Public Security Command and Warfare System Based on Bei-Dou Positioning Service

Weiwei Cheng, Kunyang Shan, Guicheng Liu, Xingchao Yang
Shandong University of Science and Technology, Tai‘an, Shandong 271000, China

*Corresponding author e-mail: 1502281316@qq.com

Abstract. Facing the increasingly serious anti-terrorism situation and the need to maintain public security, and breaking through the shortcomings of the traditional flat command operation mode, we designed a set of Bei-Dou location service as the core, integrating existing network resources, IT infrastructure and video surveillance infrastructure. An all-round, multi-level public security command and combat system integrated with the investigation and command business needs. The design and application of the system start from four different angles. Firstly, the main contents of the system construction are introduced theoretically. Then the function design of the software is described in detail. Finally, the application of Bei-Dou system and 5G communication in the single-handle handheld terminal is expounded. Scenes. The system integrates functions of information collection, command and dispatch, tracking and monitoring, and multi-level linkage. It introduces data large screen and 5G communication technology, enhances the big data visualization function of the command system and the stability of the communication link, and can modernize the national defense. Construction provides technical support and platform support.

1. Introduction
Since the 21st century, public security has gradually become the focus of attention of all countries in the world. With the steady progress of the construction of smart cities in China, the task of public security management in the whole society has become more and more arduous. In order to alleviate the pressure of handling cases and improve work efficiency, the public security departments of various places have started to build a command center system and establish a strong central command system and multi-level coordination mechanism. However, most public security command systems do not use visual analysis, monitoring and dispatching methods such as maps, positioning, video and intercom, etc., and do not make good use of communication technology to interact with the command center and the real-time interaction. Efficient command and dispatch system and custom handheld terminals that meet the needs of operational command. With the gradual maturity of the Beidou satellite system, the construction of the public security command and combat system officially entered the Beidou era. Utilizing the advantages of R&D resources of Beidou satellite navigation chip and application, the development of Beidou-based “cloud+end” public security command and control system to solve the problem of police dispatching and dispatching and emergency response has become the current public security command system. One of the top priorities [1].
The system is applicable to police officers, patrolmen, traffic police, criminal police and other police officers. It can provide technical support for multi-department joint operations, provide emergency plans for emergency and emergency handling, avoid further deterioration of the situation, and effectively improve the public security system. The level of informatization has added to the construction of smart cities.

2. System construction content
Based on the shortcomings of the current public security command and control system, and integrating the mainstream public security geographic information system, this paper designs a comprehensive, multi-level public security command and control system with Beidou positioning service as the core. The system construction uses the business applications such as command and dispatch, public security investigation, police power allocation, and emergency plan as the core of the application. The comprehensive application of 5G wireless communication, computer network, data storage, data large screen display and other technical means to build a set of advanced technology. The complete system of “cloud+end” public security command and combat system realizes effective command, resource sharing and information interaction of each linkage unit.

The main construction contents are as follows:

1. Command and dispatch system: effectively integrate video surveillance, geographic information system and BDS monitoring to achieve multi-level linkage and coordinated operations of the detachment, detachment, brigade and on-site police force, using huge spatial information, intelligence information, video information, The decision database and location information assist the leaders in formulating the operational policy, cooperating with the on-site command, assisting the single police to understand the intention, know the distribution of the enemy and the enemy, and master the real-time battle conditions to effectively fight. In the Public Security Corps, the command and control room with large screens and office seats will be built.

2. Single police terminal: a police handheld device configured for the first-line police, with Beidou positioning, 5G wireless communication, video recording and RFID functions, and equipped with customized mobile GIS-based business software for on-site intelligence inquiry and forensics And the linkage with the command center provides an effective means to work collaboratively with the access command system through wireless and security certification.

2.1. System design features
The design features of the system can be summarized as: one center, two business units, three communication networks, four key technologies, five types of command information and six levels of participation objects. The details are as follows:

One center: Command Operations Center.

Two business units: the public security command unit and the police force allocation unit.

Three communication networks: wireless 5G communication, digital IP communication network, video voice intercom network.

Four key technologies: BDS technology, 5G ultra-high speed communication technology, video surveillance technology, GIS technology.

2.2. System framework design
It adopts two major hardware components: on-site mobile device (PDA acquisition terminal, Personal Digital Assistant) and command and dispatch background system, and utilizes the "cloud + end" technology system and security through advanced, reliable, multi-type communication methods and networks. A stable system to achieve the above functions. The working mode is shown in Figure 1.
2.3. Command Center Design

The goal of data visualization is to quickly identify problems, identify problems, analyze causes, and solve problems. Nowadays, big data has gradually exerted its power, which has changed our lives invisibly. Data big screen, as a kind of big data display medium, is widely used in various exhibition halls, exhibitions, conferences and decision-making. Among them, it becomes a weapon for people to analyze and solve problems. This paper embeds the data big screen technology into the public security command and control system, and visually displays various public security information through data and report visualization for decision making. The data large screen design is shown in Figure 2.

