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Plotting of Land by Drone Surveying

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Abstract: *In construction projects, the accurate plotting of any land area, surveying method is one of the most essential processes in the planning phase. In following that, some traditional surveying techniques were followed (Chain Surveying, Compass Surveying, and the use of Total Stations) requires significant manual effort and can be time - consuming, especially when surveying large areas spanning hectares of land. To address these limitations, drone-based surveying offers a more efficient alternative. This project aims to survey the land using a drone equipped with Real-Time Kinematic (RTK) technology. The Ground Control Points (GCPs) and images captured by the drone will be stitched together and exported to AutoCAD software for plotting. The results from drone surveying are expected to be more accurate and faster than those obtained through traditional methods. Additionally, this project seeks to evaluate the challenges and capabilities of drones in surveying various terrain features*

Keywords: Drone Surveying, Flight planning app, Laptop/software for post-processing, Camera

I. INTRODUCTION

Aerial surveying techniques offer a superior alternative. This approach involves capturing photographs of the land directly above it using aerial platforms such as hot air balloons, airplanes, helicopters, and drones. These images, when merged with relative overlapping, form the basis for extracting relevant site data using stereoscopy and photogrammetric techniques. Among those aerial platforms, drone-based surveying has evolved significantly due to the compact size of drones, ease of operation without requiring extensive technical assistance, and cost-effectiveness compared to other aerial platforms. Conducting a drone survey in the GPREC (G. Pulla Reddy Engineering College) ground can be an effective way to map the area, monitor infrastructure, plan construction, or assess vegetation serve multiple purposes, such as:

II. OBJECTIVES

- Campus Mapping
- Infrastructure Planning
- Event Coverage
- Greenery/Environmental Monitoring
- Construction Planning or Progress Tracking

III. LITERATURE REVIEW

According to Heng Zhao (2020), traditional land surveying methods such as Total Station and GPS-RTK have several limitations that impact efficiency and accuracy. Total Station surveying requires a clear line of sight between measurement points, making it unsuitable for obstructed terrains like forests or urban areas, and its accuracy decreases over long distances.

Alexander (1983) highlights those traditional approaches often rely on subjective judgment and "gut-level" analysis, which can introduce personal biases and result in unrepresentative or skewed data. These methods are heavily dependent on surface exposure, making them less effective in areas with dense vegetation or complex terrain.

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Noor et al (2018) demonstrated the urban applications of drones essentially, monitoring land use/land cover changes, transportation networks and infrastructure monitoring purposes.

According to Greenwood et al (2019) drones are widely applied in post-disaster reconnaissance, infrastructure monitoring (e.g., pipelines, bridges), geotechnical engineering, and construction management, offering rapid data collection in hazardous or remote areas.

By referring of all the works done by the above authors, small changes had observed in those papers. Those changes will apply in our project work.

III. METHODOLOGY

Drone Surveying can be done once we are ready with the permission from the authority persons of the land and permission from local bodies if it lies in restricted zone as per Ministry of Civil Aviation India. Surveying is divided into three stages namely, pre-processing stage, data acquisition stage and post-processing stage which are described in the following sections shown in fig: 1.

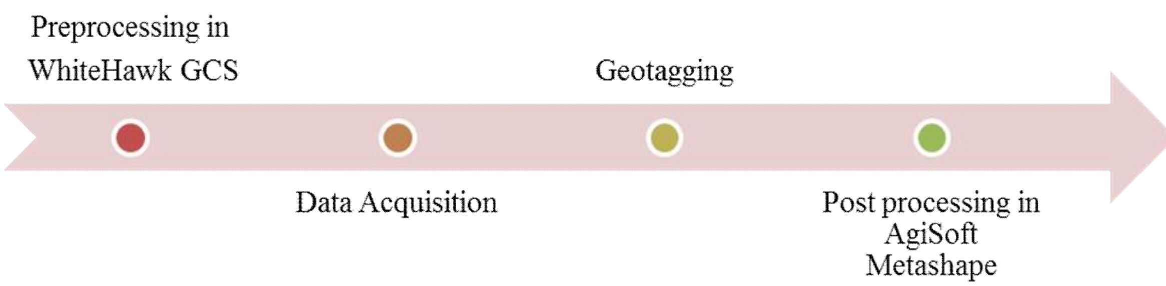

Fig. 1. Stepwise Procedure of Drone Survey

Pre-processing in WhiteHawk GCS:

To ensure uninterrupted and efficient surveying, the drone underwent a thorough preparation process shown in Fig: 2. The battery was fully charged before installation, and a spare battery was kept ready to facilitate continuous operation. The propeller blades were securely attached to the motor shafts, with their stability verified to prevent detachment during flight. A micro-SD card and macro-SD card were inserted for data logging, and the camera cap was removed.

