

# A Study on the Direction of Technology Introduction of Drone Patrol

Cheolhee YOON<sup>1</sup>, Jang Mook KANG<sup>2</sup>, Jongcheol PARK<sup>3</sup>

Police Science Institute, Asan Republic of Korea E-mail: bertter@police.ac.kr

Global Cyber University, Seoul, Republic of Korea. E-mail: honukang@gw.global.ac.kr

Police University, Asan, Republic of Korea E-mail: bjh011@police.go.kr

## Article Info

Volume 81

Page Number: 2439 - 2442

Publication Issue:

November-December 2019

## Abstract

Drone has already been used in various fields beyond the commercial field. In addition, artificial intelligence (AI), virtual reality (VR), autonomous navigation, and other keywords are fused with drones and technological growth. However, domestic technology and research and development are still applied to R & D projects using components and basic materials of advanced countries. The reason for this is that Korea's drones manufacturing technology is at an early stage of major developed countries. In particular, the design of drones and the body of drone's manufacturing sector requires long-term research know-how and large-scale investment. However, due to legal system limitations, we cannot go forward. In the above environment, the direction of R & D to be carried out at police drone patrol is suitable for drone mounted equipment and integrated operation technology field. First, in the field of mounted equipment, various sensors and equipment (Pan.Tilt) are combined according to the purpose and necessity of the mission. After that, it is necessary to integrate them into research and development to evolve into on-site patrol car decks and ground drone. It is time to apply advanced artificial intelligence technology.

## Article History

Article Received: 5 March 2019

Revised: 18 May 2019

Accepted: 24 September 2019

Publication: 12 December 2019

**Keywords:** Drone, AI, VR, Big Data

## 1. INTRODUCTION

Drone has already been used in various fields beyond the commercial field. In addition, artificial intelligence (AI), virtual reality (VR), autonomous navigation, and other keywords are fused with drones and technological growth. However, domestic technology and research and development are still applied to R & D projects using components and basic materials of advanced countries. The reason for this is that Korea's drones manufacturing technology is at an early stage of major developed countries. In particular, the design of drones and the body of drone's manufacturing sector requires long-term research know-how and large-scale investment. However, due to legal system limitations, we can not go forward. In the above environment, the direction of R & D to be carried out at police drone patrol is suitable for drone mounted equipment and integrated operation technology field. First, in the field of mounted equipment, various sensors and equipment (Pan.Tilt) are combined according to the purpose and necessity of the mission. After that, it is necessary to integrate them into research and development to evolve into on-site patrol car decks and ground drone. It is

time to apply advanced artificial intelligence technology.

## 2. THEORETICAL BACKGROUND

### A. The Concept and classification of Drone

Drone means a fixed-wing or rotary-winged airplane that flies using radio waves as an unmanned aircraft. In other words, drones refer to helicopters and aircraft-type aircraft that can fly or fly remotely without the pilot boarding.[5] The basis of the drones is stipulated in Article 2nd Article 3 of the Aviation Act, and instead of the term drones, "merciless aircraft" is used as a term.[3] At the time of the first drone development, it was used as a target for air force aircraft or missiles during training. It was called the Queen Bee in the U.K., but it was named the Drone in the U.S.[3] Currently, the drone industry has been integrated with the fourth industrial technology, with the latest technologies such as operating platform design, system integration and IoT 5G communication technology converging and continuing to develop. However, drones do not have the meaning of independent aircraft, and they still remain at the system stage. Therefore, the drone is also called the "unmanned Air System." [3] As such, the term drone does not have uniformity

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### B. Classification

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### C. The Necessity of Police Drone

The current direction of police activity is changing from the concept of pre-crime prevention, not the capture after the crime occurred. More than ever, people's safety needs are rising, and changes in police force response are essential. The police are very important because of the nature of their work, and the use of police force is efficient and extramarital. The development of technology heralds a change in existing manpower-oriented police activities. Among them, the advent of drones is a very high utilization value for the police, which are involved in crime prevention activities. In particular, drones at crime scenes can be used immediately for police-specific tasks, such as patrolling, searching for missing persons, and thus reducing the waste of effective personnel. However, the specificity of drones and the specific nature of police work requires device stability or the security of information. Currently, drones are used for a variety of purposes, but we cannot find drones that are tailored for police purposes. [11] The National Police Agency, together with the Korea Aerospace Research Institute, is working on a 'life-saving drone,' but it is understood that it is not yet in the stage of execution. It is urgent to establish a legal basis for the production of police drones that can be applied to various security situations and the establishment of police drones patrol teams that can operate them.