The center of the data big screen is the layout of various regions of Beijing. It can superimpose the ray scattering map and can display the direction and value of the police force dispatch. The upper left
and upper right corners are the ratio of female police officers and male police attendees. The middle of the left side is a statistical line chart of crime rate. The change of crime rate in the past ten years is counted on a yearly basis, reflecting the performance of public security work. The lower left part is the police force distribution heat map and police car patrol road map, which dynamically displays the current police force configuration status and allocates a decision-making basis for adjusting the police force. The middle part of the right side is the ring map and percentage map of the police force distribution, which reflects the changes in the distribution of police force in the four quarters and the maximum dispatching police force, the police force that has been dispatched, the reserve police force, and the frontline police officers. The lower right part is a radar map of the distribution of police officers and the distribution of police cars. It can clearly and intuitively see the distribution and proportion of police forces between regions.

3. software function design

3.1. Target real-time location monitoring
The Beidou location service-based operational command system can display the information of the position of police officers, police cars and target vehicles in real time on the map, including latitude and longitude information, time, speed, and the name or license plate number of the target vehicle, as shown in the following figure.

![Figure 3. Location Monitoring](image)

3.2. Positioning track playback
The system supports the user to select the target object and the time period information, and displays the positioning track information in the police map for the monitored monitoring target object. During playback, you can pause, start, accelerate, decelerate, stop, etc. Hover the mouse over the track to display the time, speed, direction, device name, device ID, etc. of the track point of the hover, as shown below.
3.3. Live video surveillance
In order to make the command center better and more intuitive to understand the scene, the camera is installed on the mobile command vehicle, and the video management equipment equipped on the command vehicle is transmitted back to the command center through the 5G super high-speed communication network to realize the command operation center and live video. Seamless connection for monitoring.

3.4. Multi-source seamless positioning technology fusion
The satellite navigation and positioning technology can only be applied to the outdoor open environment. Therefore, in practice, a variety of indoor and outdoor positioning methods should be seamlessly connected to comprehensively monitor the entire process. BDS+RFID technology integration enables point-to-point monitoring of dangerous goods, and BDS+ inertial navigation technology seamlessly locates tunnels, tall buildings and jungle canyon operations.

3.5. Multi-level linkage command function
Linkage command is the key means for the whole system to realize command operation and front-end interaction, including between different command centers, between command centers and command vehicles, between command vehicles and police officers, and between police officers and police officers. The project command center can issue texts, materials and pictures to the terminal single police, and support the command and dispatch functions of various modes such as text, pictures and map plans.

3.6. Auxiliary decision function
Auxiliary decision-making is the system's knowledge system and expert database. The system is based on the huge Beidou real-time positioning information, video surveillance information and police intelligence information, with advanced spatial analysis technology, plan design technology, Beidou positioning monitoring technology and artificial intelligence. Technology is the means to assist decision-making in the command and dispatch process. The main application scenarios are shown below:
4. Single police combat terminal design
Considering the complexity and particularity of the wireless communication network in the first line of public security command, the system uses the Beidou system and 5G signals to realize the positioning of the single police terminal and the guarantee of the communication link. The biggest advantage of Beidou is its independent property rights. The positioning accuracy reaches 10 meters in plane and 10 meters in elevation. The speed measurement accuracy is 0.2 m/s, and the timing precision is 20 nanoseconds. It has the characteristics of high positioning accuracy and good confidentiality. On December 26, 2018, the basic system of Beidou No. 3 was completed and officially began to provide global services. This also indicates that the design has certain technical feasibility.

5G is also called the fifth generation mobile communication technology. It is the communication mode that China is working on at present. It represents ultra-fast data transmission speed and wider communication coverage, and can provide real-time video communication and multi-view command service for this system.

The design of the single police combat terminal mainly has the following two core modules: (1) Beidou navigation positioning. The terminal adopts the Beidou three-generation navigation and positioning module to support the independent positioning and combined positioning of the Beidou three generations. The positioning mode can be selected independently. Key technical features:  
1. Using fast parallel processing algorithm, satellite capture and recapture speed is fast and efficient;  
2. The carrier phase smoothing pseudorange is used to improve the pseudorange measurement accuracy and positioning accuracy, and the acceptance sensitivity and positioning accuracy of the handheld navigation device are greatly improved;  
3. Through satellite wide-area high-precision synchronization, the network node transmits errors in the nanosecond-level synchronous clock, laying a good foundation for high-precision positioning.  
4. The positioning results will be uniformly distributed to the 5G network, providing an integrated operation platform with both communication and location.  

