Analysis of Landslide Mapping With Multicopter in Somangari, Kaligesing, Purworejo, Central of Java

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Abstract. Drones are unmanned aircraft, drone function mapping one of them trough landslide. This research was conducted by direct observation in the field, namely Somangari Village, Kaligesing, Purworejo. This area is famous for landslide drone areas and is a concern of Central Java Province. This research uses a multicopter with four propellers. The method used in this study prepare for making a drone, survey area to flood and landslide in Somangari; planning test altitude in the air; calibration drone; taking an aerial photograph in area landslide and then analysis of data then mapping the area in Somangari. This drone can fly with a hight of up to 100 meters and can map an area of 1.5 km. This research with hot weather conditions and wind speeds of around 20 km/hour. Multicopter has the advantage of being stable against wind speed. Drone battery can be used for 20 minutes. Battery capacity is 5000 mAH with camera DJI Phantom. The advantages in this research are that the drone used DJI Phantom has a good camera, the drone is stable so that it can produce good aerial photographs. In Somangari Village, which is famous for areas prone to landslides and floods, has greatly helped the Purworejo Regional Disaster Management Agency and Purworejo Regional Government, Central Java. With the mapping of flood and landslide areas with a multicopter to help the Somangari village government to always be prepared to the rainy season.

Keyword: drone; mapping; a multicopter; purworejo

1. Introduction
Drones are unmanned aircraft, there are two types of drones, namely drone type a multicopter and a fixed wing type drones. Drones in this study used multicopter and drone research in the Somangari area, Kaligesing, Purworejo. Why are we interested in research in the Somangari area? This is because the Somangari region is an area prone to landslides. This area is a concern of Central Java Province. In 2017 this area consumed hundreds of fatalities due to the landslide disaster. This research was carried out on July 2, 2019, with hot weather conditions and wind speeds of around 20 km/hour. Multicopter has the advantage of being stable against wind speed. There are two type of drone are a multicopter as shown in Figure 1 and a fixed wing as shown in Figure 2.

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The function of the drone is to be able to help map out flood areas, landslides, forest fire areas, remote areas and even areas that have rice field disputes. Drone fixed wing can fly an altitude of 100 meters to 200 meters until 30 minutes, the mapping results in Lampung as shown in Figure 3. [1] The function of the drone is to obtain mapping results from the north of from Congot with a drone using the DJI Phantom camera as shown in Figure 4. [2] The purpose of this research as following: to find out how the drone maps out landslide-prone areas in Somangari Village, Kaligesing District, Purworejo Regency; to find out the area in the Purworejo Regional Government that landslides often occur and To find out the results of aerial photographs and the results of mapping the landslide area in Somangari Village, Kaligesing District, Purworejo Regency. The mapping with a multicopter to find out more quickly the areas prone to flooding and landslides in Purworejo Regency.

