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Automation of Poultry Farm Feeding Process and Egg Counting Using IOT Technology

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ABSTRACT

This work focused on the automation of poultry farm feeding process and egg counting using IoT technology. Poultry is one of the most important growing economic segments of the agricultural sector in the world today because of standardized farming management and good manufacturing practices. However, this is not so in an emerging economy like Nigeria where most of its poultry farms still rely on the primitive method of manual labour. This has negatively impacted the productivity of poultry farming in Nigeria. Thus, automation and the concept of the Internet of Things (IoT) as an emerging technology have been adopted in this work to convert traditional poultry systems into automated systems using sensor technology and internet connectivity to automate the feeding and egg counting system, prevent unauthorized access and theft as well as monitor the farm online through a camera. The designed system can significantly minimize or eliminate egg theft due to manual labourers during egg collection and counting and increase productivity.

Key words: Automated feed control, egg counting, Internet of things, poultry farming

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1. INTRODUCTION

Poultry farming is the process of raising domesticated birds such as chickens, ducks, turkeys and geese to farm meat or eggs for food. It is found throughout the country wherever there are human settlements [1]. The Poultry industry is attractive and fast-growing agroindustry in many countries of the world due to the increasing demand for poultry meat and egg products. Its intensification has been towards a large commercial flock production.

In the last few decades, there has been an increase in chicken production across the world because of standardized farming management and good manufacturing practices [2]. There has also been an increased level of awareness regarding the safety of food products like chickens [3] as well as enormous demand for good quality chicken food. According to the world's agricultural produce survey, chicken is the most consumed produce, as it is a nutrient-rich food providing high protein, low fat and low cholesterol [4]. With such a high volume of chicken production and consumption, the inclusion of automation technology for the efficient management of poultry farms cannot be overemphasized. A smart system using the Internet of things (IoT) for monitoring and controlling environmental conditions of poultry farming has been studied and presented by [5]. In their work, environmental parameters such as temperature, humidity, and air quality in a poultry house which are vital for the survival of poultry birds were monitored to adequately nurture poultry birds, reduce the mortality rate and improve production.

In Nigeria, most poultry farmers still engaged in manual feeding technique that makes adequate feeding a challenge [6] and large commercial flock production impossible. Manual feeding technique in poultry farming consumes a lot of time and expends a lot of energy on the human part. Also, the cost of production is highly capital intensive and yet generates low profit. Human limitations such as fatigue, stressful manual labour, negligence, unfavourable condition in poultry, improper administration of feed and theft with the high cost of maintenance are some of the factors that discourage a lot of people from investing in the poultry industry [7]. Poultry feed takes about 75% of the cost of managing a poultry farm and the stress of feeding these poultry birds accumulates as the number of poultry birds increases. This lack of measurement structure for effective feed and egg monitoring systems has become a necessity for the optimization of poultry farm profit.

In today's world, automation plays a very important role and is increasingly important in modern agriculture, reducing dependence on labour and liberating farmers from constant work, increasing management scale and efficiency, fulfilling the precision and consistency of product quality control, enabling enforceable traceability as part of food safety efforts to achieve agricultural sustainability [8]. With the enormous demand for poetry products, there is a need for an automated system that can focus on applying the internet of things (IoT) in poultry farm feed management and egg collection for profit maximization and reduce theft which this work is geared towards achieving.

In poultry farm production, feed management and proper counting of produced eggs are critical for the maintenance of profitability and continuity of business. Smart poultry farms can be designed in such a way that feed dispensing and egg collection and counting can be achieved and controlled through the incorporation of internet of things technology into the already existing framework of poultry management. The focus is on the automation of poultry farms by using wireless sensor networks and mobile communication systems. IoT technology is used for automation. As such, parameters like feed dispensing and management, egg collection and counting are monitored and controlled using a microcontroller. The transmitted data should be received by a receiver and then transmitted through the ESP8266 module from the microcontroller to the cloud for better analysis and mobile phone display.

