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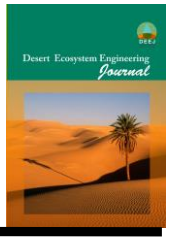

Identifying the Optimal Height to be Used for Calculating Vegetation Percentage Using A Quadcopter: A Case Study of Rezvanshahr Region, Yazd Province, Iran

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Introduction

Remote sensing science has been increasingly used throughout recent years in natural resources studies, especially for assessing and preparing vegetation maps. Moreover, aerial photography is widely used as a remote sensing tool, especially the ones taken by quadcopters in inaccessible areas, which could be effective, useful, and innovative. On the other hand, digital observation of the earth is an observed data-based approach in which photos are used to study natural resources. In many cases, using photos in time-specific and comparative studies is highly effective, taking into account the largeness of the area, inaccessibility, and lack of roads. Therefore, this study used a quadcopter to take photos from various points at different altitudes and compared them with aerial images to determine which type of photo from which height provides the best information concerning the investigated land and vegetation. Therefore, the purpose of this study is to investigate the possibility of using a quadcopter in preparing a vegetation percentage map.

Materials and Methods

Considering the costly and time-consuming nature of ground sampling of vegetation, this study used vegetation photography, digitizing and analyzing the collected photos after transferring them into computer systems. To this end, first, the intended photography centers were selected in the study area at different altitudes, from 10 meters high to 100 meters. Then, a quadcopter was sent to the area, taking photos from each selected center.

In this regard, in a single center selected as the indicator within a kilometer radius of the study area, the required images were taken at each altitude class from four main directions, moving from the 100-meter height class to the ten-meter height one. The images were used to calibrate the collected photos and the numerical values of the calculated vegetation percentage. Then, the intended maps were extracted based on image dimensions and the coordinates of the selected points in Google Earth. Finally, the phases passed for the photos taken by the quadcopter were repeated for photos obtained from the maps so that vegetation percentage could be calculated based on the prepared maps.

Results

The analysis of the study's results suggested that the variations of vegetation percentage occurred at a slower pace in the western direction at 90 meters height and above, indicating that the height is the best altitude for determining the region's vegetation percentage. However, a direct relationship was found between elevation and the changes in vegetation percentage in the eastern and northern directions at 90 meters height and above, with the vegetation percentage remaining unchanged with an increase in elevation. In other words, from 90 meters height beyond, the elevation exerts no influence on the calculated vegetation percentage, making it optimal for photography.

As for the southern direction, the vegetation variations remain unchanged from 40 meters height beyond, with the increase in elevation not affecting the calculated vegetation percentage. On the other hand, an extremely high correlation (99%) was found between the data collected in the western direction, indicating a

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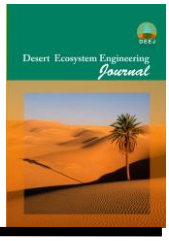

very close relationship between the vegetation percentage values collected from different altitudes by the quadcopter and Google Earth.

In the eastern direction, the first flight level lies at 20 meters high. Probably, due to the low density of the vegetation, the larger size of the shrubs, and the small surface shown in the images, the vegetation percentage is considerably different from other points, thus making it unreliable.

Discussion and Conclusion

This study found that the images cover a greater surface of the intended area with an increase in elevation. However, as the pixels become larger in such as process, fewer details are available. Therefore, the scope of the studies becomes limited, and the possibility of error increases. On the other hand, fewer areas were observed, and studies in those photos were taken from low altitudes, whose resolution was higher, though.

The study also found that the more uniform range of variations in the vegetation percentage at different elevations indicates a uniform density, and the more non-uniform density leads to abnormal changes in vegetation percentage as the elevation varies.

According to the study's results, the best elevation for investigating vegetation in terms of the existing plants in the area was 90 meters in height. Moreover, the error percentage was revealed to be too high at 20 meters elevation due to the small dimensions covered by the images, thus making the altitude unreliable for any such study.

Generally, it can be concluded that the useful elevation for photography depends on the type of vegetation under study and that the optimal height should be determined based on the type of vegetation and its minimum dimensions. Moreover, taking into account the vegetation percentage and the quality of the images taken by quadcopter and Google Earth, it could be argued that the photos taken by the quadcopter enjoy more accuracy, providing higher coverage percentage and more precision in recording greater details.

Keywords: Quadcopter, Photography, Level Surface, Vegetation, Height of Photography.

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