# Scalable Video Processing and Frame Analysis System for Automated Monitoring of Chicken Behavior Based on Artificial Intelligence Technologies

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Abstract: Modern global crises have significantly impacted the agribusiness sector, particularly poultry farming, which has experienced issues with logistics, labor shortages, and disruptions in the supply of feed and veterinary drugs. Under these conditions, the implementation of artificial intelligence (AI) has become a necessity to ensure production stability. The use of AI in poultry farming allows for the automation of monitoring processes, improves the management of poultry health, and reduces reliance on human resources, which is especially important amid the pandemic and quarantine measures. This article examines the benefits of automated systems for monitoring the condition of chickens, including methods for tracking both natural and sick behavior that allow for the timely detection of diseases and minimization of production risks. The use of digital technologies and AI helps adapt to changes in market demand and ensures higher resilience of enterprises in crisis situations. The article highlights the advantages of using automated systems to monitor chicken health under conditions of limited human resources. A software solution has been developed for monitoring chicken health, which enables video uploads from local sources or video services such as YouTube, selection of the communication language, and the LLM model. It provides a user-friendly interface for interacting with AI. The program consists of two components: the frontend and the server side. Interaction with the server side occurs via an API, allowing seamless integration into any interface. The software architecture ensures convenient scalability and functionality expansion through the addition of agents and services. Such innovative solutions hold great potential for the development of the agribusiness sector, contributing to increased efficiency and resilience to crisis situations.

## 1 INTRODUCTION

Poultry farming is the largest branch of terrestrial animal production, with approximately 70 billion birds slaughtered annually, and the demand for chicken meat continues to grow, especially in developing countries [1]. To boost productivity, production systems have been intensified – often at the expense of animal health and welfare. In large industrial operations, the low economic value of each bird complicates individual care, yet farmers have a moral obligation to provide proper housing conditions [2].

Modern digital technologies are opening new opportunities for the automated monitoring of agricultural animal behavior, particularly in chickens, which is a crucial aspect of ensuring their welfare and productivity. One promising direction is the application of computer vision and deep learning techniques for real-time video stream analysis. This approach enables the detection of behavioral anomalies, monitoring of activity levels, and evaluation of stress factors without the need for manual observation.

Ethology of chickens studies their behavior, social interactions, and adaptation to housing conditions. Chickens are social birds with a clear hierarchy, known as the "pecking order," which determines access to food, resting areas, and resources. They exhibit a wide range of behavioral responses, including exploratory, feeding, nesting, and communicative activities. Chickens are capable of recognizing the faces of other individuals, distinguishing them by status, and producing various vocalizations to express fear, satisfaction, or danger. Under natural conditions, chickens spend a significant amount of time foraging, scratching the ground with their feet and beaks. Instinctive behavioral patterns include dust bathing for feather care, nest building before laying eggs, and maternal care. Restrictions on natural behavior in industrial conditions may lead to stress, aggression, or the development of abnormal reactions, such as feather pecking. Understanding chicken ethology is key to improving their welfare and production efficiency. In this context, the development of a scalable video processing and frame analysis system for automated monitoring of chicken behavior in production environments represents a highly relevant challenge in modern animal husbandry. The combination of neural networks, image processing algorithms, and specialized tracking methods will ensure high accuracy in recognizing behavioral patterns. [1, 3, 4]. The use of such solutions contributes to enhanced management efficiency on farms, reduced reliance on human factors, and improved conditions for poultry housing [3, 5, 6].

Optimization of Chicken Welfare Monitoring. Traditional observation methods require significant human resources and do not always provide accurate assessments. Automated analysis enables the detection of signs of stress, illness, or aggressive behavior continuously, 24/7.

Enhancement of Poultry Production Efficiency. Monitoring activity levels, feeding behavior, and other key indicators allows for timely adjustments to housing conditions. Reduction of Stress Factors. Lowering the impact of stress contributes to improved poultry health and increased production efficiency.

Early Diagnosis and Disease Prevention. The system can automatically recognize behavioral changes that may indicate the early stages of diseases, allowing for prompt intervention.

