

## EARLY DETECTION AND PREDICTION OF DISEASE SILKWORM COCOON USING CNN TECHNIQUES

Roshini Barkur<sup>1</sup>, Priya Thomas<sup>2</sup>, Jincy C Mathew<sup>3</sup>, Neethu Tressa<sup>4</sup>, C Priya<sup>5</sup>

<sup>1</sup> Department of Computer Science and Applications, Christ Academy Institute for Advanced Studies, Bengaluru, India. [roshini.b@caias.in](mailto:roshini.b@caias.in)

<sup>2</sup> Department of Master of Computer Applications, New Horizon College of Engineering, Bengaluru, India. [priya.t\\_mca\\_nhce@newhorizonindia.edu](mailto:priya.t_mca_nhce@newhorizonindia.edu)

<sup>3</sup> Department of Computer Science and Applications, Garden City University, Bengaluru, India. [jincy.c@geu.edu.in](mailto:jincy.c@geu.edu.in)

<sup>4</sup> Amity Institute of Information Technology, Amity University, Bengaluru, India. [neethutressa89@gmail.com](mailto:neethutressa89@gmail.com)

<sup>5</sup> Department of Computer Applications, Dr.M.G.R. Educational and Research Institute, Chennai, India. [drcpriya.research@gmail.com](mailto:drcpriya.research@gmail.com)

**Abstract.** India is a major silk producer and buyer; hence silk manufacture is vital to its economy. Given India's substantial reliance on agriculture for GDP growth, sericulture - the process of raising silkworms to produce raw silk—is a vital economic activity. The main steps in sericulture are growing plant life for silkworms, spinning silk cocoons, reeling silk filaments, and weaving them into textiles. Silkworm diseases account for 30-40% of production losses. Silkworm illnesses include Grasserie, which is frequent. Silkworm diseases are diagnosed using several medical and laboratory methods. Technology is changing many aspects of our lives, and the agriculture sector has welcomed it. Sericulture has delayed implementing such advancements. While numerous methods have emerged for detecting silkworm eggs and moths, early detection remains difficult. Early disease detection can help farmers prevent disease spread. This research focuses on silk-worm diseases utilizing photo-type and deep-learning models. A device mastery system has been taught to distinguish healthy and unhealthy silkworms using a deep neural network and a CNN, with promising accuracy. TensorFlow was used to create layers and train the algorithm to learn the version. In conclusion, this study uses image categorization and deep learning to detect silkworm diseases. CNN in a deep neural network and TensorFlow have allowed a device to learn a version that can categorize healthy and harmful silkworms.

**Keywords:** Silkworm, CNN, Neural Network, Silkworm disease.

### 1 Introduction

Sericulture, the historic artwork of raising silkworms for the manufacturing of silk, has long been respected because the epitome of elegance, incomes the identity of the "Queen of Textiles." This exercise holds great significance for agrarian economies, which include India because it contributes to their ordinary development.[1] While China and India currently dominate silk manufacturing, accounting for more than 97% of the sector's silk sourcing, there is a developing movement to revive silk manufacturing in European international locations that were as distinguished players in this enterprise at some stage in past centuries.

One of the greatest demanding situations faced by way of the silk enterprise is the brasserie sickness, resulting from an epidemic known as Bombyx mori nucleopolyhedrovirus (BmNPV). Belonging to the Alphabaculovirus genus in the Baculoviridae family, BmNPV has left an indelible mark on the records of silk manufacturing. Its effect on the sericulture agrosystem is profound, no longer only in India but globally as well.[2]

BmNPV typically infects the larval levels of the silk moth, mainly due to a range of discernible signs. Affected larvae showcase a great luster and delicate pores and skin, experience swelling in inter-segmental areas, and show milky white hemolymph. Tragically, this viral infection frequently consequences in the dying of the larvae, which may be found striking from their prologs.[2]

Grasserie, a general disease in silkworms, bills for approximately 33% of all diseases affecting this group. It is commonly discovered in silk-rearing farms. Causative Organisms: The primary causative agent is the Nuclear Polyhedrosis Virus (BmNPV), whilst the Borrelina virus also contributes to the disease, albeit to a lesser quantity.[3]

**Symptoms:** Infected larvae show sluggish movement. Their skin turns vibrant before molting, but they fail to molt and eventually die. Swelling occurs in the intersegments of the larvae, and their pores and skin take on a yellowish hue. The larvae's integument will become fragile, without problems breaking and freeing a turbid milky white fluid called hemolymph. Soiling is observed inside the anal region, and the clasping electricity of the larvae diminishes or is lost. Occasionally, rectal protrusion and restlessness occur.[3]

**Detection:** Microscopic assessment permits the detection of grasserie sickness. When analyzing the hemolymph or larval fluid under a microscope, the presence of polyhedral bodies may be observed.

