

Smart Poultry Waste Collection Using an Iot- Controlled Movable Conveyor System

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Abstract- The Poultry farms generate Efficient management of poultry waste is essential for maintaining farm hygiene, reducing labor costs and minimizing environmental impact. This project presents a Smart Poultry Waste Collection System based on an IoT-controlled movable conveyor mechanism designed to automate the collection and monitoring of poultry waste. The proposed system employs sensors to detect waste accumulation levels and environmental conditions, while a microcontroller enabled conveyor system dynamically moves to collect waste from designated areas within the poultry shed. Allowing remote monitoring, system control and performance analysis through a mobile. Automation reduces manual intervention, improves sanitation and helps prevent the spread of disease among poultry. The system is energy-efficient, scalable and adaptable to different poultry farm sizes. Experimental results demonstrate improved waste collection efficiency, reduced labor dependency and enhanced overall farm management, making the solution a practical step toward smart and sustainable poultry farming.

Keywords- IoT, synchronous AC gear motor, Conveyor, Automation, Smart System, ESP 8266, 5V Relay Module, wireless Wi-Fi network.

I. INTRODUCTION

Poultry farming plays a vital role in the agricultural economy by providing a major source of protein through eggs and meat production. As the demand for poultry products continues to increase globally, farms are expanding in size and production capacity. However, with large-scale poultry production comes the significant challenge of managing waste effectively. Poultry waste, including manure, litter, feathers, and leftover feed, accumulates rapidly and can create serious environmental, health, and operational issues if not handled properly.

Traditional waste management methods in poultry farms mainly rely on manual labor for collection and disposal. This process is time-consuming, labor intensive, and often inconsistent. Improper waste handling leads to high moisture accumulation, foul odors, and the release of harmful gases such as ammonia. Elevated ammonia levels not only affect the health and productivity of poultry birds but also create unsafe working conditions for farm workers. Furthermore, poor waste management contributes to environmental pollution and increases the risk of disease outbreaks.

To address these challenges, the Smart Poultry Waste Collection System using an IoT-controlled movable conveyor system is proposed as an innovative and automated solution. The system is designed to streamline the process of waste

collection and transportation while maintaining optimal environmental conditions within the poultry farm. By integrating sensor technology, microcontrollers, and Internet of Things (IoT) connectivity, the system ensures real-time monitoring, automation, and remote control capabilities.

The core component of the system is a motor-driven movable conveyor installed beneath poultry cages or designated waste collection areas. This conveyor automatically transports accumulated waste to a storage unit when sensors detect that the waste level has reached a predefined threshold. The use of sensors such as ultrasonic sensors for waste level detection and temperature-humidity sensors for environmental monitoring enables intelligent decision-making within the system. Instead of relying on manual inspection, the system operates based on real-time data, ensuring timely waste removal and improved hygiene.

In addition to automated collection, the project introduces a smart storage mechanism equipped with tilting trays. These tilting trays are designed to improve airflow and reduce moisture buildup within the stored waste. Excess moisture in poultry waste often accelerates bacterial growth and increases the emission of harmful gases. By enhancing ventilation and enabling controlled drying, the tilting tray system helps maintain a cleaner and healthier farm environment. One of the most significant features of this project is IoT integration. Through Wi-Fi-enabled microcontrollers, the system transmits data to a cloud platform or mobile application. Farmers can

monitor waste levels, environmental conditions. Workers often operate without adequate protective equipment, increasing their vulnerability to occupational health hazards

II. LITERATURE REVIEW

Ayaz et al proposed the perception people may have regarding the agricultural process, the reality is that today's agriculture industry is data-centered, precise, and smarter than ever. The rapid emergence of the Internet-of-Things (IoT) based technologies redesigned almost every industry including "smart agriculture" which moved the industry from statistical to quantitative approaches. Such revolutionary changes are shaking the existing agriculture methods and creating new opportunities along a range of challenges. This article highlights the potential of wireless sensors and IoT in agriculture, as well as the challenges expected to be faced when integrating this technology with the traditional farming practices.

Behjatithe et al has reviewed integration of the Internet of Things (IoT) in smart agriculture has transformed farming practices by enabling real-time monitoring, data-driven decision-making, and automation. However, ensuring reliable connectivity in diverse agricultural environments remains a critical challenge. This paper analyzes the performance trade-offs between Low-Power Wide-Area Networks (LPWAN)—specifically LoRaWAN, NB-IoT, and Sigfox—and cellular networks (4G/5G) in agricultural applications. Beyond a comprehensive literature review (2020–2024), this study evaluates hybrid LPWAN–5G architectures that integrate the strengths of both network types to enhance cost-efficiency and connectivity reliability. Using real-world case studies, the findings demonstrate that hybrid LPWAN–5G models can reduce connectivity costs by up to 30% while significantly improving network reliability in remote agricultural settings.

