An Integrated Maximized Probabilistic and Gaussian based thresholding method and segmentation technique for Shrimp White Spot Disease Detection

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Abstract

White spot syndrome can be defined as a viral infection which can infect numbers of different crustacean species such as shrimp, fishes etc. Histopathology is considered as the oldest and most widely implemented diagnosis strategy for white spot identification and diagnosis process. By implementing the histopathology approach small pathological modifications in cellular levels can be detected. The main problem in this model is, it needs much time in order to build histological slides and formulate the diagnosis process. Also, most of the existing white spot syndrome identification models have over-segmented regions for shrimp disease prediction. Also, these models require high computational time and memory for pattern identification. Image threshold methods are necessary for the process of registration, segmentation, and identification of objects in a particular...
scenario. An efficient threshold technique improves the true positive and minimize the error rate for disease pattern detection process. Image segmentation is responsible for the extraction of the regions of interest either semi-automatic or automatically. Image segmentation is considered as complicated tasks during the white spot disease recognition process and pattern recognition process. In this paper, a novel white spot detection model is designed and implemented using the two improved models. In the first model, images are filtered using the proposed probabilistic based thresholding method. In the second model, segmentation algorithm is applied on the filtered image for white spot syndrome detection. Experimental results proved that the this filtered based segmentation approach is better than the traditional models in terms of accuracy and time are concerned.

1 INTRODUCTION

White spot syndrome is a specific viral infection that usually affects numbers of different crustacean species such as shrimps. This disease was initially identified in different Asian countries. The above said disease is the prime cause of huge economic downfall in most of the aquaculture industry. The traditional and mostly used approach to identify white spot disease is histopathology. By applying the histopathology approach minute pathological modifications in cellular levels can be identified easily. The method of histopathology results a serious issue that is:- this technique needs much time in order to build histological slides. Again, time is required to perform certain diagnosis. The time required during the diagnosis process is dependent upon the characteristics of the tissues or on every individual histopathological modification.

Almost all diseases in aquaculture are epizootic in nature. The time involved during the diagnosis of epizootic disease is very crucial, because we should make full proof plan to either terminate the disease or obstruct it from being spread. Polychromatic images are usually used to recognize various objects, but it is not efficient to recognize organisms. This technique was initially implemented to identify the inclusion bodies of the virus called as Infectious and Hematopoietic and Hypodermic Virus. In the subsequent time, this
previous approach was considered and few modifications are performed in order to show the sensibility of digital system with the help of color correlation technique integrated with phase filtering method. The above mentioned enhanced approach has the responsibility to detect inclusion bodies of WSSV successfully.

Till today there are total twenty numbers of different virus species those have the capability to infect and harm marine shrimps within no time. In between these twenty viruses, only seven viruses are considered by World Organization for Animal Health as dangerous threat for various species of marine shrimps. White spot syndrome is considered as the most dangerous type of pathogen created disease which is usually found in case of farmed shrimps. Hence, it will definitely influence the economy of shrimp business throughout the world. White spot syndrome disease is usually an infection caused by viruses.

This is the only species of the family Nimaviridae. This virus has a double strain DNA which is actually ovoid, ellipsoid or bacilliform in shape. This virus usually has a trilaminar membrane and the size of the virus is 120-150 X 270-290 nm. It has the genome with size 290 kbp. This disease spreads very rapidly and it increases mortality along with several other symptoms just like anorexia, lethargy, and so on. According to various researches, certain Asian species when affected with this virus develop white spots on the cephalothorax. In case of some American species, the infected shrimps develop reddish coloration because of the expansion of chromatophore. This virus is capable of infecting shrimps at every stage of its life cycle that is from the eggs to broodstock.

After detection of clinical signs, its mortality can be increased to 100% within only 3 days. White spot diseases highly contagious in nature and it mostly affect the shrimps of penaeid family. Apart from this, lobsters and crabs can also be infected with this deadly virus. indiffent states of Mexico, the shrimp producers suffered from huge losses because of this disease. Therefore, it is necessary to plan preventive action in order to control this disease. Different approaches have been proposed for the diagnosis process of viral and bacterial infections in case of shrimps.

