Instance Segmentation of Water Body from Aerial Image using Mask Region-based Convolutional Neural Network

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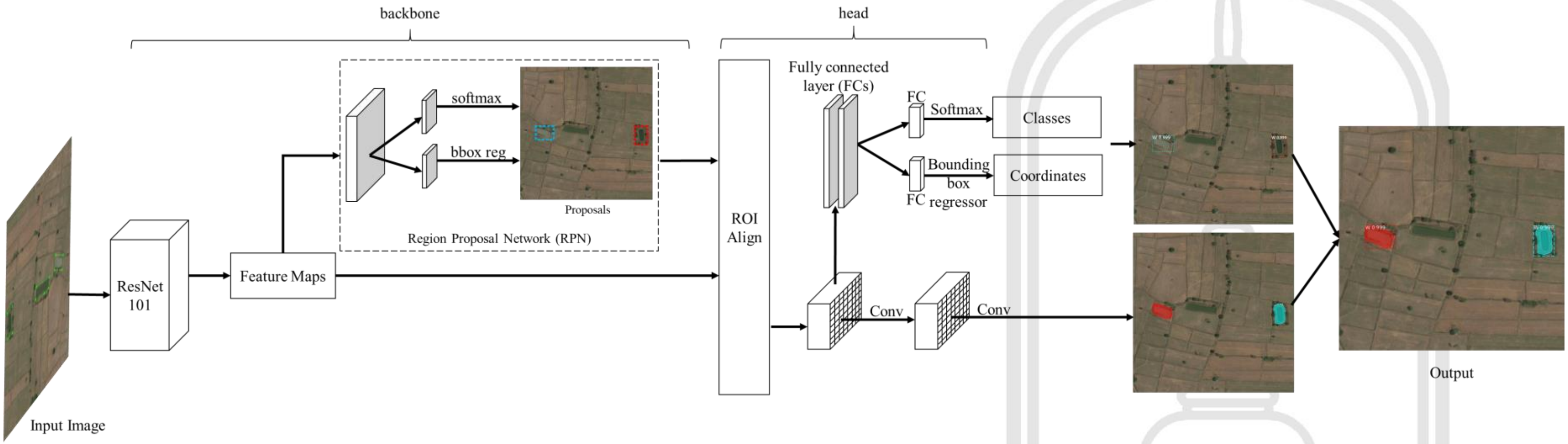
INTRODUCTION

- The two terms “land cover” and “land use” are typically used together
- Over the past ten years the difference between land cover and land use has attracted many researchers prompted by a change in land cover to accommodate changes in land use.
- As such, if land use data are accurate and up-to-date, we can apply that information to many objectives, such as city planning, environmental audit or evaluation, and national policy

