Research on the Construction of Forestry Protection Drone Project-Take the Construction of Forest Fire Monitoring Project of Huizhou Engineering Vocational College as an Example

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Abstract. With the development of electronic communication technology, high technology has been continuously applied to agricultural and forestry plant protection monitoring. Including digital, infrared and laser camera monitoring technology, image recognition and processing technology, remote sensing mapping technology, UAV technology, wireless communication technology, etc. The research on agriculture, forestry protection drone in China started late. In addition to manual patrol, satellite remote sensing and other methods also play a major role. Taking the construction of UAV forest fire monitoring project of Huizhou Engineering Vocational College as an example, this paper puts forward the method of establishing open space cooperative network by combining wireless sensor network and UAV to monitor forest fire.

Keywords: FANET · Agricultural and forestry protection · Forest fire monitoring · WSN

1 Introduction

At about 2 p.m. on April 3, 2021, a mountain fire broke out on the south side of Jinbang tunnel in Huizhou City. After all efforts to put out the fire, the open fire was put out at 2 a.m. on the 4th, and there were no casualties. According to preliminary estimation, the fire area reached about 460 mu, which is the largest fire in Honghua Lake scenic spot since its establishment (Fig. 1).

Recently, there have been many mountain fires in Huizhou. Only in the first half of 2021, Huizhou forest public security organ established 27 forest fire related cases, including 24 criminal cases and 3 administrative cases; 20 cases were solved, including 17 criminal cases, 3 administrative cases and 18 criminal suspects (Fig. 2).

Forest is the basis for the sustained, rapid and healthy development of the whole national economy, and plays an irreplaceable role in national economic construction and sustainable development. As a frequent natural disaster, forest fire has caused serious losses and harm to ecosystem, forest resources and human life and property.

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Fig. 1. Traditional forest fire extinguishing scene

Fig. 2. Deep forest fire

Therefore, the importance of forest fire prevention is not mentioned but compared, which needs to be paid unremitting attention as a regular and important work. At present, although China's forest fire prevention work has made some progress, it is still at a low level on the whole. It is urgent to explore advanced fire monitoring and identification means and establish a scientific forest fire monitoring and fighting system [1, 2].

2 Forest Fire Prevention Monitoring Technology

Forest fire prevention technology is divided into fire prediction technology, fire monitoring technology and fire prevention communication technology. At present, there are several ways of forest fire monitoring technology used at home and abroad [3–5]:

(1) GPS and GIS technology: GPS technology has been applied in forest fire protection for the longest time and the earliest. It has unique advantages in clarifying the location and scope of fire and estimating disaster losses. It has greatly improved the efficiency of fire prevention and has therefore been recognized by the forestry department. The application of GPS technology first records the key points into GPS according to the characteristics of the walking route of disaster relief personnel in

the process (affected by fire, generally not straight line), and then GPS can quickly and accurately provide the most suitable route for rescue personnel according to its positioning function. At the same time, due to the possibility of re ignition of the fire, the GPS receiver quickly provides the fire location for the staff. Subsequently, due to the emergence of "3S" technology, the combination of GPS and GIS technology is more efficient and can predict the change and trend of fire on the display screen. It can also realize the function of automatic fire extinguishing by connecting with the fire extinguisher, which reflects its unique advantages. In foreign countries, in the early days, the Canadian bureau used the infrared rays emitted by satellites to detect the surface of the monitoring area. The data analysis was used as the basis for judgment. When the monitored infrared wavelength was up to 4.0 microns, the general temperature would be between 120 and 180 degrees Celsius, which indicated that there was a great possibility that a fire had occurred. Based on GIS and wireless communication technology The web browser monitoring system combined with inertial navigation system and thermal infrared sensor can establish an effective model for forest fire prediction, which can find the fire in time and even predict the spread direction.