All of these methods can be classified into three major categories, those are:- conventional morphological Pathology, bioassay and microbiology. There are three important techniques those can
be implemented during the conventional diagnosis process. Those three techniques are mentioned below:-

1. Histological analysis

2. In situ hybridization in case of fixed issues along with WSSV gene probes

3. PCR approach along with oligonucleotide primers.

Histology is the oldest and most commonly used research technique in case of medical domain to carry out the process of diagnosis. There are certain cases where huge diagnostic requirements are present. All of the above cases, the epidemiological studies needs large amount of slides to be analyzed in order to detect minute pathological modifications in case of tissues. Pathogen detection is very crucial and complicated task. In case of the above scenario, the traditional histological technique he is no more efficient. Hence, there is necessity of other advanced approaches.

The advanced approaches must include various phases in order to get the final sample that is a tissue slice of 5 micrometer width. The above mentioned tissue must be stained with hematoxinelineosin in order to perform the whole examination process with the help of a microscope. WSSV infection is mostly found in case of cuticular epithelial cells. Apart from this, some connective tissue cells of the stomach and gills can also be affected by this disease. Furthermore, disinfection is also found in case of antennal gland, lymphoid organ, hematopoietic tissue and phagocytes of heart.

All the infected cells contain huge an enlarged nucleus and show a intranuclear inclusion. Initially these inclusions are eosinophilic in nature. But, there also exist certain cases where these are isolated through a proper halo beneath the nuclear membrane. Such types of inclusions are called as Cowdry type A inclusions. In the subsequent time, these inclusions become light to deep basophilic in which the whole nucleus is filled. Therefore, there is an necessity for a fast and sensitive diagnosis approach that can assist in the development of other advanced approaches those can include various other domains just like computing optic field.

This domain is mostly used as a vital support for the traditional approaches. Various optic and computational approaches
are proposed in order to recognize the above mentioned types of biological patterns. The analysis process of the inclusion bodies actually identifies the presence of virus. Therefore, the color correlation technique is implemented in order to analyze and recognize the presence of IHHNV. The prime objective of the above mentioned approach is to demonstrate an advanced algorithm that will be efficient enough to analyze various shrimp tissue samples those are infected by white spot disease virus. In this case, the inclusion bodies are gathered from various histological digitalized color images through implementation of Fourier spectral filtering approaches just like K-law-nonlinear filter.

These approaches are responsible for showing the ability to analyze vital features from different pathogens.

Edge detection is considered as a vital field in case of image processing. In fact, edges are responsible for characterization of object boundaries and hence, these are beneficial for the process of registration, segmentation, and identification of objects in a particular scenario. An efficient edge detection technique is responsible for decrease of huge amount of data. But, it includes very important characteristics of a particular image. The edge detection approach is generally discontinuous localization process of a particular image. This discontinuities are from various features of the scene just like discontinuities in depth, discontinuities surface orientation, modifications in case of material properties, and modifications in case of scene illumination.

All of the traditional edge detection approaches are dependent upon various numerical derivatives closer to the pixel of the image. These types of approaches are mostly simple and easy to use. The above-mentioned approaches can be implemented in case of restricted numbers of images. These techniques can be influenced by presence of noise and this may lead to the prime cause of edge rupture. There have been extensive amount of research is carried out it is field. Because of the complexity and diversity of image content and the image mechanism of digital imaging, the resulted precision is not very satisfactory. Again, the outcomes of the image detection process are not ideal in most of the cases. We can mention here that, till date there is no edge detection approach is present that can be implemented in case of all types of images.

Hence, there exists necessity of developing latest and advanced
approach. Quantum computing is actually the integration of two different disciplines, those are:- informatics and physics. In this approach, the characteristics of small particles included in the Quantum theory are used during the information processing phase. The control of quantum objects encoding information is completely non trivial task. Hence, enough theories are available in this field. Now-a-days, the concepts of quantum theory can be implemented in order to enhance various traditional approaches.

