used to resolve optimizations issues. When used in many optimized and research fields, the firefly algorithm produces very precise and effective results. Using an algorithm, the flashing pattern and behavior of fireflies was created. [3]. The goal of this study is to offer a clustering k-means picture segmentation algorithm that is merged with firefly and particle swarm optimization [7].

B. Firefly Algorithm

Swarm intelligence optimisation techniques are now primarily used in information technology applications. In many fields, optimisation techniques are employed to enhance specific functions and their results. After being used in numerous applications, the Firefly algorithm produces findings that are backed up and precise. The Firefly algorithm has to be changed because it cannot handle complex issues. Author Yang.X.S. was the one who first created the Firefly algorithm. On the basis of Firefly's flashing pattern behaviors, the Firefly algorithm was created.

The behaviors and flashing pattern of fireflies served as the foundation for the swarm intelligence programme known as the "firefly algorithm." [3].

Following are the assumptions of Fireflyalgorithm:

1) All fireflies are unisexual, which means they are attracted to other fireflies and are neither male nor female.
2) The primary key element is brightness. One firefly will be drawn to a brighter firefly if it is less luminous. Increases in distance and decreases in light intensity cause brightness to automatically dim.
3) A firefly will move at random if there are no other fireflies around.

Two crucial processes are included in the firefly algorithm: varying the light intensity and determining attractiveness. For the suggested method, we stipulate that the firefly's brightness, which is determined by an objective function, is utilised to calculate attractiveness.

The light intensity I(r) varies with distance ‘r’ monotonically and exponentially, is given by:

$$I = IOe{-}y \qquad (1)$$

Where I0 is defined as the initial light intensity and y is defined as the light absorption coefficient.

The firefly attractiveness þ is:

$$Q = Qe{-}yr2 \qquad (2)$$

Where the distance between the two fireflies is denoted by ‘r’ and þ define them attractiveness at r=0

C. Image Segmentation Usingfirefly and k-Means

Data clustering is a method of unsupervised learning. The K mean clustering algorithm separates the data into k clusters. Each data point with the shortest distance from the original centroids is assigned to the cluster. The data point is disassembled to a useful centroid, and the fresh centroid is calculated repeatedly to inform Confluence. Clusters formed from pixels of the same type. Initial centroids are a major factor in the K-means algorithm's performance and efficiency. Centroids are immediately generated now the method is running [5]. Due to this, the k mean approach is prone to local optimum trapping and is unable to deliver accurate and efficient clustering results. We employ a heuristic technique to look for global solutions to this issue.

A. Integration of K-means with Firefly Obtaining relevant findings and dynamic clustering are influenced by the following two key elements: It assists in determining the competent centroid position during initiation. It discovers universal solutions in addition to local ones. A universal solution can be attained by having a maximum intra-connection and a minimum inter-connection. Between K-means and K-means integrated with Firefly, the addition of the exploration function is the only distinction. The existing solution is continuously enhanced and optimized by this exploring feature. When a certain standard value is reached, the firefly searching agent finds a new answer and replaces the old one. K-means and universal approaches are absent from the search [10].

K-means has three steps:

1) Initialization
2) Cluster Assignment
3) Exploration and Evaluation

Figure 1 has shown working of my research following steps are to be considered in research

a) Step1: Start
b) Step2.upload data of plant images which is to be taken from plant village set
c) Step3: Extract GT as {d1n1, d2n2, d3n3 d4n4, d5n5} where where, d represents disease and n represents total no. of element Step4: For each cat in GT S= Perform Segmentation using K-means
d) Step5: Perform K-means hybrid with Particle swarm optimization
e) Step6: Perform K-means hybrid with firefly

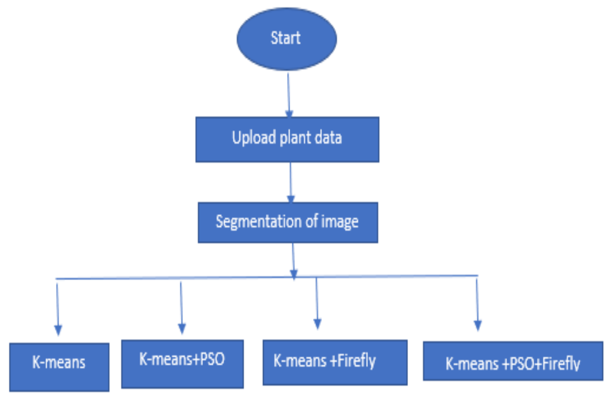

Fig 1 Algorithms applied to detect diseased and healthy images of plants

II. EXPERIMENTS RESULTS AND DISCUSSIONS

The proposed algorithm is applied on plant images. we have taken apple black rot image, disease image, healthy plant image.in these images segmentation is applied with K-means, K-means hydrated with PSO, K-means Hydrated with Firefly. Among these applied algorithms optimum result will be given by K means hydrated with firefly Figure 1.1

