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Design of Intelligent Fresh Air System Based on STC89C52 Single Chip Microcomputer

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Abstract: The air quality and cockpit environment inside the car are more and more concerned by the majority of drivers and passengers. The intelligent fresh air system in the car relies on STC89C52 MCU which equipped with infrared PM2.5 dust sensor module, DHT11 temperature and humidity sensor and mq135 air quality sensor to realize the real-time detection of PM2.5, temperature, humidity and harmful gases in the car. And the system can call the corresponding actuator to improve the air quality in the car. It puts forward the recovery and reuse strategy of vehicle air conditioning condensate. After disinfection, the condensation water is used to humidify the air in the vehicle, cool and clean the radiator of the vehicle air conditioner. Finally, the purpose of intelligent purification of the air environment in the car is achieved.

key words: STC89C52 single chip microcomputer, Intelligent fresh air system, Design

1.Introduction

At present, China has formulated a number of policies and regulations on reducing environmental pollution. It also has issued a number of laws and regulations for automobile air conditioning which will produce a lot of greenhouse gases[1]. According to the survey, the on-board air conditioning systems of several pure electric vehicles at different prices in the current market share more or less the same characteristics. For example, the pure electric vehicle represented by Xiaopeng G3 with the price of RMB 100000-250000 is equipped with automatic air conditioning system and temperature zone control system. The pure electric vehicle represented by Weilai ES6 with price of 250000 yuan to 400000 yuan is equipped with automatic air conditioning system, temperature zone control system, on-board air purifier, PM2.5 filter and anion generator. The Tesla "Model Y" which sells for 770000 yuan is only equipped with a temperature zone control system, an on-board air purifier and a PM2.5 filter. It is understood that the air conditioning systems of the above-mentioned vehicles work independently and lack of integration strategy. There is no specific strategy for the recovery and treatment of vehicle air conditioning condensate. And there is no ideal and feasible scheme for the control of the humidity in the vehicle.

In view of the above problems, this paper proposes a vehicle intelligent fresh air system based on STC89C52 single chip microcomputer, which makes improvement and optimization strategy for the existing vehicle air conditioning equipment of pure electric vehicles, including adding integration and intelligent control strategy, and adding recycling scheme for the condensate of vehicle air conditioning and controlling strategy for the humidity in the vehicle[2]. It improves the user's riding experience ,saves the energy and reduces the emission.

2.Composition of intelligent fresh air system in vehicle

The structure block diagram of intelligent fresh air system in vehicle is shown in Figure 1. The system is mainly composed of environment information acquisition module, information processing module and execution module. The

whole system is powered by on-board power supply.