Like this the process of quantum computation can easily resolved the cost related issues of traditional computer in case of vast amounts of data. Let us consider an example of the evaluation process of an inner product or search for a minimum distance. Both of the above mentioned tasks can easily be executed in case of a Quantum computer along with either linear or exponential speed up in complexity. Quantum parallelism is the major cause of the above-mentioned speed up in complexities. The quantum machine learning process is responsible for including various additional possibilities in case of quantum information processing (for example quantum state classification).

Quantum information science is a new field which is constructed by combining the traditional information science along with the quantum physics. This field has become popular since last decade. We can mention here that, the theories of quantum mechanics hot most appropriate and accurate ones. Both microscopic and macroscopic teachers are dominated with the help of quantum mechanics. QIS is responsible for the acceleration of information science domain. The processing of a particular Quantum image is considered as an important Quantum Signal Processing method.

The traditional image processing approaches are usually changed or new approaches are developed through the implementation of various mathematical models of quantum mechanics. There exist certain issues those can be resolved by the implementation of quantum computation. Quantum computation has wide range of applications in different domains of computer science just like cryptography, image processing, image theory, and so on.

The process of image segmentation has the responsibility to extract the regions of interest either semi-automatically or automatically. Image segmentation is considered as one of the difficult most tasks in case of computer vision and pattern recognition process.
It has wide range of applications in several domains such as object identification, object recognition, image extraction, medical Image processing, video surveillance, and so on. There exist various image segmentation approaches for different types of applications.

There is no standard segmentation framework which can be implemented in case of all images. Presently, active contour model is considered as the mostly used and famous segmentation technique. According to the curve of manifestation point of view, all of the segmentation techniques can be decomposed into two sub categories, those are:-

1. Parametric active contour model
2. Geometric active contour model.

The parametric active contour model is otherwise known as snake model. In case of a snake model, the curve is parameterized with the help of arc length. This approach is sensitive to the starting curve. It is not efficient to manage the topological structure deformation. In order to resolve this issue, later another technique is introduced which is known as geometric active contour model. The above model is also known as level set model. Depending on the energy function of image segmentation, all the segmentation approaches can be divided into two sub categories, those are:-

1. Edge based model
2. Region based model

The edge based active contour model is very much sensitive to noise. This sensitivity is because of the edge locality. To smooth the noise, Gaussian smooth filter approach is implemented. But, Gaussian filter will result blur edge and it will influence the performance of segmentation process. Apart from this, the sub region smoothing performance is controlled by Gaussian kernel variance. In case of non-homogeneous sub regions, it is quite complicated to select the appropriate variance technique adaptively. In order to resolve the above mentioned issue, another approach is introduced. This approach is responsible for the decomposition of the noise images into two different components, those are:- image and noise component.
After successful separation, the image component is segmented. This approach is very much sensitive in case of weak edge. Another group of researchers introduced an advanced segmentation approach that considers the prior shape for particular shape regions. The edge-based active contour model is very much sensitive to both noise and nonhomogeneous intensities of the actual image. In order to enhance the performance of segmentation process, few other improved strategies are developed.

These mechanisms are dependent upon piecewise smooth representation of image. Another active contour model that never considers edge is also developed. It includes the mean values of different sub regions intensity in order to represent region. This model is completely insensitive to noise. In order to resolve the issues of inhomogeneous intensity, another approach is proposed that is known as piecewise smooth model. In the above case, determination of fitting functions is quite complicated task. The real world images always contain nonhomogeneous regions. Again, these images are often influenced by noise.

The conventional active contour models are incapable of segmenting the images with noise and nonhomogeneous intensity regions appropriately. To overcome the above mentioned problem, another image segmentation technique is introduced. This approach involves the basic concepts of adaptive Gaussian smoothing.

Initially, a Gaussian kernel variance function is constructed depending upon the image sub-regions. Here, image smoothening occurs with the help of Gaussian filter having adaptive variance. In the subsequent phase, the level set model is implemented in order to segment the smoothing components. At last, to prevent curve vanishing, a convergence condition is formulated by considering the confidence of segmentation sub-regions. By analyzing the outcomes, we can state here that, this technique is more robust than that of all previously developed approaches. This method is more beneficial for images having non-homogeneous intensity.