Kozhubae et al highlighted the mining industry, the belt conveyor is a critical piece of equipment. The motor constitutes the primary component of the belt conveyor apparatus, and its stable and accurate operation can significantly influence the performance of the belt conveyor apparatus. The results demonstrate substantial improvements in dynamic response characteristics and disturbance rejection capabilities compared to conventional control strategies. The proposed methodology effectively addresses critical challenges in mining conveyor applications, enhancing operational reliability and system longevity.

Nalawade et al population increases at an exponential rate as human society advances, and pollution is increasingly

depleting the availability of resources such as water and land. All these problems are thought to require the use of smart agriculture. By reducing use of chemical fertilizers and pesticides, smart agriculture could mitigate land pollution and increase the sustainability of agricultural practices while also greatly enhancing the agro ecological environment, yield, and quality of crops. The steps to make agriculture smart are made possible through data and communication technology, which helps with automatic operation and cultivation. Moreover, advances in wireless communication protocols will bring agriculture to a more intelligent stage.

Navarro et al the world population growth is increasing the demand for food production. Furthermore, the reduction of the workforce in rural areas and the increase in production costs are challenges for food production nowadays. Smart farming is a farm management concept that may use Internet of Things (IoT) to overcome the current challenges of food production. This work uses the preferred reporting items for systematic reviews methodology to systematically review the existing literature on smart farming with IoT. The review aims to identify the main devices, platforms, network protocols, processing data technologies and the applicability of smart farming with IoT to agriculture.

Nazzel et al proposed Conveyor-based continuous flow transport implementations are starting to gain support with the expectations that CFT systems will be capable of handling high-volume manufacturing transport requirements. This paper discusses literature related to models of conveyor systems in semiconductor fabs. A comprehensive overview of simulation-based models is provided. We also identify and discuss specific research problems and needs in the design and control of closed-loop conveyors. It is concluded that new analytical and simulation models of conveyor systems need to be developed to understand the behavior of such systems and bridge the gap between theoretical research and industry problems.

III. DESCRIPTION OF THE EXISTING SYSTEM

The existing system typically involves human labor equipped with basic tools such as shovels, scrapers, and collection bags. Workers enter the poultry sheds and manually remove accumulated waste from under the cages. The collected waste is then packed into sacks or transported using wheelbarrows. This process is repeated at regular intervals depending on farm size and labor availability. Although this method has been widely adopted for decades, it presents several operational and environmental.

Traditional poultry housing systems, birds are either reared in cage systems or deep-litter floor systems. In cage systems, waste accumulates beneath the cages on flat surfaces or shallow pits. Workers are required to bend or crouch to access these areas, making the process physically demanding. In floor-based systems, litter materials mixed with manure must be scraped and gathered manually.

Manual waste removal system is inefficient and inconsistent. The quality of waste collection largely depends on the availability, skill level, and diligence of farm workers. In large-scale poultry farms, manual cleaning becomes increasingly difficult due to the high volume of manure generated daily.

Delays in waste removal often lead to excessive accumulation, which further deteriorates the housing environment. Poultry farms require a continuous workforce for cleaning operations, which increases labor costs. In regions where skilled labor is scarce or expensive, farm owners struggle to maintain regular waste removal schedules. Additionally, manual methods are time-consuming, reducing overall farm productivity

One of the major drawbacks of the existing system is the health risk posed to both poultry birds and farm workers. Accumulated poultry waste.

Elevated ammonia concentrations can cause respiratory problems, reduced immunity, decreased egg production, and slower growth rates in poultry birds. For workers, prolonged exposure to ammonia and airborne dust particles can result in respiratory disorders, skin irritation. high moisture levels within accumulated waste create favorable conditions for microbial growth environments increasing the likelihood of disease outbreaks. It bring many health issues to the labour while cleaning the waste in the poultry farm.



Fig. 1. Existing diagram of poultry waste collection

The manual handling increases the risk of inconsistent cleaning in the figure.1 Certain areas may be inadequately cleaned, resulting in uneven waste distribution and localized contamination. The repetitive physical strain associated with manual cleaning can also lead to worker fatigue and reduced productivity.

