Measure Drawing of Temple Layout Using UAV And Geodetic in Dalem Ped

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Abstract. On the island of Nusa Penida is one of the kahyangan jagat temples, Dalem Ped Temple. As a kahyangan jagat temple, Dalem Ped Temple receives a substantial increase in visitors each year. It is simpler for Hindus to pray at Dalem Ped Temple on Nusa Penida Island due to the island's excellent accessibility by transportation. This increase of visitors has not been accompanied by an increase in the capacity of the facilities owned by Dalem Ped Temple, resulting in several problems such as parking, toilets, and garbage which makes the temple area disorganised. Temple development is presently constrained by mapping the size of the building and area. It is difficult for the community to determine what facilities can be added or arranged to satisfy the needs of the devotees of the Dalem Ped Temple. The purpose of this community service is to assist Dalem Ped Temple Community in documenting the area and size of buildings and land owned by Dalem Ped Temple, as there is currently no research or community service that addresses this topic. Measurements will utilise UAV and Geodetic to improve the precision of measurement operations. The purpose of photo documentation and interviews is to collect data that is accurate and relevant to the problems. As the result the location of the temple complex in the temple area will be determined, which will be translated into a measure drawing to assist the community in the future with planning the development of facilities in the temple area.

Keywords: mapping, uav, geodetic, measure drawing;

Introduction

Pura Dalem Ped is one of Bali's most renowned kahyangan jagat temples. Pura Dalem Ped is situated on the island of Nusa Penida, specifically on the coast of Ped Village in the Nusa Penida District of the Klungkung Regency. There are multiple versions of the history of Pura Dalem Ped, with each version coming from the knight community, the balian, and the local residents of Pura Dalem Ped. Although there are various accounts of the origin of Pura Dalem Ped, all of these historical accounts point to the same conclusion regarding the temple's name and function as a Hindu place of worship. In Pura Dalem Ped, the extant history, both written and oral, is replete with tales of preternatural and irrational power, so that these tales are passed down through generations [1]. The real manifestation of the sanctity of Pura Dalem Ped is the fact that many Hindu communities, particularly the indigenous people of Ped Village, do not dare to renovate the old buildings in Pura Dalem Ped, so the renovations carried out thus far have consisted of constructing new buildings around the main structure in the Pura Dalem Ped area [2]

Pura Dalem Ped is a temple complex with five temples. Segara Temple, Batara Baruna Palace, Taman Temple, Penataran Ratu Gede Mecaling, and Bale Agung Temple are the five temples. According to the findings of Nyoman Glebet's research, the typology of sacred buildings in the temple complex consists of the arrangement of the temple as a building complex, the orientation of the temple, the object of worship, the temple's sponsor, and its function. The orientation or direction of a temple complex in Bali faces west, whereas the orientation of the direction of veneration for pemedek faces the sunrise point, which is believed to be the ritual's direction. A Balinese temple complex is comprised of two or three mandalas with pelinggih structures on the east and north sides; the three mandalas are referred to as Jaba Sisi, Jaba Tengah, and Jeroan [3] Upon investigation with pengempon Pura Dalem Ped, it was discovered that Pura Dalem Ped is experiencing problems in the measured drawing inventory of temple structures and areas that causes parking problem, garbage problem, and also toilet facility problem. This inventory issue generates issues that affect the layout and design of the Dalem Ped Temple area.

In order to solve the problem this community service will use interview and field observation methods with measurements using UAV and geodetic GPS and documentation of implementation through photos. Measurement technology using UAVs and Geodetic GPS is carried out because this measurement technology is suitable for measuring large areas. Mapping with UAVs and Geodetic GPS makes measurement time faster, more efficient, and more precise because in its measurements, the UAV utilizes ground control points (GCP) to increase the size accuracy of the photo object obtained by the UAV. Data collection techniques through interviews and field photos are carried out to obtain results that are appropriate and as close as possible to the problems and conditions of the field [4]. Field observations are carried out to see the shortcomings, advantages, potential, and challenges of the problem location so that they can determine the data collection strategy needed to solve the problem appropriately [5]. Based on the problems above, this community service is carried out with the aim of helping pengempon Pura Dalem Ped in realizing the database of area, size, and buildings in the Pura Dalem Ped area. Community service itself is an activity that aims to help the community in several activities without expecting rewards in any form. Through community service, it is hoped that the knowledge possessed by the university community can be channeled to the community to provide a change for the better.