Image segmentation can be defined as a process to segment a particular image into different sub-parts. Every individual part can also be further analyzed. There are large numbers of image segmentation approaches introduced, but not a single is applicable in case of all applications. According to another classification, there are three numbers of segmentation approaches, those are:-
1. Thresholding:- Thresholding approaches are implemented as the traditional selection tools during the process of segmentation. It includes large numbers of application where the objects and background are completely homogeneous in nature. All of these image points those grey levels darker than that of the threshold are considered and marked as black. Rest all points are represented as white.

2. Boundary based segmentation:- According to the boundary based techniques, different pixel properties just like intensity, color and texture can be modified.

3. Region based segmentation:- According to the region based approaches, all the pixels within the neighbouring pixel range must have equivalent values. Several clustering approaches are also implemented in order to analyze a vector input space. Here, a pre-processing step is also included in order to evaluate the feature vector for every individual pixel. All the similar vectors are included inside a common region and dissimilar vectors are included inside different regions. This technique has the responsibility to characterize different clusters, a single cluster for a single region.

4. The segmented image is identified through mapping the vectors back to the pixels. The prime objective of this clustering approach is to enhance homogeneity inside every individual cluster and heterogeneity inside different clusters.

2 RELATED WORKS

A. B. Hamza developed a new non-extensive information-theoretic measure for image edge detection [1]. Their presented approach is known as Jensen-Tsallis divergence. It can be defined among any random number of probability distributions. Only the important theoretical properties are analysed. By considering the theory of majorization, decorated the upper bounds performance. In order to achieve robustness and complement the above of divergence measure in case of imaging, certain numerical experiments are carried out. The above proposed technique is implemented in image edge detection. There also exist several limitation of this technique
and those issues can be overcome by the development of robust edge linking approaches combined with various image edge detection approaches.

The proposed technique is the simplest one among all other algorithms. Hence, it can easily be implemented in the following domains: medical Image registration, clustering, classification, indexing and extraction. In this research paper, the mention technique is implemented in order to register geographical digital elevation images.

S. Abdel-Khalek, et.al, developed an advanced technique in order to perform image edge detection smoothly with implementation of quantum computing [2]. They presented a new edge detection scheme depends upon quantum entropy. This technique uses a flexible representation of the quantum image. Information entropy is used in order to measure the exact amount of information present inside digital images during the complete process of quantum information processing. Quantum entropy considers correlations in between quantum bases in perform the required evaluation of entropy. Shannon entropy is not at all efficient in most of the scenarios, but quantum entropy is more effective as compared to Shannon entropy time of quantum information measurements. Hence, the quasithreshold maximum Quantum entropy is considered as the optimal threshold. Maximum information can be gathered only in case of the above scenario. Quantum image segmentation performs well in different computational states. This proposed method has wide range of applications fields of microscopy, microarray, medical and satellite images. The performance evaluation of this approach is computed according to the peak signal to noise ratio. The resulted outcomes are better as compared to six different approaches having real, microscopy and microarray images. In case of medical and satellite images, the quantum entropy approach shows better performance as compared to the four approaches. It can be mentioned here that, it results equivalent performance as the canny detector.

At last we can conclude that, quantum edge detection approach always results better performance as compared to other traditional approaches.

M. A. Bueno-Ibarra introduced K-law spectral signature correlation technique in order to detect white spot syndrome virus in
shrimp tissues [3]. This technique is introduced in order to detect the white spot syndrome virus mostly affect shrimp tissues. In this case, proper analysis is performed on the digitalised images collected from the infected samples. WSSV slide images are collected with the help of a computational image capture system.

An advanced identification approach is introduced in order to get these infected shrimp samples with the help of detective measurement of the complexity pattern. In this research paper, an advanced algorithm is introduced in order to detect various representative groups of digitalized images of WSSV by considering the histological slides. These histological information are collected from various organs of infected shrimps. The Fourier K- law non-linear filter approach results different vital WSSV features through the analysis of frequencies. By performing the experimental evaluation, the KSCA is considered as useful preliminary tool that can be used to analyse shrimp samples automatically. In future, water research can be performed in the application of the KSCA in case of additional tissue samples of various kinds of viruses having different pattern and complicated identification strategy.

