IMAGE PROCESSING BASED AUTOMATED SMART SERICULTURE

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ABSTRACT:
Smart sericulture automation that uses image processing relies on computer vision and machine learning to study pictures of silkworms and their surroundings in real-time. This method can help farmers boost their silk farming by giving them insights into silkworm health and growth. This approach can automate include keeping an eye on silkworm growth and spotting diseases. Computer vision algorithms then process silkworm images to pull out useful info like the silkworm's health status. Machine learning algorithms also sort the silkworms by their colour, shape, age, health, and other traits. This info helps farmers tweak the environment to create the best conditions for silkworms. Our work uses CNN-based machine learning algorithm to identify healthy and ill silkworms. This allows farmers to find any health issues in their silkworms and take quick action to prevent diseases from spreading. By optimizing environmental conditions and preventing disease outbreaks, this automated system contributes to improved productivity, higher silk yield, and superior-quality silk production.
Keywords: Sericulture, Image Processing, Machine learning, CNN.

INTRODUCTION:
Sericulture refers to raising silkworms to produce silk. Silkworm farming poses challenges in agriculture due to its need for close attention in a substantial workforce, and environmental factors that affect silk quality and quantity [17]. Silkworms grow based on key factors like temperature, humidity, and light. Each stage requires specific support to meet its needs. Changes in the environment seem to have a big impact on how silkworms grow and develop. Sericulture provides many jobs in India, but farmers still use old methods. This calls for new modern approaches to silkworm farming [2]. This work aims to make sericulture farming automatic. The model plans to use new IOT tech and smart sericulture to automate the process. The main goal of this work is to enhance the monitoring and management of environmental conditions in silkworm rearing houses.
India holds the second-highest global rank in silk production, yet its contribution accounts for only 15% of the world's total, significantly dwarfed by China's 85% share [12]. This disparity highlights the need for advancements in Indian sericulture, the labour-intensive process of silk production through silkworm rearing. A crucial aspect of successful sericulture is the early identification of unhealthy silkworms during their larval stage to prevent widespread losses [7]. Current methods often rely on manual inspection, which can be time-consuming and prone to errors. Besides, the absence of automation and the vulnerability of silkworm raising conditions to seasonal variances adversely influence both the quality and amount of silk created [9]. Research demonstrates that ecological variables like temperature, moistness, and light power assume a basic part in silk yield and quality, with explicit circumstances expected during each larval development stage (shed) for ideal silk creation. This paper proposes the coordination of computerization in sericulture, including the improvement of a high-precision model for distinguishing unfortunate hatchlings in view of

removed highlights [1], and the controlled administration of natural boundaries inside silkworm raising houses, to upgrade both the creation and nature of Indian silk. Robotizing examination and reaction frameworks can beat the restrictions of manual cycles, remembering delays for information assortment and human intercession [20].

EXISTING METHOD:

Current sericulture rehearses depend vigorously on physical work for all stages, from mulberry development to silkworm raising and wellbeing checking. Mulberry creation is ordinarily taken care of independently by ranchers, who then, at that point, give the passes on to silkworm taking care of. Silkworms are physically taken care of two times every day, and their wellbeing is surveyed outwardly by ranchers in view of size and variety. This conventional methodology experiences a few disadvantages. The high maintenance costs associated with manual labour increase operational expenses. Furthermore, the reliance on manpower leads to substantial labour costs and potential in efficiencies. Critically, manual health assessment can be subjective and potentially inaccurate, negatively impacting silkworm health, productivity, and the overall quality of the silk produced. These limitations underscore the need for improved, more efficient, and cost-effective sericulture methods. In existing, each and every work done by manually to control the sericulture process and to maintain the silkworm health. The Mulberry Plants Productions are Done Separately by the farmers and then the Mulberry leaves are fed to the Silkworms. The Silkworms are Fed Twice a day by a Farmer Manually. The Health of the Silkworms are identified by Seeing the Silkworms Color and Size. It is done by the Farmers.

