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GENERATION OF SURVEY APPLICATION PLANS USING DRONE TECHNOLOGY

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ABSTRACT

Drone technology has become a primary tool for aerial image collection. The ability to capture drone-generated images instantly and use photogrammetry platforms to process high-quality orthomosaic maps and 3D models enables professionals to perform point-to-point linear measurements without manually collecting data. Most land title documents within a single ownership contain multiple names (Co-Proprietorship). Issues often arise when one of the listed owners wishes to sell their share, while some of the owners have occupied the land since its initial allocation. In conventional methods, surveyors first conduct detailed measurements based on existing settlements before proposing a boundary subdivision. Using drone surveying method, the time is significantly reduced and more accurate without the need for detailed field measurements. This relative accuracy of two-dimensional measurements from models generated using images captured by the industry-standard DJI Phantom 4 RTK drone compared to conventionally drawn plans indicates that drone-based surveys can achieve a relative horizontal and vertical accuracy of approximately 2–5cm when Ground Control Points (GCPs) and RTK/PPK positioning are utilized. Surveys conducted without GCPs yield a relative accuracy ranging from 0.5–2m, depending on flight altitude, overlap, and environmental conditions. This shows that drones are a reliable and efficient tool for survey applications.

1. Introduction

In Malaysia, it is common for land title documents to list multiple names under a single grant. Typically, these documents are entrusted to and held by a single representative. When a transaction occurs, buyers often do not know the specific portion of land they are purchasing. The title document only indicates the fractional ownership of the land, without specifying its exact location. This situation becomes more complicated when the heirs of a deceased owner fail to manage the inheritance of shared ownership land. In some cases, the original owner passes away, and the inheritance is distributed among multiple heirs, increasing the number of

listed owners while decreasing the individual share size. There are also instances where inherited land has been passed down for several generations but remains under the name of a deceased owner, with no formal inheritance process completed. Many heirs do not know their specific land portion and rely solely on the title document. This makes land administration, transactions, and development significantly more challenging. In some cases, it may no longer be practical to develop the land or to carry out subdivisions.

Identifying heirs and obtaining their agreement becomes even more difficult if some refuse to cooperate, cannot be found, or have passed away. As a result, the land is often left idle. A practical solution is for all heirs to appoint one or more authorized representatives and collectively agree to sell their shares to one or two capable buyers at the current market price or a mutually agreed rate. Once a power of attorney document is signed, only the buyer and appointed representative handle negotiations, sale agreements, and ownership transfer documents. At this stage, signatures from all heirs are no longer required. However, it remains essential to inform all heirs before the sale and transfer process takes place.

2. Aims

To evaluate and demonstrate the effectiveness of drone technology in generating accurate, efficient, and cost-effective survey application plans for engineering, construction, land management, and environmental purposes.

3. Objectives of the Study

The primary objective of this research is to investigate the application of drones experimentally.

1. To assess the capability of drones in capturing high-resolution aerial imagery and geospatial data for survey applications.
2. To develop survey application plans (topographic maps, 3D models, orthophotos, digital elevation models) from drone-captured data.
3. To compare the accuracy and reliability of drone-based survey results with conventional surveying methods.