(2) Remote sensing technology: remote sensing technology is committed to the embryonic stage of fire. Because this technology is very effective in predicting fire and can classify combustibles, it is of great significance to carry out forest fire protection. It is now known that there is a lack of information on the classification of combustibles in the forest all over the world, because the future development direction of this technology is committed to the division of combustibles in the forest, using different resolutions to draw combustibles in the forest in an all-round and multi-scale way, so as to provide more standardized standards for forestry information reform. In terms of disaster monitoring, China has specially launched radar and optical satellites to help the monitoring work. "Environment No. 1" is a monitoring system integrating multiple measurement methods. Its advantage is that it can monitor the region in a wide range and all-weather, and the abnormal conditions can be displayed on the remote sensing image at the first time. German researchers have developed the fire watch forest fire intelligent alarm system, which is the basis provided by digital camera technology and can observe the monitoring area from a long distance. Firstly, the smoke in forest fire is discriminated by specially written software, and then the forest fire can be located by using GIS technology and digital PTZ. Realize digital fire discrimination and positioning.

(3) Collaborative monitoring system of remote sensing technology and Internet of things technology: take "3S" technology as the support to solve the problems of independence and data sharing of monitoring methods. Take Internet of things technology as the framework, establish a two-in-one forest fire monitoring system by means of remote sensing data interpretation and sensor thermal infrared detection method, It provides a new way for the timeliness and accuracy of forest fire monitoring information. Some European and American countries led by the United States are relatively mature in satellite remote sensing technology, which can be used to monitor forest fire. At the beginning of the 21st century, ESA carried an AATSR (Advanced extended orbit scanning radiometer) on the satellite. The equipment can

accurately measure the surface temperature, and also provide guarantee for early detection and later positioning of forest fires.

(4) UAV application: UAV only has flight control mode and navigation and positioning system. It has a wide variety. Fixed wing and multi rotor UAVs are mainly used in forestry. In the 1980s, the D-4 fixed wing UAV of Northwest University of technology tried to explore geology and draw maps, creating the application of UAV from military to civilian. In 2013, Z5 unmanned helicopter participated in the navigation mission in Daxinganling forest area and achieved success, which is the first application in forestry. Russia has already successfully developed a set of television system, which is a complete closed-circuit television system composed of electronic observation equipment installed at a high place in the area (such as a lookout) and the display screen of the terminal. Through technical processing, the observer can clearly grasp the panoramic image between the device radius of 15 km on the terminal equipment, and can get whether there is any abnormality through technical support. At the end of the 20th century, in the United States, with the support of the government, relevant departments installed fire mapper (an Airborne Multispectral radiometer) on aircraft. This is a fire plotter, which can also pass through the smoke at an altitude of 1500 ft to detect the smoke produced by forest fire.

(5) WSN (Wireless Sensor Network) technology: in the United States, as a pioneer in introducing WSN technology into forest fire monitoring, a monitoring system called firebug was developed. TinyOS operating system combines the hardware with multiple sensor nodes and GPS locator to monitor the fire. The nodes communicate with the remote server through the base station. The forestry department can understand the realtime situation in the forest as long as it accesses the terminal equipment. This monitoring system has also been applied in the United States.

In fact, there are several monitoring methods adopted in China, including artificial ground Patrol: Forestry personnel continuously patrol in the forest area; Lookout Patrol: it is placed high in the monitoring area and can cover the forest observation within a large radius; Aviation Patrol: low altitude flight can cover a larger area, find dangerous situations in time, and make the changes of monitoring environment clearer. However, these are not the best forest fire prevention monitoring methods because of the problems of untimely discovery or high investment cost.

In general, the domestic research in this field still has great limitations, and it is only a preliminary exploration. For forest monitoring, we can continue to make in-depth exploration on the basis of the research of these excellent researchers.

3 Construction of UAV Forest Fire Monitoring Project of Huizhou Engineering Vocational College

Huizhou Engineering Vocational College is a modern, public vocational college with high standard and high starting point approved by the people's Government of Guangdong Province in 2017. It is located in Huizhou, the central city of Guangdong, Hong Kong, Macao and the Pearl River Delta. It is adjacent to Shenzhen, Hong Kong,

Guangzhou and Dongguan, Shanwei in the East and Heyuan and Shaoguan in the north. It has convenient transportation and prominent regional advantages. Its predecessor was Huizhou agricultural school established in 1950 and Huizhou Industrial Science and technology school established in 1973. The college has nearly 60 years of school running history of secondary vocational education and has a rigorous and high-level teaching staff, including 99 professors and associate professors and more than 100 doctoral and graduate students.

