# DESIGN OF A MECHATRONIC MODULE DEVICE FOR DETERMINING AND SORTING EGG VIABILITY IN INCUBATORS

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**Annotation.** This article discusses in detail the process of designing a mechatronic module device for detecting and sorting eggs in incubators. Determining the vital activity of eggs is one of the main factors determining the success of the incubation process. Determining the internal state of eggs and separating inactive eggs is necessary for effective control of the incubation process.

The project creates the possibility of automatic control and sorting of eggs using modern sensors, such as ultrasonic and infrared sensors, microprocessors and software. Sensors play an important role in determining the vital activity of eggs, as they measure the internal state of eggs and help determine their stages of development.

The mechatronic module device is aimed at automating the egg sorting process, which speeds up the incubation process and increases its efficiency. The device consists of sensors necessary for determining the vital activity of eggs, a control system, a data storage module and a user interface. These components, working together, allow for effective control and sorting of eggs. The results of the project will allow for the application of innovative approaches in the process of incubation of eggs and will become the basis for further development of this technology in the future.

**Keywords:** Incubation, egg sorting, mechatronics, optical sensors, ESP32, Raspberry Pi, IoT, wireless communication, automation, mobile application, poultry farming.

**Аннотация.** В данной статье подробно описан процесс проектирования мехатронного модульного устройства, определяющего и сортирующего яйца на жизнеспособность в инкубаторах. Определение жизнедеятельности яиц является одним из основных факторов, определяющих успех процесса высиживания. Определение внутреннего состояния яиц и отделение



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неактивных яиц необходимо для эффективного управления процессом высиживания.

Проект создаст возможность автоматического мониторинга и сортировки яиц с помощью современных датчиков, таких как ультразвуковые и инфракрасные датчики, микропроцессоры и программное обеспечение. Сенсоры играют важную роль в определении жизнедеятельности яиц, так как измеряют внутреннее состояние яиц и помогают определить стадии их развития.

Модульное устройство «Мехатрон» направлено на автоматизацию процесса сортировки яиц, что ускоряет процесс инкубации и повышает его эффективность. Устройство состоит из датчиков, системы управления, модуля хранения данных и пользовательского интерфейса, необходимого для определения жизнедеятельности яиц. Работая вместе, эти компоненты обеспечивают эффективный контроль и сортировку яиц. Результаты проекта позволят использовать инновационные подходы в процессе инкубации яиц и станут основой для дальнейшего развития этой технологии в будущем. Это модульное устройство мехатрон позволит и дальше развивать яичное производство в агропромышленном комплексе и поможет фермерам получать продукцию высокого качества.

**Ключевые слова:** Инкубация, сортировка яиц, мехатроника, оптические датчики, ESP32, Raspberry Pi, IoT, беспроводная связь, автоматизация, мобильное приложение, птицеводство.

**Anotatsiya.** Ushbu maqolada inkubatorlarda tuxumlarni hayotiy faolligini aniqlovchi va saralovchi mexatron modul qurilmasini loyihalash jarayoni batafsil ko'rib chiqiladi. Tuxumlarning hayotiy faolligini aniqlash, inkubatsiya jarayonining muvaffaqiyatini belgilovchi asosiy omillardan biri hisoblanadi. Tuxumlarning ichki holatini aniqlash va nofaol tuxumlarni ajratish, inkubatsiya jarayonini samarali boshqarish uchun zarurdir.

Maqolada zamonaviy sensorlar, masalan, ultratovush va infraqizil sensorlar, mikroprotsessorlar va dasturiy ta'minotdan foydalanish orqali tuxumlarni avtomatik ravishda nazorat qilish va saralash imkoniyati yaratiladi. Sensorlar tuxumlarning hayotiy faolligini aniqlashda muhim rol o'ynaydi, chunki ular tuxumlarning ichki holatini o'lchab, ularning rivojlanish bosqichlarini aniqlashga yordam beradi.

