

Precise Weed and Maize Classification through Convolutional Neuronal Networks

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Presentation Outline

Introduction

Hardware and Software Used

Image Processing

Dataset

Convolutional Neural Networks

Architectures Tested

Tuning cNET

Presuming performance of cNET 16 filters

Conclusion



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Introduction

Introduction

- ▶ Maize is one of the most important **food or crop?** of the world.
- ▶ Weed can affect the maize crop up to 5000 Kg/Ha.¹
- ▶ Robotics has presented a huge advance in Precision Agriculture.
- ▶ Artificial Intelligence reached near-to-human precision.

The Propose of the present study

- ▶ Obtain samples to conform a dataset
- ▶ Segment samples
- ▶ Test different network architectures of Convolutional Neural Networks for classify Maize and Weed
- ▶ Benchmark the best architecture to analyse time of processing
- ▶ Optimize the time of processing of the net



¹suarez2005distintos

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Hardware and Software Used

Hardware

1. Raspberry Pi 3.
2. Pi camera V2.1.
3. Nvidia graphic Card GTX950M.

Software

1. OpenCV Library
2. Caffe framework
3. Ubuntu 16.04
4. PIXEL Distribution derived from Debian.



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Image Processing

- ▶ Acquire an RGB image through RPi Camera v2.1
- ▶ Detect contours and crop image to the contour
- ▶ Normalize Green Channel and then $S = 2 * G - R - B^2$
- ▶ OTSU Thresholding
- ▶ Mask image

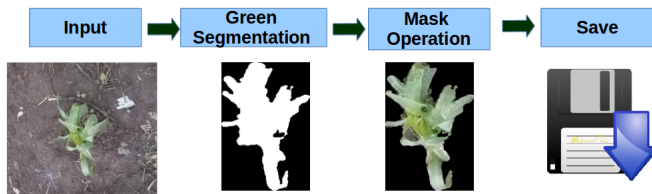


Figure : The process of image processing, **por lo pronto**

²wang2013path.



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Dataset

- ▶ Samples obtained in Pillaro-Tungurahua-Ecuador
- ▶ Images obtained in its initial stage(3-7 leaves) .
- ▶ Rotated images every 30° to improve detection of plants³
- ▶ 1/5 of the total images chosed randomly to validate training

Table : Dataset distribution of each class

Images	Maize	Weed
Original	2835	880
Rotated	34222	10762
Training	25695	8560
Validation	8325	2000

³sladojevic2016deep.



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Convolutional Neural Networks(CNN)

- ▶ Highly accurate method for image classification
- ▶ A class of deep, feed-forward artificial neural networks
- ▶ Tested on classification of plants,⁴⁵⁶
- ▶ Multiple architectures and applications

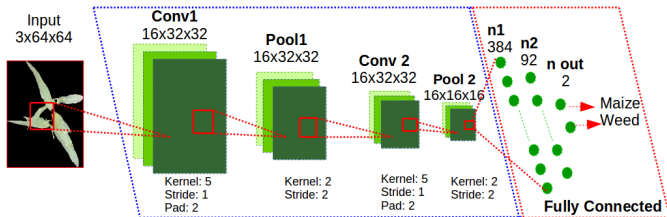


Figure : Normal architecture in a Convolutional Neural Network

⁴cheng2015feature.

⁵potena2016fast.

⁶di2016automatic.



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Architectures tested

- ▶ LeNET and AlexNet(Caffe Zoo Model)
- ▶ cNET and sNET ⁷
- ▶ 3000 iterations in each training

Table : Comparison of the 4 types of CNN in training the dataset

Parameters	LeNet	AlexNet	cNET	sNET
Input size of images	32x32	64x64	64x64	64x64
Layers numbers	9	11	8	4
Number of parameters	652500	20166688	6421568	135872
Accuracy(%)	86.48	93.86	96.4	80.4
Loss(%)	32.80	15.32	13.72	15.32



⁷potena2016fast

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cNET Performance

1. cNET can be improved by decrease the number of filters
2. Images can be batched and also Caffe can be multithreaded
3. Both nets were trained with 9000 iterations

Table : Comparison between cNET of 16 and 64 filters

Parameters	cNET 16 filters	cNET 64 filters
Number of parameters	1651376	6421568
Accuracy(%)	97.26	96.40
Loss(%)	8.39	13.72



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Presuming performance of cNET 16 filters

- ▶ A dataset of test with 202 images of each class was used
- ▶ In a single image it can be found 18 plants to classify

Table : Test of complete image classification in FPS

Parameter	GPU	CPU	Raspberry Pi
Method	One Core	Multithreading	Multithreading
Time(s)	0.0171	0.196	2.714
FPS	58.47	5.08	0.36



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Conclusion

- ▶ cNET showed the better results in classification of maize and weed
- ▶ The reduce of the number of filters allow to decrease the processing time and increase the accuracy of the net
- ▶ GPU showed the best results but with Multithreading and Batching CPU and Raspberry Pi can improve its time of processing
- ▶ Due to the limitations of the Raspberry Pi, it can't be used to classify in real time, but a Neural Module(such as Intel Movidius) can improve that result



Thanks!

