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Design of In-car Accident Prevention System Based on Moving Average Filtering

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Abstract. The design of In-car accident prevention system based on moving average filtering implements environmental data collection through hardware circuits such as the main control chip, temperature sensor, carbon dioxide sensor and camera. The extracted information is mainly processed by moving average filtering to improve the accuracy of the data. Send the collected information to the cloud platform and mobile phone through the ESP8266WiFi module and GSM module. The system has the advantages of low cost, simple operation, strong practical value, and high economic value.

Keywords: STM32F103C8T6, Android, Cloud platform, GPS.

1. Introduction

The Internet of Things is an internetwork that connects things. Its connotation contains two aspects: first, the core and foundation of the Internet of Things is still the Internet, which is a network that extends and expands on the basis of the Internet; and second, its user end extends and expands to any object and makes Information exchange and communication[1]. With the development of the economy, the Internet of Things technology is also constantly developing. There are applications in many areas from manufacturing supply chain management to production process optimization and product equipment monitoring management, and with the continuous development of cloud technology, the application area of the Internet of Things is also expanding[2]. As one of the applications of the Internet of Things technology, the in-car accident prevention system plays a significant role in preventing dangers in the car[3].

In this paper, the car accident prevention system mainly includes control chip, sensor module, signal transceiver module, mobile app and other parts. Using the cloud to realize data remote interaction and remote monitoring. No manual operation, simple and convenient. The system structure is shown in the figure 1.

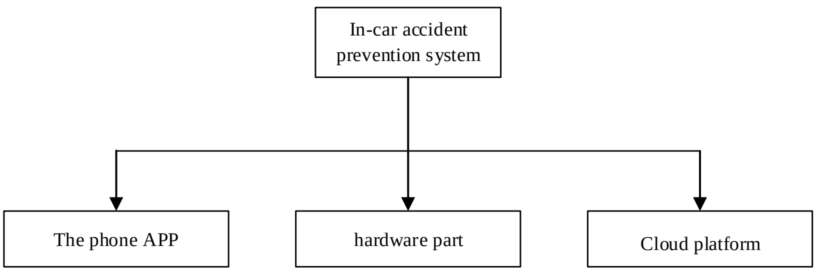

Fig. 1: System structure

2. System Implementation Principle

The anti-accident system studied in this paper can monitor in-car environment parameters and real-time situation functually, and send alarm signal to mobile phone client and network cloud platform when danger

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occurs, so as to avoid the occurrence of dangerous accidents.Its hardware structure diagram is shown in the figure 2.

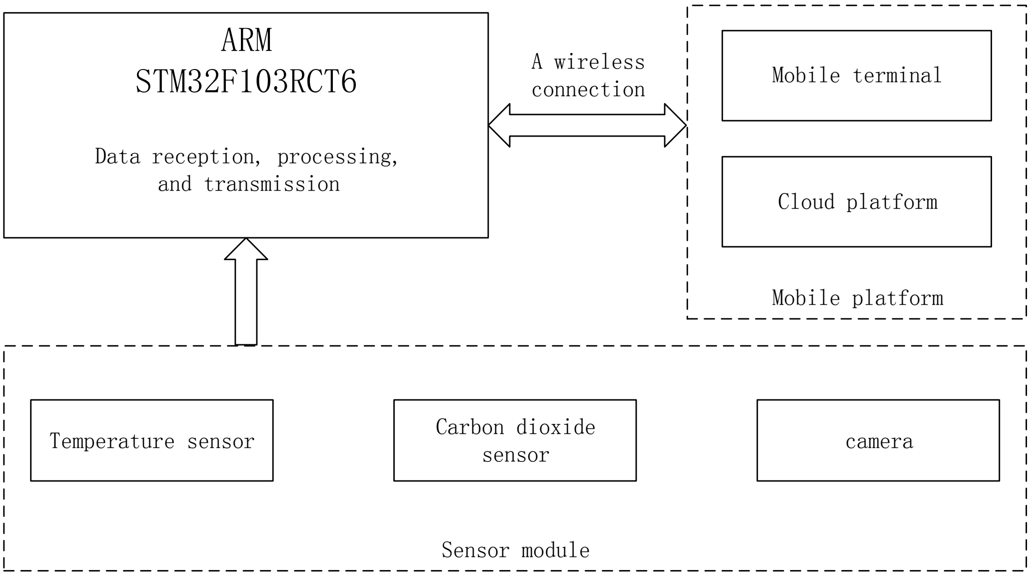

Fig. 2: Hardware structure

The system data processing is mainly implemented by a moving average filtering algorithm. The collected data is first extracted for wavelet denoising processing, and then processed by a moving average filtering algorithm. The data processing flowchart is shown in the figure 3.

