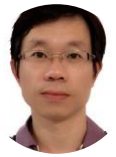
RobotHusky- Field Agriculture Robot

Group 3: Galaxy-Motion

2020/06/17

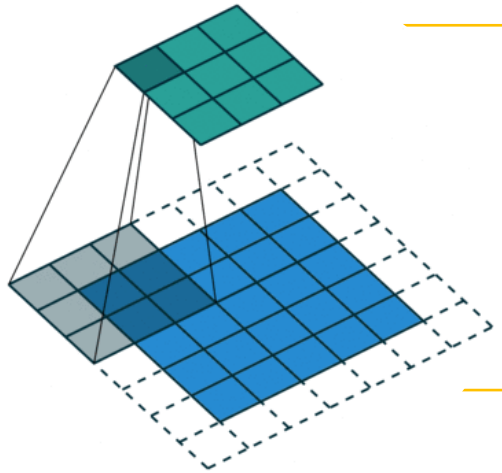
Members:

Yuewen ZHU
CEO

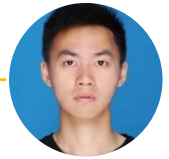


lv ZHOU
CTO

Liang WANG
COO



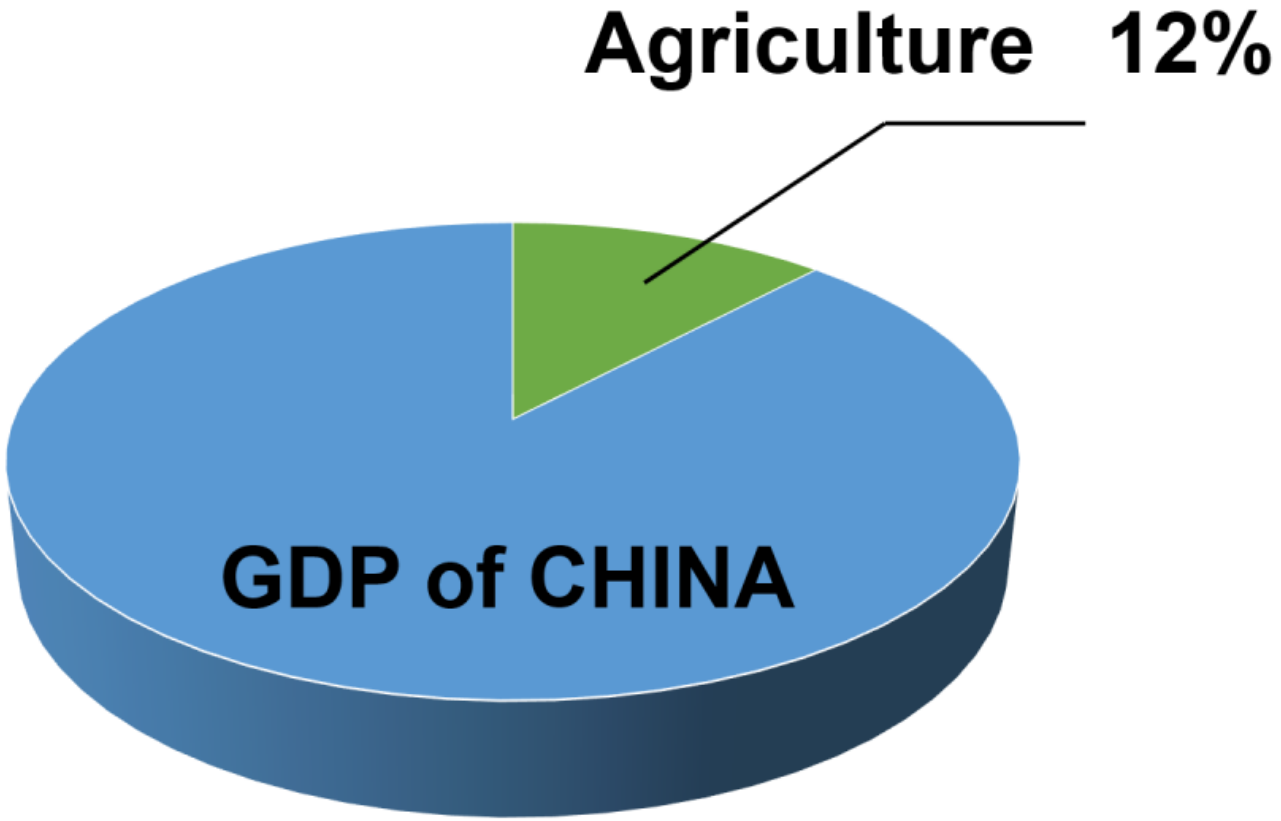
Kenan LI
CMO



Licheng LIANG
CTO

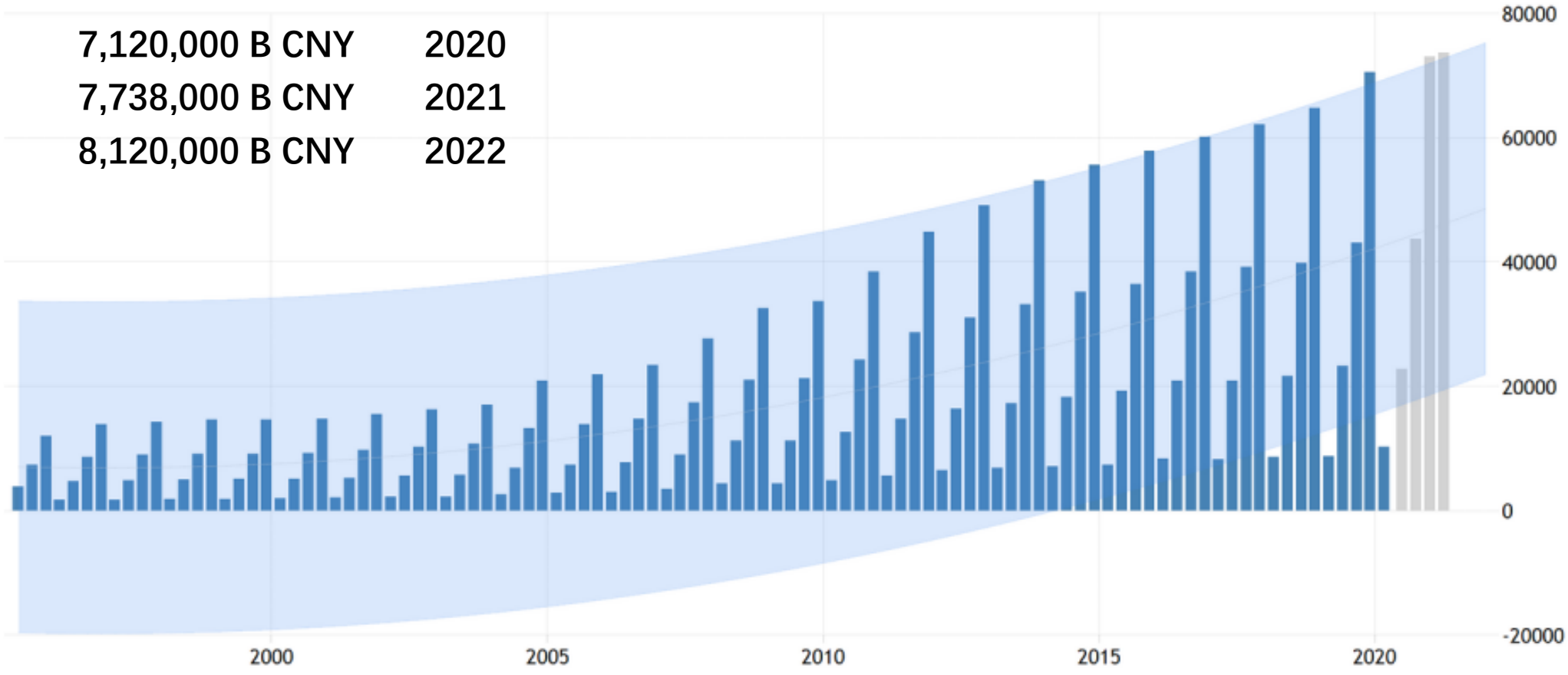
Yu ZHOU
CFO

The China Agriculture provides more than **12 percent** of the total GDP in the country



Source: tradingeconomics.com | national bureau of statistic of china

GDP from Agriculture in China



Source: tradingeconomics.com | national bureau of statistic of china

More than 300,000,000

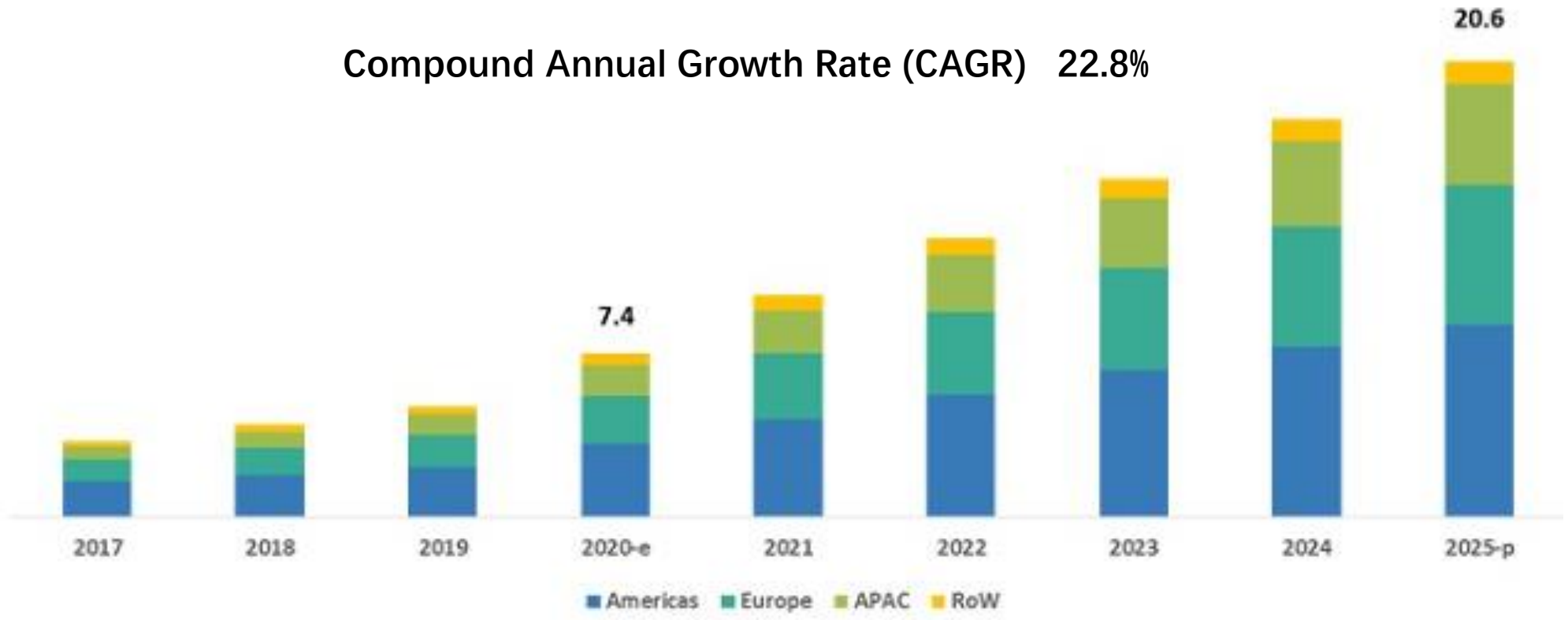
50% of labor force

https://tradingeconomics.com/china/gdp-from-agriculture

Agriculture Robots Market Analysis (by Region)