2. Mapping with a multicopter

The mapping result from at Glagah Beach and the entrance area Yogyakarta International Airports in Kulonprogo can be seen in Figure 5. This paper proposes the scheme of a multicopter design system with a platform that is done for tracking and visual detection on the platform. [4] One potential area that Multicopter functions for rescue missions in the indoor environment, the advantage is that the drone is small, agile and has no charge so it is safe. [5] This study designed a drone with electric power with a simple propeller and increase efficiency so that the cable was installed in series. [6] This study designed the research drone to create resistant drones so that if an accident occurs in the operation of the drone it will remain intact the body of the drone. [7] The drone serves to map landslide areas with slope monitoring in Ricasoli Village, Tuscany. [8] An imaging system drones with cameras can be used to observe radioactive distance. The drone is flown with a height of 9m for 550 seconds. [9] Multicopter has a spider-like structure made an innovation on the chassis for the performance of drones with low vibration transmission so that the drones move stably. [10] Due to the ecological destruction of the research regarding the creation of a low-cost drone platform, drones can be used to monitor agricultural and the environment. [11] The method proposed in the Drone can be for land mapping, floods, landslides with the Bag of Words Algorithm. [12] Drones measured their position with Cartesian coordinates, elevators, ailerons, and the throttle operations with the PID method. [13] We exploit Drones used to collect air samples with high integrity [14] The drone functions to map areas that are difficult to reach. [15] Detection and discrimination of drones functions for remote sensing, namely radar for researching military areas. [16] Using a Quadcopter propulsion system to map agricultural areas with an electric propulsion system so that the drone quadcopter can operate properly. [17] Using propulsion On the Indian Peninsula a system of transporting drugs, vaccines and fertilizers have been implemented using a quadcopter drone. [18] Using propulsion in drones designed with a maximum take-off mass weighing 5 kg to determine maximum thrust. [19] The history of drones originating far to UAVs with vertically take of and landing has a system that is less powerful because of its low durability so there is an innovation for take off maximum of 25 kg. [20]
Drones with optically camera can map landslides and then images are combined with Structure from Motion software. [21] UAV to map landslides through detection of soil changes. From the results of mapping the ground level shifted and opened so that there was a shift along 115 meters. Surveys with UAVs can survey areas prone to landslides after an earthquake. [22] This research uses a multicopter to provide the best aerial photogrammetry results with Agisoft Photoshop software, which achieved a flying height of 70 meters, obtained height resolution images with a spatial resolution of 2 inches/pixels. [23] UAV serves for aerial mapping with photography with a roaming speed of 12 m/s with a height of 100m has the best results. [24]

3. Method
A. Instrument: Drone type a multicopter with camera DJ Phantom 1.
B. Location: In Somangari Village, Kaligesing, Purworejo, Central Java
D. Methods in this research:
   1. Preparation of making a multicopter.
   2. Survey of areas prone to flooding and landslides in the Somangari area, Kaligesing District, Purworejo Regency
   3. Planning testing at a certain height in the air and in the Somangari flat area, Kaligesing District, Purworejo Regency
   4. Calibration drone at Somangari, Kaligesing District, Purworejo Regency
   5. Taking aerial photographs in the area of floods and landslides in the Somangari area, Kaligesing District, Purworejo Regency
   6. Aerial photography results.
   7. Data analysis and discussion and conclusions of mapping research in areas prone to flooding and landslides in the Somangari area, Kaligesing District, Purworejo Regency
E. Flowchart
   The research flow diagram follow is as preparation for making a drone, survey area to flooding and landslides in Somangari; planning test at altitude in the air; calibration drone; taking an aerial photograph in area landslides and then analysis of data then mapping the area in Somangari.
   Flowchart of the research can be seen in Figure 6.

4. Results and Discuss
Drawing a multicopter design with size can be seen in Figure 7 and Figure 8. This research was carried out on July 2, 2019 with hot weather conditions and wind speeds of around 20 km/hour. Multicopter has the advantage of being stable against wind speed. The battery capacity of drone is
5000 mAh with camera DJI Phantom. Drone for this research can be seen in Figure 9. The way the drones do mapping is by recording the surface image of the area using a camera mounted on the drone. Before mapping with a drone, the drone is first assembled and tested. The initial stage of assembly is the selection of components. In this study drone assembly can be seen Figure 10. After the drone assembly is finished then a flight test is carried out. If the drone has flown perfectly then proceed with the addition of a camera on the lower side of the drone. Drone flight testing and shooting are shown in Figure 11.

The initial stage of assembly is the selection of components. In this study, the frame used is the F450 Quadcopter frame, the Controller uses DJI Naza M Lite, the motor uses a 920 kV brushless motor, ESC 30 A, Ublox M8N GPS, Propeller 9443, Landing Skid, Turnigy Battery 5.000 mAh and Turnigy remote control. The drone assembly stage can be seen in Figure 10. The drone uses DJI Phantom, DJI Phantom has good camera features.