**Influencing Factors:** Temperature and humidity notably impact the danger of disease incidence. High temperatures above 28 °C or low temperatures below 20 °C growth the chance of contamination. Additionally, feeding the larvae negative high-quality mulberry leaves, along with those infected with polyhedral bodies, tender leaves, Wet leaves, low-protein leaves, and leaves with little carbs, all contribute to the danger of ailment.

**Rearing Environment:** The rearing surroundings perform a crucial role in silk yield. A lack of ventilation, flawed overcrowding bed cleaning of larvae, and the buildup of faces all impact the productivity of silk manufacturing.

**Source of Infection:** Contact among inflamed and non-inflamed larvae serves as a chief source of transmission. Feeding larvae with inflamed or contaminated leaves, in addition to the presence of various pathogens in the rearing system and silkworm waste, additionally contribute to the unfolding of the ailment.[3]

**Management and Measures:** To mitigate the sickness, it is crucial to observe proper hygiene and sanitation practices. Regular disinfection of the system and the rearing house is vital. Feeding mature larvae gentle mulberry leaves ought to be prevented. Regular cleansing of the rearing mattress to cast off excreta and waste fabric is essential. Infected larvae should be separated, disposed of, and destroyed as wished. Disinfecting the environment around the raising house and each crop employing a 0.3% slaked lime solution or a mixture of lime and bleaching powder at a 1: 9 ratio is usually recommended. Overcrowding must be prevented, and suitable separation strategies need to be hired in crowded regions. Maintaining the right temperature and humidity in the rearing surroundings is vital. The use of the medicine "Amruth" and making use of the endorsed mattress disinfectant is essential for achieving the most beneficial silk yield.[3]

In the end, the allure of silk because the pinnacle of elegance persists, driving the dominance of China and India in its manufacturing. However, efforts to restore European silk production are underway. The grasserie disease, due to BmNPV, remains a powerful challenge for the silk enterprise, with its devastating results on the silkworms' well-being and the worldwide sericulture agrosystem as an entire.[2]

In this take look, a gadget-getting-to-know approach employing ensemble algorithms is utilized to come across brasserie disease in silkworms. The proposed approach includes training various gadgets gaining knowledge of category algorithms the using a dataset comprising photographs of both healthy silkworms and those at four extraordinary levels of the disease. By using this method, the complexity related to disorder identification is reduced, at the side of the time required for detection. Moreover, this method removes the want for professional people to carry out such tasks. Leveraging machine-gaining knowledge of strategies, mainly convolutional neural networks (CNN), allows the early detection of the ailment. This early identity empowers farmers to take essential measures to save their ailment spread and minimize yield loss.[1]

## **2 Literature Review**

We looked at research that used machine learning ensemble techniques to diagnose grasseries in *Bombyx mori* silkworms. Six specialized machine-learning classification algorithms are initially trained by feeding them images of both healthy and ill silkworms from a collection of images of silkworms. The accuracy of each model is assessed, and the best model is selected after a careful analysis of the assessment measures. The difficulty of identifying disorders will be reduced, as will the time needed to do so. Additionally, it does away with the need for trained individuals to carry out such processes. Utilizing sign processing methods, By taking necessary steps to stop the spread of infections, farmers can avoid suffering a loss in production by identifying the illness early on.[1]

Several issues have plagued computer vision for more than a decade. The pervasive implementation of deep learning algorithms has significantly improved the accuracy of these concerns, which were previously inaccurate. Recently, the categorization of images has become the most pressing issue. Images of cats and canines, for instance, could be placed in the same category. This research intends to employ a cutting-edge technique for item detection to attain the highest level of precision possible.

