Final Report for Short-Stay Study Abroad Program 2017

School and Dept.	School of Multidisciplinary Sciences, Department of Informatics		
Present year: 2017	2017	Doctoral course	3 years
Name	Trung-Nghia LE		
Destination country	The United States of America		
Receiving univ./institute	The University of Dayton		
Period of study	29 days		
Date of report	11/14/1017 * A final report must be submitted within one month upon your return.		

University of Dayton

The University of Dayton (UD) is an American private Roman Catholic national research university in Dayton city, Ohio state. Founded in 1850 by the Society of Mary (Marianists), it is one of three Marianist universities in the nation and the second-largest private university in Ohio. The University has about 8,000 undergraduate and 2,200 post-graduate students from a variety of religious, ethnic and geographic backgrounds, drawn from across the United States and more than 40 countries. It offers more than 80 academic programs in arts and sciences, business administration, education and health sciences, engineering, law and, in 1988, was first in the country to offer an undergraduate degree program in human rights.

During the Short-Stay Study Abroad Program 2017, I worked under the supervision of Prof. Tam Nguyen at "Vision and Mixed Reality Lab" housed in the Department of Computer Science, University of Dayton. Prof. Tam Nguyen is an Assistant Professor in the Department of Computer Science, University of Dayton. His research works about visual saliency models have been published in premier venues, i.e., ACM Multimedia, European Conference on Computer Vision, International Joint Conference on Artificial Intelligence, International Journal on Computer Vision, IEEE Transactions on Multimedia, IEEE Transactions on Circuits and Systems for Video Technology, Neurocomputing, and Multimedia Tools and Applications Journal. My Ph.D. topic has some significant overlaps with his research (i.e., computer vision and deep learning). Therefore, I joined a research project about camouflaged object segmentation at the University of Dayton under his guidance. I firmly believe the Short-Stay Study Abroad Program is a good opportunity for me to learn more, to see more, to broaden my vision and to improve myself.

Research Topic: Camouflaged Object Segmentation

Camouflaged objects attempt to conceal their texture into the background and discriminating them from the background is hard even to us human beings. The main objective of this paper is to explore the camouflaged object segmentation problem, namely, segmenting the camouflaged object(s) for a given image. This problem has not been well studied in spite of a wide range of potential

applications including discovering and preserving wildlife animals, surveillance systems, human search-and-rescue missions in natural disasters such as earthquake, flood, or hurricane.

The objective of my Ph.D. research is to utilize deep learning for salient object segmentation. Salient object predictors aim to detect and segment salient objects in images. Though "salient" is opposed to "camouflage", techniques developed for salient object segmentation can be used for camouflaged object segmentation. This is because the two tasks target at highlighting some image regions with certain characteristics. Thus, this research project totally benefits for my Ph.D. study at NII, SOKENDAI. That is the reason that I applied to the Short-Stay Study Abroad Program in FY 2017.

Research Schedule

While joining the Vision and Mixed Reality Lab at the University of Dayton, I worked on the project of camouflaged object segmentation using deep learning models. My work at the Vision and Mixed Reality Lab focuses on building a new dataset and conducting experiments. The plan details are as follow:

- From 9/18 to 9/27, I collected 5000 images from the Internet and filtered out unsuitable images, kept 2500 images. This work was supported by two students from the University of Dayton.
- From 9/30 to 10/7, I and two students from the University of Dayton manually annotated the ground-truth label for the dataset.
- From 10/8 to 10/12, I trained the network and conducted necessary experiments.

After that, I returned to Japan and wrote a research paper at NII, SOKENDAI. We finished the paper and will submit to CVPR 2018 (the deadline is 11/15/2017). All discussion and paper writing are performed in English.

Research Results

In this project, we provided a new image dataset of camouflaged object segmentation where each image is manually annotated with pixel wise ground-truth. We also proposed a dual stream network (**DSN**) for camouflaged object segmentation where the classification stream and the segmentation stream are effectively combined to achieve good performance. Extensive experiments conducted on the newly built dataset demonstrate the superiority of the proposed framework. In addition, our method is computationally efficient, running in real time. We believe that our provided dataset will promote work to further explore this interesting yet challenging problem.
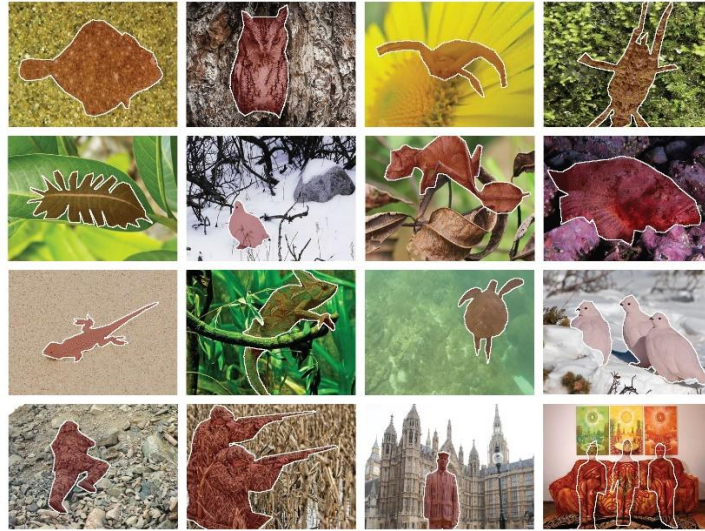
Figure 1. Example annotations of our collected dataset with ground-truth segmentation masks overlaid.
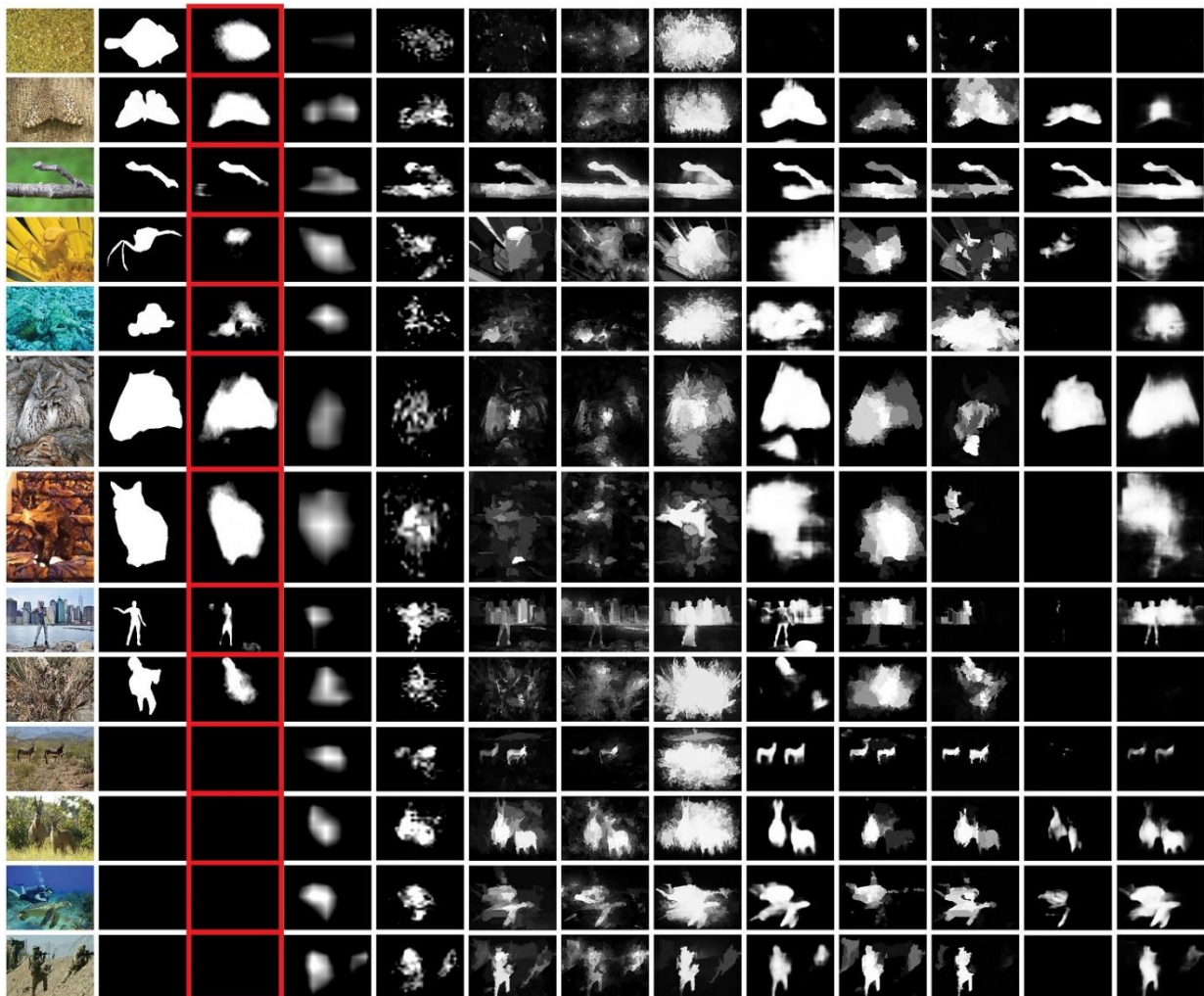

Figure 2. Visual comparison of our method against the state-of-the-art methods. From left to right, input image and ground-truth are followed by outputs obtained using our method (**DSN**) and the other methods. The first nine rows are images with camouflaged object. Our method surrounded with red rectangles achieves the best results.

Expenses

The expenses are used as below:
- Visa and insurance: 33,000 JPY.
- Domestic travel expenses: 2,960 JPY in Japan and 140 USD in US.
- Round-trip international airfares: 172,960 JPY.
- Accommodation: 161,897 JPY.
- Living expenses: 700 USD.

Opinions

I would like to thank SOKENDAI and the Short-Stay Study Abroad Program. The trip to University of Dayton sponsored by the Short-Stay Study Abroad Program is a good opportunity for me to learn more, to see more, to broaden my vision and to improve myself. In addition, I made new friends, worked with new professors, as well as had more connection for further research in the future.

Some Photos

Figure 3. Vision and Mixed Reality Lab, University of Dayton.