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Design of wildlife locating and tracking terminal based on ZCV curve modeling

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Abstract

With the development of society, human beings have more and more influence on the ecological environment of wild animals. How to better protect wild animals has become an urgent problem.In order to achieve better recovery of more data, longer research time and provide better research environment for researchers, a wild animal location and tracking terminal based on Beidou short message is designed.The terminal design uses UM220-III Beidou module, AT89552 single chip microcomputer, Packbits decomcompression algorithm, ADC analog digital converter and other technologies to achieve terminal positioning, data transmission, and battery power monitoring and other functional modules.The terminal uses beidou short message communication and positioning technology in THE BDS module to achieve long-distance positioning and tracking of wild animals, uses compression algorithm to increase the amount of information sent, and achieves the purpose of long-term positioning of wild animals by changing the battery through battery power monitoring. And App commands the terminal to feedback real-time location and intelligent analysis data to get the activity route and range of wild animals, so as to protect wild animals more conveniently, efficiently and at a longer distance.

Keywords

Beidou short message communication; Battery ZCV curve modeling; Packbits Decompression algorithm.

1. Introduction

China's vast territory, complex landscape, a wide variety of wild animals, with a variety of rare species. At the same time, environmental changes and numerous human factors, resulting in the extinction of many species, research and protection of wild animals has become inevitable[1].

Beidou, China's own global positioning system, has been widely used in transportation, agriculture and disaster relief, but its application in locating and tracking wildlife is still in the exploratory stage. GPS is the earliest and most mature global positioning system, and its technology has been widely used in wildlife location and tracking research. However, it is difficult for GPS terminals to recover data in the absence of mobile network signals. Although the beidou navigation system in China has gained some research results, its application in wildlife tracking still lags behind that of foreign countries.

Beidou is a global positioning system with active and passive positioning, independently developed by China. This is unique to Beidou, which has a great advantage over GPS. When tracking wildlife, the accuracy of location and the success of data reception determine the effectiveness of a wildlife tracking terminal[2-3].In the past, GPS system used mobile signal, radio wave and terminal shedding to recover data, resulting in poor mobile signal environment data can not be timely recovered and the observation of the same animal is limited. The existing Beidou locator has some problems, such as limited word length of short message, poor

interaction between human and animal terminal, and information can not be sent according to the needs of researchers. In order to solve the problems such as limited environment of data recovery of GPS positioning terminals, less data transmission per unit time of Beidou positioning terminals, poor interactivity, and failure to send data according to the demands of researchers, a wild animal positioning and tracking terminal based on Beidou short message was designed.

2. General design of system

After market research and background analysis, the wild animal positioning and tracking terminal based on Beidou is designed to provide timely feedback to the App for a long time without being restricted by mobile signals. It will be introduced from the following aspects:

The terminal can receive the App to obtain real-time location information. When the storage capacity of the terminal reaches the maximum value in a unit time, the terminal compresses the data and sends the data to the App through short messages. When the terminal receives the command sent by App, it obtains real-time location information and sends it to App with short message communication function.

The App receives the data, decompresses and analyzes the data, and displays the data in the form of charts on the App interface. The researcher selects the specified ID to send instructions through the App, and the terminal feeds back the real-time location.

3. Terminal design ideas and implementation principle

3.1. Terminal design idea

The terminal can send data in the following two situations:

Researchers send real-time position requests through App. Beidou satellite transmits information as an intermediate medium, and the terminal sends real-time position after receiving the request.

The terminal automatically sends data. To ensure that the number of sent short packets reaches the maximum value, the TERMINAL determines whether the number of sent short packets reaches the maximum value. When the terminal storage data reaches the maximum, Packbits algorithm[4] is used to compress the stored data. After data compression is complete, compressed data is sent through the Beidou short message technology.

