

SURVEY ON SERICULTURE AUTOMATION

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Abstract – The research aims to find the best methodology for sericulture automation, out of different emerging technologies. There are three different technologies that the paper concentrates on and their outputs are tested meticulously and after the process of testing it is finally stated that which technique is best for sericulture automation, with involvement of least computation resources and human intervention.

Keywords – Sericulture, Automation, Data Science, Internet of Things (IoT), Embedded Systems.

I. Introduction

The process of sericulture or silk farming deals with the rearing of silk worms, and cultivation and production of high quality silk from the same. ASIA is the main producer of Silk and it produces around 95% to 97% of the total silk in the world. It is found that the bulk amount of silk is produced in two countries China and India followed by other countries like Japan, Brazil, USA. According to the recent reports by Central Silk Board, a government organisation, it is clearly evident that the India still holds the 2nd rank in silk production after China which is at 1st rank. However, it is noticed that India contributes only round 1.5/10th to the total production of silk in the world which is very small as and when compared with China, which has a huge contribution towards the total production of Silk in the world which is round 8.5/10. India produces the best quality silk, still holds the 2nd position, the clear reason of the same is lack of usage of technology for production of silk and hence sericulture automation is required evidently, so that the production of silk can be increased and we can produce the best quality silk from the silk worms.

Silk is the queen of textiles because of multiple properties like its sparkling lustre, softness, elegance, durability, and tensile properties. Silk is an animal protein fibre secreted by the silkworm larva for spinning of the cocoon. This silk production is that the result of Silkworm. Silkworm larve are fed with mulberry leaves and after the fourth moult, climb a twig placed close to them and spin their silken cocoons. The temperature and humidity plays a significant role in each stage of sericulture method, with this plenty of care is additionally needed to be taken to avoid diseases. Temperature, humidity and medical aid method ought to be managed to induce an exquisite silk product. A perfect temperature of 230°C to 280°C and humidity in between sixty fifth to eighty fifth of percentage is to be maintained.

In today's world a lot of new technologies are emerging day by day which can be used for sericulture automation; to name few Internet of Things, Machine Learning, Data Science, Data Analytics, Robotics, and many more. Let's have a small insight on few of these technologies.

Internet of Things (IoT): - It is mainly used for wireless communication using internet through or via different sensors and actuators. In recent times IoT has a very strong hold all over the world as it sense, predict and communicate on its own. It is much more than M2M communication, Wireless Sensor Networks (WSN), 2G/3G/4G, Radio-Frequency Identification (RFID), Bluetooth etc. It has different range and applications in various fields and domains like agriculture, medical systems, transportation, education, door locks and many more. It does have a capacity to address all the luxurious needs of a human starting from an automatic door lock to smart room, smart AC, smart fridge and a lot more such applications. Iot uses IPv6 ie. 6th and most recent Internet Portal which has a capacity to allocate unlimited number of unique IP addresses.

Embedded System: - A basic system is consists of different software and hardware components and there are arranged together or rather connected to each other via physical or non-physical entity to perform a particular or defined task. An embedded is something of same kind; it is a computer hardware where

software is embedded into it. It can be a standalone system or it can be a part of a huge system. Microcontrollers and microprocessors are two types of embedded systems and are designed based in the requirement of task to be performed. For Eg. A fire alarm; it an embedded system through smoke is detected around it.

Data Analytics: - In the world that we live in, there is a huge amount of data and it changes very fast with each and every second, also the data that we get is too noisy and dynamic in nature. Any prediction with such huge amount of data with naked human eyes is very difficult. Nevertheless, data analysis is a technique, with the help of which we can make several predictions based the dataset we have. The dataset can be of any type static, dynamic, structured, un-structured, noisy etc. Data analysis can be done by two different ways supervised and unsupervised learning. For Eg. It can help predicting different suggestion on a particular e-commerce for a user based on his/her previous searches.

II. Literature review

There are different authors and researchers who had done a research on sericulture automation before and have proposed various techniques and method to do the same with different range of efficiency.

