Supplementary Material for "VegFru: A Domain-Specific Dataset for Fine-grained Visual Categorization"

Saihui Hou, Yushan Feng and Zilei Wang

Department of Automation, University of Science and Technology of China

{saihui, fyushan}@mail.ustc.edu.cn, zlwang@ustc.edu.cn

1. More VegFru Samples

1.1. Vegetable Samples

Figure 1. **Spinach**

Figure 2. **Red Cabbage**

Figure 3. **Carrot**

Figure 4. **Tomato**

Figure 5. **Balsam Pear**

Figure 6. **Zucchini**

1.2. Fruit Samples

Figure 7. **Pitaya**

Figure 8. **Mango**

Figure 9. **Bayberry**

Figure 10. **Cherry**

Figure 11. **Grape**

Figure 12. **Kiwi Fruit**

2. Details of VegFru Structure

Table 1. **The *sup-classes* and *sub-classes* of VegFru. #Sub**-the number of *sub-classes* included in each *sup-class*.The VegFru has taken in all species of vegetables and fruits in common, which are closely associated with people's diet.

Sup-class	**#Sub**	*Sub-class*
Alliaceous	10	bunching onion, chive, garlic, garlic chive, garlic sprouts, green Chinese onion, leek, onion, scallion, shallot
Aquatic vegetable	13	arrowhead, cattail, cress, gorgon fruit seed, lotus, lotus root, lotus seed, lotus seedpod, water caltrop, water chestnuts, water shield, watercress, zizania aquatica
Beans	15	asparagus pea, azuki beans, black soya bean, broad bean, cowpea, hyacinth bean, kidney bean, kidney bean seed, mung bean, pea, sieva bean, sieva bean seed, soybean, soybean seed, sword bean
Brassia oleracea	9	broccoli, brussels sprouts, curly kale, head cabbage, red cabbage, savoy caggage, sprouting broccoli, turnip cabbage, Chinese kale
Bud seedling	4	black bean sprouts, mung bean sprouts, peanut sprouts, soybean sprouts
Cabbage	5	flower Chinese cabbage, pakchoi, purple cai-tai, Chinese cabbage, Wuta-tsai
Eggplant	7	cape gooseberry, eggplant, green eggplant, pepper, pimento, tomato, white eggplant
Green-leafy vegetable	31	artemisia selengensis, asparagus lettuce, basella rubra, basil, beefsteak plant, burclover, celery, chicory, chrysanthemum, coriander, dandelion, edible amaranth, endive, fennel, gynura bicolor, houttuynia cordata, kalimeris, leaf lettuce, lettuce, mint, mitsuba, nankimgense, parsley, purslane, shepherd's purse, spinach, swiss chard, water spinach, Chinese mallow, Herb of Ghostplant Wormwood, New Zealand spinach
Melon	14	balsam pear, bottle gourd, chocho, cucumber, gourd, hairy squash, luffa acutangula, luffa cylindrica, pumpkin, snake gourd, watermelon, wax gourd, zucchini, Chinese pumpkin
Mushroom	24	agaricus bisporus, agaricus blazei murill, agrocybe aegerita, bolete, chantarelle, coprinus comatus, dictyophora, enoki mushroom, hen-of-the-woods, hericium, hypsizigus marmoreus, matsutake, morel, nameko, oyster mushroom, pleurotus eryngii, pleurotus nebrodensis, russula virescens, shiitake, straw mushroom, termite mushroom, tremella fuciformis, tricholoma flavovirens, Jew's-ear
Mustard	2	mustard, zha-tsai
Perennial and miscellaneous vegetable	13	asparagus, bamboo shoot, corn, day lily, globe artichoke, goji berry, mioga ginger, okra, platycodon grandiflorum, rhubarb, strawberry, toon, Lily
Root vegetable	11	beetroot, black salsify, burdock root, carrot, celeriac, green radish, kohlrabi, parsnip, red radish, wasabi, white radish
Tuber vagetable	10	ginger, jerusalem artichoke, konnyaku, kudzu, potato, sweet potato, taro, yam bean, Chinese artichoke, Chinese yam
Wild vegetable	32	achyranthes, adenophora, agrimony, allium, asparagus fern, bassia scoparia, bird pepper, carduus, centella asiatica, commelina, cudweed, cynoglossum lanceolatum, equisetum debile, fallopia multiflora, feather cockscomb, galinsoga parviflora, great Solomon's-seal, horst, milk thistle, ostrich fern, polygonatum sibiricum, polygonum lapathifolium, prickly lettuce, sea of nostoc flagelliforme, self-heal, silverweed, sorrel, thorny amaranth, vetch, viola philippica, wild amaranth, wild chrysanthemum
Total	**200**	**15 *sup-classes* and 200 *sub-classes* for Vegetables**
Berry fruit	22	banana, black currant, black grape, blueberry, carambola, cherry tomato, fig, ginseng fruit, grape, grape white, guava, kiwi fruit, munlberry, naseberry, passion fruit, pitaya, pomegranate, raspberry, red grape, syzygium jambos, wampee, wax apple
Citrus fruit	13	blood orange, citrus, dekopon, grapefruit, kumquat, lemon, lime, mandarin orange, navel orange, pomelo, ponkan, sugar orange, trifoliate orange
Collective fruit	5	annona muricata, artocarpus heterophyllus, breadfruit, pineapple, sweetsop
Cucurbites	6	golden melon, honey dew melon, muskmelon, netted melon, papaya, Hami melon
Drupe	13	apricot, avocado, bayberry, cherry, flat peach, juicy peach, loquat, mango, nectarine, olive, plum, prune, salak
Litchies	3	litchi, longan, rambutan
Nut fruit	11	almond, cashew nut, coconut, durian, hazelnut, hickory, macadamia, pecans, pistachio, walnuts, Chinese chestnut
Persimmons and jujubes fruit	6	candied date, diospyros lotus, green dates, jujube, persimmon, winter jujube
Pome	11	apple, bergamot pear, crown pear, gandaria, green apple, hawthorn, housi pear, mangosteen, plum-leaf crab, sand pear, Dangshan Pear
other fruit	2	sugarcane, yacon
Total	**92**	**10 *sup-classes* and 92 *sub-classes* for Fruits**

