

Design of an intelligent livestock transport vehicle to improve livestock welfare

Lijuan Zhang^a, Huijiang Chen^b

Yili Vocational and Technical College, Yining 835000, Xinjiang, China

^a 18702229870@163.com, ^b 1007170150@qq.com

Abstract. Aiming at the problems such as poor transport environment and physical stress caused by harsh environment during long-distance transport of livestock, an intelligent livestock transport vehicle was designed to improve the welfare of livestock transport. The sensor installed in the carriage of the transport vehicle enables the on-board personnel to monitor the environment of the carriage in real time. Through humidifier, dehumidifier, refrigerator, oxygen generator to timely control the environment of the carriage. The intelligent transport vehicle improves the welfare of livestock, ensures the environmental protection and convenience in the transportation process, and improves the intelligent degree of livestock transport vehicles.

Key words: intelligent livestock transport vehicle; Livestock welfare; Internet of Things.

1. Design background of intelligent livestock transport vehicle

At the current stage, due to the changes in the market supply and demand relationship of the breeding industry, the demand for cross-regional transport livestock is also increasing, and slaughtering, off-site fattening, and the introduction of breeding animals are the main reasons for livestock transport. It is estimated that around 60 billion food animals are raised worldwide each year, most of which are transported to the slaughterhouse. It is a typical pattern and production mode of beef cattle industry in China that cattle are fattened in different places. The consumption habits, industrial pattern and regional advantages of different places lead to the long-term existence of the pattern and production mode of beef cattle industry and production mode that cattle are fattened in different places, which makes beef cattle transportation become the main body of large animal transportation in China. Due to the regional differences of breeding level and breeding scale in China, the introduction of breeding animals in different places must also be carried out by transportation [1, 2].

However, livestock in the long distance transportation process, susceptible to environmental factors to appear stress syndrome, resulting in mental depression or excitement, fever, fatigue, weakness, coma and even death, if not controlled, will bring greater economic losses to farmers or purchasers. Therefore, how to effectively monitor and control the changes of the environment in the carriage during livestock transportation has become a key issue in livestock living logistics.

At present, domestic livestock transport vehicles are mainly fence transport vehicles, mostly simple modifications for trucks, with the development of The Times, the existing supporting facilities and functions can not meet the needs of livestock transport. Domestic companies have carried out research and development work to adapt to different functions of livestock and poultry transport vehicles, making up for the lack of some domestic livestock and poultry transport vehicles, but the price is expensive. Combined with the actual transportation of domestic animals in our country, it is imperative to develop intelligent livestock transport vehicles that are compatible with the development of the Internet of Things [3, 4].

2. Structure design of intelligent livestock transport vehicle

In order to improve the welfare of livestock transportation, the design ideas of this vehicle are as follows:

2.1 Transport vehicle structure design ideas

One side of the compartment is fitted with a door with a symmetrical arrangement through a hinge hinge. Temperature sensors, humidity sensors, ultrasonic oxygen sensors and carbon dioxide sensors are fixed on the inner wall of the top of the carriage and connected to the same controller. A refrigerator, a humidifier and a dehumidifier are fixed inside the top of the car and are connected to the controller through a wire. On the inside of the top of the car, a surveillance camera is installed and connected to the controller through a wire. An oxygen generator is fixed on the inner wall of one side of the carriage and is connected to the controller through a wire.

2.2 Structure design of transport carriage

Livestock transport vehicle is provided with a through hole on the top of the car, and the inner wall of the through hole is fixed connected with a water pipe, the inside of the car is fixed with a water collection pipe, the bottom of the water collection pipe is fixed connected with an equidistant distribution of sprinkler heads, the water supply pipe is connected with the water collection pipe, the inside of the car is fixed with a limited position plate, the inside of the car is sliding with a cleaning scraper, The outer wall of one side of the clean scraper is fixed with a push and pull handle of a door structure, a limited slot is arranged in the middle of the bottom of the limit plate, the top of the clean scraper is sliding on the inner wall of the limit slot, and the two sides of the clean scraper are provided with a symmetrical movable groove, the inner wall of the two movable grooves are sliding and connected with a wedge plate, and the inner wall of the two movable grooves are fixed and connected with a compression spring. One end of the two compression springs is fixedly connected to the outer wall of one side of the two wedge-shaped slots, and the two clamping slots are symmetrically arranged on both sides of the limit plate, and the two clamping slots are communicated with the limit slots, and the two wedge-shaped slots are slid respectively on the inner wall of the two clamping slots [5,6], as shown in Figure 1,2,3,4 and5.

