ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645
Indian Journal of Science and Technology, *Vol 8(8), 702–706, April 2015*
DOI: 10.17485/ijst/2015/v8i8/63673

Automated System for Identifying and Recognizing Rotifer Contamination in Spirulina

S. Lakshmi[1], R. Siva Kumar[2*] and S. Rajendran[3]

[1]Jeppiaar Engineering College, Chennai, India
[2]Barathiar University, India; sivaa21@yahoo.com
[3]Department of Chemistry, R. V. S. School of Engineering and Technology, Dindigul – 5, India

Abstract

The blue green microalgae *Spirulina platensis* is an important source of nutrients. An important obstacle for the production of Spirulina is Rotifer. In this paper we present a method for automated identification and recognition of rotifer contamination in Spirulina using image processing techniques. Getting the expert's advice is an essential one to improve the production. Our primary objective is to provide high nutrients Spirulina free from contaminations and secondary objective is to solve the quality issue by identifying rotifer contaminations at the earliest and giving suggestions through the mobile phones. Using microscopic examination for identifying rotifier in live culture is time consuming and manmade process. There is a chance for man made error and our new technique is machine made and the errors to be minimized. Existing system need qualified persons for operation and our proposed system can be operated by anyone. We examine lab scale Spirulina culture through both existing and new techniques for recognizing the rotifer. Our proposed tool for identifying contaminations at beginning stage is easy to eradicate the contaminations from live culture. It will be helpful to biologist to take necessary actions against contaminations of the same before further multiplications of contaminations. According to the Survey of Sun food Super Food, in 2020 the expected world wide Spirulina production is about 220 thousand tons. Hence Spirulina can be a solution for solving the world nutrition problems due to its very high growth rate and high nutritional value. Our research-automatic identification of contamination in algae through the processing of mobile phone images is an easiest way for improving and evaluating the growth of Spirulina for effective cultivation of algae.

Keywords: Automatic Detection and Contamination, Image Processing, Recognition, Rotifer, Spirulina

1. Introduction

Image processing is used in several places such as medical images, spatial images, underwater images and other biological images. Image processing has to be a standard scientific tool and image processing techniques are now applied to virtually all natural sciences and technical disciplines[1]. Some tools are employed effectively for online monitoring density of microorganism in water[2,3]. Automatic identification of algae is very difficult due to various reasons such as change in size and shape with climatic changes, growth periods and contaminations. In this paper, we have discussed the various techniques of image processing and its significance to recognize rotifer contamination in spirulina plant.

1.1 Spirulina

Spirulina is a key crop in coastal and alkaline areas where traditional agriculture struggles under water shortage. The microscopic images of Spirulina are given in Figure 1. Despite the widespread publicity about Spirulina and its benefits, it has not yet received the serious consideration.

Spirulina is also used for health food, feed and for the biochemical products since 1980s. Phycocyanin of

*Author for correspondence

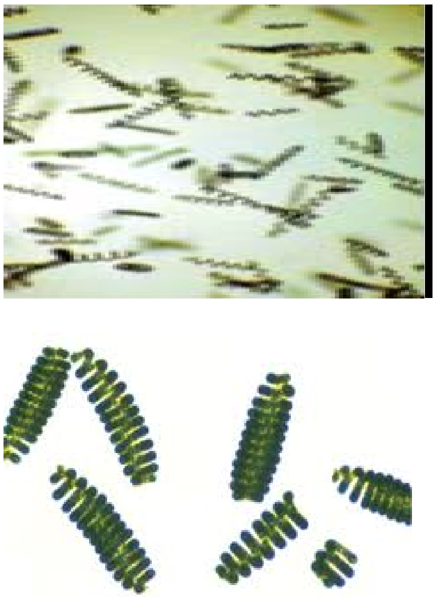


Figure 1. Microscopic view of Spirulina coils.

Spirulina platensis inhibits the growth of human leukemia K562 cells when supplemented with diet[5].

Spirulina was successfully cultured as liquid media, in a light chamber at 30^{O}C to 35^{O}C temperature[4].

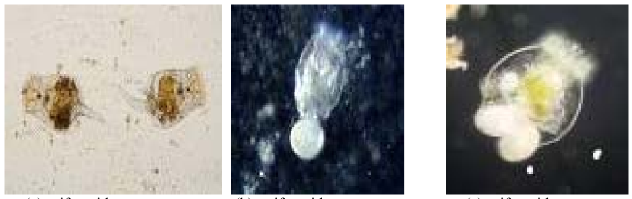
1.2 Rotifer

Rotifer size has been reported in the range of 123–292 μm in length and 114–199 μm in width. The size of the rotifer changes with environmental factors like temperature, climate and food type. A microscope with a minimum of 40 magnifications is necessary for the clear observation of rotifers in algae. Rotifers are generally classified into four types. They are

1. Rotifer without eggs
2. Rotifer with one egg
3. Rotifer with two eggs and
4. Debris

Figure 2 depicts the microscopic images of rotifer with varying number of eggs.

