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Çeşitli Arazi Türlerinin, Yetişmiş Ürün Tespiti ve İşlevselliğinin Belirlenmesi İçin, Kuşbakışı Görüntülerden Alınan Kaydın İşlenerek Yazılım Tasarımına Genel Bakış

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Öne Çıkanlar:
- Yazılım
- Python
- Arazi

Anahtar Kelimeler:
- Drone
- Tarım arazisi
- Programlama
- Video işleme

ÖZET:
İnsanoğlunun gıda talebini karşılamak için, gelişmiş traktörler, tohumlar, ürün ekme yöntemleri kullanıldığı gibi, yapay zekâ, nesnelerin interneti, drone gibi son teknolojiler de kullanılmaya başlamıştır. Tarım arazilerinde Hassas Tarım uygulaması yapılarak en son teknolojinin bu alanda kullanılması sağlanmıştır. Özellikle son yıllarda drone ile tarım arazilerinin ilaçlanması büyük ilgi görmektedir. Bu çalışmada, bir drone yardımı ile belli yükseklikten alınan tarım arazisinin video görüntülerinden elde edilen fotoğraf karesi kullanılarak, Python yazılım dili ile fotoğrafın piksel piksel işlenmesi sağlanmıştır. Her piksel farklı renk contrast değerlerine ayrılarak belli renklerin ayrıştırılması gerçekleştirilmiştir. Ayrıştırılan bu renkler daha sonra sayılarak arazi üzerinde bulunan farklı tip yüzeyler oransal olarak belirlenmiştir. Yazılım ile arazi üzerindeki ekinlerin verimliliği, ürün gelişim durumu, ürün çıkmayan alanların tanımlanması gibi çeşitli jeofiziksel özelliklerin belirlenmesi sağlanmıştır.

The Software Design Overview by Processing The Recording From Bird's-Eye View Images to Determine The Crop Detection and Functionality of The Various Land Types

Highlights:
- Software
- Python
- Land

Keywords:
- Drone
- Farmland
- Programming
- Video processing

ABSTRACT:
To meet the demand for food, humanity has begun to use the latest technologies such as artificial intelligence, the internet of things, and drones, in addition to advanced tractors, seeds, and crop planting methods. Precision agriculture has been achieved by using the latest technology in this field, especially in recent years, the use of drones for agricultural land spraying has gained great interest. In this study, a Python programming language was used to process the video footage of a certain height taken from agricultural land with the help of a drone, using individual photo frames obtained from the footage. Each pixel was separated into different color contrast values, and certain colors were distinguished by counting. The proportional distribution of different types of surfaces on the land was determined. The software enabled the determination of various geophysical properties such as the productivity of crops, crop development status, and identification of areas where the crop does not grow.

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INTRODUCTION

Agricultural lands have varying geological and topographical features, which dictate the type of crops that can be grown on each plot. However, to address issues such as crop productivity, areas of land where crops do not grow as well, and where crop yields are highest, it is necessary to observe the land from a higher vantage point. Such observation work can be done manually, either on foot or with a vehicle (Bolca et al., 2012; Mckinnon et al., 2017). By walking on the land, one can determine the necessary characteristics of the land and the condition of the crops. However, this approach is time-consuming and requires significant labor. Alternatively, drones can be used to instantly observe the land, and the images they capture can be processed automatically with specialized software. This enables the condition of the land to be determined and remotely monitored while saving time.

The use of drones in precision agriculture applications has become increasingly common today (Ahmet et al., 2016; Dakkak-Arnoux et al., 2018). Drones are now utilized for land disinfection across almost all agricultural sites. Electronic maps, such as Google and Yandex Maps, can also be used to examine the geographic and topographic features of the lands. However, instant information is necessary to determine real-time product efficiency and crop yields (Marinello et al., 2016; Abdalla, 2020).

The use of drone machines in agriculture is not a new technology, and it has been increasingly adopted in recent years, particularly in agricultural disinfection or fertilization (Capolupo, 2016). Bird's eye field observations are also carried out to identify plants or vegetation on various agricultural lands (Abdullahi, 2015; Öztürk, 2018). However, some studies have been conducted to gather different information about plants or leaves on the land using various infrared sensors (Ghasab et al., 2005; Noor et al., 2018). Nonetheless, after reviewing relevant studies, we have not found any that evaluate classical video image processing as software in this subject.

High-quality video or photo shooting can be achieved with drones, and these images can be processed with various software programs, allowing access to physical information about agricultural lands (Prasad et al., 2011; Sylvester, 2018; Uysal et al., 2013).

