

Detection of Elephantiasis patients using Image processing and Classification methods

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Abstract

The most devastating disease to humanity is commonly known as elephantiasis. Infection usually acquired in childhood but visible indication like pain, disfiguring occur later in life. Severely affected people will have a permanent disability. Not only had it generated physical challenges it also cost for social, psychological, and economical losses. The impact of the disease is so painful and devastating among young men and women as they live with the lifelong disfiguring condition. As the parasite attacks directly to the lymphatic system of the body whose primary function is to drain all the harmful components and impurities from tissues and cells also make a strong immune system of the body to fight against infection and diseases. Since the parasite attack damages the lymphatic vessels and capillaries. Hence the effect is on the flow of lymph resulting in lymphoedema. 90% of the cases are caused by the parasite wuchereria bancrofti and the remaining is due to brugia malayi parasite worm. A symptom of the infection includes tissue swelling, retention of fluid, genital diseases, and acute disease. This research investigates on detection of elephantiasis patients using image processing and classification. This research work represents a patient with elephantiasis disease and without elephantiasis disease. For this research 35, sample images were examined using image processing with classification methods. The present research represents 91.4% accuracy of detection with patients having elephantiasis disease.

Keywords: in vitro propagation, disinfection, phytohormones and acclimatization

INTRODUCTION

Lymphatic filariasis in other words elephantiasis caused by parasitic worms and can spread through mosquitoes from person to person. A symptom of the disease shows swelling of legs, scrotum, or breasts [1]. The number of people suffering from this disease is more common in the tropical and non-tropical regions of the world. According to W.H.O, more than 120 million people have suffered from these parasitic worms worldwide [2]. The cause of elephantiasis is parasitic worm causes lymphatic filariasis and the disease spread through

mosquitoes. The three types of worms are *Brugia malayi*, *Wuchereria bancrofti* & *Brugia timori*.

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It affects the lymphatic system of the body [3]. It attacks the system responsible for removing toxins and waste from the body. Due to the presence of lymphatic fluid, swelling of the body parts occurs. The people belong to tropical and subtropical areas of the world such as South East Asia, Africa, and South America, India, and so on are mostly affected by this disease [4].

Common risk factors are: Highly exposed to mosquitoes, unsanitary conditions also increase the risk factor of this disease, long time stay in tropical and subtropical areas. As such, there is no vaccine available for curing elephantiasis [5]. Only the method left for controlling it is prevention, best prevention measure is avoiding mosquitoes, at night sleeping in an AC room or sleeping under a mosquito net are the best possible ways, between dawn and dusk, use mosquito repellent on the exposed part of the body, wear long sleeves and trousers while working under mosquito exposed areas, another preventing approach to this disease is uses medicines which kills the parasitic worms, reduces the microfilariae level in the blood, slow down the transmission rate of infection and controlling mosquitoes spread. As this type of infection is irreversible [6]-[7]. People suffering from this disorder must apply extra hygiene for the affected part to control severe infection of cells and tissues. Some

precautionary measures are as follows: washing regularly the infected parts of the leg with soap and clean water prevents skin infection, dry up the leg gently and carefully by using a clean cloth or towel, the frequent elevation of the affected limb(s) can improve the condition, exercising of the affected limb(s) like walking at any time can be the best precautionary steps applying for controlling the disease, during deep pain, shivering, fever and nausea soak the affected leg in cold water until pain stops, drink water sufficiently and try to avoid movement of the affected leg, medicines and doctors prescribed antibiotics must be taken if body temperature does not reduces [8]-[9]. To give awareness among peoples camping must be conducted for controlling of elephantiasis such as Flagship Campaign 'Hathipaon Mukht Bharat'. According to WHO statically data report 40% of the disease is spread in India and 21% of states are the most affected states. Seeing the high infection rate an awareness program Mars drug administration started to eradicate the disease from the root under the flagship campaign 'Hathipaon Mukht Bharat'. Program help in providing preventive medicines to suffered communities. The goal of MDA is to control the infection rate in the blood of the infected people and reducing the infection intensity and spread of infection in high-risk communities by the mosquito vector [10].



Figure 1- Elephantiasis Disease

Materials and methods

The investigation has done through image preprocessing, segmentation with clustering, and classifications method using image processing techniques. A sample dataset of 35 images

of elephantiasis disease patients has been collected for investigation for research purposes. The most devastating disease to humanity is commonly known as elephantiasis. Infection usually acquired in childhood but visible indication like pain, disfiguring occur later in life. Severely affected people will have a permanent disability.