Huizhou Engineering Vocational College strongly supports the reform and development of information-based teaching. Based on the principle of "student-oriented, teacher model, integration and innovation", and the school orientation of cultivating compound technical and skilled talents integrating knowledge and practice, Huizhou Engineering Vocational College has created a "five in one" education mode of base, enrollment, teaching, scientific research and employment, and practiced the "three education" reform through in-depth cooperation between schools and enterprises, The college cooperates and shares high-quality resources, pays attention to cultivating students' professional ability and comprehensive quality, integrates the cultivation of professional ethics, professional spirit and innovation and entrepreneurship ability into the curriculum system, and forms a distinctive technical talent training system integrating industry and education and integrating knowledge and practice, which provides a good foundation and Implementation platform for the research of education and teaching reform in various fields.

Huizhou Engineering Vocational College has been serving the development of local economy and industry, studying UAV agriculture, forestry and plant protection technology and wireless ad hoc network technology, and applying them to the innovative forest fire early warning mode urgently needed in Huizhou, strengthening response measures and building a perfect forest fire early warning response system.

Wireless sensor networks (WSN) integrates sensor technology and wireless communication technology. It is a self-organizing and distributed wireless network. It is composed of a large number of wireless sensor nodes and base stations. It forms an intelligent network system through wireless self-organizing communication, which can monitor the environment of the sensor network, data fusion processing, target tracking and positioning. Typical wireless sensor networks include distributed sensor nodes, sink nodes or base stations, background task processing centers, etc. Sensor nodes are randomly deployed in the monitoring area to collect data from the target or integrate and forward data with other nodes. The sink node is responsible for summarizing the monitoring data in its responsible area, and its communication and data processing functions are better than those of the sensor monitoring node. The gateway or base station is responsible for monitoring external networks such as area aware data summary, communication protocol conversion, task release and connection server. Users can view the sensing node data of the monitoring area through tools such as PC or app and make corresponding processing.

WSN has become a research hotspot of information technology because of its convenient deployment, automatic data acquisition, low power consumption, low cost and can be applied to harsh environment. With the decline of computer cost and the reduction of microprocessor size, WSN has become more and more powerful. Its application in

forestry has changed the traditional forestry resource management mode, broken the limitations of traditional data acquisition methods, and promoted the implementation of intelligent forestry system in China.

The forest fire early warning system based on wireless sensor network is divided into three parts: data acquisition subsystem, control center subsystem and emergency response subsystem. The data acquisition subsystem mainly uses wireless sensor networks to collect the temperature, humidity, smoke, flame and other data of the target forest area, combined with positioning and other information, and transmits it to the monitoring server of the forestry department in real time to help it determine the fire emergency plan and quickly detect potential fire risks. The control center subsystem is responsible for processing various information collected by the nodes and displaying it in real time, determining the fire location and predicting the fire spread direction, etc. all information is placed in the monitoring server of the forestry department. In the emergency response subsystem, the forestry bureau is responsible for formulating corresponding emergency fire-fighting measures according to the forest fire monitoring data monitored in real time, and notifying the firefighters of the forest farm to accurately command the fire-fighting.

In the research on the application of wireless sensor networks to forest fire monitoring, some deploy sensor nodes in forest areas through WSN technology. When the temperature and smoke concentration exceed the threshold, the wireless sensor network system green orbs transmits data information to the base station in a wireless multi hop manner, and sends alarm signals to the ground through Beidou satellite, and relevant personnel make emergency treatment; Some wireless sensor network monitoring nodes use ZigBee technology combined with various sensors to realize real-time early warning of forest fire. The gateway will transmit the collected data to the host computer through GPRS, and the corresponding personnel will analyze and process it. In view of the shortcomings of ZigBee technology in forest wireless sensor networks, such as short communication distance and constrained by natural environment, a wireless sensor network based on Lora technology is designed to realize the software and hardware of sink nodes and acquisition nodes, and a forest data monitoring cloud platform is constructed to realize the visual presentation, early warning and supervision of pc-web terminal and app mobile terminal.

To sum up, the current wireless sensor network scheme for the data acquisition subsystem of forest fire early warning is mainly divided into two ways: ZigBee ad hoc communication technology and Lora low-power long-distance communication technology. The scheme of combining the above two technologies for forest fire early warning has not been found in the relevant literature research, the specific node deployment and network coverage connectivity are not clearly planned and studied.