Terminal design flow chart is shown in Figure 3.1:

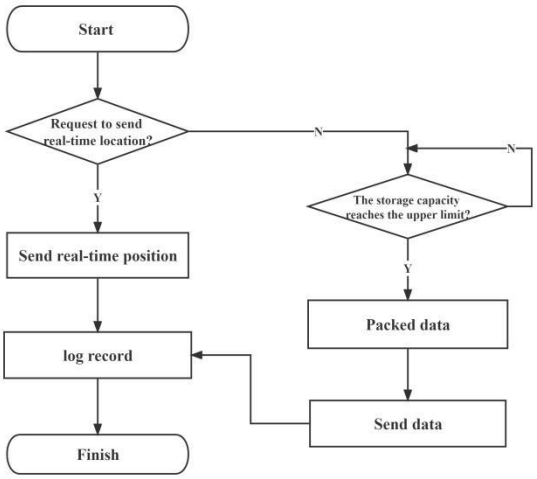

Figure 3.1 Terminal Design Flowchart

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3.2. Design content of terminal device

(1) Terminal hardware system

The device is mainly composed of UM220-III Beidou module, power module, mobile phone, memory chip, AT89S52 microcontroller, signal receiver and other hardware. Figure 2.2 and 2.3 show the physical pictures of relevant hardware:

Figure 3.2 Um220-III Actual beidou module

Figure 3.3 AT89S52 MCU physical

Beidou short message communication technology

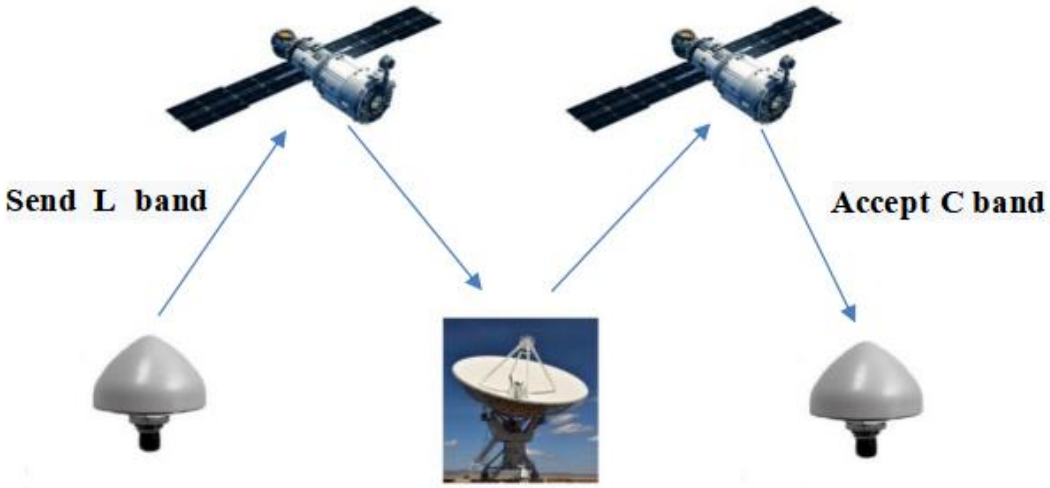

Figure 3.4 Flowchart of Beidou short message communication

Beidou Short message Communication technology[5] is based on the first-generation Beidou satellite, which can send and receive short messages. After a short message is sent, the receiver can obtain the location information of the sender. Beidou short message function is the embodiment of the bidirectional communication function of Beidou. The bidirectional communication function of Beidou is that users can send short messages to the system through satellites, and the system can also send messages to users through short messages. Information transmission does not need to go through the mobile base station and is not affected by mobile signals. It enables researchers to study wildlife from a distance in no man's land.

Figure 3.4 is the Flow chart of Beidou short message communication:

Acquisition of location information

The terminal uses The Beidou receiver module UM220-III/3-N introduced by Maihong Technology, and obtains the current longitude and latitude, date,
time and other information in the Beidou module through the RS-232 serial port and Unicore data protocol standard[6]. The terminal sends the information to the App in the form of short messages.

(2) Packbits Indicates the number decompression algorithm

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The Packbits algorithm is used to compress and shorten packet data,maximizing the amount of data that can be sent in a unit time. When the storage capacity of the terminal reaches the maximum value, the data is compressed using the Packbits algorithm and sent to the App. After receiving the data, the App uses the Packbits algorithm to decompress the compressed data. It reduces the frequency of sending short messages in unit time and reduces power loss, thus prolonging the service life of terminals and improving the accuracy of data.

