Utilizing UAV for 3D Map for Urban Land Use in Tainan City, Taiwan

Ching-Hsuan Wu[1], Ming-Shan Hsiao[2], Chien-Ming Chang[3]

Department of Applied Geoinformatics, Chia-Nan University
60, Sec 1, Erh-Jen Rd, Jen-Te, Tainan, Taiwan, ROC
[1]+886-6-2664911, +886-6-2666114, jeffereywu@yahoo.com.tw
[2]+886-6-2664911, +886-6-2666114, zxcvbnm319109@gmail.com
[3]+886-6-2664911, +886-6-2666114, B0629018@gm.cnu.edu.tw

Abstract

The progress of science and technology has changed the way of topographic mappingwhich is no longer limited to traditional ground and aerial photogrammetry. Unmanned ariel vechicle (UAV) is used to create image maps, light-probing maps, measurement vehicle scans as a new state of the art technology. Drone flight tests are different from traditional large aircraft aerial measurements. Drones are not affected by climate much and does not cause any casualty with good safety, low-altitude operation, obtaining high-precision images. They have wider building coverage. Using drones increases the multi-faceted texture image of buildings with enhaced scale up to 1:1000. The images from drones avoids cloud cover with low cost, easy operation and maintenance. Mapping is very important in geography, architecture and other fields, especially in urban planning. Thus, we combine UAV technology with urban planning to build a three-dimensional (3D) model from the original two-dimensional (2D) plane of the urban planning and economic zone. Geographic Information Systems (GIS) is also used for urban planning to facilitate subsequent application and treatment.

Keyword: unmanned aerial vehicle, law of urban planning, 3D, GIS

Introduction

Global positioning system (GPS), remote sensing, geographic information system (GIS) are called as 3S. Aero photogrammetric survey is a remote sensing method of measuring and obtaining the shapes three-dimensional (3D) of objects. They have the accuracy for a large area and disaster detection with no restrictions of intervention. The universal application of GIS covers disaster treatment, national spatial plan with unmanned aerial vehicle (UAV) technology. An UAV is used for urban planning, zoning map, being combine with GIS 3D modeling based on partitioned maps n regional division. UAVs are inexpensive, convenient to operate, highly sensitive and differentiate natural occurrence, accidents, disasters to send messages without delay and high cost. Therefore, UAV are widely used for urban planning, land-use planning and aerial surveys. Using UAVs to obtain image data and real time kinelatics (RTK) measurement of coordinates and elevation data, value processing of the data, information, results, topographic models with photoscan correction with GIS systems, the area of an urban planning is digitalized and stored in the GIS system. The data also is applied to different fields such as topographic mapping. Figure 1 show the process of this study.

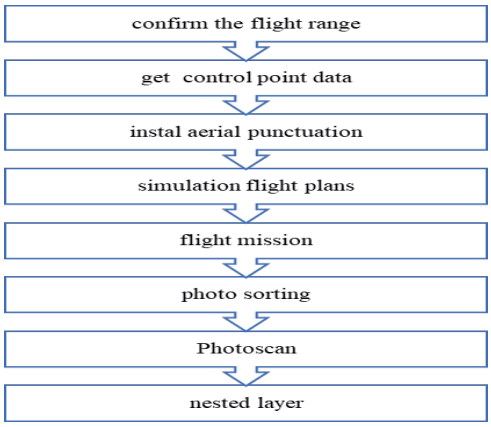

Fig. 1 Research process

Related technologies

Current UAVs have wider and larger scopes, flexibility, fast speed and low cost to use. They are not influenced by weather, but by load, height with low stability to have the limit in the range of use. Design test, production of aerial photography, and suitable platforms need to be checked to use them. To improve the performance in an unclear situation and to get high quality aerial shots, multiple flights tests are needed to confirm their application feasibility for the planning and monitoring. Aerial photos include vertical, high oblique, low oblique ones according to camera angles and directions. Geometric correction eliminates deformation, setting images to coordinate with targets and their opposite coordinates. Photoscan rebuilds plane images, 3D models without generated control points. The digitization of aerial photo is used for elevation model to get pixels on a projection.

Digital elevation model generates a cloud of geographic reference points of information maps to overlay a texture polygon model, DEM and orthographic images. The number of formal representation in actual topographical features refers only to the elevation of the spatial distribution of terrain feature points. Land uses zoning control purposes to reduce negative influence and to improve the quality of the living environment, solve urban-development problems.