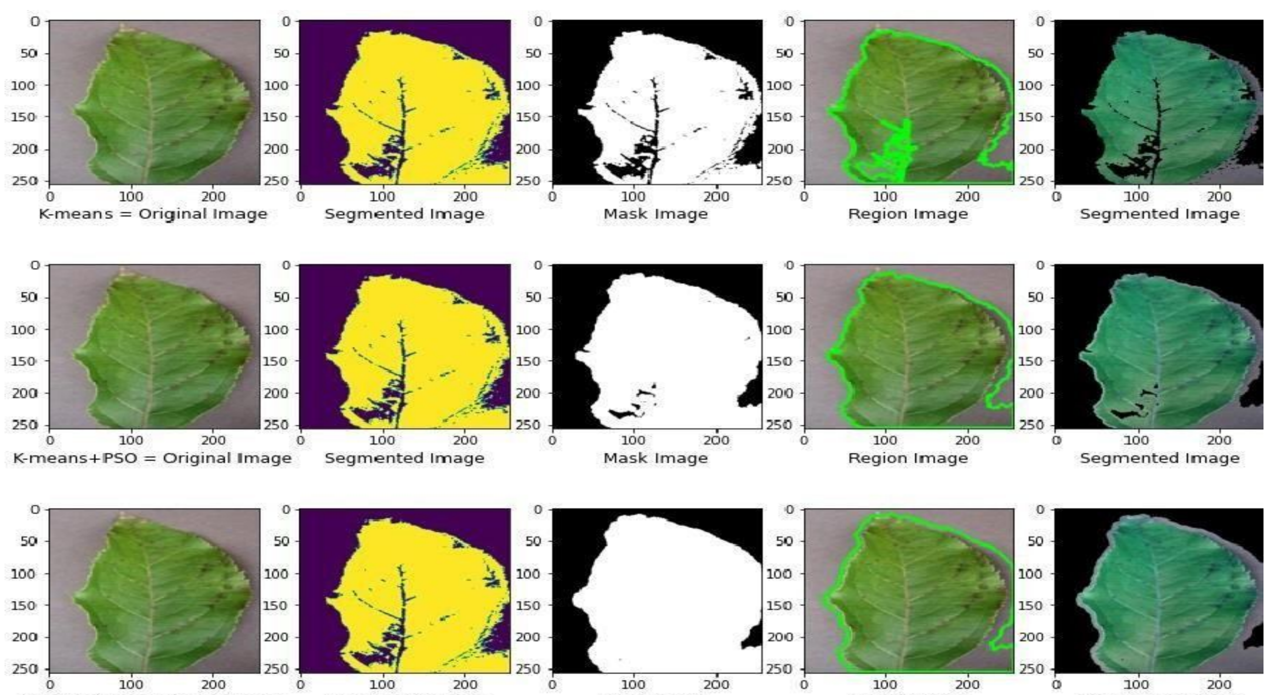

Figure 2. K-means, K-means+PSO & K-means+Firefly techniques applied on plant image 1(1)