The Packbits algorithm divides data into header and data parts. Duplicate data is recorded when repeated data occurs through a round-robin search of the data. At the end of the loop, the total number of occurrences and positions of characters are obtained. Store the total number and location of occurrences in the header section. Achieve data compression purposes. Packbits restores compressed data by reading the total number and position of characters in the header.

header	data parts

Figure 3.5 Data structure of the Packbits algorithm

(5) Automatic alarm of low battery

In wildlife research, monitoring the same animal over a long period of time and minimizing harm to the animal is what researchers seek. In order to achieve this pursuit, the terminal uses ADC (analog to digital converter) to detect terminal battery voltage and resistance value and convert it into digital signals. AT89S52 microcontroller in the terminal performs the pre-written program to calculate battery power by comparing the battery ZCV curve modeling method to generate the relevant battery parameter table. If the battery is too low, the terminal automatically sends an alert message to the App to remind the researcher to change the battery. Previous tracking wildlife terminals recovered data by automatically shedding batteries when they ran out. We add this function to facilitate the device to be used repeatedly.

Table 2.1 is the battery parameters table in the battery ZCV curve modeling method and the ADC analog digital converter detection terminal battery voltage circuit diagram parameter table Related notes: Open circuit voltage (OCV), load voltage (CV), battery capacity (mAh), internal resistance (R), percentage of battery capacity (DOD) .

Table 2.1 Battery Parameter Data

OCV	CV	mAh	R(battery)	DOD
4192			0.0783	0
4173.1	4141.8	26.8	0.0783	2
4155.8	4124.1	53.6	0.0792	3
4139.3	4107.1	80.4	0.0805	5
4123.8	4091.6	107.2	0.0805	6
4108.3	4075.8	134	0.0813	8
4093.8	4061.2	160.8	0.0815	9
4079.2	4046	187.6	0.0830	11
4065.2	4032.1	214.4	0.0827	12
4051.6	4017.8	241.2	0.0845	14
4038.3	4004.5	268	0.0845	16
4025.6	3990.8	294.8	0.0870	17

4012.8	3978.4	321.6	0.0860	19
4000.8	3965.7	348.4	0.0878	20
3989.3	3953.6	375.2	0.0893	22
3978.4	3941.9	402	0.0913	23
3967.3	3930.4	428.8	0.0923	25
3956.4	3919.2	455.6	0.0930	27
3946.8	3908.4	482.4	0.0960	28
3936.9	3898.1	509.2	0.0970	30
3927.3	3887.9	536	0.0985	31
3918.6	3877.7	562.8	0.1023	33