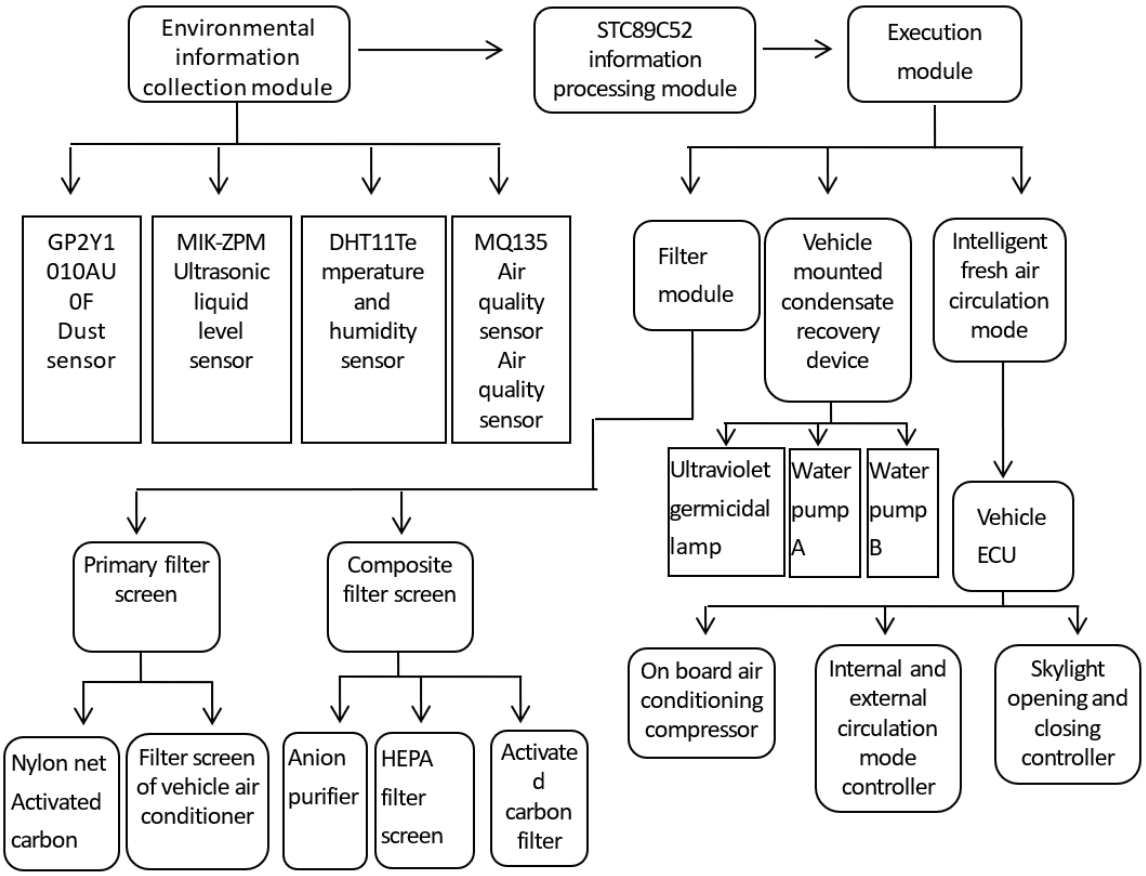

Figure 1 Structure diagram of intelligent fresh air system in vehicle

The environmental information acquisition module is composed of infrared PM2.5 dust sensor module, DHT11 temperature and humidity sensor and mq135 air quality sensor. The information processing module is composed of STC89C52 single chip microcomputer. The executive module is composed of filter module, air conditioning condensate recycling device, intelligent fresh air circulation mode and skylight ventilation system. The whole system is connected to the environment information acquisition module through STC89C52 MCU to achieve real-time monitoring of the air quality inside and outside the vehicle, and judge the air quality inside and outside the vehicle at this time. According to the specific value of "temperature in the vehicle " set by the user, the specific equipment in the execution module is called to meet the user's requirements. And the real-time monitoring data of the above sensors will also be used to judge whether the air quality in the vehicle meets the requirements set by the system. Compared with the control objective, the deviation between the two is calculated, and the deviation is gradually reduced and eliminated. The negative feedback regulation strategy is realized, and the control accuracy is improved, and the interference of other external factors to the environmental data in the input system is reduced, and the static accuracy of the system is improved effectively.

3. software design of the system

The control mode of the information processing module of the intelligent fresh air system in the vehicle can be summarized as "switching control of intelligent external circulation mode and internal circulation mode ", " regulation of water pump of condensate water recovery device" and " regulation of power of negative ion purifier ". The intelligent fresh air system in the vehicle will intelligently control the external circulation mode of the on-board air conditioner[3]. The "External circulation mode" means that the vehicle air conditioning system does not act on the air in the vehicle directly to make it flow. Instead, it opens the front and rear air inlet and exhaust channels. During the driving process

of the vehicle, the external air will be automatically inhaled into the vehicle because of the wind pressure.The “internal circulation mode” means that the front and rear air inlet and exhaust channels of the vehicle are closed, and the blower of the on-board air conditioning system blows the air in the motor car to make it flow in the vehicle. There is no gas exchanged with the air outside. The “external circulation mode” is enabled by default.

According to the data standard required by the system, the variable standard of air quality is defined as B. The data standard of “GP2Y1010AU0F”dust sensor is defined as C. The specific value of the desired air temperature in the vehicle is entered by the user. And after conversion, the standard value of the temperature sensor is given as a1 and the humidity sensor is given as a2. The error range of the defined data is 0.05, and the qualified data range is calculated by the internal program of the STC89C52 single chip microcomputer. That is to say, the fluctuation of 0.05 up and down for value of a1, a2, b, c is allowed.