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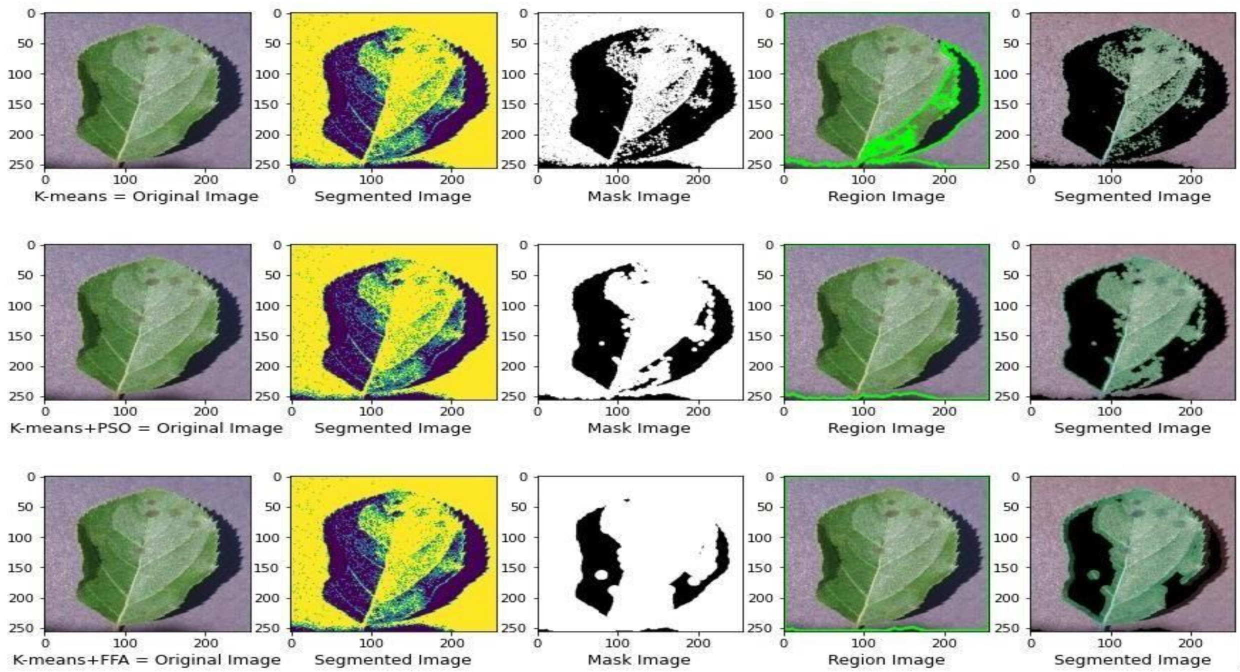

Fig 3. . K-means, K-means+PSO & K-means+Firefly techniques techniques applied on plant image 1(2)

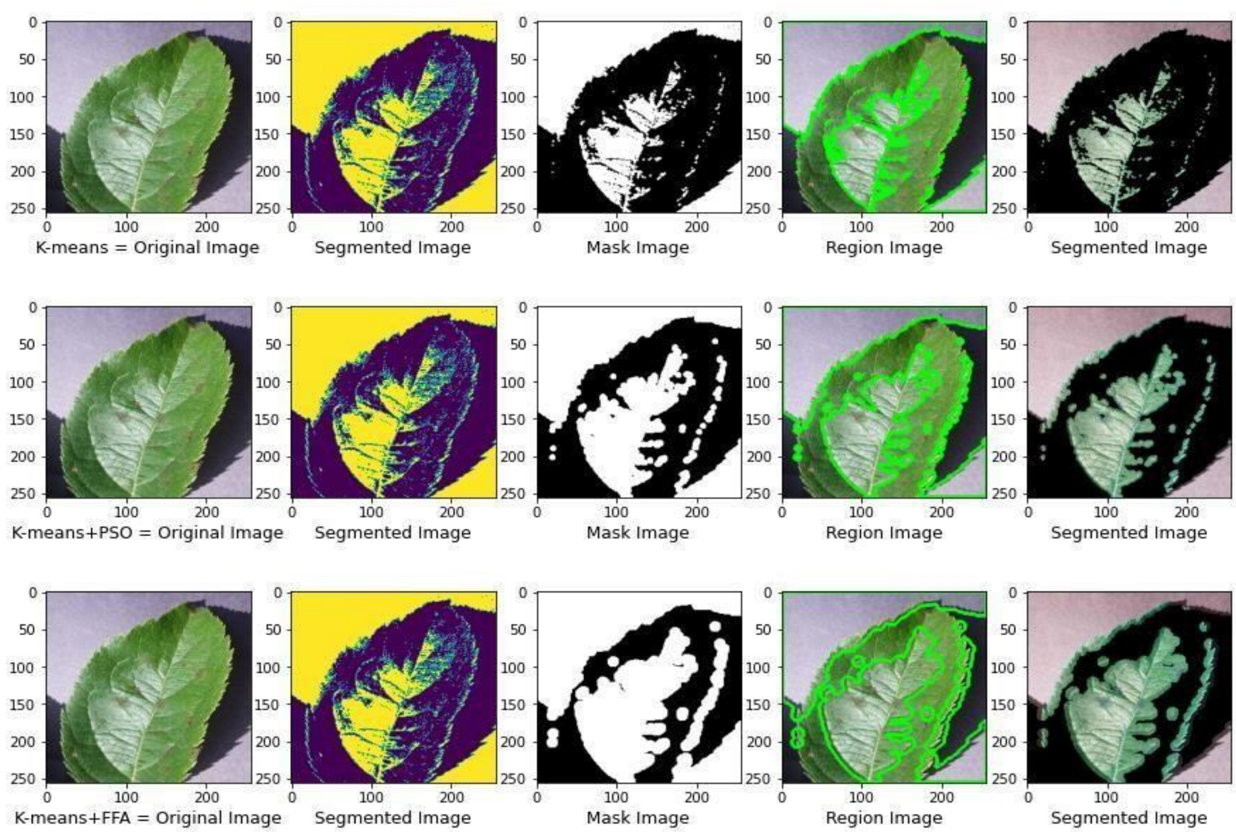

Fig.4 . K-means,K-means+PSO & K-means+Firefly techniques Techniques applied on plant image 1(3)

