American Journal Of Applied Science And Technology
(ISSN – 2771-2745)
VOLUME 04 ISSUE 11 Pages: 7-13
OCLC – 1121105677

Publisher: Oscar Publishing Services

Journal Website: https://theusajournals.com/index.php/ajast

Research Article

DEVELOPMENT OF A MECHATRONIC SYSTEM FOR A SILKWORM INCUBATOR

Submission Date: October 25, 2024, Accepted Date: October 30, 2024,
Published Date: November 04, 2024
Crossref doi: https://doi.org/10.37547/ajast/Volume04Issue11-02

Nasirdinov Bahadyr Abdullajan oglu
Namangan Institute of Engineering and Technology, Uzbekistan

Sharibayev Nasir Yusupzhanovich
Namangan Institute of Engineering and Technology, Uzbekistan

Sharibayev Soli Yusupzhanovich
Namangan Institute of Engineering and Technology, Uzbekistan

ABSTRACT

In this study, the effectiveness of using a mechatronic system in the incubation of silkworm eggs was studied. The incubator consists of an SCD41 sensor, an ESP32 microcontroller, a TES1-12706 air cooler, an electric heater and a ventilation systembo'lib, harorat, namlik va CO2, which provides automatic control of temperature, humidity and CO2 quantity2. The study showed that when using the new system, the level of egg viability increased by 4.1%, and the yield of cocoons-by 5.8%. However, the overall length of the silk fiber and the continuous length have also been improved. This innovative system can be of great importance for improving product quality and ensuring economic efficiency in the silk industry.

KEYWORDS

Mechatronic system, mulberry silkworms, incubation, microclimate control, temperature control, humidity level, CO2 control, SCD 41 sensor, ESP 32 microcontroller, Air Cooler, Silk fiber quality, Silk industry.

INTRODUCTION

The silk industry occupies an important place in the economy, and in many countries, especially in regions that specialize in silk production, the population is one of the sources of income.[1] The silkworm rearing and incubation process is an important step in silk fiber production, where optimal control of mass hatching

American Journal Of Applied Science And Technology
(ISSN – 2771-2745)
VOLUME 04 ISSUE 11 Pages: 7-13
OCLC – 1121105677
Crossref doi Google Scholar WorldCat MENDELEY
Publisher: Oscar Publishing Services

and maturation is required.[2] Thus, automating the process of incubating silkworm eggs, ensuring the production of high-quality silk, and improving the energy efficiency of the process are among the most pressing issues today.

With traditional incubation methods, eggs are difficult to grow at optimal temperature, humidity, and carbon dioxide (CO_2) levels, which often leads to lower egg yields. [3] Climate change adaptation is also a challenge, as it negatively affects egg development when temperature and humidity changes dramatically. Such limitations can be overcome by implementing innovative solutions. Therefore, it is possible to optimize this process by developing a new design of the incubator based on the mechatronic system.[4]

The use of mechatronic systems in the incubation of silkworms qo makes it possible to effectively control the egg production process. For example, 2 egg hatching efficiency can be significantly improved by controlling temperature, humidity, and CO_2 levels. The process is fully automated by obtaining accurate data using state-of-the-art sensors such as the SCD 41, and processing this data using the ESP 32 microcontroller.[5] With these technologies, it will be possible to maintain all parameters at an optimal level and improve the quality of silk production.[6]

This article will discuss the main aspects of the developed mechatronic system, its components, and their indissoluble connections. The optimal microclimate inside the incubator is created by ensuring uninterrupted operation of devices such as the SCD 41 sensor, the TES 1-12706 air cooler, an electric heater and a ventilation system.[7] These systems 2 help improve the overall quality of silk production after egg hatching by allowing real-time monitoring of temperature, humidity, and CO_2 levels.