As a mobile air information carrier, UAV (unmanned aerial vehicle) became mature in the 1970s. It plays a key role in military operations, such as intelligence collection, important area control, surveillance and so on. Since the 1990s, satellite geographic positioning technology and communication technology have opened up a new road for unmanned reconnaissance aircraft, making UAVs gradually move from military field to civil field.

With the development of mobile Internet, more and more devices are connected to the mobile network, and new services and applications emerge in endlessly. The explosive growth of mobile data demand promotes the development of communication technology. In 2019, "5g" (5th generation mobile communication) was successfully applied, gradually realizing the goals of "interconnection" and "convergence" of all things, and becoming an important engine of economic growth and social development. Facing the upgrading and iteration of business applications, the focus of communication network will gradually shift to scalability, security, mobility and flexibility, and take distributed storage computing, centralized management optimization and intelligent decision scheduling as the main objectives to meet the future business needs.

Due to the increasing number of mobile communication, Internet of things and other access network users, the substantial growth of data consumption and the complexity of information sources, the network will show the trend of multi network coexistence and multi-source heterogeneity in the future. Facing the increasingly complex information environment and the increasing types of data, UAV can quickly and accurately capture information to the air platform and expand the network dimension to get rid of the constraints of the environment on information transmission and collection. However, in the face of long-time, large-scale and strong interference tasks, the shortcomings of UAV, such as short endurance time, limited flight radius and excessive dependence on communication resources, seriously affect the task completion. In contrast, UAV group has distributed self-organization structure and flexible group mode. Through networking for perceptual interaction, information transmission and cooperative work, it can prolong the endurance time and reduce the overall flight resistance; Realize wide field of vision investigation and high-precision positioning.

Because of its advantages of low flight cost, diverse functions and strong flexibility, UAV often acts as an air base station or flight relay to complete communication tasks such as detection network, blind area coverage, link recovery and information collection in the air. When the UAV group performs tasks in an overall form, it can greatly improve the mission success rate and overall hit rate, and achieve the purpose of "blinding" with high stability and high coverage. In the process of UAV performing various communication tasks, interference is an important factor affecting the quality of network communication. Facing the complex and changeable communication environment, real-time and effective interference management measures are a powerful guarantee for the UAV cluster to successfully complete the communication task. In addition, the signal energy interaction between UAV group and ground network can greatly improve the communication efficiency, prolong the network life, fully tap the potential of information and energy, and provide more possibilities for the establishment and switching of communication links between air network and ground network.

When UAV actually performs tasks, it not only needs to face the errors caused by network equipment, channel conditions and other factors in the real environment, but also needs to consider the compatibility of software, hardware and environment, such as the docking of flight decision and flight control command, the constraints of transmission requirements and channel conditions, the difficulty of algorithm and the limitation of processing ability, etc. Therefore, in order to improve the fault tolerance and robustness of the system, it is essential to establish a demonstration platform based on networking and

intelligent flight control. It will provide auxiliary means such as planning and evaluation for UAV to ensure the safety of actual operation.

At present, UAV has penetrated into all aspects of life, changed the way people obtain and transmit information, and has become an indispensable technical means in various fields in the future, such as VR live broadcast, security deployment and control, high-altitude patrol inspection, emergency communication, information collection and other applications. UAV can also be used as an edge server to interact with cloud or other aircraft to bring convenience to life [6]. However, due to the limitation of endurance capacity, UAV can not maintain long-term air operation. In order to make up for the energy shortage, expand the application scenarios of UAV, give full play to the synergy of UAV and achieve the goal of "freedom of take-off and landing", the construction of UAV airport and vehicle portable Airport is the only way for UAV industrialization (Fig. 3).