After determining the detection range, the temperature data collected by DHT11 temperature and humidity sensor is recorded as A1 and the humidity data is recorded as A2. In the same way, the interior data monitored by MQ135 air quality sensor is recorded as B1, and the exterior air data is recorded as B2. The vehicle PM2.5 concentration data monitored by the GP2Y1010AU0F dust sensor is recorded as C1, and the vehicle PM2.5 concentration data is recorded as C2. Each sensor inputs data including A1, A2, B1, B2, C1, C2 into STC89C52 MCU through corresponding communication protocol.

3.1 Switching control of intelligent external circulation mode and internal circulation mode

As shown in the figure 2, the data A1 B1 B2 C2 is judged by the STC89C52 single chip computer.

3.1.1 When A1 fails to meet the requirements set by the user

It is judged that the temperature in the car is not up to standard[4]. At this time, STC89C52 MCU sends instructions to the vehicle ECU to keep the sunroof closed, and keep the existing cycle mode. The vehicle air conditioning compressor starts automatically to work, and it makes the temperature in the vehicle reach the value set by the user.

3.1.2 When the A1 meets the set requirements, the B2, C2 is judged.

The B2 is judged first. When the B2 is not within the range set by the system, the air state is determined to be “the air quality outside the vehicle is not up to standard”. The STC89C52 MCU sends instructions to the on-board ECU to automatically close the skylight and open the “internal circulation” mode, and temporarily shut down the operation of the on-board air conditioning compressor. After the air quality outside the vehicle meets the set requirements, the on-board ECU will receive the command to automatically start the “external circulation” mode and resume the original operation of the air conditioning compressor.

When B2 meets the requirements, the C2 is judged. When C2 is not within the range set by the system, it is judged that the air state is “the air quality in the vehicle is unqualified” and the above operation is performed.

3.1.3 The B1 shall be judged after the A1、B2、C2 has met the requirements.

If the B1 is not within the range set by the system, the air state is determined to be “the air quality in the vehicle is not up to standard”. The STC89C52 MCU sends instructions to the vehicle ECU to automatically open the skylight and “external circulation” mode, and temporarily close the operation of the vehicle air conditioning compressor, which can realize the rapid circulation of air inside and outside the vehicle. When the air quality in the vehicle meets the set requirements, the vehicle ECU will receive the command to automatically close the skylight and resume the original operation of the air conditioning compressor.

3.1.4 When A1, B1, B2and C2 are all within the set range

It is judged that the air state in the vehicle is “meet the user’s requirements”, and the existing system settings are maintained.

