Implementation of Wireless Data Communication on Unmanned Aerial Vehicles (UAV) Technology for Detecting Damage of Building Roof (Case Study: Campus Building Institute of Informatics and Business Darmajaya)

Sabam Parjuangan
Faculty of Computer Science-Computer Systems, Institute of Informatics and Business Darmajaya Jalan Z.A. Pagar Alam No.93A, Labuhan Ratu, Bandar Lampung, Indonesia sabamparjuangan@darmajaya.ac.id

ABSTRACT

Standards of care in multi-story buildings become a necessity. The standard of care should apply to all parts of the building. One of the most important storied buildings that require maintenance is the roof of the building. The side of the roof is the topside of the building, this side function to protect the building from rainwater, wind, and sun. The very important part of the roof is treated and applies to all types of buildings. Especially for a roofed building that is roofed, the problem in its maintenance is an examination of the roof itself. Side handling of the roof is difficult to handle by humans without any tools. One handling for the roof side is the detection of roof side damage. *Darmajaya* multi-story building includes a high rise building that has a roof. Thus, *Darmajaya* building has problems in detecting roof damage. So far, it detects roof damage in the *Damajaya* building just by looking at the wet part of the inside of the building. This method cannot prevent the occurrence of roof leaks. Therefore, a tool is needed to detect damage to the roof side of *Darmajaya* building. The required tool is Unmanned Aerial Vehicles (*UAV)*. Benefits of a *UAV* with a *wifi* antenna for wireless data communications. Wireless communication is used for communication and sending video to mobile stations. *Station* device moves as a medium for displaying streaming video. Mobile station devices are used to control *UAVs*. Mobile-based mobile stations to run *UAV* control applications. The *UAV* control applica[illegible] control *UAVs* and cameras. The *UAV* application is also used to control the camera as a picture capture and video recording. The results of the video in the form of streaming video that real-time as a detection of damage to the roof of the building. So, to detect the damage to the roof, can use a *UAV* equipped *wifi* antenna and camera. The results of this study the use of *UAVs* to detect damage to the roof of a multi-story building.

Keywords: ***Index Terms— Multi-Story Building, Roof, Unmanned Aerial Vehicles, Wireless, Communication***.

1. Introduction.

Damajaya IIB campus building includes a building that has a height of five floors with an average height of 25 meters - 35 meters. Darmajaya campus building consists of building A, building B, Building F, Building D, Building E, Building G, and Mosque. IIB Darmajaya campus building there is a roof that consists of tile and there is also a roof made of cement. The roof of IIB Darmajaya building which is made of tile is building F, building G, building D, building E, and mosque. Talking about building maintenance, the weakness of the building that has a roof tile is not easy to rise above it. Whereas in the care of buildings, stages up to the roof to check for damage to the roof is required. This is done to examine the feasibility or existence of the roof. The purpose of inspecting the roof of the building to anticipate so as not to leak. If there is leakage will damage the inside of the building, building contents and other inner building components.

Several times the author has found a room that experienced a leak. So damaging the ceiling of the building and water seeping up to the floor even wetting the laboratory equipment. This incident occurred in the building of buildings G and F. However, until now could not be ascertained whether the water coming in through the roof or wall

seeping or windows that do not shut down. However this situation is not good for the building and building contents.

The theory of maintenance and maintenance of high rise buildings according to Mastura Labombang (2012) is done as a preventive measure for damage to buildings and building contents. The treatment in question is such as painting time interval, the time interval of electric line replacement, waterway, and others done even if there is no damage. While maintenance is a routine inspection of both outside examination of buildings and in buildings. Inbuilding inspection is certainly easier to do because it can be reached from within the building by going through the stairs and every floor of the building. While the examination of the outer building for the multi-story building must be checked using a ladder or safety rope. However, this is also difficult to do for some parts of the building, such as the roof of the building. If the pyramid-shaped roof and roofing material is made of light and brittle material then this adds to the difficulty of regular checks. This causes rarely performed roof checks of multi-story buildings.