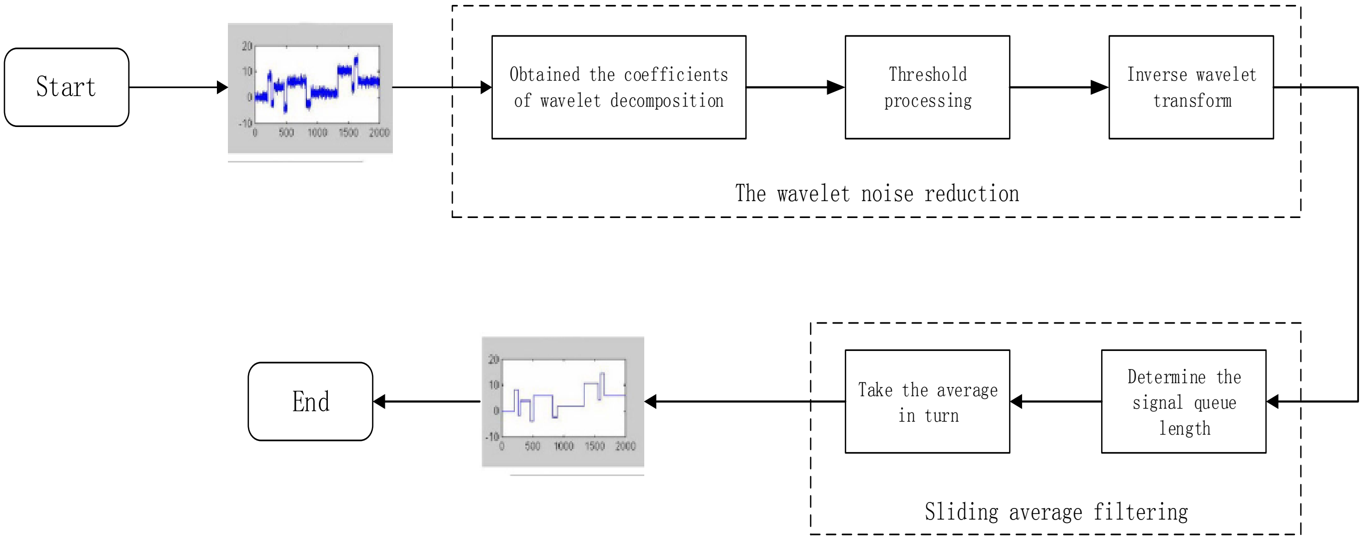

Fig. 3: Algorithm process

3. Hardware System Design

3.1. Core Chip

The chip used in this system is STM32F103C8T6 produced by STMicroelectronics. This is a microcontroller based on ARM Cortex-M core and STM32 series. The ROM capacity is 64KB. The single-chip microcomputer pin diagram is shown in the figure 4. The power-on reset circuit is connected to pin 7 and the chip is automatically reset at the moment of power-on. The clock circuit provides a beat for the circuit, and the input and output of the clock circuit are the fifth and sixth pins, respectively. Its low power consumption, low cost, and high performance make it widely used in the embedded field.

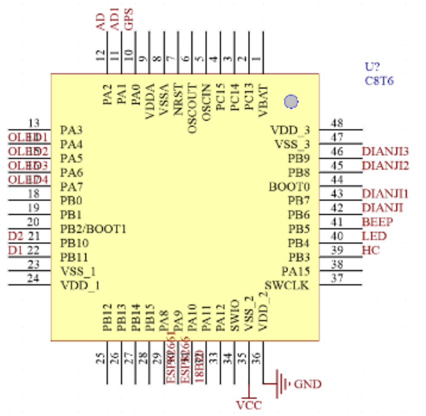

Fig. 4: Core chip

3.2. Temperature Sensor

In order to obtain accurate temperature data, the temperature sensor DS18B20 is selected for temperature data acquisition in this study, which is a relatively common digital temperature sensor, with the advantages of small size, convenient use, high accuracy (the accuracy can reach 0.625 ℃ at 12 bits), etc. The sensor adopts the digital transmission mode of "one line bus", which greatly improves the anti-interference of the system. The temperature signal in the car is transmitted to the processor through pin 2, and the collected data is compared with the threshold value to determine whether the temperature in the car is in a dangerous state. Schematic diagram of temperature sensor circuit is shown in the figure 5.