Reduction of Farm Management Costs. Automation reduces the need for personnel to monitor, analyze, and process data. Early problem detection leads to decreased veterinary expenses.

Scalability and Adaptability. The system can be integrated into both large-scale poultry farms and small family-run operations. Its adaptability to various housing conditions (cage, floor, free-range) allows for widespread application of the technology.

Environmental Aspect. Behavior monitoring helps reduce the use of antibiotics through disease prevention. Improving animal welfare meets the requirements of sustainable development and ethical agricultural practice.

## 2 PROBLEM STATEMENT

Amid the growing demand for high-quality products and the need to optimize production processes, artificial intelligence is becoming an essential tool for the modernization and development of agribusiness sectors, including modern poultry farming. The application of artificial intelligence, machine learning technologies, and computer vision in poultry farming allows for significant improvements in farm management, the automation of monitoring poultry health, the optimization of feeding processes, and the timely detection of diseases. The use of digital technologies contributes not only to increased productivity but also to reduced costs for maintaining and caring for poultry. Identifying birds with issues on poultry farms is crucial for ensuring their welfare and preventing disease outbreaks.

This work demonstrates the relevance of implementing artificial intelligence in poultry farming and presents a scalable server system for video processing and frame analysis using artificial intelligence technologies such as FastAPI, OpenCV, Streamlit, and others. The described system enables video processing and frame analysis for studying chicken behavior based on video data.

## 3 SIGNS OF CHICKEN BEHAVIOR FOR HEALTH MONITORING

To develop a video analysis system for poultry farming, it is necessary to identify the main behavioral signs of chickens that must be monitored to address this task. Chickens exhibit natural behavior characterized by certain habits that indicate their health. Even if a chicken behaves "sickly," it does not always indicate the presence of pathogenic diseases - the cause may be injuries, nutrient deficiencies, or the impact of adverse environmental factors, such as heat stress. To determine the health status of the bird, it is important to understand chicken ethology [7, 8, 9]. The natural behavioral signs of chickens include:

1) Preening. Using its beak, the chicken distributes oil among its feathers, which not only helps maintain feather condition but also signals to other flock members that it is in good health and ready for reproduction.

2) Dust Bathing. This is a hygienic process during which the chicken flaps its wings to raise dust and then carefully shakes it off, cleaning its body of parasites.
3) Foraging. In addition to feeding from the feeder, chickens often search for additional food sources, which is an integral part of their social interaction.
4) Perching at a Height. For protection against predators and to maintain the flock's hierarchy, chickens choose perching spots that are slightly elevated above the ground.
5) Play. Chickens engage in playful activities both individually and in groups, such as sparring, chasing, and lively jumps, which also serve as training for defense.
6) Aggression, Fear, and Anxiety. These are manifested through behaviors like pecking, jumping, and displays of strength (such as spreading their wings and vocalizing) to establish social hierarchy.
7) Reproduction. Reproduction begins with the onset of sexual maturity (usually at 4–5 months), when roosters display their traits (spreading their wings, loud vocalizations, dancing), and hens form nests for laying eggs and exhibit maternal instincts while raising their offspring. [1, 3, 10].

Thus, by observing these signs, it is possible to assess whether the behavior of chickens corresponds to their natural, physiological state. The assessment of the physiological state of chickens in production is carried out using a set of methods that include both visual observations and instrumental studies. The main assessment indicators are:

1) Appearance and behavior [11]:
   - Activity. Healthy chicken is active and shows interest in food and its surroundings.
   - Feather condition. Feathers should be smooth, clean and without any signs of plucking (an indicator of comfort and the absence of cannibalism).
   - Appearance of the comb and wattle. They should be bright red, well-moisturized and have no signs of pallor or swelling.
   - Movement coordination. Gait disturbance may indicate a deficiency of trace elements or joint disease.
2) Body condition and weight:
   - Regular weighing allows you to monitor growth rates and compliance with performance standards. Palpation of the pectoral muscle is used to assess muscle development and potential exhaustion.
   - Feed intake. A sharp decrease in appetite signals possible health problems.
   - Water intake. Excessive or insufficient water intake may indicate a violation of the water-salt balance or infection.
3) Litter condition. The color, consistency, presence of undigested food residues or mucus in the litter may indicate infectious or metabolic diseases.
4) Physiological parameters:
   - Body temperature. Normally 40.6–41.7°C; measured if pathology is suspected.
   - Respiratory rate. Rapid breathing may be a sign of respiratory disease or heat stress.
   - Heart rate. Normal is 250–350 beats per minute; abnormal heart rate may indicate stress or cardiovascular disease.
5) Reproductive assessment (for layers):
   - Egg production monitoring. A sharp decline in production may be due to stress, illness, or malnutrition.
   - Egg shell thickness analysis. Thinning of the shell indicates calcium deficiency or metabolic disorders.
6) Hematology and biochemical studies:
   - Blood tests are used to determine glucose, protein, liver enzymes, and electrolytes. Hematocrit and hemoglobin levels are used to detect anemia or inflammation.
   - The combination of these methods allows for effective monitoring of the physiological state of the hens [12, 13].

It should be noted that such approaches for assessing the physiological signs of chicken health and sickness are not only high-cost in terms of human resources but also rather subjective, which makes them impractical for large-scale production.

Therefore, a system is proposed that enables video processing and frame analysis to study chicken behavior based on video.

# 4 APPLICATION OF A VIDEO PROCESSING AND FRAME ANALYSIS SYSTEM

## 4.1 General Structure of the System

In today's world, automation of data collection and analysis processes is a key component of machine learning and computer vision technologies. The developed system provides video processing and frame analysis for studying chicken behavior based on video.

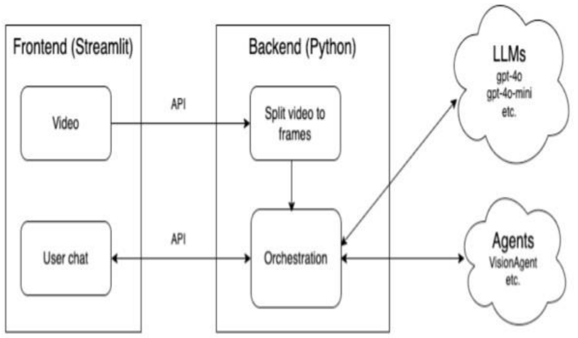



Figure 1: Program structure.

Figure 1 illustrates the general structure of the system, which consists of three main elements: Frontend (Streamlit), Backend (Python) and external services in the form of LLMs (large language models) and Agents (specialized modules).

Description:

1) Frontend (Streamlit): interacts with the backend via API: sends requests for video processing and receives results or answers to questions.
2) Backend (Python): consists of two main components:
   - Split video into frames: a module that splits the video into frames at given intervals.
   - Orchestration: a central logical unit that coordinates the entire system. It receives requests from the Frontend, calls the appropriate services (video processing modules, LLMs, agents, etc.) and compiles the response to send back to the Frontend. It makes calls to external services (LLMs and agents) to solve various tasks: image analysis, text response generation and anomaly detection.
3) LLM (Large Language Models): These models can perform tasks such as text generation, description and image analysis, and answering user questions. They are called by the backend to process text queries and images extracted from videos.
4) Agents (VisionAgent): Specialized modules or microservices that perform specific functions related to image or video processing and analysis. They can use computer vision, machine learning, or other algorithms to detect anomalies, classify objects, and evaluate chicken behavior.

The diagram shows how the frontend (Frontend), data processing logic (Backend), and external intelligent services (LLM, Agents) interact with each other to effectively analyze videos and chicken behavior.

The system allows users to upload videos from video services or local files, choose a communication language, and utilize large language models. Additionally, it provides the option to configure video segmentation parameters by specifying the interval at which frames (images extracted from the video) are generated – that is, setting the number of seconds between frames.

