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# Digital Mapping of UMK Jeli Campus Using Drone Technology

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***Abstract* - Aerial or satellite images are conventionally used for geospatial data collection and in producing a topographic map. The Unmanned Aerial Vehicles (UAV) technology such as drone has developed by providing very high spatial and temporal resolution data at a lower cost. Nowadays, drones not only use for military purpose but also been utilized widely by the public community for mapping, monitoring, video capturing activities and as a hobby. This present study focuses on the utilization of drone technology to produce a digital map of UMK Jeli Campus. The objective of this study is to access the capability and the accuracy of the drone in producing a digital map. Parrot ANAFI and DJI FC6310 devices were used as a platform to acquire digital images of the study area. After capturing the digital images, ground control points were established with the aid of a handheld global positioning system (GPS) device. Images were processed using Agisoft Photoscan software to produce a digital map of UMK Jeli Campus. This study shows that UAV can be used for producing a digital map at sub-meter accuracy and it can also be used for diversified applications.**

***Keywords*— *Digital mapping, drone, UMK Jeli Campus***

## I. INTRODUCTION

Unmanned Aerial Vehicles (UAV) is one of the greatest technologies that widely used for many types of commercial applications nowadays. For example, it has been used in research, television filming and others. The utilization of technology has arisen and has led to the development of ever sophisticated software, such as in 3D mapping software. In the development of UAVs, there has been much considerable activity of all possible kinds and is well documented on the UVS - International website [1].

UAVs can fly almost everywhere and anywhere. Due to their high flexibility, it allows them to view the angle of the location and easily can change the observed location in a short time. Because of that reason, the safety of the users of aerial spaces which including manned or other unmanned aircraft, to the property on the ground, people and also their impact on the environment, it is significant to pay attention to this [2].

Universiti Malaysia Kelantan (UMK) Jeli campus is one of the recognized public universities in Malaysia. The campus was established for almost 7 years. Development still continues in terms of management, additional buildings, upgrading the facilities and surrounding areas. As for now, the campus area has become wider than before.

There will be some obstacles in mapping when using satellite images and aerial photographs one of them is cloud cover. Furthermore, the cover of the cloud can be an obstacle to the satellite images that will be used in the humid and warm region [3]. Other than that, various significant information and data will be lost because of the cover of the cloud. All the barriers will be influenced by the technique in

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mapping and updating topographic. Hence by integrating Unmanned Aerial Vehicles (UAV) images will overcome the problem of satellite images.

Furthermore, UAV consists of lower assembling and the operating costs of the systems, the adaptability of the flying machine to change as indicated by the needs of the customer and the risk avoidance of the pilot during a troubled mission. Next, UAVs were first made and utilized in military applications where flight identification in competitor areas, unmanned investigation, observation, surveillance and mapping of enemy areas with no hazard for human pilots were the essential military points [4].

## II. STUDY AREA

The area for the current study covered the whole UMK Jeli Campus with an estimation area of 1.09265 km². UMK Jeli campus located in Kelantan state at longitude and latitude of 101° 51'15" to 101° 53'30"E and 5° 43'15" to 5° 45'30"N respectively (Fig. 1). The campus area consisted of all three faculties, administration buildings, lakes, farms, sports fields, and recreation areas. "Campus in the Forest Park" is the concept that represents the physical development of the campus. Surrounded by green scenery, the campus can promote positive health effects on the campus community.

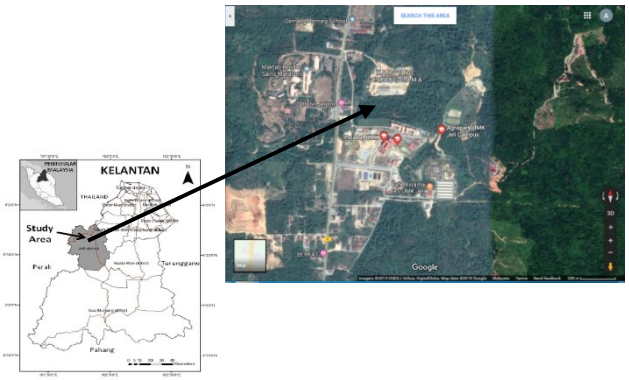


Fig. 1. Location of the study area.

In this study, the Parrot ANAFI was used to capture the data for the digital map (Fig. 2 and Fig. 3). Table I shows the specifications of both UAVs used to acquire aerial photographs.

Fig. 2. Parrot ANAFI.

Table I. Drones specifications.

| Details | Drone Specification |
|---|---|
| | Parrot ANAFI |
| Camera | HD camera |
| Resolution | 21 Megapixels |
| Speed | 33 mph |
| Focal length | 23 mm |
| Maximum flight time | 25 minutes |
| Weight | 320 g |

## III. METHODOLOGY

### *A. Acquisition of Aerial Photograph Using UAVs*

The aerial-photographs of the Universiti Malaysia Kelantan (UMK) Jeli campus were acquired by capturing the image data from the flying drones. Many small formats of aerial photographs were acquired using several flight lines.

### *B. Ground Control-point (GCP) Establishment*

In this study, several GCPs were selected with the aid of GPS by using Garmin GPS. The GCP is any point in which the positions are known in an object-space reference coordinate system and the images can be positively identified in the photographs.

### *C. Image Processing*

Aerial-photographs obtained by UAVs usually consists of hundreds of digital images acquiring at different lighting conditions and flight altitudes. The pre-processing of UAV imagery was aimed to orthorectify each image and mosaic them into a single one. This was a difficult task because the images experienced lighting variation, platform sway, and sensor displacement. All the digital images taken were then processed in the Agisoft Photoscan Software program to produce high-resolution orthophoto. After the images were successfully produced, the next stage was to process the output into the ArcMap version 10.3 software. At this stage, the orthophoto was digitized to convert the information into the digital format. To get the accurate digital map it was then processed in the georeferencing.