2. METHODOLOGY

This conceptual framework for the proposed system is shown in figure 1. Its functionality is such that any laid egg will roll down to the lowest level of the cage which is the egg-holding cage. While the eggs are rolling to the egg-holding cage, it passes through a light source and photodiodes that are systematically placed along the passage from the main cage to the egg-holding cage. Light interruptions between transmitter and receiver photodiodes will be detected by the system when an egg passes through.

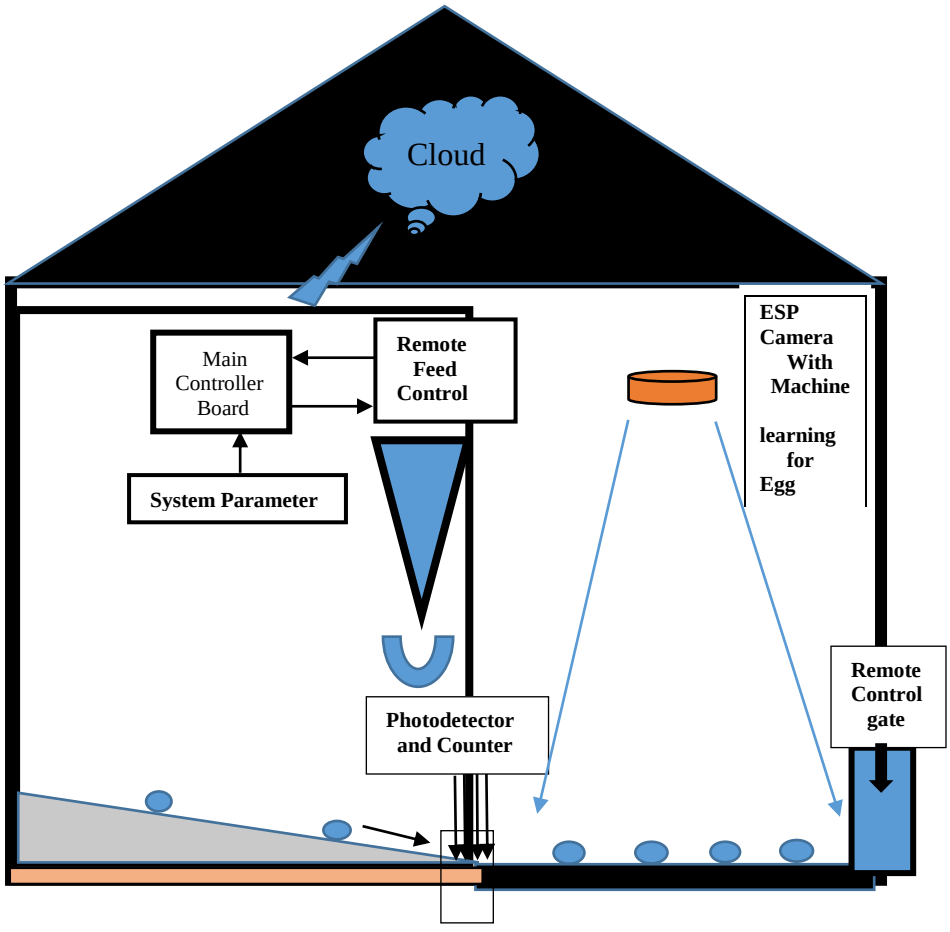

Fig. 1 Conceptual Design Framework

This IoT feeding and egg counting technique will greatly enhance production and totally eliminate feed and egg theft as compared with using of manual labour. The is made more explicit using the block diagram shown in figure 2.

