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A Survey: Silkworm Egg Counting and Monitoring Based on Image Processing and Internet of Things (IoT)

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ABSTRACT

Sericulture or Silk Farming is the cultivation of Silkworms to produce silk. India is the second largest producer of silk in the world after China. Directly or indirectly sericulture provides employability to more than 10 lakh people in India. Karnataka state contributes more production of silk in India. Silkworm seed production is important in increasing the quantity of silk production. Grainage are used for the production of large quantity of the Silkworm eggs. Counting of silkworm eggs is necessary to avoid loss to silkworm egg producers and farmers . Present methods of counting of Silkworm eggs such as manual counting is waste of time and it requires lot of man power , other method such as calculator causes harm to the eggs because of its needle. Silkworm production is adversely effected by the humidity and temperature of the environment. Silkworm undergoes various changes in its lifecycle so it requires some automation to continuously monitor the growth of silkworm to increase the quality and quantity of the silkworm. Hence automatic methods such as digital image processing techniques are used to count the number of eggs to avoid loss to the sericulturists and farmers. This paper presents the various image processing and IOT techniques used to monitor and obtain the silkworm egg count.

Keywords: *Silkworm egg counting, Image Processing, IOT to monitor silkworm*

1. INTRODUCTION

From previous recorded period silk and silk textures pulled in humankind and discovered their place among the most esteemed and rich human textures. Sericulture is both a workmanship and exploration of raising silkworms for silk generation .Sericulture and silk production have an more potential in India because it is made available to rural people and its marketing is organized independently. It can be used as an excellent mode for providing employment and increase of income. It requires not only giving new technological inputs to producers but more importantly, creating and establishing new methods of arranging of silkworm eggs perfectly in order to produce statistics linked to hatching percentage of different silkworm species. Ventures can anticipate regular necessities and plan egg generation by knowing incubating capacity of particular silkworm species. Culminate arranging of foundation in the grainages is required to expand the creation effectiveness. Farmers look to grainages for giving of silkworm seeds. The quantity of silkworm seeds is required for development of mulberry trees. Deficient supply of silkworm seed check prompts monetary misfortunes to the farmers. It is compulsory to count silkworm eggs exactly for selling the silkworm eggs to farmers. Thus this research work tries to introduce automation in Sericulture industry and thus to increase the total production of silkworms.

In silk creation, the aggregate number of silkworms required for the estate of mulberry trees, ought to be satisfactory one for good generation of silk, with the

goal that mulberry leaves won't be squandered. The agriculturists should buy surmised add up to number of eggs from grainages. disease Free Layings (DFLs) are created in grainages and given to the farmers for raising. Absence of consistency of egg amounts laid on sheets amid creation can cause economic loss. The quality control strategies to screen the egg tally is dreary and requires labor. While offering the silkworm eggs for raising it is important to tally the aggregate number of silkworm eggs precisely, so that farmers can pay accordingly and they should not suffer a loss. Hence this counting finds the fecundity (Laying capability of female moth) and hatching percentage required for silkworm rearing. Karnataka State of Sericulture Research and Development Institute, Banglore (India) changed simple pocket calculator into egg calculator in 1997. To count bacterial colonies electronic gadget were used based on that egg calculator was developed. Small probe is attached to calculator and then probe is attached to a pen for counting silkworm eggs but this method is also erroneous, time consuming and required man power, so to reduce the extra man power, time and to increase the accuracy, silkworm eggs counting system using image processing algorithm is used.

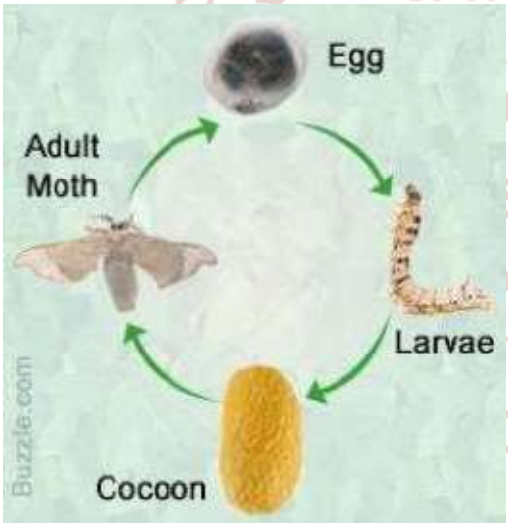

Fig. 1 The lifecycle of the silkworm

1.1 Concept of Digital Image Processing

Image processing is a system principally to change over a image into computerized shape and to play out a few activities on it, keeping in mind the end goal to get an enhance the nature of picture or to separate some helpful data from it. The two sorts of strategies utilized for picture preparing are simple and computerized picture handling . Simple or visual systems of picture preparing can be utilized for the printed copies like printouts and photos. Computerized Processing strategies help in control of the advanced pictures by utilizing PCs. In this the crude information from serial camera is gathered and it will experience different periods of handling. The three general stages that a wide range of information need to experience while utilizing computerized strategy are pre-handling, upgrade and show, data extraction . The Matlab will be utilized for numerical calculation, perception, and application advancement by utilizing different inherent calculations for flag handling.

