

# A Study on Application Methods of Drone Technology

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## 드론기술 적용 방안 연구

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**Abstract** In the fourth industrial revolution, drones are an important element to lead the industry by converging with information technology. Drones are developing various technologies by combining with communication / navigation / traffic management technology, control and detection / avoidance technology, sensor technology, SW and application technology. However, there are various problems in order to settle the drone technology. In this paper, it will be examined the problems of application of drones through application fields of drones, domestic and foreign cases, and core technologies of drones. The growth of the drone market requires improvement of laws and institutions. This paper proposed security vulnerability, privacy and safety problem in wireless communication, and present technical and management problems for drone service in the Korean environment in particular.

**요 약** 드론은 4차 산업 혁명에서 정보기술과 융합하여 산업을 이끌어 갈 중요한 요소이다. 세계적으로 드론에 대한 관심이 급격히 커지면서 많은 국가에서 드론을 미래 전략산업의 하나로 주목하고 있으며 드론 관련 기술에 대한 연구개발과 활용을 위해 많은 노력을 하고 있다. 드론은 통신/항법/교통 관리기술, 제어 및 탐지/회피 기술, 센서 기술 및 SW 및 응용기술과의 접목을 통해 다양하게 기술이 발전하고 있으며 완구에서부터, 산업, 농업 등 다양한 분야에서 드론의 공급 및 수요가 증가하고 있다. 그러나, 드론기술이 정착되기 위해서는 해결되어야 할 여러 가지 문제점들이 있다. 본 논문에서는 드론의 활용분야 및 국내외 사례와 드론의 핵심기술을 통하여 드론기술적용에 대한 문제점들을 살펴보고자 한다. 드론 시장의 성장을 위해서는 법과 제도의 정비, 무선통신에서의 보안 취약점, 프라이버시 및 안전성 문제를 제안하였으며, 특별히 한국의 환경에서 드론 서비스를 위한 기술적, 관리적 문제점에 대하여 제시하였다.

**Key Words :** Core Technology of Drone, Drone, Drone Service, Privacy, Security Vulnerability

### 1. Introduction

Drones are Unmanned Aerial Vehicles (UAVs) that would operate under remote/autonomous control without any pilot onboard. This operation relies mostly on human involvement. The very first application of this device was within military missions and now they have their permanent position in the military arsenal [1]. Some peaceful applications of these devices are in border patrol; search,

rescue and damage investigations during/after disaster; locating forest fires or frost conditions in farmlands; monitor criminal activities; mining; advertising ; scientific surveys and secure pipelines and offshore oil platforms[2]. The etymology of the word "drone" comes from the lazy male bee, who spends most of his time preparing for mating with the queen bee. It began to use the name Drone as a whining sound, and in 1982 it became fully operational in the Israel Lebanon war.

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Currently, it is used to refer to small unmanned aerial vehicles that can be controlled by radio waves. In addition, the International Civil Aviation Organization uses the term Unmanned Aerial Vehicle and the Federal Aviation Administration uses the term Unmanned Aircraft to refer to unmanned aircraft. Recently, it has been attracting attention as a kid product as it has been widely used in the private sector. The difference between a remote control plane and a drone is the presence or absence of an autonomous flight function. The remote control plane operates according to the user's command, but the drone can control itself by recognizing and judging the surrounding environment according to the program inputted in advance.

Drone is an aerial quadricopter that can be piloted remotely using a smart phone, tablet device or a computer. Since the drone is equipped with video cameras, it can provide safety managers with fast access to images as well as real time videos from a range of locations around the jobsite[3].

The drone industry is expanding so rapidly as called the future food industry. As shown in [Table 1], various technologies have been developed through the combination of communication / navigation / traffic management technology, control and detection / avoidance technology, sensor technology, and SW and application technology[4].