2020~2025 USD 7.4 B ~ USD 20.6 B

Compound Annual Growth Rate (CAGR) 22.8%

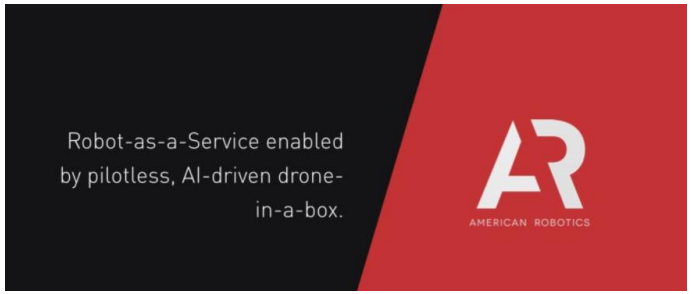


https://www.marketsandmarkets.com/Market-Reports/agricultural-robot-market-173601759.html

Company of Agriculture Robot

Abundant Robotics

Agrobot



American Robotics

Bear Flag Robotics

Blue River Technologies

ecoRobotix

Rabbit Tractors

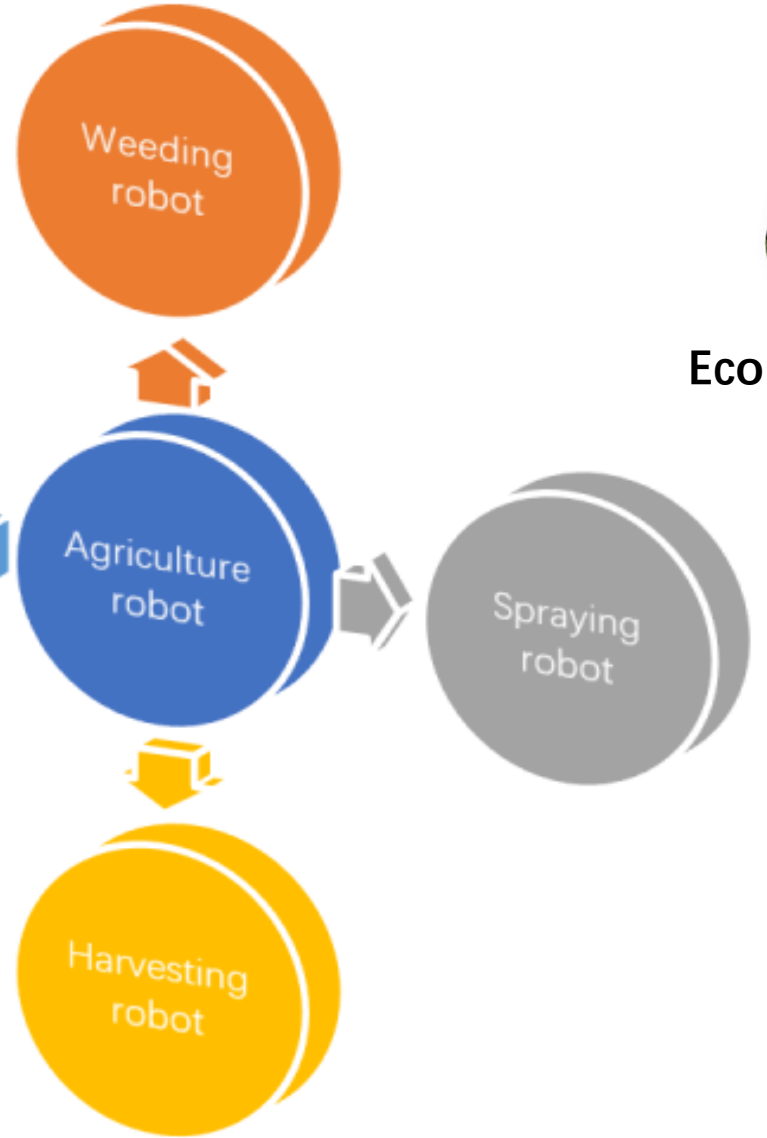
Rowbot

Small Robot Company

Apple Harvesting Robot

Virgo

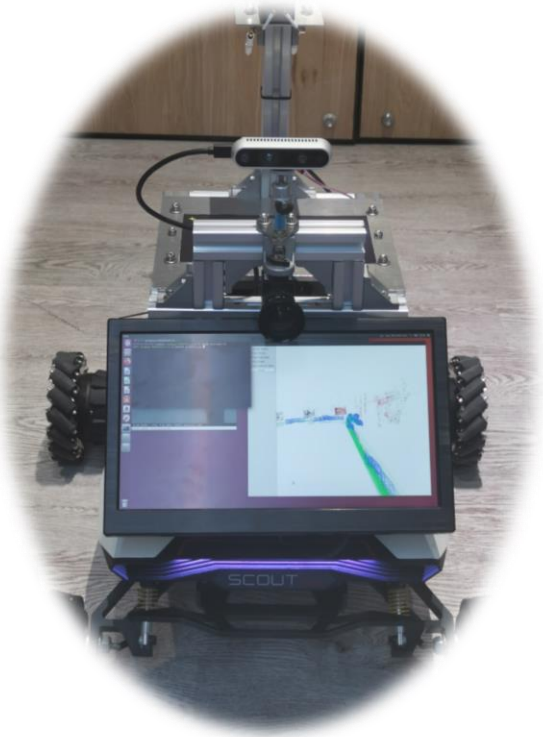
Harvey Capsicum Harvester

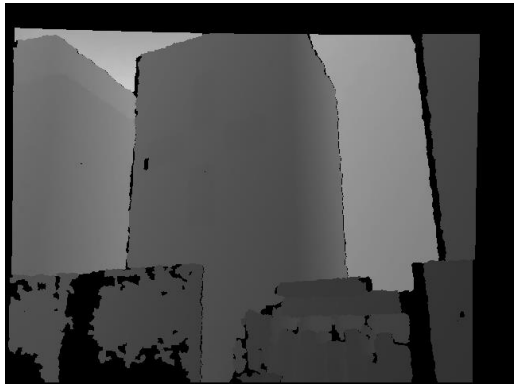


Ecorobotix Weeding Robot

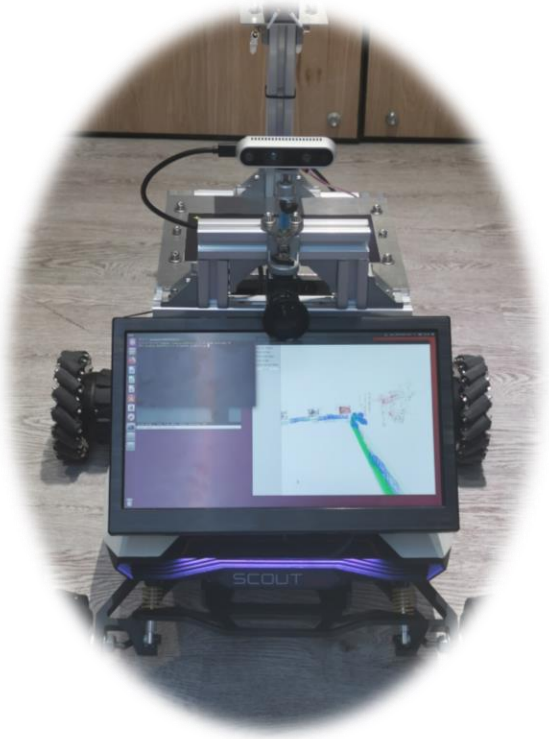
Robot Agricole Oz

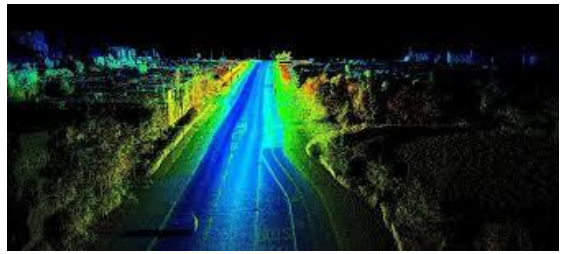
Our objective

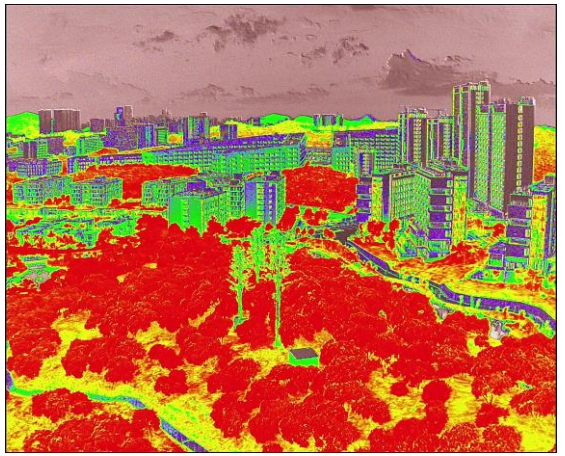




Our objective







What function will our robot have?

