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Truck Parking Cheating Detection System of the Truck Scale Using the Voltage Waveform Analysis

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Abstract

Truck scale is an important weighing instrument. The truck parking cheating method is one of the truck scales cheating method and can lead to large economic losses to the enterprise. A new truck parking cheating detection method based on the voltage waveform analysis is brought out in this paper. According to the output voltage signal waveform of the weighing transducer, if the turning point number of the output voltage is different with the truck axles, the truck parking cheating method exists. Based on the principle, the truck parking cheating detection system is designed. The instrument is using 8031 as the MCU and can be transmitted the voltage signal to the control computer. Experimental data show that the detection system can on-time detects the truck parking cheating method.

Keywords: cheating detection; analysis; truck parking; voltage waveform; truck scale

1. Introduce

China economy is developed rapidly in recent years, so the amount of cargo transport is growth rapidly. As convenient, fast, standard weighing instruments, the truck scales are widely used in automotive transportation. It becomes the more important measurement equipment in trade settlement.

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To seek illegal profits, the truck scale cheating methods are emerging endlessly; so many companies have very large economic losses. The rapid development of the technological, to find the truck scale cheating methods becomes more difficult [1-4].

The truck parking cheating method is more convenient, so it is brought more serious consequences. A novel truck parking cheating detection method based on the voltage signal waveform analysis method is brought out in the paper and the truck parking cheating detection system is designed.

2. The truck scale weighing system

The truck scale weighing method is mainly composed by four parts: the weighing platform, the force transducers, the signal amplification and the SCM. The truck scale system is shown in Figure 1.
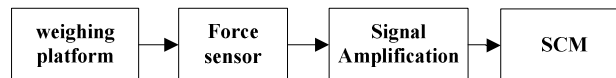

Fig.1 The truck scale weighing system

The four weighing transducers are installed under the weighing platform. Under the action of the truck force, the deformation of the weighing transducers is generated and the mV signal which is proportional to the truck weight is output. The voltage signal is amplified by the signal amplification and transmitted to the SCM. The information of the truck data can be transmitted to the upper computer. The goods weight is the difference between the full loaded weight and the empty weight of the truck.

3. Principle of the truck parking cheating method

The principle of the truck parking cheating method is shown in the figure 2. It can be divided into two kinds. The one is that the truck back wheel or the front wheel is not on the weighing platform in order to reduce the empty truck weight. The other is that many trucks are on the platform. That is to say the front or back wheel of the other truck is driving on the platform while the truck weighing in order to increasing the full loaded truck weight. So the goods weight is heavier than its actual weight.
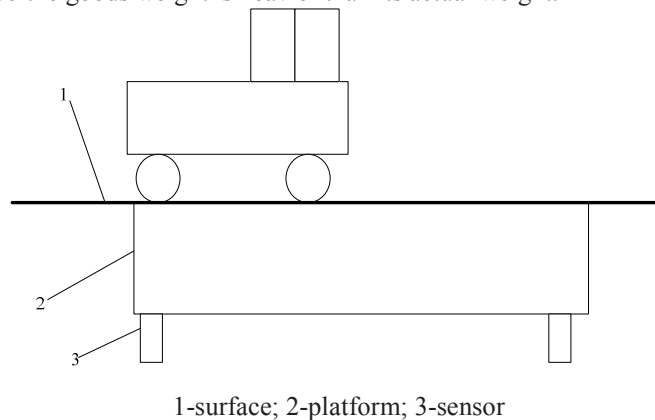

1-surface; 2-platform; 3-sensor

Fig.2 The principle of the truck parking cheating

4. The voltage signal waveform detection principle

Truck scale weighing sensor output voltage waveform is related to the axle number. The biaxial car is as the example to illustrate this problem. The force changing curve of the biaxial car is shown in Figure 3.

It can be seen from the figure, when the biaxial drives on the weighing station, the pressure curve of the weighing sensor appears twice inflection point. The occurrence moment of the inflection point is correspond respectively to the front and rear wheels of the car into the weighing station. So the output voltage signal of the weighing station is also appears twice inflection points at the same times and the output voltage waveform curve is similar to the pressure changing curve. Similarly, the output voltage signal waveform curve while the car drives off the weighing station is similar to the waveform curve of the transducer output voltage when the car drives onto the weighing station.
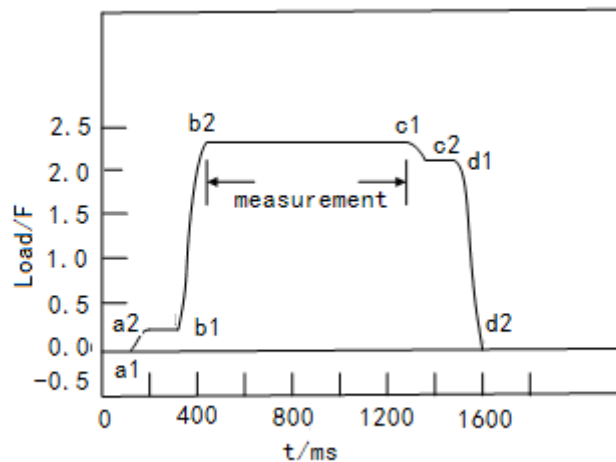