1.2 Concept of IOT

The Internet of Things (IOT) is a current correspondence, in which a system interfaces all gadgets to the web for imparting through the detecting gadgets with reasonable conventions, and trade information with each other by utilizing remote sensor systems. Utilizing an IOT the gadget is associated with the web and every one of the information is imparted to different articles without human communication. The IOT is utilized to gauge true occasions and for controlling the particular actions. IOT gives the data gathered in all divisions of agribusiness, medicinal services, home machines, and so forth. With the expansion in the aggregate number and functionalities of sensors and actuators, the IOT which is utilized to interconnect a specific arrangement of things, is effortlessly programmable, and more fit for cooperating

Fig 1.2.1 Iot Connectivity diagram

2 BACKGROUND WORK

2.1 Ms. Sanaha S. Pathan, Prof. Avinash D. Harale implemented a method called Egg counting System in which the Silkworm seeds having high degree of

heterosis are known as Disease Free Laying (DFLs) are supplied to farmers for rearing. The Images of these Disease Free Laying sheets are captured using cameras .This method is known as image acquisition. The Captured Images are further enhanced using image enhancement method. In this the image is modified to remove noise and blur so that the obtained images are suitable more specific application than original image. It include basic gray level transformations, histogram modification, average and median filtering, Top hat filtering etc. The enhanced image is subjected to image segmentation to change the representation of image for better analysis. The segmentation can be either region based segmentation or edge based segmentation. It is used to locate objects and boundaries in the images. The result of segmentation is set of contours extracted from image. The final method is object counting is done to get number of segmented areas. Methods of object counting are Hough transform, connected components analysis, statistical area measurements etc.

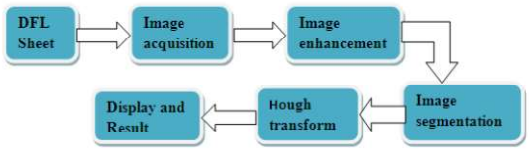

Fig 2.1.1 Block diagram of silkworm counting system

2.2 Sanaha Pathan, Avinash Harale introduced a technique of automatic silkworm eggs counting system for counting number of silkworm eggs with better accuracy and avoiding loss to sericulture producers as well as farmers. For segmentation process thresholding is used, for removing noise again thresholding technique is used based on physical and external properties of object. Counting the total number of silkworm eggs is done by using matlab command.

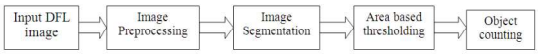

Fig.2.2.1 Block diagram of automatic silkworm eggs counting system

Within this a image database for silkworm egg counting is developed by using different DFL sample images. The images are applied to image Preprocessing where it is used for resizeing of image, HSV color transformation for gathering useful information from an image. After binary conversion of color image, one value pixel represent information about white pixel and zero value pixel represent information about black pixel.

After locating the position of white pixel, access information of HSV image for white pixel and converted it into matrix form. After representing information in matrix form, mean value is calculated from matrix. After obtaining mean value, image segmentation is performed by using thresholding method. Threshold value is obtained by trying different mean value for better output. In segmentation process non egg portion is discarded and only egg portion is keept as it is. After removing non egg portion ,figure out the individual eggs and overlapping eggs by thresholding method based on distance between HSV image pixel value and mean value. After final segmentation, the final segmented image is converted in to binary image because final segmented image is not suitable for count. After recognizing individual eggs and overlapping eggs and changing their form it into binary , still there are some obstacles between eggs. All barriers or obstacles between the eggs are removed by using again thresholding technique and threshold value based on area. Physical information of object is obtained by using region props function. After removing barriers, the final image is ready to be counted and number of objects are counted by count command in MATLAB programming software tool.

2.3 Kantip Kiratiratanapruk proposed a picture preparing strategy for recognizing number of silkworm's eggs. The proposed strategy can identify and assemble silkworm's eggs as ordinary eggs, debilitate eggs and eggs that will develop into an inadequate develop worm. From normal highlights of silkworm's eggs, the egg from different butterfly species, reproducing in various area won't look similar .It will make the eggs to have diverse assortments of shading shade and somewhat extraordinary size and shape. In addition, a factor, for example, incubating period and egg laying material will acquire more shading variety.