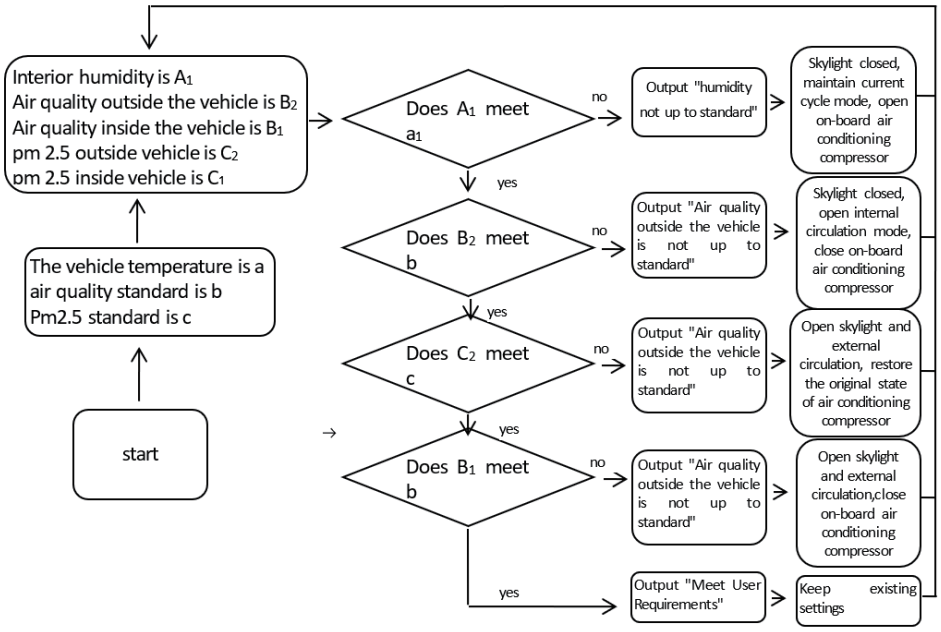

Figure 2 flow chart of internal and external circulation control

3.2 Control of condensate recovery device and in-vehicle humidification system

As shown in the figure3, the STC89C52 MCU receives the liquid level data “h” measured by MIK-ZPM ultrasonic liquid level sensor to determine the specific liquid level information[5]. When the liquid level belongs to the “normal working range”, the following control is carried out.

3.2.1 Cooling and cleaning the external heat sink of air conditioner.

The STC89C52 single chip microcomputer controls water pump A to pump water. After atomization, the nozzle sprays on the radiator of the air conditioner. It achieves the cooling and cleaning functions of the radiator and enhance the refrigeration effect.

3.2.2 Interior air humidity control module

When the vehicle skylight is closed, the STC89C52 MCU judges the humidity value A2 in the vehicle. When A2 is lower than the standard value of humidity sensor a2, the water pump B starts to work and humidifies the air in the vehicle after atomization. At the same time, the DHT11 temperature and humidity sensor will continue to collect and judge the humidity signal to realize the detection and feedback of the humidity in the vehicle[6].

3.3 power regulation of anion purifier

As shown in the figure4, when C2 is not in the range set by the system, the internal circulation mode is switched and the skylight is closed. Then the PM2.5 signal C1 in the vehicle is judged by the STC89C52 MCU.

3.3.1 When C1 is in the set range

It is judged that the air in the car is in the “PM2.5 standard” state, and the anion purifier operates at the set minimum power.

3.3.2 When C1 is not in the set range

It is judged that the air in the car is in the state of “PM2.5 not up to standard”. The STC89C52 MCU sends out the command to make the anion purifier reach the rated power and purify the air in the car.