Left Panel – "Upload Options" (see Figure 2):

- Choose upload method: The user can select the source for uploading the video (either a local file or a YouTube link).
- Select frame interval (seconds): Specify the interval in seconds at which frames will be generated from the video.
- Choose language: Allows the user to choose the language for communication or analysis.
- Select model: Enables selection of a large language model (LLM) to be used for further processing.

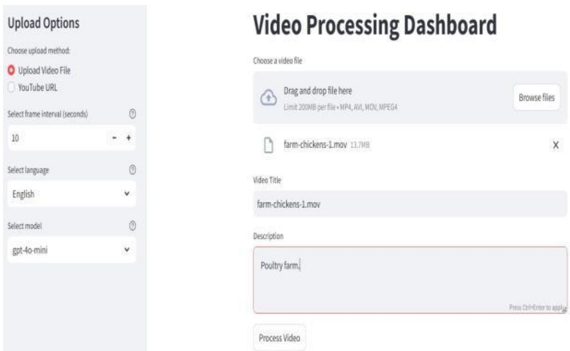



Figure 2: Screenshot of the main page of the program.

Right Panel – "Video Processing Dashboard" (see Figure 2):

- Drag and drop file here / Browse files: An area where the file can be dragged and dropped for uploading or selected from local storage.
- Video Title: A field displaying the title of the uploaded video (e.g., “farm-chickens-1.mov”) and its file size.
- Description: A text field for additional information or a description of the video (e.g.,

"Poultry farm").

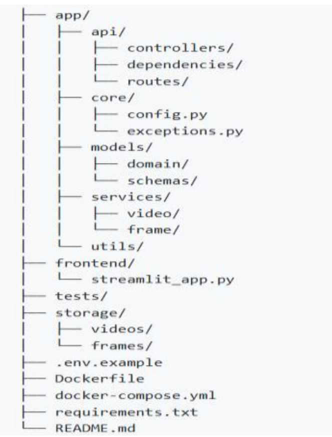
- Process Video: A button that initiates video processing (splitting the video into frames, passing the frames to the selected LLM).

This interface is built on the Streamlit framework, which allows for the rapid and convenient development of web applications for processing and analysis video. The backend is implemented using the Python programming language, and communication between the interface and the server is carried out via a RESTful API. The system development uses several powerful technologies[1]:

- FastAPI is a modern web platform for creating high-performance RESTful APIs. Thanks to its asynchronous capabilities, FastAPI provides fast request processing and easy scaling.
- OpenCV is a library for image and video processing. It allows you to extract frames from videos, resize them, and apply filters and algorithms for analysis.
- Streamlit is a library for rapid development of interactive web applications for scientific research and data analysis. It provides a convenient interface for interacting with the processing results.

The system has a modular architecture that includes the following components:

- API (FastAPI) – the API (FastAPI) is responsible for processing requests and interacting with the user via the REST API. This allows you to load videos, select the frame extraction interval, and access the processing results.
- The video processing service (OpenCV) is a module that performs basic video operations, such as extracting frames at specified intervals and saving the resulting images.