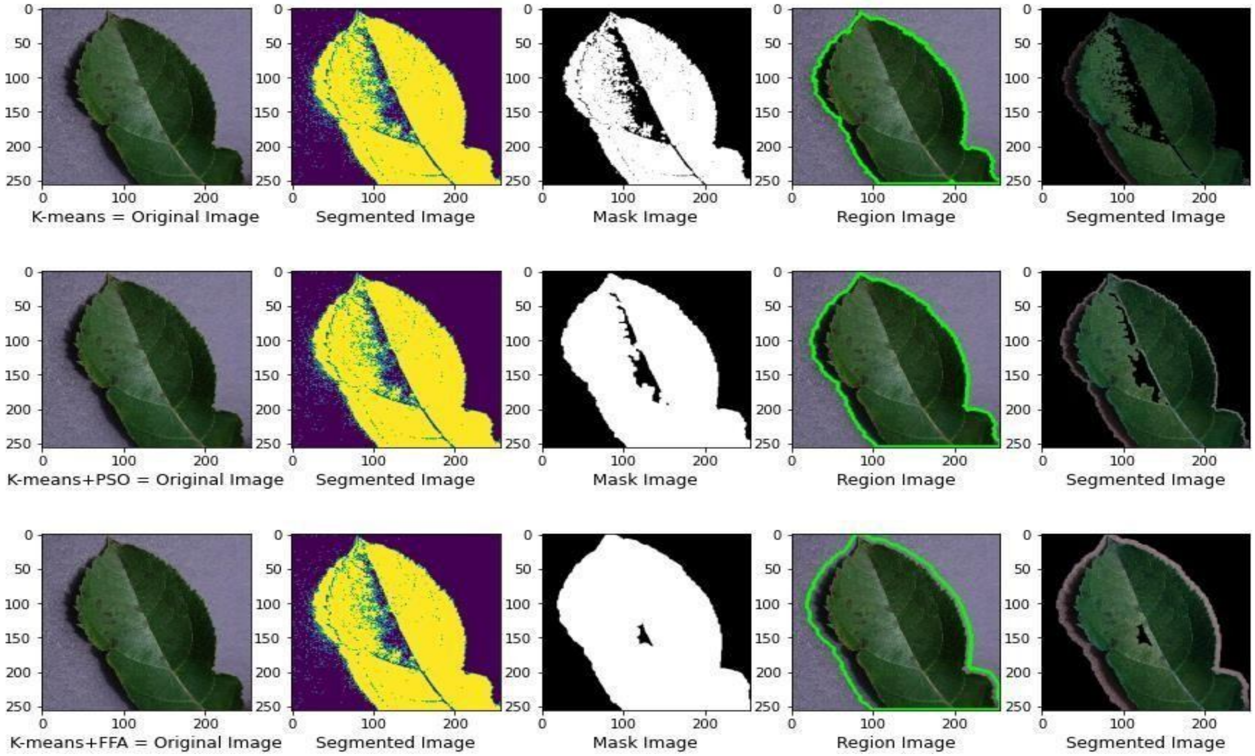

Fig 5 . K-means,K-means+PSO & K-means+Firefly techniques applied on plant Image 1(4)