Orchard mapping

Farm monitoring

Maturity detection

Fertilization management

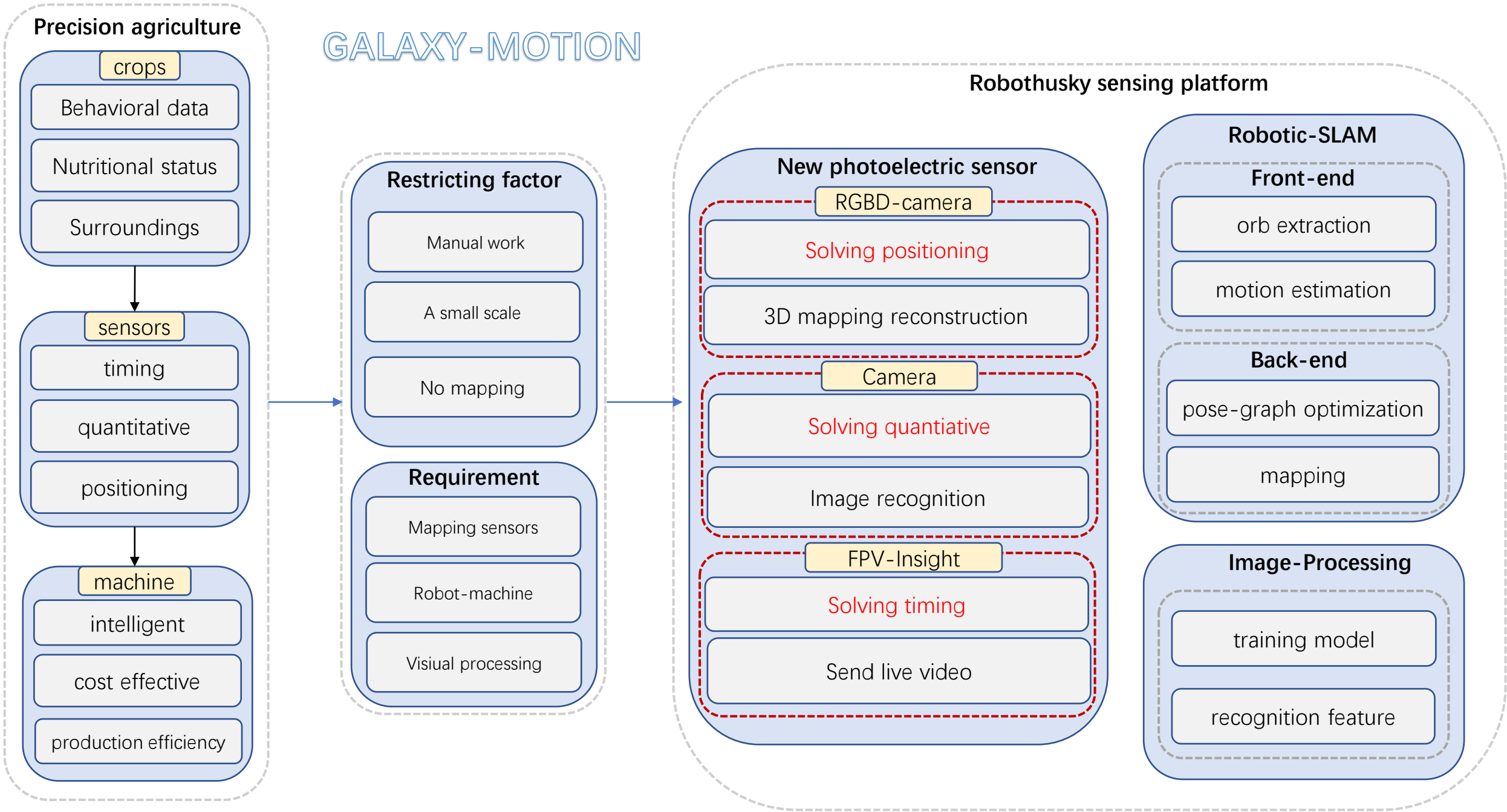
Yield prediction

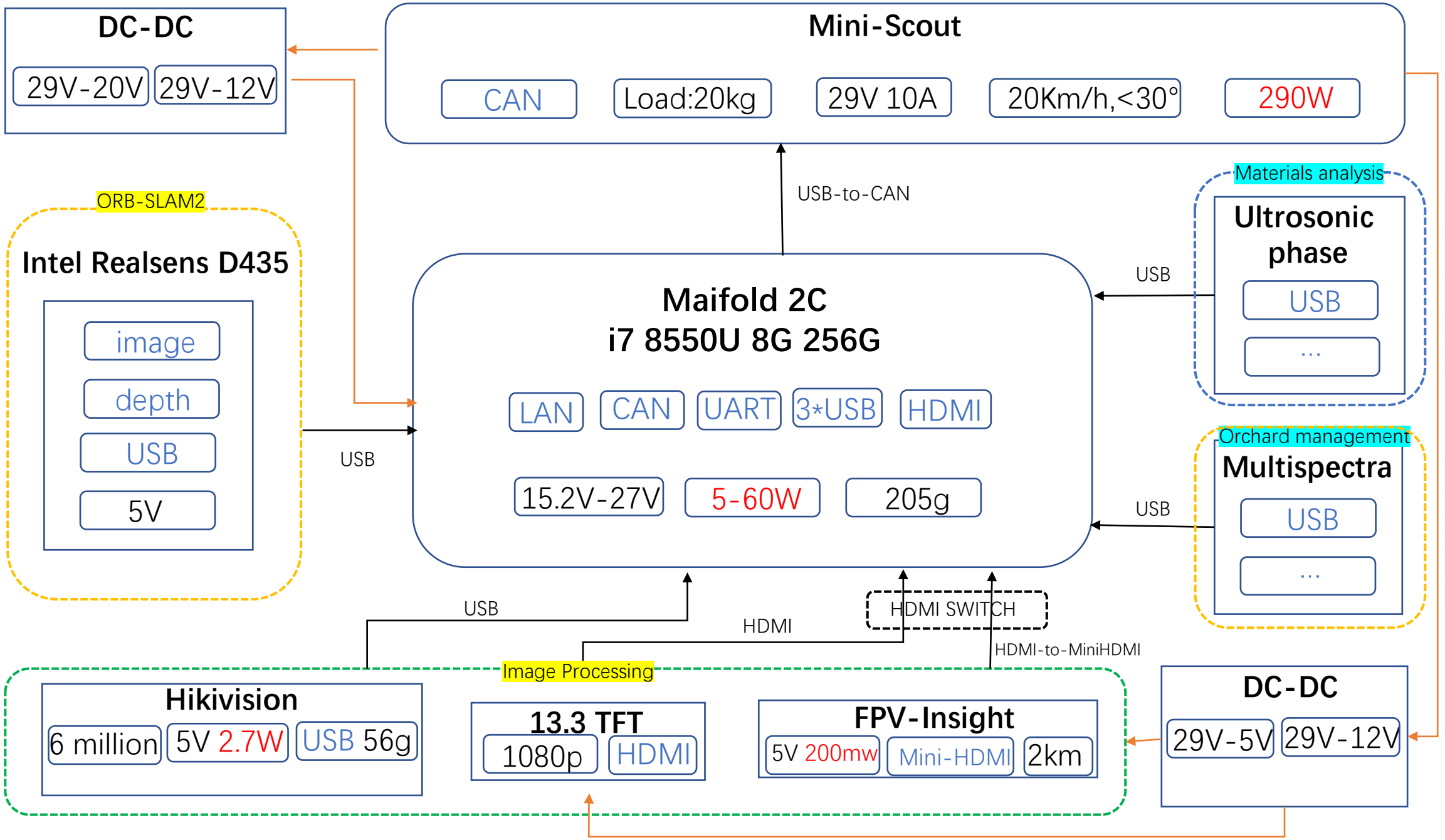
Pest and disease detection

First step：Mapping and Corn seedling stage monitoring

- Corn seedlings

- Weeds


Precision agriculture
crops
Behavioral data
Nutritional status
Surroundings
sensors
timing
quantitative
positioning
machine
intelligent
cost effective
production efficiency
GALAXY-MOTION
Restricting factor
Manual work
A small scale
No mapping
Requirement
Mapping sensors
Robot-machine
Visiual processing
Robothusky sensing platform
New photoelectric sensor
RGBD-camera
Solving positioning
3D mapping reconstruction
Camera
Solving quantiative
Image recognition
FPV-Insight
Solving timing
Send live video
Robotic-SLAM
Front-end
orb extraction
motion estimation
Back-end
pose-graph optimization
mapping
Image-Processing
training model
recognition feature


