NebulOuS - A Meta Operating System for Brokering Hyper-Distributed Applications on Cloud Computing Continuums

Windmill Maintenance

Michał Kłosiński, TTA
mklosinski@ttanalysis.pl

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Agenda

• Wind turbine inspection
• Use case background
• Cloud data processing pipelines
• Data processing approach with NebulOuS
• Software stack
• Deployment
• Data format
What we are working with?
TTA Background

- AirFusion: Cloud Asset Management platform
- Generic AI model integration
- Custom solution using dedicated model
- Flexible multi-step image analysis pipeline
- TTA: Next-gen data processing pipeline
- NebulOus: Seamless data processing on UAV, edge and cloud.
Cloud pipelines

Start

SubpipelineChoice

SegmentationRequest

SubimgCroppingRequest

ObjectDetectionSubimgRequest

SubimgMergingRequest

PostProcessingErOnlyRequest

ERSegmentationBasedBBBoxMergeRequest

TranslatePredictionResult

SavePredictionResult

HandleFailure

End

DamageDetectionRequest

SkipNotNeeded

CroppingRequest

DamageClassificationRequest

SeverityClassificationRequest

PostProcessingRequest
Algorithms behind

- Multi-step pipeline vs single model
- Trying out different algorithms and hyperparameters
  - Detection (YoloV2/V3, Detectron2 Faster-RCNN, EfficienDet)
  - Classification (Densenet121/201, Mobilenet, 3-5 layer CNNs, BiT Resnet)
  - Segmentation (PSPNet, Densenet), Unsupervised segmentation algorithms (GrabCut, kmeans/slic/felzenszwalb, other custom ideas)
- Pretrained weights, augmentation, anchors, noisy cropping data for classifiers
- Severity regression/classification
- Finding similar damages labeled differently
- Background replacement
Process transformation

Before
Process transformation

Before

Data capture → Quality assessment and data upload → Blade part detection → Damage detection and clearing house → Damage classification → Severity assessment → Report generation

After

Data capture → Quality assessment
Process transformation

Before

After
Process transformation

Before

Data capture → Quality assessment and data upload → Blade part detection → Damage detection and clearing house → Damage classification → Severity assessment → Report generation

After

Operator

Data capture → Quality assessment → Blade part detection → Clearing house → Damage detection → Damage classification → Severity assessment
Process transformation

Before

Operator
Data capture → Quality assessment and data upload → Blade part detection → Damage detection and clearing house → Damage classification → Severity assessment → Report generation

After

Operator
Data capture → Quality assessment → Blade part detection → Clearing house → Damage detection → Damage classification → Severity assessment → Report generation

Analyst
Process transformation

Before:

- Manual quality assessment
- Manual data upload
- All processing done in the cloud
- Batch process

After:

- Immediate quality feedback
- No dedicated data upload step: automated process involving initial data analysis
- Asset management application involved only after data is processed
- On-line process
Software stack
Deployment perspective
Collected data
Collected data
Collected data
Collected data
Collected data
Collected data
Collected data
Questions?
Thank you.

Michał Kłosiński
mklosinski@ttanalysis.pl