ARM 11 Based Industrial Dust Cleaner Using High Voltage Pulse Power Supply

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ABSTRACT: This paper proposes a high voltage pulse power supply controller based on ARM 11. High-voltage pulse power supply technology is a new effective improvement in electric dust precipitation. This paper provides an output pulse width modulation in the frequency range of 20~50 KHz with the duty cycle of 12% to 50%. µC/OS II- real time operation system was implemented. µC/OS II- real time operation system is currently implemented in a wide array of high level of safety-critical devices. Experiments have shown the feasibility and reliability.

KEYWORDS: High-voltage Pulse Power Supply, ARM 11, PWM, µC/OS-II.

I. INTRODUCTION

The environment is a global problem, and dust in industrial production of human environmental pollution in the largest and direct, is a worldwide problem. The industries of thermal power, metallurgy, cement and else enterprises discharge smokes and dusts everyday, which is a major source of air pollution. China attaches great importance to environmental protection. The law of environmental protection has been promulgated in 1989. In 2004, the environmental gas emission standards for dust in the atmosphere was improved from 150mg/m3 to 50mg/m3. And the newly issued national environmental protection standard of dust was implemented in 2010. The dust emission standards of various industries increased to 30mg/ m3 [1]. The standards of Guangdong province will be 10mg/m3.

The electrostatic precipitator is widely used in various industries because of its advantages of high efficiency, low energy consumption and wide applicability, which can deal with gas of high temperatures and great smoky, and the maintenance costs is lower[2]. High voltage pulse power supply technology has been used in developed country for more than 20 years, which effective have been confirmed. The power supply work with dual power supply mode[3]. By a series of basic voltage and micro-pulse voltage composition (maximum pulse repetition frequency of 200Hz) to the electrostatic precipitator power supply, and its base voltage, pulse voltage, pulse amplitude, duty cycle and frequency can be automatically adjusted under different conditions[4]. This article describes the high-voltage pulse power supply controller, which can output pulse from 20 KHz to 50 KHz with the duty cycle of 12% to 50% adjustable[5].

II. HARDWARE DESIGN OF THE SYSTEM

1. ARM 11 Processor

The ARM is a 32-bit reduced instruction set computer (RISC) instruction set architecture (ISA) developed by ARM Limited. It was known as the Advanced RISC Machine, and before that as the Acorn RISC Machine. The ARM architecture is the most widely used 32-bit ISA in terms of numbers produced They were originally conceived as a processor for desktop personal computers by Acorn Computers, a market now dominated by the x86 family used by IBM PC compatible computers. The relative simplicity of ARM processors made them suitable for low power applications. This has made them dominant in the mobile and embedded electronics market as relatively low cost and small microprocessors and microcontrollers.

2. Compact and Thin Type of Dust Sensor

The Compact and Thin type of sensor GP2U06 is a dust sensor which integrated optical sensor portion. It suitable for indoor for purifier sensor because of impact, thin, low dissipation current type shown in Figure 1.
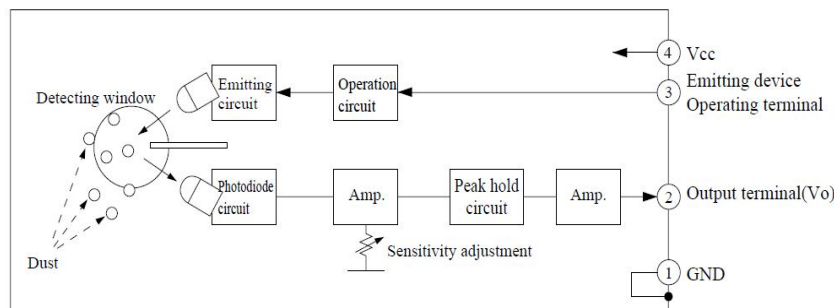

Figure 1: Block Diagram of Dust Sensor

3. Liquid Crystal Display

A liquid crystal display is a flat panel display, electronic visual display, video display that uses the light modulating properties of liquid crystals. LCs does not emit light directly. They are used in a wide range of applications, including computer monitors, television, instrument panels, aircraft cockpit displays, signage, etc. They are common in consumer devices such as video players, gaming devices, clocks, watches, calculators, and telephones. LCDs have replaced cathode ray tube displays in most applications. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they cannot suffer image burn-in.

4. Max 232 Circuit

The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply RS 232 voltage levels from a single 5v supply. Each receiver converts RS-232 to 5v TTL/CMOS levels. Each driver converts TLL/CMOS input levels into EIA-232 levels. The P3_0 (RX) and P3_1 (TX) pin of controller is connected to the max 232 driver and the TX and RX pin of max 232 is connected to the GSM modem shown in Figure 2.
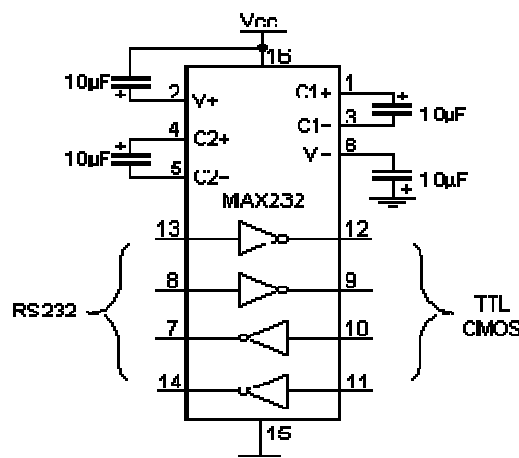