DC-DC
29V-20V
29V-12V
Mini-Scout
CAN
Load:20kg
29V 10A
20Km/h,<30°
290W
USB-to-CAN
Materials analysis
Ultrosonic phase
USB
...
USB
ORB-SLAM2
Intel Realsens D435
image
depth
USB
5V
USB
Maifold 2C
i7 8550U 8G 256G
LAN
CAN
UART
3*USB
HDMI
15.2V-27V
5-60W
205g
USB
Orchard management
Multispectra
USB
...
USB
HDMI
HDMI SWITCH
HDMI-to-MiniHDMI
Image Processing
Hikivision
6 million
5V 2.7W
USB 56g
13.3 TFT
1080p
HDMI
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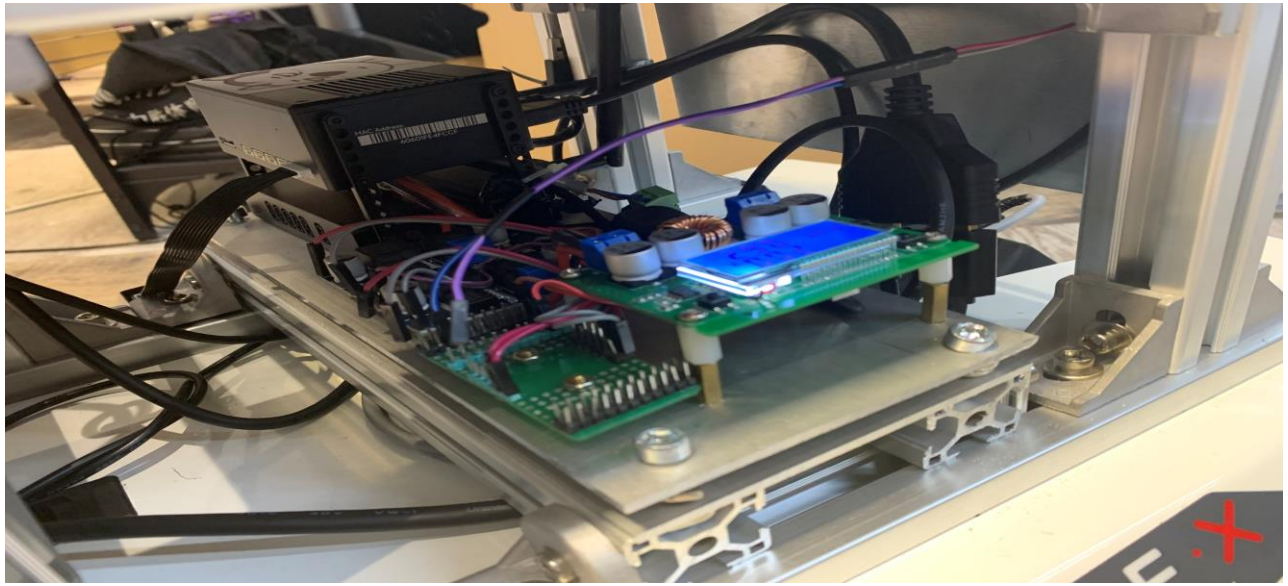
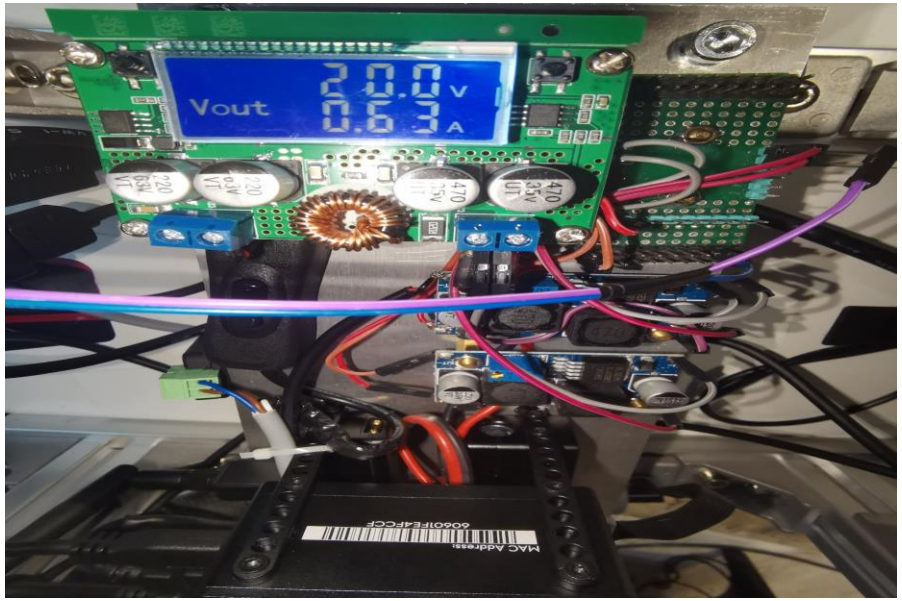
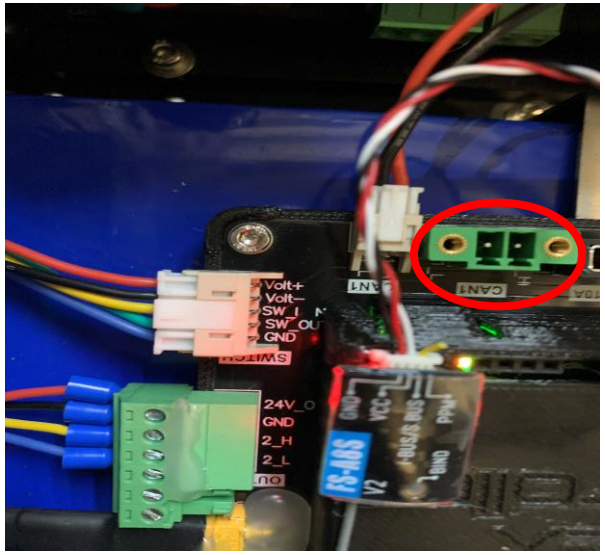
Mini-HDMI
2km
DC-DC
29V-5V
29V-12V

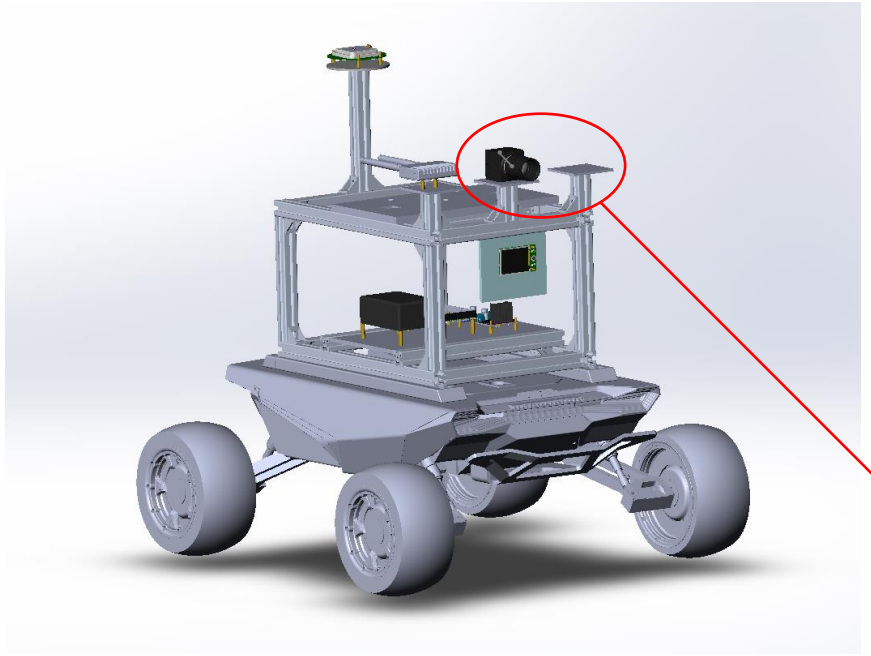




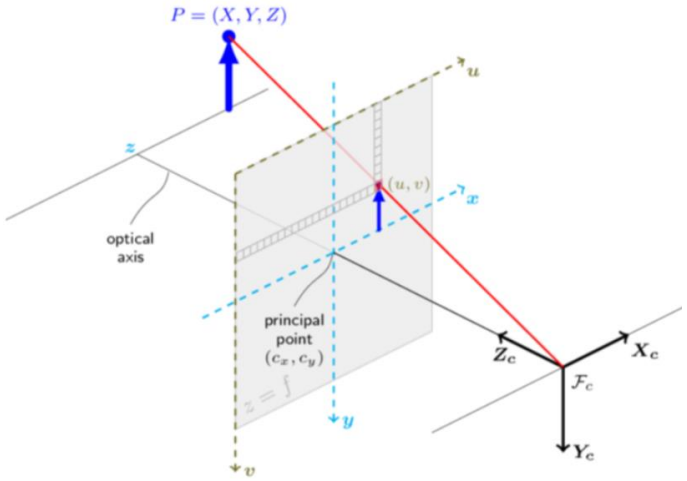


Problems encountered !!!

Fuse question because of Pin dislocation



Camera Calibration

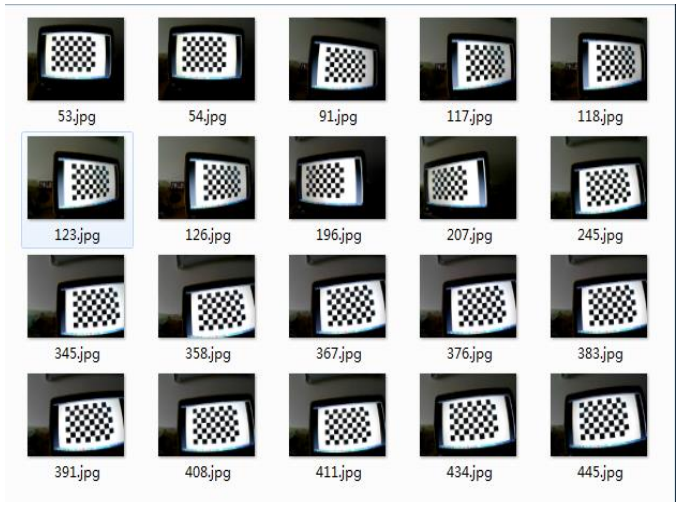


$$Zc\begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} \frac{1}{dx} & \gamma & u0 \\ 0 & \frac{1}{dy} & v0 \\ 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} f & 0 & 0 \\ 0 & f & 0 \\ 0 & 0 & 1 \end{bmatrix} * [R \mid T] * \begin{bmatrix} Xw \\ Yw \\ Zw \\ 1 \end{bmatrix}$$