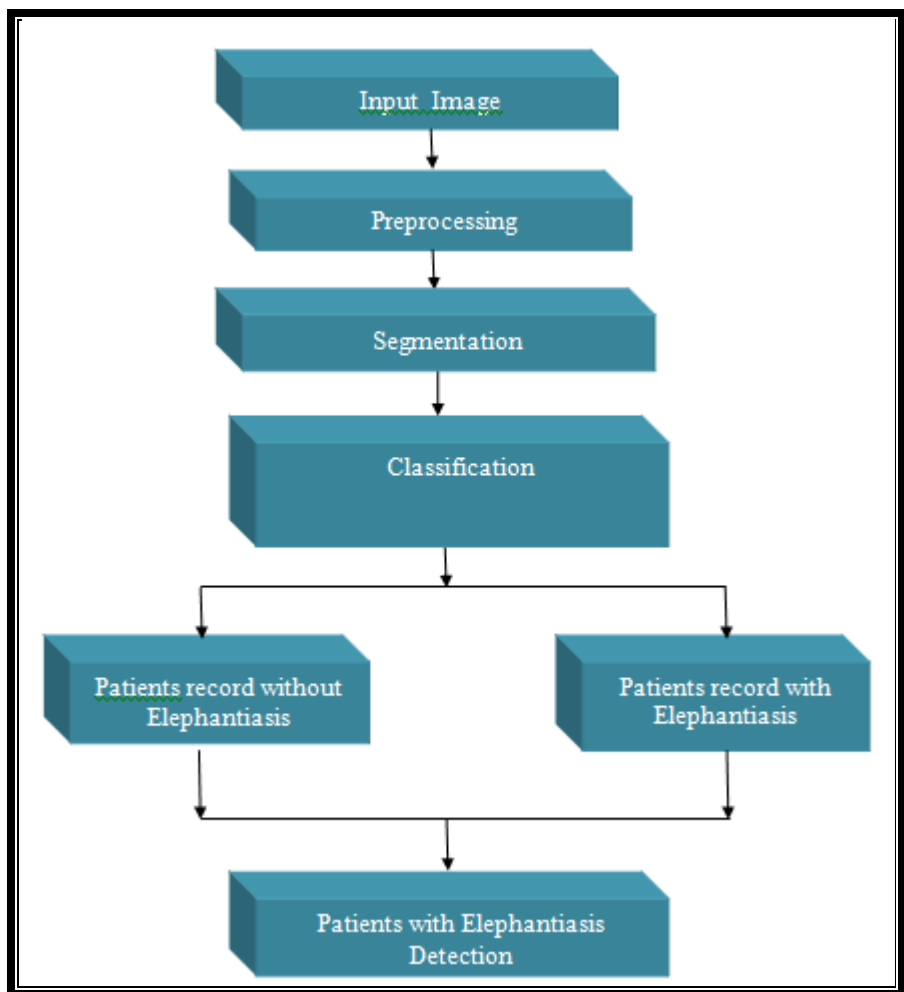


Figure 2- Methodology

Figure 2 is the methodology for research works, the first step is preprocessing methods to avoid background noise, and then segmentation method, after segmentation method then classification methods used for detection of patients without elephantiasis disease and patient with elephantiasis disease. A 35 sample image of elephantiasis disease patient has been collected for investigation and analysis.

Gaussian Filter- Preprocessing Method

The preprocessing method is used to avoid unwanted noise from background images. This research worked on a Gaussian filter with color-based segmentation for elephantiasis disease detection. It is a linear smoothing of images during the investigation. It is represented by the given equation.

$$h(n, m) = \left[\frac{1}{\sqrt{2\pi\sigma}} e^{-\frac{n^2}{2\sigma^2}} \right] * \left[\frac{1}{\sqrt{2\pi\sigma}} e^{-\frac{m^2}{2\sigma^2}} \right]$$

The above equation represents a separable process. It is useful in normal distributions of removal of noise from the image. It is used as two dimensional with a rotational symmetric function for the image. In Gaussian filter smoothing of image governed by σ variance. For this research 3x3 Gaussian filter is used. 3x3 masks generate through the third row of the

triangle in the image. As we are using 3x3 masking then use third-row pixel value for investigation- 1 7 1. Then sum the selected element from the third row of image- 1+7+1= 9.

