Deep Learning Methods for Tassel Count Time-Series

Gayara Fernando[a], Ved Piyush[a], Souparno Ghosh[a]

[a]Department of Statistics, University of Nebraska-Lincoln, 340 Hardin Hall North Wing,

Lincoln, NE 68583-0963

ABSTRACT

Counting maize tassels in field conditions is predominantly done manually. Recently, computer-vision based methods have been utilized to detect tassels from images captured by UAV transects or poled-mounted cameras [1], [2], [3]. Once tassels are detected, deep-learning based local regression methods, *Tasselnet*, have been used to estimate in-field tassel counts [4]. However, field images are mostly captured over a period of time. Consequently, the input images in the foregoing *Tasselnet* technique are not independent but often form unequal sequences of correlated images. As such, the temporal sequence of images offers information about the growth trajectory of the plants.

We propose a hybrid model that (a) utilizes convolutional neural network-based tassel localization in images, and (b) drives the local count of tassels utilizing the plant growth trajectory learned from the time-series of images. The resulting model can also handle important auxiliary information, obtained from in-field sensors (for example: soil moisture, air temperature etc.), that impacts plant growth and tassel counts. We implement our methodology on benchmark dataset [4] and compare our results with the SOTA Tasselnet [5]. Our initial results suggest that our technique is computationally viable and can produce accurate point estimates of tassel counts along with interval estimates capturing the precision of our estimates.

Keywords: Computer vision, Convolutional neural networks, Deep learning, Maize tassels, Time-series.

REFERENCES

[1] Shi, Y., Alzadjali, A., Alali, M., Veeranampalayam-Sivakumar, A. N., Deogun, J., Scott, S., & Schnable, J. (2021). Maize tassel detection from UAV imagery using deep learning. *Dryad*. https://doi.org/10.5061/dryad.r2280gbcg.

[2] Mirnezami, S. V., Srinivasan, S., Zhou, Y., Schnable, P. S., & Ganapathysubramanian, B. (2021). Detection of the Progression of Anthesis in Field-Grown Maize Tassels: A Case Study. *Plant Phenomics, 2021*, 4238701. doi:10.34133/2021/4238701.

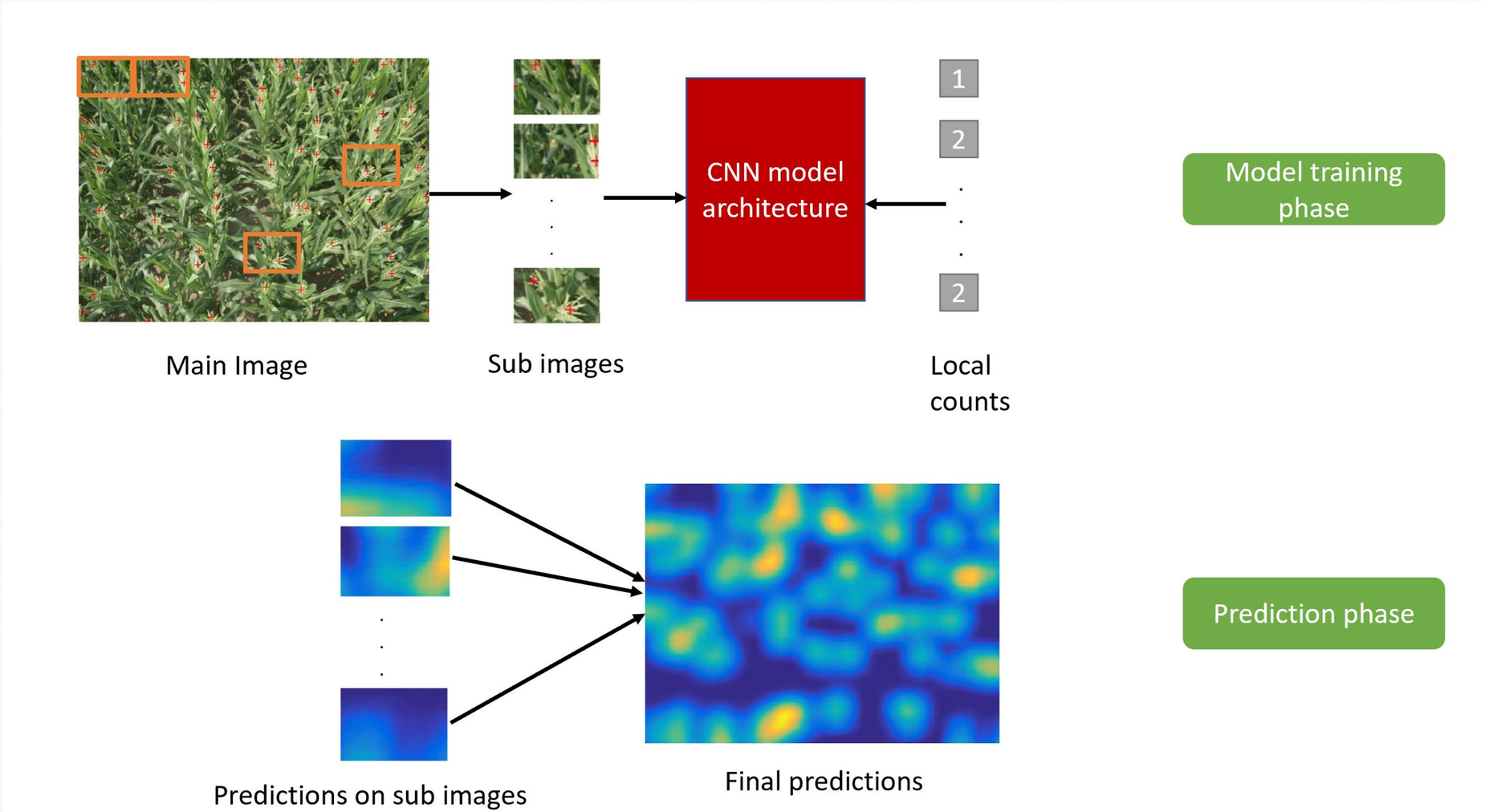
[3] Shete, S., Srinivasan, S., & Gonsalves, T. A. (2020). TasselGAN: An Application of the Generative Adversarial Model for Creating Field-Based Maize Tassel Data. *Plant Phenomics, 2020*, 8309605. doi:10.34133/2020/8309605.

[4] Lu, H., Cao, Z., Xiao, Y., Zhuang, B., & Shen, C. (2017). TasselNet: counting maize tassels in the wild via local counts regression network. *Plant Methods*, *13*(1), 79. doi:10.1186/s13007-017-0224-0.

[5] Xiong, H., Cao, Z., Lu, H., Madec, S., Liu, L., & Shen, C. (2019). TasselNetv2: in-field counting of wheat spikes with context-augmented local regression networks. *Plant Methods*, *15*(1), 150. doi:10.1186/s13007-019-0537-2

Objective:

Automating the process of crop monitoring and yield forecasting for the maize farmer using AI.



Contact details: gayara-demini@huskers.unl.edu https://www.linkedin.com/in/gayara-fernando/

Some image content borrowed from [1]