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AUTOMATED SILKWORM INCUBATOR

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ABSTRACT

A silkworm incubator is a specialized device used in sericulture to create and maintain the optimal conditions for the incubation. This paper on automated silkworm incubators represents a groundbreaking initiative that seamlessly blends cutting-edge technology with traditional sericulture practices. By precisely controlling temperature, humidity, and other crucial variables, the system ensures the ideal conditions for silkworms to thrive and cocoon efficiently. The development of an automated silkworm incubator using the microcontroller involves a structured approach. ESP32 is interfaced with sensors DHT11 and MQ135 to monitor the parameters such as temperature, humidity, and toxic gases detection (such as CO, NOx, and fragrance compounds). The ideal temperature and humidity for the silkworm incubator is 24-28 degree Celsius and 70-85% respectively. The DC motor connected to the blades is used to cut the leaves and store in the bin. If the temperature exceeds the threshold limit there is an exhaust fan to cool down. Each parameter such as temperature, humidity, and air quality is displayed on a 16x2 LCD display. And also the buzzer turns on for every emergency indication. The successful integration of technology into sericulture not only boosts productivity but also opens new avenues for sustainable and technology-driven silk farming. This paper's application holds immense potential in transforming the silk industry, offering a harmonious blend of tradition and modernity to meet the demands of an evolving agricultural landscape.

Keywords - Silkworm, Sericulture, Node MCU, Temperature, Humidity, Arduino IDE

I. INTRODUCTION

A field of study called sericulture studies the raising of silkworm embryos for the purpose of producing silk. India is the world's second-largest producer of silk, per a Central Silk Board study. But India only makes up 15% of the world's silk production, with China holding an 85% market share. Furthermore, China and India combined account for 85% of global silk production. Raising silkworms for the purpose of producing silk is a labor-intensive and painstaking procedure known as sericulture. One major reason for the striking variation in productivity is the absence of mechanization in the sericulture industry. Cocoon weight, shell ratio, and general quality are all impacted by seasonal variations and environmental shifts in the silkworm raising homes.

Silk production, a crucial industry worldwide, heavily relies on maintaining optimal environmental conditions, preventing predator attacks, mitigating dampness-related risks, and averting fire hazards. Our smart sericulture system addresses these limitations by employing IoT devices [1]. The silkworms are mostly fed by the mulberry leaves. Mulberry leaves are the main source of food for the silkworms. The purpose of planting this mulberry plant in the field is to benefit the silkworms that inhabit it. For the purpose of cutting mulberry plants, there are various cutting techniques. The processes of cutting by hand and by machine. When compared to hand cutting, machine cutting is easier since it requires fewer workers and a significant reduction in time. This paper describes a novel automated machine cutting method for silkworms using mulberry plants harvested from the field. Given that a labor scarcity is the main obstacle to their involvement. As a result, the paper cleared the way for a decrease in the number of workers needed to gather mulberry leaves, which are then fed to silkworms.

II. RELATED WORKS

Inspite of high demand for sericulture and silkworms, maintaining optimal conditions such as temperature and humidity on a farm is difficult through manual efforts alone. Lack of mechanization in sericulture sector is a significant factor contributing to difference in production. Proposed idea monitors and regulates temperature, detects hazard such as fire attacks, predator attacks, disease spreading and takes preventive measures. Includes sensors for temperature and humidity monitoring, as discussed in reference [1]. Sericulture process having lack of automation is primary cause of significant gap. The proposed system is an embedded system that would continuously monitor and control the climatic conditions of sericulture farm. Eliminates issues with system by minimizing human input to greatest extent possible has been discussed in [2]. Sericulture is the important occupation in India and techniques used by the agriculturists are yet outdated. Hence providing automation in sericulture is necessary. The enhancement of the proposed system can observe temperature and humidity, light power through sensors. Any variations in parameters sends the message to user mobile application as in reference [3]. The cutting process is not automated and the leaves will fell on the ground. So, they designed with a movable holder/arm and a rotating cutter arm (to hold the mulberry plants) then the cutter starts to cut. Due to this process, it reduces the manpower and labor wages [4]. There is a requirement for more effort and time in weeding and spraying process. Thus, the proposed system uses image processing. This has advantages such as operating with closer tolerances, offer few errors and higher speeds. But there is computational complexity as discussed in reference [5].Sericulture is important occupation in India and techniques used by agriculturists are yet outdated. Analysis of sericulture in India brings up a need for automation especially during pre-cocoon stages. Climatic factors have significant influence on disease incidence in silkworm which leads to crop loss. Maintaining optimal conditions - temperature and humidity on farm is difficult through manual efforts. IoT to lively monitor environmental changes. More manpower is required to the cut the mulberry plants and carry them to the silkworm shed. The above can be concluded from the surveyed papers.