In this study, images were captured from a field using a drone, and these images were processed using the Python software language. Additionally, the software was developed to determine the total cultivated or uncultivated area by identifying areas on the land without vegetation. This study enables the automatic analysis of real-time images of agricultural lands, providing remote information about the land. The software, which is entirely locally developed and coded, is open source. It can be utilized on Android and iOS-based smartphones as well as on desktop computers with Windows and Linux operating systems.

MATERIALS AND METHODS

Our method involves two stages. The first stage involved capturing images of the land using a drone with a mounted camera. The drone was remotely controlled and was positioned at a fixed height to capture images. The second stage involved processing the images using a software developed with open-source codes written in Python and Java programming languages. The captured images were divided into individual frames, and the desired land area was determined by selecting a single photo frame. These photo frames were then processed using the Python software language for image processing. Image processing was carried out by dividing the frames into corresponding pixels and determining the color codes of each pixel. The color codes to be separated or considered were determined based on a color scale created from the germination stage of corn to the late harvest stage.

The software determined the relevant color scale ratios in each scanned frame. The areas outside the color scale were removed, and the software calculated the general vegetation ratio of the land. This method was developed specifically for cornfields, but it can be adapted for other types of land as well.

The video obtained from the drone can be processed instantly or saved on a hard disk/micro SD card for later processing. Furthermore, various geological information such as altitude, agricultural land area, and slope can be obtained from the drone to determine the topological characteristics of the land.

Some parts of the software coding are given in Figure 1. The software automatically continued until the entire relevant land area was scanned and processed. Information on the crop status of the whole land area is displayed on the screen using the last processed photo. Figure 2 illustrates a flowchart of the relevant process, and Figure 3 shows an example of field analysis with the photo frame obtained from the drone's snapshots.

```
for i, cnt in enumerate(countours):
    area = cv.contourArea(cnt)
    rect = cv.minAreaRect(cnt)
    box = cv.boxPoints(rect)
    box = np.int0(box)
    if (area > maxed):
        maxed = area
    if area > (60) and area != maxed:
        x, y, w, h = cv.boundingRect(cnt)
        print(x,y,w,h,area,((w + 10)*(h + 10)))
        yuzdeliAlan = (((w + 10)*(h + 10)) * 100)/toplamAlan
        cv.rectangle(frame, (x - 10, y - 10), (x + w + 10, y + h + 10), (0, 0, 255), 2)
listOfData = os.listdir(scriptPathDataPath)
dataCounter = 0
for data in listOfData:
    dataCounter += 1
    gelen_im = Image.open(os.path.join(scriptPathDataPath,data))
    gelen_width, gelen_height =gelen_im.size
    gelen_im_rgb = gelen_im.convert("RGB")
    npdata = np.zeros((gelen_height,gelen_width,3), dtype=np.uint8)


    for sutunD in range(0,gelen_height):
        for siraD in range(0,gelen_width):
            renkDeger = gelen_im_rgb.getpixel((siraD,sutunD))
            degerdi = str(renkDeger).replace('(','')
            degerdi = degerdi.replace(')','')
            degerdi = degerdi.replace(' ','')
            degerdi = degerdi.split(",")
```

Figure 1. Brief view of the coding content

The field scanning started after determining the regions requested over the video, whether the video was recorded instantaneously or later. Color contrast adjustment or separation can be done as desired within the software. In this example, different colored sections without crops were observed by looking at the color contrasts. The software can analyze these sections by separating them as desired. The green areas shown in panel a of Figure 3 represent the crops while the rest represent non-crop areas. In the software, these color codes were determined as scales and analyzed. After selecting the roads and areas where crops do not grow in dark blue tones, the photograph was converted, as shown in panel b of Figure 3. Then, the unwanted area was subtracted from the total scanning area.