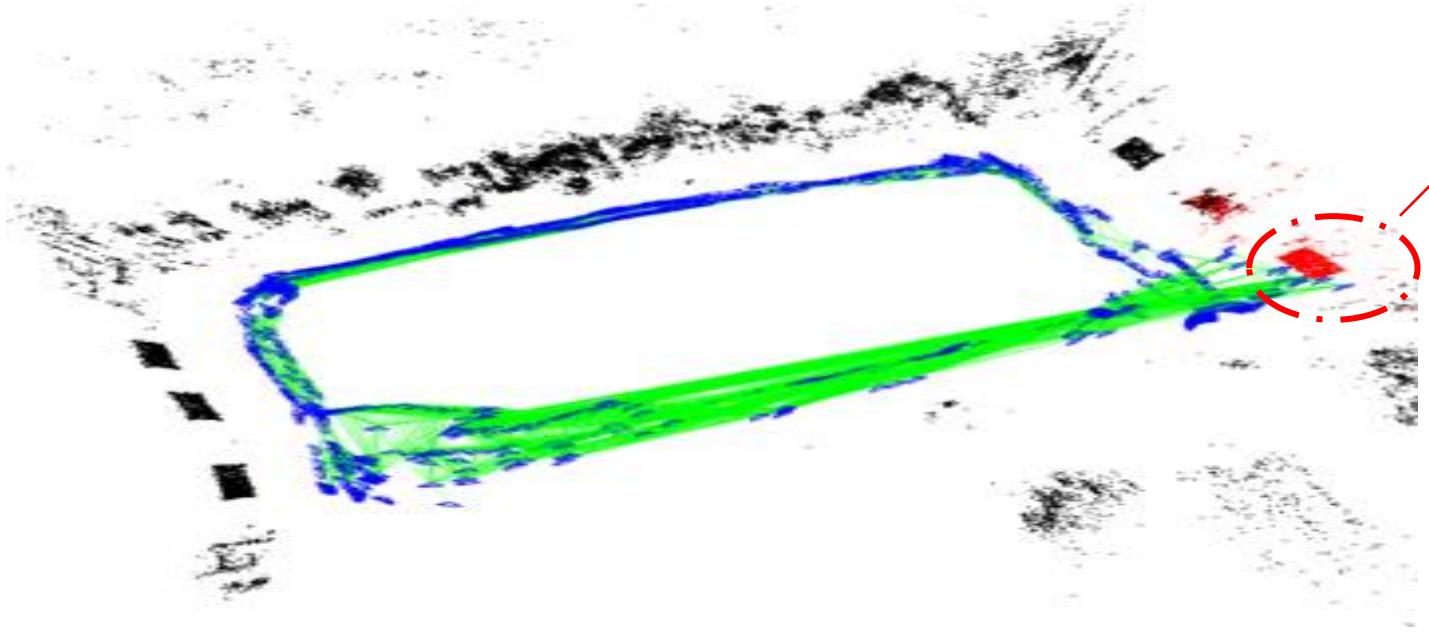
世界坐标系转换到相机坐标系

相机坐标系转换到图像物理坐标系

图像物理坐标系转换到图像像素坐标系



RGBD-SLAM



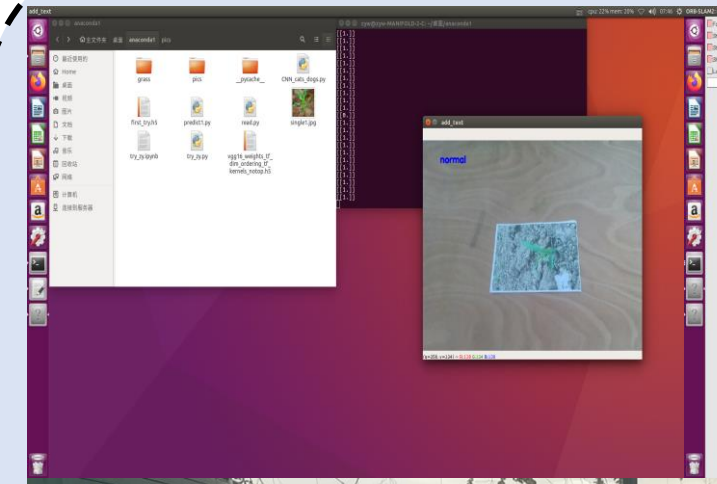
Precision agriculture

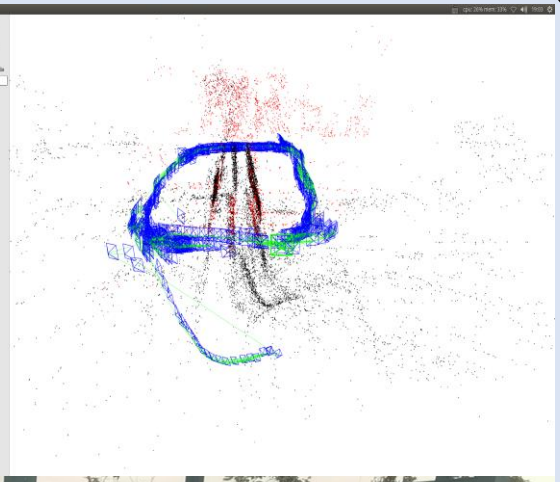
Corn's image
Corn's status
Corn's localization
Global mapping

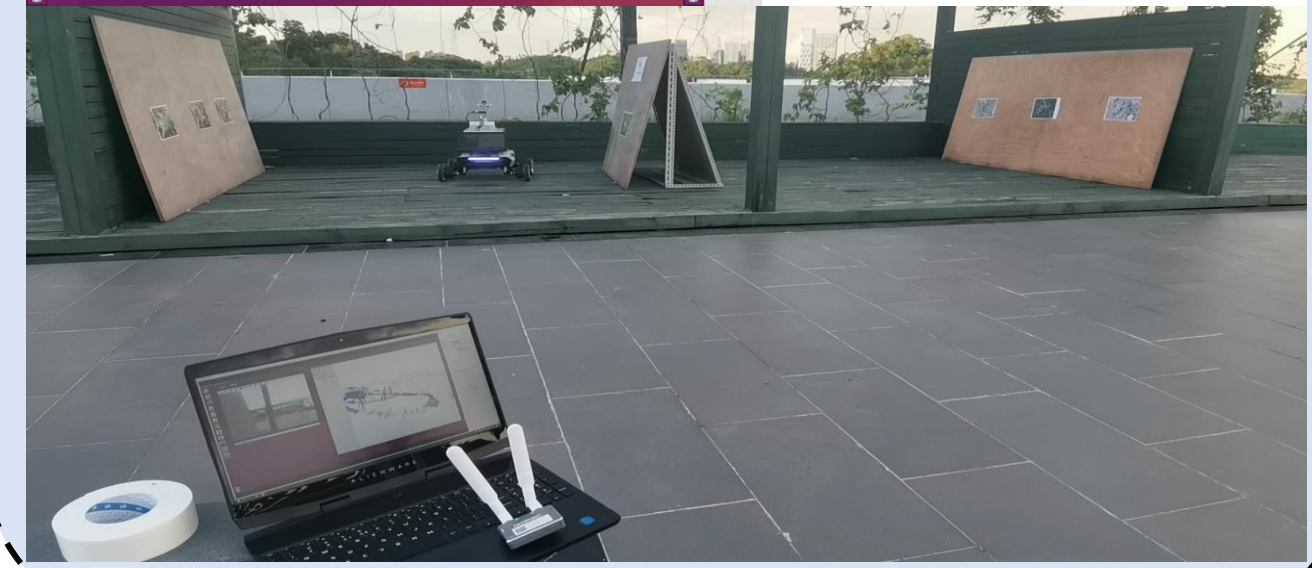
Sensors

Robothusky

Mapping&image processing&transferring







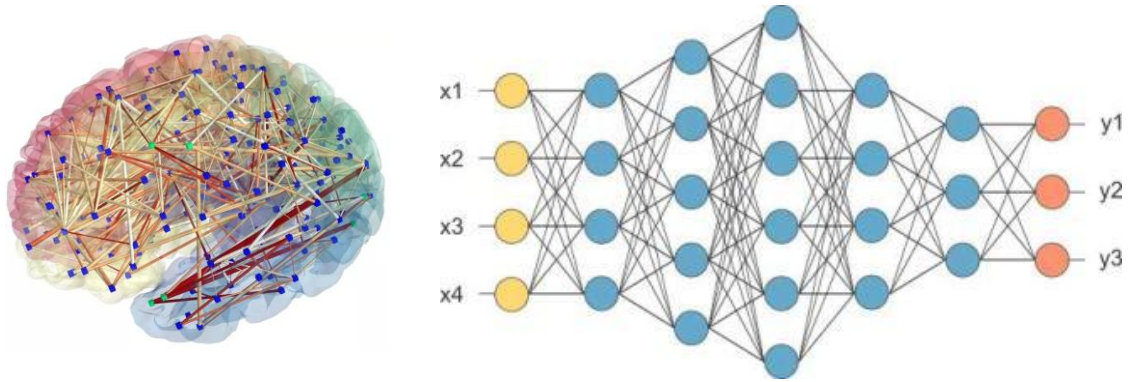
How to distinguish:
Corn seedlings and **weeds** automatically?

Corn seedlings
玉米幼苗

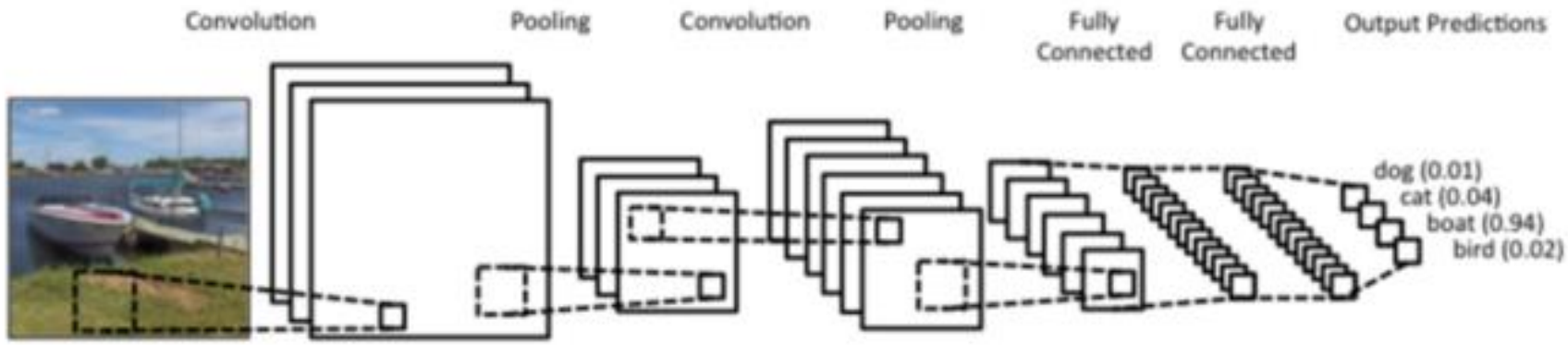
weeds
杂草

CNN!!!

1. Traditional recognition algorithms need features extraction and data reconstruction . CNN can extract features automatically;
2. non-contact and high precision in recognition, classification;
3. process high dimensional data (RGB images) without pressure.

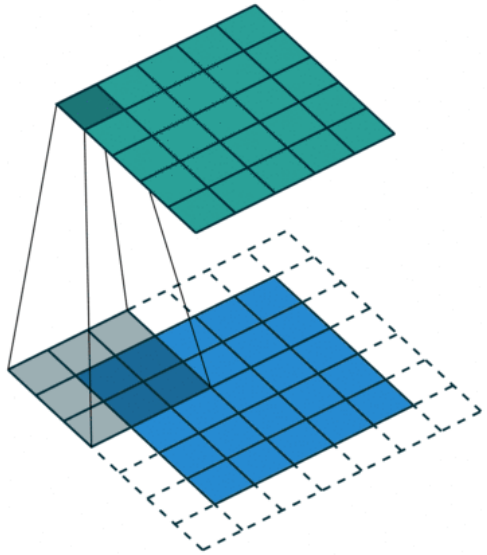


CNN structure



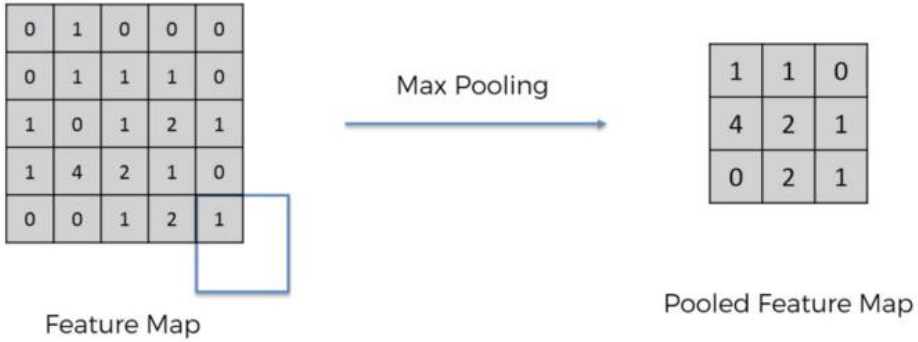
1.Convolution layer

Help us extract some features of the picture

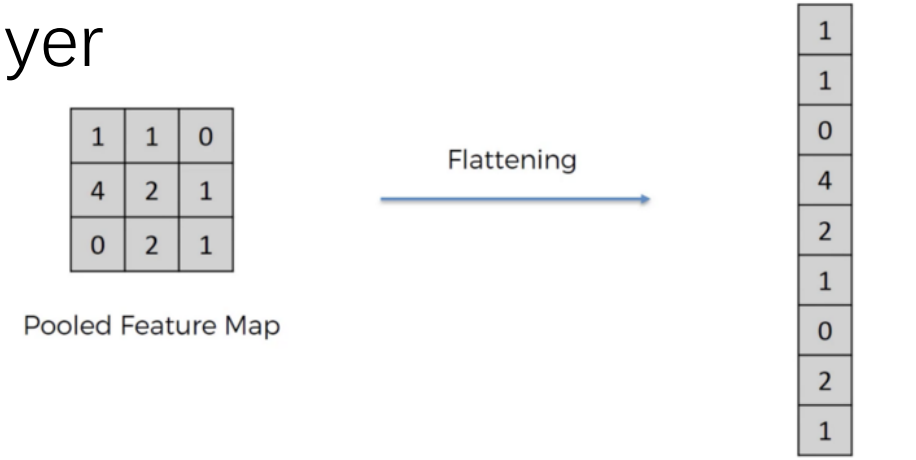


2.Pooling layer

decrease dimension to reduce the parameters and calculations



3.Fully connected layer



Algorithm

PreWork.py

1. all pics → train set / test set (8:2)

