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Article

Application of Wireless Network Positioning Technology Based on GPS in Geographic Information Measurement

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Abstract: Based on the analysis of the advantages and disadvantages of GPS positioning system in practical application, this paper proposes the combination of wireless network positioning technology and GPS positioning system to overcome the low accuracy of GPS positioning system in the case of occlusion. This paper introduces in detail the principle of the application of wireless network positioning technology based on GPS positioning system in geographic information measurement, and illustrates its practical application in production by taking coal mine positioning as an example.

Keywords: GPS; network location; geographic information measurement

1 Introduction

With the improving of the precision of GPS positioning, application more widely, in various areas of work such as building orientation, the dam deformation localization, line exploration work, etc., the application principle through the analysis of several satellite measurement data to accurately calculate the user's position and get high precision positioning information. The wireless sensor can get the corresponding node position well, and can carry out geographic information measurement work well. However, GPS technology also has some shortcomings in the practical application. The detailed analysis and summary of GPS technology and the accurate measurement of geographic information through wireless sensor network provide positive significance for the empirical study of geographic information measurement.

2 GPS Positioning

2.1 Composition of GPS System

GPS is mainly composed of three systems, which are the combination of user equipment system, space constellation system and ground monitoring system. GPS data processing package, receiver hardware and in-machine software are the main components of user equipment system. The ground monitoring system is mainly composed of 1 master control station, 3 injection stations and 5 monitoring stations.

2.2 Characteristics of GPS

GPS has the characteristics of high precision, global coverage, constant operation and high static positioning observation effect. During operation, barrier-free operation is realized regardless of environment, time and place; There are many corresponding satellites distributed in the GPS system, and the distribution of these satellites is carefully designed by scientists, so as to play a better monitoring effect and realize the active acquisition of coordinate, time, speed and other relevant information, so as to improve the accuracy of information. When carries on the observation, but also can control the positioning precision, at the same time in accordance with the standards of positioning accuracy,

observing object positioning observation, time for a few minutes, so as to complete testing and data processing and data collecting, unlike traditional observation technology, application technology of GPS static positioning observation efficiency is relatively high, is now in agriculture, navigation, exploration and engineering survey field, wide-ranging applications.

3 Principle, Advantages and Disadvantages of GPS Positioning

GPS in the process of locating, through the GPS satellite constellation send ground receivers with navigation message ranging signal, the receiving device to receive the navigation message will send ranging signals of GPS satellite constellation in the process of time, at the same time and compare yourself time to receive ranging signal, so that you can accurately the satellites and their ground distance, user after accurate measure distance, usually on the satellite navigation message information analysis, thus acquiring a satellite's position when the cable in launch [1].

By determining the location of more than four GPS satellite constellations, the exact location of the ground receiver can be determined by means of rendezvous.

3.1 Advantages of GPS

GPS positioning technology has the characteristics of all-weather, high timeliness, high precision and real-time.

GPS technology has strong adaptability and is not affected by any climatic environment. It can provide high-precision positioning services even in extremely complex terrain.

When using GPS positioning technology to collect geographic information data, it can collect location information even if it is not visible, and can set out samples anytime and anywhere, which greatly improves the efficiency of geographic information data collection.

GPS positioning technology has high precision, uniform error distribution and short observation time.

GPS positioning technology can not only collect plane position information, but also collect elevation position information, which is well adapted to the measurement needs of various projects. GPS positioning technology has strong anti-interference ability, good confidentiality, can achieve all-weather operation.

3.2 Disadvantages of GPS

In the process of practical application of GPS technology, there will also be some problems. If the work is carried out in the place with shielding (indoor, tunnel, etc.) or strong interference source (under the strong magnetic environment, under the high-voltage line, etc.), the GPS positioning technology will have a certain blind area and cannot provide high-precision positioning service. In order to better solve this kind of solution, some new technical methods have emerged, such as gyroscope technology, network positioning technology, inertial navigation technology, etc., which have been well applied in various fields through the integration with GPS positioning technology.

4 Application of Network Positioning Technology

With network positioning technology as the foundation, and combines the detected data for mobile terminal location, according to the mobile terminal box receiver detects the Signal Strength to determine the actual distance, by measuring data can accurately determine the location of the mobile terminal, according to the detected Signal Strength RSSI (Received Signal Strength Indication) determine the actual distance, but the measure value may does not match with the actual distance.

The wireless network positioning system mainly has the following nodes: mobile node and reference node. The difference between them is that the reference node does not participate in the process of positioning and measurement, the mobile node can move normally and move freely within the control range of the node. When the mobile node receives the RSSI signal from the reference node within the range, it can accurately locate the location according to the measured value. For example, a relatively simple positioning system is mainly composed of a positioning node and three reference nodes. The more

reference nodes there are, the more accurate the measured position will be. Compared with other technologies, the resolution of positioning technology based on wireless sensor network can reach 0.5 m and the positioning accuracy is within 5 m, with excellent index [2].

4.1 Principle of Wireless Network Positioning Technology

Radio Frequency (RF) technology and device embedded positioning engine is an important part of indoor wireless network positioning technology. For hardware architecture, the combination of positioning engine unit in GPS technology and internal microprocessor in chip RF transceiver can save cost and reduce energy consumption. From the point of view of its application field, the positioning engine involves a wide range of indoor and outdoor can meet the requirements, through wireless LAN can be achieved, do not need to re-install a new network.