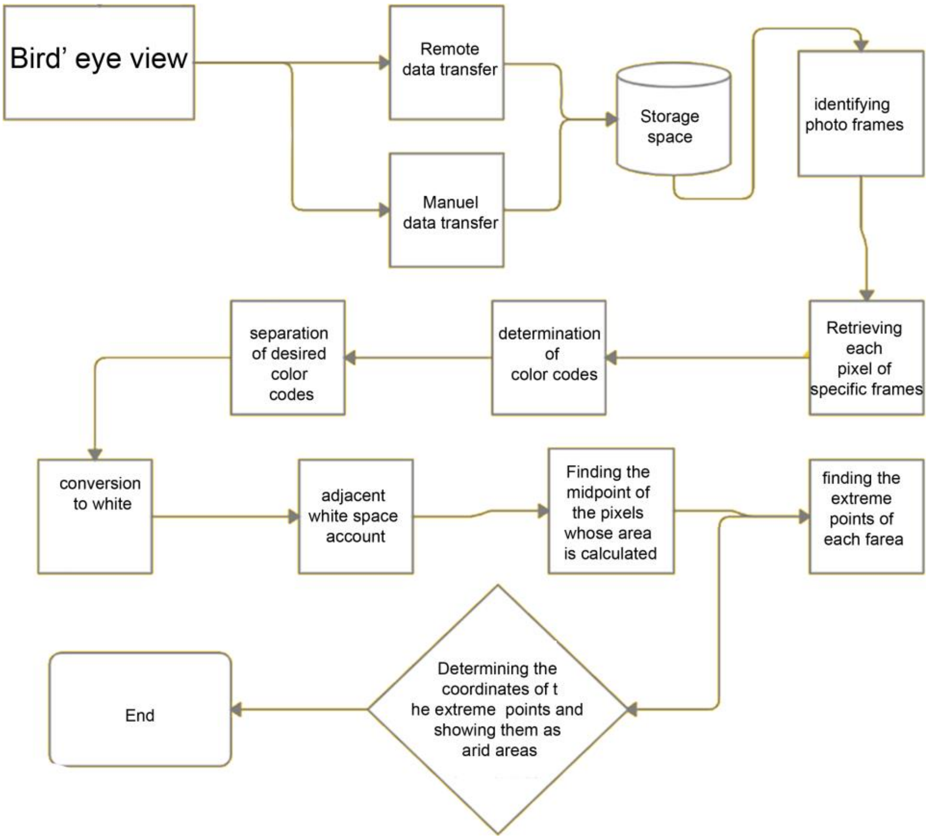

Figure 2. Flow chart of the software

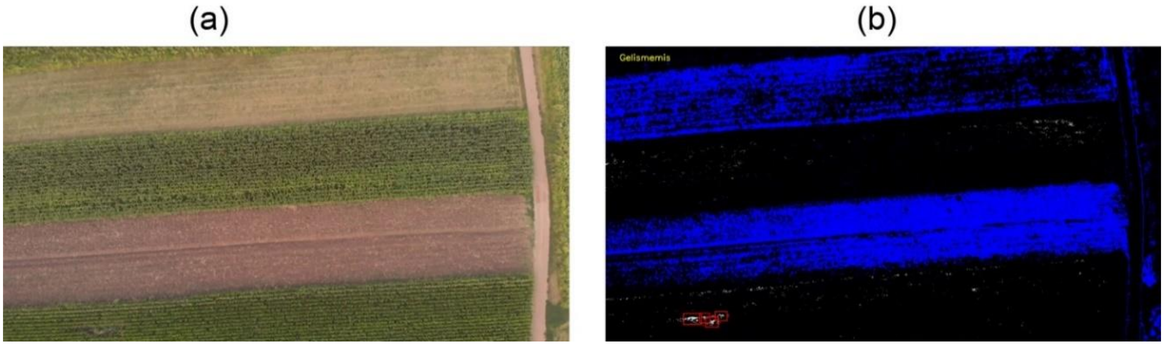

Figure 3. Sample analysis photo taken from drone footage

RESULTS AND DISCUSSION

According to the initial analysis, in the recordings with an image quality of 1920×1080 pixels and without expanding the top-side alignment, the areas with a size of 60 pixels and above were identified as arid regions. These areas were subsequently excluded from the scanned area. Additionally, the contour colors of the relevant areas were determined, and the total area of the remaining sections was calculated. A similar application was carried out by Marinello et al. (2016) and the agricultural land was scanned at regular intervals, but only one observation was made in the study.

The figures 4 and 5 display the results obtained from two different photo frames. Both figures show the selected frame (a), the figure with contrast applied during the operation (b), and the figure after the operation (c). Once the area to be scanned is selected, the system displays the results promptly. Each pixel is separated according to the desired color scale, and the ratio of the respective areas is shown. Abdalla WK (2020) applied color contrast transformation in his study, which he obtained from satellite images for the lands. Since the resolution was not very good, the contrast range remained narrow. With this study, however, the uncultivated area or the areas with different crops in the relevant area are determined proportionally.

In Figure 5, the software initially scanned the white area and created a contour for this region as shown in steps (a), (b), and (c). As white areas correspond to roads in the color scale, they were excluded from the total area. Regions outside the color scale were marked as red squares and also excluded from the total area. The software displays the total area value or percentage value for the remaining areas.