III. METHODOLOGY

The automated silkworm incubator incorporates several key components to optimize the silkworm rearing process. The heart of the system is the ESP32 microcontroller, orchestrating the functionality of various sensors and actuators. The power supply ensures consistent energy provision. The DHT11 sensor monitors temperature and humidity levels within the incubator, ensuring an optimal environment for silkworm development. If the temperature monitored is more than the threshold value, the exhaust fan is turned on. The MQ135 gas sensor contributes to a safe atmosphere by detecting and alerting to any gas anomalies. The relay turns on the DC Motor, then the leaves are cut into pieces and moved to the storage space. This integrated system streamlines the silkworm incubation process, providing a controlled and automated environment for optimal silk production.

Figure 1, is the proposed system's block diagram, which shows the DHT11 and MQ135 gas sensors among its sensors. The ESP32 is configured and capable of keeping an eye on the model using the given threshold values. Both the hardware device and the software component are included in the scheme. Mechanizing the controller's action is the primary goal of the program design. The code needed to complete the task is loaded into the microcontroller. Based on the conditions specified in the code, it is simple to manage the entire process.

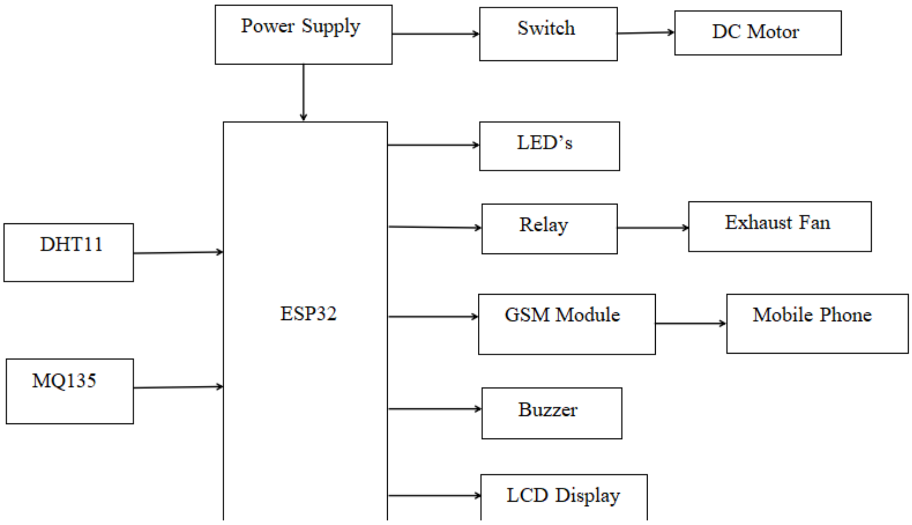