The results of aerial photographs carried out during the observation of landslide areas were carried out in Somangari Village, Kaligesing District, Purworejo Regency. Monitoring of aerial photographs shows that the area is an area with a contour of hills that has a very steep slope. So that when the rain has the potential to be prone to landslides. The novelty in this research is that the drone used has a good camera, the drone is stable, resist for windproof so that it can produce good aerial photographs. Good aerial photography in Somangari Village, which is famous for areas prone to landslides and floods, has greatly helped the Purworejo Regional Disaster Management Agency and Purworejo Regional Government, Central Java. The results of aerial photographs taken during the observation of landslide-prone areas were carried out in Somangari Village, Kaligesing District, Purworejo Regency. Monitoring from aerial photographs shows that the area is a contour with hills that have very steep slopes. So that when it rains it has a potential for landslides. An example of the results of the photos taken has been shown in Figure 12, Figure 13 and Figure 14. More complete photos are in the attachment. Aerial photograph conducting by the area prone to landslide seen from the south in Figure 13 and Aerial photograph conducting by the area prone to landslide seen from the east Figure 14. In Figure 15 can be seen landslide area in Somangari, Kaligesing, Purworejo.
Observations made in Purworejo area, areas that often experience landslides including in Purworejo 1 village, Bener 3 village. Furthermore, there are 5 villages in Kaligesing District. One village in Loano Subdistrict. Whereas in Gebang Subdistrict there are 4 villages and in Kemiri sub-district and Bruno Subdistrict, each is 1 village. The novelty in this research can be used as a simple initial observation to see the threat of landslides early, so the danger from landslides can be avoided. Good aerial photography in Somangari Village, which is famous for areas prone to landslides and floods, has greatly helped the Purworejo Regional Disaster Management Agency and Purworejo Regional Government, Central Java.

5. Conclusion and Future Works
The way drones do mapping is by recording the surface image of the area using a camera mounted on a drone. This research was carried out on July 2, 2019 with hot weather conditions and wind speeds of around 20 km/hour. Multicopter has the advantage of being stable against wind speed. This drone can fly with a height of up to 100 meters and can map an area of 1.5 km. This research with hot weather conditions and wind speeds of around 20 km/hour. Multicopter has the advantage of being stable against wind speed; the drone used DJI Phantom has a good camera, the drone is stable, stable, so that it can produce good aerial photographs. Drone battery can be used for 20 minutes. The battery capacity is 5,000 mAh with camera DJI Phantom. This research greatly helped the Purworejo regional government because it could help in mapping landslide in the village. The results of aerial photographs carried out when observing landslide areas were carried out in Somangari Village, Kaligesing District, Purworejo Regency, showing that the area was a hill area with steep slope. So that when the rain has the potential to be prone to landslides. With the mapping of flood and landslide areas with multicopter to help the Somangari village government to always be prepared to the rainy season. The weakness in this research is that the decision to determine the existence of a landslide is still limited based on visual observations by humans, so the results of the decision require a long time. For the next research, an analysis of the observation of landslides will be carried out based on image processing by a computer, so that the decision results are expected to be faster and more accurate.

