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Different Approaches of Robotic Spraying Drones for Agricultural Activities

By

Dr. Kuldeep Panwar
Department of Mechanical Engineering, Shivalik College of Engineering, Deharadun, INDIA
Email: kuldeeppanwar.kec@gmail.com

Dr. Shambho Prasad
Agriculture Department, Shivalik College of Engineering, Deharadun, INDIA,
Email: shambhu.prasad@sce.org.in

Dr. Alok Semwal
College of Pharmacy, Dehradun
Email: alok.semwal@copdoon.org.in

Abstract

Food production in the world is dependent on agriculture as the plants are a food source. Agricultural activities are practiced since ancient times for food production as well as different plant products. So, it is necessary to take care of plants from different insects as well as a pest by sprayers. Thus, the focus of a study is to know the importance of robotic sprayers used in various farming activities. So the sprayers are used which helps the farmer control pest as well as spraying a fertilizers to enhance the productivity of the farm. There are different approaches made for developing robotic spraying drones using IOT as well as AI. Thus after analysis of different approaches, it is observed that the robotic spraying drones are efficient and reduce the time of farmers in the spraying activity. The study will help in knowing the importance of robotic sprayers in agricultural activities and develop new technologies from the present implementation in the sprayers.

Keywords: Agriculture, Drones, Fertilizers, Robot, Spray.

1. Introduction

Unmanned aerial vehicles (UAVs) known as agricultural drones are utilised in agricultural operations, often for yield optimization and crop development and production monitoring. Agriculture-related drones can collect data on soil variances, crop health, and crop growth stages. Agricultural drones employ multispectral sensors to capture electromagnetic radiation, such as near-infrared and short-wave infrared that is not visible to the human eye. The Federal Aviation Administration (FAA) led to the promotion to employ this cutting-edge technology to keep an eye on their crops as drones became popular in agriculture. However, the FAA soon withdrew such encouragement in the wake of the unanticipated rise in agricultural drone use, awaiting new rules and restrictions. The FAA as well as the AFBF (American Farm Bureau Federation) started talking about regulations to allow the productive use of such drones in a safe and effective manner in response to events like drones colliding with crop dusters [1]–[3].

The FAA released regulations for corporate drone operations in 2016. Commercial drone operators must adhere to the established regulations, pass a knowledge test, and register their aircraft in order to operate legally. The AFBF is pleased with the regulations as a whole but requests minor modifications to many of the restrictions that have been put in place. As

seen in Figure 1, many nations, like Malaysia, Singapore, and Australia, have put in place regulations governing the use of drones. While 15 nations have banned all drone activities, such rules are still lacking in many other nations. A uniform set of drone laws will be implemented by the EU with all of its members [4]–[6].

Drone usage in agriculture has moral and societal repercussions. They can effectively monitor and manage the usage of pesticides, which is one advantage. This enables reducing the negative effects of pesticides on the environment. However, drones flying under 400 feet above ground level do not need authorization to do so (120 m). Drones may be equipped with microphones and cameras, which has led to some criticism due to worries about potential privacy violations. Other businesses could start using drones to examine their rivals, the health of their crops, and agricultural output in unrestricted regions [7]–[9].

Figure 1. *Illustrates the Pesticide Spraying Drone Robot for Various Agricultural Activities [Source: Future Farming].*

The market for agricultural drones has a lot of room to develop. Crop imagery will need to advance along with the rapidly advancing technology. Farmers may assess their crops as well as make informed decisions about how to proceed with the help of the data that drones collect from the fields. The market for software tools that analyze and improve agricultural productivity has room to expand. Farmers will use a drone to correctly scan their crops for problems, then take the appropriate steps to address those problems. Rather of wasting time inspecting their crops, the farmer now has more time to concentrate on the entire goal of production [10].

Keeping tabs on animals, inspecting fences, and keeping an eye out for plant infections are further applications. Modern drones are too costly for small fields in underdeveloped countries due to the expense of both the initial purchase and ongoing maintenance. [16]–[17]. Pilot programmes in Tanzania are reducing these costs by producing agricultural drones which are simple to use and durable sufficient to be managed locally. [18]–[19]. A Washington State University research team has created an autonomous drone system that keeps pests like European starlings and crows away from grapes and other crops. The drone's loudness could drive the birds away, but researchers might also use predatory bird noises and distress cries. [20]–[23]. Researchers working in e-Science fields such as meteorology, connectomics, sophisticated physics simulations, biology, genomics, and environmental studies meet difficulties.[16]- [41].