Method

The implementation method carried out in "Community Service at Pura Dalem Ped MRIL Measurement and Inventory of Pura Dalem Ped Buildings" uses an implementation method in the form of interviews and field observations with measurements using UAVs and geodetic GPS and documentation of implementation through photos. This service uses UAVs and geodetic GPS as measurement tools on the grounds that photo data recording uses UAV (Unmanned Aerial Vehicle) technology because drones have digital cameras with high resolution so that they can take pictures of land conditions from the air with good quality. Besides that, drones are also equipped with GPS based on a coordinate system and uniform scale so that the resulting images can be combined to form an upright mosaic image (Orthomosaic) [6]. The use of Geodetic GPS in measuring the Pura Dalem Ped area provides several advantages, including that it can be used at any time without paying attention to the weather or the time of measurement; determining the relative position of the GPS is not affected by the topographic conditions of the survey area; and application in the field is easier and faster [7]

UAV, or Unmanned Aerial Vehicle, is one of the tools widely used in spatial data collection on a large scale. The UAV itself is an unmanned aircraft that can be controlled remotely via radio wave transmission. Mapping or measurement using UAVs has many benefits and advantages. By using this UAV technology, measurement work can be carried out at a low cost with a fast and relatively short processing time [8]. Geodetic GPS is a type of GPS that utilizes a combination of air control from UAVs and GCP (ground checking point) to obtain precise coordinates on the ground. GCP is used to mark a point on the ground by placing a GCP at that point, GCP is the first step in the orthorectification process, which involves correcting data errors as well as the overall picture from the UAV [7] By using Geodetic GPS, the area of the Pura Dalem Ped Temple Area can be determined. Besides that, the use of Geodetic GPS also helps in terms of measurement time due to the easy use of this tool and its high level of accuracy. Drone-captured aerial images are then processed to generate high-resolution photo data from UAV recordings. The photo extraction process will go through several stages, including: Alighment Photos: This step is carried out to determine the geodetic GPS points captured by the drone. The purpose of this step is to determine the location of the photo point so that the resulting photo can form an orthophoto picture of high quality. Identification of control points (GCP) is carried out to process the coordinates of the GCP points, which will then be adjusted to the image results from the drone. Coordinate optimization is the process of applying the right coordinates to the orthophoto image points. Build Orthomosaic is the stage of analyzing aerial images that have been corrected using GCP data so that they can be used for measurement and mapping purposes. The results of an orthophoto can be interpreted visually. Visual interpretation is the act of studying an image with the intention of identifying objects depicted in the image. Visual interpretation of imagery is based on the recognition of spatial characteristics of objects. By using the image interpretation above, the measurements of the Pura Dalem Ped area will be stored in the form of CAD.Dwg files and JPEG or PNG images.



Figure 1. Using GCP and UAV to measure dalem ped temple area

Result and Discussion

From the data generated by the UAV and GCP, the results obtained in the form of aerial photographs of the Dalem Ped temple area, which has an area of 17,715 m2, are divided into two parts, namely the temple area and the parking area of the Dalem Ped Temple and the parking area of

the Dalem Ped Temple Area. In the area of the Dalem Ped Temple, there are several buildings that are supporting facilities for religious activities and worshipers who pray at the Dalem Ped Temple:

Table 1. Building exsisting outside main temple area

Name	Picture	Size	Location	Description
Wantilan		157,8 m2	West side of Pura Penataran Agung	This building serves as a gathering place for worshipers and a meeting hall for temple management.
Wantilan		44,38 m2	On the left side of the first wantilan	This building serves as a gathering place for worshipers and a warehouse for storing tools.
Wantilan		53 m2	In front of the first wantilan	This building serves as a gathering place for worshipers
Bale Gong		107 m2	South side of Pura Penataran Agung	This building functions as a place to store gong instruments and a gong performance hall.
Sekretariat Prawartaka		52,76 m2	On the right side of Dalem Ped temple main entrance	This building serves as the secretariat office of the dalem ped temple management.
Bale Pewaregan		355 m2	On the east side of sekretariat prawartaka building	This building functions as a kitchen and a place for worshipers to rest.
Bale Peringgitan		208, 82 m2	On the west side of Pura Ratu Gede	This building serves as a place for the preparation of offerings and banten
Linggih Taru		81,85 m2	On the north side of Pura Ratu Gede	