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Method

Anding district in Tainan city of Taiwan is flat with no high-rise buildings. UAV flight area urban land use planning data is shown in Fig. 1. The flight range is shown in Fig. 2 .

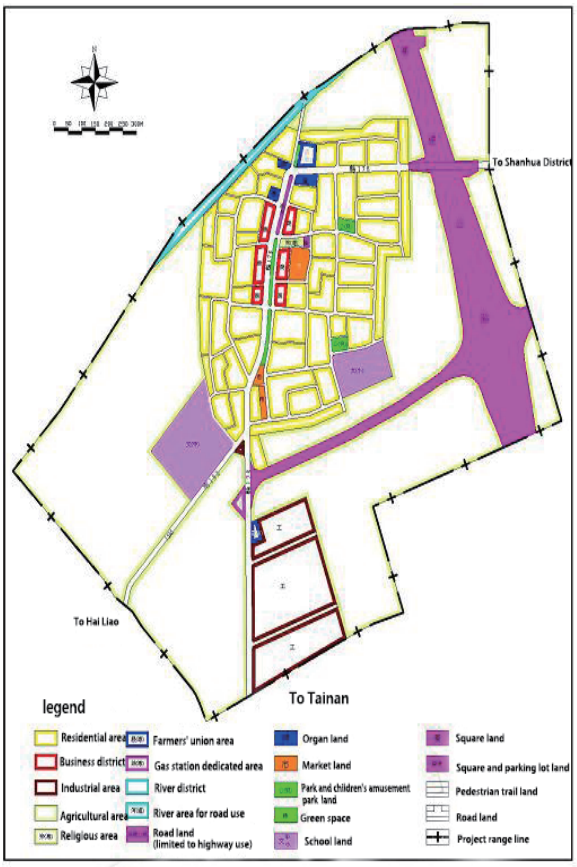

Fig. 2 Partition diagram

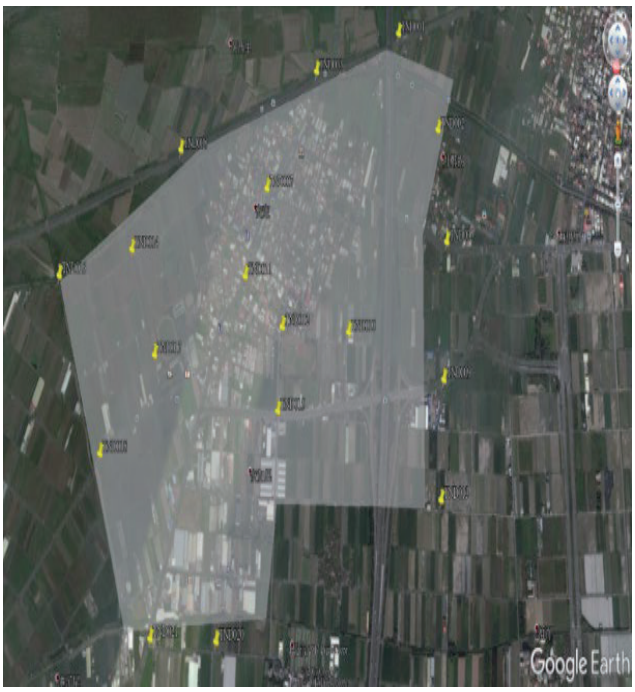

Fig. 3 Flight range

A. Beacon point setting

1) The beacon point is set to a position with good air sight. The zenith is at an angle of more than 40 degrees.
2) The landmark points are marked with water-soluble paint in a cross shape.
3) After the points are set, each mark is named.
4) Before taking aerial photography, it is necessary to confirm the integrity of each navigation mark to ensure the beacon to be imaged clearly.

B. Beacon point measurement

Control points are measured by RTK measurement method to coordinate elevation points in the survey area. The coordinate elevation is directly measured by the GPS RTK method as the coordinates of the full control point.

TABLE 1
THE COORDINATES OF TWD97

Point number	N coordinate	E coordinate	elevation
AD01	2557081.893	172236.364	26.262
AD03	2558187.220	171862.057	32.325
AD04	2557577.200	172102.699	25.411
AD05	2557602.307	171752.540	25.095
AD06	2557737.640	171494.201	26.790
AD07	2557223.391	171070.410	25.591
AD08	2557098.813	171542.189	24.869

C. Photoscan

The scope of this experiment is defined in the <101.08.28 Changed Urban Planning (Fourth Comprehensive Review). The purpose of the program is to reduce the residential area around the industrial area that is marked in red line as in Fig. 4.

