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IoT and image processing Techniques-Based Smart Sericulture Nature System

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Abstract

Silkworms are reared for the production of raw silk in sericulture. Sericulture's main tasks include growing food plants to feed silkworms, spinning silk cocoons, and reeling the cocoons to unwind the silk thread for value-added services such processing and weaving.

The Smart Sericulture paper provides a clear picture of technical innovation in underperforming agricultural branches such as sericulture, as well as an explanation of the system and strategies that can be used to improve sericulture quality and production. The intricate procedure of monitoring environmental indicators such as humidity, temperature, and rain, as well as the health of the silkworm, will be presented in this brief communication.

Development and implementation of a cropping Mulberry leaf monitoring system:

Mulberry leaves are silkworms' only source of nutrition. Silkworm vitality is reduced when there aren't enough mulberry leaves. Mulberry leaves and branches can also be used to feed animals, make paper, and make healthful drinks. It is vital to plan for a mulberry leaf crop in order to have enough fresh leaves for silkworm raising and other uses. In light of this, this research proposes a sound strategy for developing a cropping mulberry leaf management system. The information system's thorough design and execution are documented, and service components present its architecture.

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The design and implementation of a cropping mulberry leaf management system were proposed in this paper. It allows farmers and purchasers to keep track of their own and linked farms' mulberry growing and harvesting data. As a result, purchasers in the sericulture or other domains can make plans for breeding silkworms or mulberry leaf utilisation based on information about estimated and actual mulberry leaf yield. A client-server architecture was also used to create the information system. Data is transferred between the front end and the back end using REST/HTTP APIs.The study's disadvantage is that the mulberry leaf model was estimated without taking into account some of the elements that influence mulberry leaf yield, such as soil quality, meteorological conditions, and fertiliser in mulberry farming. More research on estimating mulberry leaf yield is needed to increase the accuracy of estimating outputs by taking into account more variables.More research is needed to encourage farmers to collaborate in the agricultural ICT and smart farming fields in the same way.

Silkworm :

During the metamorphosis phase of the silkworm's life cycle, it begins as a larva and ends as a butterfly. During this phase, the worm builds a cocoon in which it spends its time while through transformation. Because the larval stage is the worm's newborn stage, environmental elements such as humidity and temperature play a critical role in its health; the larva's health also influences the quality of the silk produced[1,2]. To track these parameters, an automated system is required[3,5]. Other biological factors, such as fungi and bacteria, will affect the health of people in addition to environmental factors.

The agriculture area is currently undergoing a revolution in terms of innovation. And the internet of things (IoT) is redefining how complex and time-consuming tasks may be made simple with the use of open-source software, hardware, and internet connectivity .Silk farming is one of the most difficult fields in agriculture due to the need for intensive care and additional human resources, as well as environmental conditions that influence the quality and quantity of silk production[4]. Dedicated hardware systems, comprising sensitive sensors and image processing techniques, are used to tackle similar kinds of difficulties in various fields and system independent software is used to securely connect these hardware units with one or several serves.

Design suggestions :

The system relies on readily available parts to ensure that parts are available when they are needed. And it leverages open-source tools like the Arduino IDE and the Rest API, as well as commercial software like Matlab for image processing techniques, and all of the code is available on code repositories like Github. The system is made up of two components: hardware and software.

A) Piece of hardware :

The Arduino Mega serves as the system's brain, monitoring the system based on data from the temperature, humidity, and rain sensors, as well as sending that data to the host computer for real-time data logging.

It also interfaces with the relay module to regulate electrical devices such as fans, heaters, lights, and spray setup. The camera module is used to keep track of the worm's and cocoon's health and quality. The status of the devices and sensors is displayed on the LCD matrix display. It's built in such a way that new features can be introduced without interfering with the current functioning.

B) Software :

The Arduino IDE is used to write the code that the Arduino Mega uses to monitor and control external devices and sensors. Matlab is used for image processing, which aids in distinguishing adult cocoons from juvenile cocoons, as well as detecting unhealthy worms and alerting the system. Segmentation, edge detection, feature extraction, and noise cancellations are all part of the image processing algorithm, which also uses Otsu's algorithm and Gabor filters for the best results.The Rest API connects the system to the cloud and offers real-time data through the internet; it requires no additional software or apps, is platform-independent, and is protected against attacks and illegal access. Because the programme is open-source, It's simple to update and adapt platforms as needed, and they've also become more cost-effective.

C) Processing of images :

Otsu's Algorithm and Otsu's Texture Feature Extraction are the two main components of this section.To find the threshold level where the sum of the foreground and background spreads is at its lowest, Otsu's thresholding procedure involves iterating over all potential threshold values and measuring a spread calculation on each side of the threshold for the pixel levels, *i.e.* pixels appearing in the foreground or even in the background. Because of its intuitive features and convenience of use, picture thresholding plays a crucial role in image recognition applications.However, it performs exceedingly poorly for photos of poor quality with non-uniform illumination and low contrast.