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├── app/
│   ├── api/
│   │   ├── controllers/
│   │   ├── dependencies/
│   │   └── routes/
│   ├── core/
│   │   ├── config.py
│   │   └── exceptions.py
│   ├── models/
│   │   ├── domain/
│   │   └── schemas/
│   ├── services/
│   │   ├── video/
│   │   └── frame/
│   └── utils/
├── frontend/
│   └── streamlit_app.py
├── tests/
├── storage/
│   ├── videos/
│   └── frames/
├── .env.example
├── Dockerfile
├── docker-compose.yml
├── requirements.txt
└── README.md
```

Figure 3: Screenshot of the system structure.

The interface (Streamlit) creates a user interface where users can upload videos, select intervals for analysis, and view the results in real time. Figure 3 shows a screenshot of the system structure.

## 4.2 Video Processing and Frame Analysis Methods

The video processing and frame analysis pipeline consists of three key stages designed to systematically analyze chicken behavior, beginning with data acquisition and culminating in automated anomaly detection[2]:

1) Video Upload. The user can upload videos from a local computer or paste a YouTube link.
2) Frame Extraction. The video processing service extracts frames from the video at a specified time interval (from 1 to 20 seconds). This is accomplished by calculating the necessary number of frames based on the video's duration and the specified interval.
3) Frame Analysis. Additional processing methods, such as filtering, color analysis, or the use of machine learning algorithms, can be applied to the extracted frames to detect anomalies in chicken behavior. See Figure 4 and Figure 5.
4) Interactive Interface. Through the interface, the user can view the processed frames, ask questions, clarify details, and analyze individual frames.

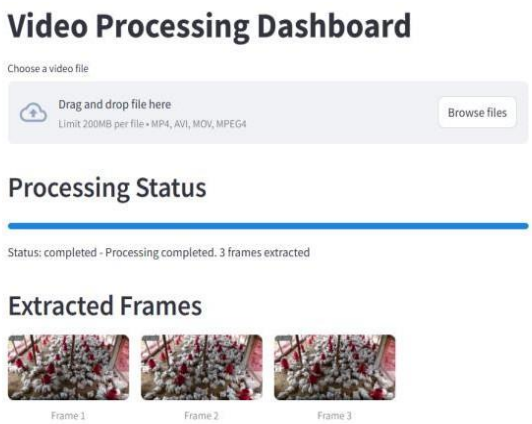


Figure 4: Screenshot of selecting frames from a video at a specific time interval.

Experimental studies of the developed scalable server system for video processing and frame analysis were conducted on test data sets. The studies showed that when working in real time, the accuracy

[1] https://www.renesas.com/eu/en/document/oth/um-wi-023-da16200-threadx-evaluation-kit-user-manual

[2] https://nypost.com/2025/02/15/us-news/us-egg-farmers-concerned-bird-flu-unwinnable-as-experts-consider-vaccinations/?utm_source=chatgpt.com

of counting chickens in a frame is at least 90%, which is comparable to analogues. However, the developed system has more flexible capabilities.

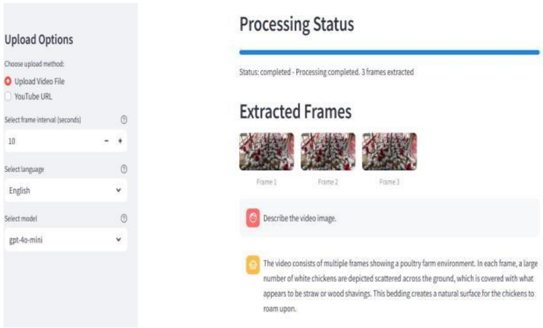


Figure 5: Screenshot of the request processing shown in the video.

## 5 CONCLUSIONS

A scalable server system for video processing and frame analysis using artificial intelligence technologies FastAPI, OpenCV, Streamlit, etc. has been developed. Its application to study the behavior of chickens based on video is shown.

During the study, the developed system demonstrated high efficiency in computer vision and animal behavior analysis across various video materials. The system does not rely on traditional model training methods (such as collecting visual data, image processing and analysis, or machine learning). Instead, it features an intuitive interface that allows users to optimally configure processing parameters and rapidly obtain results. The proposed system is an effective tool for automated video processing and the analysis of chicken behavior. The application of artificial intelligence methods contributes to the creation of a high- performance and user-friendly solution that does not require lengthy neural network training. This is particularly relevant for agribusiness research, where automated monitoring of animal health is crucial. Improvements to the system may include integration with other agents and services for image and video analysis, which will provide a more detailed examination of chicken behavior and health status. The system enables communication with the user in various formats, ranging from text chat to visual frame review. Its architecture allows for the rapid integration of new agents, language models, or image and video processing services. Configurable analysis parameters and an open RESTful API simplify integration with third-party tools and services. Although the system is designed for use in the agribusiness sector (specifically poultry farming), it can be adapted for analyzing the behavior of other animal species or any objects in video. It can serve as a foundation for scientific research, automated health monitoring, and ensuring animal welfare. Thanks to these features, the system provides a comprehensive solution for efficient and scalable video analysis, significantly simplifying the process of collecting and interpreting data on the behavior of objects-particularly chickens-in real time.

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