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Comparative Analysis of LSTM and GRU Models for Chicken Egg Fertility Classification using Deep Learning

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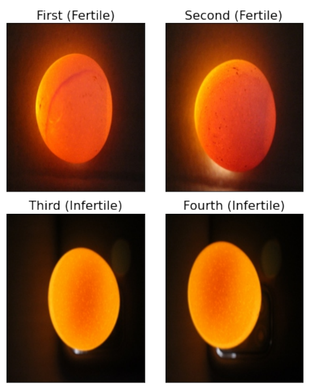
Introduction

- **Traditional egg fertility assessment** is manual (e.g Candling), labor-intensive, and inaccurate.
- **Machine Learning** offers a reliable, scalable alternative.
- **Recurrent Neural Networks** (RNNs) such as **Long Short-Term Memory** (LSTM) and **Gated Recurrent Units** (GRU) are suitable for sequential data like image rows.

Objectives:

- Automate chicken egg fertility classification using deep learning.
- Compare the effectiveness of LSTM and GRU models in terms of accuracy, loss, and generalization.

Methodology

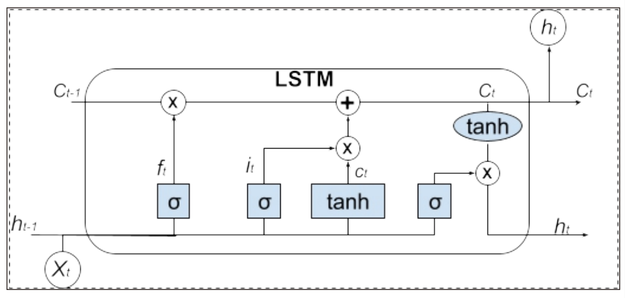


Dataset

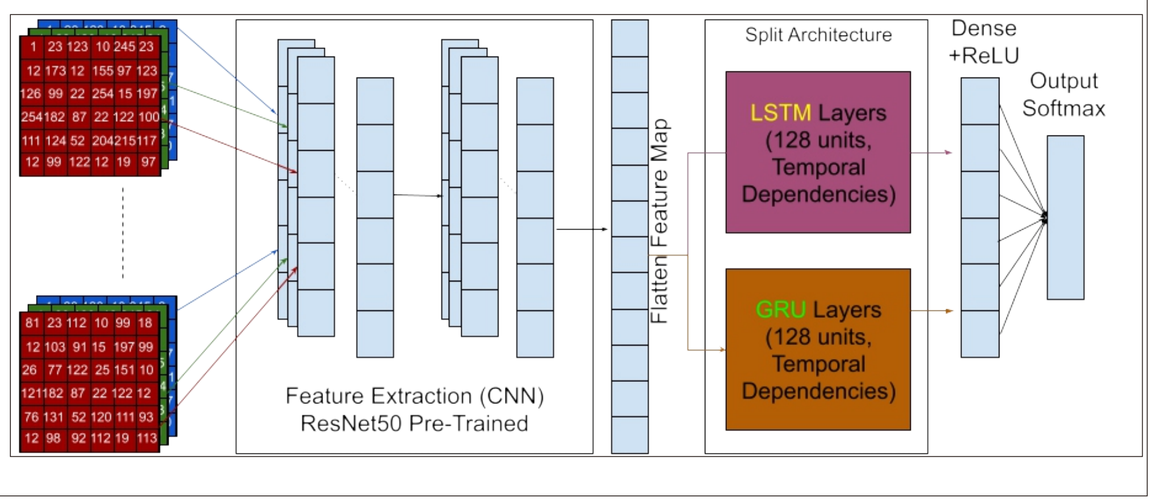
- **240 images** (high-resolution)
- **Preprocessing:** resized to 256x256x3).
- **2 classes:** Fertile and Infertile

Models

- **LSTM**
  - **128 units** in recurrent layers
  - Captures **long-term** dependencies
- **GRU**
  - **128 units**
  - Fewer **parameters**, computationally **efficient**