$$3 \times 3 \text{ Mask Gaussian Filter} = \frac{1}{9} \begin{bmatrix} 1 \\ 7 \\ 1 \end{bmatrix} \times \frac{1}{9} [1 \quad 7 \quad 1] \tag{1}$$

$$3 \times 3 \text{ Mask Gaussian Filter} = \frac{1}{81} \begin{bmatrix} 1 \\ 7 \\ 1 \end{bmatrix} \times [1 \quad 7 \quad 1] \tag{2}$$

$$3 \times 3 \text{ Mask Gaussian Filter} = \frac{1}{81} \times \begin{bmatrix} 1 & 49 & 1 \\ 49 & 9 & 49 \\ 1 & 49 & 1 \end{bmatrix} \tag{3}$$

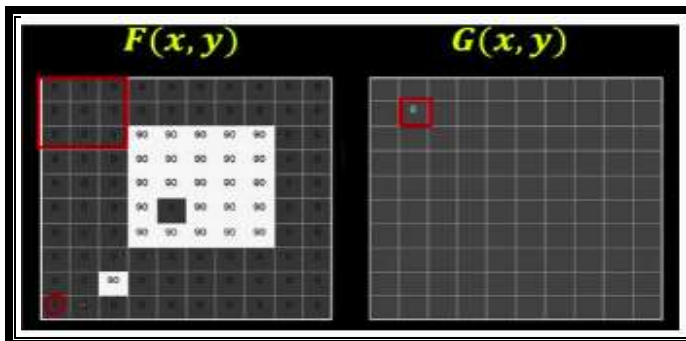


Figure 3- Gaussian Filter

Segmentation

The thresholding technique produces segments with similar intensity values. Thresholding is useful in developing boundaries in images. An adaptive thresholding method is used because to check the background noise whether it is constant or not. In this research, the clustering method is used. Clustering methods represent the relationship between the input data pattern and clustered value. Initially, it clusters n objects according to attribute into 'c' partition where $c < n$. Then measure the similarity between numbers of observations, to achieve similar observation it is necessary to calculate

Euclidean distance. Euclidean distance is a measure of the distance between observations.

$$d_{pq} = \sqrt{(p_1 - q_1)^2 + (p_2 - q_2)^2 + (p_3 - q_3)^2 + \dots + (p_z - q_z)^2}$$

$$d_{pq} = |p_1 - q_1| + |p_2 - q_2| + |p_3 - q_3| + \dots + |p_p - q_p|$$

Then randomly select the cluster center, it is denoted with c, then calculate fuzzy center then update the cluster center. For updating the cluster center a centroid needs to be calculated for each cluster. To calculate centroid it is important to find an average of all 'x-axis and y-axis'. To re-compute the new cluster center, it is necessary to take the mean of all points in each cluster.

Classification

In the classification method, the present research measures the accuracy of patients without elephantiasis disease and patient with elephantiasis disease. The total number of samples tested is 35 with the disease. In which 10 patient's details were collected without having elephantiasis disease and 25 patients record collected having elephantiasis disease.