IV. CHALLENGES IN THE EXISTING SYSTEM

The existing system manual cleaning remains one of the most widely practiced waste management methods in poultry farms, particularly in small and medium scale operations. Despite being a traditional and straightforward approach, manual waste removal presents numerous challenges that affect farm productivity, worker safety, poultry health, and environmental sustainability. As poultry farming continues to expand to meet the growing demand for meat and egg production, the limitations of manual cleaning practices become increasingly significant. The continuous accumulation of poultry manure, litter, feathers, and residual feed requires frequent removal to maintain hygienic conditions. Health risks to workers represent another critical challenge in manual cleaning systems. Poultry manure emits ammonia gas due to microbial decomposition of uric acid. When waste accumulates and remains untreated for extended periods, ammonia concentration levels increase significantly within poultry houses. Prolonged exposure to ammonia can cause respiratory irritation, eye discomfort, headaches, and chronic lung conditions. Workers directly involved in waste handling are particularly vulnerable, especially if adequate protective equipment is not consistently used.

V. PROPOSED SYSTEM

The proposed system integrates automation, sensor technology, and Internet of Things (IoT) connectivity to create an intelligent and efficient waste management solution. The primary objective of this system is to automate the collection, monitoring, and transportation of poultry waste while maintaining optimal environmental conditions within the poultry house. The core component of the proposed system is a motorized movable conveyor mechanism installed beneath poultry cages or along designated waste collection pathways. Unlike conventional systems where waste accumulates until manually removed, the conveyor system automatically transports poultry manure to a centralized storage unit when accumulation reaches a predefined threshold. This threshold-based activation is achieved using sensors strategically placed to detect waste levels. When the measured value exceeds the preset limit, the control unit activates the conveyor motor through a motor driver circuit, initiating the waste removal process.

In addition to waste level detection, the proposed system incorporates environmental monitoring sensors to track critical parameters such as temperature and humidity inside the poultry shed. Temperature and humidity sensors provide continuous feedback to the control unit, enabling assessment of environmental conditions that influence ammonia generation and microbial growth. High humidity levels are particularly associated with increased moisture retention in manure, which accelerates bacterial activity and gas emissions. By integrating environmental sensing, the system not only manages waste removal but also contributes to improved climate control within the poultry house. A distinctive feature of the proposed design is the inclusion of a smart storage system equipped with tilting trays. Once transported by the conveyor, the waste is deposited into a controlled storage chamber. The control logic of the proposed system is designed to operate efficiently with minimal energy consumption. The conveyor mechanism runs only when necessary, based on sensor input, reducing unnecessary power usage.

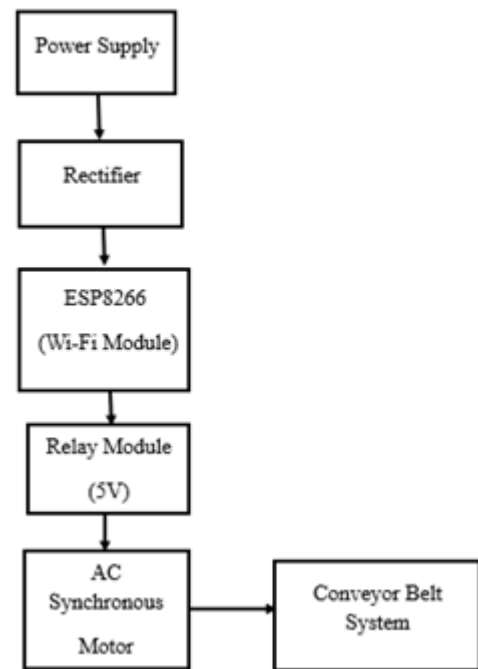


Fig. 2. Block diagram of the Proposed System.

The block diagram figure.2 represents system consists of a power supply, rectifier, ESP8266 microcontroller, relay module, AC motor, and conveyor belt mechanism. The power supply provides electrical energy to the system, and the rectifier converts the AC voltage into DC voltage required for the control circuit. The ESP8266 acts as the main controller and Wi-Fi communication unit, receiving commands from a mobile phone through a wireless network. Based on the received commands, the ESP8266 sends control signals to the relay module. The relay functions as an electrical switch that isolates the low-voltage control circuit from the high-voltage motor circuit and turns the AC motor ON or OFF. When the relay is activated, the AC motor starts rotating and drives the conveyor belt system, enabling material transportation. When the relay is deactivated, the motor stops, and the conveyor belt halts. Thus, the entire conveyor belt operation can be controlled remotely using a mobile device.

