Accuracy and effectiveness of 3D model reconstruction from UAV photogrammetry for physical road safety investigation

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I. Introduction

Traditionally, the inspection of the physical roads for assessing road safety can use many methods such as field surveying and the use of tape measurement. If a road safety audit needs to inspect a large area, it will be time-consuming and labor-intensive to survey in the field. Also, it might be very costly compared to conventional survey. In the present, the UAV photogrammetry has an important role in the applications of topographic survey because it can help for time-saving methods and reducing the cost of survey (Ismael & Henari, 2019). In particular, the UAV approach has been widely used that is concerned with the study of the physical factors for roads. For example, the use of an unmanned aerial vehicle (UAV) can apply to provide the topographic data for road design and traffic accident investigation (Outay et al., 2020; Pérez et al., 2019; Zulkipli & Tahar, 2018). Thus, the application of UAV photogrammetry has enormous potential for surveying the physical road conditions in order to assess the road safety.

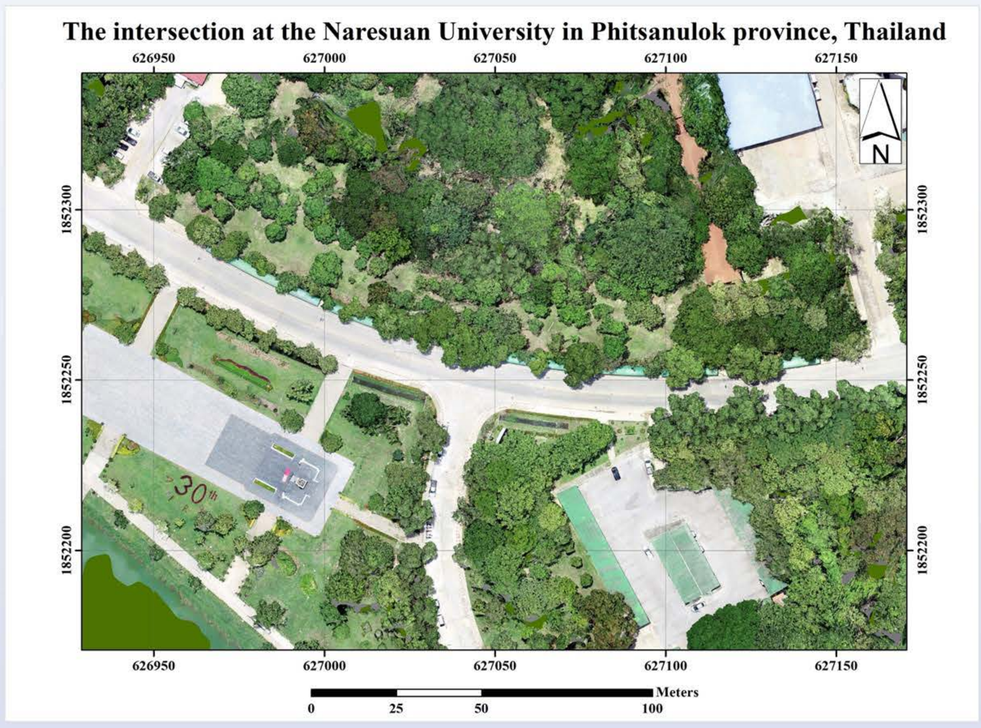

Figure 1. The intersection used in this study area.

II. Methodology

The purpose of study is the application of UAV photogrammetry in order to inspect the physical factors of the intersection for evaluating the road safety. Figure 2 illustrates the methodology used for this study.