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References
[1] Suroso, I., and Irmawan, E 2018 Analysis Of Aerial Photography With Drone Type Fixed Wing In Kotabaru, Lampung. Journal of Applied Geospatial Information. 2 1 102-107
[2] Suroso, I. Analysis Of Mapping Multicopter Drones In the Entrance Area Of Prospective New Airports In Congot, Temon, Kulonprogo, Yogyakarta 2018 Journal of Applied Geospatial Information. 2 2 130-134
[3] Suroso, I. Analisis Peran Unmanned Aerial Vehicle Jenis Multicopter Dalam Meningkatkan Kualitas Dunia Fotografi Udara Di Lokasi Jalur Selatan Menuju Calon Bandara Baru Di Kulonprogo 2018 REKAM: Jurnal Fotografi, Televisi, dan Animasi. 14 1 17-25
[4] Acevedo, J. J., García, M., Viguria, A., Ramón, P., Arrue, B. C., and Ollero, A 2017 Autonomous landing of a multicopter on a moving platform based on vision techniques. In Iberian Robotics Conference, Springer Charm. 272-282
[5] Saldivar, J., Tran, A., Gomez, D., Nguyen, A., Herrera, A., Ruiz, A., and Watkins, P 2016 Multicopters for Search and Rescue in Indoor Environments
[6] Bauer, F., Hackl, C. M., Smedley, K. M., & Kennel, R. M. Multicopter with series connected propeller drives 2017 IEEE Transactions on Control Systems Technology. 26 2 563-574
[7] Mintchev, S., de Rivaz, S., and Floreano, D 2017 Insect-inspired mechanical resilience for multicopters. IEEE Robotics and automation letters. 2 3 1248-1255
[8] Rossi, G., Nocentini, M., Lombardi, L., Vannocci, P., Tanteri, L., Dotta, G., and Moretti, S 2016 Integration of multicopter drone measurements and ground-based data for landslide monitoring. Landslides and Engineered Slopes. Experience, Theory and Practice–Aversa et al.(Eds)
[9] Sato, Y., Ozawa, S., Terasaka, Y., Kaburagi, M., Tanifuji, Y., Kawabata, K., and Torii, T 2018 Remote radiation imaging system using a compact gamma-ray imager mounted on a multicopter drone. Journal of Nuclear Science and Technology. 55 1 90-96
[10] Rossi, G., Tanteri, L., Salvatici, T., Scaduto, G., Tacconi Stefanelli, C., Casagli, N., and Moretti, S 2017 A new improved multicopter chassis structure tested on slope stability monitoring. In EGU General Assembly Conference Abstracts. 19 15024
[11] Chang, C. C., Wang, J. L., Chang, C. Y., Liang, M. C., and Lin, M. R 2018 Development of a multicopter-carried whole air sampling apparatus and its applications in environmental studies. Chemosphere. 144 484-492
[12] Anweiler, S., & Piwowarski, D. Multicopter platform prototype for environmental monitoring 2017. Journal of Cleaner Production. 155 204-211
[13] Sato, K., & Daikoku, R. A simple autonomous flight control of multicopter using only web camera 2016 Journal of Robotics and Mechatronics. 28 3 286-294
[14] Chang, C. C., Chang, C. Y., Wang, J. L., Lin, M. R., Ou-Yang, C. F., Pan, H. H., and Chen, Y. C. 2018. A study of atmospheric mixing of trace gases by aerial sampling with a multi-rotor drone. Atmospheric Environment. 184 254-261
[15] Kruse, L. A., Bradley, J. M., and Wolf, M. A Control Authority Switching System for Avoiding 2019. Multicopter Loss of Control Using a Markov Decision Process. In AIAA Scitech 2019 Forum. 1688
[16] Chadwick, A. D. Micro-drone detection using software-defined 3G passive radar 2017
[17] Brun, N. S. Preliminary design of a fuel cell-battery hybrid propulsion system for a small VTOL UAV (Master's thesis, University of Stavanger, Norway 2018
[18] Reshma, B., & Kumar, S. S 2016 Precision aquaculture drone algorithm for delivery in sea cages. In 2016 IEEE International Conference on Engineering and Technology (ICETECH). 1264-1270
[19] Nonami, K. Research and Development of Drone and Roadmap to Evolution. 2018. Journal of Robotics and Mechatronics. 30 3 322-336
[20] Theys, B., & De Schutter, J 2016 Parameter selection method and performance assessment for the preliminary design of electrically powered transitioning VTOL UAVs. Proceedings of IMAV 2016. 221-228
[21] Rossi, G., Tanteri, L., Tofani, V., Vannocci, P., Moretti, S., & Casagli, N 2018 Multitemporal UAV surveys for landslide mapping and characterization. Landslides. 15 5 1045-1052
[22] Valkaniotis, S., Papathanassiou, G., and Ganas, A 2018 Mapping an earthquake-induced landslide based on UAV imagery; case study of the 2015 Okeanos landslide, Lefkada, Greece. Engineering geology. 245 141-152.
[23] Anurogo, W., Lubis, M. Z., Khoirunnisa, H., Hanafi, D. S. P. A., Rizki, F., Surya, G., and Dewanti, N. A 2017 A simple aerial photogrammetric mapping system overview and image acquisition using Unmanned Aerial Vehicles (UAVs). Geospatial Information. 1 1 11-18
[24] Muliady, M., and Subagya, E. J 2019 Sistem Pemetaan Udara Menggunakan Pesawat Fixed Wing. TESLA: Jurnal Teknik Elektro. 21 1 26-35.