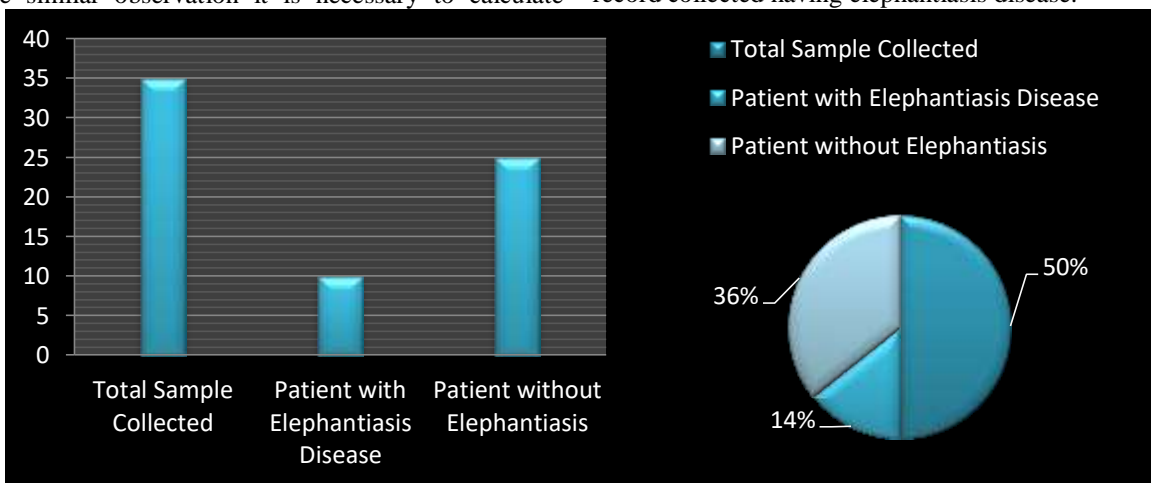


Figure 4- Number of Patients Record with Elephantiasis Diseases

Result and Discussions

Now a day's image processing plays an important role in medical science as well as the field is also developing in many ways. Various methods in image processing help doctors to get maximum information about the disease with minimum possible errors. These advanced technologies are capable of detecting all the biggest to smallest defects in the body. All these computerized techniques are equipped with high resolution and better quality image readers. This study gives the idea of Elephantiasis and its harmful effects on the human body and commonly used diagnosis technique. A sample dataset of 35 images of elephantiasis disease patients has been

collected for investigation for research purposes. The most devastating disease to humanity is commonly known as elephantiasis. Infection usually acquired in childhood but visible indication like pain, disfiguring occur later in life. Severely affected people will have a permanent disability. In this present work first step is preprocessing methods to avoid background noise, and then segmentation method using thresholding and clustering methods, after segmentation method then classification methods used for detection of patients without elephantiasis disease and patient with elephantiasis disease.

TABLE 1- Result and Analysis of Patient Record without Elephantiasis Disease

Registered Patient	Information	Output
	Patient without Elephantiasis Disease	Output results of Patients without Elephantiasis Disease
ID_501	Patient Healthy	Yes
ID_502	Patient Healthy	Yes
ID_503	Patient Healthy	Yes
ID_504	Patient Healthy	Yes

ID_505	Patient Healthy	Yes
ID_506	Minor	No
ID_507	Patient Healthy	Yes
ID_508	Patient Healthy	Yes
ID_509	Patient Healthy	Yes
ID_510	Patient Healthy	Yes

Table 1- represents the number of patients without elephantiasis disease. The table is divided into three groups, Registered Patient ID, a patient without elephantiasis disease. which patient ID_506 denotes error code with patients without

TABLE 2- Result and Analysis of Patient Record with Elephantiasis Disease

Registered Patient	Information	Output
	Patient without Elephantiasis Disease	Output results of Patients without Elephantiasis Disease
ID_511	Disease Detected	YES
ID_512	Disease Detected	YES
ID_513	Disease Detected	YES
ID_514	Disease Detected	YES
ID_515	Disease Detected	YES
ID_516	Disease Detected	YES
ID_517	Disease Detected	YES
ID_518	Disease Detected	YES
ID_519	Disease Detected	YES
ID_520	Disease Detected	YES
ID_521	Disease Detected	YES
ID_522	Disease Detected	YES
ID_523	Disease Detected	YES
ID_524	Disease Detected	YES
ID_525	Disease Detected	YES
ID_526	Disease Detected	YES
ID_527	Disease Not Detected	NO
ID_528	Disease Not Detected	NO
ID_529	Disease Detected	YES
ID_530	Disease Detected	YES
ID_531	Disease Detected	YES
ID_532	Disease Detected	YES
ID_533	Disease Detected	YES
ID_534	Disease Detected	YES
ID_535	Disease Detected	YES

Table 2- represents the number of patients with elephantiasis with the total test image is 25. In which registered patients with ID_527, and ID_528 resulted as a disease not detected due to minor stage. The total number of samples tested 35 elephantiasis patients. The table is divided into three groups, registered Patients ID, patients with elephantiasis, and classification results with logical two outputs yes/ no. If the condition satisfied it will result as '1' for true value or else it will denote with '0' as a false value. In this research, the clustering method is used. Clustering methods represent the relationship between the input data pattern and clustered value. Initially, it clusters n objects according to attribute into

'c' partition where $c < n$. Then measure the similarity between numbers of observations, to achieve similar observation it is necessary to calculate Euclidean distance. Euclidean distance is a measure of the distance between observations. Then randomly select the cluster center, it is denoted with c, and then calculate fuzzy center will update the cluster center. For updating the cluster center a centroid needs to be calculated for each cluster. To calculate centroid it is important to find the average of all x-axis and y-axis. To re-compute the new cluster center, it is necessary to take the mean of all points in each cluster.