2. Literature Review

A wide range of inventions are made in the technological world. Then research is a continuing procedure, the underlying notion of flying vehicles is developed to incorporate a variety of applications, such as agricultural drones. Based on the characteristics of drones, applications for drones are created in a variety of disciplines.

Kurkute S.R. et.al. (2018) [11] examined that India's primary economic engine is agriculture. A number of factors, including temperature, humidity, rain, and other factors, affect the rate at which crops are produced in agriculture. Those are external variables beyond the control of farmers. In order to regulate issues like pests, disease, fertilisers, etc. in the realm of agriculture, crops must be treated properly. Pesticides may boost crop yield, but they also have an impact on people's health. Therefore, the primary goal is to create an agriculture drone for pesticide spraying. The usage of pesticides in agriculture is crucial, and if we employ intelligent devices like robots using modern technology, it will be very simple.

Dileep M.R. et.al (2020) [12] studied that in conventional agriculture, land vehicles were employed to monitor many agricultural operations, which took a great deal of labour and time. The usage of drones in agriculture has more advantages than traditional methods. And Depending on their capabilities, drones can be controlled by computers, which enables them to be automated across a specific region, locate faraway areas, and even be partially automated. In agriculture, drones can be used effectively for a range of jobs, such as analysing weather patterns and changes, crop illnesses, soil fertility, and other things. Drones can be used for a range of agricultural jobs because of their effectiveness.

R. Shamshiri Redmond et.al. (2018) [13] described the newest advancements in agricultural robotics, particularly those employed in autonomous weed control, field scouting, and harvesting. In the context of digital agriculture, challenges include object detection, task planning algorithms, digitization, and sensor optimization. In order to create virtual farms, a number of entrance points for digital agriculture were emphasised, including multi-robots, human-robot collaboration, as well as ecosystem reconstruction using aerial pictures and ground-level sensors.

Kiran Kumar B M et.al. (2020) [14] proposed that Automation and robots have transformed the agricultural industry, resulting in reduced labour and production costs and a rise in agri-products to fulfil market demand. Individuals and the environment are harmed by the hand application of insecticides, herbicides, and weed inhibitors to crops and fields. And offers a solar-powered, flexible, semi-autonomous, three-degrees-of-freedom (DoF) mobile pesticide spraying robot. Bluetooth is used to control the micro-spraying system through an Android application. The robot is made to directly spray insecticide or pesticide upon predetermined lesions, hence reducing chemical waste and consumption, thereby making the system inexpensive and environmentally friendly. Application of insecticides with precision prevents environmental pollution. The efficiency of a prototype is produced and evaluated in various topographical circumstances.

P.Rajesh Kanna et.al. (2020) [15] investigated a pesticide spraying gadget is a device for precision pesticide spraying that may address fuzzy shapes and diverse item targets. On a pan-tilt unit is mounted a single splash syphon engine with ultrasonic sensors for flexible spraying. The site-specific spraying technology aims to reduce pesticide use while targeting specified targets. In addition, the gadget is designed to limit pesticide use by spraying just

certain targets and altering the spraying distance dependent on the target. The spraying equipment is designed to limit the amount of connected insecticides. Actual reserve funds are contingent upon spraying duration, target size, & allocation.

3. Discussion

By ensuring the farmer's safe cultivation, it is imperative to increase the production and efficiency of agriculture. A numerous task, such as applying insecticides with a sprayer and sprinkling fertilizer, are crucial. Even though pesticide spraying is now required, farmers still suffer negative effects from the practice. Farmers take a lot of precautions, especially while spraying urea, such as donning the proper clothing, masks, and gloves. Any negative effects on the farmers will be avoided. Since the desired outcome must be achieved, totally avoiding pesticides is not really practicable. Therefore, using robots in these situations provides the greatest answers for these types of issues, as well as the necessary productivity as well as efficiency of the product.

Proponents of drones have long argued such precision agriculture crop management with GPS as well as big data may increase crop yields while also solving water and hunger issues. Sadly, up until recently, drones didn't have much of an influence on farming methods. Precision farming and drone uses in agriculture are a hot topic right now. Drones attempting to convey agricultural intelligence to farmers and agricultural consultants are altering agricultural practises, from the potential to image, recreate, as well as analyse individual leaves on a corn plant from 120 metres in height to obtaining information on the moisture abilities of soils and varying watering practises. Despite having access to the requisite expertise, drone service providers were unable to fulfil many of the pledges to producers.