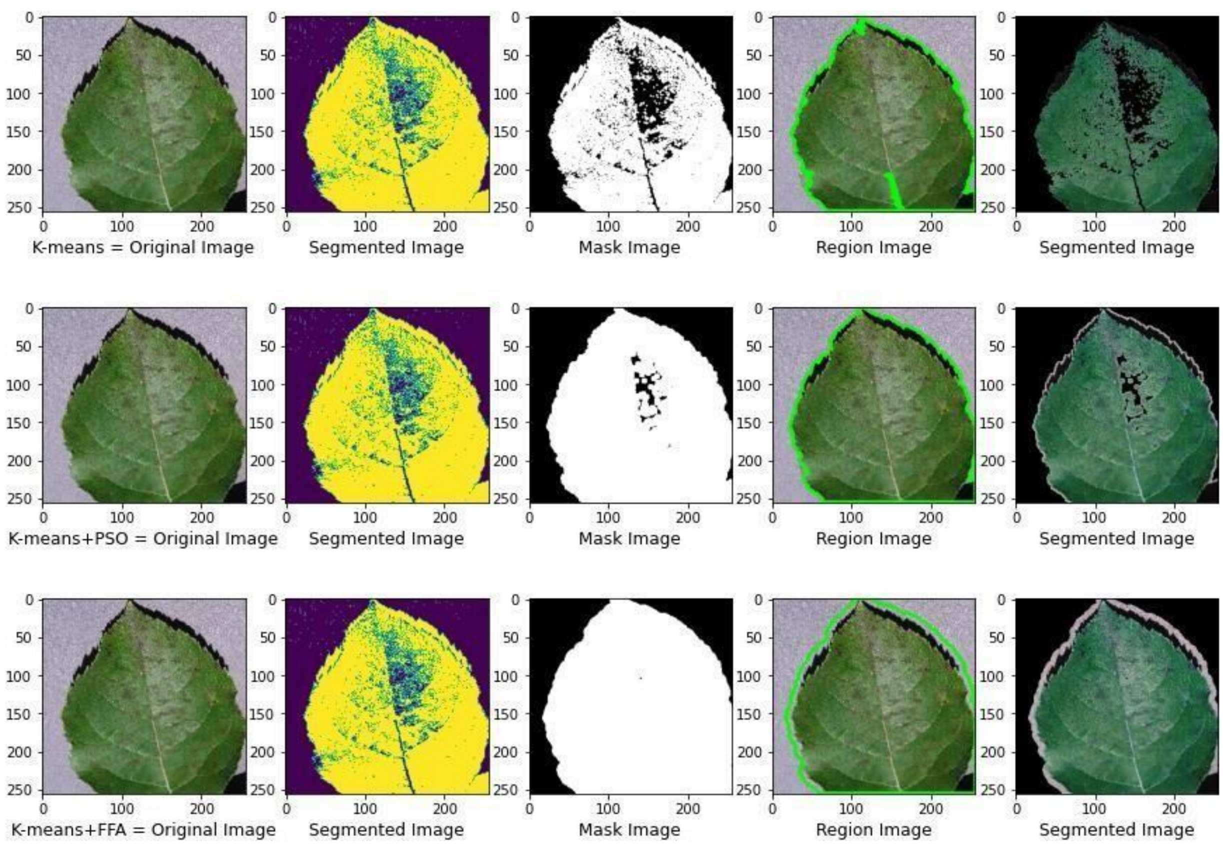

Fig6. . K-means, K-means+PSO & K-means+Firefly techniques applied on plant image 1(5)

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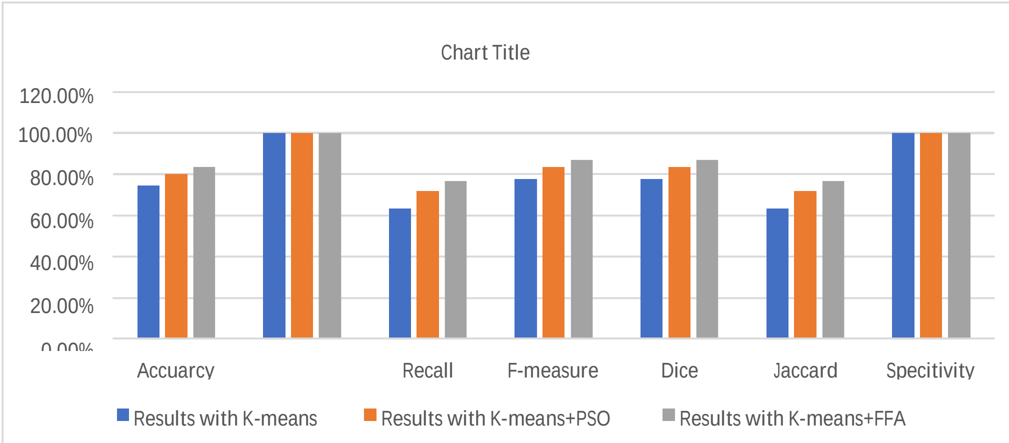

Fig.7 Comparative analysis of various ML techniques for image segmentation under specific parameters for image1(1)