Figure 2. Site Plan of Dalem Ped Temple

Pura penataran agung dalem ped temple is divided into three parts of space, namely jaba, madya, and main mandala. In the jaba section of the temple, there is a waiting area before entering the madya mandala. The jaba temple area is integrated with the circulation flow for the Dalem Ped Temple area. The mandala area in the penataran agung temple has an area of 699.9 m2. In the middle mandala area, there are 3 buildings and 2 temples, where the buildings are bale kulkul, bale sake nem, and bale agung, which has sake 12 for temples in the middle mandala in the form of pelinggih apit lawing. Entering the main mandala area, which has an area of 879.99 m2, there are 11 pelinggih, 1 padmasana, 1 palinggih pamaruman, bale piasan, bale gong, bale pemangku, and bale sake roras. The following is a description of the measurement results that have been carried out:



Figure 3. Layout Plan and Aerial View of Pura Penataran Agung

The dalem ped garden temple is divided into three parts of space, namely jaba, madya, and main mandala. In the jaba section of the temple, this area is separated by angkul-angkul from the garden temple. The jaba section of the garden temple is a circulation area in front of the garden temple. The madya mandala area in the garden temple has an area of 884.67 m2 in the madya mandala area of the bale pemangku, which is the area for worshipers to pray in. Entering the main area of the mandala, which is separated by a pond from the madya mandala, there is one pelinggih in the form of pelinggih pamaruman. The main area of the mandala in the garden temple can only be entered by pemangku or certain people. The following is a description of the measurement results that have been carried out:

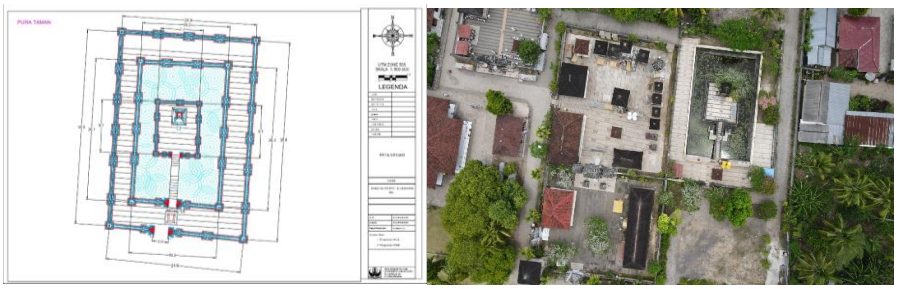


Figure 4. Layout Plan and Aerial View of Pura Taman Dalem Ped

The Ratu Gede Dalem Ped Temple is divided into two parts of space, namely the middle and main mandalas. The middle mandala area of the ratu gede temple functions as a circulation area in the dalem ped temple area, and the middle mandala and main mandala of the ratu gede temple are separated by the grand kori. Entering the main mandala area of the Ratu Gede Temple, which has an area of 457.95 m2, there are 1 pelinggih, 1 padmasana, bale sake nem, bale pemangku, and two bale bengong, which function as places to put sesari. The following is a description of the measurement results that have been carried out:



Figure 5. Layout Plan and Aerial View of Pura Ratu Gede Dalem Ped

Pura segara dalem ped is divided into two parts of space, namely the madya and main mandala. The madya mandala area of the segara temple functions as a circulation area in the dalem ped temple area, while the madya mandala and main mandala of the Ratu Gede temple are separated by the grand kori.Entering into the main mandala area of the ratu gede Temple, which has an area of 441 m2, there is 1 pelinggih pamaruman, 1 bale sake nem, and 1 bale pemangku. The following is a description of the measurement results that have been carried out:



Figure 6. Layout Plan and Aerial View of Pura Segara Dalem Ped

Conclusion

Community service at Pura Dalem Ped using UAV and GPS geodetic technology can be effectively used in measuring and inventorying temple buildings.The use of this technology accelerates the measurement process, increases efficiency, and produces precise data. With comprehensive data, the pengempon can carry out more targeted planning of the temple area arrangement. Using interview and field observation methods in data collection is effective in obtaining accurate and relevant information about the problems faced at Pura Dalem Ped. This community service provides direct benefits for the pengempon Pura Dalem Ped community by providing a layout plan of the temple area which will be a reference in the development and arrangement of the temple area in the future. Collaboration between the community service team, pengempon Pura Dalem Ped, and related parties plays an important role in the success of measuring and inventorying temple buildings and preparing a layout plan for the temple area.

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