MINISTRY OF EDUCATION AND TRAINING

VIETNAMESE GERMAN UNIVERSITY

SOCIALIST REPUBLIC OF VIETNAM

Independence – Freedom - Happiness

APPLICATION FORM

Project Title: Aerial-view traffic image segmentation using deep learning
Code:

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Department/Program: EEIT
Faculty: Faculty of Engineering

I. SUMMARY

Traffic jam has always been a major concern and distress for many citizens in crowded city like HCM and Hanoi. Several solutions have been carried out, including: Allocating extra police resources to conduct the traffic flow; asking voluntary drivers to provide the traffic status at that road segment, which will then be updated and publicly informed on the radio channel, etc. However, these approaches are very costly, inefficient, using mainly human labor, serving as short-term solutions. To partly solve this problem, we propose the use of UAV (drone) to film traffic footage video, transmitting data back to the station and deploying an automated image segmentation algorithm on the captured aerial-view traffic images. Various potential applications, notably traffic density estimation, can be derived from the proposed framework. Our project makes use of a hot-trend and state-of-the-art approach – Deep learning, applied with fundamental techniques in image processing and computer vision.

The proposed project includes eight stages:

1. Performing academic literature research on deep learning, computer vision and traffic monitoring;
2. Deploying and evaluating neural network algorithms on computer and testing it with available online traffic dataset;
3. Building the drone and practicing the flying mechanism;
4. Flying the drone to capture realistic images of the exterior environment and enhance the training dataset. Re-training the neural network with the newly-updated dataset;
5. Setting up the wireless video transmission module between the drone and station;
6. Validating the quality of the streamed video in terms of spatial and temporal resolution as well as latency;
7. Assessing the performance of the deployed neural network algorithm in terms of object segmentation's accuracy on the transmitted video frames. In addition, we need to carry out experiments under various different traffic conditions for final assessments;
8. Finalizing the hardware & software product and writing report.

In the first stage, we need to do some research on previously published related papers on neural network, deep learning and traffic monitoring to find the best approach for the problem. So far, we have decided to adopt the image segmentation to estimate the traffic density.

In the second stage, we need to use deep learning algorithms to train a Convolutional Neural Network (CNN) model, which will perform semantic segmentation and differentiate between road and vehicles regions. Our algorithms utilize a novel CNN architecture – DenseNet. All the training of the model will be based on online available large dataset of traffic images on the internet, which might not fit with the real traffic scenarios of Vietnam.

In the third stage, we will rebuild our drone from scratch to fit with our purpose. We also have to train ourselves to be capable of controlling and flying the drone, which is the most challenging task, before applying the autonomous flying mode.

In the fourth step, we need to fly the drone to outside environment to enrich our training image dataset because the most of the dataset on online database are captured at side view of traffic, not from aerial

view (top view), which is the view of the drone. From this dataset improvement, we can make our CNN model much more accurate.

In the fifth stage, we will use the Wi-Fi communication module to set up a wireless video transmission kit between the drone and the station using the Raspberry Pi via SSH and ROS. By means of this kit, recorded video can be transmitted back and processed at the station. The transmission system must ensure that the recorded video quality is good enough for further processing on the computer; the frame rate is high enough for capturing all the traffic events and the transmission delay time is acceptable.

In the sixth stage, we will test the transmission in exterior environment by flying the drone outside again and transmitting back captured video to validate the performance of the transmission kit in terms of spatial and temporal resolution as well as latency.

In the seventh stage, we will take several frames from the video to validate the processing capability of the neural network algorithm in terms of segmentation accuracy. The validating experiments must be carried out at different road segment to ensure the robustness of the method.

In the last stage, we will write the report to summarize all the progress and achievement of the project.

The outcome of the project would be:

- *Hardware*: A drone equipped with a wireless transmission kit capable of streaming videos and images at reasonable spatial and temporal resolution as well as with acceptable latency.
- *Software*: A semantic segmentation model based on CNN DenseNet architecture trained with aerial view traffic dataset; tested on a single video frame at a time on the local server.