Therefore, there is a necessity to characterize in order to construct a new and efficient filter bank. At last, we can mention here that, this approach can be implemented to analyse and identify are the types of shrimp viruses in future.

Cai Aiping, et.al, proposed an advanced technique for image edge detection [4]. The above technique depends upon fuzzy support vector machine classification. Various traditional approaches dependent upon support vector machine technique are analysed in this piece of research work. By performing a thorough survey on the above mentioned traditional approaches, an effective object cover edge detection strategy can be proposed. This technique considers Canny edge detection technique and identify several pseudo edges and low anti-noise ability. These are the shortcomings of the traditional support vector machine algorithms which can be eliminated by implementation of fuzzy support vector machine.

To introduce an effective edge detection approach, the researchers presented new identification technique that is dependent on fuzzy support vector machine. The whole algorithm is mentioned year step by step:-

1. Initially, it is responsible for training classification sample. It
results various membership functions at the end of the first step.

2. Another new training sample is constructed in case of certain wrong sub sample. Here, the fuzzy support vector machine classification approach is implemented in order to carry out both the training and testing phases.

3. The edges retrieved from the object image through implementation of the above model.

By analysing the outcomes of the evaluation phase, we can mention here that, better edge image can be obtained. Additionally, the above propose technique has an improved anti-noise feature. Fuzzy support vector machine algorithm is an enhanced version of the traditional support vector machine algorithm. Various membership functions are included inside numbers of different samples to decrease the effects of noise. The overall performance of the fuzzy support vector machine technique can be enhanced through construction of new membership function.

The above improve classification technique has the responsibility extract the edge of image. This approach can easily reduce the false detection rate. Again, this method results better anti-noise performance.

M. C. ChavezSanchez, et.al, emphasized on the processing of policromat images as diagnostic technique in order to identify White Spot Syndrome Virus (WSSV) in white shrimp [5]. The white spot syndrome is basically a viral disease that can infect large numbers of crustacean species very rapidly. Here we have considered WSSV infection in case of commercial shrimps. It is very much required to develop fast and efficient approach in order to diagnosis the presence of the above mentioned white spot disease. Hence, various approaches can be implemented in order to avoid the dispersion and to decrease the mortality rates. Histopathology is considered as the oldest and mostly adapted diagnosis strategy. There exists a single serious limitation of the above histopathology technique that is:- it needs enough time in order to prepare the histological slides.

Again, it needs more time to plan an effective diagnosis strategy. The complete diagnosis process is dependent upon the nature of the collected tissue samples. Apart from this, the numbers of
collected samples and the efficiency of the technician are also vital. The above research paper has the responsibility to demonstrate the sensibility of a single digital system of processing and recognition of images through color correlation along with phase filters. Histological slides are obtained by the processing of the infected tissues. In situ hybridization technique is implemented for the verification of the inclusion bodies.

The above proposed approach can achieve sensibility results of the recognition as 86.1%. Maximum percentage of recognition can be detected in case of nervous system and tegument glands that is 100%. But, in case of stomach epithelium and heart tissue recognition rate was 78.45%. Lymphoid organs show the lowest recognition rates.

In future, further research can be carried out in order to enhance the sensibility and to obtain the specificity.

M. Corteel, et.al, analysed the molt stage and cuticle damage effects in case of white spot syndrome virus [6]. The growth and transmission of white spot syndrome virus (WSSV) in shrimp has attracted various researchers for their researches. But in case of the presented research paper, the researchers have concentrated on the influence of molt process and artificial lesions in the cuticle. The susceptibility rate is evaluated with the help of intramuscular and immersion routes. The above research can easily prove that shrimps are more susceptible to WSSV infection through the process of immersion just after molting. We can mention that, prior to molting the chances of infection is quite less. In this research paper, the authors proved that, the molt stage can never affect the susceptibility rate at the time of virus injection. On the contrary, shrimps after completion of molting can easily become infected by WSSV through water as compared to pre-molt phases. The chances of infection are relatively higher in case of animals when their exoskeleton gets damaged. Hence, we can conclude here that, the cuticles can stand as prevention for the WSSV virus infection. With increase of wounds, the susceptibility of shrimps can also be increased.

