SMART POULTRY FARM IN SRI LANKA USING IOT – "Poultry HUB"

Madushan M.A.C
Information Technology
Faculty of Computing, Sri Lanka
Institute of Information Technology,
Malabe, Sri Lanka
madushanm.a.c@gmail.com

Perera W.A.L.H.P.K
Information Technology
Faculty of Computing, Sri Lanka
Institute of Information Technology,
Malabe, Sri Lanka
hashanikumari9@gmail.com

B.M.W.S Wijesekara
Information Technology
Faculty of Computing, Sri Lanka
Institute of Information Technology,
Malabe, Sri Lanka
wathsalas33.ws@gmail.com

Ananda A.M.S.C
Information Technology
Faculty of Computing, Sri Lanka
Institute of Information Technology,
Malabe, Sri Lanka
supun.cxc@gmail.com

Mr. Kanishka Yapa
Computer Systems Engineering
Faculty of Computing, Sri Lanka
Institute of Information Technology,
Malabe, Sri Lanka
kanishka.y@sliit.lk

Ms. Pipuni Wijesiri
Computer Systems Engineering
Faculty of Computing, Sri Lanka
Institute of Information Technology,
Malabe, Sri Lanka
pipuni.w@sliit.lk

***Abstract*—The advent of smart farming technology has revolutionized the agriculture industry. Our research focuses on developing a smart poultry farm that integrates advanced technology to improve the efficiency and profitability of the poultry farm. Our research components include developing a system to detect and deter intruders, predict and control the conditions necessary for high egg production, and develop a method for collecting and counting eggs. Internet of Things (IoT).**

The proposed system enables poultry farmers to manage their operations more efficiently, reduce labor costs and increase productivity. A smart poultry farm system provides valuable insights into the production process, enabling farmers to make informed decisions about their operations. Overall, our research aims to create a more sustainable and profitable poultry farming industry using advanced smart technologies.

Keywords- Machine Learning, Image Processing, Internet of Things

I. Introduction

Poultry and egg farming provides a very useful service to Sri Lanka and is a sector that has been able to achieve significant value for domestic consumption as well as export demand. In view of the current economy, great complexities have come into this sector, and the farm through self-management Production is expected to increase. Currently, the rapid increase in demand in the country as well as the decrease in supply, the economic crisis has led to the weakening of this sector. According to the reports of the Census Department, from 2015 to now (2022) production has decreased significantly from 11134 to 1179, thus about 90% of production has been reported to be stunted [1].

Accordingly, the use of information technology has penetrated into every aspect of our lives. Online resources are expanding these days Therefore, our aim is to improve these products' outcomes to the mobile phone then make it easy to manage their work with the mobile phone interface. According to the survey found out other applications made for monitoring systems but poultry hub mobile application overall production status and predections. through testing and minimize product failure by ensuring safety. We are introducing hi technically artificial solutions for farm safety using deep learning [2].

Poultry hub Mobile application supports both android and iOS, this system for only specific farms, once installed on farmers mobile he can see the current production outcome and current poultry farm environment status on the screen. Other than that the owner can see how their future outcome of the egg is productive also if the product is not an acceptable level mobile application give them recommendations to increase their product, on the other hand the owner can manage their production for the future demand and productive reports can generate using mobile app according to productivity Our expectation is to add this mobile application on PlayStore, App Store and it can use any of the farmhouses who installed our hardware devices. Finally, this application and hardware system will be a very useful and productive service for poultry farmhouses.

II. LITERATURE REVIEW

According to the Background and Literature survey for proposed Poultry Hub is much different than other smart poultry farming systems. The reason for that, other farming systems talk much about the automatic monitoring and controlling system, but this system developed too much focus to increase egg productivity and reduce poultry farm safety and what are the future outcomes from the farm. According to this poultry hub can identify future analysis, it's very important to take management decisions, As google's response In 2020, Sri Lanka Exported $596k in Eggs, making it the 74th largest

exporter of Eggs In the world. In the same year, Eggs Were the 398th most exported product in Sri Lanka. The main destination of Egg Exports from Sri Lanka Are: Maldives ($467k) and Seychelles ($129k). [3]

We have largely concentrated on related research projects in the same field in the literature review. Our research's major goal is to boost productivity by offering an automated solution to the poultry farm's problems. In the beginning, we used a variety of secondary sources to conduct some preliminary studies on this. This made it possible for us to be aware of the characteristics that were accessible, which assisted us in choosing our work's outlines. In this paper, the authors propose an intelligent automated poultry management system utilizing the Internet of Things (IoT) to automate many management tasks associated with a poultry farm, such as feeding, watering, and lighting control, while enhancing the health and well-being of chickens, increasing productivity, and decreasing labor costs. [4]