The presence of UAV technology (Unmanned Aerial Vehicle) can be used as a tool to check the roof of high rise building. UAVs are unmanned drones that can be controlled at short distances. The use of UAVs is generally to detect things that are difficult to reach by humans, such as checking the existence of the roof of buildings, examining the causes of road congestion, shooting looks over and other things that are difficult to reach by humans.

UAVs used as multilevel inspectors must be equipped with a camera that has a high resolution, so images can be taken in a clear state. The camera placed in the UAV must be controlled by the UAV operator, to see the precision of the image to be taken. Possible thing to do to control the camera is by utilizing wireless network or exploiting internet network as media of controlling UAV. However, if using the Internet network will depend on the bandwidth of the network. So in this research media UAV control is used a wireless network.

2. Research Method.

A. Building of Multi-story Building

The building is a place in which the gathering of a group of people to perform activities and shelter from rain, wind, and the sun. Therefore, before it is built, it is necessary to calculate the strength of the building so that there is no doubt about its strength and robustness to the workforce. Construction of a building is a unity and a series of several elements that are planned to be able to accept the burden of the outside and the weight itself without experiencing changes in shape that exceeds the requirements.

Classification of multi-story building: a). A high-rise building is declared if a building has more than eight floors (> eight floors); b). Medium-story building, a building declared to be a medium-rise if the building has a floor between five until eight floors; c). Low-rise building; said to be low-rise if it has a floor <five. Building IIB Darmajaya campus into the category of medium-rise buildings and lowrise buildings (Mastura Labombang, 2012).

Unmanned Aerial Vehicles

UAV is an aircraft technology that does not use crew. The UAV is controlled by the operator through radio waves. UAV is an unmanned system (Unmanned System) that is an electronics-mechanical based system that can perform certain missions that have been programmed. There are two ways to control the UAV by using radio waves as well as the UAV controlling itself based on the program that is inserted into it.

UAVs are capable of carrying cameras, sensors, communication devices, and some other equipment. This allows for aerial photography. Based on the type of wings UAV is categorized into two group namely multi-copter and fixed wing. Type of fixed-wing requires aerodynamic design on the wings and body so that the design is quite complicated. While multi-copter is a type of UAV that utilizes the propeller spin to fly. Multi-copters are subdivided into categories of single-rotor and multi-rotor.

Single-rotor type shaped like a helicopter using a single propeller, while the multi-rotor uses three until eight propellers. The advantages of multi-copter can fly vertically up to 300 meters, making it suitable for

mapping infrastructure, agricultural land, and forest areas. Multicopter can fly for 40 minutes with a coverage area of 100400 hectares. As for the fixed-wing type, although it can cover a much wider area and fly up to 1.5 hours, this drone cannot fly vertically (Chao Z, 2012).

Camera

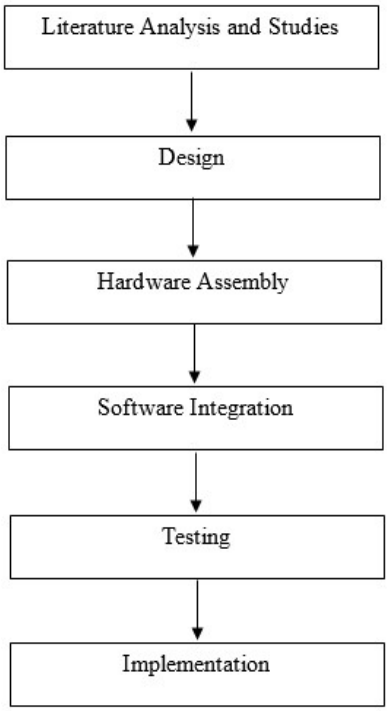
The Camera mount is the part that serves as a place to put the camera when carried on the air. World aerial photography, camera mount is often also called by the name of Gimbal. The growing world of aerial photography, dreadlocks are not only used as a place to put the camera but also as a tool to control the movement of the camera and stabilize it.
Based on the freedom of movement, dreadlocks are divided into three types, namely one axis, two axes and three axes. Gimbal one axis means only able to make movement in one direction only that is a pitch. Dreadlocks two axis means to be able to make a two-way movement, namely pitch, and roll. While dreadlocks three axis means can make the movement into three directions, namely pitch, roll, and yaw. The movement with the X-axis of the axis is called Roll, the movement with Y axis is called Pitch and the movement with Z axis is called Yaw (Rahmat Hidayat, et al 2014).

