# Newsletter No.21

# Intelligent cowshed management

10/22/2022

Control temperature and humidity

Control illumination

Control the concentration of harmful gas

The cowshed environment monitoring system includes: terminal sensor, cowshed environment data collector, wireless transmission module, cowshed intelligent environment monitoring platform, and intelligent remote control module.

The terminal sensor collects the temperature, humidity, light, wind speed and other basic parameters of the cowshed, as well as the parameters of $CO_2$, $H_2S$, $NH_3$ and other harmful gases, so as to master the overall environment of the cowshed.

The cowshed environment data collector collects and optimizes various sensor data in real time through the industrial field bus for the platform's analysis or real-time control of cowshed equipment.

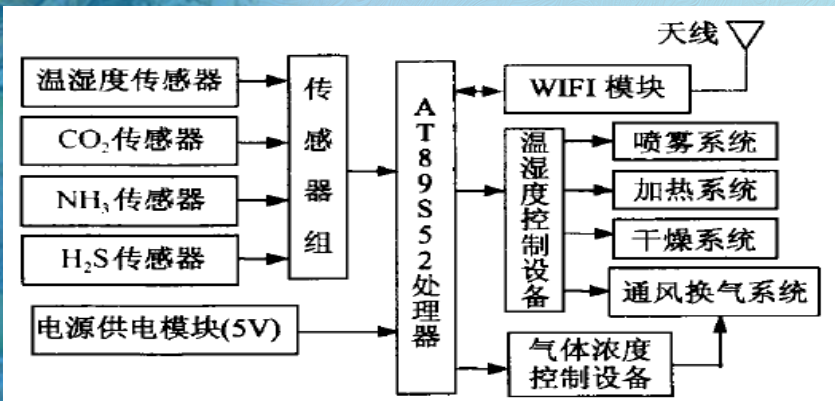
The wireless transmission module adopts LORA ad hoc network wireless transmission technology, which can report the information of each collector node to LORA concentrator in real time, and the concentrator transmits the platform data through 4G or Ethernet.

The intelligent environment monitoring platform of cowshed can build a field data cloud storage and remote monitoring system to save, analyze and process historical data and provide analysis basis for breeding environment parameter evaluation.

The intelligent remote control module executes the operation of equipment including axial flow fan, hot air fan, spray cooling equipment, sun shade, electric window, etc. through the control command issued by the platform to achieve appropriate environmental parameters.

The temperature and humidity are the basic elements of the cowshed environment. The AHT21 temperature and humidity module with high accuracy, low delay, and low power consumption and the standard IIC communication interface are used. It is a temperature and humidity composite sensor with calibrated digital signal output, which has the advantages of excellent quality, rapid response, strong anti-interference ability, and high cost performance. It can be used in the most demanding environment. The wind speed sensor adopts ultrasonic wind speed sensor. The ultrasonic wind speed sensor mainly uses the ultrasonic time difference method to measure the wind speed. It has the advantages of convenient installation and accurate measurement, and can be flexibly used in many fields.

The $NH_3$ and $H_2S$ sensors adopt electrochemical sensor probes, which have linear output, low power consumption requirements and good resolution. Their measurement repeatability and accuracy are also very good. The excellent signal acquisition circuit is adopted, and the temperature compensation processing is done. The $CO_2$ sensor adopts the infrared NDIR absorption monitoring technology, selects the absorption characteristics based on the near-infrared spectra of different gas molecules, and uses the relationship between gas concentration and absorption intensity (Lambert Beer law) to identify gas components. It has the characteristics of high accuracy, long life, anti poisoning, low maintenance cost, etc.



The cowshed environment data collector uses the industrial MCU as the main chip, and has a variety of data acquisition interfaces. It can collect 4-20ma, 0-5V and other analog signals, as well as RS485/RS232 and other digital industrial bus signals. It has its own LCD display, self scanning sensor, voice alarm, and built-in LORA node module. The collected data can be uploaded at the first time. The wireless transmission module adopts LORA collector, which can connect multiple cowshed environment acquisition nodes through an ad hoc network, with low power consumption, long-distance transmission, 4G/Ethernet transmission, and can upload the information uploaded by nodes to the platform. The intelligent remote control module controls various equipment in the cowshed through strategy, and each equipment not only affects the only environmental factor. During temperature control, if the detection temperature is higher than the set value, the cowshed intelligent environment detection system will send corresponding commands to control the axial flow fan and spray cooling equipment, but this will inevitably affect the environmental humidity. For the above situations, priority shall be set according to the different importance of environmental factors, i.e. temperature>humidity>illumination, etc. The corresponding level control program is designed according to the priority relationship.

Tab. 1 Records of 12h cowshed environment parameter

| 时刻 | 温度 /℃ | 相对湿度 /(%RH) | $CO_2$ /(mg·m$^{-3}$) | $NH_3$ /(mg·m$^{-3}$) | $H_2S$ /(mg·m$^{-3}$) |
|---|---|---|---|---|---|
| 09:00 | 17.3 | 53.4 | 570.63 | 4.37 | 1.51 |
| 10:30 | 16.6 | 51.6 | 600.25 | 4.62 | 1.43 |
| 12:00 | 17.0 | 47.2 | 632.47 | 5.21 | 1.62 |
| 13:30 | 17.5 | 53.0 | 686.35 | 6.06 | 1.67 |
| 15:00 | 17.2 | 50.1 | 581.03 | 5.83 | 1.40 |
| 16:30 | 16.9 | 49.4 | 619.60 | 4.70 | 1.05 |
| 18:00 | 16.5 | 47.8 | 673.47 | 4.76 | 1.15 |
| 19:30 | 16.3 | 49.3 | 689.20 | 5.61 | 1.36 |
| 21:00 | 16.8 | 55.6 | 613.06 | 4.38 | 1.53 |





Intelligent cowshed management system is mainly used in large-scale operation and management of the ranch cowshed, and ranch operators can effectively improve the efficiency and reduce operating costs. The system consists of upper management platform software, transmission equipment, terminal controller and execute components, forming an efficient management system, which is easy to use and can be accessed by remote control. The application of the system is able to create the best environment for the cows, and increase milk production to a large extent.