(2) Complementary communication.
In order to realize the smooth connection between the command and control center and the single-handle handheld terminal and the communication link, the terminal device needs to have a plurality of communication modules built in. With built-in 5G, WiFi, RFID and other communication methods, the device can work online anywhere, which ensures that the out-of-town personnel can keep in touch with
the command center or other team members. The 5G signal is preferred over data communication links, allowing terminals to continuously access real-time navigation data and network-based services over the mobile Internet. Since the base station adopts the beamforming technology, the antenna array is arranged on the base station, and by controlling the phase of the radio frequency signal, the lobes of the electromagnetic wave after the interaction become very narrow, and the beams do not interfere with each other [3], and can provide more A large number of communication links greatly increase the number of terminals served by the base station, thereby meeting the possibility of large-scale operations. The terminal can realize the electronic tag reading function by using RFID radio frequency identification technology. By touching the designated positions of the two terminals, the NFC near-field sensing can automatically identify and establish a connection to realize the transmission of files and data.

In addition to the Beidou positioning receiver installed on the customized handheld terminal, the Beidou positioning receiver is also installed on police vehicles such as police cars and patrol cars. Both the police officer and the police car can upload their own location information to the command center in real time. The command center can know the precise configuration of the police force in each jurisdiction based on the large data of the positioning data. When there is an alarm, according to the location of the police and the distribution of nearby police forces, select the police force that is closest to the place where the police occurred. The police officers who received the dispatching command arrived at the police scene in the shortest time according to the Beidou navigation system combined with the optimal path planning algorithm. The command center is always concerned about the real-time distribution changes of the police force. If the perpetrators of the case have escaped, the command center will prejudge the suspect's possible escape, and direct the police to intercept the suspect according to the real-time police force distribution. At the same time, the method of DNS spoofing is used to attack the hidden signal of the electronic device on the suspect, so that it can be exposed to the 5G network signal terminal without being discovered, and the Beidou system can accurately track the positioning of the signal [4].

5. Analysis of police force allocation based on Beidou positioning

In the previous section, we analyzed the application scenarios of the Beidou system in public security policing, and police deployment is the most important component. It is the key point of emergency decision-making and investigation command. Based on the simulation data, this paper establishes the electric field gravitation model and conducts case-based reasoning and map analysis, aiming to provide a scientific and reasonable solution for police force deployment.

Assume that the average patrol speed of the police car is 20km/h, and the average speed at the time of the police is 40km/h. The time for the police car to arrive at the scene after receiving the police should be within three minutes, and the time to reach the key location must be within two minutes. We regard the whole city as an electric field, and police cars patrol as electrons moving under the influence of electric field forces. In order to make the movement of the electrons meet the requirements of police car patrol, the following rules are defined:

Rule 1: The points on the road are attractive to the police car, and the key parts are more attractive to the police car than the ordinary points.

Rule 2: Without the point covered by the patrol police car, the attraction to the police car will gradually increase.

Rule 3: At the point that has just been covered by the police car, the attraction to the police car will gradually decline, preventing the attraction from being too large, so that the police car patrols around the point.

Rule 4: There is a certain repulsive force between the police cars. The magnitude of this repulsive force is related to the distance between the two police cars. The smaller the distance, the greater the repulsive force.

It can be found that the above rules and the interaction between protons and electrons are very similar. The same kind of charge repels each other, the different kinds of charges attract each other, the electric quantity increases, and the force increases accordingly; the farther the distance, the smaller the force.
Discrete points on the road are equivalent to protons, police cars are equivalent to electrons, and the gravitational formula between them is as follows:

$$F = k \frac{Q_1 Q_2}{r^2}$$

Where $k$ is a constant, $Q_1$, $Q_2$ are the amount of electricity carried by protons and electrons, respectively, and $r$ is the distance between them. $Q_1$ can be adjusted, the power $Q_2=1$.

This system can be represented in the form of a potential energy surface map, as shown in the following figure:

![Potential energy surface graph](image)

**Figure 6.** Potential energy surface map

6. Summary
The public security command and combat system based on Beidou location service proposed in this paper can fully meet the needs of the police, and fine-tune the police force and patrol route in combination with the actual situation of the jurisdiction, which can ensure the maximum value of police officers, avoid waste of resources, and avoid the police force. The shortage of police and the delay in handling cases have provided an effective solution to fill the gap in police force.

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