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POTENTIAL OF UNMANNED AERIAL VEHICLES FOR AGRICULTURE : A REVIEW

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ABSTRACT

In few years, agriculture drones emerge for monitoring, planting, spraying, and mapping to increase crop production and reduce labor. This review results show its significance and farmer's demand for agriculture. The UAV technologies enable farmer management based on measuring and observation based on real-time crop and livestock monitoring, significantly maximize their production. The farm drone consists of user-friendly software with interactive maps, and a global positioning system will improve production. It will support farmer for farming in efficient, effective, and economical ways.
Keywords: agriculture, Unmanned Aerial Vehicles (UAVs), review, potential

Introduction

Recent few years, UAVs demand increased in agriculture for monitoring, mapping, and measuring. It emerges as the technology for precision agriculture that monitors cultivated fields, providing practical solutions for precision agriculture (Mulla, 2013; Tsouros et al. 2019). It significantly increases the amount of crop production, which is estimated to reach 11.8 billion US dollars by the year 2022 in the global market (Radiant Insight Research Firm, 2018). Their cost decline and growth rapidly due to high-resolution images at quick, easy, and cost-effective ways in recent years. For example, farmers collect information through time-lapse drone photography to get information about crops irrigated improperly. However, satellite images and aerial photographs monitor vegetation status and their stages (Bauer et al. 1973; Mora et al. 2017). Due to the low spatial resolution of images acquired and temporal resolution restrictions, it requires a combination of ground and satellite-based monitoring and mapping of agricultural land (Reger et al. 2018; Tsouros et al. 2019). These technologies can minimize these issues, which increases its potential, and application is a broad range.

These technologies provide farmers with opportunities for monitoring, mapping, and surveying various crops, located in many countries around the world (Tsouros et al. 2019). Recently, crops irrigation and management (Alborrnoz et al. 2017; Chartzoulakis et al. 2015; Dos et al. 2017), Vegetation growth, diseases detection, and yield estimation (Jung et al. 2018; Kerkech et al. 2018; Montero et al. 2018), and spraying (Garre et al. 2018; Zhao et al. 2018). The problem of irrigation, soil variation, and infection could be solved using agriculture drones (Reger et al. 2018). This study reviews published research articles to find the concrete answer to how UAVs have to be applied by farmers and researchers worldwide for smart agriculture.

Evaluation

The small UAV is fast, reliable, and cost-lower than the traditionally crewed aircraft, which rapidly raises its market demand (Zang et al. 2016). It captures the farmer’s crop with various camera filters, which provides multiple spectral imaging and analysis for information on their crop’s health and identifying areas of the plants that need closer and lower attention (Norasma et al. 2019). It flew quickly and maintained easily; it increases farming by merging agriculture with remote sensing (Cano et al. 2017). There are two types, which are fixed-wing and multirotor (Reger et al. 2018). This substitute for satellite-based remote sensing and identified to generate high spatial resolution imagery and temporal frequency appropriate for timely responses for crops and field status (Elarab et al. 2015). For agriculture mapping, the RGB camera should be enough for data collection (Reger et al. 2018). Table 1 shows the proposed framework of drone use, the necessity for pilots' certificates, online flight registration, size classification per weight (Tsiamis et al. 2019).

Table 1. Recommendations framework for Agriculture UAVs.

Purpose of Use	Certification for Pilots	Flight Online Registration	Size Classifications					Flight Altitude (Without Special License)	
			100 gr	< 4 kg	4-25 kg	25-150 kg	> 150 kg	120 m	150 m
Agriculture	✓	✓		✓	✓	✓	✓		✓

Source: Processed data

Yamaha developed the first agriculture UAV model (Mogili et al. 2018). From 2011 uncrewed aerial vehicles (UAVs) and systems started (Frankelius, 2013). This field requires comprehensive technical analysis of UAVs in precision agriculture for applicability such as crop monitoring, height determination, spraying (Bending et al. 2012; Anthony et al. 2014; Huang et al. 2009).

Table 2. Evaluation of different research papers on UAVs for smart agriculture.