Fig 1: Block diagram of the proposed system

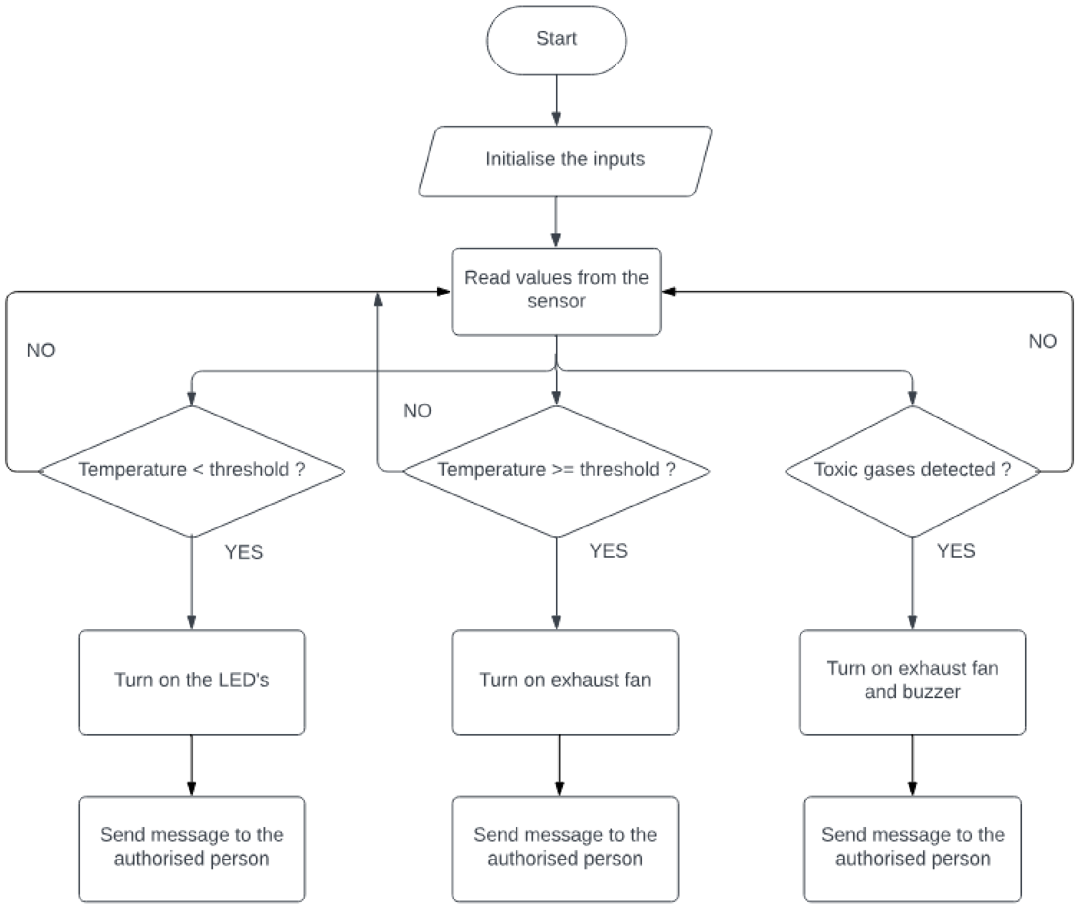

Fig 2: Flowchart of the proposed system

Figure 2, is the flowchart that describes the flow of working inside the incubator. The threshold values are set while programming, according to the requirements needed by the silkworms. The values are being monitored regularly and are read from sensors. If the temperature is lesser than the threshold, turn on the LED's in-order to increase the temperature. If it is found greater than or equal to threshold (28 degree Celsius), turn on the exhaust fan. If the toxic gases (like carbon monoxide) are detected, then the fan is turned on in order to circulate the fresh air. Messages are sent to the concerned.

IV. RESULT AND DISCUSSIONS

The outcome of the automated silkworm incubator, including the leaf cutting part, utilizing microcontroller technology, is a transformative advancement in silk production methodologies. It has led to increased silk yield and overall production efficiency by precisely controlling environmental factors such as temperature and humidity, as well as the leaf cutting process. Integration of ESP32 enables remote monitoring and control, while a user-friendly interface enhances practicality and adoption. Additionally, scalability offers the opportunity for silk farmers to expand operations, promising positive economic and environmental impacts on the silk industry.

The figure 3, shows the model of the built proposed system.