## 3. PRIOR RESEARCH AND PATENT ANALYSIS

### A. Analysis of Pre-Study

To date, prior research and patents were analyzed in order to find out what challenges were involved in drone technology in Korea. Through this process, the government wanted to identify the trend of drone technology and develop a technology specialized in police drones to avoid technological overlap with other research. A total of 42 research tasks were

carried out in Korea in 2016 regarding drone technology, which can be divided into radio (4), flight (13), video (10), anti-fighting and noise (2), system (10), and cell (3). The following [Table 1] presents a representative study by item among the preceding research tasks of drone technology.

### B. Patent Analysis

To investigate patent applications and registration information for drone technology, Korea Patent Information Retrieval Service([www.kipris.or.kr](http://www.kipris.or.kr)) was used. The search terms were for patents and practical sectors, and the patent trends survey was conducted on drone gas and drone operations. Patent search results showed that 1,211 cases of drone gas were investigated, and 951 cases of drone operation appeared, indicating more patents for drone gas. Specifically, the results of the analysis of patent information are as follows: First of all, major patents related to drone gas development include drone separation flight, drone failure revenge, drone controller and unmanned take-off and landing. Second, major patent contents related to the development of drone operation technology include drone monitoring system, drone charging and management, drone intelligent image surveillance, multi-function drone operation and central control system for drones

## 4. ANALYSIS OF TECHNICAL AND OPERATIONAL CASES

It is the Defense Acquisition Program Administration, the Korea Aerospace Research Institute and the Ministry of Science, ICT and Future Planning that are currently conducting research and development of similar technologies on the tasks needed for the police drone patrol. Strategic collaboration and joint participation in research and development with the above agencies are critical for the future settlement of the police drones patrol. The following is an analysis of the above organization's technological development. First, the Defense Acquisition Program Administration conducted a plan and integrated movement control study to optimally allocate multiple drones. To this end, real-time exercise control and integrated control of multiple drones were measured, and three-dimensional spatial information was accumulated within the pilot area. It also built numerical surface model and obstacle information for drone search. The above information is based on the world's geographies, with the reference of the coordinates and the units of the coordinates in "m" respectively, and the values are obtained up to three decimal places. Then, data are obtained using a numerical surface model with a grid spacing of 0.5 m\*0.5 m and 1 m\*1 m using the air laser measuring equipment. Information such as power towers or power lines installed by the Korea Electric Power Corp. is also expected to help establish a base point.

Second, the Korea Aerospace Research Institute has built an ROS-based 2D drone location estimation software production and modeling, and a 3D mapping simulation environment.

Location estimation software was implemented based on ROS indigo, and gas and sensor modeling and gas API function were developed. In addition, 2D liDAR was used to create a map (Occupancy Grid).

Third, Ministry of Science, ICT and Future Planning conducted measurement and analysis of radar RCS and investigated and analyzed drone observation radar technology. Radar RCS refers to radar technology that detects small objects such as drones in a mobile communications environment. Monostatic and Bistatic methods were used in the mobile frequency band to measure the radar RCS of drones. In addition, the results were analyzed in the chamber and outdoors to perform RCS measurements of the drones.

## 5. DIRECTIONS FOR THE INTRODUCTION OF POLICE DRONE

### A. Development of drone Patrol

To make up for the shortcomings of the drone's battery life within 30 minutes, it is necessary to develop a vehicle deck (roof-trunk) for police, which is used as an integral part of the patrol and to develop robot equipment that can start a roundabout 16km radius around the patrol car. Already, there is a vehicle built by the Red Cross rescue team in Austria to utilize drones in saving lives, a Land Rover Discovery vehicle called Project Hero, which is impressive for installing a drone hangar on the roof to enhance the drone's

usability. In the case of the drone patrol, it could be a big advantage for police officers to reduce time and increase efficiency by applying them to vehicles along with drones. It also has the advantage of being able to take off and land faster while running, and reduce the number of people to operate drones. When ordering police patrol vehicles, not only the design of on-demand deck for drone loading, but also the review of police patrol vehicles at the beginning stage of the space where sliding systems can be installed in the trunk can be combined. By using this method, it is possible to secure a working space for field command and to have power and telecommunication equipment for parallel R&D on development of on-site adaptive patrol vehicles. The following [Figure 1] shows a separate drone for patrol cars.



