IMPROVEMENT IN DETECTION OF CHICKEN EGG FERTILITY USING IMAGE PROCESSING TECHNIQUES

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ABSTRACT-The objective of this paper is to improve the efficiency in predicting the fertility of chicken eggs using digitalised techniques. The traditional technique finds incongruence in predicting the fertility by manual method. By using this system the digital images obtained as the result of candling process is used for fertility prediction. The obtained image is converted to RGB components as the components clearly depicts the inner view of the image than the original one. The mined component is transformed to binary image to determine the yolk dimensions (height x diameter). This dimensions help in the prediction of air room region which helps hatching. The yolk size value that lies close to the range of threshold value is considered fertile. The investigational study results nearly 80 to 85 % of efficiency than the existing techniques. With the same data set, efficiency is compared with manual method and trained neural network algorithm to provide better accuracy.

I. INTRODUCTION

In hatcheries the selection of fertile eggs finds the major functional part of the industry. In nature, all the eggs laid by the hens are not hatched. These eggs are subjected to incubation by the mother hen. As a result, only the fertile eggs get hatched and the remaining eggs are considered loss by the hatcheries as they are not suitable for edible purpose. The incubation cost of infertile eggs is a loss to the hatchery industry. This approach aims to achieve this purpose well by using soft computing approaches. Other techniques of prediction of infertile eggs prior to incubation is a difficult process and requires more attention of human resource. To make this process automated this paper proposes a naive approach. In this method fertility is predicted based on the color characteristics and index value of the egg is calculated with the help of the image obtained as a result of candling process. The image is processed to determine the yolk dimension. This dimension is the height of the egg to the diameter of the yolk. To obtain the image of the egg a simple experimental setup is build. The setup contains high resolution digital camera to get the inner characteristics of the egg without harming it. After processing the image, the sensitive area of the egg shall be shown accurately. Digital vision is the broad area of research in root techniques and real-time applications.

The base of this vision gets enhanced with the knowledge of many theories and having applications in several domains. The main use of machine vision in hatching process is to improve the productivity of the eggs, to increase the fertility rate and to decrease the incubation cost. This paper uses the image enhancement techniques to determine the fertility of chicken eggs. Despite, recent development of advanced techniques, digital vision acquires importance in most fields. In the hatching industry, the fertile egg selection plays a vital role. Eminence of fertile eggs is the major factor over the yielding of poultry. The information given by hatcheries shows that nearly 10% of incubated eggs does not hatch. Detecting this type of infertile eggs before incubation is a difficult process. In real-time application, candling process takes place at 7 to 12 days of incubation, but this only shows the aliveness of the egg. Classification of fertile eggs and infertile eggs prior to incubation finds space for fertile eggs, reduces the incubation cost and increases the profit percentage of hatcheries. There avails many nondestructive methods for detecting fertile eggs but they all focus during middle and late stage of incubation. The results of all those approaches are less efficient and less accurate.

In this proposed system, using Image Processing techniques, acquired egg images are evaluated to determine egg to the yolk dimension and color of yolk region as characteristic parameters. This classification approach is proposed in order to obtain better accuracy and efficiency. Using the characteristic region, the size of the egg is measured based on which a threshold value is fixed. The size above that threshold value is considered fertile. The process of finding the yolk size is by obtaining the image of the egg through a process of candling which takes place in a dark room.

II. MATERIALS AND METHODS

A. EGG SAMPLES
To process the system 250 fertile eggs are taken. The fresh egg is taken without affecting the outer protective coating of the egg. It is proved that outer shell contains some pigments which are necessary for the egg while hatching. The egg should not be washed and should be maintained at 25°C. the eggs should be handled with more care and should kept at a sterilised room to avoid infections through microorganisms. Samples are maintained cautiously.

**B.IMAGING SETUP**

The experimental system consists of light source (sodium vapour lamp), Sony digital camera, dark room, egg and a transformer. Sodium vapour lamp of about 1000 lux is used as a luminous source.