A convolutional neural network was developed for the image-processing tasks. We

utilized these methods to classify silkworms into healthy and diseased populations for our research. [4]

Silk is produced by the larva or caterpillar of the domesticated silky moth, *Bombyx mori*. The silk produced by this insect is of vital economic importance. Flacherie has been linked to bacterial infections. The entire digestive systems of diseased silkworms have been gathered and examined here. The samples were serially diluted and then plated at two distinct concentrations ( $10^{-5}$  and  $10^{-6}$ ) on nutritional agar. We utilized a variety of techniques, such as colony morphology, staining properties, and biochemical analyses, to identify the most vital colonies. Among the bacteria discovered to date are *Bacillus subtilis*, *Streptococcus pneumoniae*, *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas fluorescens*, *Bacillus cereus*, and *Klebsiella cloacae*. Since the bacterium that causes bacterial flacherie in silkworms has been identified, the issue can now be resolved. Therefore, it may be advantageous for the economy and health of silkworms to learn how to prevent the spread of disease caused by specific bacterial species. [5]

As AI continues to develop, it is likely that deep learning will become more prevalent in the field of image reputation. Due to their superior efficacy in image processing, convolutional neural networks have acquired popularity as a common deep learning strategy. It has had a great deal of success and is extensively employed in a variety of fields. The public's negative perception of computer vision is the field's greatest obstacle. Because of the versatility of computer identification, computer vision has numerous applications. [6]

Recent years have witnessed a rise in scholarly investigation into the relationship between object recognition video analysis and image comprehension. Conventional object recognition techniques rely on basic, easily-created attributes and trainable structures. Their performance typically reaches a plateau due to the complexity of their ensembles, which combine several low-level image capabilities with high-level information from object detectors and scene classifiers. The rapid expansion of deep learning has resulted in the development of more efficient tools for analyzing semantic, high-level, and deeper characteristics, which can be applied to the issues currently confronting conventional systems. The models differ in numerous ways, including network structure, training methodologies, and optimization parameters. [7].

### **3 Methodology**

The centered image is acquired from a digital fundus camera, and then the pre-processing steps are observed. After that, the photo is identified using image processing strategies. Finally, the form of ailment could be displayed. Images of silkworms are first gathered. The pink, green, and blue aspects of the real photo. Similar procedures convert an RGB image into a greyscale photograph. The influence of noise is then lessened using a filtering strategy. Here, the median filter is being used. A non-linear filter type called the median filter out is used to lessen the effect of noise without distorting the sharp edge. With the use of contrast-limited adaptive histogram equalization, the median clean-out outcome image is more suited. After that, we perform a morphological operation on the improved image. The morphological processes are final, initial, erosion, and dilation. In this case, we are utilizing Ultimate. To close the identical depth values, use closing. Using the edge cost, the morphological result is converted from a binary image. Before

applying the gray threshold technique to determine the threshold cost of the morphological final product. Finally, the silkworm's grasserie is discovered.

### 3.1 Description of the Dataset

The dataset used on this test is personally captured via us.

### 3.2 Algorithm Used

Support Vector Machine (SVM), Convolutional Neural Networks (CNN).

### 3.3 Algorithm Explanation

**Support Vector Machine (SVM):** SVM is a supervised mastering set of rules used for category tasks. It targets to discover the most advantageous hyperplane that separates extraordinary instructions inside the information. SVM can handle each linear and non-linear classification issue. SVMs are the principal applied algorithms displaying strengths in such cases, also it's far the fundamental applied getting to know algorithm for regression issues and class. The model of SVM represents the examples as factors in a multi-dimensional area, shown in a way that the individual categories' examples were divided into clean obstacles that have been as huge as possible [8].

**Convolutional Neural Networks (CNN):** CNNs are deep mastering fashions designed for processing structured grid-like information, together with images. They study hierarchical representations from input information using convolutional layers. CNNs are broadly used in image classification, object detection, and photo segmentation duties [9].