These challenges highlight the need for a more efficient and cost-effective alternative. The literature survey explores various innovations in sericulture through IoT, automation, and machine learning, aiming to improve silkworm farming. Studies like Zhang et al. [1] utilize deep learning (CNN) for disease detection but face challenges such as limited real-time monitoring and lack of integration with IoT systems. IoT-based smart sericulture plants, such as those developed by Kumar et al. [12], automate environmental monitoring but lack predictive analytics, disease prevention, and require human intervention. Patel & Sharma [7] focus on fully automated systems, yet these systems lack real-time monitoring of growth stages and sustainability in rural areas. Rao & Joshi [2] highlight cost-effective IoT-based incubators, but scalability and durability issues remain. Singh and Gupta [9] propose modernizing customary silk cultivating through IoT and robotization, however they miss incorporating AI for better independent direction and rancher instruction. Also, A.P., A.B.U., H.N.C.,L.J., S.B. Padashetty, and S. Deshpande (2024) present an IoT-based brilliant sericulture plant plan that intends to streamline sericulture processes yet doesn't incorporate AI for prescient investigation or constant wellbeing checking of silkworms. In general, while these endeavours push sericulture forward, holes in real-time checking, AI combination, adaptability, and manageability endure.

PROPOSED SYSTEM :

To address the difficulties in sericulture cultivating, the proposed framework uses robotization in view of sensors and regulators, close by image processing to screen the soundness of silkworms progressively. The framework coordinates numerous parts, including temperature sensors, humidity sensors, gas sensors, Light Ward Resistor (LDR), and computerized picture processing. The primary goal is to consequently control the climate for ideal silkworm development and anticipate the state of the silkworms, in this way assisting ranchers with expanding efficiency.

The framework keeps up with the temperature, moistness, and light circumstances consequently, all constrained by an Arduino Uber regulator. To control the temperature, an exhaust fan is utilized, while a siphon engine is utilized to control the moistness of the sand. Continuous checking is empowered through these sensors, permitting the framework to adjust to natural changes and keep up

with the best circumstances for silkworm development. To evaluate the wellbeing of the silkworms, computerized picture handling is utilized. The pictures of the silkworms are caught and broke down utilizing the Convolutional Brain Organization (CNN) calculation in MATLAB. This calculation assesses the variety, size, and other visual elements of the silkworms to decide their wellbeing status, empowering early identification of illnesses or medical problems.
By foreseeing the state of the silkworms in view of continuous information, this robotization framework furnishes ranchers with important bits of knowledge, permitting them to go to preventive lengths before issue heighten. This outcome in higher efficiency and better silkworms, eventually working on the yield and nature of silk.

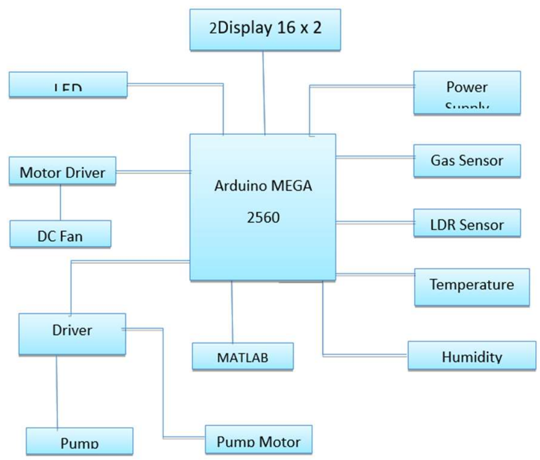

Figure 1: Block diagram of proposed sericulture system

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Working Principle:
This proposed framework uses an Arduino MEGA microcontroller to oversee different parts of silkworm raising. A DHT11 sensor screens surrounding temperature, setting off an exhaust fan to manage exorbitant intensity. Soil dampness is surveyed utilizing a devoted sensor, which enacts a water siphon for water system of mulberry plants when required. Air quality inside the raising space is observed by a MQ-135 sensor. A LDR (Light Ward Resistor) recognizes day/late evening cycles, controlling Drove lighting as needs be. Fundamentally, silkworm wellbeing is assessed utilizing a Convolutional Brain Organization (CNN) calculation carried out in MATLAB. After distinguishing undesirable silkworms, the framework enacts a medication siphon engine will turn on and shower the medication.

Maintain the Warehouse Condition :

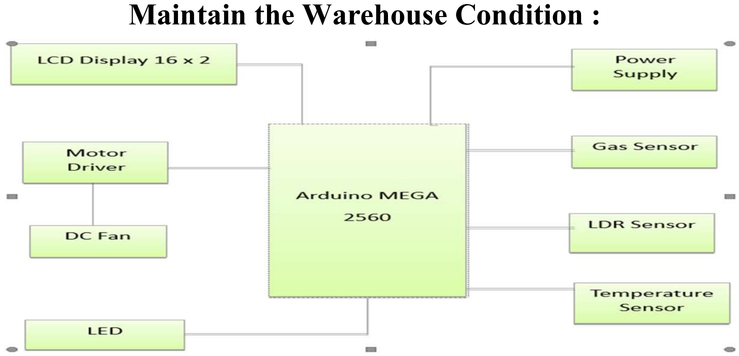

Figure 2: Block diagram to maintain warehouse condition

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Referring fig 2. Maintaining optimal natural circumstances is essential for silkworm wellbeing and efficiency. This framework tends to this need via computerizing key natural controls inside the silkworm raising stockroom. Temperature guideline is accomplished through an exhaust fan, initiated consequently by a regulator when the distribution centre temperature surpasses a predefined limit. Light levels are checked utilizing a LDR (Light Ward Resistor). The LDR distinguishes varieties in light power, enhancing normal daylight with counterfeit lighting while vital, and guaranteeing predictable brightening. Air quality is constantly observed by a MQ-135 sensor, considering likely mediations assuming air quality crumbles.

MAINTAIN THE SILKWORM FOOD PLANT:

This framework tends to the significant ecological variables influencing silkworm wellbeing and silk creation. As portrayed in the going with figure, an Arduino Mega 2560 microcontroller fills in as the focal handling unit, dealing with an organization of sensors and actuators. Surrounding temperature and dampness are checked utilizing a DHT11 sensor, giving fundamental environment data. Light levels are controlled through a LDR (Light Ward Resistor), which sets off a Drove light source to enhance regular light while vital, guaranteeing steady enlightenment for the silkworms.

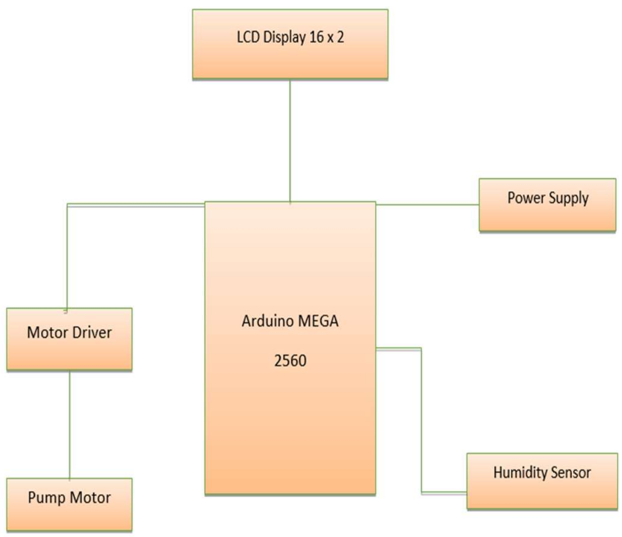

Figure 3: Block diagram to maintain silkworm food plant

Air quality is surveyed utilizing a MQ-135 gas sensor, empowering the framework to answer possibly destructive gas focuses. Moreover, the framework integrates a dirt dampness sensor to robotize the watering of mulberry plants, the silkworms' only food source, consequently guaranteeing their sound development and a more than adequate inventory of sustenance. Two engines are incorporated, reasonable for controlling ventilation or other robotized assignments inside the silkworm raising climate. An LCD show gives continuous criticism on the checked circumstances. At last, an exhaust fan is incorporated to control temperature, enacted when readings from the temperature sensor surpass a characterized edge.

MAINTAIN THE SILKWORM HEALTH:

A Convolutional Brain Organization (CNN) executed in MATLAB is utilized for robotized silkworm wellbeing evaluation. The framework catches pictures of silkworms inside the raising distribution centre and utilizes the prepared CNN to investigate these pictures.

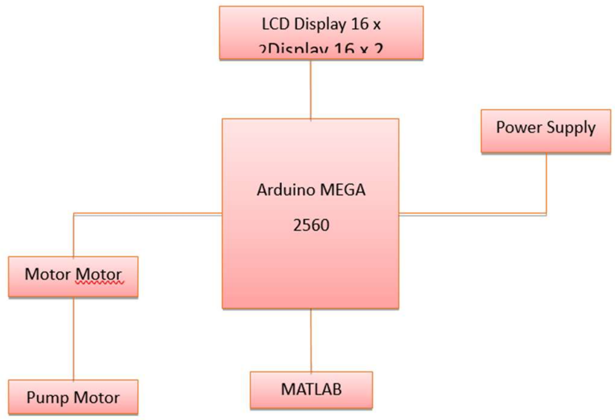

Figure 4: Block diagram to maintain silkworm health

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By looking at the caught pictures against a prior data set of sound and undesirable silkworm models, the CNN characterizes individual silkworms as either solid or showing indications of illness. After recognizing an unfortunate silkworm, the framework can then set off a designated reaction, for example, the exact utilization of medication, along these lines limiting death rates and boosting silk creation.

RESULT AND DISCUSSION

The proposed robotized brilliant sericulture framework offers a vigorous, constant answer for observing silkworm wellbeing and enhancing sericulture rehearses. The coordinated system, incorporating a set-up of sensors and actuators constrained by an Arduino Mega 2560 microcontroller, successfully directs key ecological boundaries inside the silkworm raising climate. The framework's capacity to definitively oversee temperature, stickiness, and light levels adds to a more steady and controlled raising interaction, limiting the effect of outer vacillations. Besides, the execution of AI methods, explicitly a CNN inside MATLAB, for robotized infection recognition empowers early intercession and focused on treatment, altogether further developing infection n the executives. This proactive way to deal with wellbeing observing, joined with enhanced natural control, means a verifiably improved yield, a decrease in silkworm mortality, and eventually, a greater silk item. The real- time monitoring capabilities and automated responses provided by the system empower sericulture farmers with the tools necessary to make informed decisions and implement timely interventions, leading to increased efficiency and profitability.

Hardware Outputs :

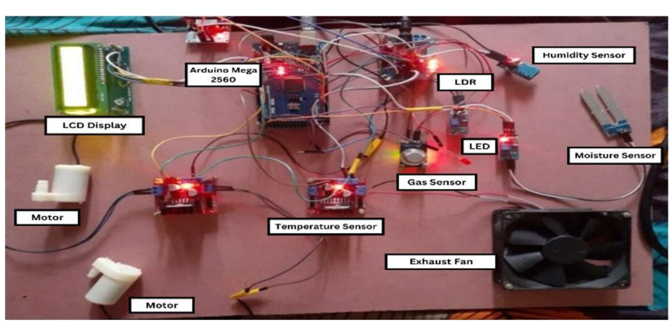


Figure 5: Prototype Kit

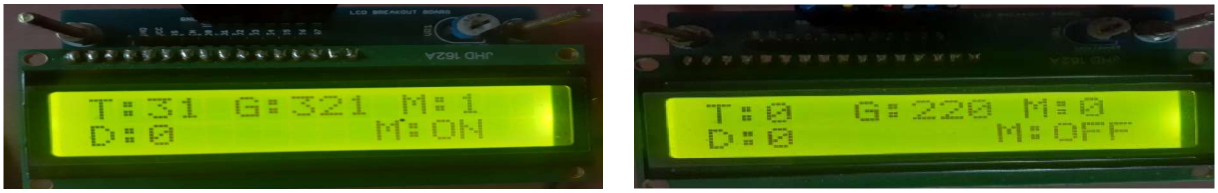


Figure 6: Humidity Level

If the sensor output is less than 65% then the value in "M" change to "1" and the pump motor is turned ON automatically to irrigate the soil else the value in "M" change to "0" and the pump motor is turned OFF automatically.