Figure 2: Pin Diagram of MAX232 Circuit

5. Driver Circuit

The ULN2003 is a monolithic high voltage and high current Darlington transistor arrays. It consists of seven NPN Darlington pairs that feature high-voltage outputs with common-cathode clamp diode for switching inductive loads. The collector-current rating of a single Darlington pair is 500mA. The Darlington pairs may be paralleled for higher current capability. Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED gas discharge), line drivers, and logic buffers. The ULN2003 has a 2.7kW series base resistor for each Darlington pair for operation directly with TTL or 5V CMOS devices. There are four features of drive circuit shown in Figure 3.
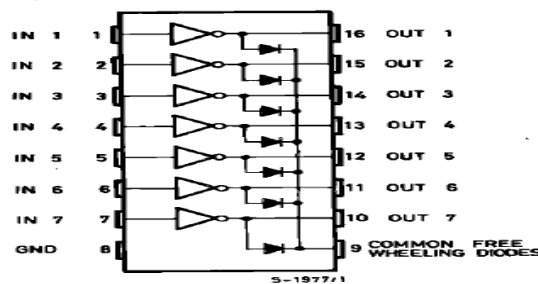

Figure 3: Pin Diagram of Driver Circuit

III.SOFTWARE DESIGN OF THE SYSTEM

1. OVERVIEW

The system chosen of LM3S8962 ARM and the LM link compilers conform to the operating system of the transplant conditions. The host establish the cross-development and debugging environment on target board through the JTAG interface. The main task of the whole control system including: reading and writing PWM data and change the parameter to adjust the waveforms. After the completion of the codes for above tasks, then preparation the interrupt service routine, and start the operating system, the applications is running shown in Figure 4.
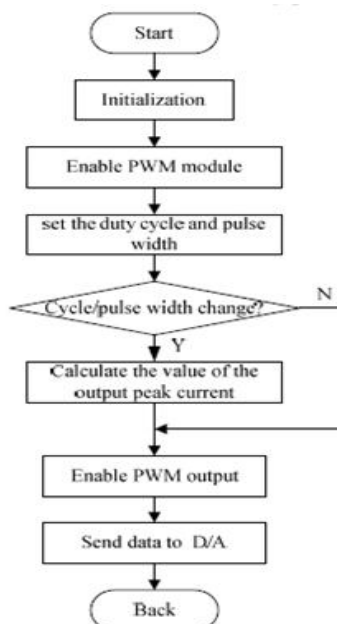

Figure 4 : QNX 4 File system structure

2. UC/OS II

UC/OS- II is a portable, ROMable, Scalable, Pre-emptive, Real time deterministic multitasking kernel for microprocessors, microcontrollers and DSPs. It manages upto 250 application tasks. It includes : semaphores , event flags, mutual exclusion semaphores that eliminate unbounded priority inversions, message mailboxes and queues, task, time and timer management and fixed sized memory block management. It is a very small real time kernel. Memory footprint is about 20KB for a fully functional kernel. It is simple to use and simple to implement but very effective compared to the price and performance ratio.

IV.EXPERIMENTAL RESULTS

The results obtained from the Figure 5 shows that the single ARM 11 Processor Board control and co-ordinates the entire operation carried out inside the industry. With the help of high voltage pulse power supply electric dust precipitation technology the dust particles can be removed anywhere from the industry.
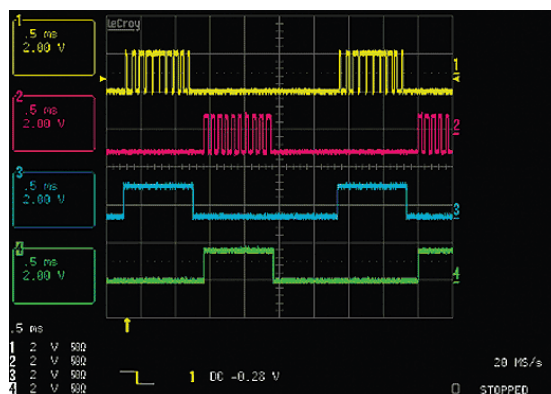

Figure 5: Simulation result of Pulse Generation

Figure 6: ARM friendly board

V.CONCLUSION

High voltage pulse power supply electric dust precipitation technology is a new type of traditional environmental technology, which can be used in renovation project of traditional DC power supply electric dust precipitation, and can be used in flue gas treatment too. It is good technology accordance with the national sustainable development strategies for high dust collection efficiency and energy efficiency.

High-voltage pulsed technology can save power and increase the dust of charged speed, which can overcome back corona. The energy efficiency can be 60% - 90% than the average DC intermittent power supply, and the dust

collection performance can reach 30mg/m3 and better, can satisfy the new national emission standard. The implementation of high-voltage pulse power controller based on ARM11, various pulse parameters can be regulated. Cooperate with the high power electronic devices and specifically driver modules, it can work stabilized and reliable.

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