A.A. Farag et.al, introduced a stochastic modelling technique for region-based image segmentation [7]. In this piece of research work, the issues related to region based segmentation are analysed and another advanced approach is proposed that can easily overcome the above mentioned shortcomings. The presented new algorithm is
based upon MA segmentation. The image is considered is actually a composite of two processes, those are mentioned below:-

1. A high level process which is responsible for describing different regions in case of images.

2. A low level process which is responsible for describing every individual region.

A Gibbs-Markov random field model is implemented in order to describe the high level process. Again, another autoregressive random field model is implemented in order to describe the low level process. The MAP segmentation approaches are developed by considering two different models. Another recursive version of the above presented approach is introduced. By analysing the outcomes of the above proposed technique, different synthetic and natural textures are responsible for the process of texture segmentation. There are several issues exist in this model, those are mentioned below:-

1. This approach considers that all parameters are estimated a priori.

2. The influence of the clique potentials in case of MAP segmentation outcomes are not quantified properly. This is considered as the most serious issue of the above presented model.

3. The resulted performance must be studied and analysed further.

In future, further research efforts can be carried out in order to overcome the above mentioned issues.

_G. Junrui, L. Xina, H. Kun_ concentrated on image segmentation on adaptive sub-region smoothing [8]. In order to enhance the performance of the active contour segmentation in case of actual images, a new segmentation strategy is formulated. In the above model, they built a function that is related to Gaussian variance depending upon the sub-regions intensity. In order to prevent curve vanishing, they formulated the convergence condition according to the confidence level of segmentation sub-regions. By properly analysing the outcomes of the above approach, we can know that,
this technique is poorly sensitive to noise. Additionally, it can suppress the inhomogeneous intensity regions effectively.

Adaptive smoothing segmentation completely depends upon the CV model. Initially, in order to smooth noise as well as inhomogeneous intensity regions, they proposed Gaussian function. The above presented technique is efficient enough in order to evaluate the standard variance of sub-region intensity adaptively. Both the over and under segmentation can be prevented through implementation of Gaussian kernel function. During the segmentation process, smoothing components with the help of level set functions are introduced. In order to prevent curve vanishing, they formulated the convergence condition according to the confidence level of segmentation sub-regions. This technique is very strongly robust against noise and can easily suppress the influence of inhomogeneous intensity to a certain extent. The only limitation of the above proposed model is that, it can evaluate the Gaussian kernel variance at the time of iteration. This will no doubt result blur edges and sometimes the curve ends at the place of incorrect location during the process of segmentation.

S. Guimares, et.al, proposed hierarchical graph-based image segmentation approaches that depend upon the region dissimilarity [9]. This research idea is the initial step in the route of general theory for hierarchizing non-hierarchical image segmentation process. This presented technique completely depends upon a region-dissimilarity parameter that is responsible for controlling the required levels of simplification. Every individual level of hierarchy is as close as possible to the outcome that can be generated through the non-hierarchical approach along with the simplification parameter. The hierarchized segmentation approach can no doubt permit the user to choose a particular level of hierarchy. Apart from this, it can control required numbers of regions. By analysing the outcomes of the evaluation phase, we can conclude that, this technique outperforms the traditional segmentation strategies.

3 Proposed Model

There are several methods for computing the texture features. The most commonly used methods for describing the texture are spec-
tral, structural and statistical methods. The spectral method uses the images in the frequency domain to extract the texture feature. So, this method requires Fourier transform of the actual image to acquire frequency domain representation of an image. The periodicity and directionality of the texture are revealed by the two dimensional power spectrum of an image. Therefore the iterative thresholding approaches perform well with the texture having the strong periodicity. The performance of these approaches degrades as the periodicity of the texture weakens. Structural methods perform well with deterministic patterns. In general, most of the textures may not be stick on to that geometry but they exhibit uncertain random behaviour.