Block Diagram:

Flow Chart:

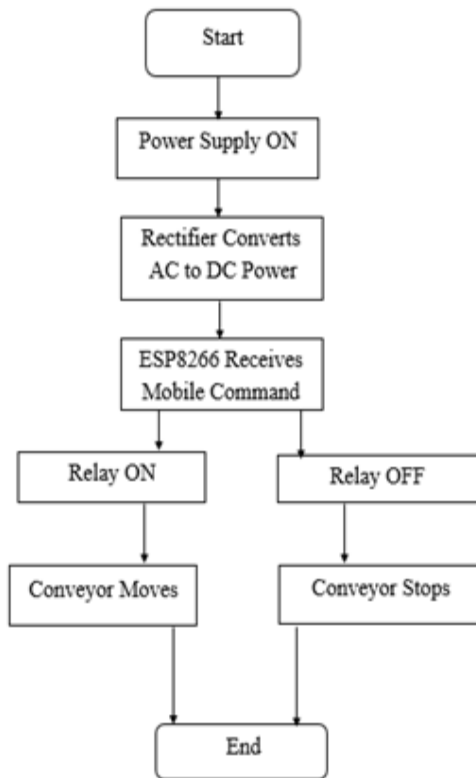


Fig.3. Flow Chart of Proposed System.

Hardware Implementation:

The hardware implementation of the system starts when the power supply is turned ON. The rectifier converts AC voltage into DC voltage for the ESP8266 and relay. The ESP8266 receives control commands from the mobile device through Wi-Fi. If the command is ON, the relay is activated and the AC motor starts, which moves the conveyor belt. If the command is OFF, the relay is deactivated, the motor stops. Thus, the conveyor system is controlled remotely using a mobile phone.

Hardware components:

[i] ESP 8266: The ESP8266 is a low-cost Wi-Fi enabled microcontroller widely used in Internet of Things (IoT) applications. Acts as the main controlling unit of the conveyor belt system. The ESP8266 in the figure.4 receives commands from a mobile phone through a wireless Wi-Fi network and processes



Fig. 4. ESP8266

[ii] Single Channel Relay Module: The figure.5 is a single channel relay module is an electrically operated switch used to control high-voltage devices using low-voltage. It allows the microcontroller to safely control the AC motor and motor speed controller. The relay provides electrical isolation between the control circuit and power circuit, ensuring safe and reliable motor switching.



Fig.5. 5V Relay Module

[iii]Transformer (12V): A step-down transformer is a device that reduces high voltage to low voltage. It works on the principle of electromagnetic induction. The primary coil has more turns than the secondary coil. It is used in chargers, adapters, and power supplies. Step-down transformers make electricity safe for household and electronic devices in figure.6



Fig. 6. 12V Transformer

iv] Bridge rectifier: The figure.7 is a bridge rectifier is an electronic circuit used to convert alternating current into direct current. It consists of four diodes arranged in a bridge configuration, which allows current to flow in the same direction during both the positive and negative cycles of the AC

input. This makes output smoother and more efficient compared to a half-wave or center tapped rectifier.



Fig. 7. Bridge rectifier

[v] AC Synchronous Motor: An AC synchronous motor in the figure.8 is an electric motor that operates at a constant speed called synchronous speed, which is exactly equal to the speed of the rotating magnetic field produced by the stator. It works on the principle of magnetic locking between the stator's rotating magnetic field and the rotor's magnetic field, which is produced either by DC excitation or permanent magnets. Unlike induction motors, synchronous motors have zero slip under steady operating conditions



Fig. 8. AC Synchronous Motor

[vi] Conveyor Belt: The conveyor belt in figure.9 is a mechanical system used to transport materials from one place to another efficiently. It consists of a continuous moving belt that runs over rollers or pulleys and is driven by a motor. Conveyor belts are commonly used in industries such as manufacturing, mining, agriculture, and packaging to move goods, raw materials, and products quickly and safely. They

help reduce manual labor, increase productivity, and improve the speed of material handling operations.