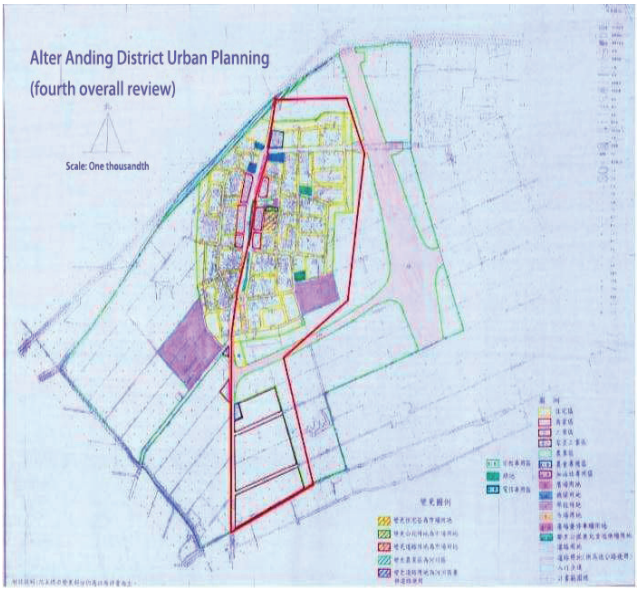

Fig. 4 Orthophoto processing (Photoscan)

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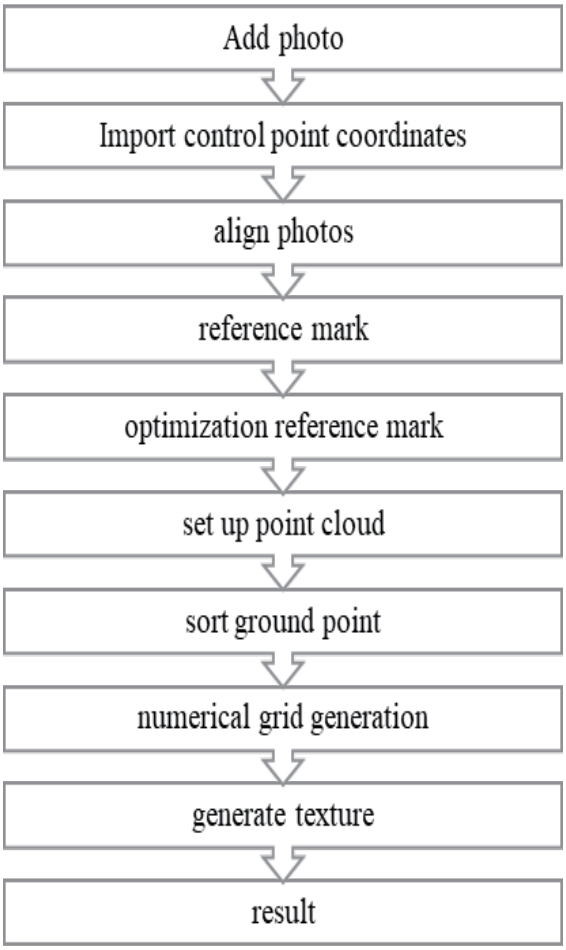
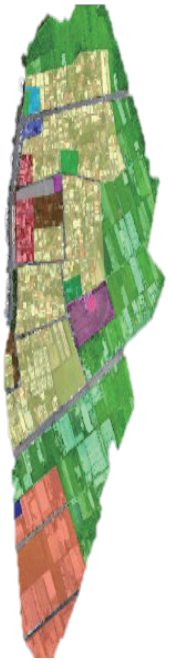


Fig. 5 Photoscan image processing flow

Results

The following is the results of the model processed by photoscan.



•Green → Agricultural area
•Yellow → Residential area
•Light blue → Farmers' Union Area
•Navy blue → Government land
•Red → Business district
•Brown → Change residential area to market land
•Orange → industrial area
•Purple → School land

Conclusion

Based on the image data obtained by UAV in the Anding District of Tainan, Taiwan, this study combines photo-scanned image with the urban planning zone. The results showed that RTK measured each of eight coordinates and elevations through the images. 3D models combined with the change of Taiwan's Anding District showed the use of zoning land in this area more clearly by color zoning. Future GIS application provides information of uses of buildings in addition to appearance.

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