Pre-processing
Pre-processing of shrimp white spot is the primary step in disease prediction, to minimize noise and to optimize the image quality. An adaptive median filter is used to enhance the image quality as well as remove the poison noise from the images. In the median filter, a window moves along the image and the computed median value of the window pixels becomes the output. It preserves the edges and reduces the noise in the image. Each pixel is replaced with the median value of the neighborhood of the input pixels as shown in Figure 1.

![Enhanced Segmented Method](image-url)

Figure 1 Enhanced Segmented Method
Maximized Probabilistic and Gaussian Thresholding Approach

The iterative method uses the exhaustive search based on the classes background and foreground. Each frame in the training data is processed using threshold algorithm to filter the noise in the edges.

\[ \mu_k = \frac{\sum_{i=1}^{N} X_{i,k}}{N} \]

\[ \mu_k = \frac{\sum_{i=1}^{N} X_{i,k}}{N} \]

\[ T_0 = (\mu + \mu_k) \]

Step 2: Determine the foreground level lower threshold using C-V model.

The variance of foreground level, \( f_0 = 0, 1, 2, 3 \) is

\[ M_f(x, y) = (G(x, y) = \sigma_0^2) \]

\[ M_f(x, y) = (G(x, y) = \sigma_0^2) \]

\[ Q_{min}(x, y) = \min(\frac{\sum_{i=1}^{N} I(x, y)}{\sigma_0^2}, \frac{\sum_{i=1}^{N} I(x, y)}{\sigma_0^2}) \]

\[ Q_{max}(x, y) = \max(\frac{\sum_{i=1}^{N} I(x, y)}{\sigma_0^2}, \frac{\sum_{i=1}^{N} I(x, y)}{\sigma_0^2}) \]

\[ T_1 = M_k T_0 \sum_{i=1}^{N} \text{min}(\text{prob}(x, y)/\text{ch}_L, \text{prob}(x, y)/\text{ch}_R)/\text{ch}_L \]

Step 3: Determine upper threshold.

\[ T_t = M_k T_0 \sum_{i=1}^{N} \text{max}(\text{prob}(x, y)/\text{ch}_L, \text{prob}(x, y)/\text{ch}_R)/\text{ch}_R \]

Step 4: Compute the intra and inter disease variance of each block.

\[ s_{\text{block}}^2 = \sum_{i=1}^{N} \text{min}((\text{prob}(x, y)/\text{ch}_L), \text{prob}(x, y)/\text{ch}_R) + \sum_{i=1}^{N} \text{max}((\text{prob}(x, y)/\text{ch}_L), \text{prob}(x, y)/\text{ch}_R) - \text{prob}(x, y)/\text{ch}_L)^2/|N| \]

\[ s_{\text{block}}^2 = \sum_{i=1}^{N} \text{max}((\text{prob}(x, y)/\text{ch}_L), \text{prob}(x, y)/\text{ch}_R) + \sum_{i=1}^{N} \text{max}((\text{prob}(x, y)/\text{ch}_L), \text{prob}(x, y)/\text{ch}_R) - \text{prob}(x, y)/\text{ch}_R)^2/|N| \]

\[ s_{\text{block}}^2 = \sum_{i=1}^{N} \text{prob}(x, y)/\text{ch}_L + \text{prob}(x, y)/\text{ch}_R + \sum_{i=1}^{N} \text{prob}(x, y)/\text{ch}_L - ((x+y)^2 + \text{prob}(x, y)/\text{ch}_R)^2/|N| \]

Step 5: Intra-class variance can be calculated using

\[ \sigma_{\text{intra}}^2 = \sigma_{\text{inter}}^2 - \sigma_{\text{intra}}^2 \]

Step 6: Repeat steps 2 to 5 until the condition is satisfied.