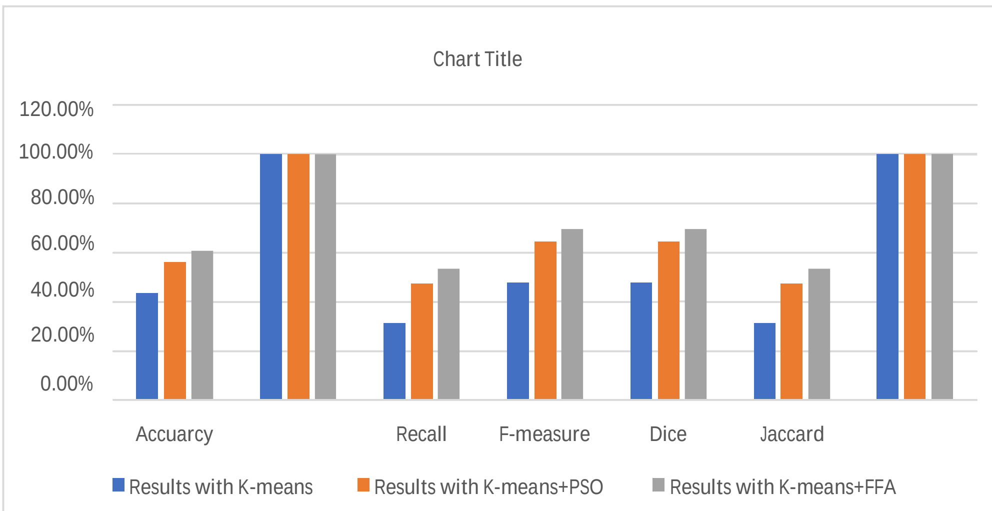

Fig 8. Comparative analysis of various ML techniques for image segmentation under specific parameters for image1(2)

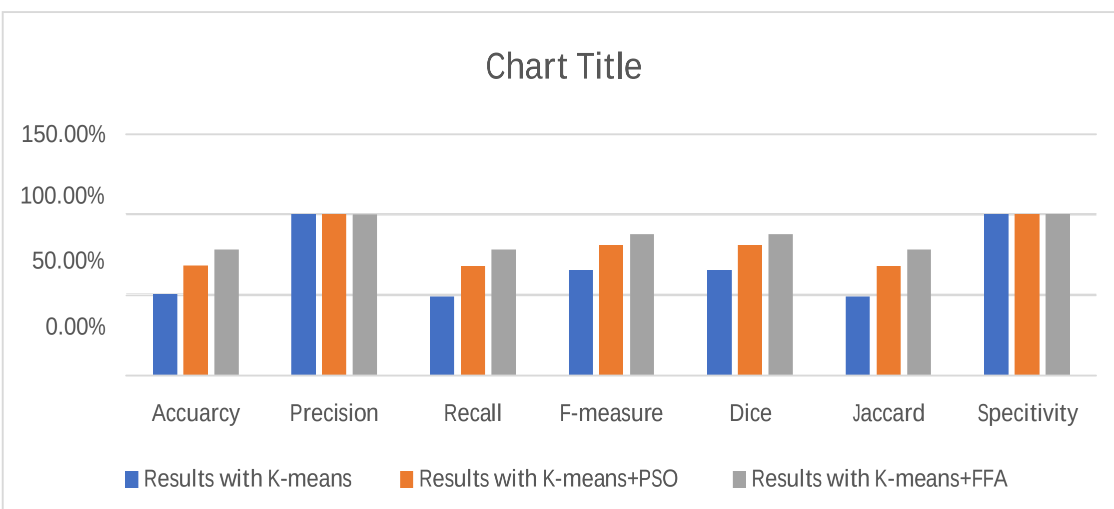

Fig.9 Comparative analysis of various ML techniques for image segmentation under specific parameters for image1(3)

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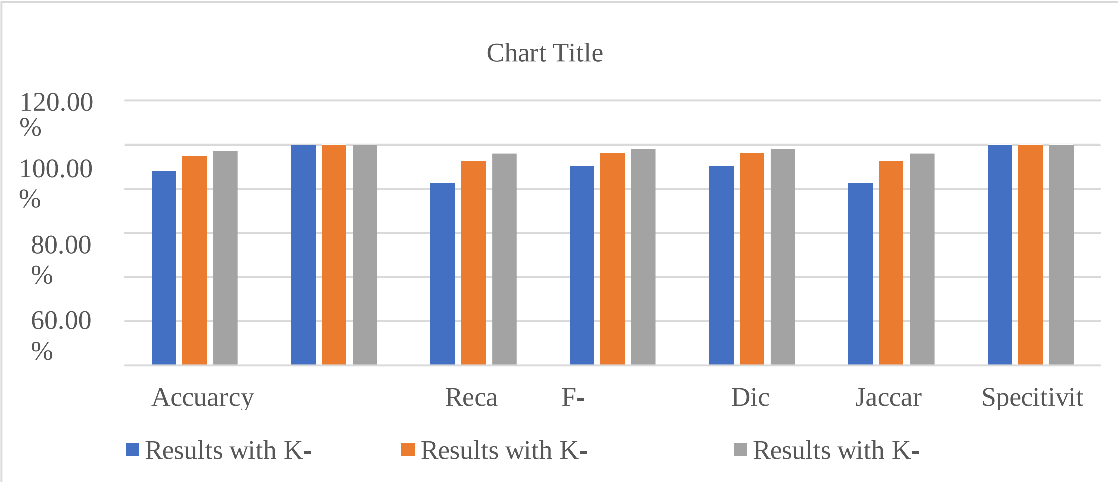