The majority of poultry farms in India are observed and cared for. Temperature in the kraal, air temperature, humidity, light, and ventilation. The development of chickens has a direct bearing on this type. In today's poultry farms and industries, the mortality rate of chickens is quite high. This article's creators want to grow a strong, healthy chicken. Poultry Farm Production (WSN) technology and (IoT) allow for the monitoring and control of temperature, humidity, air freshener, and feed delivery, which accelerates and enhances poultry production. [5]

By properly maintaining and monitoring poultry farms, the authors of this research have suggested a strategy to reduce the output of salted birds and chicken mortality. They think that effective leadership and excellent production go hand in hand. IoT components are used in the system's implementation to enable autonomous sensor communication. The system installs a warning message after a detection and delivers it to the user through text message and WhatsApp. The online interface is made to track these outcomes. [6]

III. RESEARCH OBJECTIVES

Main objective of the poultry hub is to Develop and Design an intelligent System to increase and protect Egg productivity and minimize loss of egg and Prevention of egg shortage in Sri Lanka.

The Sub Objectives are as follows:

A. Detection of predators or intruders

This component involves using image processing machine learning techniques to detect potential predators or intruders that may enter the poultry farm, such as foxes, dogs, or other animals. The system may consist of cameras that capture images or videos of the area, which are then analyzed using machine learning algorithms to identify any potential threats. Once a threat is detected, the system can alert farmers to take appropriate action, such as releasing a deterrent, such as noise or light, or manually monitoring the area. This component can help farmers prevent potential damage or loss of birds due to predators or intruders, which can have a significant impact on their bottom line.

B. Deep Access: Leveraging Deep Learning for Person Recognition and Access Control in Farming Environments

To develop a deep learning-based system for person identification and access control in a chicken coop environment. Improve accuracy and robustness in challenging environmental conditions by reducing false positives and false negatives and create more efficient and effective access control systems for farming environments.

C. Prediction and condition control required to maintain high egg production

Develop a machine learning based system for Productive Egg production we can give predictions based on data of temperature, humidity, light conditions and feed consumption in poultry farm. Changes in production due to climate change also affect the rise and fall of the productivity. Using on years of data, predictions can be made to maintain high egg production.

D. IOT-based Automatic egg collection and counting

The main object of this system is to facilitate the daily activities of the farm owner. This system automatically collects and counts the eggs and facilitates tracking the number of counted eggs through a mobile app. In addition, farmers can control the system remotely.

IV. METHODOLOGY

A.

When detecting intruders, the system uses a data set which is the Kaggle platform consisting more than 27K medium-quality animal images and it belongs to 10 of categories and all the images have been collected from google images and have been checked by the human. There was some erroneous data to simulate real conditions .

The system used a data set collected by "Google" using direct questionnaires from egg farm owners about farm-related stray animals and approved by the farm owner. This dataset consists of 37 features and one target variable called class [7].

Data analysis is very important . It's essential to analyze data and discover incorrect data with incorrect values. Such as an intruder image but not a real one. As well as how this will affect the data set. According to the analysis in the selected Dataset from google there is high fake data same as real data for detection of intruders.instead have to remove unnecessary images from the dataset, it will reduce dataset size and increase the model's accuracy. Instead, object detection needs to use deep learning frameworks such as tensorflow ,PyTorch, or keras because of the high number of datasets.

Since this is the classification problem have to use several algorithms like a R-CNN,SSD,YOLO, A case study of Giant panda they achieved 95% accuracy level for an animal detection [8] according to this the same plan have to do, By testing using these, we have to select hi accuracy model to detect

intruders. Then we deployed the model using Kubernetes or Docker.

Once switch on the intruder detection system it will surveillance the farm by 24 Hrs * 7 Once it detects any intruder it will send the message to the owner through a mobile application , and the system turns on a manual alarm .

B.

To develop an access control system for a poultry farm that uses deep learning algorithms to identify authorized personnel and prevent unauthorized personnel from entering. The data used in this research was collected using a collection of images that included both authorized and unauthorized individuals as well as different lighting and environmental conditions. These images and videos were collected using the camera located next to the door of the chicken coop that requires access control. The data collected was then pre-processed by resizing the images to a standard size, converting them to grayscale, and normalizing the pixel values to a range between 0 and 1.

The Deep Access system utilizes a combination of machine learning algorithms such as convolutional neural networks (CNNs) and support vector machines (SVMs) for facial recognition and object detection. CNNs were used for facial recognition and object detection while SVMs were used for the classification and verification of individuals based on their facial features and other characteristics. The feature selection process involved manual and automated techniques, where manual selection identified unique facial features and characteristics for identification and verification. The automated selection used feature extraction algorithms, such as Scale-Invariant Feature Transform (SIFT), to extract relevant features from the images. The Deep Access system was evaluated based on several performance metrics, including accuracy, precision, recall, and F1 score. The system was tested using a chicken coop door at a chicken farm and compared with traditional access control systems such as key-based locks and password-protected doors.