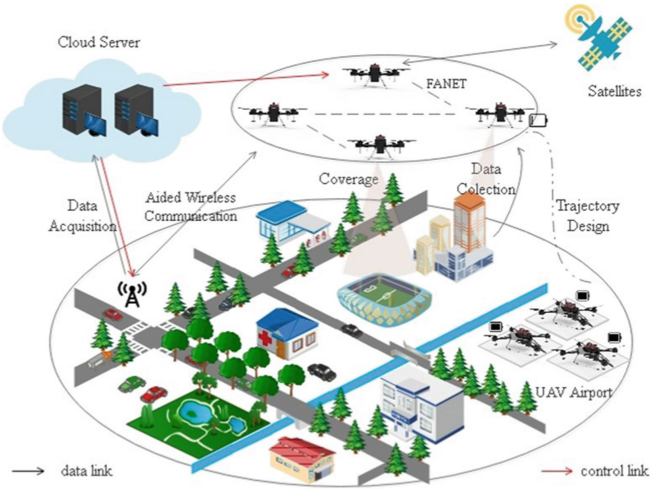

Fig. 3. UAV application scenario

UAV intelligent technology and its radiated peripheral applications seem to have become the mainstream technology and application direction in the future. Our University attaches great importance to the development of UAV field and the construction of UAV specialty. After early investment and construction, we have preliminarily planned a training room with a certain scale and an industrial college jointly built with companies in the industry, forming the prototype of industry university research chain. Through further increasing investment, integrating advantages and refining direction, we will face the high-tech, high-tech and scientific research in the UAV field in the future Intelligent technology and application, it is planned to build a UAV technology and Application Research Center for our university and our city [7].

With the advent of the Internet of things and the era of big data, the development of information technology is changing with each passing day. The whole human society is making great strides towards globalization, modernization and intelligence. More and more services are based on the reliable access to effective information. The demand for information in social development exceeds that in any previous period. Due to its high flexibility, strong deploy ability and other advantages, UAV has unique advantages in the fields of information collection and regional blind filling. It was first proposed by Britain in the 1920s and mainly serves military operations. With the continuous development of UAV technology, civil UAV has developed rapidly in various countries. There are more than 130 development units and 15000 civil UAVs in China, and the types of civil UAVs are gradually enriched, including fixed wing UAV, rotor UAV, etc. To a large extent, the above achievements are the result of the gradual penetration of military UAV technologies such as high altitude, high speed and large load into civil use. There are two types of civil UAV development units in China: one is subordinate units of military industry group and scientific research institutes; Second, more and more private enterprises are involved in the development of UAVs. For example, Dajiang company has reached the world leading level in the development of consumer UAVs. The UAVs developed by Dajiang company are shown in Fig. 4.

Fig. 4. Dajiang Jingwei M100 UAV

The representatives of foreign civil UAV companies are 3D robotics of the United States and parrot of France. Both of them have realized various functions such as aerial photography, video recording, mapping and 3D modeling on UAVs, and have the ability to provide high-tech solutions in the field of urban UAVs. The UAVs produced by 3D robotics and parrot of France are shown in Fig. 5.

Fig. 5. UAVs of 3D robotics and parrot

Compared with foreign countries, domestic civil UAVs have also begun to emerge in recent years. At present, the two fields of agriculture, forestry and plant protection and power and energy inspection have shown an urgent demand trend, and have a considerable market scale prospect. In recent years, civilian UAVs have developed rapidly. Some scholars have carried out UAVs equipped with communication equipment to assist in 5g network blind patch, UAV intelligent path planning, stable and reliable networking of large-scale UAVs, information and energy interaction between UAV network and ground sensor network, and UAVs provide computing unloading services as edge computing servers, This series of research on UAV anti-jamming technology has attracted the most attention, as shown in Fig. 6.

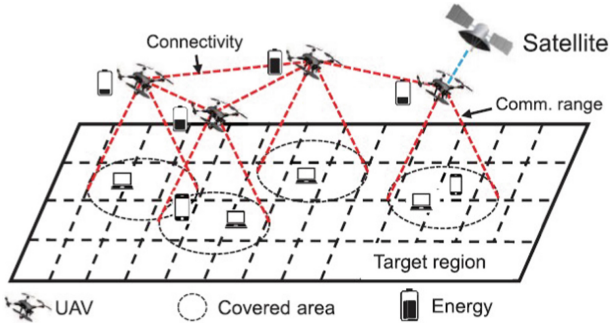

Fig. 6. UAV information acquisition

However, the limitations of limited communication distance, low battery capacity and less payload of civil UAV still exist. When performing large-scale, all-weather tasks, due to the need for frequent charging, the task execution efficiency is low and the repetition rate is high. Countries also cooperate with universities and enterprises to carry out innovative research on the shortcomings of civil UAVs. It is generally believed in the industry that based on the existing capabilities, civil UAVs will develop towards synergy and intelligence in the future. Collaboration means that dozens or even hundreds of UAVs perform tasks at the same time. UAVs share information through networking technology to avoid repeated work. They are uniformly scheduled by the ground control platform to improve task execution efficiency. At the same time, due to the large number of UAVs performing tasks, the design of efficient routing protocol can ensure that the temporary offline of a single UAV will not affect the whole UAV network, so as to improve the robustness of the system. The schematic diagram of multi UAV networking using routing protocol is shown in Fig. 7.