Step by step, Otsu's algorithm :

The first step is to load the RGB image.

Step 2: Estimate the noise using the mathematic function. in the backdrop

Step 3: Get rid of the background noise

Step 4: Sharpen the image by increasing the contrast.

Step 5: Makes a black-and-white image

The histogram is calculated in step six.

There's also another factor.

The system uses the Matlab function grey matrix (1) to return a grey-level featured co-occurrence matrix (GLCM) from the input nige grey maaix. The GLCM is produced by calculating the periodicity of a pixel with the grey-level (grayscale) value, and the process continues horizontally adjacent direction to a pixel value j.

Result 1

The fully assembled system uses sensors to monitor external elements such as temperature, humidity, and rain, as well as blowers and heaters to control the culture environment. The image processing algorithms used were successful in removing background noise from the cocoon images (see TABLE L), allowing the immature and mature cocoons to be distinguished. With the addition of HSV filters, it was also able to detect infected silkworms. The LCD matrix effectively presented the live status of all sensors without any errors. The user had access to real-time data because to the integrated cloud and Rest API communication. It also secures illegal access to the cloud without the need for any additional apps or software connection.

Result 2 :

Mulberry is a type of shrub that grows in (*Morus* spp., Moraceae) The presence of idioblast, an expanded epidermal cell in the leaf, is a distinguishing feature of members of the Moraceae family (particularly *Morus* spp.).

Environmental criteria Mulberry may grow up to 800 metres above sea level in the right climate. The mean ambient temperature should be between 13°C and 37.7°C for optimal mulberry development and efficient bud sprouting. The optimal temperature is from 24 to 28 degrees Celsius, with a relative humidity of 65 to 80 percent and 5 to 12 hours of sunlight every day.

Mulberry may be cultivated anywhere from 600mm to 2500mm of rainfall. Growth is restricted in low-rainfall areas, necessitating additional irrigation. Mulberry requires an average of 50mm of rain every ten days.

Pruning :

i) Trimming at the base :

The plants are chopped at ground level, leaving a 10-15 cm stump. Once a year, this kind of pruning is done.

ii) Pruning from the middle :

At a height of 40-60 cm above ground level, the branches are chopped. The following cuts are conducted at 45-50 cm height after the bottom pruning.

iii) System of Kolar or Strip :

This sort of pruning is done in a densely planted area. Every time, the branches are trimmed to the ground level. As a result, every year it is pruned five times. Heavy fertiliser and irrigation are required for this form of harsh pruning.

iv) Harvesting :

The procedure for harvesting leaves is determined by the sort of raising used. Harvesting the leaves in the morning is the best option. Mulberry leaves can be collected in three different ways.

v) Choosing leaves :

Individual leaves with or without petioles are collected. Leaf picking begins ten weeks after bottom pruning and continues every seven or eight weeks thereafter.

vi) Removing branches :

The worms eat the entire branch. Topping is done first to guarantee that the lower leaves are all at the same stage of maturity.

vii) Harvesting of the entire shoot :

Bottom pruning involves cutting the branches at the ground level. Shoots are collected every 10-12 weeks, for a total of 5 to 6 harvests each year.

viii) Harvest time :

The best time to gather the leaves is early in the morning.

Leaves can be stored in a leaf preservation chamber or wet gunny bags, or the bamboo basket can be covered with wet gunny bags to keep it cold and fresh.

Result 3 :

Technology for Post-Cocoon :

Silk is currently manufactured in the country primarily employing three reeling technologies: Charka, Cottage basin / domestic basin, and Multiend reeling technique. About half of the silk produced is Charka, with the remaining 35 to 40% coming from cottage basin and a tiny amount from multiend reeling. It is impossible to make good grade silk due to intrinsic flaws in charka. Even though cottage basin silk is of higher quality than charka silk, it still falls short of international standards. The fundamental reason for charka's continued dominance is that the majority of raw silk produced is used by the handloom sector, where raw material costs must be kept low. Poor-quality cocoon can only be pulled on charka for a profit.

The following must be taken into account in order to improve reeling performance:

1. Cocoons are cast in such a way that raw silk of a consistent denier is present.

2. To increase the quality of the winding, the broken end during reeling must be knotted.

3. To optimise reeling performance and silk colour, water must be changed when it becomes muddy.

4. To obtain clean silk, the water quality must be preserved.

5. A motorised charka is required to maintain a consistent reeling speed and save money on labour.

6. CSRTI's economical oven saves money on fuel.

7. It's critical to keep your reels dry while reeling to avoid gum stains.

8. It is necessary to stretch, dry, and store silk waste carefully.

With very few human interactions, the system may be utilised to improve the quality of silk fam output. Aside from quality control and monitoring, the system can be programmed to perform additional tasks in the silk farm as needed by the farmer.It provides a basic framework for any agricultural production inventions in the field of IoT and Embedded Systems, as the system is built on open-source resources.

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