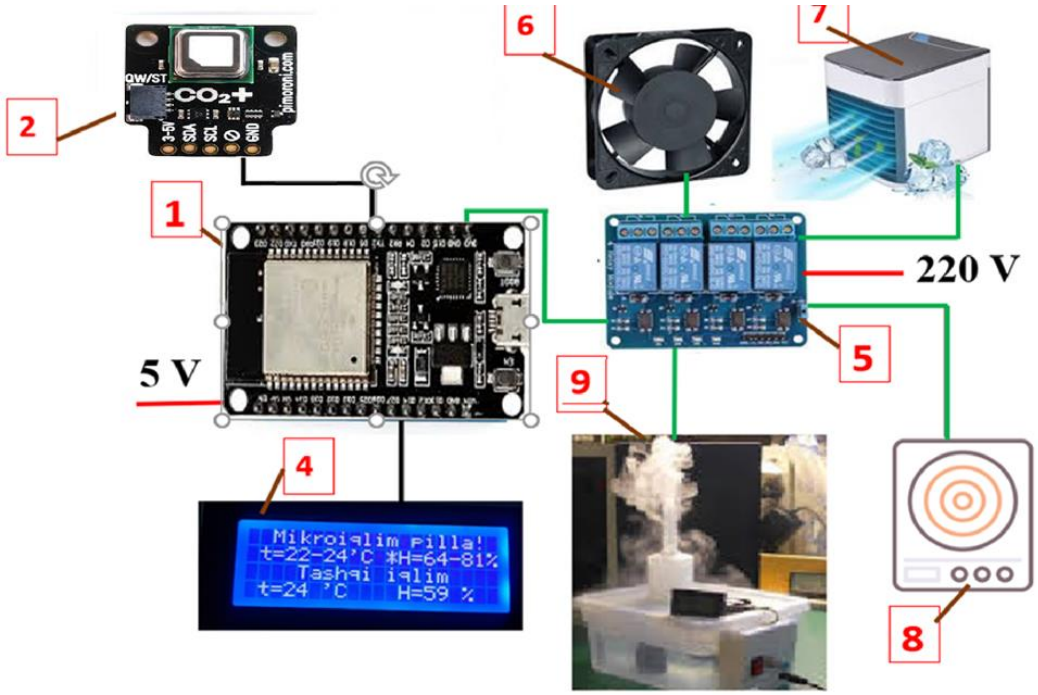
METHODS

The mechatronic system developed for this study is mainly designed to control the incubation process of silkworm mo EGGs. The main components of the system are: SCD 41 sensor, ESP 32 microcontroller, TES 1-12706 air cooler, electric heater, ventilation system and rotating DC motor. The SCD 41 sensor provides real-time monitoring and analysis of the incubator's temperature, humidity, and CO_2 content.[8,9] these components are inextricably linked to create optimal conditions, and special algorithms have been introduced into the system to ensure their efficient operation.

The control part of the incubator system is organized on the basis of a microcontrollerESP32 and performs the function of sending commands to all executive equipment. Data on temperature, humidity and levelCO_2 taken from the sensorSCD41 and are processed by the microcontroller ESP32. Based on these processed data, actuating devices, such as an electric heater or air cooler, achieve the desired state. This system continuously analyzes all measurements and immediately takes corrective action when deviations from the required parameters occur.[8]

953135 1640205 The TES 1-12706 air cooler in the system operates at high temperatures and quickly cools the air inside the incubator. The refrigerator helps to maintain the microclimate parameters at an optimal level and works effectively at high outdoor temperatures, mainly in the summer months.[10] the operating frequency changes depending on the algorithms set by the ESP 32 microcontroller, in order to increase the efficiency of the cooler. This not only increases energy efficiency, but also extends the life of components.