4. Methodology

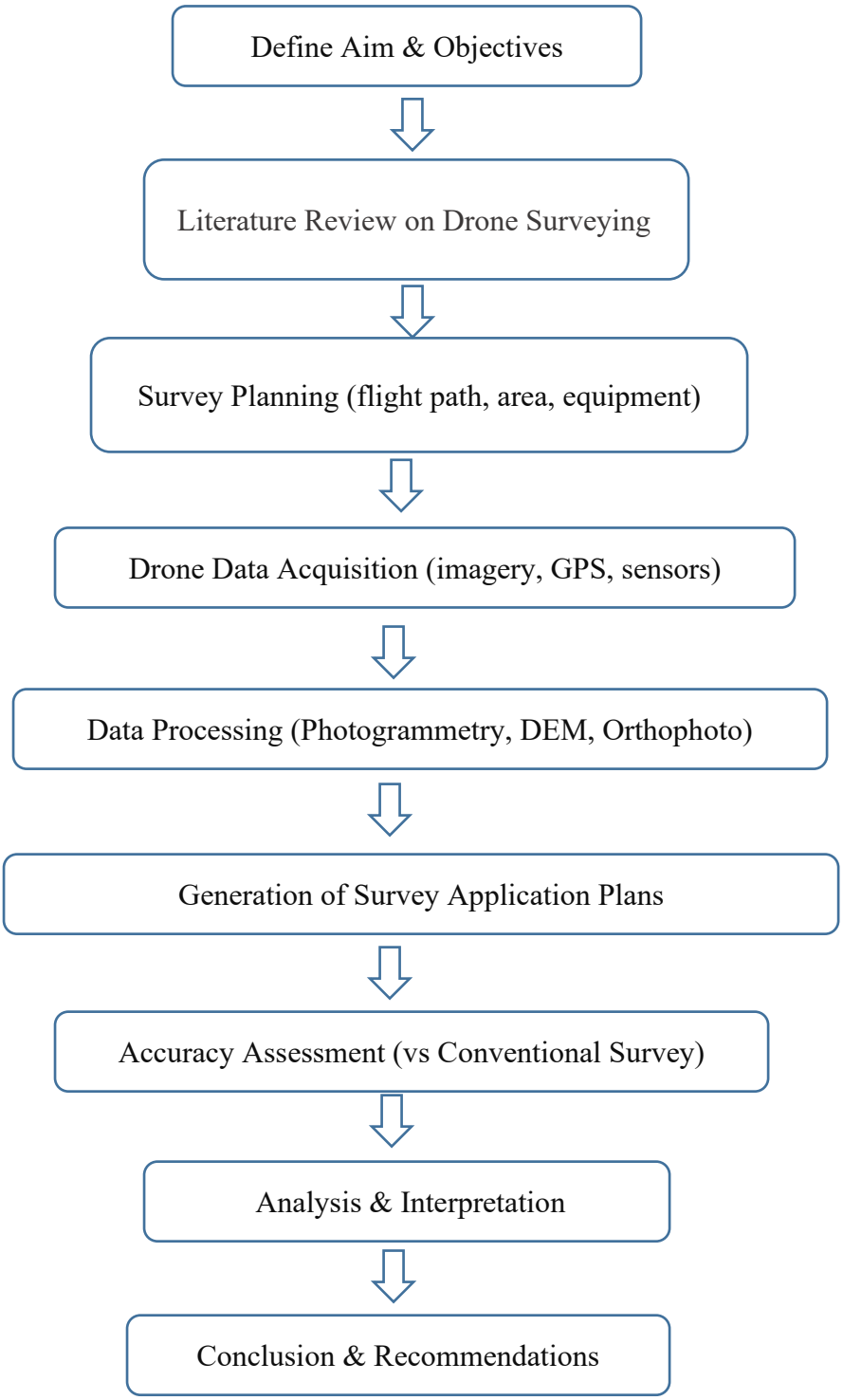

Figure 1. Experimental workflow of this research

5. Case Study

Study case is in Mukim Kota Lama Kiri, Kuala Kangsar district, Perak. Lot 4987 is divided among eight landowners and classified as agricultural land. With the consent of the landowners, as stated in the land grant, they have agreed to proceed with a boundary subdivision. However, under the National Land Code (NLC) Section 135 regarding Land Subdivision, such a subdivision is generally not permitted. One of the primary obstacles to land development is the difficulty in obtaining separate titles for parcels smaller than 0.4 hectares (or 2/5 hectares) for agricultural land. For other land uses, the subdivision must comply with the minimum area requirements set by local building regulations and authorities.

To address this issue, Section 140(3) of the NLC was amended to allow co-owners of agricultural land measuring 2/5 hectares or less to proceed with subdivision. Additionally, Section 141(1)(c) was revised to remove restrictions on subdividing agricultural land below this size. To further facilitate the process, Section 141A was introduced, enabling any co-owner to initiate a subdivision. Furthermore, Section 143A was established to grant the State Authority (PBN) the power to approve the subdivision of agricultural land of 2/5 hectares or less. Therefore, to develop the land for more productive use, or for sale and transfer to other parties, the subdivision or partitioning process can be applied by national land legislation. However, only five of the registered owners have agreed to mark the land according to their respective shares as stated in the title document. In 1980, the land was previously partitioned and marked through precise measurements conducted by an individual with a background in land surveying. Unfortunately, those markers have since been lost. As a result, the landowners have agreed to conduct a new survey by appointing a licensed and certified surveyor. This survey, however, is not intended for a formal application to the land office but will serve as a reference for the landowners of this lot.