- **Architecture**

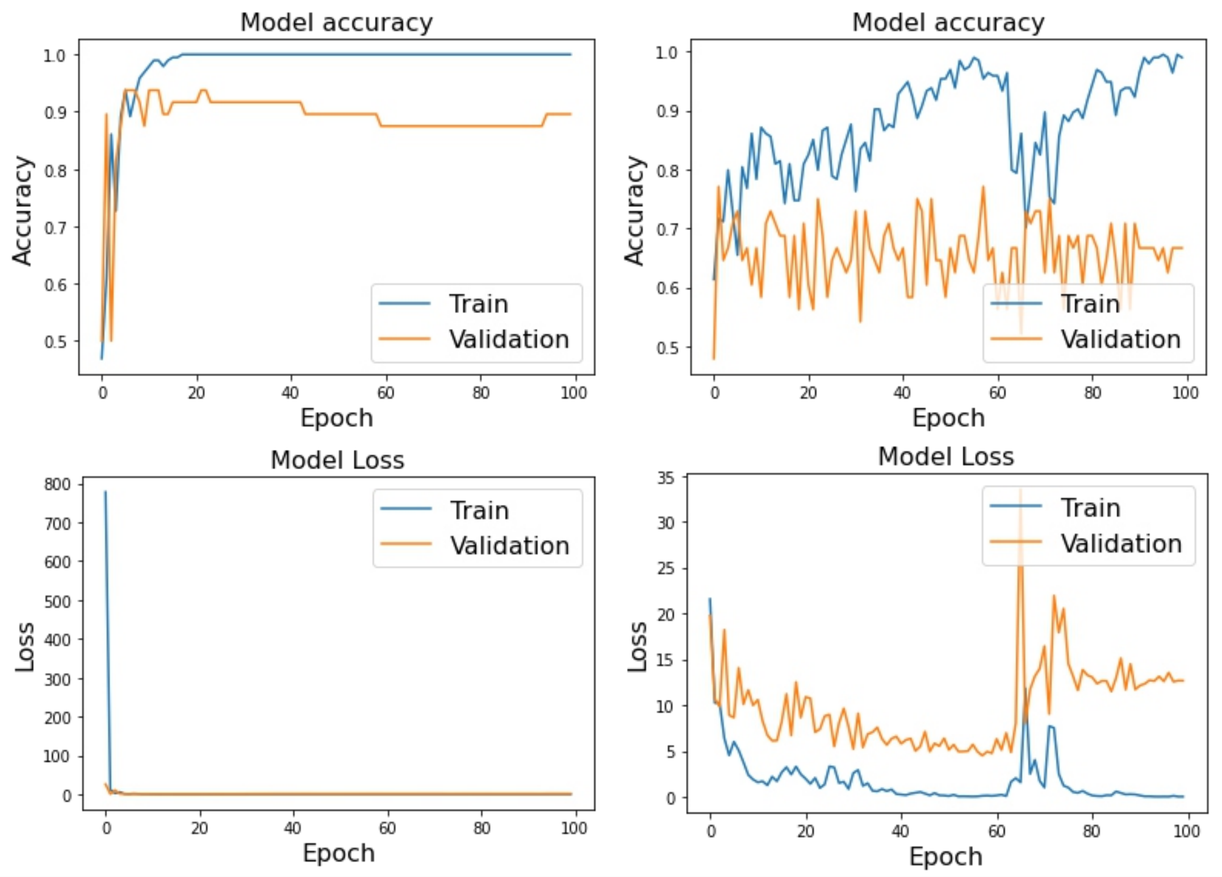


Results and Discussion

Taining Settings

- Adam opmizer, binary cross-entropy loss
- 100 epochs, batch size of 32
- 20% validation split for generalization

Model Performance Metrics



Performance Results

- **LSTM**
  - **Accuracy:** 89.58%
  - **Loss:**1.1691
- **GRU**
  - **Accuracy:** 66.67%
  - **Loss:** 12.6634

Analysis

- LSTM superior in capturing long-rang dependencies
- LSTM better generalization compared to GPU
- GRU computational efficiency but poor generalization
- GRU struggles under constrained data conditions
- Overfitting observed in models, esp. GRU

Conclusion

- LSTM is the preferred choice for precision-critial takss in poultry farming
- GRU is suitable for scenarios demanding faster computations but less accuracy
- Future works: improve robustness, scalability, and extend RNN applications in agriculturals automation