Table 1. Core technology for drone[5]

Technical classification	Technology
Communication / Navigation / Traffic Management	Highly reliable, unmanned control link technology for secure integration into drones' national airspace
Control and detection / avoidance	Drones landing and flight control and autonomous enhancement Detection avoidance device that detects other objects for flight and detects danger and avoids collision
Sensor	Sensor technology for safe navigation resources and mission
Software and application	Support high-reliability real-time operating system and interoperability for drone control and mission execution

The supply and demand of drones is increasing in various fields such as toys, industry, and agriculture. The annual demonstration of the drones is increasing every year at the exhibition hall of the International Consumer Electronics Show (CES), the world's largest consumer electronics IT products exhibition in Las Vegas every year. It can be said that the drone industry is highly evaluated in the future technology.

## 2. Application areas of drones

### 2.1 Skill level of major companies

It would be a shipment of goods as a revolutionary industry change in the commercialization of drone. There are too many challenges to overcome with the present level of technology, and it is pointless to mention one by one. The first problem to be solved is the time of flight. And because it is UAV, if the stability of communication is not verified, operation is

impossible. In addition, there are many problems to be solved such as securing communication line-of-sight and radio interference. Most of the key components of small drones are electronic components such as sensors. It is very vulnerable to temperature and external environment, and it is necessary to develop original technology for materials.

#### 2.1.1 Amazon.com

Amazon.com's Prime Air, one of the fastest-growing drones for delivering goods, changed the shape of its early flight body from Octoporters to Vertical Take Off and Landing Air Plane(VTOL) type. The reason for the change is probably due to the flight time and stability of the aircraft. The performance of the flight is loaded with 2kg of payload and it is said to fly for 30 minutes. Also, due to the stability problem of automatic landing, we are in the process of delivering the goods depending on the wire. The recent registration of a patent for parachute courier at Amazon.com in 2017 seems to be technically insufficient to develop the service delivery method.

#### 2.1.2 EHAN

At the CES in 2016, the start-up company named EHAN emerged as a notable drones company by introducing the drone EHANG184 that the person boarded. The airplane performance was announced that it was possible to carry 23 minutes by loading 100kg of payload. However, after the CES, a video of a demonstration of flying over San Francisco in the United States was discovered by CG, and a report by the press that a

person was not boarded and operated by a bin dragon came out. This year he announced that he would do a drone taxi pilot project in Dubai. Of course, these technological advances are important, but they are not just a few pilot projects or tests to be validated for flight stability[6]. Stability should be verified by testing thousands or even hundreds of thousands of times. In order to be able to service people by boarding, many operational data should be collected and analyzed, and reliability of the aircraft should be ensured so that it can be commercialized.

## 2.2 Domestic drone-related companies

As shown in [Table 2], drone industry in Korea is focused on Korean Air and Korea Aerospace Industries, and only a small number of companies are developing drones. The Future Creation Science Department announced the "Technology Development and Industrial Growth Strategy for Unmanned Mobile Technology," a driving system for the development of the drone industry. In addition, Korea National Land Information Corporation announced that it will build a forum for revitalizing the space information industry by using unmanned airplane, and to grow the unmanned airplane related business by 13 trillion won in 2023. Drone use is increasing in various fields in Korea.

CJ Korea Express decided to support six CJ Sky Doors in cooperation with the National Disaster Prevention Center for emergency rescue activities in the event of a disaster. Café Bene, a coffee shop, also conducted a marketing campaign to display product images on the drones at Gangnam Highway

and Ewha Woman University in Seoul[7].

Table 2. Drone Industry Outlook

Company	Business Contents
Korean air	Successful development of tilt loader type UAV (TR-60) in cooperation with Aerospace Research Institute and commercialization in 2020
Hanhwa	A total solution of its own unmanned helicopter that combines military hardware and ultra-small hardware
LG CNS	Development of total unmanned helicopter solution that combines software and hardware
LG uPlus	Securing drone control technology using LTE network
KAI	Development of Legionary / Next Legion Unmanned Vehicle
Yukon System	Exported ground control equipment to UAE for the first time in Korea
ViRobot	Developed Industrial Flying Robot with "Doll Fighter", a toy flying robot
Sungwoo engineering	Successful commercialization of agricultural unmanned control helicopter

Note: Korea Evaluation Institute of Industrial Technology

### 3. Core technology of Drone

The drones perform their mission through remote control or autopilot through the controller, where wireless communication technology is used. Wireless communication systems that can be used for civilian drones include IEEE (Institute of Electrical and Electronics Engineers) 802.11 Wi-Fi (Wireless fidelity) and GPS (Global Positioning System). In the following, characteristics according to each communication method are examined.

