Green areas mapping of Telkom University as a support towards green campus

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Abstract. Environmental problems are the main thing and great concern given the issue of global warming and climate change is no longer just an issue but has become a fact. That is what makes the concept of green campus where the role of universities to help raise awareness and take part in reducing global warming. Efforts to set up a green campus should not only start with planting trees around the campus area or just protecting the environment by banning smoking or littering. But environmental design is one of the processes in realizing a green campus. Therefore, the first stage of environmental design is made to meet these needs. The purpose of this study is to map the environment within Telkom University campus using the aerial photographic approach like drones to collect visual data and observation as the design process in environmental design. The results obtained in this study are a map of Telkom University and the surrounding environment that can be used as observation data and visual data in developing the campus environment. This mapping is a process and a first stage in the development and design of Telkom University as a green campus. For further developments, campus mapping can be used as a reference in seeing environmental design so that the next process can be determined with visual data on campus mapping.

1. Introduction
Global warming, loss of biodiversity, pollution is global environmental problems that threaten life. The issue of global warming is no longer a fictional story but has become a fact. Environmental problems are problems that must be confronted together.

The University has several activities which have the potential to damage the environment significantly and have been ignored from social or environmental responsibility. This includes building maintenance, laboratory use, and the use of energy and materials [1].

The cooperation of all elements in the community must play a role in creating a healthy environment, one of them is the academic community. Campus lifestyle must be further improved and prepare vacant land for green space such as parks or campus forests. As academics, it should fully support environmental conservation to help build a campus with a green campus concept.

Other world campuses have widely applied the concept of the green campus. Telkom University is one campus that has a great commitment to being able to contribute to improving environmental management. As an indicator, Telkom University has taken part in the Green Matric University of Indonesia 2018 and entered the top 10 as a green campus [2].

Realizing a campus with the concept of the green campus is an academic community behavior that is environmentally sound and makes the campus environmentally friendly. Green campus is not only...
defined as a campus that only has trees and green paint colors, but students and employees can make and use resources effectively and efficiently. Environmental design is also needed as one of the processes in realizing the Green campus. Therefore, initial mapping as a necessity in realizing campus spatial planning is needed.

2. Methodology
Observation data and visual data are basic references needed in the structuring process. This arrangement, as an example by building a lake, replacing energy-saving lamps (LED solar cells), preparing a bicycle parking lot, building a Bio Pore [3].

The mapping process of the Telkom University campus uses an aerial photography approach by using camera drones to capture photos as graphical data. The visual data saw does not use video but use the photography process by stitching (merging plentiful amounts of photos into one large picture) in the software so that the result is a large visual mapping that covers all environments on campus.

3. Literature study

3.1. Green campus
Green Campus is a long-term commitment to improving the environment and community within the campus as a support to reduce carbon emissions which has a role in global warming. The first step taken by the campus to support the green campus is to strengthen and expand energy conservation programs. Thus, the need to carry out campus activities with an energy saving process is needed as a basic reference [4]. By creating a healthy environment, campus can produce a maximum learning and supportive learning environment for students. In creating a healthy environment, collaboration is needed in the campus community starting from students, teaching staff, non-teaching staff, local businesses, visitors, ETC.

Green campus environmental impacts can improve performance, namely, Improve the management of environmental aspects, improve overall environmental performance, encourage innovation, and change on campus, and creating a more balanced campus community.

![Figure 1. Telkom university as a green campus webpage.](image)

3.2. Aerial photography
Aerial photography is a technique taking photos from above using airplanes or other flying objects. In its history, a photographic technique was first performed in 1858 by Gaspard-Félix Tournachon [5], better known by the name Nadar.
The first technique performed using an artificial flying balloon. Various methods of photography have been carried out and explored from the use of pigeons to kites. In today's technological development of aerial photography has been in great demand, especially for young people by using an unmanned aerial vehicle (UAV) or better known as a drone.

Aerial photography already has many roles in the field of photography. Aerial photography supplies new perspectives that not everyone has access to because to be able to produce aerial photography, a building or plateau is needed or riding a helicopter or an airplane. The role of aerial photography in addition to archeology and environmental interests, aerial photography can also be used to determine climate change from time to time. For example, if we look from a certain height the amount of water in a lake or the change in ecosystems can be very clearly seen. By using these data researchers can make decisions more quickly.

In addition to environmental interests, aerial photography can also be used to produce high-quality photos and can be used as comparative data in regional mapping. The area mapping technique uses vertical aerial photography techniques. Vertical aerial photography is a photography technique from the top perspective with the angle taken above the subject of the image [6].

Modern aerial photography is captured in a color photo format that has more information than panchromatic (black and white) [7] colors that were used a lot in the past because of technological limitations. Most of aerial photography in ancient times, using film-based cameras which are then converted into digital format with scanography techniques [8].

3.3. Mapping
Mapping or Geo-mapping is a grouping of images related to the geographical location of an area which includes environmental information in the form of lakes, forests, buildings, and resources. Mapping is a science that visualizes a situation in one area and can produce exact information about the development of spatial planning and the environment [9].