Application of wireless location technology development always follow the rules of the development of the technology data intensive measurement should be done firstly, namely measuring computer nodes location parameter data, and then transmit the information to a central data patch to measure of node position, in the end, to measure the data transmission to the original node in the node position. Due to some defects in the measurement method of this node, the traffic required by this node will increase continuously with the number of nodes in the process of calculation, which is not conducive to the expansion of its application scope and is more suitable for small networks and fewer nodes [3–4].

At present, the wireless network positioning technology in China mostly adopts the distributed positioning calculation method, which is simple. It only needs to calculate the nodes based on the data obtained from the nearest reference point, and then determine the location through the nodes.

4.2 Positioning Engine Technology in Wireless Network

As an important part of positioning technology in wireless network, the positioning engine has a simple technical principle, which only needs to calculate coordinates by triangulation.

This method of measurement is also a more common positioning method, which finds the coordinate position by the distance between different points. In summary, as a non-three-dimensional coordinate system, it is necessary to have three to five reference nodes in order to determine the distance between coordinate points. This method can also be applied to 3D coordinates by adding a few reference points, which has certain similarities with GPS positioning technology [5].

The triangulation problem can be described as: given a group of reference points x_1, y_1, z_1 and a group of distance measurement r1, the unknown x_u, y_u, z_u can be solved by simultaneous equations:

$$\begin{aligned}
&(x_1 - x_u)^2 + (y_1 - y_u)^2 + (z_1 - z_u)^2 = r_1^2 \\
&(x_2 - x_u)^2 + (y_2 - y_u)^2 + (z_2 - z_u)^2 = r_2^2 \\
&(x_3 - x_u)^2 + (y_2 - y_u)^2 + (z_3 - z_u)^2 = r_3^2 \\
&(x_4 - x_u)^2 + (y_2 - y_u)^2 + (z_4 - z_u)^2 = r_4^2
\end{aligned} \tag{1}$$

From the solution of the equation, we can conclude that u is the coordinate position referred to by the moving node.

In the positioning system, the engine generally has low requirements for positioning calculation according to RSSI, and the calculation method is relatively simple, which can reflect a very good characteristic during the experiment. If the detection environment is changed, the accuracy of the data can be ensured through continuous improvement of practical application. In the new environment, the radio frequency and the radio frequency signal may appear very significant changes, if the radio frequency signal is inserted into an interference signal, then the reception of the signal will bring a great impact. In order to avoid or reduce these differences, and improve the positioning accuracy, in the process of test and add several groups of RF signal points, for example by positioning the engine to measure of 16 RF RSSI, and add a large number of nodes, so as to check whether the change of the RSSI is in a state of

balance, can be very good avoid due to external factors affect the positioning result [6].

4.3 RSSI Positioning System

The wireless positioning engine system is mainly composed of reference node and mobile node. The reference node, as a static node, can send its position to other nodes, and the mobile node can determine the corresponding coordinates by obtaining the position of the reference node. The received signal is quantified to be the corresponding RSSI value to be sent to the positioning engine, and the corresponding position is obtained through the calculation of the positioning engine [7].

4.4 Locating the Engine's Coverage

Common coverage is 64 × 64 m, but can't deny the possibility of application in wide scope, if want to widen the range of engine positioning, to be able to reference node arrangement within a larger environment, in order to make the can locate in an optimal state, in the process of the reference node layout, the adsorption effect of the indoor and outdoor environment be taken into account [8].

In general, more reference nodes should be set, so as to better conduct spatial positioning. Too few nodes will affect the accuracy of RSSI value, so the accuracy of the obtained coordinates will also change.

5 Typical Applications

The most common application of positioning technology is to locate coal mines, which are often underground, making it difficult to obtain satellite signals, as well as the movement of personnel and equipment in limited space. Conventional measurement methods cannot be well applied, while the use of wireless network positioning system can well solve this phenomenon [9].

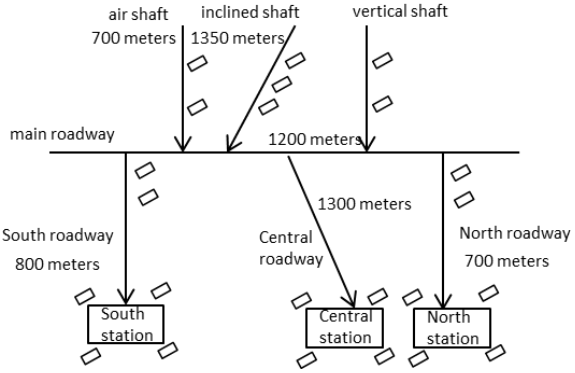

Figure 1: Distribution diagram of base station

Generally speaking, the basic architecture of wireless positioning system mainly includes identification card and base station, because both have the common wireless communication module. Therefore, the base station and the mine should be properly arranged according to the distribution characteristics, so as to form a complete wireless positioning network, and the density of the base station can be increased in some special areas, which involve working face, wellhead and entrance. Avoid setting up base station in mine roadway. Underground work personnel through identification card for identification, identification card, respectively, with different number of the data, in the process of practical application should be followed: identification card through the wireless communication module for data transmission, due to the transfer out of the data signal will be get by the base station around the base station after receiving the signal processing and identification card to complete identification, according to the received signal strength and signal quality is analyzed, can be very good to calculate the distance between stations with identification card. The details are shown in Fig. 1.

6 Conclusion

To sum up, both GPS positioning technology and wireless sensor network or other location in the process of practical application has certain limitation, the future of the development of positioning technology will toward the direction of more advanced and more accurate, the GPS positioning technology can be well combined with wireless positioning technology, then the precision and coverage will be greatly improved.

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