3. Baselines on the *val* set of VegFru

The performance on the *val* set of VegFru achieved by CaffeNet [2], VGGNet [4] and GoogLeNet [5] is shown in Table 2. The top-1 mean accuracy on the *val* set is close to that on the *test* set.

Table 2. **Baselines on the *val* set of VegFru.** The CaffeNet, VGGNet and GoogLeNet are chosen to set the benchmarks. All results are reported in the top-1 mean accuracy.

Dataset	Category	CaffeNet	VGGNet	GoogLeNet
Veg200	15 *sup-classes*	75.59%	83.67%	83.99%
(*val* set)	200 *sub-classes*	67.00%	78.26%	79.92%
Fru92	10 *sup-classes*	81.89%	88.48%	88.17%
(*val* set)	92 *sub-classes*	72.00%	79.65%	81.65%
VegFru	25 *sup-classes*	74.42%	82.94%	83.06%
(*val* set)	292 *sub-classes*	66.52%	77.34%	79.73%

4. Evaluate HybridNet on the coarse-grained categorization

Here we provide the experimental results of evaluating HybridNet on the coarse-grained categorization. The network architecture and training strategy keep the same except that the *Fused Classifier* is changed to handle the coarse-grained categorization. The results are shown in Table 3 and reported on VegFru and FGVC-Aircrafts. The coarse-grained categorization is less challenging than fine-grained categorization, and the accuracy with CBP-CNN is relatively high (VegFru: 83.84%, FGVC-Aircrafts: 94.03%). The experiments show that the results of coarse-grained categorization with HybridNet (VegFru: 84.27%, FGVC-Aircrafts: 94.33%) are a little improved compared to CBP-CNN on both datasets.

Table 3. **Performance comparison for HybridNet on the coarse-grained categorization.** HybridNet is trained on the *train* set of VegFru and *trainval* set of FGVC-Aircraft [3]. All results are evaluated on the *test* set and reported in the top-1 mean accuracy.

Dataset	VegFru (25 *sup-classes*)	Aircrafts [3] (70 *sup-classes*)
CBP-CNN [1]	83.84%	94.03%
HybridNet (ours)	**84.27%**	**94.33%**

References

[1] Y. Gao, O. Beijbom, N. Zhang, and T. Darrell. Compact bilinear pooling. In *CVPR*, 2016. 3

[2] A. Krizhevsky, I. Sutskever, and G. E. Hinton. Imagenet classification with deep convolutional neural networks. In *NIPS*, 2012. 3

[3] S. Maji, J. Kannala, E. Rahtu, M. Blaschko, and A. Vedaldi. Fine-grained visual classification of aircraft. Technical report, 2013. 3

[4] K. Simonyan and A. Zisserman. Very deep convolutional networks for large-scale image recognition. *arXiv preprint arXiv:1409.1556*, 2014. 3

[5] C. Szegedy, W. Liu, Y. Jia, P. Sermanet, S. Reed, D. Anguelov, D. Erhan, V. Vanhoucke, and A. Rabinovich. Going deeper with convolutions. In *CVPR*, 2015. 3