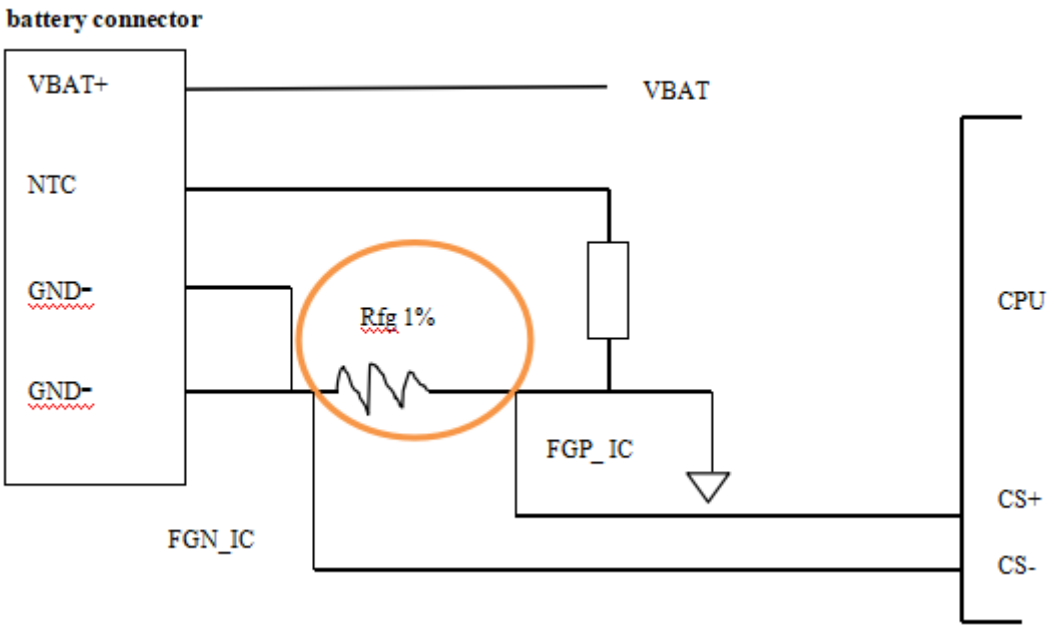

Figure 3.6 Battery circuit diagram

(6) Send real-time location on time

Because the current animal location terminal can only send location information periodically, it has a relatively large limitation. For example, in 2007, when giant panda Xiang Xiang was released into the wild, the radio signal of the terminal was weak and then disappeared. Researchers finally found the dead panda more than a month later. When the endangered Tibetan antelope migrates, its range of activity increases greatly, and the accuracy of location information sent regularly will be greatly reduced. In order to solve the problem that researchers cannot immediately know the location information when the terminal occurs, the location data is not accurate when the animals are migrating, and the limitations of real-time monitoring of wild animals when they are in a special period, such as migration, breeding, courtship, etc. This terminal design puts forward the function of sending real-time position on demand. When researchers need to know the current location of animals, they can send instructions to the terminal through the App. After receiving the instructions, the terminal can obtain real-time location, time and other information through Beidou satellite, and then edit the information into short messages and send them to the App. Through this function, the state of the animal can be detected in real time after returning to nature.

(7) Related App interfaces

In order for researchers to obtain various situations of wild animals more intuitively, and to study and protect wild animals more conveniently and efficiently, a relatively intelligent App is designed. The main functions of the App include real-time positioning, low battery reminder, data analysis, etc. Real-time positioning is based on the needs of researchers in different wildlife situations. The low battery warning is designed to observe the same animal for a long time and realize terminal recycling. Data analysis is intelligent analysis based on batch data sent from terminals, which facilitates researchers to monitor animal conditions. Part of the App interface is shown in Figure 2.7 and 2.8:

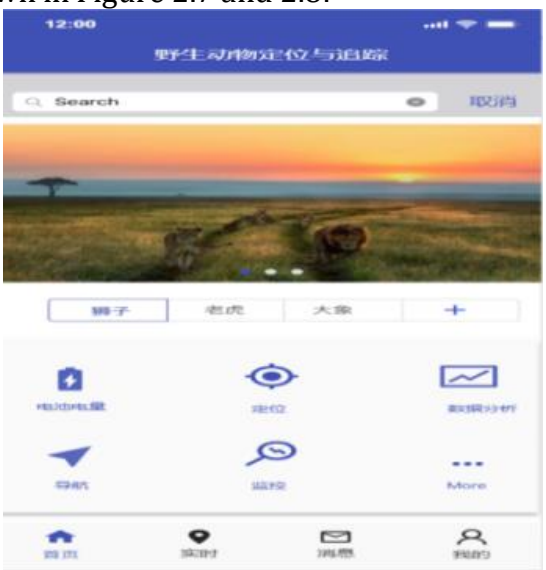

Figure 3.7 App main interface

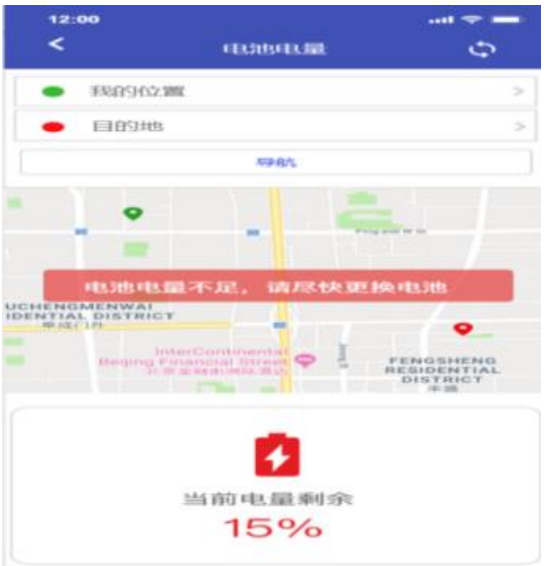

Figure 3.8 Battery reminder interface

4. Conclusion

The content of wildlife positioning and tracking terminal in this paper includes the following aspects: voltage parameter monitoring and electric quantity state assessment, data storage decompression, beidou module to obtain real-time position, Beidou short message data transmission, App and terminal interaction. Through the system software and hardware experimental tests, the experimental results show that: the design through the combination of software and hardware, to achieve battery monitoring, real-time position acquisition, decompression data, data transmission module. Among them, the establishment of this system greatly reduces the restrictions of environmental factors on researchers, and provides researchers with a large number of effective data, thus largely solving the problem of difficult research and protection of wild animals.

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