This method is divided into two sections one is object detection and other classification to identify an each unique egg objects and its type. The object detection is mainly used to identify an individual silkworm egg object. Usually the eggs have elliptic shape with non-identical orientation and there are many eggs and they are mostly interlinked to each other. since the image

contain large plenty of objects ,hence the traditional counting algorithms are not suitable. Hence a different technique called centroid position based object detection technique which is suitable for elliptic objects is used. In this method the object size ,distance and diameter is applied to identify individual egg objects.

The got egg shading picture is changed into a fine paired picture. The forefront pixel is made to isolate from the foundation by utilizing versatile thresholding method. Every special question ought to have just a single centroid position. Another centroid will be compared with all of centroid positions. On the off chance that separation got from another centroid is sufficiently long when contrast with each other, that position will be acknowledged

In question order process, the info test for protest characterization demonstrate is produced by shading pixel picture from RGB shading space as a principle include. To distinguish the sort of egg, the Gaussian mixture model (GMM) is utilized to display the arrangement of shading for each egg write. To evaluate the strategy, a desire expansion (EM) calculation is connected to locate a greater probability of shading circulation. The sort of the egg is chosen from a model that plays out a most astounding likelihood.

It utilizes a graphical UI programming for building up an arrangement model to help clients when they discovered new extraordinary shading shade design . The software provides a manual modification tool that allows user to correct an obtained result for high accuracy requirement. This function is mainly used in breeder paper for species conservation purpose. In addition, the software also provides tool for creating a classification model to help users when they found new different color shade pattern. Silk worm eggs image contains large amount of objects.The product separates original picture into a few sub pictures .Then each sub picture is handled parallely.

2.4 Ms. Amruta Pandit, Mrs. Jyoti Rangole paper displays a programmed technique for checking of silkworm eggs counting utilizing computerized picture handling calculation. The calculation is acknowledged in Lab VIEW graphical programming condition that abbreviates the advancement cycle. The framework comprises of the example input picture of DFL sheet; camera interfaced to NI EVS 1464 RT, picture handling calculations and last aggregate egg count consider as a yield. NI EVS is utilized to make a remain solitary application for programmed eggs tallying. The tally acquired by picture preparing calculations contrasted and that of the manual check of DFL sheet. The product application that understands the picture preparing calculation for silkworm eggs including which is acknowledged LabVIEW.RGB demonstrate does not contain helpful data consequently it is should have been altered into dim scale. To dispense with this impact of non-uniform lighting, top-cap morphological sifting is utilized. This activity focuses to adjust for possible light contrasts inside the picture that has a dull foundation.

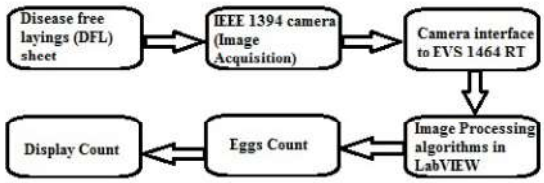

Fig. 2.4.1 System Overview of Real-time Eggs Counting System

RGB color model does not contain useful information for segmentation. First step of this method is to convert original RGB image to gray scale. It is carried out by casting image in IMAQ.

Thresholding strategy comprises of portioning a picture into two locales: a molecule district and a foundation area. It creates parallel binary picture by turning all picture pixels beneath some edge to zero and all picture pixels above edge to one. The benefit of first acquiring double picture is that it lessens the issues related with objects information and improves the procedure of acknowledgment of items.

2.5 Divya Darshini.B , Adarsh.B.U built up a strategy for IoT based sericulture raising house approach with steady observing and activation. IoT based silkworm raising house comprises of sensors and actuators, which are associated with battery worked remote sensor hubs. Sensors will give the continuous data and in view of the readings, moves will be made by brilliant remote sensor hubs and activation is performed. In this keen procedure, the ongoing sensor information gathered by the sensors in the 6LoWPAN system will be transmitted to the 6LoWPAN Border Router (6LBR) through neighbor hubs utilizing RPL convention [12]. Association is set up between 6LBR

gadget and 6LoWPAN gadgets through Internet more than 3G, Wi-Fi or wired Ethernet.

The 6LoWPAN will enable the end user to monitor and to actuate the sericulture system in real time by making use of an internet. CoAP protocol will be successfully implemented for an application layer. Prototype test proves that implemented prototype is successfully capable to monitor the parameters in real time and to control the condition inside the deployed environment and has several advantages in term of remote monitoring, automated actuation to suitable condition inside the system, image processing to know the real time status incomplete sericulture process, low cost of the system, flexibility, user friendliness and energy.