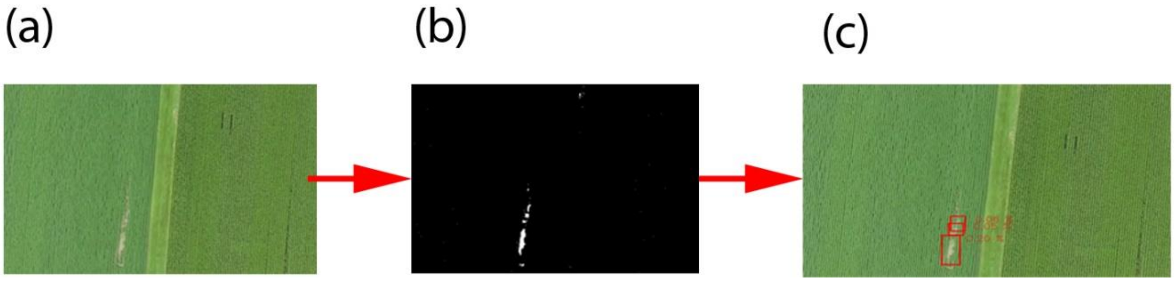

Figure 4. Processing the photo frame (a) before, (b) during the processing, (c) after the processing.

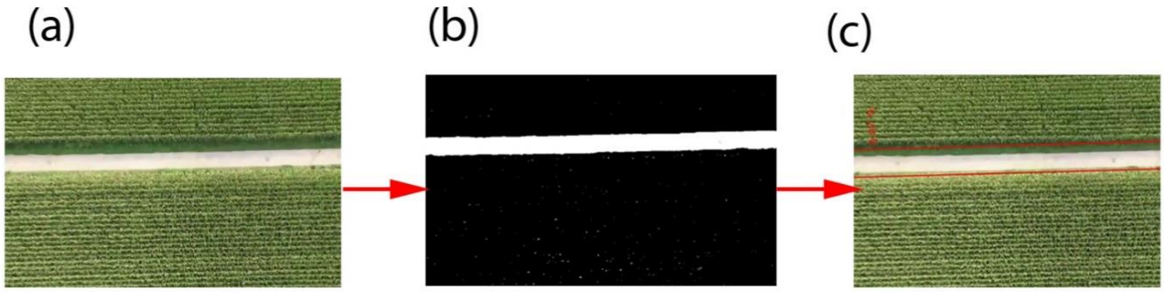

Figure 5. Processing a different photo frame (a) before processing (b) during processing (c) after processing

A user-friendly interface was designed for the software, as shown in Figure 6. The software interface is easy to use. The video to be processed is imported into the program and then the frames and desired regions are selected. For each region, the analysis is conducted for all available frame photos one by one. Ahmed T et.al. (2016) conducted a very similar study by comparing satellite images and images captured with drones and observed that the contrast separation method using three main color scales yielded better results for drone images but did not provide information about the software and content used. However, this study was programmed with an open-source programming language.

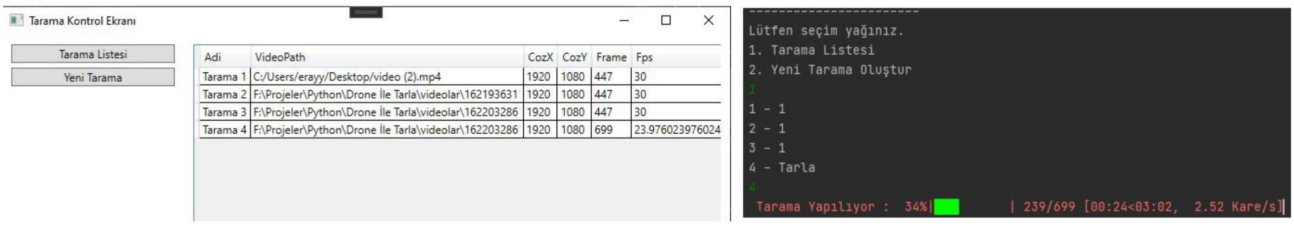

Figure 6. The interface of the software used

The obtained images and data can be evaluated instantly and can provide information about the productivity or inefficiency situation that emerges over the years by using a database (Sylvester, 2018).

Similarly, various roads or paths on a land can be considered, and the land area determined. This software is open for development, not only for determining the productivity of the cultivated area, but also for finding the physical, topological and similar properties of the land.

CONCLUSION

In this study, a software was developed using an open-source programming language to analyze the crop status of a particular land. The software processes images obtained with the help of a drone to obtain a proportional value of the product yield. The initial results from the corn field analysis show that uncultivated and road sections in the field were identified and separated, and the remaining parts were expressed as a percentage of the total cultivated area. This open source software is primarily designed for mobile applications and is not only suitable for providing information about land productivity but also for examining its topological and physical properties.

Conflict of Interest

The article authors declare that there is no conflict of interest between them.

Author's Contributions

The authors declare that they have contributed equally to the article.

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