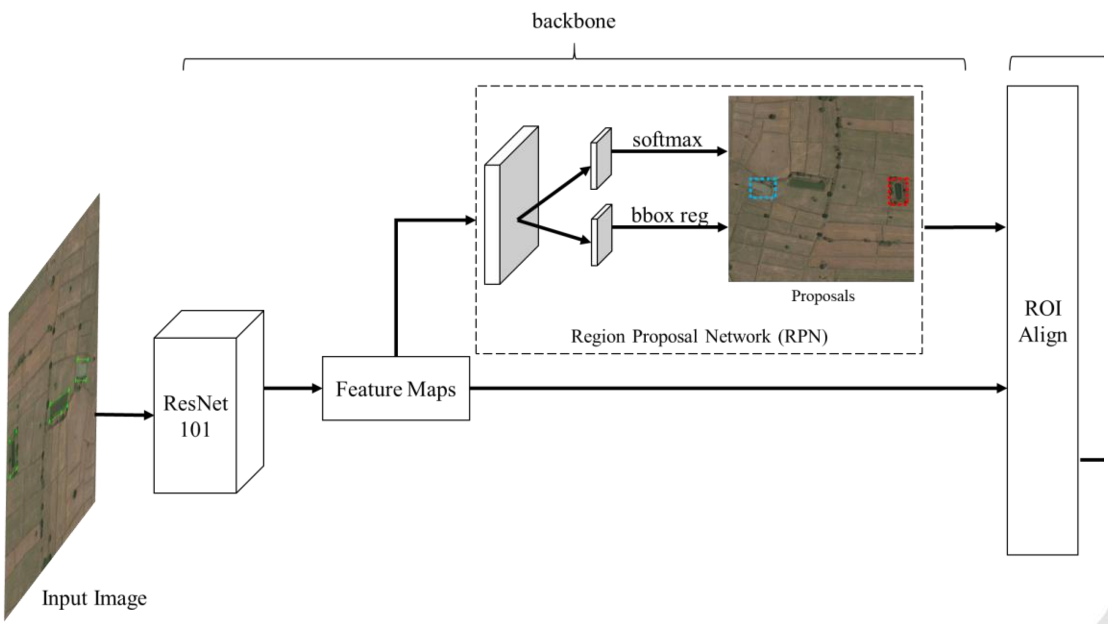
Contribution

- This article presents mask region-based convolutional neural network (Mask R-CNN) for water body segmentation from aerial images.
- Mask R-CNN architecture was tested with aerial image water resources dataset (AIWR).
- The AIWR is the images of agricultural areas in the northeast region of Thailand
- Water body data were collected from 2 types, natural water bodies (W1) and artificial water bodies (W2).
- The aerial images of water bodies were different in color, shape, size, and similarity.
- This dataset includes 800 images, so AIWR dataset challenges the instance segmentation process.