Fig.10 Comparative analysis of various ML techniques for image segmentation under specific parameters for image1(4)

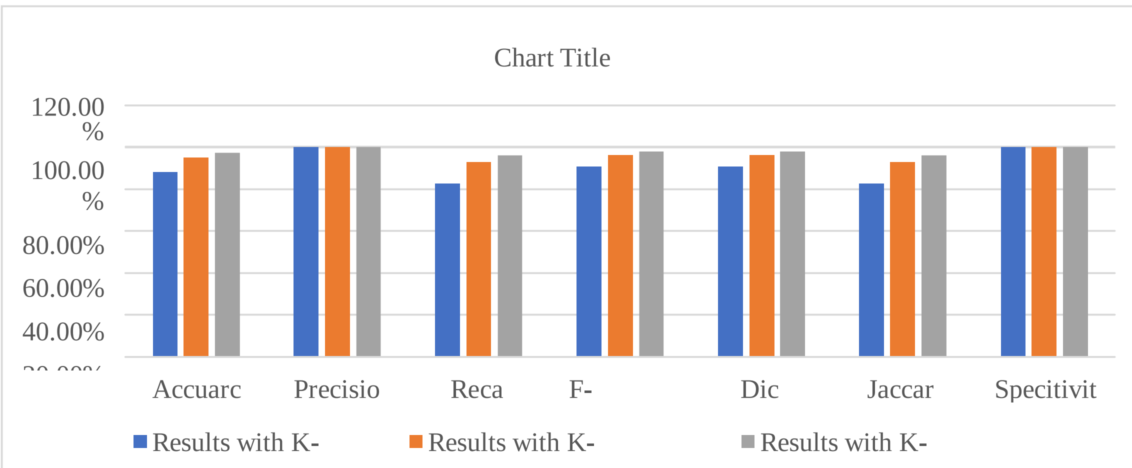

Fig.11Comparative analysis of various ML techniques for image segmentation under specific parameters for image1(5)

TABLE 1 Showing by applying algorithm on different images given different values for different parameters

Image 1			
Accuarcy	74.51%	80.26%	83.63%
Precision	1	1	1
Recall	0.633000995	0.718406625	0.769020796
F-measure	0.775261003	0.836131117	0.869431041
Dice	0.775261003	0.836131117	0.869431041
Jaccard	0.633000995	0.718406625	0.769020796
Specitivity	1	1	1
Image 2			
Accuarcy	43.71%	56.10%	60.69%
Precision	1	1	1
Recall	0.313470124	0.474797011	0.5345717
F-measure	0.477315956	0.643881168	0.696704754

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Dice	0.477315956	0.643881168	0.696704754
Jaccard	0.313470124	0.474797011	0.5345717
Specitivity	1	1	1
Image 3			
Accuracy	50.19%	68.28%	78.20%
Precision	1	1	1
Recall	0.486502117	0.678826714	0.78132735
F-measure	0.654559602	0.808691818	0.877241738
Dice	0.654559602	0.808691818	0.877241738
Jaccard	0.486502117	0.678826714	0.78132735
Specitivity	1	1	1
Image 4			
Accuracy	88.18%	94.87%	97.24%
Precision	1	1	1
Recall	0.827176201	0.925744292	0.960466354
F-measure	0.905414815	0.961440515	0.97983457
Dice	0.905414815	0.961440515	0.97983457
Jaccard	0.827176201	0.925744292	0.960466354
Specitivity	1	1	1
Image 5			
Accuracy	86.00%	95.75%	97.20%
Precision	1	1	1
Recall	0.801383331	0.940757362	0.961345393
F-Measure	0.889742141	0.969474475	0.98029179
Dice	0.889742141	0.969474475	0.98029179
Jaccard	0.801383331	0.940757362	0.961345393
Specitivity	1	1	1

III. CONCLUSION

This work introduces a novel hybrid picture segmentation technique called KFA (k-mean firefly algorithm). The suggested approach is a meta-heuristic that effectively segments images and achieves clustering convergence. The correlation coefficient for the numerous images in the various clusters was calculated, and it revealed that the image segmentation had an accuracy of 88%. The experimental finding demonstrates that this strategy yields superior outcomes and correlation coefficient. Numerous uses for this proposed technique exist, such as the detection of plant diseases, medical imaging, content-based picture retrieval, etc. This method can be improved upon to produce outcomes and applications that are more effective. Future modifications to this algorithm could include automatic cluster count calculation and clustering itself.

