ENGG6500 Machine Learning Project Proposal

Yaowen Mei (1177855)

The Nondestructive Prediction Model for Egg Fertility Using Machine Learning

Introduction:

Fertility and hatchability are two of the most fundamental terminologies in poultry production. Fertility is defined as the number of fertile eggs over the number of total incubated eggs; while, hatchability is defined as the number of hatch eggs over the number of fertile eggs [1] . These data will normally be recorded and expressed on a regular basis as the important indicators to monitor the output of the day-old chicks for modern commercial poultry facilities at all levels[2]. Alternatively, these infertile eggs and non-hatching eggs, if detected and isolated in the early stage of the incubation period, can then be used as a good source of commercial table eggs, and this could save Canada over 300 million dollars a year[3].

Overview of the previous work on this problem:

1. **Traditional Candling Approaches (non-destructive):** Historically, fertility is assessed via candling during incubation period (see Fig.1), white eggs usually get examined on the 3rd day while the brown shelled eggs usually get examined on the 6th day after being laid. This method is subjective and slow, as an egg inspector needs to be involved in this process, and the accuracy of this method is solely depending on the experience of the egg inspector.
2. **Microscope Inspection for Embryonic Development (destructive):** In 1945, Kosin proposed a method to accurately identify the un-incubated fertile eggs based on the embryonic development process via a macroscopic system[4]. At oviposition, inside of a fresh opened egg, an ring-shaped opaque discoid structure, which is about 3mm in size, and consists of about 50K cells, can be observed from the stage X chicken embryo. This structure is called blastoderm and it has a less-dense pellucida area in the center surrounded by an opaque ring. In contrast, the unfertilized eggs contain a structure called blastodisc which is an asymmetrical solid opaque spot with a smaller diameter (about 2.5mm) than the blastoderm (See Fig.2)

Outline my work: what I plan to do with my project:

My plan is to 1) review some of the most recent published papers to understand how currently people are utilizing machine learning technology to solve this problem, and then 2) use stereoscopic microscope to take pictures on the fertilized egg's shell and unfertilized table egg's egg shell to see if there are any difference in between so that I can try to train a classification model to predict egg's fertility, 3) I am also expecting that there should be some heat capacity difference between fertilized eggs and unfertilized eggs, therefore, I am also going to take some images with a thermal camera on these eggs, and try to train a classification model based on the heat images.

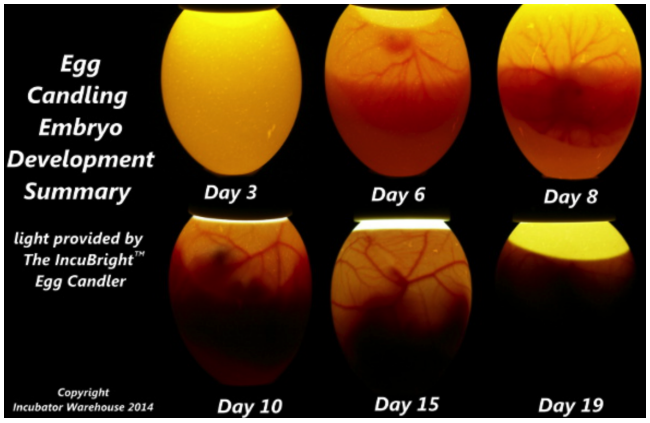

Fig.1 Egg candling on normal development eggs
. https://incubatorwarehouse.com/egg-candling

Fig.2 Blastodisc (unfertilized egg from Walmart) vs. Blastoderm (fertilized egg from a chicken farm)

References

1. King'Ori, A. M. (2011). Review of the factors that influence egg fertility and hatchability in poultry. International Journal of poultry science, 10(6), 483-492.
2. Ogbu, O. C., & Oguike, M. A. (2018). Hatchability of fertile eggs in the poultry industry. Journal of Agriculture and Sustainability, 12(1).
3. Adegbenjo, A. O., Liu, L., & Ngadi, M. O. (2020). Non-Destructive Assessment of Chicken Egg Fertility. Sensors, 20(19), 5546.
4. Kosin, I. L. (1945). The accuracy of the macroscopic method in identifying fertile unincubated germ discs. Poultry Science, 24(3), 281-283.