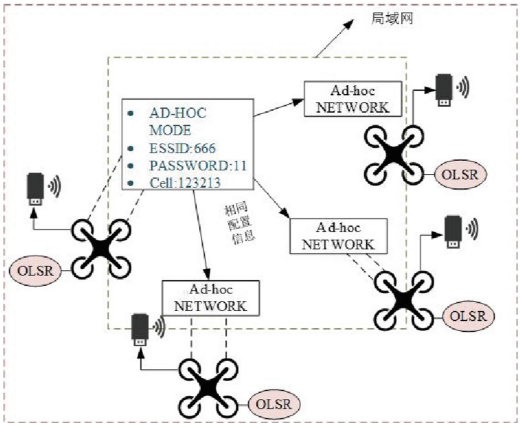

Fig. 7. Multi UAV networking using routing protocol

At the same time, the industry is also designing UAV airports that can automatically charge UAVs, which are mainly divided into fixed and vehicle mounted. The wide application of UAV airports can greatly improve the endurance ability of UAVs when performing tasks and reduce the burden of UAV data processing and transmission. The schematic diagram of UAV airports is shown in Fig. 8.

Fig. 8. Fixed and vehicle mounted UAV Airport

Intelligence means that UAVs can complete tasks independently and efficiently. At present, the control of civil UAV is mainly completed by "flying hand". However, the cultivation of professional "flying hand" requires a lot of time and resources. Combined with the deep learning and reinforcement learning technology in artificial intelligence, the development of UAV intelligent path planning, target recognition, information collection, regional monitoring and other functions is in full swing. Intelligent UAV can liberate the labor force. It can be predicted that the future civil UAV will become an important part of the intelligent society and will play a more important role in all walks of life.

The traditional network construction includes four stages: node startup and pre-allocation, neighbor node discovery and exchange, broadcasting and stable synchronization. The network topology is single and simple, generally star or ring structure. The network composed of UAV group and ground station usually has the characteristics of multi-dimensional, high dynamic and fast entry and departure. In the face of complex environment and task requirements, the traditional networking technology can not meet the requirements of delay, throughput and security. Therefore, it is necessary to adopt reliable random access and stable routing mechanism on the basis of traditional networking theory to ensure the stability of control and data link. Aiming at the topology change of high dynamic and multi-dimensional UAV cluster, this paper studies the networking technology with the characteristics of fast addressing, self-healing, high reliability and low overhead, realizes the high-speed and dynamic entry and departure of each node, and establishes a stable and reliable air link for the transmission and interaction of control information and data information.

Integrate and improve the networking technology based on node information and link state to form a distributed and hybrid networking theory to meet the needs of different business scenarios. At the same time, although the reliable networking theory has laid the foundation for the implementation of various tasks, the specific technical implementation is still a difficult problem to be solved. The implementation of the protocol needs to customize appropriate physical transmission boards, standardize and unify various development interfaces, protocol simulation and embedded implementation.

4 Construction Objectives

Based on the future development plan of China's forest fire prevention monitoring network, do a good job in customizing diversified and personalized solutions for different regions and industries, and meet the intelligent trend of air cooperation network in an all-round and multi-level manner. Improve the popularity of UAV forest fire prevention monitoring system, expand the application scope of intelligent air ground collaborative Internet of things communication, make the research results with leading performance facilitate the development of industry and agriculture, and activate the driving force of rapid industrial growth. The ultimate goal is to improve the architecture of the open space (A2G) collaborative network nationwide, formulate the forest fire prevention monitoring industry standard of the open space collaborative network, enable the open space collaborative network communication system, shape a new generation of network communication form, give full play to the advantages of the open space collaborative network, cover the shortcomings of the existing forest fire prevention monitoring network system, and break the network performance bottleneck, Comprehensively improve the overall performance.

(1) Solve the key technical problems of the unmanned unit network, such as energy consumption, mobile routing, road planning and other topics, give play to the advantages of our university's platform and talents, form a series of peak achievements in scientific research, master the core technology of the unmanned unit network, and enable Huizhou to form a large leading advantage in this field in the medium and long term.