Mexatron modul qurilmasi tuxumlarni saralash jarayonini avtomatlashtirishga qaratilgan bo'lib, bu jarayon inkubatsiya jarayonini tezlashtiradi va samaradorligini oshiradi. Qurilma, tuxumlarning hayotiy faolligini aniqlash uchun zarur bo'lgan sensorlar, boshqaruv tizimi, ma'lumotlar saqlash moduli va foydalanuvchi



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interfeysidan iborat. Ushbu komponentlar birgalikda ishlash orqali tuxumlarni samarali nazorat qilish va saralash imkonini beradi. Loyihaning natijalari tuxumlarni inkubatsiya qilish jarayonida innovatsion yondashuvlarni qo'llash imkonini beradi va kelajakda ushbu texnologiyani yanada rivojlantirish uchun asos bo'ladi. Ushbu mexatron modul qurilmasi qishloq xo'jaligi sohasida tuxum yetishtirishni yanada rivojlantirishga xizmat qiladi va fermerlarga yuqori sifatli mahsulotlar olishda yordam beradi.

**Kalit so‘zlar:** Inkubatsiya, tuxum saralash, mexatronika, optik sensorlar, ESP32, Raspberry Pi, IoT, simsiz aloqa, avtomatlashtirish, mobil ilova, parrandachilik.

**Introduction**

This project is devoted to the design of a mechatronic module device designed to determine and sort the vital activity of eggs in incubators. During the project, the advantages, technical capabilities and methods of its implementation in practice will be analyzed. At the same time, detailed information will be provided on how the main indicators of the incubation process of eggs are determined and monitored using mechatronic modules[1].

Currently, humanity is widely using modern technologies in agriculture to ensure food security and effectively use animal products. One of such technologies is the control of egg incubation and hatching processes using incubators. In the modern development of agriculture, the effective production of food products and improving their quality are of great importance. Automation and optimization of hatching processes in animal products, in particular, poultry farming, are relevant today. This, in turn, requires the widespread use of modern technologies, in particular, achievements in the field of mechatronics and automation.



**Figure 1**. Egg incubator.

The need to monitor and sort eggs during incubation not only increases agricultural efficiency, but also ensures the efficient use of resources. For this, it is important to properly monitor the development of eggs, early identify damaged or non-developing eggs, and sort healthy eggs. Therefore, mechatronic modules that detect and sort egg vitality are of great importance in automating the incubation



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process. To make this process more efficient, technical solutions for monitoring egg vitality, identifying and sorting healthy eggs are of great importance[2].

Special mechatronic modules have been created to monitor egg vitality during incubation. These modules allow for accurate and timely assessment of egg condition, identification and sorting of defective eggs. Such systems allow optimizing the overall development of eggs, ensuring the hatching of healthy chicks, and increasing economic efficiency.

The project uses modern technologies such as optical sensors, ESP32, and Raspberry Pi. These devices allow for wireless data transmission based on IoT (Internet of Things). It is also planned to develop a mobile application to automate the processes of monitoring and sorting eggs[3].

The main goal of this project is to develop a modern mechatronic module that allows for maximum accuracy in monitoring and sorting the vital activity of eggs in incubators. This will increase the efficiency of egg incubation processes in the agricultural sector and provide an opportunity to reduce human resources[4].

This project has a number of advantages and disadvantages. Taking into account these advantages and risks, I believe that the correct selection of technology and its optimal configuration when implementing mechatronic modules will ensure better performance of the device

**How a Chicken Incubator Works**

1)A chicken incubator is a device designed to hatch chicks by artificially providing heat and humidity instead of the natural incubation of eggs by the mother chick. Its working principle is as follows:

2)Heating system - Electric heaters or infrared lamps are used to keep the eggs at an optimal temperature.

3)Humidity maintenance - Special water tanks or sprayers are used to provide humidity during the incubation process to prevent the inside of the egg from drying out.