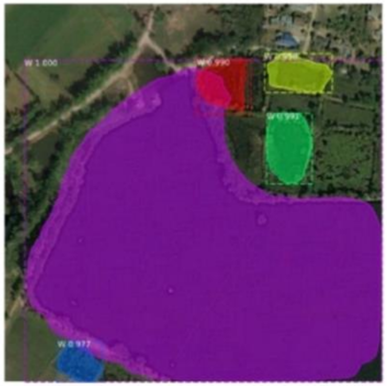
MASK R-CNN ARCHITECTURE



- Backbone Architecture



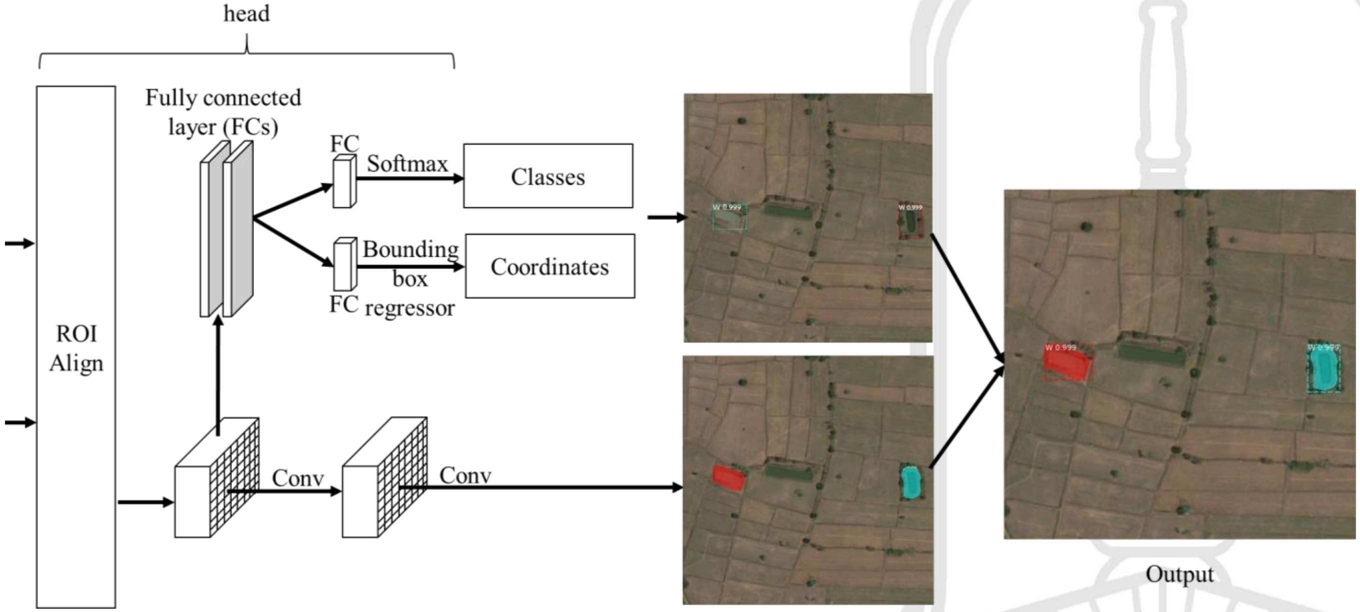
Faster R-CNN method



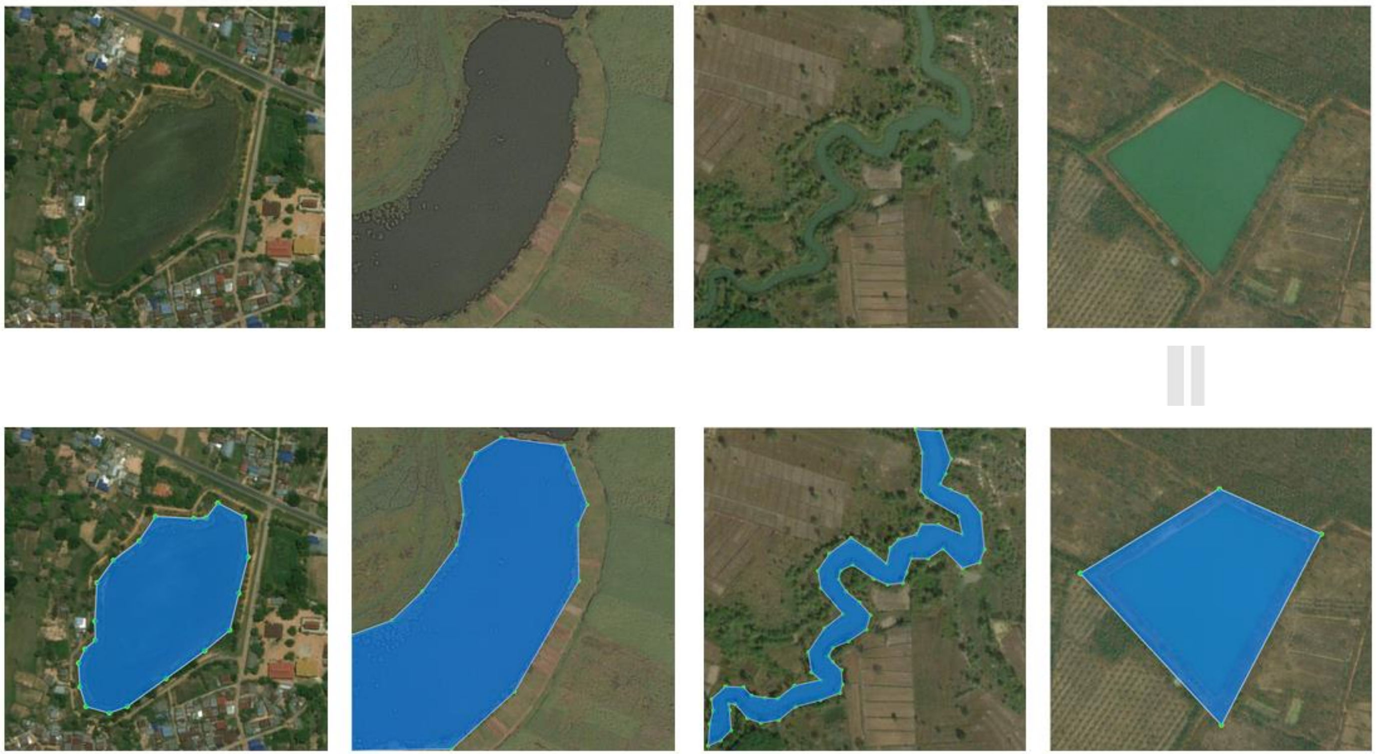
Mask R-CNN

ResNet-101 was used as backbone architecture.

- Head Architecture



AERIAL IMAGE WATER RESOURCES DATASET (AIWR)



aerial images

ground truth

- Aerial image water resources dataset, AIWR : 800 images

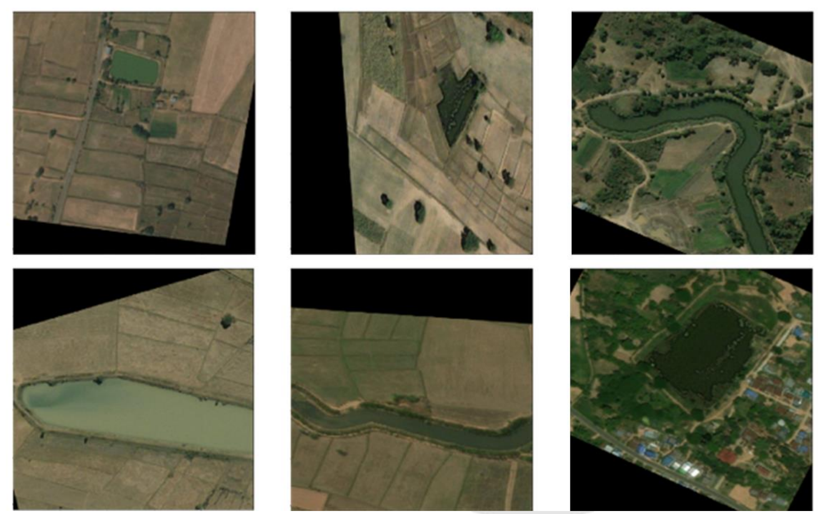
Train : 720	Test : 80

- There are 4 challenging objectives:
  - color,
  - shape,
  - size,
  - similarity