Fig. 2. Pre-processing of Drone by White Hawk Software

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Mission Planning:

Prior to the flight, essential parameters were uploaded in GCS software to ensure optimal data collection and compliance with site conditions. The drone is ready to flight shown in Fig: 4 and also these parameters included an altitude of 75 meters, a front and side overlap of 80%, and a drone velocity of 10 m/s.

Fig. 3. Flighting a Drone above 75m from ground

Data Acquisition:

During the data acquisition stage, the drone follows a pre-determined flight path using its onboard GPS at an altitude level of 75m. Simultaneously, it captures high-resolution photos of the land along with GPS coordinates, which are stored on separate SD cards mounted in the drone.

Geo Tagging:

We can add the geotagged images either storing them in a separate folder and adding the folder in the software or selecting the geotagged images separately. Aligning of photos is also defined as Image alignment which is the process of adjusting multiple images to fit within a shared coordinate framework shown in fig: 4

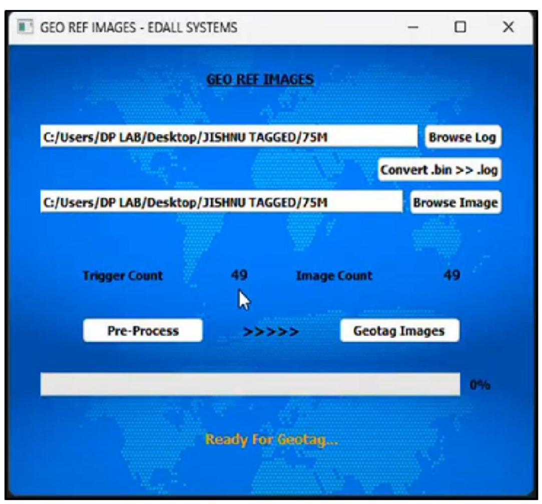

Fig. 4. Geo Tagging the Images and Control Points

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Post-Processing:

In this stage, the geotagged images are to be aligned according to their GPS data making it foundation to generate Digital Elevation Models (DEM), 3D Models and Orthomosaic maps using photogrammetry software such as Agisoft Metashape, Pix4D, DJI Terra, Drone. Deploy to name a few.

Creating Dense Point Cloud :

We create dense point cloud which is a data point in space representing a 3D object or shape. This process involves an intermediate process of creating depth maps which is a special kind of 2D image where each pixel shows how far an object is from the camera. It helps to understand the distance of objects in a flat image, making it look more 3D.

IV. RESULTS AND DISCUSSION

The post-processed results obtained from drone surveying offer a wide range of practical applications. The generated orthomosaic map and contour map shown in Fig: 5 provides a highly accurate and detailed representation of the surveyed area, enabling users to perform precise calculations such as volume estimations, area and perimeter measurements of objects or topographical features, and retrieval of latitude and longitude coordinates for any specific point on the map.

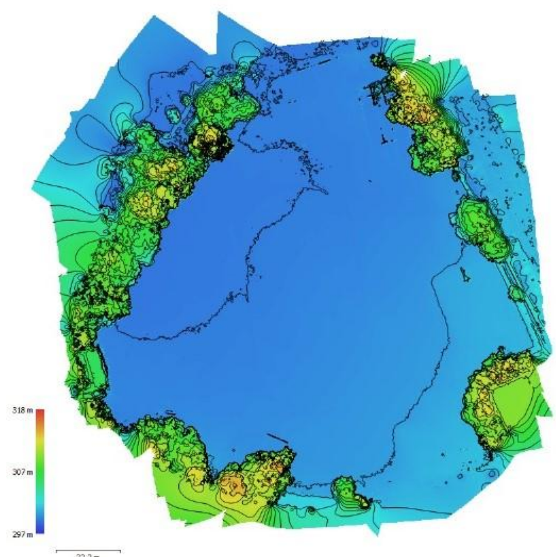

Fig. 5. Contour Image of GPREC Ground after the post processing technique

V. CONCLUSION

This paper provides a comprehensive overview of drone-based surveying, detailing the step-by-step process from data acquisition to result processing. The drone surveying of the GPREC college ground was successfully conducted, yielding high-resolution aerial imagery and accurate geospatial data. The survey provided a detailed view of the campus layout, open spaces, and infrastructure, enabling effective mapping and analysis. The orthomosaic maps and 3D models generated from the data offer valuable insights for campus planning, land use optimization, and future development projects.

Overall, the drone survey proved to be a fast, efficient, and cost-effective method for capturing and analyzing the physical characteristics of the college ground. The results will support data-driven decision-making for academic, administrative, and developmental initiatives at GPREC.

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