Author Divya Darshini.B and his team suggested that the automation can be done by IoT; to be precise 6LoWPAN and image processing. IoT based sericulture rearing house approach with monitoring and actuation. IoT based silkworm rearing house consists of sensors and actuators, which are interfaced with battery operated wireless sensor nodes. Sensors will offer the real time information and based on the readings, decision are going to be taken by smart wireless sensor nodes and actuation is performed. During this smart process, the real time sensor information collected by the sensors within the 6LoWPAN network will be transmitted to the 6LoWPAN Border Router (6LBR) through neighbour nodes using RPL protocol. Connection is established between 6LBR device and 6LoWPAN devices via internet over 3G, Wi-Fi or wired Ethernet and is accountable for handling traffic to and from the IPv6 and 802.15.4 interfaces. [1] The IoT based heterogeneous sericulture model for real time monitoring of the parameters and performing the automated actuation with serial camera interfaced within the system to capture real pictures to understand the status. Based on the hardware necessities for monitoring and actuation system, we have use LM35 temperature sensor, that maintains an accuracy of 0.40 C at temperature, over a range of 00 C to 1000 C with a sensitivity of 10mv/C and it operates at 5V DC input with ground pin and output pin connections. [1]

Author Sneha Priya M. and her team proposed an automated embedded system approach that uses sensors to sense the temperature and moisture variations. To save memory however offer a nice control flow within the code, IoTivity uses a mechanism known as protothreads. Protothreads is a mixture of the event-driven and also the multithreaded programming mechanisms. [2]

Author M.A. Dixit and her team proposed a system for sericulture automation using machine learning. They divided the whole lot of the worms into different samples and named them as zones. Zones were established to group together the different stages with similar requirements of temperature and humidity. These zones are partitioned using inexpensive plastic sheets to ensure environmental regulation. The concept of zoning was proposed considering the fact that different stages of the life of the worm requires different amount of humidity and temperature and hence stages which has same requirements were grouped together. Once the zones are ready they collect the data and it was processed with Principle Component Analysis to find the exact requirement of a particular zone and hence producing maximum high quality silk from the worms. [3]

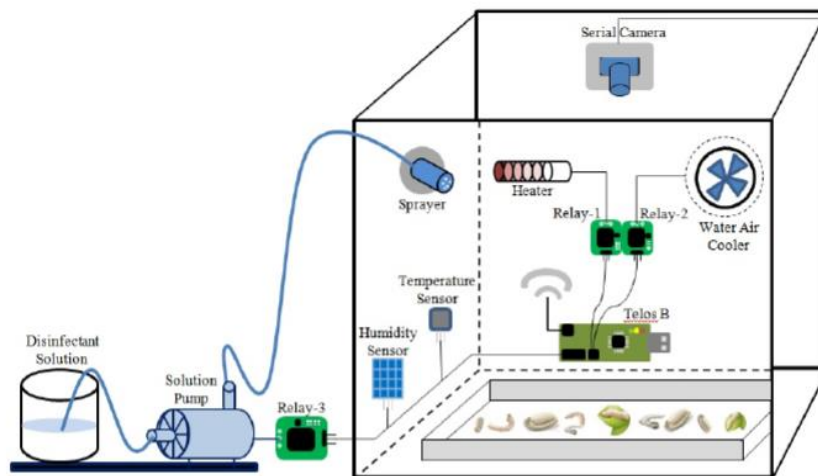
III. Problem Definition

Sericulture automation can be done in several different ways. The aim of the research is to find the best way to bring up sericulture automation in existence. As it is noticed that there are endless number of ways through which this problem can be approached, but in this research work we'll be focusing only on three techniques and out of these it will be predicted that which one of these is the best way to approach the problem.

IV. Research Work

As mentioned before there are different techniques through which sericulture automation can be implemented. Given below are three different methods to do the same.

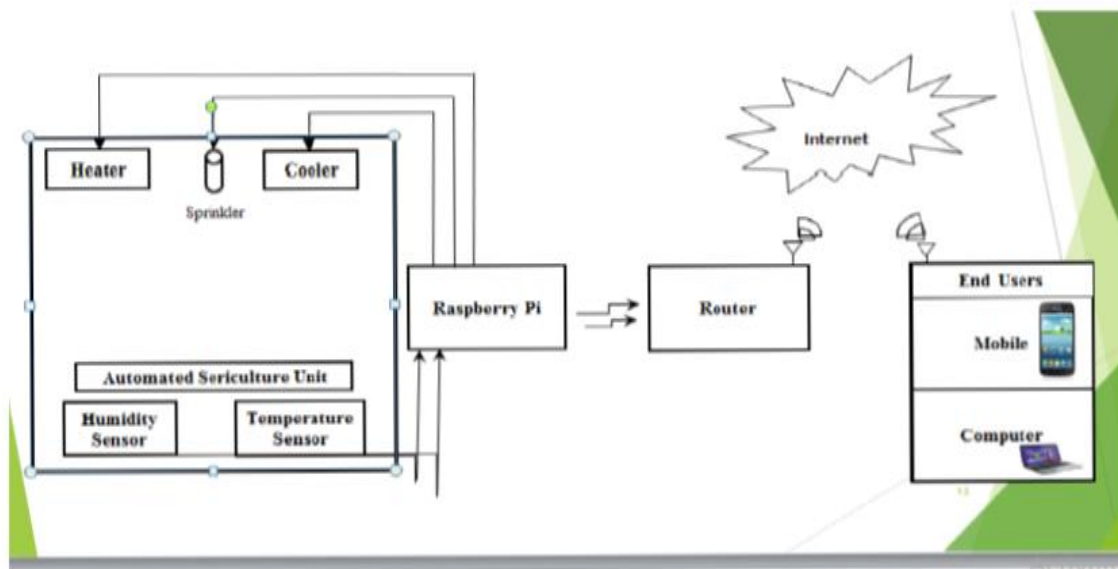
A. Sericulture Automation using Image Processing



