The Structure Design and Process Analysis for a Meteorological Monitoring Device Based on GIS

Ying Wang
Jiangxi Province Key Laboratory for Water Information Cooperative Sensing and Intelligent Processing, Nanchang Institute of Technology, Nanchang 330099, China
Email: wyzwzzzx@163.com

Abstract. A kind of meteorological monitoring device based on geographic information system (GIS) is studied in this paper, which belongs to the field of meteorological monitoring technology. The device include base, turntable, thermometer shelter, roof, bracket and processor. Specifically, batteries and turntables motors are fixed on the left side and middle on the top respectively, and motors are fixed on the middle of the bottom. The device adopts a technological design of modularity design to ensure its scientific, rigorous and flexible. Its configuration can not only meet functional requirements of meteorological monitoring and the overall performance, but also its scalability can be achieved by adjusting the hardware configuration or adding a server to achieve a smooth upgrade of the device and expanding the overall performance of the device.

1. Introduction
Meteorological information and observations carry out the weather association prevention, monitoring, prediction and meteorological services, which promotes the development of meteorological science and study. And the services are closely related to national economy and there is an ever-growing demand for the various walks of life [1]. Meteorological monitoring is an important part of the modern meteorological business system, and it is a major foundation for improving the capacity of public meteorological services and improving the accuracy of forecasting weather forecasts [2]. Therefore, it is especially important to collect meteorological data.

A meteorological monitoring device with self-check and self-recovering function refers to digitalization, output standardization and communication network features. Combine with this project design, it is devised for multi-factor micrometeorological monitoring device according to the local meteorological environment monitoring of transmission line corridor. It will collect various meteorological parameters and their changes, and transmit to the central monitoring and analysis system in real time through 3G/GPRS/CDMA network [3-5]. The system will send out warning messages in a variety of ways and prompt managers to pay attention to the alarm points or take necessary precautions when abnormal cases happened.

There are still some deficiency in the process of using the existing meteorological monitoring devices, such as not intelligence, remote monitoring and accommodation. In view of these problems, the device based on GIS is proposed, which can achieve more intelligent and adjustment when the users are using it [6].
2. The Device Design

2.1. Technical Proposal

The meteorological monitoring device includes bases, turntables, thermometer shelters, footstocks, trestle and processors. A battery, turntable and motor are fixed on the left side of the top, in the middle of the top and on the bottom centre of the base respectively, and motor output is connected to the turntable through the footstock. Whatmore, an electric telescopic rod with connecting plate on its top is fixedly installed on the top of the turntable, and a buzzer and thermometer shelter are fixed on the bottom right and on top of the connecting plate. And a buzzer and thermometer shelter are fixed on the bottom right and the top. It should be noted that a display screen and base are fixedly installed in the middle of the front surface and on the top of thermometer shelter. We will elaborate more on these details that a temperature and humidity sensor, rain sensor and intensity sensor & trestle are fixedly installed on top right, in the centre position and the right side of the footstock respectively.

2.2. Implementation of Performance

In order to achieve the above research purposes, characteristics and advantages of the monitoring device, and to enable a more obvious understanding, its specific embodiments will be described in detail below with reference to the accompanying drawings.

In figure 1, The top left side of the base 100 for carrying the turntable 200 and the trestle 500 is fixedly mounted battery 130 for offering the electric energy. And the turntable and a motor 210, whose output is connected through the footstock 400, are fixedly mounted in the middle of the top of the base. An electric telescopic rod 220 is fixedly mounted on the top of the turntable, which a connecting plate 230 with the buzzer 240 is fixedly installed on its top. In particular, the top of the base 100 is rotatably connected to the turntable, and the middle of the bottom is screwed to the motor. And the output end of the motor is connected to the turntable through the footstock. The top of the turntable is soldered with the electric telescopic rod, and the top of the turntable is soldered with the connecting plate (the bottom right side is screwed with the buzzer). The turntable and motor are respectively used to carry the electric telescopic rod 220 and provide power. To be clear: the rod 220 is used to carry the connecting plate and adjust its height, and the plate is used to carry the thermometer shelter 300 and the buzzer, which can be used as an alarm. The thermometer shelter is fixedly arranged on the top of the plate, and there is the display screen 310 (for displaying data) on its front surface. Specifically, the thermometer shelter for carrying a processor 600 is welded to the top of the plate. And the screen is screwed to the front surface of the thermometer shelter. There is the footstock on the top of the thermometer shelter, and the temperature and humidity sensor 410, rain sensor 420 and intensity sensor 430 with welded on intensity sensor for loading detection device are fixedly mounted on the top left side, in the middle and on the right side respectively.

More specifically, the footstock 400 with connected together by temperature and humidity sensor and rain sensor is welded on the top of the thermometer shelter as shown in figure 2. The sensor 410 (Specifications: COS-03), 420 (Specifications: FM-TL) and 430 (Specifications: RS-GZ-DY-2) are used to detect air temperature and humidity, the amount of rainfall and strength of illumination respectively. A trestle 500 and wind bag 510 are respectively fixedly mounted on the top right side and the surface of the base 100, and the wind sensor 520 (Specifications: PHWS-2) for detecting wind speed and direction is fixedly installed on the top of the trestle. Specifically, the trestle for carrying wind speed and direction sensor 520 is welded to the right side of the top of the base, the wind bag for detecting wind direction is bonded to the top of the side wall of the trestle, the sensor 520 is screwed to the top of the trestle.