**C. IMAGING PROCEDURE:**

The sampled eggs are subjected to candling process. The candling process is the process in which the eggs are subjected to luminous source to obtain egg’s internal view. The luminous source used here are of less intensity and harmless. The previous system uses harmful radiations which may mutate the egg and may cause genetical disorder and at times leads to the death of embryo. To overcome such serious consequences this paper uses harmless radiation and also low intensity light source. The eggs are placed over the egg holder where the light source is made to fall on the egg. While the light from the mercury vapor lamp falls on the egg the internal view of the egg can be obtained. The internal view of the egg is picturised using SONY digital camera. This image is used for the further processing to predict the fertility.

**D.CHARACTERISTICS FEATURE EXTRACTION:**

There are few differences between fertile and infertile eggs in the internal view and color characteristics of the egg. In fertile eggs, it is observed a dark orange concentric small sized circle whereas in infertile it was left. The shape of the yolk varies from egg to egg. The yolk may be oval, round or slightly elongated. In this paper five different shapes of the yolk are considered. In this paper height of the egg and height of the yolk region is taken as the characteristic parameter as the air room region helps hatching. The image of the egg is obtained through a technique called candling. Candling is a technique used to study the growth and development of an embryo inside an egg. The method uses luminous source of light behind the egg to show the internal view through the shell. For the process of candling, light source of less radiation is used. This process takes place in a dark room where light source is made to fall through a small hole. All the luminous power is focused over the egg. The images of the egg are obtained from all the directions through the camera fixed in the candling room. The image thus obtained is subjected to change in color characteristics of the image. The image is transformed to RGB component. From that the Green component is selected for the upcoming prediction, as it shows the clear internal view of the egg. The G-component is further converted to grayscale image. This gray image is used in further feature characterization of the fertility prediction. The gray image is subjected to reverse backing to obtain binary images of the egg. The binary image thus gives the exact yolk diameter. Based on the ratio of egg to yolk diameter, the fertility of egg is predicted. The yolk and the egg dimensions decide the air room space, based on which the fertility is predicted at the end of incubation. Thus this image transformation helps in fertility prediction process.

**III. RELATED WORK**

Owing to commercial breeding programs, there is a considerable change in ratio of structure of egg components and their biochemical constituents. This in turn results change in biochemical composition and embryo development environment. There is a need for selection trait for yolk size, to increase nutritive and processing value of eggs. Measurement of yolk size is difficult due to unavailability of advanced methods without breaking the egg. There is a possibility for break of egg while measuring its yolk size. There arises a need to propose a non-destructive method to measure the size of the yolk. This paved the way for the proposed approach. The main motive of this system is to develop a naïve approach on yolk size evaluation without breaking the egg shell. The yolk size can be evaluated using two methods:

- Weighing using traditional machines (in grams)
- Weighing using ultrasonic scan (in cm³)

The obtained ultrasonic images are made to work on algorithms. This way ultrasonic scanned image is used to measure the dimensions of the yolk.

This method of using ultrasonic increases the cost and needs a technician to be always with. The use of ultrasonic waves harm the egg, the egg may get mutated. For this purpose we applied a method of ultrasonic scanning. In addition we use an imaging device, to get the internal image view of the egg. The obtained image clearly shows the morphological character of the egg. The resulted image on conversion to binary image results the actual yolk size of the image. The size and shape of the egg give the fertility of the egg.

**Figure.1. Machine Vision System**

Once a method is identified to measure the yolk size,
the system can frame a method to predict the fertility. The fertility prediction is not an easy thing. It requires some advanced results for prediction. This method aims at proposing such advanced methods.

In the proposed approach of fertility prediction height of the egg and size of the yolk are considered to determine the air room region space, which is the main characteristic parameter at the last stage of incubation. The whole work aims at predicting this space.