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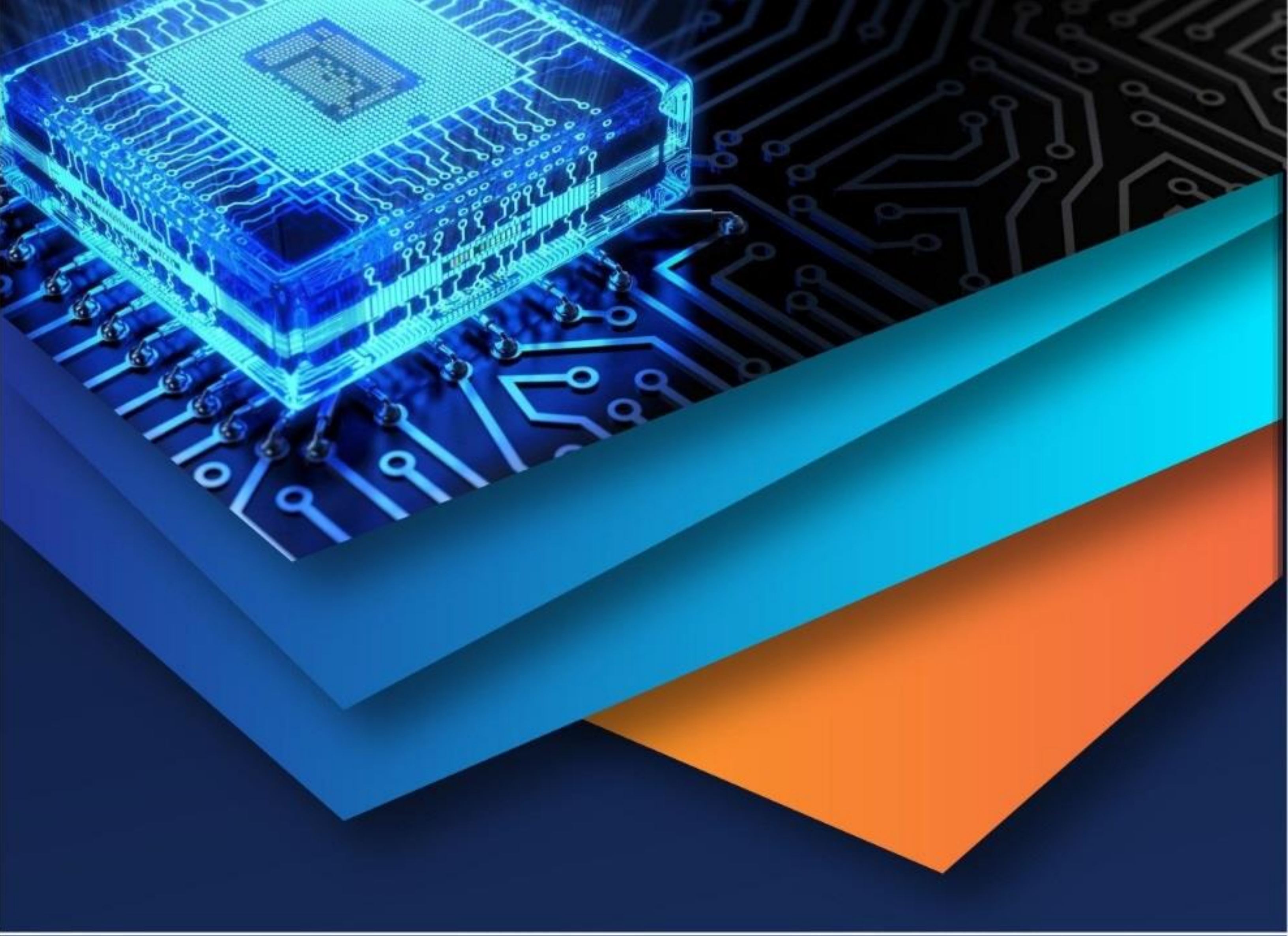

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