

# Wireless Sensor Networks Overview

Yuqiao Wang<sup>1,\*</sup>

<sup>1</sup>School of Computer Science, Electrical and Electronic Engineering, and Engineering Maths, University of Bristol, Bristol, BS8 1QU, UK.

\*Corresponding Author's Email: gx22274@bristol.ac.uk

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**Abstract:** Wireless sensor networks have become widely used for their high accuracy, safety, and reliability, particularly in military applications where information is critical to victory. Chinese scholars have conducted research on wireless sensor technology, with the aim of reducing costs, meeting low power requirements, and adapting to environmental changes to enhance China's military strength. However, data transmission speeds are slower and signal strength weaker compared to wired networks due to physical and technical limitations, which may result in slower or even interrupted data and file transfer speeds. Despite these limitations, wireless sensor networks have played a critical role in China's reconnaissance system for collecting and processing information in the battlefield environment. The technical principles of wireless sensor networks involve a distributed sensing system with multiple nodes consisting of data collection, big data processing, information processing, and energy supply modules. The identification and tracking of battlefield targets rely on passive observation of objects in activity using acoustic vibration sensors. The development of wireless sensor networks is still ongoing, with problems including limited computing power, storage capacity, communication ability, and energy supply of sensor nodes, as well as the potential for information leakage during the transmission process.

**Keywords:** Military, Automation, Wireless sensor.

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## 1. Introduction

Wireless sensor networks are widely used due to their high sensitivity, safety and reliability, including applications in military, medicine, agriculture, home, ecological environment monitoring and other fields [1]. Among them, the military is one of the main application areas of wireless sensor networks. In the battlefield, controlling more information is the key factor in winning. Future battles will inevitably be globally informationalized in a high-tech environment. The development of high-tech such as computers and electronics has brought significant changes in the spatial characteristics of global information warfare. Therefore, future warfare will be dominated by information. Initially, wireless sensor networks emerged to serve military activities with the primary purpose of acquiring real-time information on the battlefield and conducting evaluations. With the advancement of technology, automated command systems have been integrated into military activities, which rely heavily on wireless sensing technology. Wireless sensors play an irreplaceable role in military affairs with its high accuracy and survivability. This article elaborates on the basic characteristics of wireless sensor networks and focuses on their application in the military.

## 2. Literature Review

Since the emergence of wireless sensor network technology, it has been recognized and highly valued by scholars both domestically and internationally. In recent years, Chinese scholars have conducted a series of research on communication, information processing and coordinated control, including methods to reduce costs, meet low power requirements and adapt to environmental changes [1]. In addition, Chinese scientists have made great efforts in the development and use of wireless sensor systems.

Due to the enhancement of military strength of China, the way of warfare is constantly being upgraded and improved,

one of which is the automation of information transmission [2]. Collecting information, transmitting information, and processing messages are key issues in modern warfare. At the same time, the intelligentization of military command system has become one of the main goals of the development of military technology. An effective information-based command system can increase the level of the troops scientifically and technologically, as well as improving the efficiency of collecting and processing information, thereby enhancing their combat effectiveness.

Therefore, the application of wireless sensor network technology in military command and communication has become particularly important [3]. As most of the current wireless sensors are placed in enemy areas through air drops and are placed randomly to conduct reconnaissance in the battlefield environment, they have become a critical part of China's reconnaissance system.

However, the wireless sensor system has not been fully popularized for the following reasons: the file sharing speed provided by wired or wired networks is much faster than that of wireless networks. Due to physical and technical limitations, wireless networks can transmit a certain amount of data. Generally speaking, the signal strength of wireless devices will weaken as users move away from the router or Wi-Fi source, and may even be unable to receive the signal. This may result in slower or even interrupted data and file transfer speeds. Home items and interiors such as refrigerators, window glass, walls, ceilings, etc. may cause signal deviation or weakening, which may result in poor performance of wireless systems. In addition, the security level of wireless sensor networks is not high. Although China's related research has covered key areas of wireless sensor networks and has reached an international level, it still lacks original technology with independent intellectual property rights.

Wireless sensor networks can also be used in the military fire control and electronic guidance system [4]. The core component of the commonly used weapon aiming system is

the fire control electronic computer (also known as the fire control unit or ballistic computer), which can store and manage all signals and data of the weapon aiming system, predict the target movement, solve the ground projectile equation under actual combat conditions, or check the stored firing tables to determine the launch parameters, and correct them based on the shooting results. The National Military High-Tech Research and Development Program of the United States is responsible for a field application experiment of a network-embedded operating system, which uses new sensor fusion algorithms, self-positioning algorithms, and a large number of sensor nodes distributed in designated areas, checkpoints, buildings, and escort vehicles, to accurately locate hidden enemy snipers. The sensor system determines the source of the projectile by detecting the jet shock wave emitted by the projectile, the sound vibration after the projectile is fired, and the duration of the gun vibration.

### 3. Technical Principles

Wireless sensor networks consist of a distributed sensing system, with sensor devices at their ends, enabling them to recognize and monitor the surrounding environment. [5]. The sensors in the wireless sensor network system communicate with each other in a wireless network mode, so the network system can be set up flexibly and diversely, and the location of the devices can be changed freely. Moreover, the interconnection between the network system can be achieved by wired or wireless methods. It uses a multi-hop self-organizing method established by wireless communication. Wireless sensor networks usually consist of several nodes, and the main sectors that make up the information node are data collection module, big data unit, information processing module, and energy supply module. The main nodes in the wireless sensor network are energy concentration nodes and signal nodes.

In military applications, the identification and tracking of battlefield targets mainly rely on passive observation of objects in activity (such as various vehicles) using acoustic vibration sensors, followed by identification and tracking. In

August 2003, the US Army developed the "SADS" system, which not only detects moving or static metal-rich objects, but also perceives sound, light, climate, chemicals, and the life characteristics of plants and animals.

### 4. Conclusion

With the continuous progress of technology, modern warfare has developed into an informationized digital warfare, in which wireless sensor networks play an important role due to their precision and flexibility. However, with the development of wireless sensor networks, many problems have also arisen. Firstly, due to various constraints such as volume, cost, and application scenarios, the computing power, storage capacity, communication ability, and energy supply of sensor nodes are severely restricted. Secondly, due to its wireless transmission method, information leakage is easily generated during the transmission process. Although wireless sensor network technology is not yet fully mature, it has become an important technology that is valued by various countries and has broad development prospects.

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