Literature Work	Application Area
Thurling et al. 1985	Obtaining detailed vertical photographs, Competition experiments
Andersson, 1993	For crop mapping trails, crop color reveal nutritional deficiencies and diseases
Schnug et al. 1998; Capolupo et al. 2014	Analysis of soil profiles
Ben-Dor et al. 2002	Determining soil properties, Map underground surface
Zhu et al. 2010; Faic¸al et al. 2014; Zhou et al. 2016	Spraying herbicides/pesticides, and fertilizers
Cajzek et al. 2016	Marketing campaigns, photos and films for farms, machinery
Abutalipov et al. 2016	Pollination
Hahn et al. 2016	Protecting crops from wild animals including birds— ‘‘scarecrow’’
Yamaha, 2017	For crop dusting, Can lease with package of education
Ryberg et al. 2007; Berni et al. 2009; Pena et al. 2007; Rasmussen et al. 2013; Martinez et al. 2017	An Analysis of weed presence
Prakash et al. 2014; Martinez et al. 2017	Analysis of plant health, fungus abundance.

Source: Processed data

Developed countries started using UAVs in their precision agriculture (Aditya et al. 2016; Colomina et al. 2014). However, their hardware implementations rely on weight, flight range, payload, configuration, and costs (Maurya, 2015). Research is ongoing to gather information regarding technologies, methods, systems, and limitations (Haung et al. 2013). Yamaha RMAX developed for pesticide spraying in Asia's rice fields (Giles et al. 2015; Mogili et al. 2018). Its operations are increasing because of its speed and accuracy. But, some limitations demand intensive research work. Thus, researchers are working independently and collaboratively to support and fulfill the demands of framers.

Response

This information age will potentially integrate technological advances into precision agriculture (PA) (Whelan et al., 1997). It's a system approach to re-organize agriculture's total agricultural system towards low-input, high-efficiency, sustainable agriculture (Shibusawa, 1998). After more than ten years of development, PA has reached a crossroads with much of the necessary technology available and the environmental and economic benefits unproven (Stafford, 2000) and from PA technologies' success, measured by economic and ecological gains (Naiqian et al., 2002). Crop production per unit area increased a lot while soil and other natural resources conserved to maintain our ecosystem (Gerland et al. 2014; Lal et al. 2016; Tilman et al. 2011). UAVs used in agriculture for different applications such as midseason crop health monitoring, irrigation equipment monitoring, and midfield weed identification (Veroustraete, 2015; Marinello et al. 2016). Farmers use drones for data acquisition and analysis and continuously monitoring fields for learning and developing advanced farm management skills (Mahajan et al. 2016). Recently, drones used for agriculture are medium-sized (usually for analysis applications). In contrast, larger drones need to carry a load (i.e., planting or spraying applications), industries currently using drones, multi-rotor configurations seem favourite in agriculture, likely due to their lower cost and high level of simplicity (Tripicchio et al. 2015; Probst et al. 2019).

Conclusion

This paper has presented an evaluation essay from different research papers about using UAVs used in agriculture. Based on reviewing the literature and findings, it discusses their objectives, UAV architecture, and crop. This work gives an overview of UAV applications and their potential for making agriculture smart, their current status, and the scenario. Similarly, provide a glimpse of applications in UAVs applied for better the farmer's need. This review will provide the framework for the policy and decision-maker (Thapa, 2019). The main barrier for widely used it in farms could be that every local government should agree on similar UAVs regulations. It should be synchronized and make it similar that significantly increase the investor and user. These rules are due to minimizing the risk for security and aviation; however, every government authority prohibits certain places and other places such as farmland with simple registration on local authorities, including the explicit purpose of work like spraying and monitoring grant permission. Every Government will need to rethink the licensing and operating regulations for farm drones and perhaps require certain limitations built into their specifications. In time and with farm drones, agriculture may become less labour-intensive and even attract a new generation of young, tech-savvy farmers. The farm drone should have user-friendly software with maps and GPS; this will enhance the applications and attract more farmers.

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