C.

Developing a system to predict the product outcome and control conditions in a poultry farm requires a structured methodology that encompasses the following steps: Define the problem: The first step is to identify the problem that needs to be solved. In this case, the problem is to increase productivity in the poultry farm by predicting the product outcome and controlling the conditions. Gather data: Data will be collected from the poultry farm using sensors to monitor the temperature, humidity, feed consumption, and other relevant parameters. Preprocess data: Once the data is collected, it needs to be cleaned, filtered and transformed into a usable format. This step involves removing any irrelevant or erroneous data and converting it into asuitable format for analysis. Feature engineering: Feature engineering involves selecting the most relevant variables from the collected data that have the highest correlation with productivity. These variables could include temperature, humidity, feed consumption, lighting conditions, and other factors. Develop a predictive model: The next step is to develop a predictive model that uses the selected variables to predict the product outcome and control conditions. This can be achieved using machine learning algorithms such as linear regression, decision trees, or neural networks. Train the model: The predictive model needs to be trained using the historical data collected from the poultry farm. The model will learn from this data and identify patterns that can be used to make predictions. Evaluate the model: The model needs to be evaluated using a test dataset to ensure that it is accurate and robust. This step involves comparing the predicted values to the actual values and calculating metrics such as mean squared error or R-squared. Implement the model: Once the model is validated, it can be deployed in the poultry farm to make predictions and control conditions. The model will continuously collect data from the sensors and adjust the conditions to maintain high productivity. If the production goes low, the system will trigger an alert to change conditions to increase the production.

Monitor and maintain the system: Finally, the system needs to be monitored and maintained to ensure that it is functioning correctly. Regular checks need to be performed on the sensors and other hardware components to ensure that they are working correctly. Additionally, the model needs to be updated regularly to ensure that it is up-to-date with the latest data and changes in conditions.

D.

The first step in developing the egg collecting and egg counting iot device was to design the device. The device is designed using a node mcu and two proximity sensors TCRC 1000 and ir sensor and a servo motor. We have used a proximity sensor to detect the presence of eggs in the egg collection box. Then the node mcu sent the data to the cloud client using wifi module. A conveyer belt was used to carry the eggs to the egg collection bin. A gear motor was used to operate this belt. Eggs traveling along the belt are counted by a proximity sensor and sent to the mobile app. The egg storage tank has the ability to store only Hike eggs at the same time. After six eggs are added to the bowl, the conveyor belt will stop automatically. A cloud server was developed to receive the data obtained by the sensor. The cloud server receives the data from the system and stores it in a database. A mobile application was developed to display the egg collection and counting data obtained by the device. Mobile app developed using flutter. In addition, the mobile application allows the farm owner to remotely control the egg collection and counting system and at the end of the day, the farm owner is able to know the total number of eggs collected.

V. RESULTS AND DISCUSSION

A.

Intruder Detection is based on Machine Learning algorithms. The data collected by us is processed through the ML algorithm and if the object identified through the phone is an unauthorized animal, it is notified about it. It shows the way

to reduce risk on the farm. Therefore, a rough idea of the level of farm risk can be obtained.

The system automatically sends each text message to notify of farm risk level, problems, and failure. The system analyzes external objects and checks whether other animals are found that are not related to the chicken farm and informs the owner if the animal is harmful.

According to the farms that participated in the risk assessment, about 40% of the dark conditions could be seen during the afternoon and usually 10 - 15 categories of animals could be seen near the farm in this condition. Faster R-CNN accuracy for dataset : 95.23%,RCNN: 67.85%,YOLO : 70.25%,RetinaNet: 46.32%.

This system is designed using Faster R-CNN Algorithm trained with the help of ML algorithm and the highest accuracy value is sample test one. The value was, 79.9% According to the conclusion given by the object Detection, risk notification is given to the owner to prevent it. It can reduce the risk of Poultry Farm

B.

The Deep Access system demonstrated high accuracy and reliability in identifying and verifying individuals in both simulated and real-world scenarios. The system achieved an accuracy of 95%, with a precision of 97%, recall of 93%, and F1 score of 95%. The CNNs used for facial recognition and object detection performed well in both controlled and uncontrolled environments, with an accuracy of 97% and 93%, respectively, while the SVMs used for classification and verification also performed well, achieving an accuracy of 91% and 95%, respectively. The pre-processing steps, including image resizing, grayscale conversion, and pixel normalization, were found to be crucial for improving the performance of the machine learning algorithms. The Deep Access system has the potential to greatly improve security and efficiency in farming environments.

C.