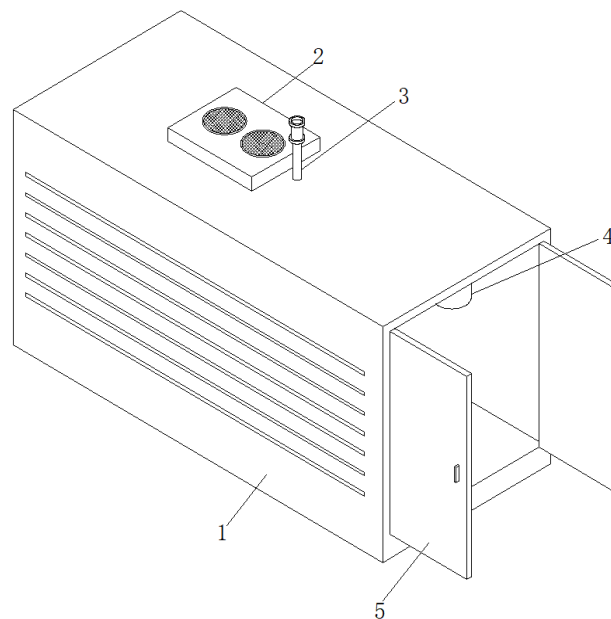


Figure 1. Schematic diagram of the overall structure of the carriage

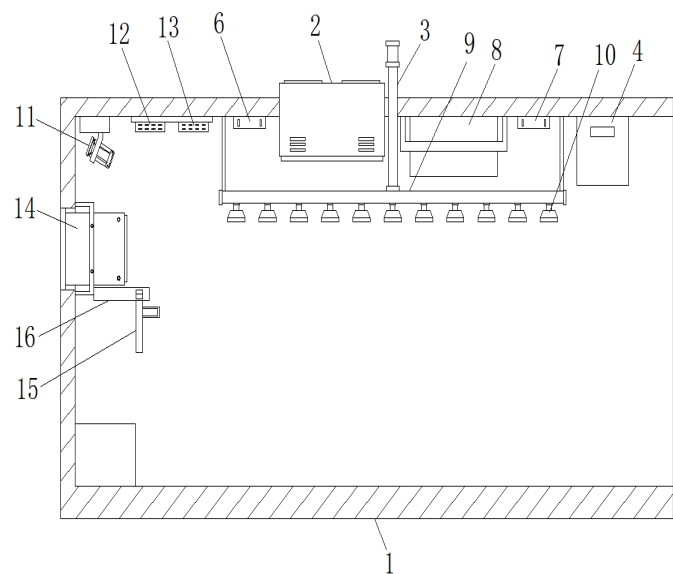


Figure 2. Schematic diagram of the side view section structure of the carriage

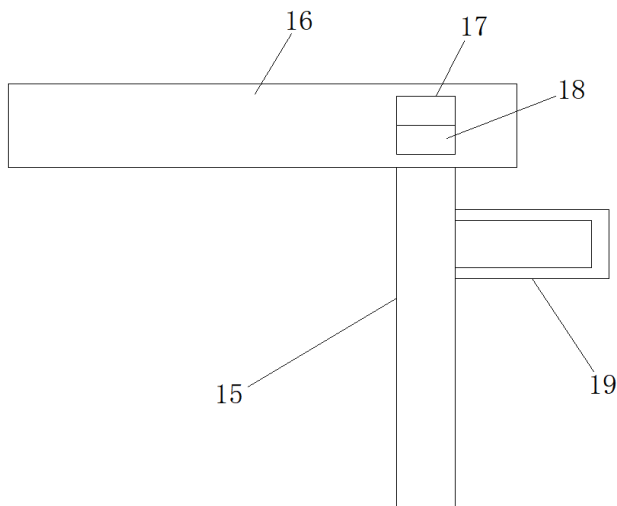


Figure 3. Side view structure diagram when the clean scraper is connected with the limit plate

