AISAAC PROJECT
Network Search Architecture Model in domain data classification.

Agenda

Document information

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AISAAC basic information

AISAAC is a visual classification system, that can create dynamic convolution neural network architecture dedicated for specific set of images. Thanks to this image classification is very precise and can recognize anything that human can using only visual recognition. You can classify industrial materials, food, plants, machines, medical images (and many more) and create advanced quality control system with precision higher then 85%.

System works in three phases

- Data acquisition
- Model training
- Production classification

Thanks to it modular architecture and advanced technology, you can easily train models on your custom domain data. Most of system components are hosted inside Docker containers, so system is cloud agnostic.

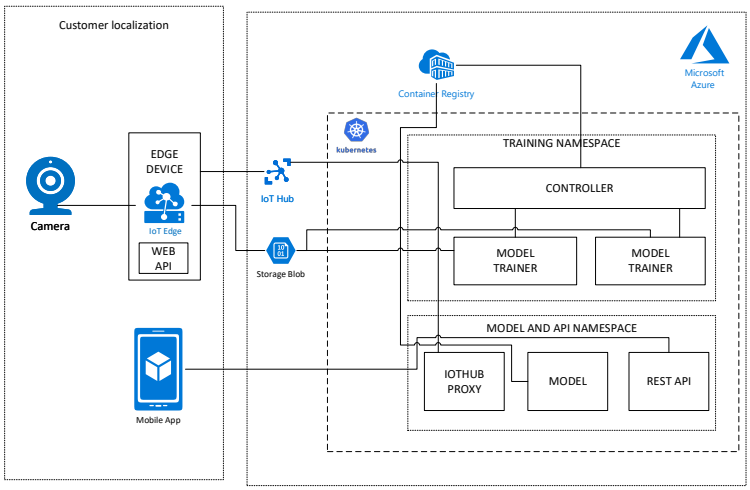
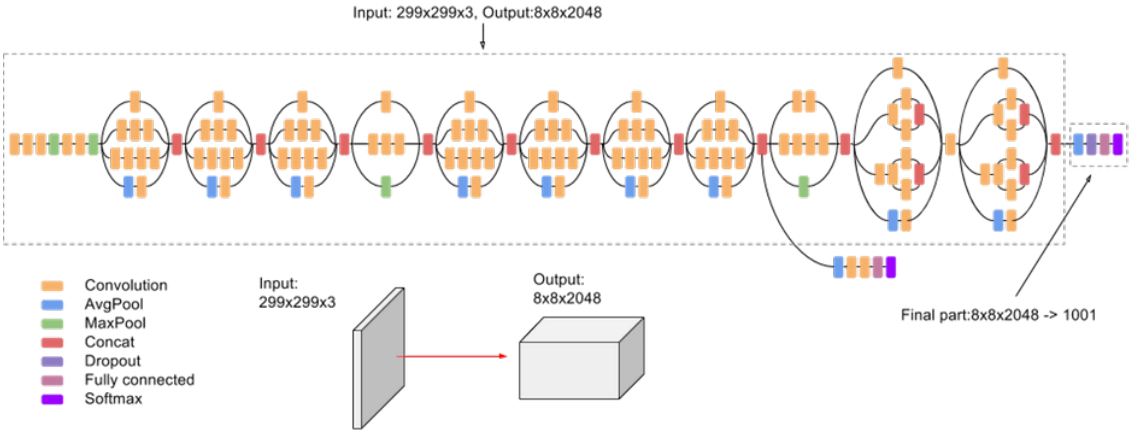


Figure 1 AISAAC HIGH LEVEL SCHEMA

Technology used in project for classification.

Main classification mechanisms are based on deep learning algorithms.

Deep learning is the part of machine learning based on human brain analogy. The models are constructed from layers used in artificial neural networks. One of the subclasses of deep learning are **convolutional neural networks (CNN)** which are mainly used to image processing like classification or object detection. Classic CNN models (like Inception V3) are built based on many convolution layers connected in different way.



Picture 1 Inception Model V3 CNN architecture

Those models are trained on datasets of classic images. Dataset used for training purpose is ImageNet that contains more than 14 000 000 pictures. These models are optimized for normal image detection.

The problem occurs when we need to classify domain specific images. Then classic models can be trained using transfer learning. Their accuracy in classification problem is about 80%.

Thanks to cloud computing scaling possibility, new technology was created, providing us possibility to use network architecture search and create best architecture of CNN for specific domain images. In our studies, this mechanism obtain accuracy at level of 90% on industrial material images dataset, which was better by 10% then classic image classification models.

Based on the newest researches, Chmurowisko created AISAAC neural architecture search mechanism, that can create models with high classification accuracy for specific domain image datasets.

Datasets acquisition phase

In this phase data are transferred to the cloud storage by dedicated mobile app or edge device with camera. Device is installed on customer production localization and integrated with automatic triggers.

