

**Authors' response to Reviewers of
"Enhancing Urban Mobility through Traffic Management with UAVs and VLC Technologies"
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(Manuscript Drones-2724071)**

REVIEWER 3:

Authors: We sincerely thank to Reviewer for their valuable feedback and insightful suggestions. We truly appreciate your time and effort in reviewing our paper.

Reviewer: In this paper, the authors present the challenges in future traffic and mobility, proposing a solution based on the UAV equipped with VLC technologies. The structure and presentation are well organized; however, there are a few points that need to be more clear.

- 1) It could be better to add more practical (real urban traffic) data-based simulation results, at least with some case studies.

Authors: We appreciate your suggestion regarding adding more results. While we acknowledge the conventional expectation for research papers to include a results section that bolsters the proposal, this is not entirely applicable to our current work. Instead, our aim is to pave the way for a new avenue of research within the realm of Smart Cities development. We encourage fellow researchers to center their theses on the evolution of this application. Therefore, the primary objective of this paper is to present a prototype and propose a novel approach to urban traffic management using UAVs and VLC technologies. In the case of this prototype, the presented work offers an alternative for integrating various technologies and establishing a network of UAVs tailored for a specific application. The actual implementation is reserved for future endeavors, constituting a significant challenge that we are actively addressing. However, achieving this implementation requires additional time. Hence, our current focus is to solidify this proposal as a prototype.

To compensate for the absence of a traditional results section, we have incorporated an evaluation segment detailing the advantages, needs, problems, and potential research directions arising from our work. Through this analysis and evaluation, our primary objective is to establish the groundwork for a research trajectory centered on this application. We hope for your understanding regarding our unique approach and the overarching goal of this work, irrespective of the absence of a dedicated results section.

In the context of a prototype proposal, the results are inherently embedded in the description of the prototype itself. This paper introduces the conceptual framework or system architecture and integrates technologies to address urban traffic challenges. Since the work is centered around developing and proposing a prototype, a traditional standalone results section, as seen in more mature studies, may not be applicable. This means that the culmination of this paper lies in the tangible form of a prototype—an integrated amalgamation of diverse technologies complemented by the introduction of a novel communication protocol and messaging system, collectively embodying the proposed solution for enhanced urban traffic management.

Nevertheless, we understand the importance of clarity in presenting our findings. To address this concern, we ensure that the manuscript explicitly highlights and discusses the outcomes and

implications of our prototype throughout the document, providing a clear narrative of the system's performance and capabilities. We have included a new section to cover all of these issues.

Additionally, concerning the validation of the framework, its components have undergone independent validation in a lot of works in the literature. As an instance, the selection of YOLO is substantiated by findings in the literature, where vehicle detection has been thoroughly tested. We have gathered data to justify and validate this choice, drawing upon [new reference 1]. VLC links are tested in [reference 10 in the paper].

New References:

[new reference 1] J. -a. Kim, J. -Y. Sung and S. -h. Park, "Comparison of Faster-RCNN, YOLO, and SSD for Real-Time Vehicle Type Recognition," 2020 IEEE International Conference on Consumer Electronics - Asia (ICCE-Asia), Seoul, Korea (South), 2020, pp. 1-4, doi: 10.1109/ICCE-Asia49877.2020.9277040.

- 2) The machine learning part of the paper is to some degree well written; however, there seems to be insufficient optimization methods in practical VLC-UAV operation.

Authors: We appreciate your feedback on the machine learning section. It's important to note that our objective in this paper is not to extensively optimize the machine learning methods or the practical VLC-UAV operation. The tools chosen are selected for their availability, and our intention is to introduce the architecture and prototype for enhancing traffic, rather than focusing on optimization at this stage. While optimization is acknowledged as a potential avenue for future work, our current emphasis is on presenting the overall system architecture and prototype.

- 3) The proposed approach assumes that fully networked VLC on the UAV is feasible. However, there are significant issues such as onboard processing, alignment problems, and S_Wap_C ... It could be beneficial to predict how those can be challenged so that subsequently the proposed method can be applied.

Authors: We appreciate your consideration of potential challenges related to fully networked VLC on UAVs. It's important to highlight that the current focus of this paper is on presenting the proposed approach and its potential applications as a new path for the research and developer community. We recognize that there are challenges to be addressed, and these considerations are crucial for future work. In a new section, we have included an evaluation of advantages, issues, challenges, future line to be solved. The intent of this paper is to introduce the concept and methodology, laying the groundwork for addressing such challenges in subsequent research.

Regarding the issues mentioned by the Reviewer, they are not a problem in this phase of the prototype for the following reasons:

- On-board processing: In the present era, chip technologies, such as AI accelerators based on GPUs, are providing extensive advantages for signal processing in diverse scenarios. Notably, these scenarios encompass nanosatellites, CubeSats, and, of particular relevance to our discussion, Unmanned Aerial Vehicles (UAVs), as elucidated in the recent reference **[new reference 2]**. The processing demands mandated by the YOLO algorithm align adequately with the application at hand.
- The issue of alignment is effectively addressed through the use of VLC technologies. The inherent nature of light emission in LEDs, a key component of VLC, eliminates the need for

alignment. The referenced study [reference 10 in the paper] specifically illustrates how alignment is a non-issue in scenarios involving streetlights, akin to the conditions encountered with traffic lights in this particular study.

- As mentioned in previous discussions, the primary focus of this paper is on presenting the integration proposal rather than optimization. Characteristics like SWap_C extend beyond the scope of the communication system design discussed in this paper. The intention is not to assess the UAV itself but rather to explore the communication capabilities it can employ. Nonetheless, this aspect holds potential interest for future works, particularly concerning the overall system. Now, SWap_C is not relevant to this proposal.

New References:

[new reference 2] Ortiz, F.; Monzon Baeza, V.; Garces-Socarras, L.M.; Vásquez-Peralvo, J.A.; Gonzalez, J.L.; Fontanesi, G.; Lagunas, E.; Querol, J.; Chatzinotas, S. Onboard Processing in Satellite Communications Using AI Accelerators. *Aerospace* 2023, 10, 101.

- 4) In reference 11, DOI is wrongly written.

Authors: We appreciate your observation and are sorry for this typo. The DOI for reference 11 has been corrected in the revised manuscript to ensure accurate referencing.

Thank you again for your valuable feedback, and we are committed to incorporating these enhancements to improve our manuscript's overall quality and comprehensibility.

Sincerely,
The Authors