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Unmanned Aerial Vehicles (UAV) Technology in Agriculture and Challenges

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There are too many developments in precision agriculture for increasing the crop productivity. Especially, in the developing countries like India agriculture is the primary source of income. Agriculture accounts for 17 percent of India's total GDP, with almost 70 percent of the rural people directly or indirectly depends upon the agriculture fields. The agriculture fields face dramatic losses due to the diseases. These diseases came from the pests and insects, which reduces the productivity of the crops. Pesticides and fertilizers are used to kill the insects and pest in order to enhance the crop quality. The WHO (World Health Organization) estimated as one million cases of ill effected, when spraying the pesticides in the crop field manually. The unmanned aerial vehicle (UAV) aircrafts are used to spray the pesticides to avoid the health problems of humans when they spray manually. UAVs can be used easily, where the equipment and labors difficulty to operate. Thus, the usage of the unmanned aerial vehicle (UAV) is an alternative to manage a farm properly to increase its yield.

Keywords: Introduction, UAV technology in agriculture, challenges

1. Introduction

The use of UAV in almost every sector of the economy is growing fast, but UAV usage in the agricultural industry is booming. According to some reports, the agricultural UAV market is expected to grow from a $1.2 billion(USD) industry in 2019 to $4.8 billion in 2024. From scouting to security, UAV use will become more ubiquitous on large and small scale farms in a few short years. The information gathered by UAV on farms is often used to better inform agronomic decisions and is part of a system generally referred to as 'precision agriculture'. In many areas, UAV use has become an essential part of large scale precision farming operations already. The data collected from UAV recording fields help farmers plan their planting and treatments to achieve the best possible yields. Some reports indicate that using precision farming systems can increase yields by as much as 5%, which is a sizeable increase in an industry with typically slim profit margins. In this article we look at some of the areas where UAV technologies are already being used on farms, some new agricultural UAV technologies being explored, and we will touch on some of the steps and challenges to adopting widespread UAV use in agriculture.

2. Unmanned aerial vehicle technology in Agriculture

2.1. Scouting/Monitoring Plant Health: One of the uses for UAV imagery that has already been rolled out with great success is for monitoring plant health. UAVs equipped with special imaging equipment called Normalized Difference Vegetation Index (NDVI) use detailed

colour information to indicate plant health. This allows farmers to monitor crops as they grow so any problems can be dealt with fast enough to save the plants. This image illustrates simply how NDVI works

2.2 Monitoring Field Conditions: UAV field monitoring is also being used to monitor the health of soil and field conditions. UAVs can provide accurate field mapping including elevation information that allow growers to find any irregularities in the field. Having information on field elevation is useful in determining drainage patterns and wet/dry spots which allow for more efficient watering techniques. Some agricultural UAV retailers and service providers also offer nitrogen level monitoring in soil using enhanced sensors. This allows for precise application of fertilizers, eliminating poor growing spots and improving soil health for years to come.

2.3 Planting & Seeding: One of the newer and less wide spread uses of UAVs in agriculture is for planting seeds. Automated UAV seeders are mostly being used in forestry industries right now, but the potential for more widespread use is on the horizon. Planting with UAVs means very hard to reach areas can be replanted without endangering workers. They are also able to plant much more efficiently with a team of two operators and ten UAVs capable of planting 400,000 trees a day.

2.4 Spray Application: UAV use to apply spray treatments is already widespread in south-east Asia, with South Korea using UAVs for approximately 30% of their agriculture spraying. UAV sprayers are able to navigate very hard to reach areas, such as steep tea fields at high elevations. UAV sprayers save workers from having to navigate fields with backpack sprayers, which can be hazardous to their health. UAVs sprayers delivery very fine spray applications that can be targeted to specific areas to maximize efficiency and save on chemical costs.

2.5 Security: UAV security is a fast growing industry apart from agriculture but is also extremely useful to farm management. Using UAVs to monitor the far reaches of a farm without having to get there saves valuable time and allows for more frequent monitoring of hard to reach areas. Security UAVs can be deployed to monitor fencing and perimeters of more valuable crops like cannabis instead of employing more security personnel. UAV cameras are also being used in exciting ways to protect farm animals by locating missing or injured herd animals in far off grazing areas. Monitoring remote areas, which used to take hours of walking can now be completed in a few minutes.

2.6 UAV Pollination: Some of the newer uses for UAV use in agriculture are still in testing and development. One of the most publicized (and often fictionalized) uses is pollinating UAV technology. Researchers in the Netherlands and Japan are developing small UAVs that are capable of pollinating plants without damaging them. The next step is to create autonomous pollinating UAVs that will work and monitor crop health without constant instruction from operators.

2.7 UAV AI: Another UAV technology in development also involves machine learning. Improving Artificial Intelligence (AI) in UAVs is important to be able to make them more useful to smaller farmers in developing nations. Current UAV technologies are more effective in monitoring well known crops like corn which are planted in large monoculture field patterns.

3. Hindrances and challenges

The challenges were broadly classified into business and technical, and include:

1. Cost: The technology is perceived as expensive as a result of the technical nature of UAVs. Deployment, integration and training can be very expensive. Similarly, in a

project management perspective to deployment of UAV related projects and highlighted cost as a key element that needs to be considered. It was also noted that proper estimations need to be using various technique prior to undertaking any such project.

2. Licensing and regulation issues: This is still a gray area with respect to UAVs. Regulations are either none-existent or a loose adaptation of aviation laws, which do not perfectly fit in with UAVs. There is therefore the need to draw up legislation to regulate the new possibilities and application areas of UAVs.
3. Business Adoption: From a business perspective, it might not be out rightly easy to justify the adaptation of UAVs into Agriculture. Though one might argue that there might be cost savings in the long run, counter arguments can be put forward regarding the actual acquisition cost of the UAVs, insurance / replacement of crashed UAVs, purchase of high resolution cameras for imagery as well as the accompanying software solutions and other running costs. When all these are added, it makes it a hard case to sell to farmers and Agriculture business owners.
4. Technical Challenges: These come in the form of system integration - integration of the middleware services with the UAV, high performance systems for data analytics, Net-centric infrastructure which enable any member of a team to control the UAV and retrieve imagery and sensor information in real time and application of machine learning / computation intelligence to identify and retrieve useful insights from the large pool of data.
5. Ethics and privacy: Some feel that the use of UAVs for monitoring and surveillance would lead to the invasion of their privacy. A lack of standard operational and technological procedures needed for safe performance of the UAVs is a great challenge. There could be GPS-jamming and hacking because of the vulnerabilities in the command and control of UAV operations.

4. Conclusion

UAV have already vastly altered the agricultural industry and will continue to grow in the coming years. While UAV use is becoming more useful to small farmers, there is still a way to go before they become part of every farmer's equipment roster, particularly in developing nations. Regulations around UAV use need to be made and revised in many countries and more research needs to be done on their effectiveness at certain tasks, such as pesticide application and spraying. There are many ways UAVs can be useful to farmers but it is important to understand their limitations and functions before investing in expensive equipment.

5. References

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