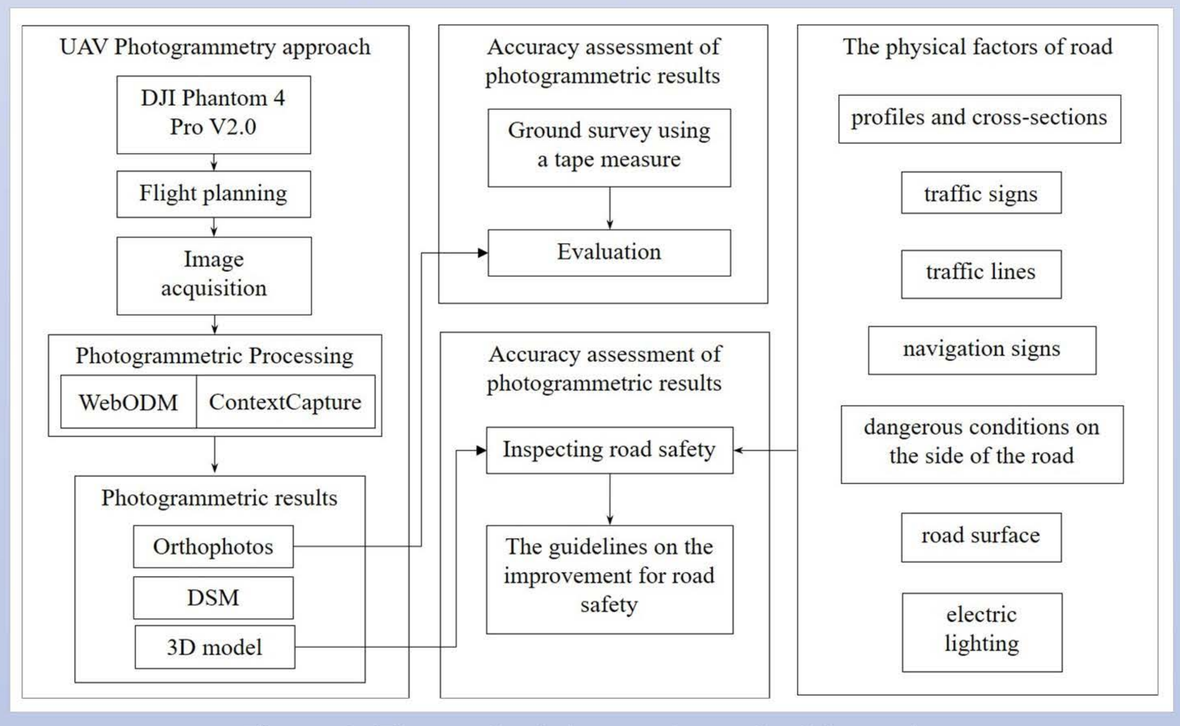

Figure 2. The methodology schema in this study.

References

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III. Results and Discussion

The results of 3D models obtained from the WebODM and ContextCapture photogrammetric software packages are presented in Figure 3. For assessing the photogrammetric accuracy from different software packages and different altitudes of UAV, the values of statistical errors from both photogrammetric software packages are showed in Table 1.

Figure 3. The 3D models obtained from (a) WebODM, and (b) ContextCapture using the UAV flying height at (1) 50 meters, and (2) 70 meters above the ground.

Table 1. The statistical errors for the assessment of photogrammetric accuracy.

Software	UAV flying height (m)	Errors	
		Mean (m)	RMSE(m)
WebODM	50	0.073	0.088
	70	0.095	0.104
ContextCapture	50	0.042	0.071
	70	0.054	0.082

From Figure 1, the radius of this curve was approximately 250 meters. Normally, the speed limits of this designed curve should not more than 60 – 70 kilometers per hour. However, the suitable speed limits of the curve for all vehicles should not more than 40 kilometers per hour following a guideline for road safety. That is the reason why traffic accidents might happen easily at the intersection. Road safety is not guaranteed by road design and construction regulations (Huvarinen et al., 2017). Hence, this intersection should have improved to increase road safety, as illustrated in Figure 4.

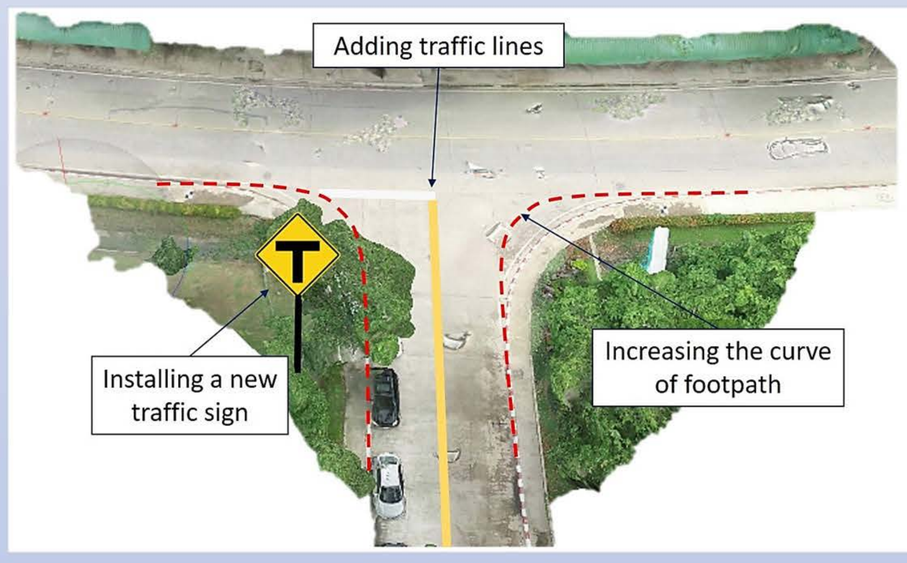

Figure 4. The guidelines on the improvement of the intersection for road safety.

IV. Conclusion

The potential of the UAV photogrammetry has been utilized for inspecting preliminary road safety for this study. The application of UAV approach also helps decrease time-consuming and labor-intensive methods of road safety audits. Evaluating some physical factors of roads can identify on the 3D model reconstructed from the UAV imagery that facilitates extensively the assessment of the road safety. In this study, the photogrammetric accuracy from UAV approach depends on the photogrammetric software for processing. The WebODM opensource/free software can be potentially used for generating 3D models and photogrammetric results that provide accuracy at decimeter level. The outcomes of UAV photogrammetry (i.e. orthophotos) were used to analyze the causes of traffic accidents for decreasing human and economic loss. Moreover, a 3D model of the road was applied for offering guidelines on the improvement of road safety in the future.

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