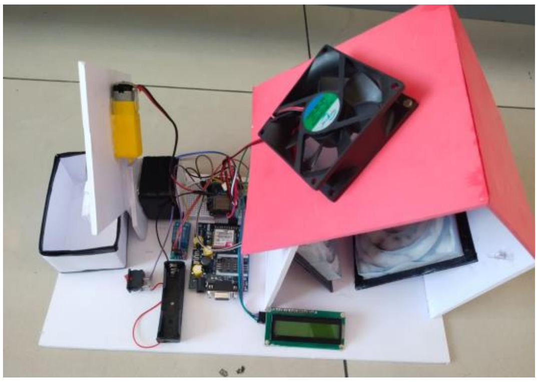

Fig 3: Automated Silkworm Incubator

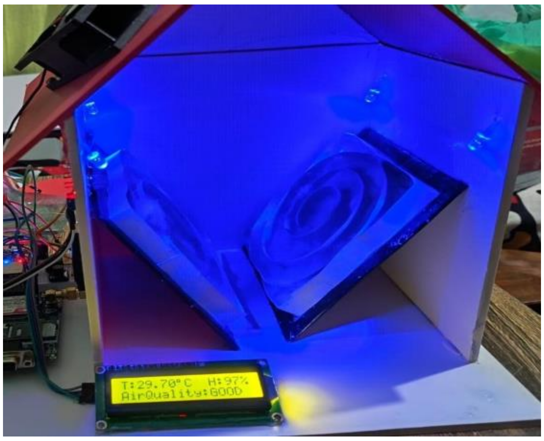

Fig 4: Temperature drop below threshold

The figure 4, shows the indication of the action taken when temperature drops below threshold. The LED's are turned on to regulate the temperature.

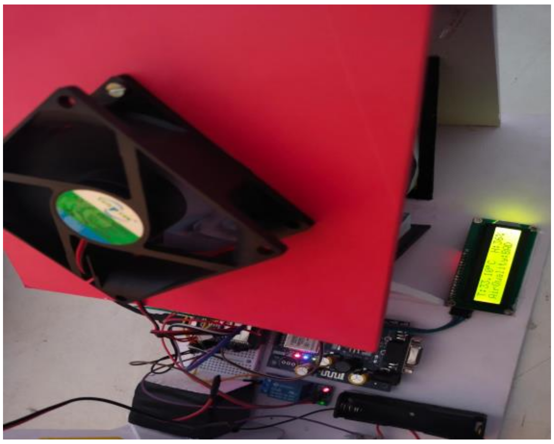

Fig 5: Temperature rise above threshold

The figure 5, shows that the air quality is bad and also the temperature has rised above the threshold. Exhaust fan turns on to regulate the air as well as to cool down the temperature.

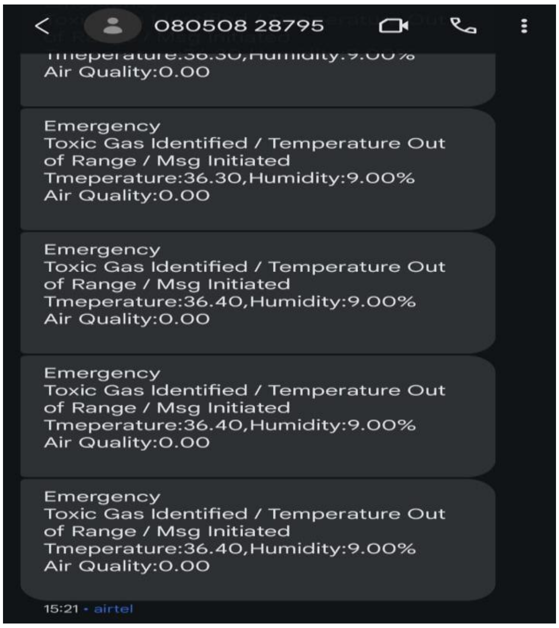

Fig 6: Messages sent

The above figure 6, shows the messages sent to the concern, regarding the conditions inside the incubator.

V. CONCLUSION

In summary, the automated silkworm incubator offers a promising solution for enhancing silk production efficiency and sustainability. This paper aims to monitor the temperature and humidity conditions for optimal silkworm growth and detect the toxic gases, also to reap and store the mulberry leaves in the shaded area. This has been achieved. Despite its advantages, including increased yield and remote monitoring capabilities, challenges such as initial costs, technological dependency, and potential disruption of traditional practices must be addressed. Nevertheless, with continued innovation and careful implementation, the project has the potential to revolutionize sericulture practices while fostering positive economic and environmental outcomes for the silk industry.

Further research could explore optimizing the automated system to accommodate different breeds of silkworms and varying environmental conditions. Incorporating AI algorithms could enable the system to adapt and optimize parameters dynamically based on real-time data, further improving efficiency. Integrating additional sensors for monitoring factors like CO2 levels and air quality could provide more comprehensive insights into the incubation environment. Collaboration with academic institutions and industry partners could facilitate continuous innovation and refinement of the technology.

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