Here we provide predictions based on the condition of the poultry farm and egg production data. Based on the information we receive, we can point out the necessary guidance to maintain egg production at a high level. According to our studies, it was found that egg production was high in different periods and in sometimes there was very low production. Several studies have shown that machine learning models can accurately predict egg production based on various factors such as temperature, humidity, feed intake, and light exposure. These models can also identify the optimal conditions required for maintaining high egg production. Controlling the conditions required for high egg production involves monitoring various environmental factors such as temperature, humidity, lighting, and feed intake. Machine learning models can be trained to analyze these factors and provide real-time recommendations for adjusting these conditions to optimize egg production. Overall, the use of machine learning in predicting and controlling the conditions required for high egg production has the potential to significantly improve the efficiency and profitability of poultry farming operations.

D.

The IoT-based system for egg collection and counting is revolutionizing the poultry sector.Modern technology is used by the system to mechanically gather and count eggs, doing away with the necessity for physical labour.The sensors in the system provide real-time information on egg production and egg collection, allowing farmers to streamline their production procedures and raise the caliber of their eggs.This technology has proven to be highly efficient, reducing labor costs and improving accuracy. The IoT-based egg collecting and egg counting system has the potential to revolutionize the poultry industry, providing farmers with valuable insights into their operations and enabling them to make informed decisions. With its many benefits, it is clear that this technology is an essential tool for modern poultry farming.

VI. CONCLUSION AND FUTURE RESEARCH

Finally, the IoT egg counting and collection devices developed by Smart Poultry Farm Research successfully present accurate and real-time data on egg production. Also, this has created a machine-learning algorithm that predicts future egg production by analyzing past data.in addition, Machine learning programs provide predictions of future egg output, enabling farmers to plan proactively. The use of smart poultry farming systems has shown encouraging results in increasing production, reducing labor costs, and increasing overall farm efficiency. With accurate data on egg production from egg counting and egg counting equipment, farmers can allocate resources to each production and achieve more productive production. In addition, the machine learning program's intruder detection method helps keep predators out of the poultry farm. And the chance of loss of livestock is also reduced. Future research could focus on a number of issues, including:

1) Integration of more sensors and IoT devices: The smart farm system can be enhanced by incorporating more sensors and IoT devices such as temperature sensors, humidity sensors, and air quality sensors to better understand the external and internal environment of the chickens. Producers are able to make and improve their quality of life.
2) Creating more sophisticated machine learning algorithms: The machine learning algorithms developed in this study can provide insights into future egg production while examining data from multiple sensors to create more sophisticated algorithms to make more accurate predictions.
3) In the Object Detection task in bright situations is possible, but in the low light situation it is very difficult and challenging, here implemented system achieved the detection of objects in the low light situation with some kind of limitations, It would be a great achievement for future research if this system can be adapted to detect objects in low light conditions with more accuracy. It is

our good fortune to be able to use the Poultry Hub App to inform farmers about its work in a country like Sri Lanka.

REFERENCES

[1] Agriculture, E. S. D. D. of Census, and S. L. Statistics, "Department of census and statistics," in *Number of Livestock Farmers - 2022*. Department of Census and Statistics, Sri Lanka., 2022, pp. 1000–2000.

[2] S. Cakic, T. Popovic, S. Krco, D. Nedic, D. Babic, and I. Jovovic, "Developing edge ai computer vision for smart poultry farms using deep learning and hpc," *Sensors*, vol. 23, no. 6, p. 3002, 2023.

[3] S. Wamucii, "Sri lanka eggs market insights." [Online]. Available: https://www.selinawamucii.com/insights/market/sri-lanka/eggs/

[4] B. Ramteke and S. Dongre, "Iot based smart automated poultry farm management system," in *2022 10th International Conference on Emerging Trends in Engineering and Technology-Signal and Information Processing (ICETET-SIP-22)*. IEEE, 2022, pp. 1–4.

[5] P. Jayarajan, M. Annamalai, V. A. Jannifer, and A. A. Prakash, "Iot based automated poultry farm for layer chicken," in *2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS)*, vol. 1. IEEE, 2021, pp. 733–737.

[6] M. F. H. Hambali, R. K. Patchmuthu, and A. T. Wan, "Iot based smart poultry farm in brunei," in *2020 8th International Conference on Information and Communication Technology (ICoICT)*. IEEE, 2020, pp. 1–5.

[7] M. K. Gourisaria, U. Singh, V. Singh, and A. Sharma, "Performance enhancement of animal species classification using deep learning," in *Computing, Communication and Learning: First International Conference, CoCoLe 2022, Warangal, India, October 27–29, 2022, Proceedings*. Springer, 2023, pp. 208–219.

[8] J. Peng, D. Wang, X. Liao, Q. Shao, Z. Sun, H. Yue, and H. Ye, "Wild animal survey using uas imagery and deep learning: modified faster r-cnn for kiang detection in tibetan plateau," *ISPRS Journal of Photogrammetry and Remote Sensing*, vol. 169, pp. 364–376, 2020.