Color shape size similarity

EXPERIMENTAL RESULTS

- Those images were divided by the 10-fold cross-validation method.
- All aerial images were resized to 512x512 pixel.
- The parameters used for Fine-tune, for example
  - NUM_CLASSES=2
  - IMAGES_PER_GPU = 1
  - LEARNING_RATE=0.0001
- GPU GeForce GTX 1070 Ti, Intel(R) Core-i5, 7400CPU @ 3.00GHz, 8GB RAM, Linux Operating system.
- Data augmentation, which includes
  - Scale
  - translate_percent
  - Rotate
  - shear



- Model evaluation

To Evaluation Mask R-CNN algorithm, we use mean average precision (mAP)

$$mAP = \frac{1}{N}\sum_{i=1}^{N} \mathrm{AP_i}$$

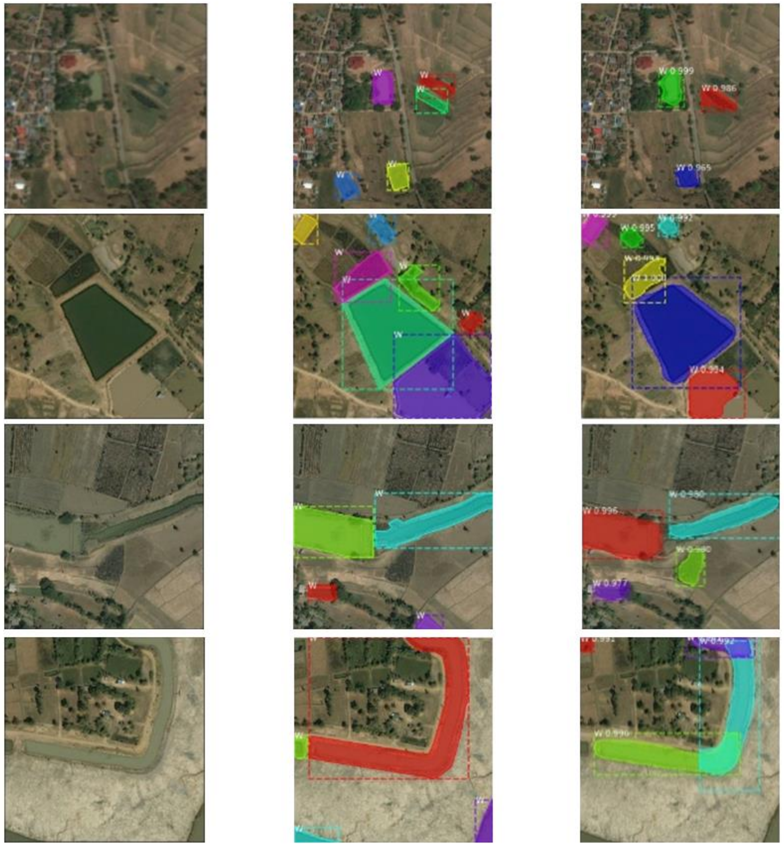
Result of instance segmentation of water body

The result of the experiment using mask R-CNN with the AIWR Dataset.

Augment	Validation loss	mAP	Training Time	Test Time /img
False	1.08	0.30	11d 15h 16min 27s	3 µs
True	0.41	0.59	12d 9h 48min 25s	4 µs

Result of instance segmentation using mask R-CNN with data augmentation.

A) Aerial images
B) images with ground truth
C) instance segmentation



a) b) c)

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Error results in segmentation.

A) Aerial images

B) images with ground truth and

C) error of instance segmentation.

CONCLUSION

- This research tested with aerial images of water resources dataset (AIWR).

- This research tested the accuracy of instance segmentation by Mask R-CNN together with data augmentation.

- This research has shown that the mask R-CNN architecture combined with data augmentation can identify the water surface using the mAP value for measurement. The mAP value was up to 0.59.

- In future work, because the data tested is aerial photography obtained from Bing map, only RGB colors can be tested.

- If other research can use data from satellites, such as Landsat, which has a band specifically for water analysis, the result of an analysis of water bodies with different color might give higher accuracy.

- Any new architecture suitable for water body analysis might be used to expect an even higher accuracy rate.

THANK YOU FOR YOUR ATTENTION