TABLE 3- ELEPHANTIASIS DETECTION USING CONFUSION MATRIX

Result	VALUES (ACTUAL)	
	True Positive 23 cases	False Positive 1 case
Table 1	False Negative 2 cases	True Negative 9 cases
	$(\text{Correct detection cases} \times 100) \div \text{Total Number of Cases}$	Table 1 = $(9 \times 100) \div 10 = 90\%$
	$(\text{Correct detection cases} \times 100) \div \text{Total}$	Table 2 = $(23 \times 100) \div 25 = 92\%$

Table 2	Number of Cases	
TPV	(True Positive ÷ All Samples based on Positive values)	TPV= $23 \div (23 + 1) = 0.95 = 95\%$
FPV	False Positive ÷ All Samples based on Negative values	FPV = $1 \div (2 + 9) = 0.09\%$
ACCURACY	True (Positive Value) + True (Negative Value) ÷ (Total number of Samples)	Accuracy = $(23+ 9) \div (35) = 32 \div 35 = 91.4\%$

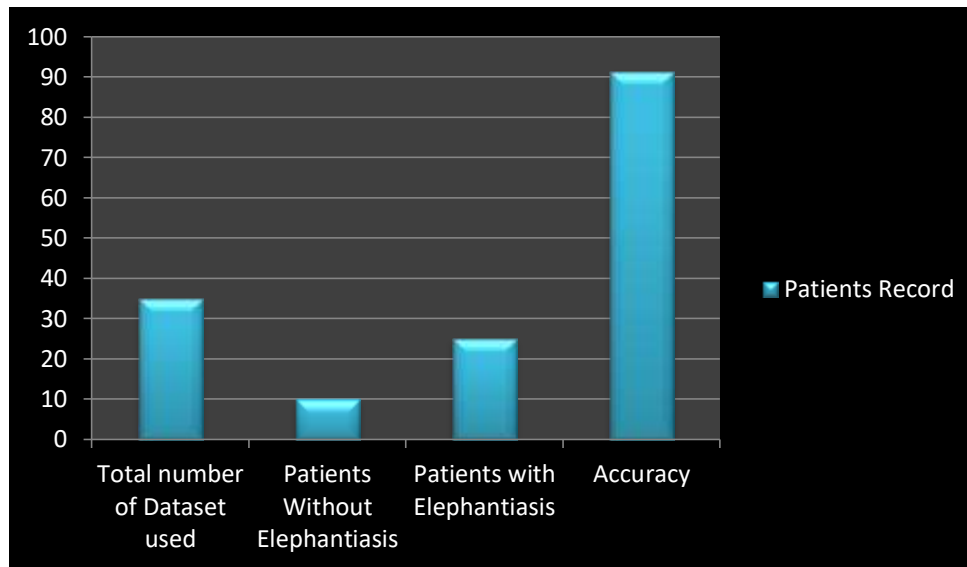


Figure 5- Patients with Elephantiasis Disease

Table 3 and figure 5- represents patients with elephantiasis disease using a confusion matrix with true positive, false positive false negative and true negative values with an accuracy of 91.4% with a total number of the sample analyzed. The graph represents the total number of datasets used, patients without Elephantiasis, patient with Elephantiasis, and accuracy using the confusion matrix.

CONCLUSION

This research investigates on detection of elephantiasis patients using image processing and classification. This research work represents a patient with elephantiasis disease and without elephantiasis disease. For this research 35, sample images were examined using image processing with classification methods. The present research represents 91.4% accuracy of detection with patients having elephantiasis disease. This research helps in the detection of elephantiasis disease patients' records. The most devastating disease to humanity is commonly known as elephantiasis. Infection usually acquired in childhood but visible indication like pain, disfiguring occur later in life. Severely affected people will have a permanent disability. Not only had it generated physical challenges it also cost for social, psychological, and economical losses. The impact of the disease is so painful and devastating among young men and women as they live with the lifelong disfiguring condition. As we know elephantiasis is a parasitic worm that causes lymphatic filariasis and the disease spread through mosquitoes. So it is very important to

regularly monitor, awareness programs must conduct and analyze the disease for faster prevention and safety of human health. The present research performs well with 91.4% accuracy of detection elephantiasis disease.

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