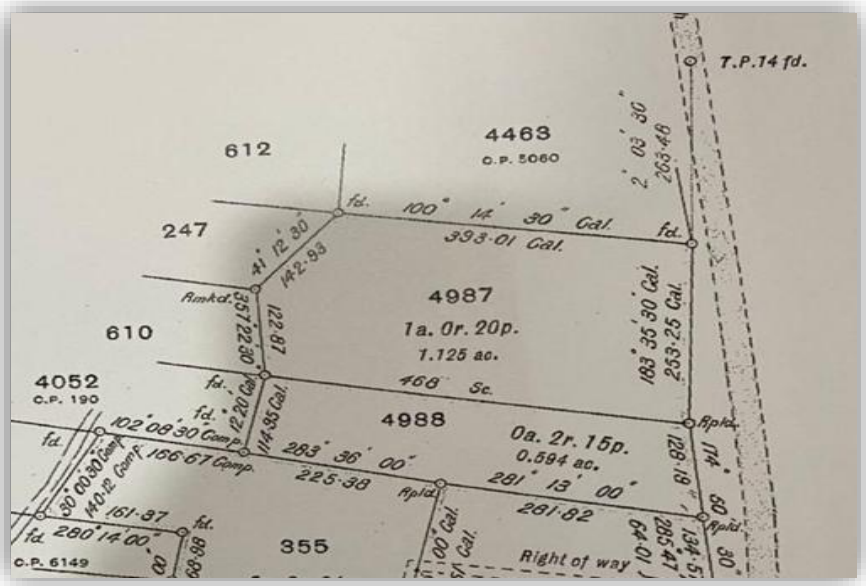

Figure 2. Certified Plan Lot 4987.

The owners requesting the boundary re-marking are as follows:

- Norakhidah Bt Yahaya.
- Mohamad Suhairi Bin Yahaya
- Norhaniza binti Mohd.Haris
- Rohani Binti Haroun
- Izatun Azwa Binti Sabri

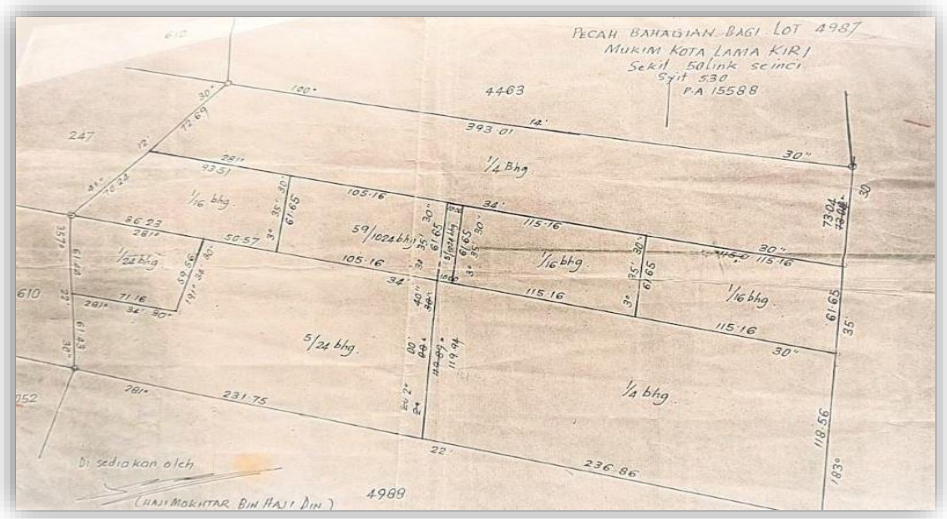

Figure 3. Original subdivision proposal from 1980

It looks like after reaching an agreement, a boundary subdivision plan was created based on the 1980 land area measurements**,** with precise surveying conducted and PVC pipe markers placed in the field.

