

# Extracting the height of lettuce by using neural networks of image recognition in deep learning

Xiyue Guo

[gxy529708425@163.com](mailto:gxy529708425@163.com)

Lettuce

Plant Height

Neural Networks



# CONTENT

**1** RESEARCH BACKGROUND

**4** PROPOSED METHOD

**2** RESEARCH STATUS

**5** RESULTS

**3** RESEARCH OBJECTIVES

**6** DISCUSSION



## nutritional value

protein, vitamin E, vitamin C,  
potassium, calcium,  
copper, carotene

## Edible effect

analgesic hypnotic, expelling  
cold, inhibiting viruses,  
stimulating digestion

## lettuce production in changes in China and the world

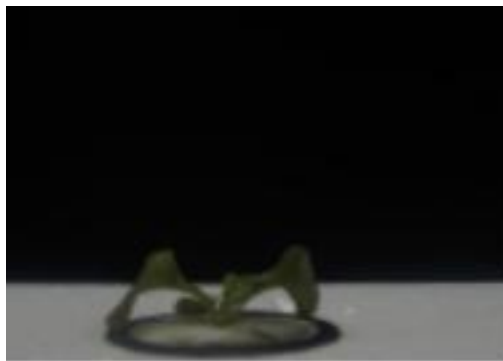
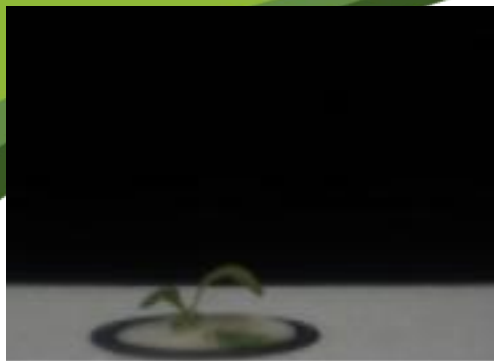


- 1.Traditional plant height measurement methods have low efficiency, high cost and large errors.**
- 2.The plant height measurement method based on special sensors can obtain the highest accuracy, but its sensors are expensive and cannot be used on a large scale**
- 3.The method of using RGB images to obtain plant height information is not only low-cost and convenient to operate, but also its accuracy largely depends on the image processing algorithm used, that is, the software part, which can be improved.**

**Plant height**

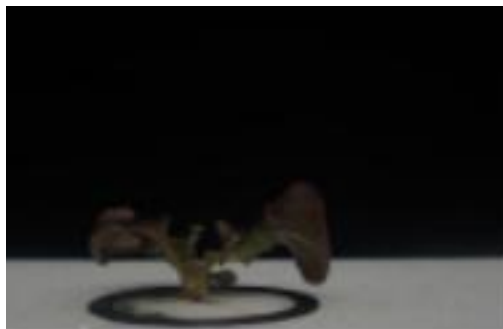
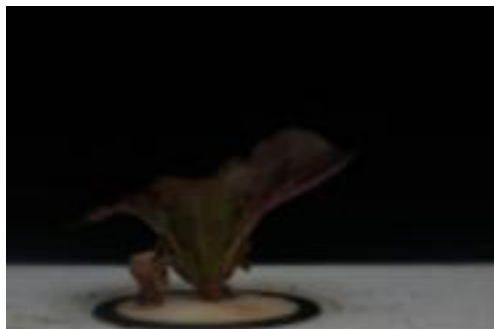
**RGB**

- 1** The image of single lettuce was taken as the research object
- 2** Model fusion technology is used to construct regression model
- 3** Based on the regression model,evaluation the lettuce height based in no-reference object



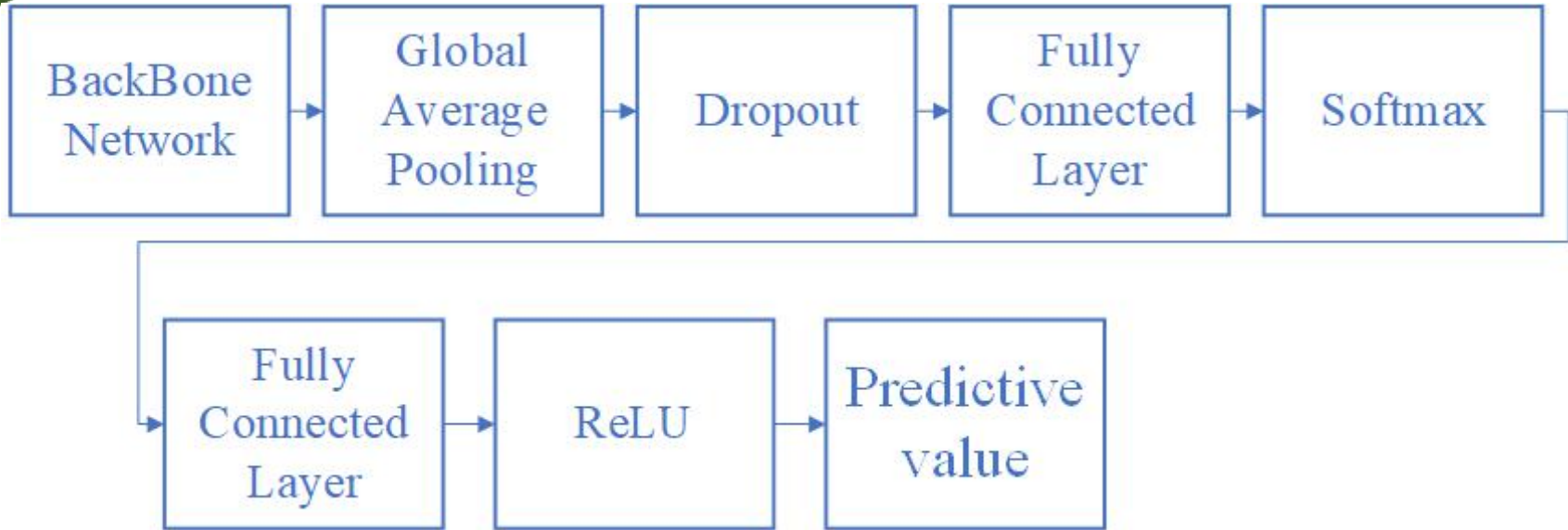
dataset: 402 pictures(train 273,val 49,test 80)

Collection conditions:  
Environmental variables are constant(temperature, humidity, light intensity, and CO<sub>2</sub> concentration)



data preprocessing: Random Lighting,Random,Contrast,Median filtering,Gaussian filter

# Regression Network





# BackBone Network

Model	Parameters (Millions)	MAdds (Millions)	FLOPs (ms)	Accuracy
MobileNetV1	3.23	550	72	0.704
DenseNet-121	7.04	2839	174	0.75
ResNext-50	42.27	4293	297	0.777
EfficientNet-B3	17.67	2806	232	0.817

# The results of all models in predicting the height of lettuce

Model	MAE(mm)	MSE(%)	HAE(mm)	HSE(%)
MobileNetV1	1.45	4.59	7.6	16.83
DenseNet-121	1.36	4.47	9.33	18.49
ResNext-50	1.42	4.55	9.71	15.97
EfficientNet-B3	1.35	4.64	7.28	16.24
Average Fusion	1.22	3.91	7.57	16.07

- 1** It is effective to use image recognition neural networks in deep learning to predict lettuces height from RGB images.
- 2** if a network has higher accuracy on ImageNet, it may perform better in height prediction.

# THE END

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# THANK YOU