2.6 Nivaashini M. Soundariya R. S. Dinesh Kumar A. introduces an Internet of Things (IoT) empowered Wireless Personal Area Network (WPAN) system in order to deal with a continuous observation of silkworm development in sericulture and picture handling innovation to recognize the phases of silk worm life cycle. The proposed model is employed utilizing Arduino Software and sensors to gauge the environmental circumstances within the arrangement of silkworms according to the prerequisites for each and every stages of silkworm life cycle. The entire model will be fabricated utilizing the Arduino Board stack integrated with moistness and temperature sensors in the company of a camera to catch the photos and to examine it utilizing a picture preparing technique to confirm the condition of sericulture progression. A perfect temperature of 22 0C to 28 0C and moistness in the middle of 65% - 85% must be maintained. In order to maintain the moistness and temperature as per the requirement, a computerized checking based on the IoT activation framework is composed and executed. If the temperature (<220c or >280c) and the moistness (<65% or >85%) is critical. The system automatically sends the message to the concern person “the temperature is critical with the reading”.

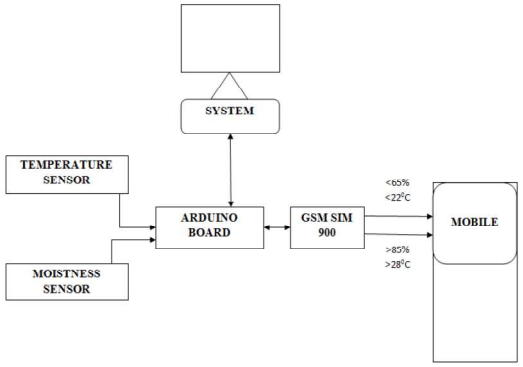

Fig. 2.6.1 Systematic Design of the monitoring System

3 DESIGN METHODOLOGY

The Main problem we understood is the various abiotic factors has to be maintained properly for good productivity and in many of the farms the monitoring was purely manual. A supervisor must be present all day near the worms monitoring the values of temperature and humidity. If any value changes the supervisor initiate the procedures for correcting the climatic change. Ex:If the temperature goes down the person in charge will actually turn-On the heater and should turn off it after he attains the required temperature. And If Humidity is fallen to low rate, then the person was sprinkling water on gunny bags hanged around the inner walls of the room to increase the Humidity. For a special type of silkworm known as Bivoltine Mulberry, these factors face a crucial role. For these worms to survive, the temperature must be in 25°C to 27°C. And humidity should also be maintained to exact value. These types of worms produce better quality of silk than other type which are majorly produced. For silk production, using this worm need constant monitoring and great precision, and this may not be obtained by Manual Monitoring

The farmers look to the grainage for supply disease free laying (DFL) seed which produce cocoons with rich silk content and high yields. Farmers expectations of good quality seed supply and accurate counting of eggs from grainage is high. Traditional method of counting eggs is by using ink/sketch pen, but this method can harm the embryo when pressure is applied on the egg and is time consuming and labor intensive and there are chances that the objects may appear overlapped, this makes the counting tedious. Continuous counting leads to eye fatigue and affects the accuracy of results. However, the process of counting objects is not always straightforward or trivial, even performed manually. Most counting

methods have peculiarities that make them tricky to tackle. For example, the objects may occur in large number and overlapped making counting tricky and tedious that in turn leads to error. Manual method must be replaced by computer vision as the results of this method are erroneous and time consuming.

The background survey consists of automatically control methods for the a biotic parameters like Temperature and Humidity in the sericulture farm to get improved yield and quality of silk. In the present system, the climatic parameters are controlled manually, which is inefficient. The system will continuously monitor the environment conditions needed for good growth of silk worm. The system mainly contains actuation units which is monitored using cloud based system. The current values that is sent to cloud is compared with thresholds and corresponding calculated values is sent back to microcontroller.

Silkworm eggs counting system using image processing algorithm will be useful for counting eggs accurately, reduces the time of manual counting and will increase benefits to the sericulture production and increasing the production of silk in India by automation in counting of silkworm eggs. This algorithm also useful in other application fields for counting small objects. Segmentation method is very useful for separating egg portion from non egg portion. Object counting is based on matlab count command which gives better result By using this system, sericulturists can be guided for production of mulberry plantation before rearing process. It is also useful to count objects which are in very small size.

CHALLENGES

- In the process, smaller eggs are treated as background and are eliminated leading to decrease in the count compared to the actual count.
- Overlapped eggs were detached into many pieces and this increased the count.
- It consumes lot of time in the analysis of the high resolution image and this is mainly due to the tiny physical dimension of the eggs.
- It is observed that if the prepared paper inhibits noisy background, there is increase in the number of the centroids detected

CONCLUSION

The survey report gives various image processing methods for counting silkworm eggs. The work in this survey is a part of technical seminar to explain the efficiency and best methods for silkworm egg quality and quantity control and also to monitor its growth. It includes various detection and classification technique for color variation in silkworm eggs image. Their approach may give sharp accuracies for different styles of eggs. The survey also consists of automatically control methods for the a biotic parameters like Temperature and Humidity in the sericulture farm to get improved yield and quality of silk and the system will continuously monitor the environment conditions needed for good growth of silk worm.

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