Wireless

Wireless is one type of computer network that belongs to the category of Local Area Network (LAN). Along with the development of communication devices, the need for mobile network access (moving) that does not require cable as transmission media. That is what causes the emergence of wireless local area network (WLAN). WLAN is often known as Wifi which stands for wireless fidelity. Wifi technology is built with the IEEE 802.11 standard. Wifi currently can be used by various communication devices including tablet and smartphone devices. However because it belongs to the LAN category, wifi also has a wide coverage area. The general range of a wifi repeater ranges from 100 meters. The farther the signal that can be captured by the communication device will be smaller (M. Sreerama Murty, et al., 2012).

The weakness of Wi-Fi is the first data transmission in Wi-Fi network is smaller than the network using cable. The tool has a price more expensive than LAN devices that use cables. Easy interference between other users (wave interference) such as limited access for multiple devices when connected in multiple user states on Wi-Fi. Access security has a lower guarantee than wired networks. Allows the occurrence of multipath symptoms that is radio propagation from sender to receiver through many lost paths. It has a considerable latency compared to cable transmission media (Umesh Kumar and Sapna Gambhir, 2014).

DESIGN DEVELOPMENT



Source: Image Processed, 2017
Figure 1. Stages of System Development

3. Discussion.

1. Design Results
   The designs carried out in this study include several components including, camera, wifi, UAV and station (receiver). The design results in detail as in Figure 2 below.

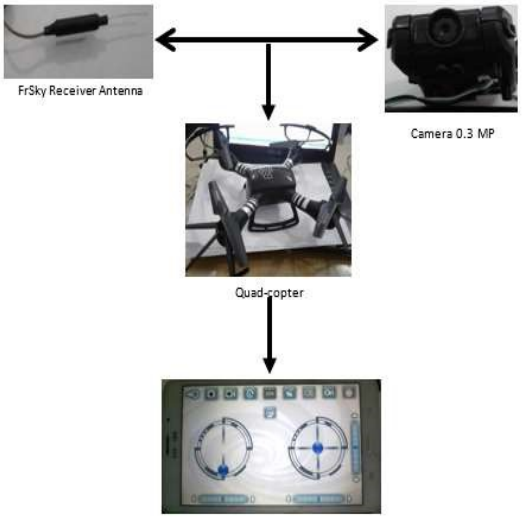


Figure 2. System Design

Based on figure 2 above the design of several components combined with the flow of frsky antenna combined with the camera as the receiver control drone command and also as a transmitter data from the camera to the station. Then, the camera and the antenna are mounted on the drone and configured according to the calibration present in the drone. After that, connect the drone to the station via wifi connection.

2. Assembly Results
   Assembling performed includes several components, including camera assembly, wifi to drones and stations. The assembly results as shown in figure 2 above. The result of assembling into one unity between the components used in this study. The result is the integration of frsky antenna with camera and drone and calibrated appropriately.

3. Results of Software Integration
   Software used in this study is HELICUTE FVP, this software is available in the market. Things to do is configure the software with drones and cameras and wifi to the station. The result of integration is that the connected drone with the station used. The connected indicator is that the drone can be controlled using software that has been installed on the station and can receive data sent by the drone to the station.

Table 1. Result of Damage Test Possible Soft of Roof Root the Motor th: Building Using Flown Drone

4. Test Result

Table 1. Result of Damage Test Possible Soft of Roof Root the Motor th: Building Using Flown Drone

Number	Drone Station Distance	Drone-Roof Distance	Streaming Video Results	Capture Image Results	Stabled rone in the Air	Wifi Signal
1	10 meters	-	Real-time	Realtime	Stable	4 bar
2	20 meters	-	Real-time	Realtime	Stable	3 bar
3	30 meters	-	Real-time	Realtime	Unstable	2 br
4	40 meters	2-5 meters	Unrealtime	Unrealtime	Unstable	1 bar

The things tested in this study is the overall testing of drones in detecting roof leakage damage. The test results show that the drones that have been done cannot be optimal for the detection of roof damage, it is depicted from the results of streaming video is done. Detailed test results as shown in table 1 below.

by the wind. The load has been added to the drone used for 500 grams, but the load can increase the use of battery power so that the duration of drone power usage is shorter that

is around <4 minutes. The solution that can be done is to replace the motor that is suitable for the load> 2000 grams, and also replace the battery that has more power.