In both scenarios data must be labeled by client. Every category of data requires at least 200 images. Most of our production solution have more than total 10 000 images in training dataset. This stage lasts about two months and require customer cooperation to label data.

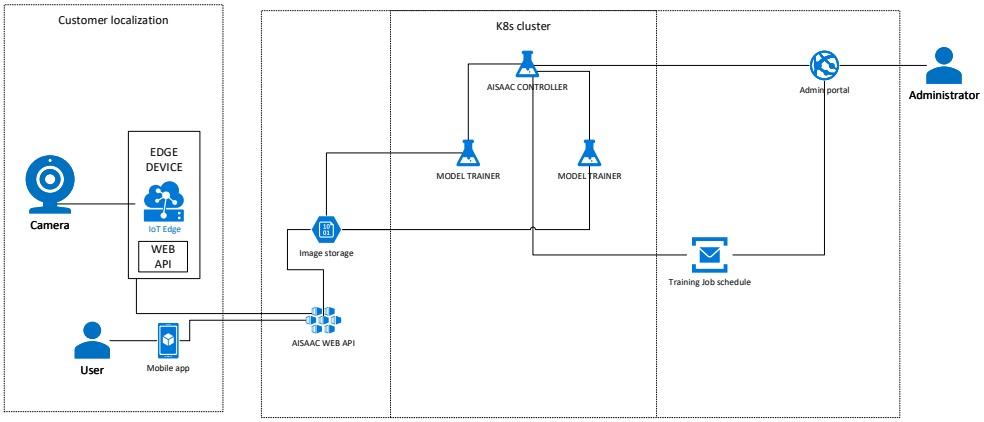


Figure 2 Data acquisition architecture

Training phase

In this phase classification model is created. Using labeled data from phase one, our reinforcement learning mechanism is searching the best CNN architecture for model. Controller is training hundreds of different models, choosing the best modifications to it architecture and then adding new layers of CNN. Whole training process is parallel thanks to cloud computing possibilities and takes something about one day per iteration. The whole phase lasts about four weeks.

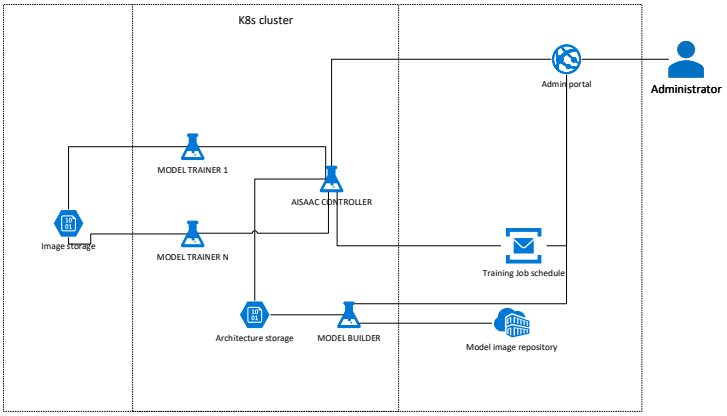


Figure 3 Training model architecture

Administrator can see all possible training and their results and then choose best fitted model, or system can make auto selection. Model builder based on tested CNN architecture creates model and deploy him to container image repository.

Production deployment phase

In this phase system is deployed on production environment. Edge device or mobile app is customized for customer specific requirements (integration with internal customer systems, specific cloud provider etc.). This phase can take up to three months, based on customer requirements.

Case study

Problem definition.

Our customer wants to create automated system to classify steel based industrial materials. Normally this work requires skilled human for this process. The classification process have to be done by mobile app and integrate with internal ERP system.

Data acquisition

Dataset was prepared by client and have 80 000 images divided to 30 categories.

Classification results

Results of classification process was better than human classification results. Our model scores 90,544% of precision. Model also detected human errors in image labeling at data acquisition stage.

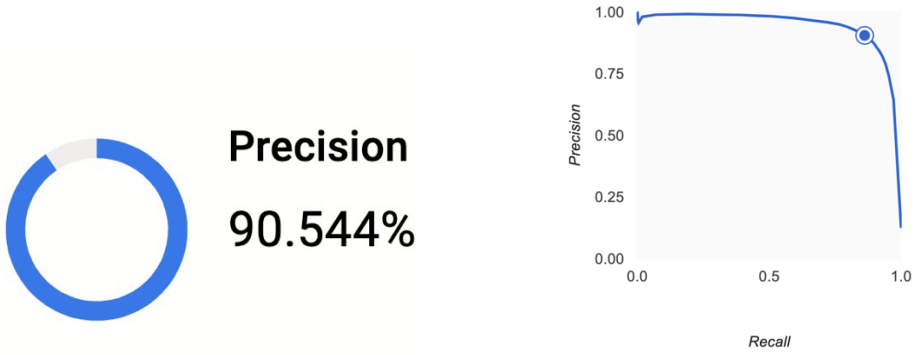


Figure 4 Model precision