

## Low Cost LiDAR-GNSS-UAV Technology Development for PT Garam's Three Dimensional Stockpile Modeling Needs

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**Abstract :** Unmanned aerial vehicle (UAV) technology has cost efficiency and data retrieval time advantages. Using technologies such as UAV, GNSS, and LiDAR will later be combined into one of the newest technologies to cover each other's deficiencies. This integration system aims to increase the accuracy of calculating the volume of the land stockpile of PT. Garam (Salt Company). The use of UAV applications to obtain geometric data and capture textures that characterize the structure of objects. This study uses the Taror 650 Iron Man drone with four propellers, which can fly for 15 minutes. LiDAR can classify based on the number of image acquisitions processed in the software, utilizing photogrammetry and structural science principles from Motion point cloud technology. LiDAR can perform data acquisition that enables the creation of point clouds, three-dimensional models, Digital Surface Models, Contours, and orthomosaics with high accuracy. LiDAR has a drawback in the form of coordinate data positions that have local references. Therefore, researchers use GNSS, LiDAR, and drone multi-sensor technology to map the stockpile of salt on open land and warehouses every year, carried out by PT. Garam twice, where the previous process used terrestrial methods and manual calculations with sacks. Research with LiDAR needs to be combined with UAV to overcome data acquisition limitations because it only passes through the right and left sides of the object, mainly when applied to a salt stockpile. The UAV is flown to assist data acquisition with a wide coverage with the help of integration of the 200-gram LiDAR system so that the flying angle taken can be optimal during the flight process. Using LiDAR for low-cost mapping surveys will make it easier for surveyors and academics to obtain pretty accurate data at a more economical price. As a survey tool, LiDAR is included in a tool with a low price, around 999 USD; this device can produce detailed data. Therefore, to minimize the operational costs of using LiDAR, surveyors can use Low-Cost LiDAR, GNSS, and UAV at a price of around 638 USD. The data generated by this sensor is in the form of a visualization of an object shape made in three dimensions. This study aims to combine Low-Cost GPS measurements with Low-Cost LiDAR, which are processed using free user software. GPS Low Cost generates data in the form of position-determining latitude and longitude coordinates. The data generates X, Y, and Z values to help georeferencing process the detected object. This research will also produce LiDAR, which can detect objects, including the height of the entire environment in that location. The results of the data obtained are calibrated with pitch, roll, and yaw to get the vertical height of the existing contours. This study conducted an experimental process on the roof of a building with a radius of approximately 30 meters.

**Keywords :** LiDAR, unmanned aerial vehicle, low-cost GNSS, contour

**Conference Title :** ICGESS 2022 : International Conference on Geography, Environment and Spatial Sciences

**Conference Location :** Kuala Lumpur, Malaysia

**Conference Dates :** December 09-10, 2022