### 3.4 System Architecture Diagram

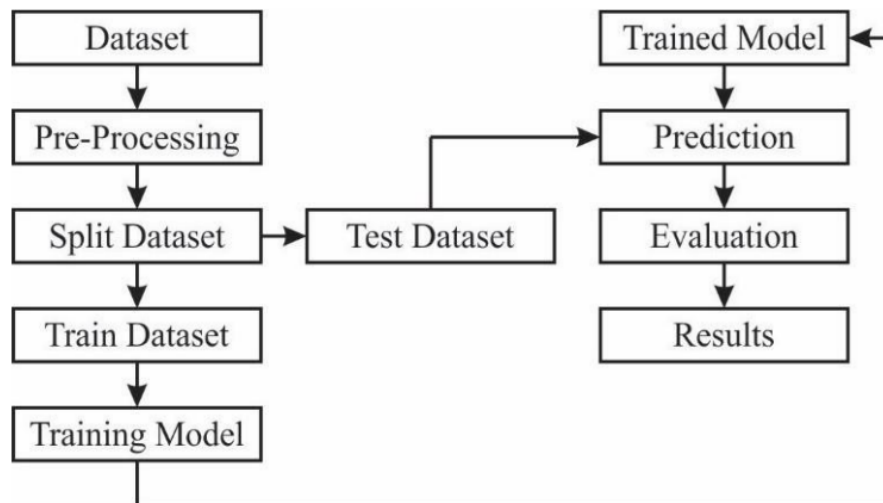


Fig. 1. System Architecture

### 3.5 Pseudocode

Here are the process steps for the pseudo-code provided:

Step 1: Initialization

Pick a sample that best represents the dataset.

Step 2: Create a decision tree

By defining conditions for each sample, build a decision tree. When classifying items, judgments are based on these criteria. The ultimate forecast is influenced by each decision-making element in the decision tree.

**Step 3: Superpixel Segmentation and Mapping**

Use superpixel segmentation to divide the image into sections. Calculate the segment’s representational characteristics for each segment. Using distance measurements from the cluster centroids, map the segment to a cluster with similar attributes.

**Step 4: Calculate Cluster Centroids**

By identifying relevant feature values inside each cluster, you may calculate cluster centroids. Utilize pertinent elements that were taken from the segmented images while considering traits connected to the health and sickness of silkworms.

**Step 5: Assigning Data to Clusters**

Every segment:

- Transfer the segment’s centroid to the cluster with the closest location.
- Based on the allocated segments, update the cluster centroid.

**Step 6: Final Prediction**

Every segment:

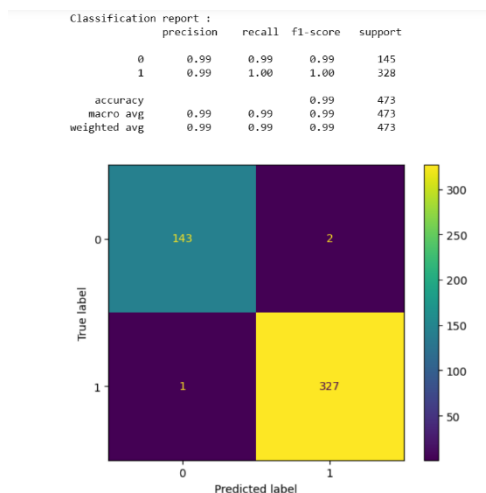
- Obtain forecast outcomes from the decision tree’s built-in decision components.
- Combine the forecast findings while taking into account the votes from various decision-making components.
- Assign the most popular prediction result as the final one for Grasserie disease detection.

**Step 7: Produce**

The final illness detection findings for each split area should be output

**4 Result and Discussion**

In this part, we go through the findings of our study on silkworm dressers' illness identification using image classification methods. To enhance sericulture procedures, our study attempted to use machine learning and image analysis to automatically detect cases of the dresser's illness in silkworms.



**Fig. 2.** Classification table

The performance indicators of a classification model are displayed in the classification report. The precision ratio is the proportion of accurately predicted positive cases to all positive instances that were forecasted. The fraction of genuine positive events that were accurately detected is called recall, also known as sensitivity. The harmonic mean of recall and accuracy is the F1-score, which offers a fair comparison of the two. The dataset's "support" is the actual number of instances of each type. The model performs fairly well in the context of the supplied report, obtaining 99% accuracy. The model has a great capacity to reliably identify both classes, with few false positives and false negatives, according to the values for accuracy, recall, and F1-score. The weighted average takes into account class proportions, whereas the macro average computes the metrics' overall averages across classes. In this particular instance, the model has good prediction ability, successfully separating the classes under investigation.