Once the rotifer gets into the culture, eventually consume the algae and reduce the number of spirulina coils. Since rotifers are small, a sample from the pond needs to be examined under the microscope for contamination. Figure 3 shows the rotifer contaminated spirulina algae image. Hence, the major objectives of this study were to develop a system for the rotifer identification using image processing.



(a)rotifer with no eggs (b) rotifer with one egg (c)rotifer with two eggs

Figure 2. Rotifer classification.

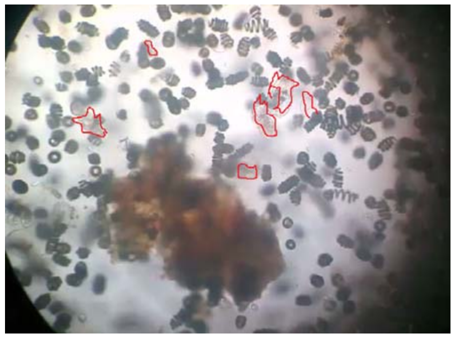


Figure 3. Rotifer contamination.

2. Methodology

Understanding of spirulina algae culture changes in environment is necessary for optimization of large scale micro-algae production and designing an automated system for algae contamination. The development process of the automated spirulina contamination identification system involves image acquisition, image segmentation, contamination of micro organisms' identification and recognition. The system architecture is shown in Figure 5.

2.1 Source Data Description/Training Data Set

The microscopic images of rotifer will be collected and stored in training dataset for further identification of rotifer contamination in Spirulina ponds. The data set included rotifer images, spirulina coils/filament images. The algae images samples are then classified into two groups, training group which contains 40 images of every rotifer classification, and testing group which contains 100 images of blue green algae.

2.2 Image Acquisition

Spirulina culture sample images are captured for every 2 minutes by the microscopic enabled cell phones and those images are loaded to the system as input image for further processing. Computational delays are avoided by resizing the captured images to 256*256 pixel size which will help us to manage the time effectively.

2.3 Proposed System Development

The following image processing techniques must be performed sequentially.

(i) Captured: Captured images are loaded to the system from mobile phones then the images are converted to gray scale image.
(ii) Noise Removal: Mostly the captured images may not be clear. It is necessary to remove the noise or unwanted information to improve the quality of the captured images. Median filter[7,8] is used to reduce image noise and to preserve the edges.
(iii) Image Segmentation: Objects within the image are separated from the image background via the process called segmentation. Usually algae images contain foreign bodies such as bacteria and other micro organisms. We used the novel edge detection algorithm[6] to perform image segmentation.
(iv) Rotifer Detection and Recognition: Training data set consists of some sample images of rotifer shown in Figure 4. Input images are those images which are taken by using microscopic enabled camera and are loaded into this detection system.

In this automated system all images are preprocessed then the key points are selected for matching the training and testing images.

Key points of the training images as well as the testing images are taken and then input images are splitted into packets. Then we apply the key points matching algorithm using ordinal measure[9,10] for matching the training and the input images to verify the rotifers are present in the input images or not.

Each task must execute in sequence because output from each process is the input for next step.

Figure 4. Training set-Rotifer images.

3. Results and Discussions

The automated rotifer detection and recognition system is shown in Figure 6 and 7. The system allows as performing image preprocessing and rotifer detection and recognition automatically using simple steps.

Figure 6 (a) shows the first screen of our automated system for rotifer recognition.

We have displayed the results of two sample images in this paper.

Figure 6(b) and Figure 7(a) images are trained and stored for further process. Figure 6(c) shows the preprocessing step i.e., noise removal and edge detection. Once the rotifer images are trained then the microscopic images of spirulina is loaded. Figure 6(d) shows the input images of the spirulina coils and Figure 6(e) shows the noise removal and edge detections steps. Finally, our automated system identifies the rotifer present in the given spirulina image and that is shown in Figure 6(f).