Furthermore, the thermometer shelter is bonded with the processor, and the electrical output is connected to the signal sending module 610 and a remote terminal 620. And the electrical input of the processor is coupled to the sensor 410, 420, 430, 520, the buzzer, the motor and display screen 310. For the realization of functions, the processor 600 (Specifications: RS45), the module (Specifications: FN1991) and the remote terminal are respectively used for receiving and processing circuit signals,
transmitting signals and remotely monitoring weather.

Figure 3 shows, in the process of using the meteorological monitoring device based on GIS, the meteorological detection is realized by the thermometer shelter 300, the 410, 420, 430, 520 and 430; comprehensive application of the processor 600, motor 210, turntable 200 and rod 220 realizes convenient automatic adjustment [7]; and remote monitoring via the processor 600, module 610 and terminal 620.

Figure 1. The structural diagram of the meteorological monitoring device.

Figure 2. The side structure view of the thermometer shelter.
3. Experimental Verification

In order to verify whether the remote monitoring function of the device meets the requirements, we conducted experiments in laboratory.

(1) When the ambient simulation temperature reaches 40°, the display screen 310 show 40°. The data is transmitted to the remote terminal 620 via the processor 600 and the signal sending module 610 through the temperature and humidity sensor 410.

(2) When the simulated rainfall reaches 200 mm, the display screen 310 show 200 mm. The data is transmitted to the remote terminal 620 via the processor 600 and the signal sending module 610 through the rain sensor 420.

(3) When the illumination intensity of the incandescent lamp is 100 lx, the display screen 310 show 100 lx. The data is transmitted to the remote terminal 620 via the processor 600 and the signal sending module 610 through the intensity sensor 430.

(4) When the simulated wind speed is 11 m/s (strong wind) and the wind direction is NW, the display screen 310 show 11 m/s and 315°. The data is transmitted to the remote terminal 620 via the processor 600 and the signal sending module 610 through the temperature and wind sensor 520.

The above verification results show that the device fully meets the requirements of functional design. But we need to say that, the numerical values of temperature, rainfall, illumination and wind speed in the design should be understood to mean that each of their two endpoints and any one of the two endpoints can be selected; for instance, temperature range is -30°~50°.

4. Conclusion

According to the using environment and function requirements of the meteorological monitoring device, using GIS for the meteorological monitoring device for structural design.

In order to fully understand the design and process of the meteorological monitoring device, a lot of specific details are explained in the description. For demonstration purposes, the sectional view of the device structure is not partially enlarged according to the general proportion, and the schematic diagrams are only examples, which should not limit the scope of protection of the present invention herein. In addition, the actual production should include 3D dimensions of length, width and depth [7].

The device adopts a technological design of modularity design to ensure its scientific, rigorous and flexible based on GIS [8, 9]. And it provides a good interface environment, ensures multiple data communication in homogeneous and heterogeneous environments, and can flexibly access various peripheral systems with different software and hardware environments, improving the interconnection capability between the system and other devices, so that the system has very strong accessibility [10].

The device can flexibly add or modify functional modules without affecting the original services according to the needs of service expansion, so that the system has good function scalability. On the
other hand, the configuration of the device can not only meet functional requirements of meteorological monitoring and the overall performance, but also its scalability can be achieved by adjusting the hardware configuration or adding a server to achieve a smooth upgrade of the device and expanding the overall performance of the device. Furthermore, it can select and flexibly configure the device according to the needs of the user and the function, so that the resources can be fully utilized.

Acknowledgments
This work was supported by The Key Research and Development Project of Jiangxi Province of China (20161BBG70055).

References
[1] Rosengaus M, Collado J and Ortega E 1994 Int. J. Water Resour. D 10 313
[2] Bryukhan F F, Vinogradov A Y and Lavrusevich A A 2015 Atom. Energy 118 365
[3] Gaffin S R, Khanbilvardi R and Rosenzweig C 2009 Sensors 9 2647
[4] Rosiek S and Batilles F J 2008 A Energ. Convers. Manage. 49 3746
[5] Huang J, Zhou L M, Zhang F M and Hu Z H 2019 Environ. Monit. Assess. 191 276
[6] Liu Z H 2017 J. Nanchang I. Technol. 36 75
[7] Ren G F, Zhang C R and Zhang S S 2014 Adv. Mater. Res. 905 565
[8] Li S D, Bai Y H, Jiang Y, Wang Z H, Wei W H, Li X and Liu L N 2017 J. Earth Sci. Environ. 39 286
[9] Lara S, Susanna T, Alessio D L, Cioci D, Monaco F, Polci A, Orsini M, Calistri P and Conte A 2018 Plos One 13 e0196429
[10] Wilhelmi O V and Brunskill J C 2003 B. Am. Meteorol. Soc. 84 1409