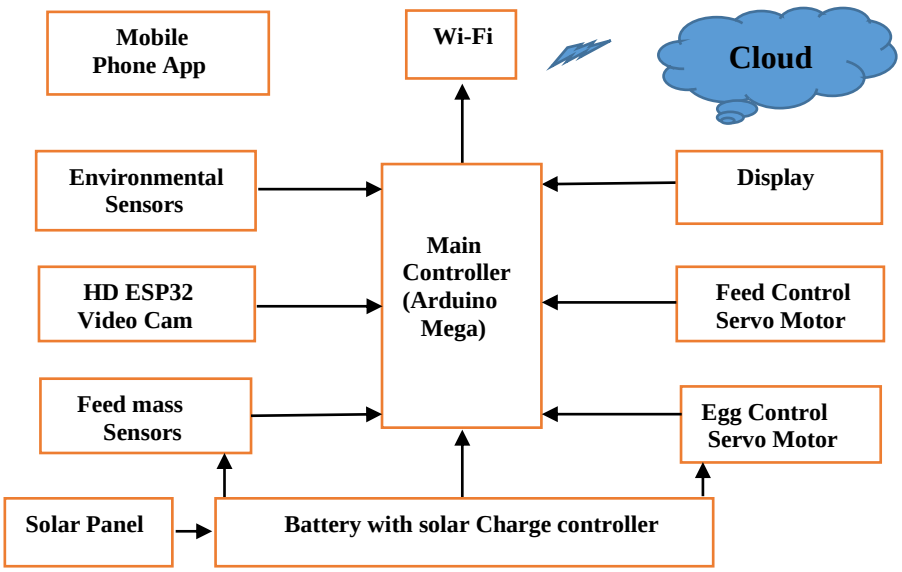

Fig. 2 Block diagram of the system Design

The system monitors the total number of light interruptions that occurred within a given time frame which will correspond to the number of eggs laid within that period. The system consists of an auto or remote feed dispenser controlled remotely using Wi-Fi. Environmental parameter sensors like temperature, air quality and humidity are also incorporated. ESP32 camera module with python machine learning program is used to remotely monitor the activities going on in the farm via cloud transmission and mobile phone control to reduce theft.

The time frame for egg identification and counting is designed to coincide with the periodic timing sequence of the photodetector such that the camera is triggered to capture, analyse, detect and count only when the periodic time frame for the photodetector is completed and the passage hole is automatically locked. This is to prevent eggs from rolling into the camera time frame during capture and counting to generate an error. After counting using a camera, the conveyor is activated to gently push out the counted eggs through the remotely controlled exit door for the eggs and still under the watchful eye of the administrator through the mobile app view.

3. SYSTEM DESIGN AND DISCUSSION

The circuit diagram of the entire system is shown in figure 3. To ensure a steady power supply, a rechargeable battery of about 12V and 30A is required. The large battery requirement is to power all servo motors required to actuate the feeding process, door open and close, and egg discharging mechanism. From the solar panel, a charge controller is required to maximize the recharging cycle of the battery. For efficient operation, resistors R5 and R6 form a voltage divider network through which the main controller monitors the battery voltage. The proposed system uses Arduino Mega microcontroller to control the whole system. When the system is switched on, the feeding mechanism is activated to dispense feed into the feeding troughs while a 6-hour time frame is activated by the main controller to allow for randomly laid eggs to pass through the series of LEDs and photodiodes placed between the main bird's cage and egg holding cage. Each egg that passes through the series of photodiodes detectors generates a single pulse which is noted and counted by the system. At the end of the 6-hour time frame, a control signal is generated to close the eggs holding area from the main bird cage while simultaneously open the door to discharged the counted eggs through the exit door for the attendant to gain access to the eggs. After this, the cycle is repeated. The camera is needed for image identification and monitoring. The IOT application used for remote monitoring is the blynk app. Using this app, remote monitoring and feedback control can be achieved with the system. This was done using a unique identification code from the blynk cloud on the system hardware during registration and setup. The current status such as environmental parameters feed rate and remaining quantity with the number of eggs counted can also be displayed on LCD and can also be sent to the owner through mobile application.