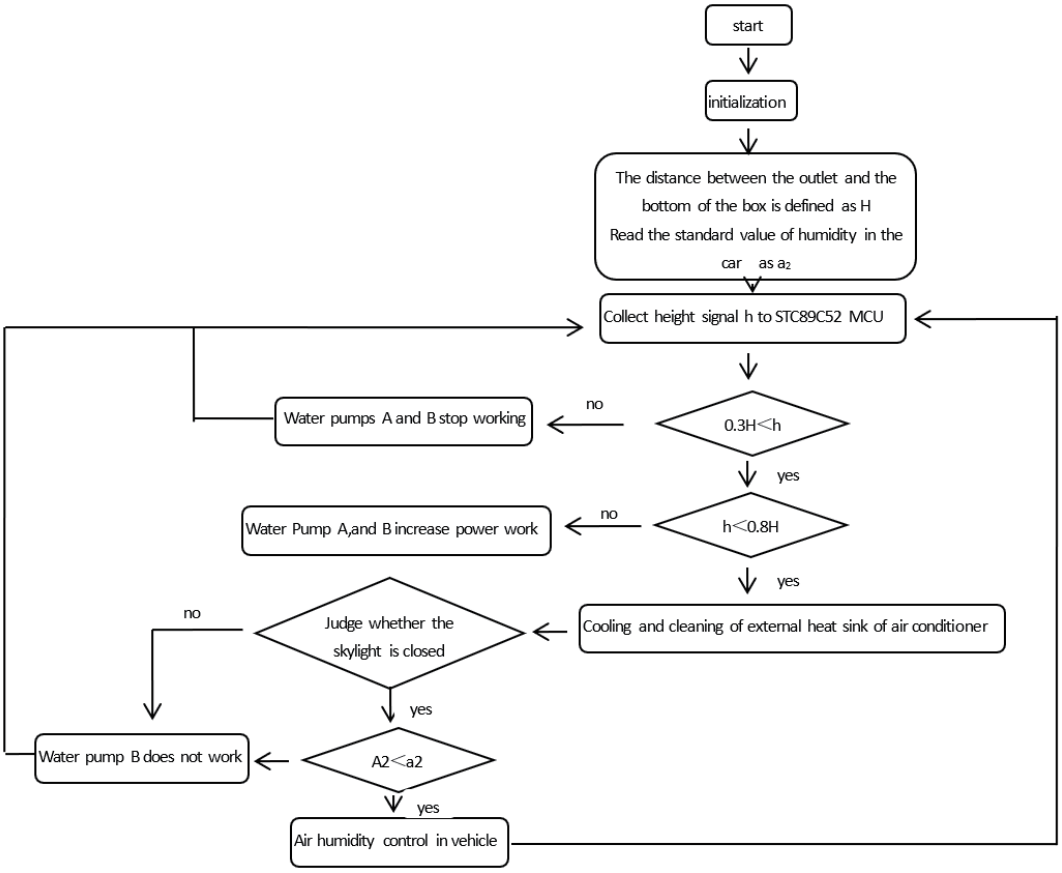

Figure 3 control flow chart of vehicle condensate reuse

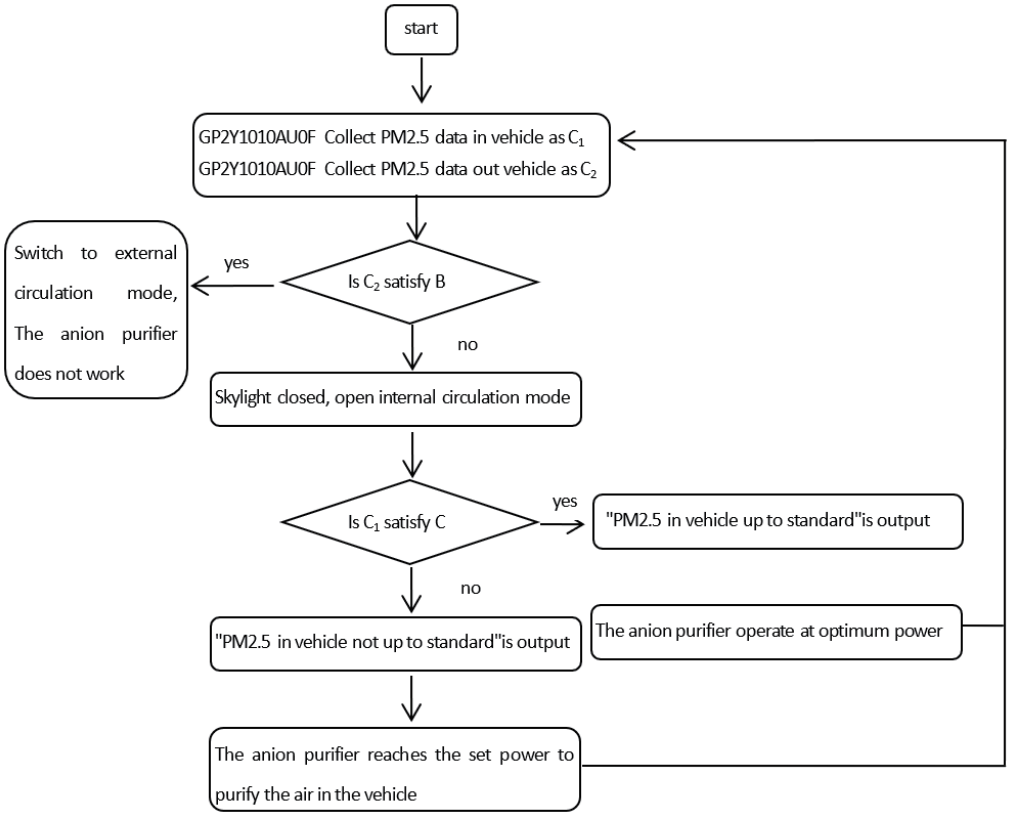

Figure 4 control flow chart of anion purifier

4. Conclude

This paper presents a design scheme of intelligent fresh air system based on STC89C52, which can real-time monitor the air indicators in the vehicle, and intelligently call the actuator to improve the air quality in the car. The paper also puts forward the recycling strategy and reuse scheme for the condensate of the car air conditioner, which realize the integrated control strategy basically.

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