2.classify and label

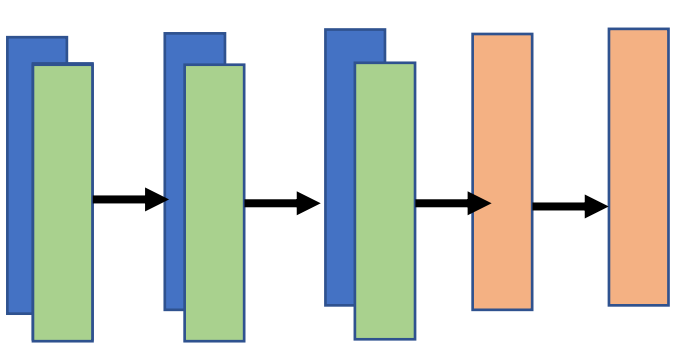
corn
label:0

weed
label:1

3.batch processing

CNNModel.py

1.design a simple CNN model



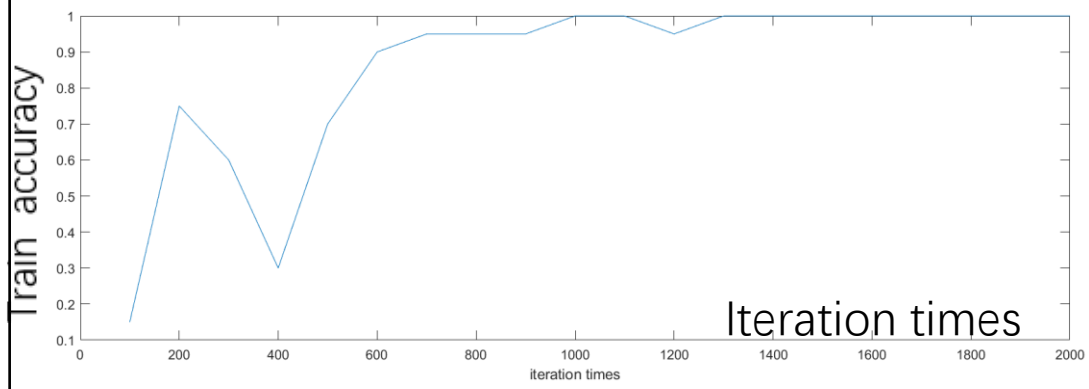
convolution layer

pooling layer

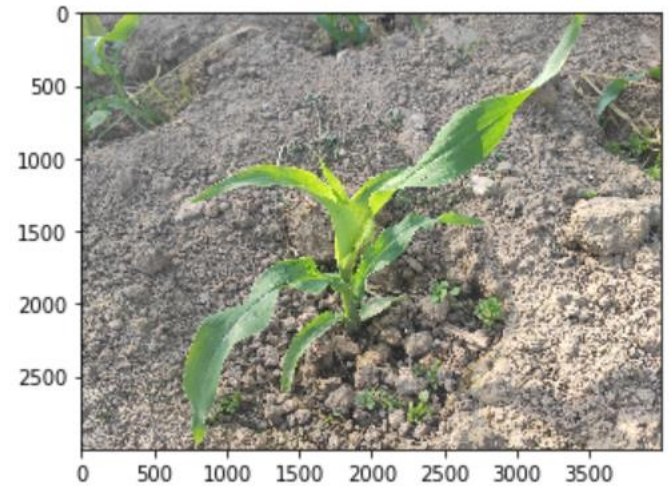
full connected layer

Train.py

Train the established network and save the training parameters for the next use



Test with the data of test set and get the prediction result



Desktop/新建文件夹 (2)/tryagain

test - Jupyter Notebook

localhost:8889/notebooks/Desktop/新建文件夹%20(2)/tryagain/test.ipynb

未同步

jupyter test 最后检查: 上星期一21:37 (未保存改变)

Logout

File Edit View Insert Cell Kernel Widgets Help

可信的 Python 3

运行 代码

In [22]:
```
import os
import numpy as np
from PIL import Image
import tensorflow as tf
import matplotlib.pyplot as plt
from CNNModel import deep_CNN
```

In [24]:
```
N_CLASSES = 2

img_dir = './corn_test1/'
log_dir = './'
lists = ['corn', 'weed']


# 从测试集中随机挑选一张图片看测试结果
def get_one_image(img_dir):
    imgs = os.listdir(img_dir)
    img_num = len(imgs)
    # print(imgs, img_num)
    idn = np.random.randint(0, img_num)
    image = imgs[idn]
    image_dir = img_dir + image
    print('随机挑选出来的图片的路径是：{}。该图片显示如下：'.format(image_dir))
```

prework (5).py 打开文件

prework (4).py 打开文件

全部显示

Low prediction accuracy(29/42)? Why?

- 1. too few data sets
- 2. CNN structure is too simple(5 layers)

Improvement

1. extend data set
2. use more complex CNN structures

- original pics : Shooting with phones
- add new pics :
  - Search online
  - pics augmentation

Weeds： 105
Corn ： 105

Weeds:105

Corn seedlings:105

Pics augmentation to increase data sets

```
from keras.preprocessing.image  import ImageDataGenerator

datagen  =  ImageDataGenerator  (
        rotation_range = 40 ,
        width_shift_range = 0.2 ,
        height_shift_range = 0.2 ,
        rescale= 1 / 255 ,
        shear_range = 0.2 ,
        zoom_range = 0.2 ,
        horizontal_flip = True,
        fill_mode = 'nearest' )

            ..........
```

Augment methods

105


single_0_10.jpg


single_0_195.jpg


single_0_1925.jpg


single_0_2522.jpg


single_0_3061.jpg


single_0_5900.jpg

1050


single_0_7129.jpg


single_0_7325.jpg

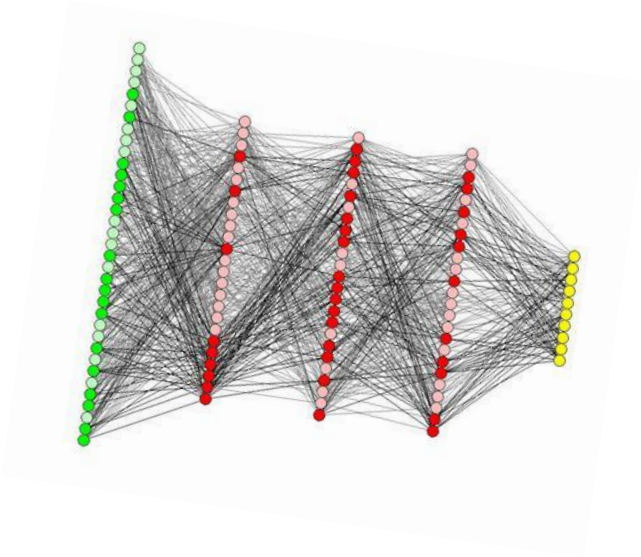

single_0_8134.jpg

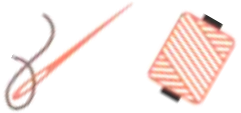
Updated CNN Neural Networks

10000+

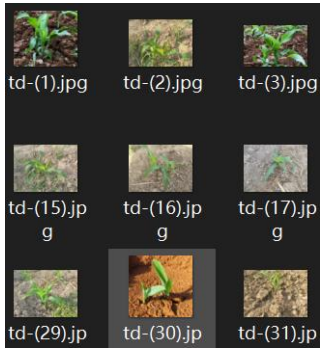
VGG16

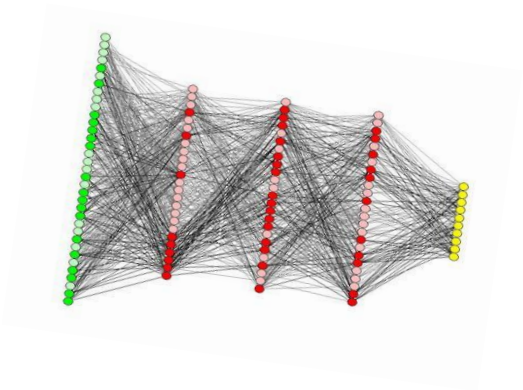
An intuitive assumption





Our Maize seedling

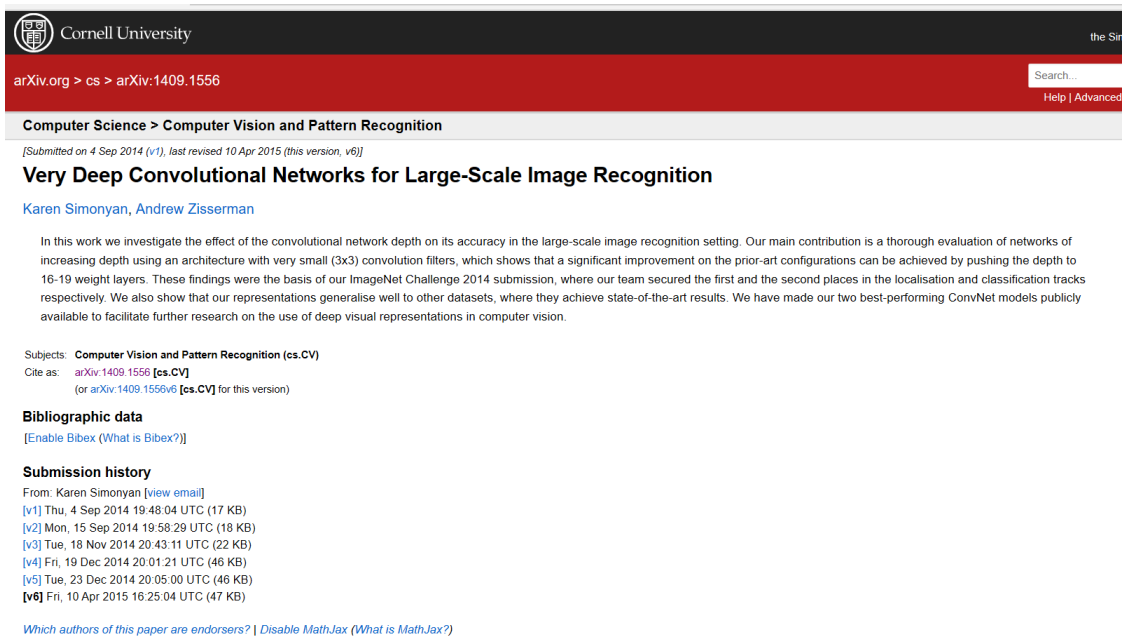




VGG16 - a brief introduction

- Why VGG

VGG
(abbr. Visual Geometry Group)



Cornell University

arXiv.org > cs > arXiv:1409.1556

Search...