## IV. RESULTS AND DISCUSSION

A total of 500 images were captured in this study. Flying altitude of the drones was 152.5 m with the tie-points at 138900. The ground resolution was at 0.0336842 m/pix and covers about 0.4659 km$^2$. Figure 3 showed the analysis output of the study. The orthophoto is an aerial photograph that used Digital Elevation Model (DEM) data and Ground Control data to correct the geometric error so that it can be used for mapping purposes without any distortion of scale along with the image range.

Fig. 3. The digital ortho-mosaic photo of the study area.

Meanwhile, Table II showed the camera specification while Fig. 3 showed the location of the drones includes the image overlapping during the image capturing process.

Table II. Cameras specification

| Camera Model | Resolution | Focal Length | Pixel Size |
|---|---|---|---|
| FC6310 (8.8M) | 5473x3648 | 8.8m | 2.4 x 2.4nm |

There were 500 of images captured by the drone. The previous study stated that in urban areas, it is necessary to point out the available details and information contents for reference to the user. The important of object identification is the number of spectral bands, pixel size, high-resolution images, spectral range, sensor types and high-quality image [5].

Figure 4 showed the Digital Elevation Model (DEM) which was to get the exact geometric DEM for the altitudes of 152.486 meters respectively of the study area. Like the orthophoto mosaic, as the altitude of UAV increases, the area of DEM increases. The DEM pattern was generally the same where the red colour indicates the higher part of the study area, whereas the blue colour indicates the lower part of the study area.

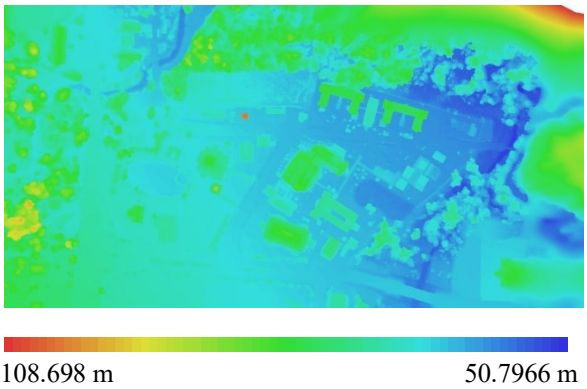


Fig. 4. The Digital Elevation Model (DEM) capture from the data.

The orthophoto was then used to extract features to update the existing map. The orthophoto was exported to the ArcMap version 10.3 software for the digitization process (Fig. 5). Digital maps with virtual fly-over and fly-through are an important part of many graphical user interfaces because people intuitively understand maps and aerial views, and many kinds of information have a spatial component that makes spatial representation and visualization appropriate. Digital mapping is considered as a new era of cartography, among advantages of digital maps compared with paper maps are visible at first glance, can include any area, scalable, more accurate and up-to-date [6].

Fig. 5. Digitizing the map.

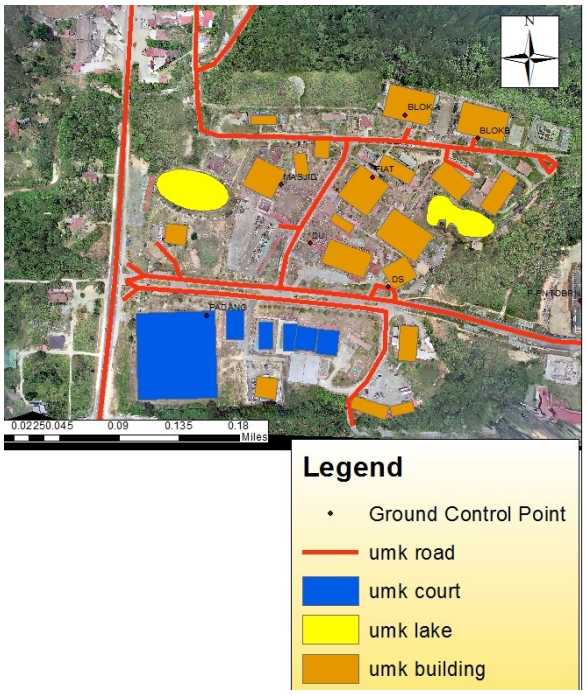


Fig. 6. Digital map of UMK Jeli campus.

Figure 6 showed the digital mapping produced using the 10.3 ArcMap software. As in the map, layout showed the location of the building area, court, road and others of the entire area of UMK Jeli Campus. The accuracy of digital mapping produced in the present study was assessed by the control point and sample of field measurements. The current total area obtained from this study was 4.622246 km². The results indicate that with a low-cost UAV and photogrammetric techniques, it is possible to obtain high-quality products. Compared to the time and cost of traditional photogrammetric surveys, this technique represents a promising alternative in mapping the latest condition of the UMK Jeli campus.

## V. CONCLUSION

From this study, it was found that the digital photogrammetric software is capable of producing digital orthophoto and digital map. This study demonstrates that UAVs provide promising opportunities to create a high-resolution and highly accurate orthophoto, thus facilitating map creation and updating. UAVs have given scientists a new appeal to remote sensing in a more flexible method. It is predicted in the near future, UAVs will become the preferred platform for the production of digital maps. However several technical limitations of current UAV systems may require a solution, such as the battery life-limitation that limiting the flight duration. Future work may also answer further case studies when using UAV in the environmental uses and hence bring different types of additional sensors, such as an infrared camera for vegetation detection.

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