American Journal Of Applied Science And Technology
(ISSN – 2771-2745)
VOLUME 04 ISSUE 11 Pages: 7-13
OCLC – 1121105677
Crossref doi Google Scholar WorldCat MENDELEY
Publisher: Oscar Publishing Services



1-ESP 32 microcontroller, 2-SCD-41 sensor (CO_2, temperature and humidity), 4-LCD display, 5-relay module, 6-electric ventilation float, 7-electric air cooler, 8-electric air heater, 9-water evaporator, 220 volt 5 V power supply and 220 volts

Fig. 1. Mechatronic system developed for the silkworm incubator

A rotating disk is also installed to evenly distribute the temperature inside the system. With the help of a DC motor, the disc rotates 180 degrees, which allows you to ensure the same temperature for all parts where the eggs are located. The disk rotation speed is controlled by a sensorSCD41 and a microcontrollerESP32 according to the established standards.[7]this, in turn, ensures a more uniform incubation of eggs and contributes to a more uniform and rapid development of the silkworm.

Using an incubator developed on the basis of this mechatronic system, the level of animation of silkworm eggs increased by 4.1%. This change in CO2 is associated with ensuring a uniform and comfortable development of eggs due to the constant control of temperature, humidity and CO2 content in the system. Thanks to the automated system, each egg was kept in optimal conditions in a timely manner, which significantly improved the recovery process compared to traditional methods.

RESULTS

American Journal Of Applied Science And Technology
(ISSN – 2771-2745)
VOLUME 04 ISSUE 11 Pages: 7-13
OCLC – 1121105677
Crossref doi Google Scholar WorldCat MENDELEY
Publisher: Oscar Publishing Services

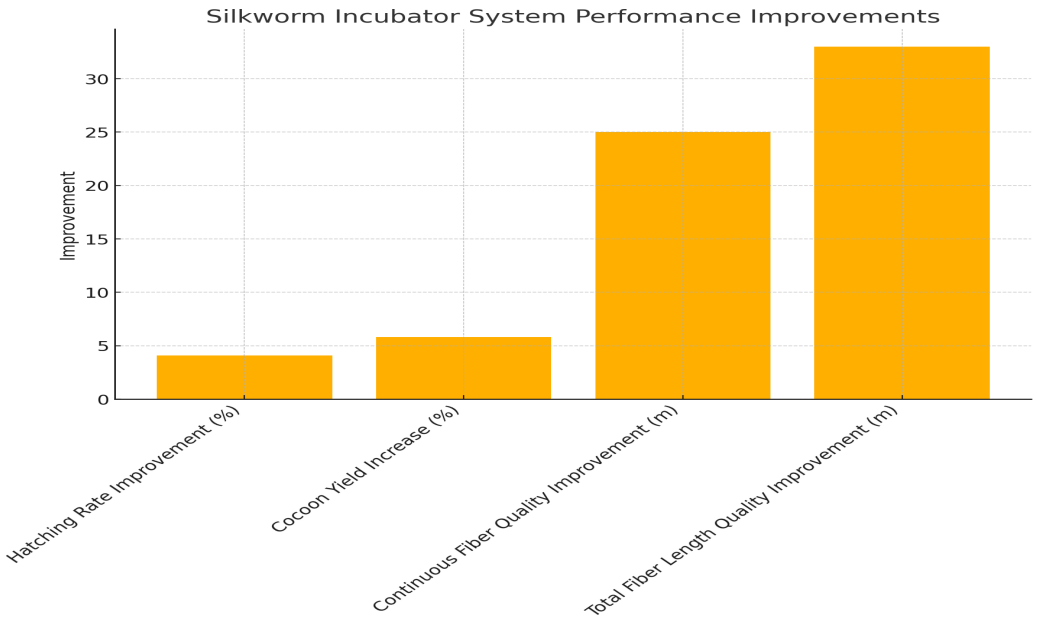


Fig. 2. Mechatronic system for silkworm incubator

The overall yield of cocoons also increased significantly with this mechatronic incubator. According to the results obtained, the yield of cocoons created by silkworms improved by 5.8%. This change is due to the fact that the parameters inside the incubator are constantly monitored, and eggs develop evenly due to an even temperature distribution. This improvement will help increase silk production and increase economic efficiency.