**Fig. 3.** M-segmentation

In image classification for silkworms, M-segmentation divides an image into understandable chunks according to common traits. This method makes use of sophisticated algorithms to extract distinguishing patterns from photographs of silkworms, assisting in the identification and classification of various locations within the photos. The complexity of categorization is decreased by image segmentation, allowing for a more accurate study and classification of silkworm-related characteristics.



**Fig. 4.** Gray image

To classify silkworm photos, colorful representations of the creatures are converted into grayscale versions. With this conversion, the image's color channels are combined into a single channel that represents the range of grayscale intensities. The classification algorithm may concentrate on the crucial structural and textural characteristics of the silkworms by simplifying the image in this way, enabling more accurate and efficient categorization. Grayscale conversion streamlines the processing needs for classification tasks while improving the model's capacity to differentiate silkworm patterns and traits.



**Fig. 5.** Threshold conversion

To classify images for silkworms, threshold conversion entails converting pixel values in an image to binary values depending on a certain threshold. By categorizing pixels as either foreground or background, this method streamlines the image and helps separate silkworms from their surroundings. Pixels with intensity levels over a threshold are classified as primary features, while those below it is handled as background. By highlighting essential information in silkworm photos, this conversion streamlines further analysis and increases the effectiveness of image classification systems.

## **5 Conclusion**

This study's result emphasizes the critical value of utilizing images to identify and manage the Brasserie illness in silkworms. We have created a powerful tool that is excellent at finding this condition using clever computer algorithms. The gadget offers excellent test results, which demonstrate how well it can determine whether a silkworm is infected. Finding illnesses by looking at photos is an excellent method because it is simple and doesn't hurt the silkworms. Additionally, this instrument operates swiftly, which is advantageous for those who rear silkworms. They may use it to swiftly determine whether the illness is harming their silkworms and take action to stem the spread of the illness. The silkworm business benefits from using this image tool since it maintains the creature's health and productivity while also saving money. We can improve this technique in the future and use it to detect more illnesses in silkworms. To maintain the health of all the silkworms, this would be very helpful. In conclusion, this research uses intelligent technology to tackle a significant problem in the silkworm business, and it represents a step toward integrating farming and technology for the benefit of future generations.

## **References**

1. Raghavendra, C.,G., and Raghavan, Dharini.: Grasserie Disease Identification in Bombyx Mori Silkworm the use of Ensemble Learning Approach, International Journal of Electronics Signals and Systems, Vol. 4(3), (2022)
2. Urbanek, K., A., Bakonyi, T., Ando, I., Kurucz, E., Solymosi, N., Pongrac, P., Berčič, R.,L.: The Effect of Feeding with Central European Local Mulberry Genotypes at the Development and Health Status of Silkworms and Quality Parameters of Raw Silk, Insects 2022.
3. Puneet, C., Raghavendra, C.,G., Mohana, K.,S., Bhaskar, R.,N.: Assessment of ill-nesses in bombyx mori silkworm – A survey,Global Transitions Proceedings, Vol 2(1), Pages 133-136 (2021).
4. Tushar, J., Pankaj, G.: Image Classification – Cat and Dog Images, International Journal of Scientific Research in Computer Science, Engineering and Information Technology, (2021)
5. Sakthivel, S., Angaleswari, C., Mahalingam, P.,U.: Isolation and identity of bacteria responsible for flacherie in silkworms, Department of Biology, Gandhigram Rural Institute-Deemed University, (2020)
6. Lan, C., Zhiyuan, J., and Zhiyong, W.: Image Recognition Based on Convolution Neural Network with Small Data Setl, (2021).
7. Zhong-Qiu, Z., Peng, Z., Shou-tao, X., and Xindong, W.: Object Detection with Deep Learning: A Review, (2019).
8. Ahmed, S.: Detection and category malicious URLs on social media the usage of Machine Learning, (2021).
9. Immadisetti, Naveen, N.,V.,D., Manamohana, K., Rohit, V.: Detection of Malicious URLs using Machine Learning Techniques, (2019).