Help | Advanced

Computer Science > Computer Vision and Pattern Recognition

[Submitted on 4 Sep 2014 (v1), last revised 10 Apr 2015 (this version, v6)]

Very Deep Convolutional Networks for Large-Scale Image Recognition

Karen Simonyan, Andrew Zisserman

In this work we investigate the effect of the convolutional network depth on its accuracy in the large-scale image recognition setting. Our main contribution is a thorough evaluation of networks of increasing depth using an architecture with very small (3x3) convolution filters, which shows that a significant improvement on the prior-art configurations can be achieved by pushing the depth to 16-19 weight layers. These findings were the basis of our ImageNet Challenge 2014 submission, where our team secured the first and the second places in the localisation and classification tracks respectively. We also show that our representations generalise well to other datasets, where they achieve state-of-the-art results. We have made our two best-performing ConvNet models publicly available to facilitate further research on the use of deep visual representations in computer vision.

Subjects: **Computer Vision and Pattern Recognition (cs.CV)**
Cite as: arXiv:1409.1556 **[cs.CV]**
(or arXiv:1409.1556v6 **[cs.CV]** for this version)

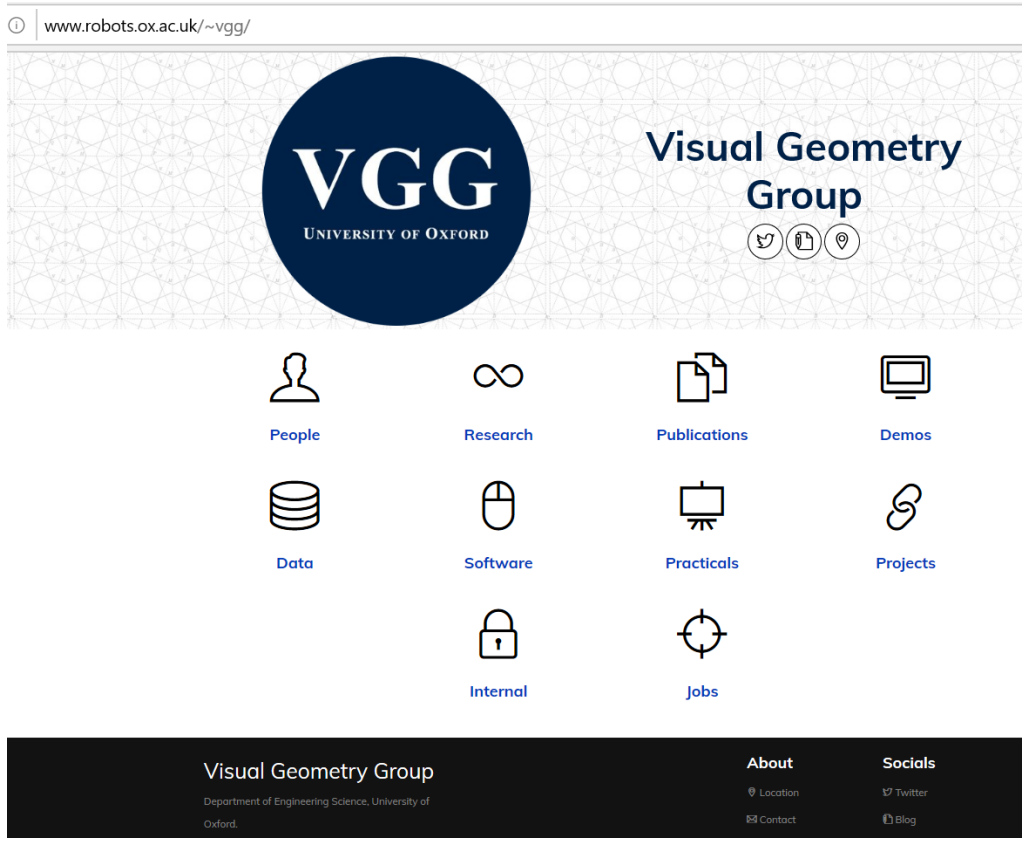
Bibliographic data

[Enable Bibex (What is Bibex?)]

Submission history

From: Karen Simonyan [view email]
[v1] Thu, 4 Sep 2014 19:48:04 UTC (17 KB)
[v2] Mon, 15 Sep 2014 19:58:29 UTC (18 KB)
[v3] Tue, 18 Nov 2014 20:43:11 UTC (22 KB)
[v4] Fri, 19 Dec 2014 20:01:21 UTC (46 KB)
[v5] Tue, 23 Dec 2014 20:05:00 UTC (46 KB)
[v6] Fri, 10 Apr 2015 16:25:04 UTC (47 KB)

Which authors of this paper are endorsers? | Disable MathJax (What is MathJax?)



www.robots.ox.ac.uk/~vgg/

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Department of Engineering Science, University of Oxford.

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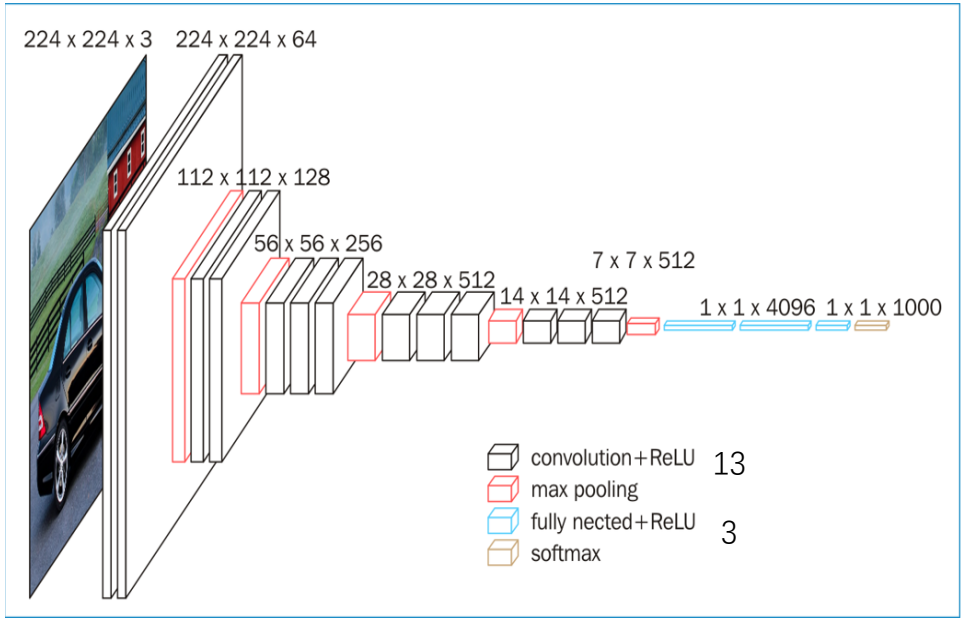
VGG16 - a brief introduction

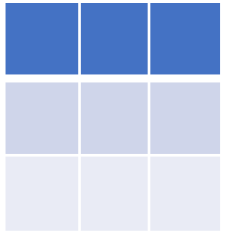
- Why 16

Network structure



Key parameters

Name of the layers	Number of layers
Convolutional Layer	13
Fully connected Layer	3
Pool Layer	5



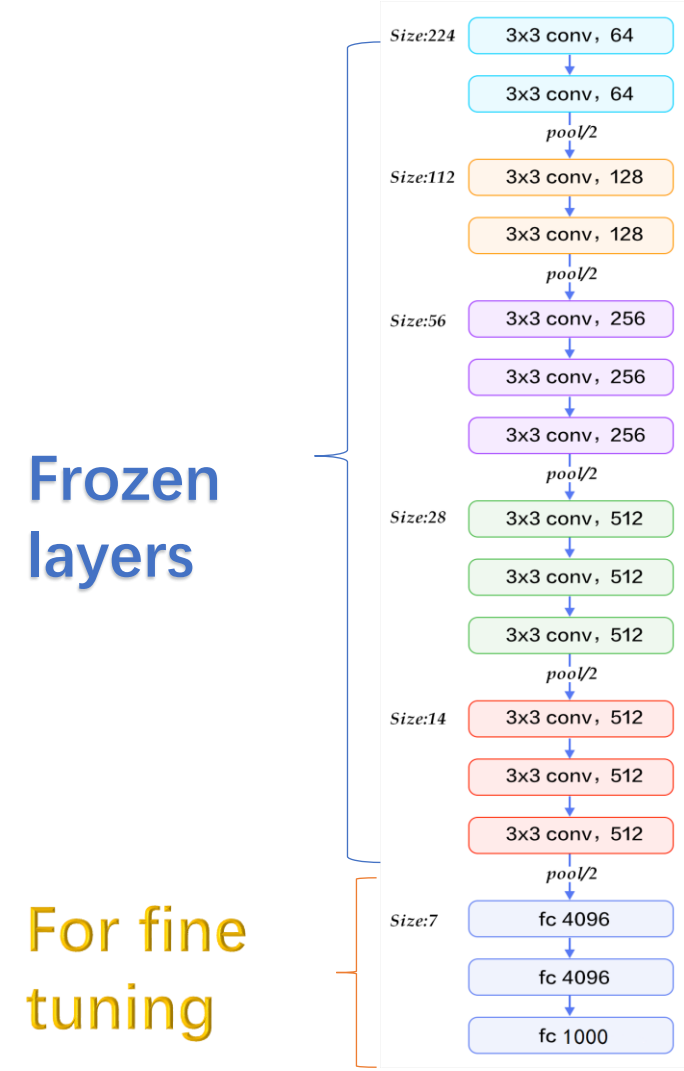
Kernel size 3x3

Padding = same

Training process

Usually the first layer is not particularly related to the specific image data set,while the last layer is closely related to the selected data set and its task goal [1]