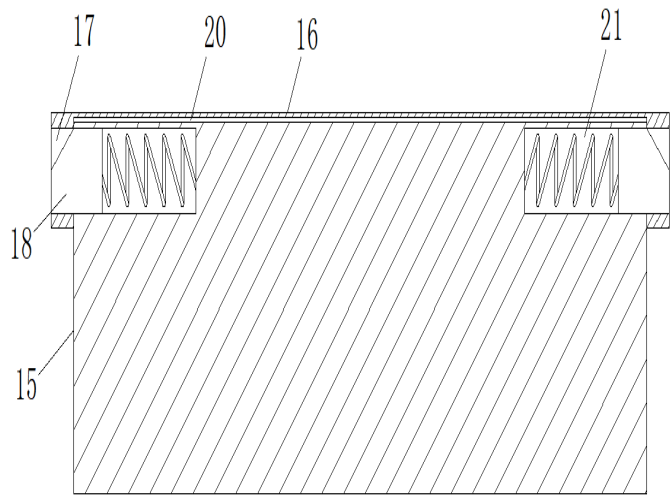


Figure 4. Schematic diagram of the main view section when the clean scraper is connected with the limit plate

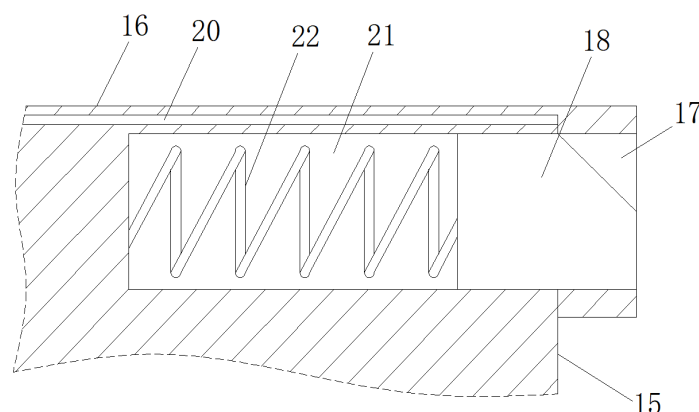


Figure 5. Schematic diagram of local main view section when the clean scraper is connected with the limit plate

1. Carriage; 2, refrigeration; 3, water pipe; 4, humidifier; 5, box door; 6, temperature sensor; 7, humidity sensor; 8, dehumidifier; 9. Water collection pipe; 10. Sprinkler head; 11. Surveillance cameras; 12, ultrasonic oxygen sensor; 13, carbon dioxide sensor; 14, oxygen generator; 15, clean scraper; 16, limit plate; 17, clamping slot; 18, wedge plate; 19, push and pull the handle; 20, limit slot; 21, active slot; 22. Compress the spring.

There is a through hole on the top of the carriage, and the inner wall of the through hole is fixed connected with a water supply pipe, the water collection pipe is fixed on the inside of the carriage, the water supply pipe is fixed connected with the water collection pipe at the bottom, the limited position plate is fixed on the inside of the carriage, the cleaning scraper is sliding on the inside of the carriage, and the push and pull handle of the door type structure is fixed on the outer wall of the clean scraper. A limited slot is arranged in the middle of the bottom of the limit plate, the top of the clean scraper sliding is arranged on the inner wall of the limit slot, the two sides of the clean scraper are provided with symmetrical grooves, the inner wall of the two active grooves are sliding connected with a wedge plate, the inner wall of the two active grooves are fixed connected with a compression spring, one end of the two compression springs are fixed connected to the outer wall of the two wedge plate. Both sides of the limit plate are provided with symmetric clamping slots, and the two clamping slots are connected with the limit slots. The two wedge plates are sliding and arranged on the inner wall of the two clamping slots respectively. When the clean water is gathered, the staff can enter the carriage and press the two wedge plates to remove the two wedge plates from the two clamping slots respectively. And the two wedge plates are moved to two active slots, and then the cleaning scraper is moved down to contact with the inner wall of the bottom of the car, pulling the push and pull the handle to move horizontally, you can remove the accumulated feces at the bottom of the car to the outside of the car, to achieve timely cleaning of the car, to avoid the bad smell in the car continues to spread to the surrounding air environment.