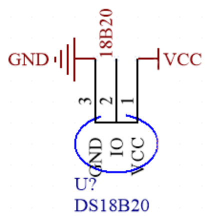

Fig. 5: Temperature sensor

3.3. Carbon Dioxide Sensor

The human body infrared sensor used in this system is hc-sr501. Generally, human body temperature is kept constant at about 37 degrees Celsius. At this temperature, human body will emit a specific infrared ray of about 10 nm. However, the infrared induction source usually adopts pyroelectric element, which will lose the charge balance when receiving the change of infrared radiation temperature of the human body, and release the charge outward, and the subsequent circuit can produce alarm signal after detection and processing. The human body infrared sensor selected by this system has the characteristics of low power consumption, good concealment and low price. The schematic diagram of infrared sensor circuit of human body is shown in the figure 6.

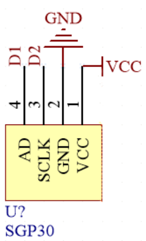

Fig. 6: Carbon dioxide sensor

4. System Software Design

4.1. Wavelet Denoising

In the process of collecting temperature and carbon dioxide data by the system, the signals collected due to various factors such as environmental influences always have noise. The presence of noise often masks the information that the signal itself is intended to display. Preprocessing, and the main step of preprocessing is noise reduction. A noisy model is shown below:

$$\mathrm{S(k)} = \mathrm{f(k)} + \varepsilon * e(\mathrm{k}) \;\; k = 0,1,2 \ldots n-1 \tag{1}$$

Among them, f(k) is the useful signal, S(k) is the noisy signal, e(k) is the noise, and ε is the standard deviation of the noise figure. The basic idea of wavelet denoising is that after wavelet transforming the signal, the wavelet coefficients generated by the signal contain important information of the signal. After wavelet decomposition of the signal, the wavelet coefficient is larger, the wavelet coefficient of the noise is smaller, and the wavelet coefficient of the noise is smaller The wavelet coefficient of the signal. By selecting an appropriate threshold, wavelet coefficients greater than the threshold are considered to be generated by the signal and should be retained. Those smaller than the threshold are considered to be generated by noise. Set to zero to achieve denoising. purpose. From a signalling perspective, wavelet denoising is a signal filtering problem. Although wavelet denoising can be regarded as low-pass filtering to a large extent, because it can successfully retain signal characteristics after denoising, it is superior to traditional low-pass filters in this regard[4]. It can be seen that wavelet denoising is actually a combination of feature extraction and low-pass filtering. The flowchart is shown in the figure 7.

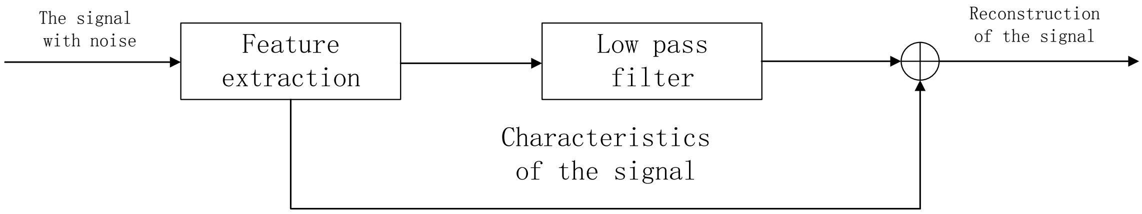

Fig. 7: Wavelet denoising flow chart

4.2. Sliding Average Filtering

Moving average filtering is to treat N consecutively obtained sampling values as a queue, and the length of the queue is fixed at N. Each time a new data is obtained, it is placed at the end of the team, and the original data of the first team is discarded. By averaging the data, new filtering results can be obtained. The calculation formula is shown below. Where m is a positive integer.

$$\mathrm{y(n)} = \frac{1}{2m+1} \sum_{k=n-m}^{n+m} x(n-k) \tag{2}$$

The algorithm code is implemented as follows:

```
char value_buff[N];
char i=0;
char filter()
{char count;
 int sum=0;
value_buff[i++]=get_data();
if(i==N) i=0;
for(count=0;count<N;count++) sum+=value_buff[count];
return (char)(sum/N);
}
```

5. Experiment and Analysis

This system uses the Internet of Things and single-chip microcomputer technology to compare the environmental data received by the sensor with the initial threshold to determine whether the situation in the car is dangerous. After a series of debugging experiments, the system successfully realized the safety protection function. When a danger occurs, the monitoring end in the car will issue an alarm and send a message to the mobile client, waiting for rescue. The mobile phone can release the alarm according to the situation, or send an alarm through the cloud platform, and send the vehicle location information to the police through the cloud platform for rescue. The actual equipment picture is shown in the figure 8.

Fig. 8: Equipment picture

In summary, the system runs stably and reliably, has good safety protection functions, and has low cost, simple operation, and good economic value.

6. Acknowledgments

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