**Automated weight estimation of broiler chickens using 2D computer vision**

**Application**: To develop an automated camera-based system to measure the live weight of broiler chickens

**Introduction**: The measurement of bird live weight during the production cycle is a key management practice in commercial broiler farming. However, there are concerns over the accuracy and practicalities of current methods of weighing broiler chickens (i.e. manual sampling and platform weighers) (Nyalala et al., 2021). Automated camera-based weighing systems could overcome these challenges by offering a non-invasive method of obtaining live weight data (Amraei et al., 2017). This paper proposes the use of low-cost, overhead cameras combined with computer vision techniques to automatically weigh broiler chickens. The main objectives were to explore the potential of image features from 2D video analytics, together with regression modelling, to calculate the live weight of broilers and to establish the impact of age and posture (i.e. sitting/standing) on the accuracy of weight estimation.

**Material and methods:** The study was approved by the School of Biological Sciences (Queen’s University Belfast) Research Ethics Committee (reference number MHLS 20-128). Data were collected in one commercial broiler house in Northern Ireland containing 28,000 mixed sex birds of the Ross 308 broiler line. A temporary passageway was created in the house and an overhead camera (GeeKam action camera, Shenzhen Bodalong Technology Co. Ltd, Guangdong, CN) was placed at a height of approximately 2m from the floor (Figure 1). Birds were selected from the flock at random and a reference weight was obtained by manually weighing each bird in a container connected to a digital scale (Dr Meter Fishing Scale, Shenzhen Thousand shores Technology Co. Ltd, Guangdong, CN) before placing them in the temporary passageway and allowing them to walk under the camera. This procedure was performed when birds were 23 (n=21 broilers) and 35 (n=23 broilers) days old and weighed between 0.57 to 2.98kg. Sample sizes were limited to minimise disturbance in the house. A feature analysis was performed using two types of feature sets relating to bounding box and automatic segmentation information (Figure 2). The bounding box feature sets included width, height, ellipse axes, ellipse area, posture and age. The segmented feature sets included ellipse axes, convex area, eccentricity, perimeter and age. The relationship between the 2D video features and the reference weight (i.e. the manual weight) was evaluated using six multivariate regression models (linear, robust linear, interaction, pure-quadratic, quadratic linear and nonlinear Hougen-Watson models). The results from the best performing feature sets and regression model are presented.



**Overhead camera**

**Temporary passageway area**

≈2 m

**Camera stand**

**Figure 1.** Schematic diagram of the camera setup used to record broilers of varying weights.

**Results:** For both the bounding box and segmentation feature sets, the “minor axis + age” feature set produced the lowest error of weight estimation. The best segmentation feature set had a mean absolute error (MAE) of 103.9 ± 85.7g (or mean relative error (MRE) of 7.9 ± 5.9%), whilst the MAE of the bounding box feature set was 88.8 ± 82.5g (MRE of 6.4 ± 4.5%), when the feature sets were fed into an interaction linear model. The results indicated that the posture feature did not improve weight estimation whilst age improved the performance of all models.

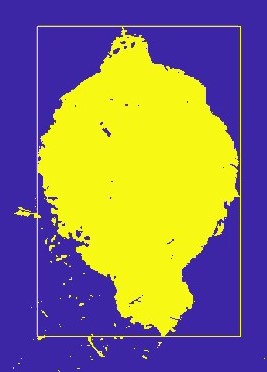


(a)

min axis

max axis

(b)



##### **Figure 2.** Two types of feature sets were generated to predict broiler weight using (a) bounding box and (b) segmentation methods.

**Conclusion:** The analysis of 2D image features using video analytics and regression modelling is a promising method of automatically measuring broiler live weight, whilst causing minimal disturbance to the birds. The system could estimate the weight of individual broiler chickens with a mean relative error of 6.4 ± 4.5%. Further work is needed to refine and test the approaches on different age groups of broiler chickens in a non-experimental farm setting.

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**References:**

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