IV. SYSTEM ARCHITECTURE

The architecture diagram shows the sequence about how the image is being processed and transformed to predict the fertility of the egg. The detail image flow is shown in figure 2. The egg is fed to the system one by one and the image gets transformed to grayscale images. The grayscale images help further stages of predicting fertility. Fertility is predicted using the threshold images. In artificial neural network, these are done through network training. The neural network is trained for the conversion process and then the fertility is predicted based on the size.

Fig2. Architecture of fertility prediction

V. Employing Artificial Neural Network(ANN) for Fertility Prediction

In recent years, many systems of agricultural engineering are automated to achieve accuracy in the field. For predicting the fertility of eggs the image conversion and comparison are done by human. There is a possibility for error in this prediction process. To overcome the human error, this method can be employed using ANN. The image conversion and comparison can be trained to the neural network and the network in turn provide the result. There are differences found between yolk shape from egg to egg. The different eggs are analysed and trained to the neural network. Each shape has the different characteristics with different behavior. The neural network will identify the shape of the yolk. The corresponding parameters are evaluated and the measurement for those shapes are verified. Then the fertility is predicted automatically by the network.

<table>
<thead>
<tr>
<th>Yolk Shape</th>
<th>Egg Height (in mm)</th>
<th>Yolk diameter (in mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round</td>
<td>56-59</td>
<td>28</td>
</tr>
<tr>
<td>Slightly elongated</td>
<td>56-59</td>
<td>30</td>
</tr>
<tr>
<td>Oval</td>
<td>54-57</td>
<td>26</td>
</tr>
</tbody>
</table>

Table1. Height and yolk dimensions

The above table shows the dimensions of various yolk types. These values were regarded as the threshold value and the values that match these values for considered fertile. Based on the height to the yolk dimensions the air room region is evaluated. Air room region of the egg plays a vital role in the hatching of the egg. Based on this dimension the air room space for the egg is calculated and the fertility is predicted.

Classification of the eggs plays a vital role in this system. The classification should be done in such a way that no fertile egg is discarded. In practical, it is quite difficult. So the algorithm should minimize the level of failure. Those algorithm classifies the egg accordingly based on the constraint given to it. The algorithm processes through all the eggs laid and classifies the fertile eggs based on the constraint. The algorithms used are LS-SVM and back propagation algorithm. These algorithm classify the eggs and those fertile eggs are subjected to incubation. The incubation result of the fertile eggs being selected by the algorithm are subjected to incubation. The result is tabulated in table 2.

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Number of Egg sampled</th>
<th>Result Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS-SVM</td>
<td>250</td>
<td>91.4%</td>
</tr>
<tr>
<td>Backpropagation</td>
<td>250</td>
<td>83.9%</td>
</tr>
<tr>
<td>Manual</td>
<td>250</td>
<td>81.34%</td>
</tr>
</tbody>
</table>
Table 2. Test result

The table result shows the hatched rate of chicken eggs. For comparison and to achieve better accuracy of the system was implemented using different algorithms have been used. By comparing the results it is clear that the automated method is better than the manual method of predicting fertility.

VI. FUTURE WORK

During this study it has been observed that the yolk shape differs from egg to egg. As the yolk size is considered the characteristic parameter for fertility, the study on various yolk shapes is mandatory. The work has to be extended to identify the availability of even more yolk shapes. The threshold value for those shapes has to be evaluated. This concept could be tried using some emerging algorithm such as Cuckoo bird and Frog Jump algorithm. The proposed system predicts fertility only for single yolk egg. The future work could aim at enhancing the system to work on twin egg.

VII. CONCLUSION

The proposed system thus predicts the fertility of the egg before the incubation period using image processing techniques. The image processing techniques help in predicting the size of the yolk based on which fertility is predicted. This automated system for the prediction of fertility of egg, increases the profit of hatcheries by reducing the incubation cost. The eggs once incubated cannot be used for edible purpose. So this system brings profit by classifying those eggs into fertile and infertile. The proposed system does not use any harmful radiations as the previous systems. Hence the efficiency is better than the existing system.

REFERENCES