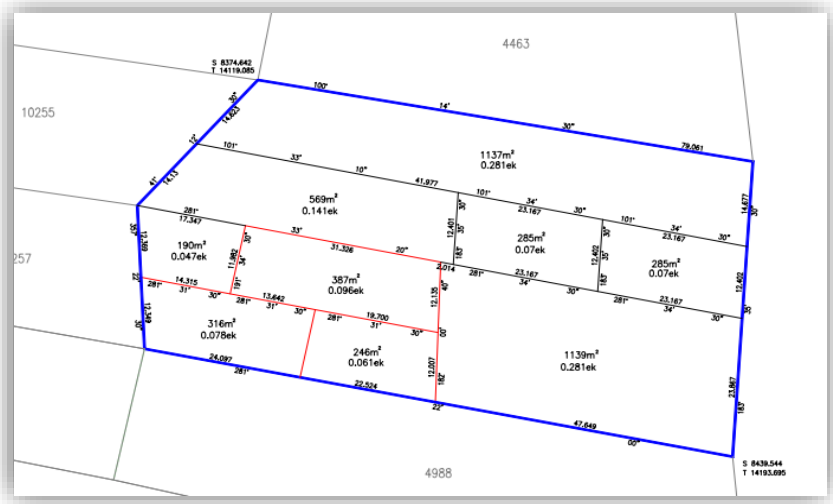

Figure 4. New boundary divisions based on the latest agreements

It looks like some adjustments were made to the original layout plan due to land transactions among family members. Although each landowner has a copy of their portion, they struggle to visualize their exact land division due to existing settlements. To address this, a drone survey was conducted to map out land boundaries based on current settlements. The Phantom 4 RTK drone was used for this survey, flying at an altitude of 100 meters to capture high-precision aerial imagery.

Figure 5. Phantom 4 RTK

6. Discussion

The results of the study indicate that the method used to produce the boundary subdivision plan is more effective and visually appealing. Landowners can directly identify their respective land parcels without the need for a site visit. Additionally, land encroachments and existing settlements can be clearly and immediately observed. The time taken for this process is much shorter, and the generated images appear exceptionally clear.

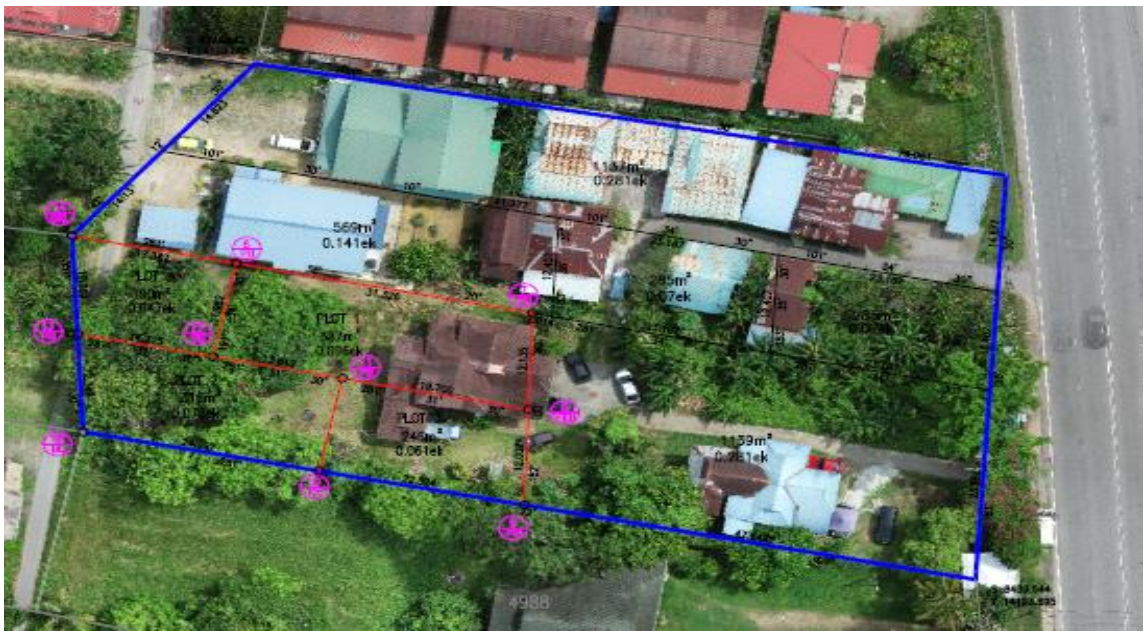

Figure 6. Submission plan from Phantom 4 RTK

Table 1. Comparison: RTK Drone vs NDCDB

	RTK Drone Survey	**NDCDB (JUPEM Standard)**
Horizontal Accuracy	±2–3 cm (with RTK, GCPs)	±5 cm (benchmark data)
Vertical Accuracy	±3–5 cm	±5–10 cm (depends on terrain, survey class)
Data Coverage	Wide area (hundreds of hectares in hours)	Parcel-based (cadastral lots, precise lines)
Reference System	WGS84/GDM2000 (with transformation)	GDM2000 / Cassini Soldner
Best Use	Topographic mapping, construction monitoring, engineering works	Legal cadastral boundaries & land ownership
Limitation	Requires careful GCP placement & corrections	Expensive, time-consuming survey methods

4. Conclusion and Recommendation

It is recommended that drone technology be utilized in the future for boundary subdivision or land partition applications at the land office or the land and mines office for approval. This approach allows authorities to directly assess any instances of land encroachment in real-time. The shift to this method can significantly enhance the efficiency and speed of the application process, making it more effective and accurate**.**

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