Algorithm 2: Enhanced Bayesian-Segmentation Algorithm

Input: Image filtered data \( \text{IF}[x,y] \), reference segmented image and Output; Results \( \text{R}[x,y] \) Procedure:

Find the image features of the shrimp images using k-means clusters as \( S_{IF} \).
For each feature set $S_{IF}[i]$

Do

\[
\begin{align*}
\eta_1 &= \sum_{x,y} \Phi(i) \text{sim}(N_i, N_j, x, y) \\
\eta_2 &= \sum_{x,y} \Phi(i) \text{sim}(N_i, F_i, x, y) \\
\text{SSIM}(N_i, F_i, x, y) &= \frac{\text{Max}(\text{Corr}(N_i, F_i), \text{Cov}(N_i, F_i), \text{Abs}(N_i, F_i))}{\text{Max}(\text{Abs}(N_i, F_i), \text{Abs}(F_i, x, y))}
\end{align*}
\]

Similar Region Segmentation $SRS = \frac{\text{SSIM}(N_i, F_i)}{N_i}
$

Done

4 Experimental results

Experimental results are performed on different shrimp image datasets. In order to analyze the efficiency of our model, noisy white spot images of the shrimp are used with different variations. The average values of structural similarity index (SSIM), correlated measure and mean squared error (MSE) for the proposed model with the traditional models are performed on the datasets. Further, similarity coefficient is used as performance metric to provide the comparison between the segmented regions.

SSIM: Structural similarity index is used to compute the image distortion level between the noise image (NI) and the filtered image (FI).

\[
SSIM_{F,NI} = \frac{1}{N} \sum_{i=1}^{N} \left[ \Phi(i) \text{sim}(NI, F) + (1 - \varphi(i)) \text{sim}(NI, F) \right]
\]

where sim is the similarity index between two images and $\varphi(i)$ is the covariance between the two images.

Table 1: Comparison of proposed model to the existing models

<table>
<thead>
<tr>
<th>Model</th>
<th>SSIM</th>
<th>Detection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amira</td>
<td>0.464</td>
<td>78.43</td>
</tr>
<tr>
<td>SRGAN</td>
<td>0.383</td>
<td>62.64</td>
</tr>
<tr>
<td>DCAN/ESARN</td>
<td>0.3183</td>
<td>89.35</td>
</tr>
<tr>
<td>PROPOSED MODEL</td>
<td>0.2143</td>
<td>95.64</td>
</tr>
</tbody>
</table>
Figure 2, describes the comparison of the proposed model to the existing models in terms of SSIM measure. As shown in the figure, proposed model has better SSIM ratio compared to the existing models.

Table 2: Comparison of proposed model to the existing models in terms of detection time and average number of oversegments.

<table>
<thead>
<tr>
<th>Model</th>
<th>AvgDetection Time</th>
<th>Avg(Oversegments)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KNN</td>
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<td>15</td>
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<tr>
<td>EM segmentation</td>
<td>4697</td>
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</tr>
<tr>
<td>PCA-NMF</td>
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<td>PROPOSED Model</td>
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5 CONCLUSION

White spot syndrome is defined as a viral infection which can infect marine shrimps. Now-a-days, the image segmentation algorithms are implemented in many applications to combine multi-focus image data into a single composite image. The main problem in this model is, it needs much time in order to build histological slides and formulate the diagnosis process. Also, most of the existing white spot syndrome identification models have over-segmented regions for shrimp disease prediction. Also, these models require high computational time and memory for pattern identification. Image threshold methods are necessary for the process of registration, segmentation, and identification of objects in a particular scenario. An efficient threshold technique improves the true positive and minimize the error rate for disease pattern detection process. Image segmentation is responsible for the extraction of the regions of interest either semi-automatic or automatically. Image segmentation
is considered as complicated tasks during the white spot disease recognition process and pattern recognition process. In this paper, a novel white spot detection model is designed and implemented using the two improved models. In the first model, images are filtered using the proposed probabilistic based thresholding method. In the second model, segmentation algorithm is applied on the filtered image for white spot syndrome detection. Experimental results proved that the this filtered based segmentation approach is better than the traditional models in terms of accuracy and time are concerned.

References


cuticle damage influence white spot syndrome virus immersion infection in penaeid shrimp, Veterinary Microbiology 137 (2009) 209216.