4. Discussion
4.1. UAV Drones
UAV (Unmanned Aerial Vehicle) or commonly called as drone, is a flying device that no human or robot is riding on it. In modern terms, UAVs are better known as drones. Drone is a flying device that is widely used in industrial needs and other needs in terms of mapping and photogrammetry. Currently, drones have immense potential in acting as a mapping data collector with aerial photography techniques.
on cameras mounted in drones. Drones are used as a valuable source of data for inspection, surveillance, and mapping [10]. Unlike aerial photography found on satellites, because of the wide access to the drones, humans can use it and can control it freely. Drone flights are controlled using a remote mounted via a smartphone for GPS data collection when the drone takes pictures.

4.2. Aerial photography in Google Maps
Google Maps is a web-based mapping service that has been developed by Google. Google Maps can display map images, topographic maps, and satellite images, and can achieve global location search, classified information access, traffic information query, driving directions lines and even street scene three-dimensional model. Google maps can project images in the form of maps and images from satellites. With this technology, locations can be generally searched and accessed by users. The information is not only in the form of location data, but also can find direction of the road and traffic information, and display the shape of the 3-dimensional model of the road [11]. Google Maps is one technology that has high innovation in terms of mapping and navigation. Google provides users with a satellite perspective, aerial photography, street mapping, and street planning. Visual image capture Google Map uses data from satellites that collaborate with Google technology which is Google Earth. In making references and accuracy Google uses Google Street View as the accuracy of data retrieval, then compiled and combined into one large world mapping.

![Google Maps, vertical aerial photography.](image)

The image display on the Google Map is a vertical display of aerial photography with a 90-degree angle to the bottom. In this view, Google Maps can display home mapping information. Information conveyed using daylight during the day.

4.3. Image comparison on Google Maps
What distinguishes it from Google Maps? In taking pictures using a drone, the researcher can see directly in determining the sharpness point in the photo. This influences the ability to make correct photo results and can maximize visual mapping. Comparison with images on Google Maps, Google Maps uses technology that can collaborate with various data sources from large program partners and agencies to be able to send data to Google [12].

In the Mapping process, the researcher calculates angles and boundaries in taking photographs to make the process of unifying images into one unit. In the photo taking technique, researchers used a Mavic Pro type UAV drone from DJI.
As an example, in the picture above, this image is a comparison of aerial photographic images taken directly using UAV drones and images from Google Map results. In that comparison, it is already very clear that the image from google map has lost significant detail. Details in the form of color, texture, and depth information are more clearly seen using aerial photography techniques from drones.

If the image is zoomed, the lack of detail will be more visible on the google map. In this comparison, there are visible differences. The following will describe some of the differences obtained by researchers:

4.3.1. **Details.** Details obtained by using drones get more significant details. Visible details can be shown such as texture, depth, dimension, and sharpness [13]. This information is important that can be read and can be analyzed about building structures or environmental information (green spaces, etc.).

4.3.2. **Resolutions.** The resolution displayed in the image is the result of a high-resolution photo. It can be interpreted that if the image is enlarged the other details will be increasingly visible. High resolution can display more information.

4.3.3. **Color.** Color has a significant role in displaying information. The use of color in making maps is included in cartographic rules that recommend how the colors in maps can be conveyed effectively and can be reached for meaning [14].
Color stands for the condition of the environment. More color accuracy can be obtained using drones because it uses a camera with a high resolution. Because of the large amount of information in one picture, information can be obtained further by reading the role of color [15,16]. Color can also be used to measure changes in altitude.

The colors on the map are associated with symbolic and temperature representations of the environment. In the cultural context, color is associated with physical colors found in nature or people's ideas about natural objects. Sea and water areas have blue, forest areas have green, or land use red or brown [17].

The color categories in the map can be divided into several sections, namely:

- **Blue**: The blue color represents water conditions such as lake, sea, river, river, etc. The color of the blue density can measure measurement of high and low water. If the color shown is dark blue, the color can stand for high depth. Conversely, if the color shown is light blue, the color stands for shallow water [15].
- **Green**: The green color stands for the green condition. Plants present colors in different shades of green. For example, as an example the dark green color stands for the condition of the forest, the light green color stands for Grassland. if the color shown is yellowish-green, it can be represented as dry grassland [15].
- **Brown**: Brown stands for the ground. Color presentations for soils can be marked with a variety of other colors, for example, if the pale brown color that is normally found in dry lakes can be shown by the presence of minerals based on salt, silicon, or calcium. Brown color can also be defined as the shape of a lake because some lakes have a brown color that has information that the lake has more wet soil content [15].

5. **Conclusion**

Mapping on campus is a support for the vision and mission of the campus in applying the concept of green campus. with this research, data accuracy in mapping becomes one of the main elements in the first stages of designing the environment.

For further developments, campus visualization data can be used as a first allowance to record or analyze the environment by using technology. For example, this mapping can be used as a pathway for installing sensors that can detect activities or activities outside the green campus concept close.

The data captured using UAV drones, tend to have more detailed color and accuracy than data taken by Google satellites. By comparing the size of the image in a large area, aerial photography from Google satellite has more capabilities than UAV drones because the drones can only cover only one area. However, for details and aerial photography information for one specific area, UAV drones will be more suitable for use.

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