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Concept of AI-powered system triggering continuous and automated monitoring in poultry production system

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Abstract - *The concept of AI-based poultry monitoring system has been in place with lots of studies, modifications and innovations helping poultry farmers save labour, time and addressing welfare and economic analysis. The present review envisages at providing analysis of literature to guide on cutting-edge techniques providing future directive on chicken welfare monitoring in market-led poultry rearing ecosystem. Hence, the present work would focus on recent research trend providing relevant technical information towards development of reliable and relevant AI-powered technique for chicken welfare targeting to enhance productivity and strengthen economics of poultry rearing. Out of many innovations, the welfare issues, image analysis on weight, body uniformity and market ready issues and IoT powered poultry ecosystem monitoring have been discussed.*

Keyword: Automation, Imaging, Poultry, Productivity, Welfare

Introduction

Climate change along with other constraints have contributed immensely to decrease in the crop productivity since 1980 [1}. Further, increasing demand is being realised for animal protein [2]. Hence, future per capita meat requirement is predicted to enhance by around 70% in next 3 decades [3]. A study on trend in meat consumption reported heavy demand of poultry meat and its products, mostly because of the preference of chicken white meat along with varieties of products [4][5]. Under intensified chicken production ecosystem and awareness on animal-welfare along with sustainable environmental conditions challenges have been raised to fulfil [3]. Hence, livestock monitoring through human surveillance has reduced its importance [5]. Antidote to the challenges could be considered through Precision Livestock Farming (PLF) by conferring effective real-time based automated system while maintaining animal welfare in production system [6].

PLF systems are being adopted due to the recent technology interventions and the interventions through computer vision system and artificial intelligence (AI) powered analytics in livestock and poultry monitoring. AI-powered systems could provide effective non-invasive supervision consistently. It also strengthens data recording for future usage and strong analysis. Besides, AI helps reduce difficult and labour-intensive processes. Furthermore, it confers a robust sensing technology, which is robust and can be used to address many aspects of the farm.

Poultry Welfare

Overall animal welfare is characterised by happy living with good health having lack of injury and optimum management with regard to food and water. Besides, the animal with its wants be fulfilled every now and then [7]. Besides, 12 criteria are earmarked as standards of optimal poultry welfare conditions as per [8]. The points of the criteria are expression of natural behaviour, pain less management procedures, without injuries, lack of disease, absence of long thirst and hunger, comfort at movement, presence of comfort at rest, thermal comfort, satisfactory human-animal relationship, expression positive emotion. In general, these criteria above can be summed up as “animal health and animal want” [7].

In the absence of animal welfare, there would never be good quality meat, milk or eggs. In poultry production, there will be decline in egg production if the birds are mistreated and under stress [9]. Similarly, the meat obtained from broilers and other meat animals will be of poor quality if handled poorly during raising or at slaughter [10][11]. The benefit of livestock welfare could be evaluated with regard to healthiness of animal or bird [12][7][13], enhanced quality of product [14][7], decreased mortality [7][13] diminished risk of zoonosis [7][5], resilience to diseases [15] and satisfaction of farmer [16][17]. However, cost of produce is realised to be more under optimum animal welfare practices and the consumers are seen to be reluctant in paying higher amount [18][19].

Despite the hurdles in achievement of animal welfare and practising PLF, many studies argued on some PLF technology in monitoring several bio-processes and bio-responses addressing good health, welfare and economics in chicken rearing under factory farming system.

Computer-vision interventions for addressing of chicken welfare issues viz. lameness, weight, temperature and health have been studied [20][21][22][23][24][25].

Image Analysis

Identification of image, detection of object, classification of image and semantic segmentation along with recognition of specific object are the tasks in computer vision for general object recognition [26].

Besides welfare issues, in livestock production system, live body weight is a very important parameter and tagged to health, feed conversion ratio, growth rate, body uniformity, and marketability [27]. Further, monitoring weight at growing stage can infer manage mental strategies such as feeding schedule and marketing. Hence, no coincidence with the standard growth curve would be considered as a clear inference of an issue like disease prevalence or any vital issue [20][28]. Hence, live weight of any meat animal may be considered as a predictor of perfect animal welfare condition. Studies have recommended 2D computer vision-aided chicken weighing and also argued for 3D images [28]. Though theoretically simple, it is quite challenging under real farm ecosystem. First of all, the chicken's body has to be segmented through ROI extraction. Then the body, segmented from the image has to be presented through feature extraction. Thirdly, the defined characters are put for correlation with the bodyweight through mathematical model.

Internet of Things (IoT)

IoT-powered poultry monitoring system [29] monitors the ambient temperature, humidity and food level in the poultry shed. On any deviation from the range, it transmits a real time information to the stakeholder's phone.

The IoT system proposed by [30] claimed help feeding chickens and cleaned the floor without intensive human intervention. Sensors and tiny electronic devices were used to check the need of food for chickens with automated supply as per requirement. Besides, a cleaning device enabling cleaning of floor by removal of waste material regularly or as and when required. The whole system could be monitored with the help of a mobile phone or computer. This helped farmers on reduction of labour, saving time and keeping the poultry under good health under a clean environmental condition.

Conclusion

Differential benefits of innovative systems addressing issues in poultry production ecosystem are expected to be accomplished. Farmers may face challenges in understanding and configuring the system, leading to potential errors in setup or operation. Additionally, troubleshooting technical issues or system failures may require specialized knowledge or assistance, further complicating maintenance and support efforts.

The complexity of integrating various sensors and components into an IoT system can require technical expertise.

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