- froze parameters of former 13 layers
- train it and get features
- use the features set to train last 3 layers
- combine the two sections
- do predicting



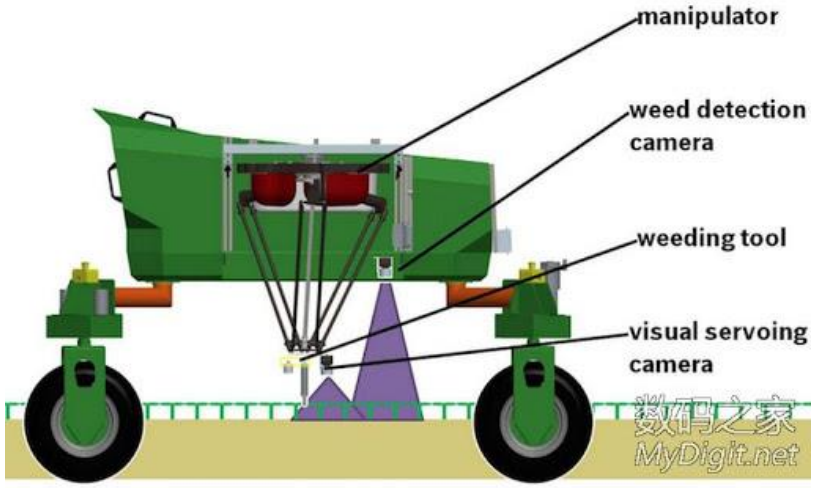
[1] How transferable are features in deep neural networks（NIPS2014 Bengio et al.）

The predict result

```
2020-06-17 06:43:57.714772: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1102] Device
or with strength 1 edge matrix:
2020-06-17 06:43:57.714783: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1108]      0
2020-06-17 06:43:57.714789: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1121] 0:   N
2020-06-17 06:43:57.717723: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1247] Created
localhost/replica:0/task:0/device:GPU:0 with 30233 MB memory) -> physical GPU (device: 0, na
 pci bus id: 0000:5b:00.0, compute capability: 7.0)
2020-06-17 06:43:59.421417: I tensorflow/stream_executor/platform/default/dso_loader.cc:44]
ic library libcublas.so.10
2020-06-17 06:43:59.686477: I tensorflow/stream_executor/platform/default/dso_loader.cc:44]
ic library libcudnn.so.7
the accuracy is:
0.89
lianglicheng@sdlm-PowerEdge-R940xa:~/corn$
```

Future development

· Automatic weeding.



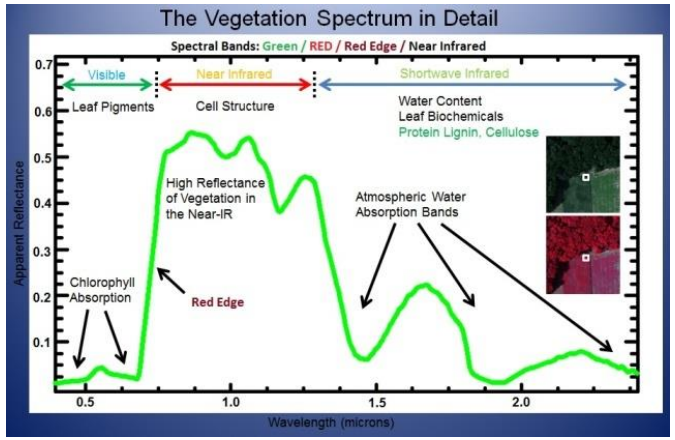
· Count the number of fruits.

(Target Detection)

Future development

· Plant health testing.

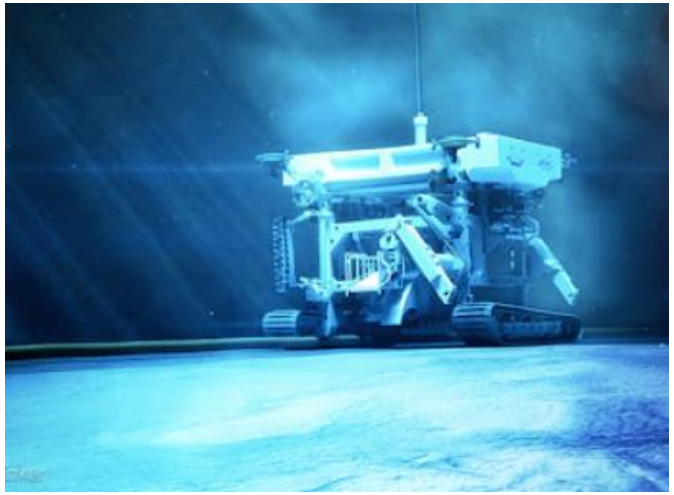
(Multispectral camera)



(Spectrum)

· Underwater mapping.

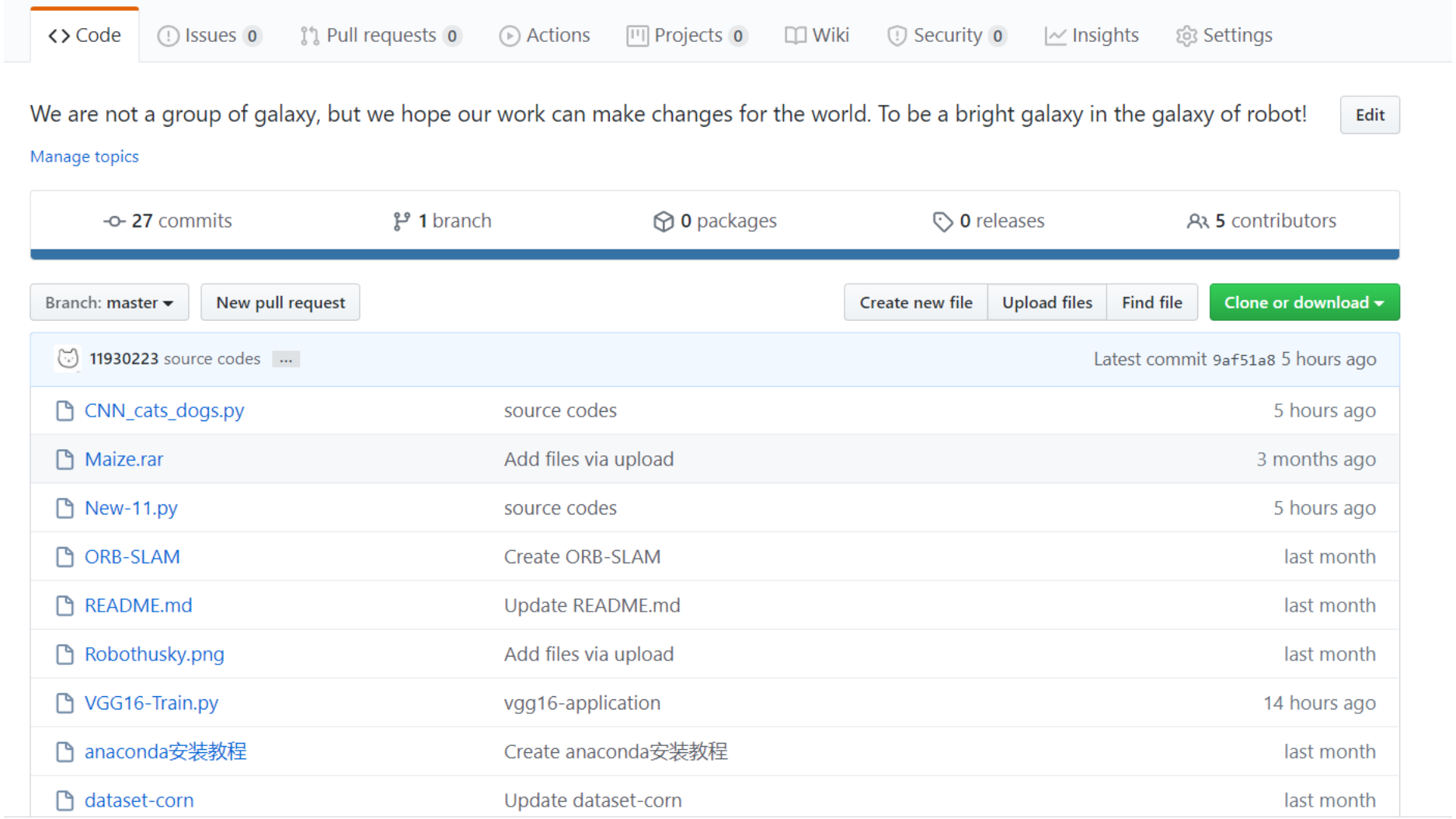
(ultrasonic sensor)



Cost

product	price	remarks
Manifold 2-C	8000	DJI Y
FPV-Insight SE	1650	Insight Y
MV-CE060-10UC	1300	海康威视 Y
Mini Scout	11000	松灵机器人 Y
Corn model	50	Alibaba N
Intel real sense D435	1200	Intel Y
13.3' TFT	150	创乐博 N
Standard Aviation aluminum support	500	https://m.tb.cn/h.VP8phZa?sm=705ee9
Total	700	
Y: already have N: need buy		

GitHub: https://github.com/Galaxy-Motion/RobotHusky



GitHub: https://github.com/Galaxy-Motion/RobotHusky

dataset-corn	Update dataset-corn	last month
first_try.h5	source codes	5 hours ago
orb-feature-extraction.mp4	Add files via upload	last month
orb-mapping.mp4	Add files via upload	last month
orb-matching.mp4	Add files via upload	last month
predict1.py	source codes	5 hours ago
vgg16-read&test.py	vgg16-application	14 hours ago
vgg16_weights_tf_dim_ordering_tf_kernels_n...	source codes	5 hours ago
vm虚拟机+Ubuntu16.04+ros系统安装教程	Create vm虚拟机+Ubuntu16.04+ros系统安装教程	last month
使用cnn分类的一个例子	Create 使用cnn分类的一个例子	20 days ago
利用图片增强的技术增加数据集	Create 利用图片增强的技术增加数据集	3 days ago
有关图像识别的资料	Create 有关图像识别的资料	last month
有关深度学习的资料	Create 有关深度学习的资料	last month
有关语义分割的资料	Create 有关语义分割的资料	last month
深度学习500问	Create 深度学习500问	3 days ago

README.md

Thank you!

We are not a group of galaxies, but we hope our work can make changes for the world and to be a bright star in the galaxy of robot!

我们不是一群显赫的人，但是我们希望我们能为世界带来改变。在机器人的银河系中成为一颗绚丽的新星！