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Silksage: Empowering Sericulture with Silkworm Eggs Counting System.

[1]Ms. Divyani Subhash More, [2]Dr. Ms. Neeta P. kulkarni, [3]Ms. Aishwarya Pandurang Joshi

[1]M.Tech Student, [2]Associate Professor, [3]M.Tech Student

[123]Department Of E & TC Engineering,

[123]SVERI's College Of Engineering, Pandharpur, India.

Abstract : The world's most exquisite fabric, silk is prized for its unmatched grandeur, high absorbency, smooth texture, natural sheen, lightweight nature, and exceptional durability. Silk has deservedly been dubbed the "Queen of Textiles" throughout the world due to its natural affinity for dyes. The agro-based sector of sericulture is centred on the creation of cocoons, with silkworm eggs acting as the basis for the silk industry.The first step in the rearing process is to buy silkworm eggs, also known as Disease-Free Layings (DFLs), from authorised seed suppliers or government grainages. DFLs are purchased by sericulturists according to the capacity of mulberry plantations. Since there are variations in the quantity of silkworm eggs per DFL, precise counting is essential to avoiding financial losses for both grainages and sericulturists. The hatching percentage and fecundity are significantly influenced by this count. The traditional counting approach, however, is labour-intensive, error-prone, and manual. The goal of this project is to replace the current manual method of counting silkworm eggs by creating an automated system employing image processing techniques. It is anticipated that the system will produce more precise and effective results by leveraging the Circular Hough Transform, a potent method for detecting circular objects

Index Terms - Image processing, silkworm, DFL, eggs, Sericulture.

I. INTRODUCTION

Sericulture is art of rearing silkworm for production of cocoons. Production and timely supply of superior quality silkworm seed is essential to sustain sericulture as a commercial crop in competition with other cash crops. Sericulture in India is practiced both in temperate and tropical zones. Silkworm breeds differ because seasons and rearing conditions vary. The demand of eggs for rearing silkworm is not uniform throughout the year. Timely supply of quality seed requires proper planning of seed production and distribution of the same. Silkworm seeds having high degree of heterosis are known as Disease Free Laying (DFLs). They are supplied to farmers for rearing. Silkworm farming is a significant agricultural activity, especially in India. The quality of silk depends on efficient egg management. Manual egg counting is labor-intensive and prone to errors. Automation helps save time, improves accuracy, and benefits farmers by enhancing productivity.

It is essential to count the number of silkworm eggs accurately in order to generate statistics related to hatching percentage of different silkworm species. Centers can forecast seasonal demands and plan egg production by knowing hatching capability of specific silkworm species. Good planning of infrastructure in the grainages is required to increase the production

efficiency. Farmers look to grainages for supply of silkworm seeds. The count of silkworm seeds is required for plantation of mulberry trees. Variation in the supply of silkworm seed quantity leads to economic losses. It is necessary to count silkworm eggs accurately for selling the silkworm eggs to farmers

II. NEED OF THE STUDY

The conventional method for the silkworm egg counting is by using ink/sketch pen. The transparent paper is put on the egg sheet and eggs from one DFL are counted by marking it using sketch pen. This is usually performed in manual, visual and non-automatic form which is erroneous and time consuming. This project work approaches the development of automatic silkworm eggs counting system using image processing and it will saves the time and man power required for manual counting.

Manual counting of silkworm eggs is:

1. Time-consuming and inefficient.
2. Prone to human error.
3. A barrier to scalability in large-scale sericulture farms.

The project proposes an automatic counting system to address these challenges.

III. RESEARCH METHODOLOGY

The system comprises five stages:

1. Image Acquisition:

Capture high-resolution images of silkworm eggs using a digital camera or smartphone.

2. Preprocessing:

- Convert to grayscale.
- Apply Gaussian filters for noise reduction.
- Enhance contrast using histogram equalization.

3. Segmentation:

- Thresholding: Separate eggs from the background.
- Morphological operations to fill gaps or eliminate noise.

4. Counting Algorithm:

Use connected component labeling or blob analysis to identify and count eggs.

5. Post-Processing:

Validate and correct the count to handle overlapping or irregularly shaped eggs.

Hardware and Software Requirements

• Hardware:

- Digital camera/smartphone for image acquisition.
- A computer.

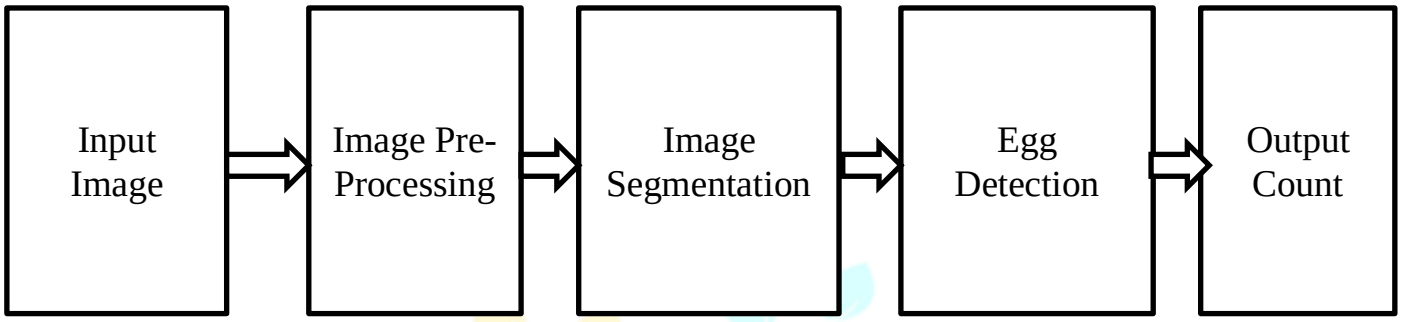
• Software:

MATLAB R2021a or later with the Image Processing Toolbox.

System Design

Flowchart

Illustrate the step-by-step process:



IV. RESULTS AND DISCUSSION

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. By using this system, Seri culturists can be guided for production of mulberry plantation before rearing process.

The system was tested on over 50 sample images with varying lighting and egg densities. The average accuracy achieved was 95.6% compared to manual counting. Results showed the following:

- Best performance under uniform lighting conditions.
- Errors occurred when eggs were clustered or overlapped.
- Time taken per image: Less than 5 seconds.
- Interface usability was rated high by test users.

Overall, the system performed reliably and showed potential for deployment in real-world sericulture environments.

Performance Metrics:

1. **Accuracy:** Compare system results against manual counts.
2. **Processing Speed:** Time taken to process a single image.
3. **Error Rate:** Percentage of missed or falsely counted eggs.

V. CONCLUSION:

The silkworm egg counting system, utilizing an image processing algorithm, will enable accurate egg counting, significantly reducing the time required for manual counting. This automation will enhance sericulture productivity and contribute to increased silk production in India. Additionally, the system will assist sericulturists in planning and managing mulberry plantations before the rearing process begins.

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