Fig. 9. Conveyor Belt

[vii] Wheel: The wheel is an important mechanical component of the conveyor belt system. It is used as a roller to support and guide the conveyor belt during operation. The wheel is usually made of metal or hard plastic to withstand continuous rotation and load. One wheel is connected to the motor shaft and acts as the driving wheel figure.10



Fig. 10. Wheel

Working Of Proposed System

The proposed system mainly consists of a power supply unit, rectifier circuit, ESP8266 Wi-Fi microcontroller, relay module, motor driver, AC/DC motor, movable conveyor belt mechanism, and a mobile application for remote control. The power supply provides electrical energy to the system. Since the control circuit requires DC power, the rectifier converts the AC supply into DC voltage. This DC power is used to operate the ESP8266 microcontroller and relay circuit. The ESP8266 is the core controller of the system and provides wireless communication through Wi-Fi. It connects to a local Wi-Fi network or the internet and receives control commands from a mobile phone or IoT application. The user can monitor and control the conveyor system remotely using a smartphone. The ESP8266 processes the received commands and sends control signals to the relay module or motor driver circuit. The relay module acts as an electronic switch that isolates the low-voltage control circuit from the high-voltage motor circuit. When the ESP8266 sends a signal, the relay turns ON or OFF the motor. The motor is connected to the conveyor belt and movable platform. When the motor is activated, it rotates the rollers and

moves the conveyor belt. The belt collects poultry waste from the cage area and transports it to a collection bin or disposal area. When the relay is turned OFF, the motor stops, and the conveyor belt halts.

Implementation Of The Proposed System

The implementation of the Smart Poultry Waste Collection System in figure.11 involves the integration of hardware components, mechanical structures, and IoT-based software control. The system is designed to automate the process of collecting poultry waste using a movable conveyor belt controlled remotely through a mobile application. The implementation is divided into power supply design, controller programming, conveyor mechanism setup, and IoT communication. In the first stage, the power supply unit is implemented to provide the required electrical power to the system. An AC power source is used to operate the motor, while a rectifier circuit converts AC voltage into DC voltage for the ESP8266 microcontroller and relay module. Voltage regulators are used to ensure a stable and safe DC supply for electronic components. The firmware is developed to control the motor operation based on user inputs such as start, stop, and movement commands. The ESP8266 acts as a bridge between the user and the mechanical system.

The relay module or motor driver circuit is implemented to control the motor safely. Since the motor operates at high voltage and current, the relay provides electrical isolation between the low-voltage ESP8266 and the motor circuit. When the ESP8266 sends a signal, the relay switches the motor ON or OFF, enabling automated conveyor operation. The movable conveyor belt mechanism is implemented using rollers, wheels, belt material, and a supporting frame. The motor is connected to the driving roller, which moves the belt. Additional wheels are used for support and smooth movement of the conveyor system. The conveyor structure is designed to move under poultry cages and collect waste materials such as droppings and feed residues. The belt transports the collected waste to a designated disposal container or storage bin. The IoT control interface is implemented using a mobile application such as Blynk or a custom IoT dashboard. The user can monitor and control the conveyor system remotely using a smartphone. Commands are sent via the internet to the ESP8266, which processes them and controls the relay and motor accordingly.



Fig. 11. Implementation of Proposed System

VI. RESULTS AND DISCUSSIONS

The poultry waste conveyor system in the figure.11 operated reliably and efficiently under real farm conditions, demonstrating its suitability for practical poultry waste management. Waste generated inside the poultry shed was continuously transported to a designated collection point without interruption, ensuring smooth and uninterrupted operation. The automated system significantly reduced dependence on manual cleaning methods, which are labor-intensive, time-consuming, and unhygienic. By minimizing human involvement, the system improved safety and reduced health risks for farm workers. The accumulation of waste on the poultry shed floor improved cleanliness helped in reducing foul odor, fly infestation, and the spread of harmful microorganisms inside the poultry farm. This cleaner environment contributes to better bird health, improved productivity, and reduced disease outbreaks.

VII. CONCLUSIONS

The conveyor system successfully demonstrates an efficient and automated method for poultry waste collection in modern poultry farms. By using a movable conveyor mechanism, the system significantly reduces the need for manual cleaning, thereby saving labor time and cost. It improves overall farm hygiene by continuously removing waste from the poultry area, which helps in maintaining a cleaner and healthier environment for both birds and workers. The system also supports centralized and organized waste management, making it easier to collect, store, and transport poultry waste. Health risks such as infections, bad odor, and exposure to harmful gases for farm workers are significantly reduced due to reduced human interaction with waste materials. Furthermore, the collected waste can be reused effectively for manure preparation or

biogas production, contributing to sustainable and eco-friendly farming practices. The design of the system is simple, compact, and cost-effective, making it suitable for both small-scale and large-scale poultry farms. The conveyor system requires low power and is energy-efficient, which reduces operational costs. Its modular structure allows easy installation, maintenance, and scalability based on farm size and requirements.

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