During incubation, an increase in the total length of the silk fiber by 33 meters was noted. This result is of great importance in sericulture, as improving the overall length index contributes to improving the quality of the finished product. This was achieved through a controlled microclimate inside the incubator and an even distribution of eggs, resulting in improved fiber development.

In addition, the continuous length quality indicator of silk fibers also gave a positive result. Compared to traditional methods, the continuous length has been improved by 25 meters with this incubator. Improving the continuous length helps the fibers look beautiful and even. This result is due to the control of the microclimate and constant uniform temperature distribution.

DISCUSSION

Thanks to this study, the effectiveness of using a mechatronic system in the incubation process of silkworm eggsqo‘it was confirmed in practice. In comparison with traditional incubation methods, the mechatronic system has made it possible to further improve the development and revitalization of silkworms by automating microclimate control. This system is particularly2 helps you accurately control factors such as temperature, humidity, and

American Journal Of Applied Science And Technology
(ISSN – 2771-2745)
VOLUME 04 ISSUE 11 Pages: 7-13
OCLC – 1121105677
Publisher: Oscar Publishing Services

quantity.CO2 ensuring more even hatching of eggs. Thus, such a system can provide high profits in the silk industry.

Table 1 Incubator temperature and humidity

	Stage	Temperature (°C)	Humidity (%)
1	EGG development	24	75
2	larval stage	25	80
3	pupal stage	25	75
4	cocoon formation	24	70

The results obtained during the study revealed the advantages of a mechatronic incubator for increasing the efficiency of silk production. An increase in the yield and quality indicators of the cocoon occurred due to the uniform distribution of all microclimate parameters inside the incubator and constant monitoring. This means that using a properly configured mechatronic system, you can ensure mature and high-quality development of eggs, which directly affects the quality of finished products.

Summing up, we can say that this mechatronic incubator has provided a higher level of quality and efficiency than traditional methodsko. The system has shown high results in ensuring a stable microclimate, which makes it possible to achieve high quality and efficiency of silkworm incubation.

This new approach opens up promising opportunities for improving the quality and volume of products in the silk industry. Therefore, the application of this system in practice can increase economic efficiency and make the production process more environmentally friendly.

CONCLUSION

This study showed the effectiveness of using a mechatronic system in the incubation of silkworm eggs. Thanks to the temperature, humidity and2 contentsCO2 the eggs developed evenly and comfortably. The results show that this system not only increases the efficiency of the incubation process, but also increases silk production. This allows you to get high-quality products in the silk industry and increase economic efficiency.

Using the Center 1659255 mechatronic incubator, improvements in cocoon yield and silk fiber quality were noted. In particular, an increase in total length and continuous length indicates an improvement in product quality. This to ' system allows you to fully control the development of silkworms, which serves to optimize the process of silk production on an industrial scale. These results expand the possibilities of achieving high efficiency at every stage of the silk production process.

American Journal Of Applied Science And Technology
(ISSN – 2771-2745)
VOLUME 04 ISSUE 11 Pages: 7-13
OCLC – 1121105677
Crossref doi Google Scholar WorldCat MENDELEY
Publisher: Oscar Publishing Services