3. Intelligent equipment design of transport vehicles

In the specific implementation mode, a symmetrical door is installed on one side of the carriage through the hinge hinge, when the domestic animal is transported to the destination, the door is opened, and when the domestic animal comes out of the carriage, the water pipe is connected to the external water source through the pipe joint, and the clean water can be transported through the water pipe to the collection pipe, and sprayed into the carriage through the nozzle. The inner wall of the top of the car is fixed with a temperature sensor, humidity sensor, ultrasonic oxygen sensor and carbon dioxide sensor. The temperature sensor, humidity sensor, ultrasonic oxygen sensor and carbon dioxide sensor are connected with the same controller. The inside of the top of the car is fixed with a refrigerator, a humidifier and a dehumidifier. The refrigerator, humidifier and dehumidifier are all connected to the controller through a wire. The model of the controller is AQMD3620NS. The temperature sensor

installed on the inside of the top of the carriage can monitor the temperature inside the carriage. The cooler transmits the cold air to the compartment, so that the temperature in the compartment can be reduced, and the humidity sensor set can monitor the humidity in the compartment. When the humidity is higher than the monitoring humidity range, the signal is sent to the controller, and the dehumidifier is controlled by the controller to dehumidify the compartment. When the humidity is lower than the monitoring humidity range, the temperature is reduced. The humidifier is controlled by the controller to humidify the compartment, and the oxygen concentration and carbon dioxide concentration are monitored in real time by the ultrasonic oxygen sensor and carbon dioxide sensor. When the oxygen concentration is lower than the monitored concentration, the signal is sent to the controller, and the oxygen generator is controlled by the controller to work, and the generated oxygen can be transported to the compartment. The inside of the top of the car is installed with a surveillance camera, the surveillance camera is connected to the controller through the wire, the interior wall of the car is fixed with an oxygen generator, the oxygen generator is connected to the controller through the wire, through the monitoring camera set, the environment in the car can be recorded and displayed on the monitor in real time.

4. Transport vehicle environmental protection system design

When the livestock is transported to the destination, open the door, and when the livestock comes out of the carriage, the water pipe is connected to the external water source through the pipe joint, and the clean water can be transported to the collection pipe through the water pipe, and the nozzle is sprayed into the carriage, so that the bottom of the carriage has an appropriate amount of clean water, when the clean water is completed, The staff can enter the compartment and press the two wedge plates, remove the two wedge plates from the two clamping slots, and move the two wedge plates to the two active slots, and then move the clean scraper down to contact with the inner wall of the bottom of the compartment, pull the push and pull the handle to move horizontally, you can remove the accumulated feces at the bottom of the compartment to the outside of the compartment. To achieve timely cleaning of the carriage, to avoid the bad smell in the carriage continues to diffuse to the surrounding air environment.

5. Summary

This intelligent transport vehicle based on improving the welfare of livestock transport, through the Internet of Things technology to monitor and control the environment of the carriage, the transportation process visualization, controllability, maximize the welfare of livestock transport, providing a safer and more comfortable choice for livestock transport.

References

- [1] Zheng Anqi, Huang Kaining. Design and implementation of animal husbandry environment monitoring system based on Internet of Things [J]. Internet of Things Technology, 2022, 12(05):15-17+21.
- [2] HE P. Application of Internet of Things technology in animal husbandry [J]. Journal of Agricultural Engineering, 2019, 9(07):22-24. (in Chinese)
- [3] YUAN Haifang. Design of New Livestock Vehicle [D]. Southwest Jiaotong University, 2007.
- [4] Li X B. Design of intelligent pasture enclosure monitoring system based on Internet of Things [D]. Tianjin university of science and technology, 2022. DOI: 10.27359 /, dc nki. Gtqgu. 2022.000772.
- [5] Li Yaqi, Meng Xianjiu, Ren Jian et al. A kind of railway livestock carriage [P]. Shandong Province: CN217515158U, 2022-09-30.
- [6] JIN Kwang-soo. Air Supply device for transportation container for welfare and prevention of death during livestock Transportation [P]. South Korea: CN105934367B, 2018-05-18.