(2) Form specific application cases, construct Huizhou open space collaborative network forest fire prevention monitoring industrial chain, and create demonstration application groups in some application directions where open space collaborative networking has great advantages. In the fields of urban patrol inspection, information collection, emergency communication, agriculture, forestry and plant protection, through coordination and cooperation with Huizhou Municipal government and municipal enterprises, incubate practical projects for open space collaborative networking applications, deeply tap technical potential, continuously optimize integration, and do a good job in the combination of industry, University and research. On this basis, realize the deeper integration of air space collaborative networking technology and socio-economic development, actively promote industrial development, and form an air space collaborative network monitoring related industrial chain with greater economic benefits and greater contributions to society.
(3) In the UAV application technology major of Huizhou Vocational College of engineering, we will set up characteristic courses related to air ground cooperative network, strengthen talent training, and build a research team related to air ground cooperative network, so as to conduct long-term and stable research and form technology accumulation and project pre research experience. While serving the local economy of Huizhou, promote the improvement of employment rate and talent reserve.

5 The Following Key Issues

In the process of forest fire monitoring by air ground cooperative network combined with sensor network and UAV, Huizhou Engineering Vocational College will solve the following key problems in the next step:

(1) Research on information energy interaction in cluster collaboration.
In the actual application scenario of wood fire monitoring, the air UAV network and ground sensor network are energy limited networks. Whether the node energy can be saved as much as possible has a great impact on the life cycle of the whole network. Generally, node silence is a good way to save energy. In the studied scenario, the information energy transmission mode of clustering cooperation is adopted. The sub nodes in the cluster (UAV or ground sensor) summarize the information to be transmitted at the main node. The air and ground networks only communicate between the main nodes, while other sub nodes are silent. Considering the energy level of system nodes, the information transmission scale between heterogeneous networks, the energy collection requirements of ground network and the path design requirements of UAV network, appropriate clustering cooperation mode is adopted to achieve the required system performance indicators.
(2) Research on path planning of UAV.
Due to the limited energy of aircraft, it is very important to design an appropriate flight path to realize the information transmission between air and ground networks and the energy collection required by ground networks. On the basis of the research on the information energy interaction of clustering cooperation, considering the constraints required to realize the system requirements, such as throughput

constraints, energy efficiency constraints, UAV network link constraints, additional mission constraints, etc., the joint trajectory optimization problem is established and the optimal path of UAV is designed.

(3) Research on optimal resource allocation scheme.

In the process of communication and energy interaction, the wireless energy transmission of UAV to ground nodes will inevitably lead to the decline of wireless communication performance. Therefore, it is necessary to study the optimal resource allocation in this process. By studying this problem, we can further understand the relationship between UAV network coverage, transmission success rate and energy collection efficiency. Make a trade-off between wireless communication performance and energy collection efficiency, solve the problem of reasonably allocating the time ratio between energy transmission and data transmission within the time limit, and plan the transmission power of sensor nodes and UAV under the condition of limited energy, so as to meet the required performance index requirements.

6 Conclusion

During the construction of UAV agriculture, forestry and plant protection project of Huizhou Vocational College of engineering, it is oriented to the cutting-edge technology of open space collaborative network, which provides effective support for improving the core technical ability of forest fire prevention monitoring in Huizhou, mainly including open space collaborative blinding and management, open space collaborative efficient networking and stable routing mechanism.

Air ground cooperative blind patch and management is a typical application of UAV assisted wireless sensor networks, including air ground network topology modeling, inter air ground channel state modeling, blind area detection and effective coverage, UAV autonomous path planning, relay node deployment strategy, interference perception and management, etc. It involves information transmission system of air ground cooperative ad hoc network, 5g / b5g cooperation and auxiliary communication, UAV path planning, MAC layer access control, computing unloading under the background of Internet of things, etc.

Efficient networking and stable routing mechanism is an important guarantee for the effective operation of air ground cooperative network, including the design of stable low collision access protocol, the optimization of routing protocol driven by task, network self-healing and reconstruction under the condition of network topology change, and the stability research of large-scale high dynamic network. The theoretical research content is in NS2, MATLAB, Actual verification on Python and other simulation platforms.

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