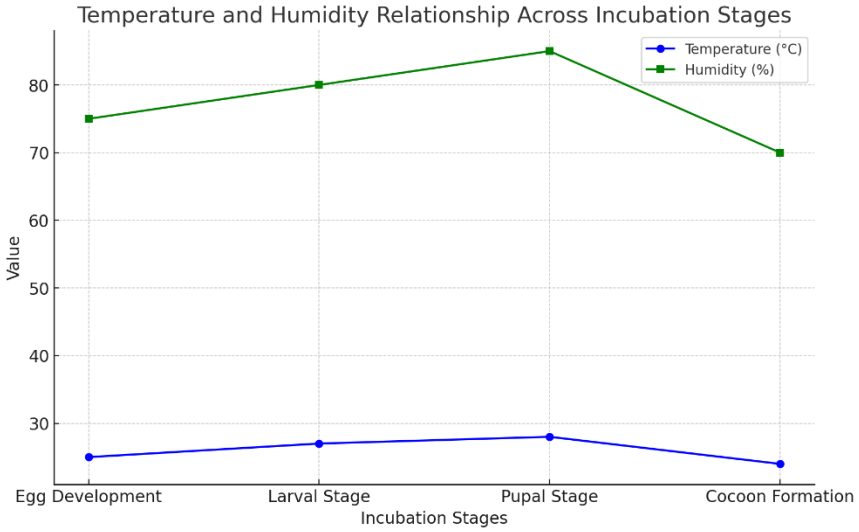


Fig. 3. Temperature and humidity for the incubator

The automated control of this mechatronic system allows you to create continuous processes without human intervention in production. By continuously monitoring the temperature, humidity and CO_2 content inside the incubator using the SCD 41 sensor and ESP 322 microcontroller, the stability of the process is increased and high-quality egg development is ensured. This system is very convenient for the industry and plays an important role in expanding the product range and optimizing the production process.

Thus, the use of a mechatronic system in the incubation of silkworm eggs turned out to be much more effective than traditional methods. This system serves to increase the efficiency of production, expanding the possibilities of obtaining high-quality silk fiber in sericulture. However, it is possible to achieve better results from both an economic and environmental point of view, and this system can make a significant contribution to the practice of sericulture. Such innovative solutions will be important for the further development of the silk industry in the future.

REFERENCES

1. Gorai, S., And Sengupta, K. (2020). Silk Production and Breeding Techniques: A Comprehensive Overview. Agricultural Reviews, 41(2), 104-111.
2. Pandey, J. P., & Kumari, M. (2019). Automated Environmental control for Sericulture: technological development in Silkworm production. Journal of Sericulture Technology, 30(3), 151-160.
3. Kumar, S., & Patel, A. (2021). Effect of temperature and humidity on silkworm cocoonYield and Silk Quality. International Journal of Agricultural Sciences, 13(4), 245-253.
4. Suzuki, Moscow, & Sasaki, T. (2018). Mechatronics research for controlled incubation in Sericulture. Transactions of the Japanese Society of Agricultural Engineering, 84(5), 193-200.
5. Zhou, L., & Huang, H. (2022). Integration of sensors and microcontrollers in precision agriculture: applications in the silk industry. Computers and electronics in agriculture, 194, 106672.

American Journal Of Applied Science And Technology
(ISSN – 2771-2745)
VOLUME 04 ISSUE 11 Pages: 7-13
OCLC – 1121105677
Crossref doi Google Scholar WorldCat MENDELEY
Publisher: Oscar Publishing Services

6. Park, k.H., & Lee, J. S. (2020). Automated Climate Control Systems for Silkworm Rearing: a case study. Asian Journal of Agriculture and Development, 17(2), 137-145.
7. Yoshida, Yu., & Nakamura, Yu. (2021). Developing an intelligent systemSericulture usingIoT and environmental sensors. Journal of Agricultural Engineering Research, 92(3), 267-273.
8. Wang, J., & Liu, X. (2019). Impacts of Environmental Parameters on Silkworm Incubation and Cocoon Production. Journal of Insect Biotechnology and Sericulture, 88(4), 412-420.
9. Das, S., And Roy, R. (2021). Application of mechatronics in agriculture and agriculture: an overview. Advances in Agricultural Research and Technology, 5(2), 120-129.
10. Chandra, P., & Awasthi, A. (2022). The role of microclimate management in silk production: methods and innovations. Journal of Agricultural Science, 45(1), 54-62.