To conclude, the proposed project investigates a deep-learning-based image segmentation approach for aerial view traffic images. Specifically, a Convolutional Neural Network model adopting DenseNet architecture is implemented at server to segment vehicles and road scenes. In addition, the robustness of the algorithm is validated upon the realistic traffic images captured by an UAV equipped with Wi-fi transmission module. A promising application of this project could be a vision-based system for traffic density estimation.

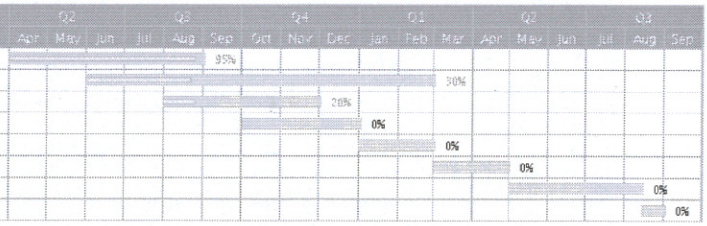
Keywords: UAV, drone, Deep learning, Convolutional Neural Network, Raspberry Pi, Computer vision, Traffic density, DenseNet.

II. TIMELINE

Please provide a general timeline for your research project, including the start date, the completion date, and the current status of your project

Start Date: 1st September, 2018
Completion Date: 1st September, 2019
1st April 2018 – 1st September 2018: Performing literature review 1st June 2018 – 1st March 2019: Deploying CNN model and validating on online datasets of aerial-view traffic images 1st August 2018 – 1st December 2018: Setting up transmission module for the UAV 1st October 2018 – 1st January 2019: Building the drone 1st January 2019 – 1st March 2019: Gathering training data 1st March 2019 – 1st May 2019: Validating UAV transmission module 1st May 2019 – 1st August 2019: Validating CNN model on the traffic image transmitted from UAV to the station 1st August 2019 – 1st September 2019: Writing report

	Task Name	Duration	% Complet	Assigned to
1	Performing literature review	5 months	95%	Phuc & Khiem
2	Deploying CNN model & validating on online dataset of aerial-view traffic images	10 months	30%	Phuc & Khiem
3	Setting up transmission module for the UAV	4 months	20%	Khiem
4	Building the drone	3 months	0%	Phuc
5	Gathering training data	2 months	0%	Phuc
6	Validating UAV transmission module	2 months	0%	Khiem
7	Validating CNN model on the traffic image transmitted from UAV to the station	3 months	0%	Phuc & Khiem
8	Writing report	1 month	0%	Khiem



III. BUDGET

Please complete the following form by listing the itemized projected expenses for your research project. When expenses are not known, make a conservative estimate. Remember that receipts will be required for reimbursement of all expenses from VGU. Items which you expect to fund from sources other than the anticipated grant should be included in the 'total estimated cost' line, but excluded from the 'total requested funding' line.

Item	Estimated cost	Requested funding	Note
Motor	2,200,000 VND	2,200,000 VND	x4
Flight controller	4,400,000 VND	4,400,000 VND	
ESC	1,100,000 VND	1,100,000 VND	x4
Receiver	700,000 VND	700,000 VND	
Frame	2,000,000VND	2,000,000VND	
Lipo battery	2,200,000 VND	2,200,000 VND	x2
Gimbal	3,300,000 VND	3,300,000 VND	
Raspberry Pi 3	2,000,000 VND	2,000,000 VND	
Camera	1,100,000 VND	1,100,000 VND	
Wi-Fi module	1,000,000 VND	1,000,000 VND	
TOTAL:	20,000,000 VND	20,000,000 VND	

IV. ACADEMIC SUPERVISOR

I have reviewed this project description and projected budget, and I support this undergraduate research grant request.

N. Thien Nguyen Minh Hien 31.08.2018

Supervisor's signature *date*

Pham Anh Duy 31.08.2018

Supervisor's signature *date*

Biện Minh Trí 04/09/2018

Supervisor's signature *date*

V. ACADEMIC RESEARCH

The proposed undergraduate research project is supported by the following research grants solely or jointly administered by me (*leave blank if not applicable)*:

Supervisor's signature

Grant title:
Principal Investigator:
Project number:
Source of funding:

DO NOT WRITE BELOW THIS LINE

(This part is filled in by the Chair of the Evaluation Committee)

Comments:

Decision:

Funded amount:

Date:

Signature:

Name:
