

portable instrument services like security patrol cars and aerial drones.

ACKNOWLEDGMENT

National Priority Programs support this work in Engineering Sciences, Indonesian Institute of Sciences (LIPI) No. 26/A/DT/2021.

REFERENCES

- [1] World Health Organization, "WHO announces COVID-19 outbreak a pandemic," Mar. 12, 2020. <https://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/news/news/2020/3/who-announces-covid-19-outbreak-a-pandemic> (accessed Mar. 13, 2022).
- [2] WHO, "Coronavirus disease (COVID- 19): How is it transmitted?," 2021. [Online]. Available: <https://www.who.int/news-room/q-a-detail/coronavirus-disease-covid-19-how-is-it-transmitted>. [Accessed: 21-Jan-2020].
- [3] IDSA, "Physical Distancing," 2020. [Online]. Available: <https://www.idsociety.org/covid-19-real-time-learning-network/infection-prevention/physical-distancing/>. [Accessed: 21-Jan-2020].
- [4] WHO, "COVID-19: physical distancing," 2021. [Online]. Available: <https://www.who.int/westernpacific/emergencies/covid-19/information/physical-distancing#:~:text=Physical distancing helps limit the,Protect yourself and others.> [Accessed: 21-Jan-2021].
- [5] D. K. Chu *et al.*, "Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19 : a systematic review and meta-analysis," *Lancet*, vol. 395, no. June, pp. 1973–1987, 2020.
- [6] N. M. Ferguson, D. Laydon, G. Nedjati-gilani, N. Imai, K. Ainslie, and M. Baguelin, "Report 9 : Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand," 2020.
- [7] M. W. Fong *et al.*, "Nonpharmaceutical Measures for Pandemic Influenza in Nonhealthcare Settings — Social Distancing Measures," *Emerg. Infect. Dis.*, vol. 26, no. 5, pp. 976–984, 2020.
- [8] E. Arulprakash and M. Aruldoss, "A Study on Fight Against COVID - 19 from Latest Technological Intervention," *SN Comput. Sci.*, vol. 1, no. 5, pp. 1–3, 2020.
- [9] M. Cristani, A. Del Bue, V. Murino, F. Setti, and A. Vinciarelli, "The visual social distancing problem," *IEEE Access*, vol. 8, pp. 126876–126886, 2020.
- [10] S. Suryadi, E. Kurniawan, H. Adinanta, B. H. Sirenden, J. A. Prakosa, and P. Purwowibowo, "On the Comparison of Social Distancing Violation Detectors with Graphical Processing Unit Support," in *Proceeding - 2020 International Conference on Radar, Antenna, Microwave, Electronics and Telecommunications, ICRAMET 2020*, 2020, pp. 337–342.
- [11] H. Adinanta, E. Kurniawan, Suryadi, and J. A. Prakosa, "Physical Distancing Monitoring with Background Subtraction Methods," in *Proceeding - 2020 International Conference on Radar, Antenna, Microwave, Electronics and Telecommunications, ICRAMET 2020*, 2020, pp. 45–50.
- [12] S. Bian, B. Zhou, and P. Lukowicz, "Social distance monitor with a wearable magnetic field proximity sensor," *Sensors*, vol. 20, no. 18, pp. 1–26, 2020.
- [13] G. M. Williams, "Optimization of eyesafe avalanche photodiode lidar for automobile safety and autonomous navigation systems," *Opt. Eng.*, vol. 56, no. 3, pp. 1–9, 2017.
- [14] S. Royo and M. Ballesta-Garcia, "An overview of lidar imaging systems for autonomous vehicles," *Appl. Sci.*, vol. 9, no. 19, pp. 1–37, 2019.
- [15] C. Li, Q. Chen, G. Gu, and W. Qian, "Laser time-of-flight measurement based on time-delay estimation and fitting correction," *Opt. Eng.*, vol. 52, no. 7, p. 076105, 2013.
- [16] C. Rablau, "LIDAR - A new (self-driving) vehicle for introducing optics to broader engineering and non-engineering audiences," in *Proc of SPIE*, 2019, vol. 11143, no. July 2019, pp. 1–14.
- [17] I.-G. Jang, S.-H. Lee, and Y.-H. Park, "A parallel-phase demodulation-based distance-measurement method using dual-frequency modulation," *Appl. Sci.*, vol. 10, no. 1, pp. 1–15, 2020.
- [18] D. Bronzi, Y. Zou, F. Villa, S. Tisa, A. Tosi, and F. Zappa, "Automotive Three-Dimensional Vision Through a Single-Photon Counting SPAD Camera," *IEEE Trans. Intell. Transp. Syst.*, vol. 17, no. 3, pp. 782–795, 2016.
- [19] T. Fersch, R. Weigel, and A. Koelpin, "A CDMA Modulation Technique for Automotive Time-of-Flight LiDAR Systems," *IEEE Sens. J.*, vol. 17, no. 11, pp. 3507–3516, 2017.
- [20] A. Ronchini Ximenes, P. Padmanabhan, M. J. Lee, Y. Yamashita, D. N. Young, and E. Charbon, "A Modular, Direct Time-of-Flight Depth Sensor in 45/65-nm 3-D-Stacked CMOS Technology," *IEEE J. Solid-State Circuits*, vol. 54, no. 11, pp. 3203–3214, 2019.
- [21] A. Tontini, L. Gasparini, and M. Perenzoni, "Numerical model of spad-based direct time-of-flight flash lidar CMOS image sensors," *Sensors*, vol. 20, no. 18, pp. 1–19, 2020.
- [22] P. Padmanabhan, C. Zhang, and E. Charbon, "Modeling and Analysis of a Direct Time-of-Flight Sensor Architecture for LiDAR Applications," *Sensors*, vol. 19, no. 5464, pp. 1–27, 2019.
- [23] J. Jang, S. Hwnag, and K. Park, "Design of Indirect Time-of-Flight Based Lidar for Precise Three-Dimensional Measurement Under Various Reflection Conditions," in *Proceedings of the 4th International Conference on Sensor Device Technologies and Applications Design*, 2013, pp. 25–29.
- [24] J.-H. P. Sung-Woo Lee, Haesoo Jeong, Seoung-Ki Lee, Young-Kweon Kim, "LIDAR system using indirect time of flight method and MEMS scanner for distance measurement," in *2016 International Conference on Optical Memes and Nanophotonics (OMN)*, 2016, pp. 31–32.
- [25] S. H. Chung, S. W. Lee, S. K. Lee, and J. H. Park, "LIDAR system with electromagnetic two-axis scanning micromirror based on indirect time-of-flight method," *Micro Nano Syst. Lett.*, vol. 7, no. 1, pp. 4–8, 2019.
- [26] S. Bellisai, F. Villa, S. Tisa, D. Bronzi, and F. Zappa, "Indirect time-of-flight 3D ranging based on SPADs," in *Proceedings of SPIE*, 2012, vol. 8268, pp. 1–8.
- [27] M. M. Bayer, R. Torun, I. U. Zaman, and O. Boyraz, "Multi-tone continuous wave lidar in simultaneous ranging and velocimetry," *Opt. Express*, vol. 28, no. 12, pp. 17241–17252, 2020.
- [28] T. Raj, F. H. Hashim, A. B. Huddin, M. F. Ibrahim, and A. Hussain, "A survey on LiDAR scanning mechanisms," *Electronics*, vol. 9, no. 5, pp. 1–25, 2020.
- [29] Benewake, "Product Manual of TFmini," Beijing, 2018.