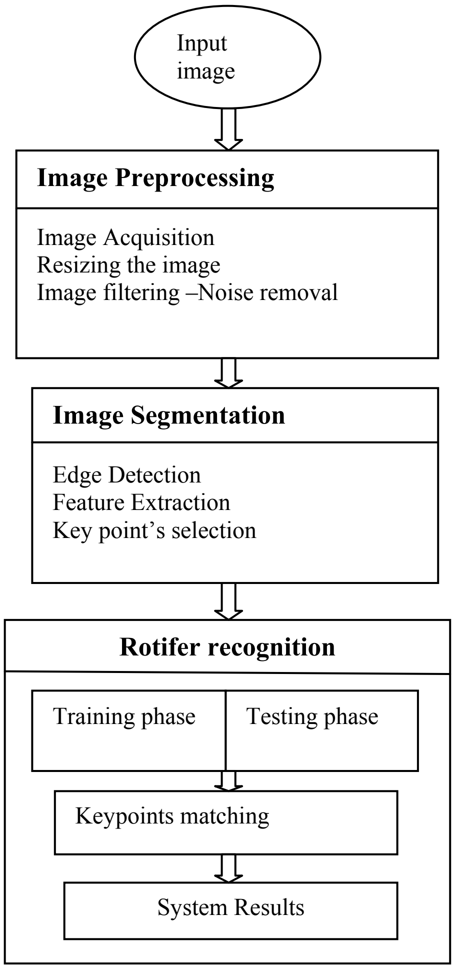
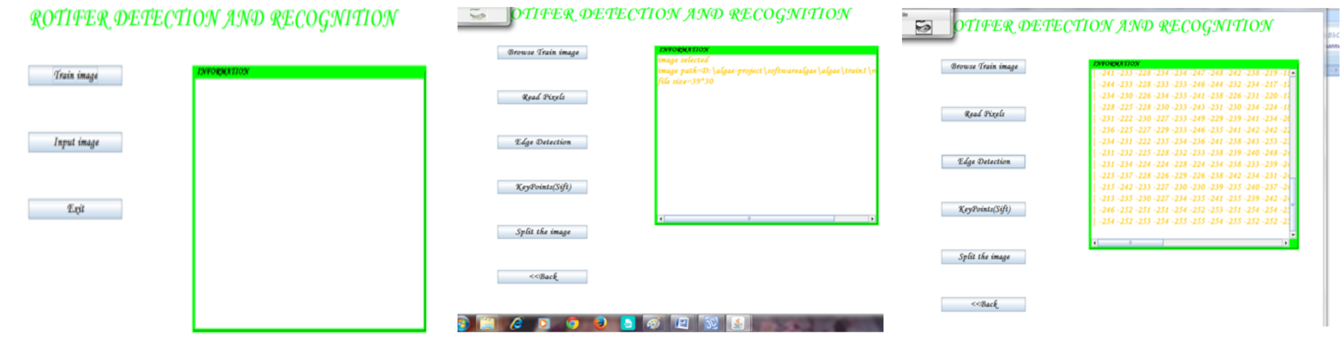
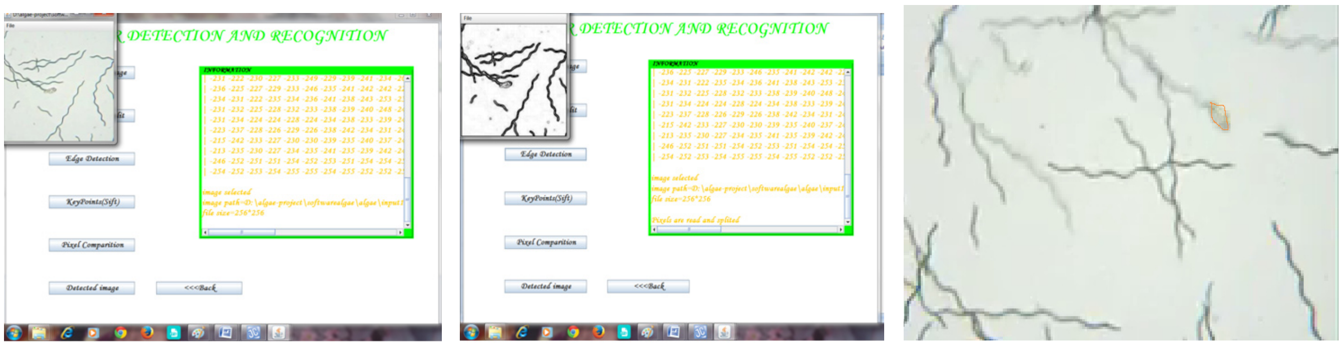


Figure 5. System Architecture.

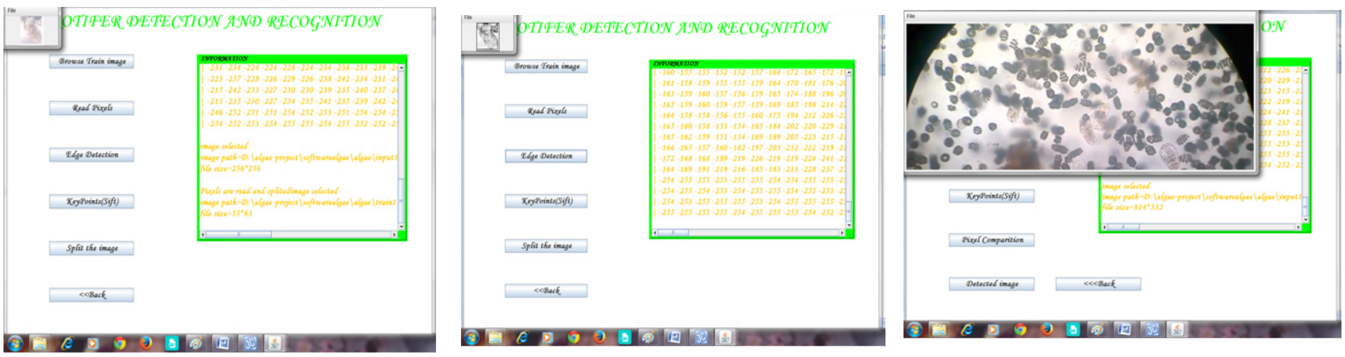


(a) (b) (c)

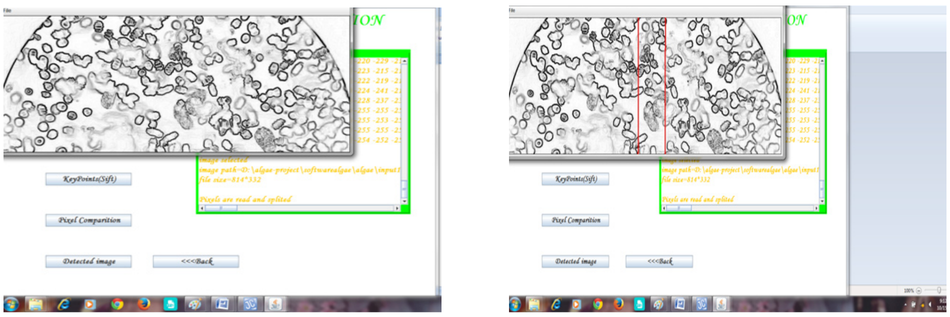


(d) (e) (f)

Figure 6. Rotifer identification in sample image 1. (a)Main page (b) Train the rotifer image (c) Noise removal and Edge detection (d) Imput image of Spirulina (e) Preprocessing (f) Output image.



(a) Rotifer training image. (b) Gray scale image of rotifer. (c) spirulina microscope view.



(d) Image preprocessing. (e) Detected rotifer image.

Figure 7. Rotifer identification in sample image 2.

The gray scale image of the rotifer is displayed in Figure 7(b). The original microscopic image of the spirulina is given in Figure 7(c). The preprocessed input image of spirulina is displayed in Figure 7(d). The recognized rotifer image is shown in the figure 7(e).

4. Conclusion

In this paper, we have shown that the automated recognition of rotifer contamination in Spirulina ponds which is certainly important for mass production. The preprocessing techniques are enhanced the appearance of rotifer and Spirulina significantly.

5. Future Work

This research can be considered as a preliminary study towards the development of computer software that can identify and recognize the rotifer contamination in algae. A new technique yet to be developed to count the number of rotifers to understand the level of contamination.

6. References

1. Jahne B. Digital image processing, 5th revision. London: Springer; 2002.
2. Sandesh BK, Shalini C, Brinda BR, Kumar MA. Digital image processing - an alternate tool for monitoring of pigment levels in cultured cells with special reference to green alga Haematococcus pluvialis. Biosens Bioelectron. 2005; 21:768–73.
3. Cheng J, Ji G, Feng C, Zheng H. Application of connected morphological operators to image smoothing and edge detection of algae. International Conference on Information Technology and Computer Science; 2009. p. 73–6.
4. Joshi M, Kaur K, Mishra T, Singh S. To evaluate lab scale cultivation of spirulina by using different substrates and to evaluate its chlorophyll and protein content. International Research Journal of Biological Sciences. 2014; 3(1):22–30. ISSN 2278-3202.
5. Liu YF, Xu LZ, Cheng N, Lin LJ, Zhang CW. Inhibitory effect of phycocyanin from Spirulina platensis on the growth of human leukemia K562 cells. J Appl Phycol. 2000; 12:125–130.
6. Lakshmi S, Sankaranarayanan V. A novel approach for edge detection. IJCSNS. 2010; 10(4):278–82.
7. Kumar VVR, Manikandan S, Ebenezer D, Vanathi PT, Kanagasabapathy P. High density impluse noise removal in color images using median controlled adaptive recursive weighted median filter. IAENG IJCS. 2007; 34:1, IJCS_34_1_2.
8. Arce G, Paredes J. Recursive weighted median filters admitting negative weights and their optimization. IEEE Transactions on Signal Proceedings. 2000; 48(3):768–79.
9. Lakshmi S, Sankaranarayanan V. Robust key points matching by ordinal measure. International Conference on SIP; 2011. p. 346–55.
10. Tran TTH, Marchand E. Real-time keypoints matching: application to visual servoing. IEEE International Conference on Robotics and Automation ICRA'07. Roma: Italia; 2007.