4)Air circulation - Fans or natural air circulation systems are available to maintain a uniform internal temperature and humidity.

5)Egg turning - Eggs are turned manually or automatically at set intervals every day to ensure proper chick development[5].

**Chicken Incubator Methods:**

1.Natural Incubation – The mother hen incubates the eggs in natural conditions while sitting on them.

2.Artificial Incubation (Homemade Incubators) – Simple incubators can be made at home using wooden boxes and electric heaters.



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3.Industrial Incubators – These are divided into types of automated incubators used on large poultry farms[6].



**Figure 2. General view of the image acquisition and incubation system.**

**Airflow:**

All incubators should have holes for air exchange (developing eggs are alive and breathing!), but there are 2 types of airflow to consider: still air and forced air[6].

1) Still Air Incubator: This is the most basic type found in inexpensive incubators. It relies on simple gravity to circulate the air naturally, a concept similar to a still room without ventilation. This often creates hot and cold spots throughout the incubator, resulting in poor hatching with some chicks hatching early and some hatching late.

2)Forced Air Incubator: This type of incubator has a built-in fan to distribute warm, moist air evenly. This will result in all of your eggs developing evenly and frequently, resulting in a better overall hatch. The cost of forced air is worth every penny, in my opinion[7].

**Advantages of a chicken incubator:**

-Ability to hatch more eggs - Many eggs can be incubated at the same time.

-Stable temperature and humidity - Allows for controlled hatching of chicks, independent of natural conditions.

-Hatching of various bird species - In addition to chickens, quail, duck, goose and other poultry eggs can be hatched.

- Cost-effective - Helps prevent egg losses and increase the efficiency of poultry farms[8].

**Disadvantages:**

1) Dependence on electricity – Many incubators depend on electricity, and if the power goes out, the eggs can die.

2) Initial investment – It takes a lot of money to buy a good quality incubator.



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3) Need for control – Constant monitoring of temperature and humidity is required, otherwise the eggs may spoil.

4) Risk of disease – If sanitary rules are not followed, the eggs or chicks can become infected with bacterial diseases[9].

**Conclusion**

This article provides a detailed review of the design process of a mechatronic module device for determining and sorting eggs in incubators. The project uses modern technologies, including optical sensors, ESP32 and Raspberry Pi, to optimize the automatic control and sorting of eggs. This approach allows for the detection of egg viability during incubation and the early detection of inactive eggs, which is important for increasing agricultural efficiency and ensuring efficient use of resources.

Mechatronic modules allow for accurate control of egg development, sorting of healthy eggs, and automation of the incubation process. The process of determining egg viability is carried out using modern sensors, which allows for an accurate and timely assessment of the internal state of eggs. As a result, the process of detecting and sorting defective eggs becomes more efficient.

The mechatronic module developed in this article also allows for wireless data transmission based on IoT (Internet of Things). This makes the egg control process more convenient and efficient, as users will be able to monitor the condition of eggs in real time and take quick action if necessary. Through the mobile application, users will be able to monitor the vital activity of eggs, view the sorting results, and manage the incubation process.

During the preparation of this article, I realized that this project will provide opportunities for more efficient and accurate control of egg incubation processes in the agricultural sector. The mechatronic module device that detects the vital activity of eggs will help farmers obtain high-quality products and will serve to introduce innovative solutions in the poultry sector. This project will also help agricultural producers bring economic benefits and save resources.

In addition, the introduction of this mechatronic module will also serve to increase competitiveness in the agricultural sector. Automation in the process of incubation of eggs speeds up production processes and reduces human resources, which allows farmers to deliver timely and high-quality products. In the future, further development and expansion of these technologies will create new opportunities for the introduction of innovative solutions in the agricultural sector. Mechatronic modules that detect the vital activity of eggs will help agricultural producers obtain high-quality and efficient products, as well as play an important



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role in ensuring food safety. Thus, this project will ensure not only technological progress, but also sustainable development in the agricultural sector.

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