Figure 1. Patrol Car Separated Drone

The parallel development of intelligent patrol drones (robots) is expected to improve the drone patrol's preoccupation capabilities. It can increase the efficiency of work in areas where work intensity and fatigue are high and areas where police officers are hard to respond directly. With the current robot model of the U.S. Night-Scope and the development of patrol equipment at the same time, it is easy to recognize and respond to emergency situations of people on the site at night.

### B. Automatic collision prevention

It is not a drone that has the same power as Google's Loon project, but it is also developing a police-related technology that can launch balloon-like hot air balloons in the stratosphere to allow high access to the city. The specific goal of the project is to build a network by floating a device attached by a 4G LTE router at a stratospheric altitude, and when it reaches the stratosphere with helium gas, it sends IoT communication and LTE signals and communicates with each hot air balloon to form a single net-like wireless network. Since a hot air balloon delivers a 4G signal that boasts download speeds of up to 10 megabits per second in an area with a radius of several kilometers, it can link drone patrols that can monitor the criminal's information in cities that require high access.

### C. Automatic Tracking Algorithm

When multiple drones fly, a fleet of drones is formed, and the location and moving information of multiple drones are controlled and controlled by ground control devices (GCS). Hand-over control of the drone network is important, and it is necessary to predict the drones that will be newly deployed or incorporated from other batches based on stored management information, and assign network connection information to the predicted drones).

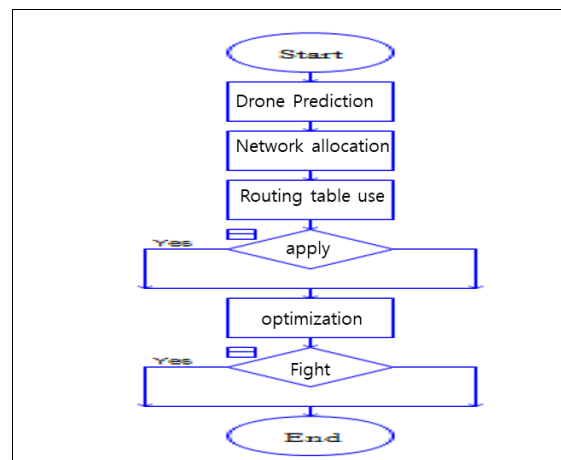


Figure 2. Automatic tracking of drones

### D. Tracking System

Equipment that is used for drones is minimized in size and

weighs very light for real-time image transmission. It is 110\*65\*15mm in size and weighs 140g. Not only is it easy to detect drones, but it can also be applied to drones that are used for prevention of safety accidents and warning broadcasts. In addition, for drones equipped with GPS after learning the face shape of the culprit with a selfie-drone, the functions of tracking down the culprit by checking the movement of the drone while shooting points on the tablet and laptop while using algorithms that can learn the navigation and facial recognition algorithms on the computer to specify the path of automatic driving are implemented. It is also known that radio frequencies are useful for patrolling areas where people cannot access the pilot.

## 6. CONCLUSION

Already around the world, drones are being used in various fields beyond balls and private domains, and their scope is also expanding continuously. Key words such as artificial intelligence (AI), virtual reality (VR), and self-driving, which are frequently spoken, have been converging with drones in recent years. Simply put, drones are being combined with all the latest technologies. However, the technology status and R&D trends in Korea are still generally composed of advanced countries' parts or basic materials to be applied to R&D projects after use. The reason is that South Korea's drone manufacturing technology lags behind major advanced countries. As we have seen earlier, advanced countries are already removing the limitations of drone technology development and further expanding the utilization of drones. In this domestic environment, the direction of introduction of research and development that should be carried out by the police drone patrol team can be said to be appropriate for the field of drone-mounted equipment and integrated operational technology. First of all, R&D needs to be carried out in the field of mounting equipment by combining various sensors and equipment (Pan.Tilt) according to mission purpose and needs, and by integrating them, evolving into on-site patrol vehicle deck and ground drones. And the integrated operation technology field needs continuous research such as automatic collision prevention and automatic tracking system and algorithm so that the field police officers can control drones autonomously through ground control equipment. From now on, the appearance of drones at police sites plays a very important role in national safety. Therefore, the introduction of the drone patrol's technology, which is suitable for the purpose of police activities, will serve as an opportunity to enhance the country's crime response capabilities to the next level [14-15].

## ACKNOWLEDGMENT

This work was supported by Institute for Information & communications Technology Promotion(IITP) grant funded by the Korea government(MSIP). (No.2018-0-00705, Algorithm Design and Software Modeling for Judge Fake News based on Artificial Intelligence)

This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2018S1A5A2A03038738, Algorithm Design & Software Architecture Modeling to Judge Fake News based on Artificial Intelligence)

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