The "T" in the display denotes the temperature in the warehouse, if the temperature is increased above 35ºC then the exhaust fan is turned ON automatically.

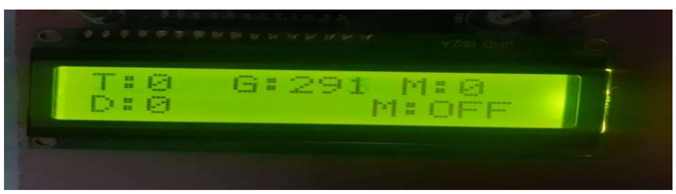


Figure 8: Gas Level

The "G" in the display represents the gas concentration or gas level present in the warehouse.

Figure 9: Light Density Level

The "D" in the display denotes the light Density in the warehouse, if the light density is decreased below the 15 lux the led will ON automatically.

Figure 10: Silkworm Health Status

The display shows the Health status of the silkworms and if the silkworm status is unhealthy then the pump motor will ON automatically and spray the Medicine.

Software Output

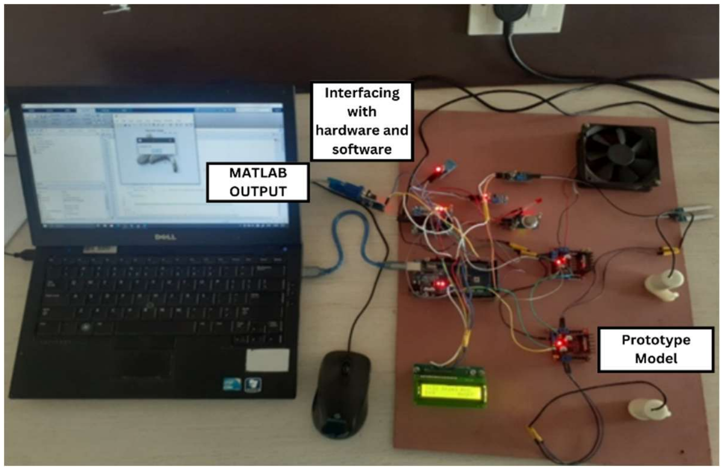
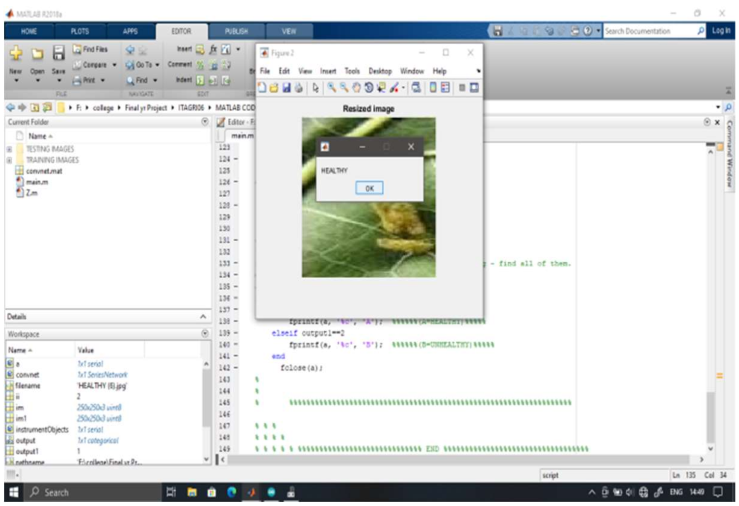


Figure 11: Interfacing with hardware and software

Figure 12:



Silkworms Health Status Simulation Output

CONCLUSION:

This automated sericulture system offers significant advancement in sericulture practices by introducing automation and precise environmental control. By maintaining stable and optimal conditions within the silkworm rearing house, specifically temperature, relative humidity, and light intensity, the system provides a controlled environment crucial for healthy silkworm development. The automated control of lighting, heating, and ventilation based on real-time environmental data ensures that the required parameters are consistently maintained. Testing of the prototype system has validated its ability to effectively monitor and regulate these conditions within the rearing house. The proposed system presents a viable and efficient solution for improving sericulture outcomes, offering economic benefits to sericulturists through increased productivity and reduced losses.

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