#### 3.1 IEEE 802.11 WiFi

Wi-Fi is a wireless LAN (Local Area Network) that is a near-field computer network. In the early days of trying to

wireless LAN, device makers used different wireless LAN standards, but they did not have compatibility[7].

Currently, most Wi-Fi devices comply with the Wi-Fi standard, so "Wi-Fi is recognized as a wireless LAN". Wi-Fi is capable of high-speed data transmission, so that it is possible to transmit the control signal and the image in real time in one channel. It also allows direct connection to a commonly used notebook or smart phone without additional receivers, but there are some problems with using it in drones.

#### 3.2 GPS

GPS is a satellite navigation system that receives a navigation message from a satellite and calculates its position by calculating its position at the receiver. Three of the 24 satellites are Backup satellites and are currently circling the Earth in a 12-hour cycle. If the receiving terminal receives a signal from 3 or more satellites of 45 satellites, the position can be grasped and the positioning method is calculated as the time taken for the propagation to reach between the terminal and the satellite[6]. Recently, it has been used in various places such as smart phones and IoT products. However, GPS signals are very susceptible to various radio disturbance problems due to very low received signal strength on the ground.

#### 3.3 Satellite communication

Satellite communication is a long-distance communication method in which a satellite plays the role of a relay station, relaying the

communication signal through a satellite launched in the air outside the atmosphere [8]. A satellite is classified as a military satellite, a weather satellite, a scientific satellite, or a communication satellite. Among them, a communication satellite is a satellite that circulates the earth for relaying a communication signal.

Unlike cellular systems and Wi-Fi environments, where satellite networks are mostly deployed on the ground, they can also be used in situations where ground-based communications facilities such as disaster or display are collapsing. This can be a big advantage over other communication technologies, especially considering that drones are often used for military purposes[10].

#### 4. Drone Technology Application Issues

There are still many challenges that need to be addressed in order for the drone to grow. The first challenge is battery performance. The battery mounted on the drones is a lithium-polymer battery, which has the advantage of being light and long-lasting, while consuming the battery quickly. It can be used for about 10-20 minutes when used once. The second task is drone steering. General-purpose drones are difficult to control compared to military drones. Improving the interface technology is the best way, but it may be a solution to provide an institutional mechanism for the implementation of pilot safety education[11]. The biggest challenge that needs to be addressed in order to grow the drones market is the development of legal systems

related to drones.

##### 4.1 Improvement of law and system

The US Federal Aviation Administration has strictly regulated comprehensive and preliminary permits for UAV, but recently, it is conducting a "UAV-free business activation policy" that focuses on deregulation in light of the expansion of drones and their growth potential. There is still a long way to use UAV for commercial purposes, but it seems to be improved through ongoing discussions. The main contents are as follows[11].

- ① fly at a maximum speed of less than 100 miles
- ② Limit loading capacity to less than 25kg
- ③ Observe URN license acquisition (less than 2kg exemption)
- ④ Permission to use commercial drones in case of sight compliance and flight 1 flight

The European Aviation Safety Agency has taken a more open stance than the United States, issuing guidelines for UAV regulation. It is classified as open, specific, and certification requiring items according to the level of flight risk[11].