Up until this point, air traffic controllers did not let commercialized drone agricultural research to actually occur in portions of the airspace over agricultural regions. A shift in trade frameworks in this industry, as shown in Figure 2, allows licenced drone service providers—many of which are still at the beginning stage—to help both small and large agricultural enterprises manage water and disease while billing for these services. The service providers will also be able to utilise unrestricted airspace and a predetermined flying altitude in order to give better plantings and crop rotation methods, along with a greater degree of daily plant development monitoring in different sections of an agricultural field. Drone network operators and farmers themselves will develop all feasible uses for drones in the upcoming years. Increased agricultural intelligence will increase farm productivity and enable smaller businesses to compete with larger, better-funded ones and large agricultural rivals.

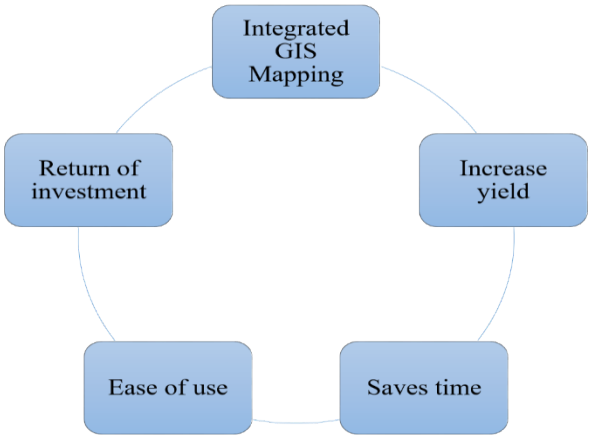

Figure 2. *Illustrates the Advantages of Using Drones in Agricultural Activities by Farmer.*

Farmers may choose wisely how to employ agricultural inputs thanks to the real-time data offered by agricultural drones. Micro drones have the ability to significantly enhance and enrich previously gathered data by flying near to crops and enabling the gathering of data with a better spatial-temporal resolution. Drone film allows very precise loss estimation. The drone might be used as a tool to more precisely estimate agricultural damage from animals and the consequent expenses of compensation. Drones offer the privilege of being able to observe a field and having greater picture quality than satellite or piloted aircraft aerial photos of a field. The current application of drone technology in agriculture is supporting agricultural enterprises in meeting the future's growing and expanding demands.

In various aspects of farming, such as crop spraying, crop management, livestock management, irrigation mapping, planting, and other activities, drones can help to improve efficiency. Drones are helpful in agriculture for a variety of reasons, such as how they help farmers maximise their produce by spotting issues early on and controlling the crops by utilising particular cameras to spot pests and water shortages. The agricultural sector has recently seen the emergence of a number of cutting-edge technologies that aid farm management techniques in enhancing efficiency through the exact utilisation of farm inputs. Drone technology that has become increasingly popular in recent years, has been extensively used in precision agriculture.

Several optical sensors that are coupled to GPS allow for accurate mapping of the location of the measurements, allowing farmers to track the development of growing crops like cereals, brassicas, maize, & ryegrass. Depending on the kind of crop analysis being done on a farm, many types of cameras are attached to a drone to capture NIR images, including RGB, multispectral, hyperspectral, thermal, and low-cost consumer-grade cameras. Due to the utilisation of drones and other ICTs, a new era of precision agriculture, smart agriculture, e-agriculture, and digital agriculture is emerging. With the IoD, which evolved from of the IoT, we can now use drones for a variety of purposes, including delivering packages, traffic surveillance, search and rescue, and more.

The aerial drones are used in the different advanced countries which improves the productivity. There are different types of surveillance drones and sprayers. Aerial drones can be used for a variety of purposes that serve to increase agricultural productivity and quality of life. The various herbicides, insecticides, and fertilisers that can be sprayed on crops are as a result available. Modern agriculture makes use of a variety of technology to assist farmers increase yield. With time and technology, most farmers now use IoT and AI. After using technology to agriculture, the farmer gains benefits from the various crops.

Conclusion

Agriculture is one of India's key industries. A number of factors, including temperature, humidity, rain, and other factors, affect the rate at which crops are produced in agriculture. Those are external variables beyond the control of farmers. In order to regulate issues like pests, disease, fertilizers, etc. in the realm of agriculture, crops must be treated properly. Pesticides may boost crop yield, but they also have an impact on people's health. Therefore, the primary goal of this work is to build an agricultural drone for pesticide application. In this study, discussed about several unmanned aerial vehicle-based architectural designs (UAVs). The application of pesticides within agriculture is crucial, and if we employ intelligent devices like robots using modern technology, it will be very simple. This essay discusses the different technologies that are being utilized to decrease labor-intensive agricultural tasks including

insect identification, UREA application, fertilizer application, etc. This paper examines the evolution of the quad copter UAV as well as the sprinkler mechanism. The study will help to find the different develops in the aerial drones for betterment of farmers.

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