To handle the stability of the drones, trials are also carried out by providing additional load to the drones with load specifications as in table 2 below.

Table 2. Stability Test of Drones with Load Additions

NUMber	Weight Additional Expenses	Berat Total Drone	Total Drone Weight	Stability Drone	Information
1	500 gram	1200 gram	10 meters	Stable	Flying Abilities <4 Minutes
			20 meters	Stable	
			30 meters	Unstable	
2	700 gram	1400 gram	10 meters	Stable	
			20 meters	Stable	Flying Abilities <3 Minutes
			30 meters	Unstable	Only able to fly <1 Minute

5. Implementation Results

Based on the results of testing the implementation of the drone device as a detector of damage to the roof of the building can be implemented. However, it cannot give optimal results. The resulting image does not give a clear picture. In addition to high rise buildings that have a height of> 30 meters, this drone is inefficient to use because at that height the drone is unstable.

6. Discussion

Discussed discussion of the results of design, assembly, software integration, test results and implementation results. Results of the resulting image and transmitted through wifi on the drone, the image cannot represent the damage to the roof clearly. Results like this caused some of them:

1. The camera used has a low resolution that is 0.3 MP, so the resulting image cannot represent the real.
2. 0Instability of drones when located at an altitude of> 30 Meters, a drone that weighs 700 grams so it is easily influenced by the existing wind. The drone states can be stable above altitude> 30 meters if there is no wind.
3. Wifi station coverage limit, the distance is more or more lower, so the drone will give a slow response due to low data transmission. Additionally, the data sent by the drone to the station is not real-time. The solution is to add wifi (wifi extender).

3. Conclusion.

The conclusions in this study are. than 20 meters then the data transmission power is

1. Drones can be used as a detector of roof damage, but must be equipped with camera specifications that have a high resolution (> 5 MP).
2. The drone must also weigh> 1400 grams so it cannot be affected by winds that have a speed> 10 KM / Hour and has a motor suitable for lifting weights> 1400 grams. Altitude> 30 Meters, tend to have wind> 10 KM / Hour.
3. Wifi extender is used if the target distance> 30 Meters.

Bibliographies

[1] Chao, Z., Zhou, S. L., Ming, L., & Zhang, W. G. (2012). UAV formation flight based on nonlinear model predictive control. Mathematical Problems in Engineering, 2012.

[2] C. Y. Lin, M. Wu, J. A. Bloom, I. J. Cox, and M. Miller, "Rotation, scale, and translation resilient public watermarking for images," IEEE Trans. Image Process., vol. 10, no. 5, pp. 767-782, May 2001.

[3] Hidayat, R., Komarudin, M., & Raharjo, Y. (2014). Rancang Bangun Sistem Penstabil Kamera Untuk Foto Udara Berbasis Wahana Udara Quadcopter. Electrician, 8(2), 112-123.

[4] Iskandar, I., & Hidayat, A. (2015). Analisa Quality of Service (QoS) Jaringan Internet Kampus (Studi Kasus: UIN Suska Riau). Jurnal CoreIT, 1(2), 67-76.

[5] Kumar, U., & Gambhir, S. (2014). A literature review of security threats to wireless networks. International Journal of Future Generation Communication and Networking, 7(4), 25-34.

[6] Labombang, M. (2012). Manajemen Pemeliharaan Fasilitas Dalam Pengelolaan Gedung. MEKTEK, 10.

[7] Murty, M. S., Veeraiah, A., & Rao, S. (2012). Performance Evaluation of Wi-Fi comparison with WiMAX Networks. arXiv preprint arXiv:1202.2634.

[8] Valdiya, K. S. (2016). Palaeoproterozoic Mobile Belts in Peninsular India. In The Making of India (pp. 125-184). Springer International Publishing.
Manual Book Helicute FPV Scout X-Drone H805W