The process starts with initialization of the microcontroller MSP430F1611 and also the wireless radio CC2420. The node will be receiving an interrupt request either for sensor information or to start the actuation system. If the interrupt request is detected for actuation system, the medical aid spray will be switched on for fixed quantity of time and continues the process of looking for next interrupt. If the interrupt request is for sensor data, the node will scan the real time temperature and humidity sensors output and the required analog to digital conversation will be performed. The ADC converted information of sensors are compared to the predefined threshold values. First the temperature information are going to be compared with the threshold, if the temperature is higher than threshold, the cooler will be switched on, and if it's below the threshold the heater actuation system will be powered on. After fixing the temperature, humidity will be compared with the threshold values and same procedure of temperature will be followed to fix the humidity value within threshold values. This whole actuation system process will be automatically handled by sensor node and the real time temperature and humidness will be transmitted to the end user.

The raw data from serial camera is collected and it'll undergo numerous phases of processing. The 3 general phases that all varieties of data have to undergo whereas using digital technique are pre-processing, enhancement and display, information extraction. The Matlab will be utilised for numerical computation, visualization, and application development by using multiple built-in algorithms for signal processing. Usually Image processing system includes treating pictures as 2 dimensional signals while applying already set signal processing strategies to them. Determine the color change in the body of the worms, which indicates the various stages and the Light yellowish indicates that they have reached to the cocoon stage.

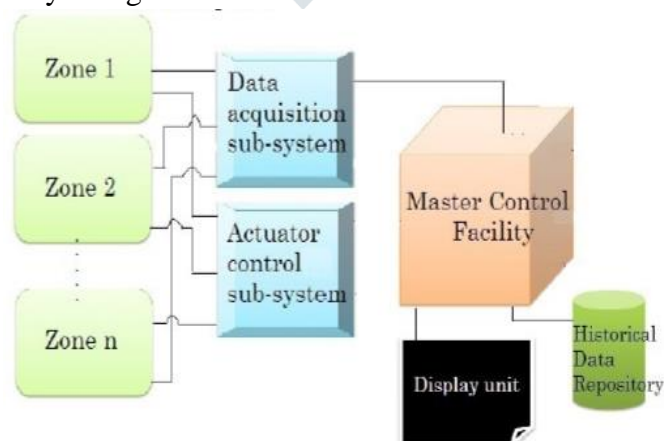
B. Sericulture Automation using Embedded System



The proposed technique involves numerous steps like data acquisition, computation, and actuation for the sericulture. It involves the design and implementation of Wireless sensor Network for observance of the sericulture unit with parameters like temperature, humidity and so on using various sensors. Hence, the author has proposed a unique machine-controlled sericulture plant, which incorporates less human intervention towards maintaining proper environmental necessities for the growth of silk worms, reducing the probabilities of reduction in silk production. This method focuses on designing and developing an automated system for sericulture based on embedded system and wireless sensor network. In this approach, the sericulture atmosphere is controlled using sensors and automated actuators. The information from these sensors will be transmitted wirelessly to the end user.

According to the variations found, appropriate actions will be taken by the system. This to observe temperature variation that is the root cause of several diseases in silk farming. The author has designed a timer based disinfectant sprayer and lime water sprayer to avoid the disease spread. The chopper blade selection buttons act as inputs for selection of blades to chop the mulberry leaves if required, since in the initial stages of larva development sliced leaves has to be fed. Sprinkler selection buttons are used to choose an appropriate sprinkler if there's demand.

C. Principal component analysis algorithm



In order to improve the efficiency we map the two parameter models into a single parameter model, which will be shown later to be suitable for linear regression. The algorithm includes the following steps:

i. Pre-processing:

Feature scaling: The range of values of different parameters may vary in different proportions. Their numerical ranges, if vary too much may lead to formation of a skewed optimum curve. Thus the range of values is scaled to a common number.