Fig.3 two-axle vehicles weighing sensor force

Whether the truck parking cheating method exists or not can be judged by analysis the waveform of the weighing transducer output voltage.

While the truck wheels are not on the platform entirely, the waveform curve of the transducer output voltage is different from the normal condition. If the front wheels drive off the weighing station, the pressure of the weighing transducer is smaller than the pressure while the truck is on the weighing entirely and the output voltage signal is also smaller. So the voltage signal curve appears the additional downward inflection point before weighing. That is to say the third inflection point appears in the voltage curve.

While the front or back wheel of the other truck is driving on the platform while the truck weighing, the pressure of the weighing sensor is bigger than the pressure while only one truck is on the weighing station and the output voltage signal is also bigger. So the voltage signal curve appears the additional rising inflection point before weighing. That is to say the third inflection point appears in the voltage curve.

Therefore for the biaxial car, if the weighing sensor output voltage signal waveform appears only two inflection points, the weighing system is normal and there is no cheating phenomenon; if the weighing sensor output voltage signal waveform appears three inflection points, the cheating phenomenon exists in the weighing system.

5. Truck scale cheating monitoring system

5.1. Hardware design

The hardware structure of the electronic truck scale sensor output voltage signal detection circuit is shown in Figure 4. The MCU of the voltage waveform detection system is 8031, the analog-to-digital conversion chip is ADC0809, the communication chip is MAX481, the watchdog chip is MAX705[5-7]. The output voltage signal of the weighing sensors is enlarged by the amplifier circuit and changed into the digital signal by ADC0809. The MCU collects a plurality of sensor output voltage signal simultaneously and sends the measurement data to the monitoring system through the MAX481.
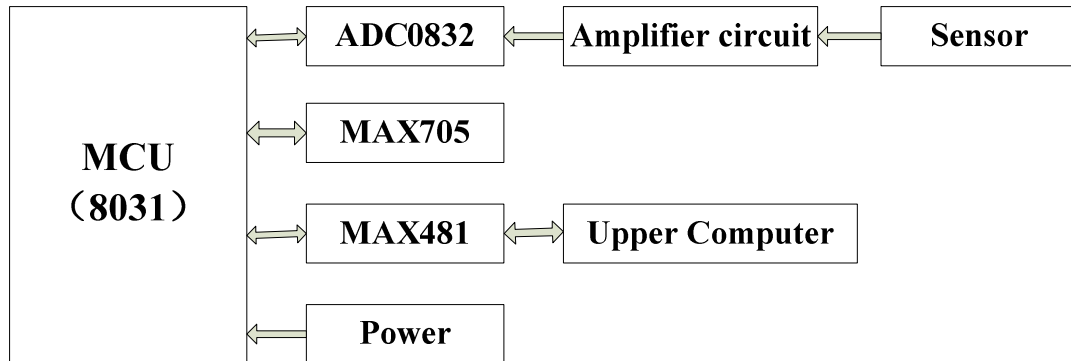
Figure 4 the hardware structure of the output voltage signal detection system

5.2. Software design

The SCM software uses KeilµVersion2 development platform and uses the modular design method. The software of the detection system includes the analog-to-digital conversion, the signal filtering and the data transmission subroutine. The SCM software flow chat is shown in Figure 5.
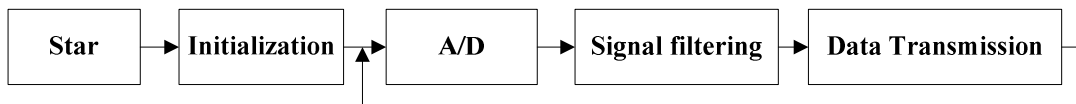
Figure 5 SCM software flow chat

6. Conclusion

This paper proposes a new truck parking cheating detection method of the truck scale based on the output voltage signal waveform of the weighing sensor. The experiment is carried out in the truck scale weighing platform in a factory. The experimental data show that the truck parking cheating detection system of the truck scale based on this method can real-time detects the truck parking cheating method and provides an effective method for real-time detects the truck scale cheating methods.

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