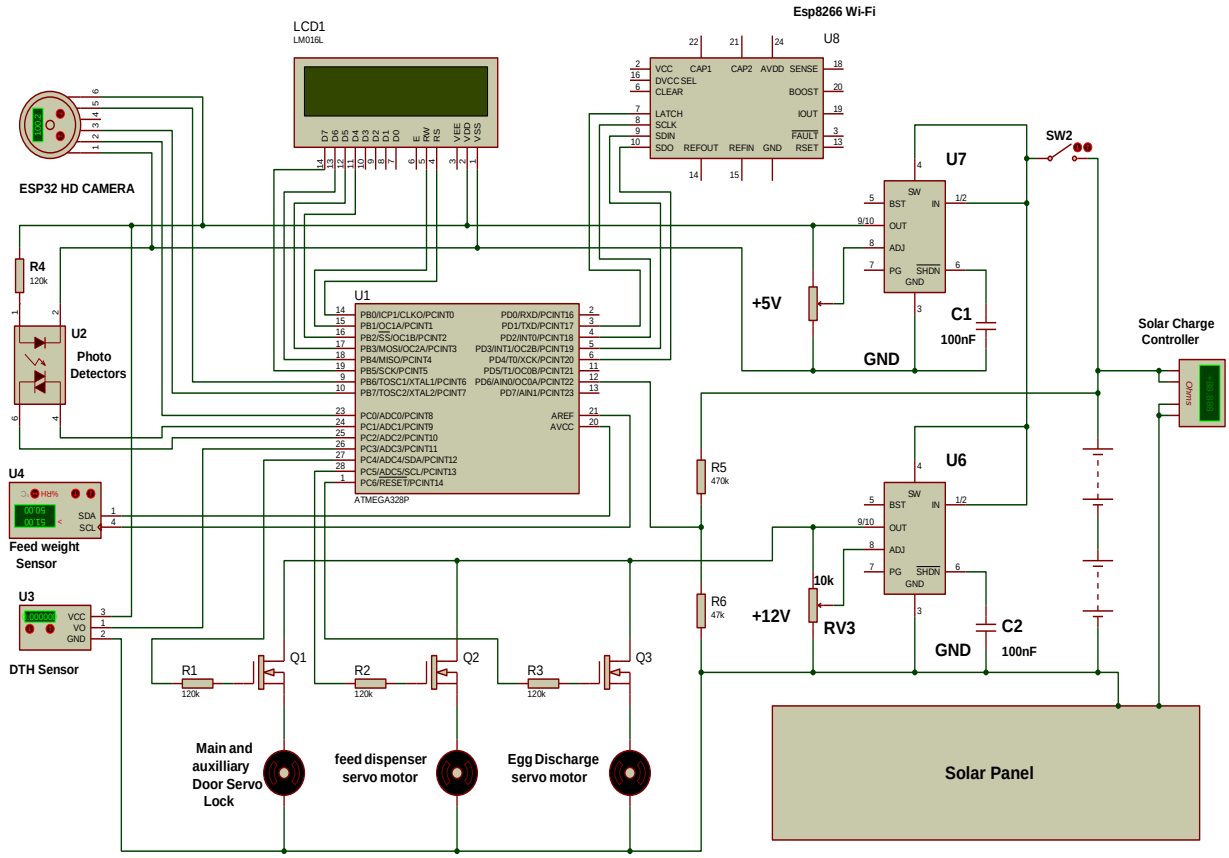

Fig. 3 Circuit diagram of the system

The feeding system is automated such that it carries out replenishing the feeding troughs without manual input and being inside the main cage structure will eliminate human access to it and hence theft. As such, if the feed level decreases, the feed dispensing pump and relay will be ON respectively and it is filled automatically while a notification of the feeding process and time is sent to the owner through the user's mobile phone app. The quantity of feed remaining in the container is constantly monitored and evaluated to determine the quantity of feed left while a notification is sent to update the owner.

The owner can remotely view information and control the system through internet connectivity on his/her mobile phone. The designed system can significantly minimize or eliminate egg theft due to manual labourers during egg collection and counting.

4. CONCLUSION

This century is the era of technology and as such things are changing very rapidly. Poultry farming in Nigeria has been plagued with lots of economic losses and hence brought low business viability due to feed and egg theft. To scale this hurdle, it is therefore important to adopt modern electronic and communications technology into the design, manufacture and day-to-day running of poultry systems. An ioT-based solution has been proposed in this work. To this end, a smart poultry system has been conceived and developed to enable automatic and remote monitoring of all poultry environmental parameters, feed and egg counting procedures with emphasis on preventing feed and egg theft through IOT automated control and remote online viewing of system parameters.

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