Mean Normalization (optional): It adjusts the range of various parameters on to a common scale, giving zero mean for every feature.

$$\mu_j = \frac{1}{m} \sum_{i=1}^m x_j^{(i)}$$

μ_j : mean of j th feature

$x_j^{(i)}$: i th example of j th feature

Replace each x_j with $x_j - \mu_j$, to get comparable range of values for each parameter.

ii. Singular value decomposition:

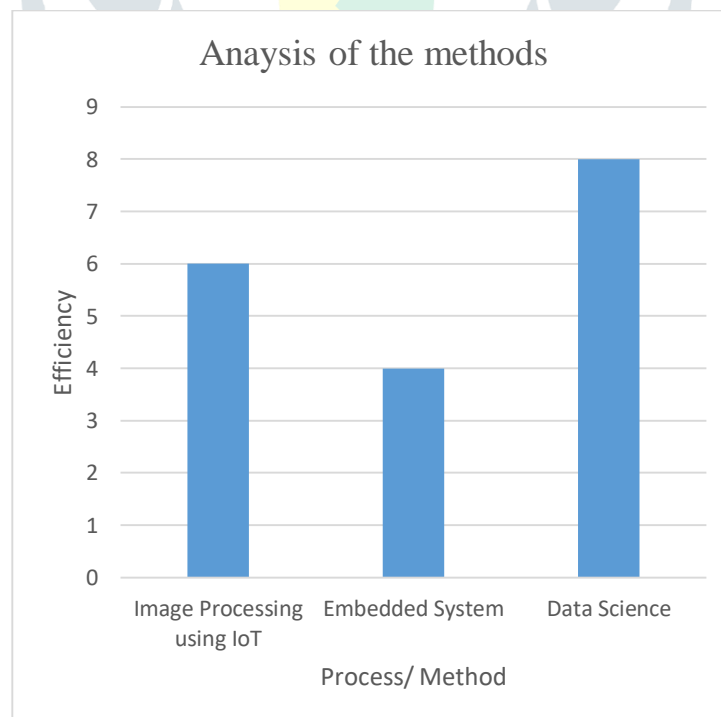
This function returns a required number of parameter values say k from n . Here, the 3D optimum curve gets converted to 2D curve, with the dependent and independent variables both being a transformation of temperature, relative humidity and yield respectively.

When yield of silk is optimum, there is minimum deviation of the actual parameter values from the ideal ones. This implies that we must minimize the cost function for every incoming parameter value until we arrive at a global minimum.

$$\theta_j = \theta_j - \alpha * \frac{1}{m} \sum_{i=1}^m (h\theta(x(i)) - y(i)) * x_j(i)$$

θ_j : j th feature

α : learning rate

V. Result Analysis

It is very much evident from the graph that the best method for sericulture automation is data science with the prescribed algorithm, which is explained in the above section. The efficiency of each algorithm is measured with respect of two common parameters and those are humidity and temperature. A lot of other factors are considered for different analysis nevertheless there were two common parameters which

were humidity and temperature. Data science is the most efficient technique which can be used for this purpose as the resources and the computational power used is really very less, and the human intervention is almost null. All the actions and the commands are taken by the computer or the processor itself.

VI. Conclusion

As it was mentioned in the aim of the paper, the task was to determine the best way to approach sericulture automation to increase the total production of silk via silkworms in India and hence increasing the GDP for the same. As mentioned in the introduction of the paper India is the second largest country in Asia, also in the world and this will help the silk farmers to grow and excel in their production and hence business, and thereby increasing the GDP of the country as whole.

References

- [1] D. Darshini.B, Adarsh.B.U, Shivayogappa.H.J and Navya.K.N, "Automated Smart Sericulture System based on 6LoWPAN and Image Processing Technique," in *2016 International Conference on Computer Communication and Informatics (ICCCI -2016)*, Coimbatore, 2016.
- [2] S. P. M, K. G. J, A. S.N. and K. G. M, "AUTOMATED SMART SERICULTURE SYSTEM - AN EMBEDDED SYSTEM APPROACH," MS ENGINEERING COLLEGE MAGAZINE, BANGALORE, 2018.
- [3] M. Dixit, A. Kulkarni, N. Raste and G. Bhandari, "Intelligent Control System for Sericulture," in *International Conference on Pervasive Computing (ICPC)*, Pune, 2015.
- [4] Neha Raste, Amruta Kulkarni, Gargi Bhandari, "Intelligent Sericulture System using Zone-based Cascade Control", IJSET, vol. 2, issue 7, Sep - Oct 2014.
- [5] "Sericulture Development in Non-traditional Areas", proceedings of National workshop, Pune, 2012, BAIF.
- [6] V.K Rahmathullah , "Management of Climatic Factors for Successful Silkworm (*Bombyx mori* L.) Crop and Higher Silk Production", Psyche, vol. (2012), article id 121234.