- ① Open items: less than 500g UAV, security required area altitude less than 150m, flight less than 500m
- ② Specific items: The regulatory authorities directly conduct safety inspections (robustness, stability, operator capability, communication safety, etc.)
- ③ Items requiring certification: Application at the level of general aircraft

The Ministry of the Future of Creation Science and Industry and Commerce, etc. announced the growth strategies for the development of the drone industry. However,

the military authorities are enforcing restrictions on prohibited areas and restricted areas in Seoul. In addition, there is no standard for development of drones, insurance, and privacy infringement, so it is urgent to create a legal system. The Ministry of Land, Transport and Maritime Affairs announced the systematic complementary measures such as the 2013 Pilot Operator Qualification Provision and 2014 Pilot Safety Training for the Unmanned Turning Device. However, commercial shooting using the drone is necessary only after the aviation registration.

#### **4.2 Wireless communication techniques and security vulnerabilities**

A drones security vulnerability could lead to key hacking after illegal hijacking. After stealing the flying drones illegally, enough time and equipment can be used to hack the secret key through reverse engineering, memory analysis, subchannel analysis. And when the secret key is exposed, the risk of flight information and collection information increases. In addition, it is possible to disable the flight or communication of the drones by obstructing reception of GPS signals, jamming communication radio waves, obstructing gyro sensor operation, and the like. An attacker can disrupt the drones' flight itself and cause them to fall, so there is concern about the loss of life / property due to unexpected collisions. Information leakage may increase the risk of information leakage through unauthorized eavesdropping and unauthorized access if there is no security technology for stored information, transmission information,

and processing information. In the case of personal information, it may lead to damage to privacy and abuse of personal information[6]. There is a risk that malicious code infringement can take control of most of the functions of the drones, and cyber / physical attacks such as change of destination and transmission of collected information to the attacker may be possible by manipulating the flight information of the drones. Failure to find illegal / unauthorized drones' illegal devices can lead to social confusion.

#### **4.3 Privacy and stability issues**

Drones can be equipped with high-performance cameras, infrared sensors, facial recognition technology, and license plate readers, which can result in more privacy danger than you might imagine[10]. Although the base technology including GPS technology is advanced, other base technology is still being developed, and there is a safety problem that there is no way to cope with a sudden fall when an unexpected device defect occurs due to the characteristic of 'UAV'. So in the United States, all UAVs over 2 Kg against terrorism have enrolled.

#### **4.4 Drone delivery problems**

Korea has a very high percentage of the population living in apartment houses. In large cities, 80% of residents live in apartment buildings. In the case of apartment houses, there is no yard for each household, so it is impossible to use the method of dropping goods. Then the person should receive it. Because the drones are controlled

automatically, there is a problem of micro-manipulation at the level of hovering in front of the window of a specific address. If the recipient comes out of the building and receives the goods, the convenience of delivering to the door disappears. If you fall into a crowded area due to inexperienced or unexpected situations during flight, you may experience a lot of human casualties. Drones are highly likely to invade privacy. The high-resolution camera installed in the drones can shoot real-time video and photographs, which can cause mistakes or deliberate flying of the drones to a place where privacy is likely to be violated, such as a home, a building, or a hotel.

## 5. Conclusion and Suggestions

Drones offer new opportunities and possibilities for individuals, corporations, governments and public institutions. In addition, the popularization of drones has had a profound impact throughout the industry. As new technologies are applied and combined with drones, related industries can grow and drones of new concepts are being released. In addition, there is an active effort to strengthen existing business capabilities by using drones.

Drones are a sustainable industry that fuses with various industries and creates new value. The excellent mobility of drones and the availability of various sensors can fulfill various tasks in environments that are difficult for humans to access, and the drones are becoming smaller and the price of production is dropping, suggesting various applications for general consumers.

In the future, the market for drones is expected to grow more and more and the utilization rate will increase. But there are also a few side effects. There are many issues to consider in terms of safety and privacy in order to use drones more safely and universally. In order for the drones industry to grow, efforts should be made to expand R & D investment, to improve laws and systems, and to set up industry development policies.

The drones have a flight skill that humans can not do, so they give freedom to human life and action, but new problems that humans could not imagine will follow. If the willingness to solve the new problems that arise from the drones and the efforts to solve the problems are followed, the popularization of the drones will be successful.

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