DESIGN OF MEASURE AND CONTROL SYSTEM FOR PRECISION PESTICIDE DEPLOYING DYNAMIC SIMULATING DEVICE

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Abstract: A measure and control system for precision deploying pesticide simulating equipment is designed in order to study pesticide deployment technology. The system can simulate every state of practical pesticide deployment, and carry through precise, simultaneous measure to every factor affecting pesticide deployment effects. The hardware and software incorporates a structural design of modularization. The system is divided into many different function modules of hardware and software, and exploder corresponding modules. The modules' interfaces are uniformly defined, which is convenient for module connection, enhancement of system's universality, explodes efficiency and systemic reliability, and make the program's characteristics easily extended and easy maintained. Some relevant hardware and software modules can be adapted to other measures and control systems easily. The paper introduces the design of special numeric control system, the main module of information acquisition system and the speed acquisition module in order to explain the design process of the module.

Keywords: precision pesticide deploying, measure and control, numerical control system, function module, Information measure terminal.

1. INTRODUCTION

The resulting pollution from pesticide over use is increasingly become health threat. It is a main factor breaking the ecological balance and hindering the sustainable development of agriculture .The out-dated pesticide deployment technology leads to poor efficiency use of pesticide and it is the main factor of pesticide pollution. Employing pesticide is a complex process affected by many factors which affect and restrict each other. The factor affecting pesticide deployment efficiency has been accurately researched in order to study new pesticide technology and equipment. The precision pesticide deployment simulation equipment is designed in order to conquer the restriction of natural conditions. The system can simulate every state of practical pesticide deployment, adjust and carry through precise, simultaneous measures to every factor affecting pesticide deployment. The measure and control system for pesticide deployment pesticide dynamic simulation device is developed in order to enhance the precision and efficiency of simulating device.

2. THE ANALYSIS OF PRECISION EMPLOYING PESTICIDE DYNAMIC SIMULATION DEVICE DESIGN

The precision pesticide deployment dynamic simulating system includes a moving simulated prototype, static fog distributing test-bed and wind fed simulation equipment. The simulated prototype is the main part of the simulation system. It simulated the movement of signal nozzle or grope nozzles through measurement of speed flux and pressure. The fog distribution is measured on the static fog distributing test-bed. It is realized by measuring the fog weight of fog collection groove which is measured by 30 precise subminiature weight sensors. The step less regulation of wind direction and speed is realized by simulated wind feed. So it is convenient for research on the affect of wind feed effects on pesticide deployment. The wind speed is gathered by the wind speed sensor.

The mission of system is controlling pesticide deployment prototype, at the same time collecting and disposing of data. The dynamic simulation precision deployment process includes automatic run of prototype, on-off control of pump and control of liquid spray. The measure parameters include the speed of prototype, temperature, humidity, wind speed, the distribution of fog, flux and so on. The system measures each factor accurately and simultaneously. After pretreatment the data is transferred wirelessly to numeric control system and then transferred to industrial computer. The

control mechanism of the industrial computer is executed by the numeric control system. Each control function is achieved on keyboard of numerical control system. Thinking about the character of precision pesticide deployment dynamic simulation device and functional request of measure and control system, the whole configuration of precision pesticide deployment dynamic simulation system is designed as fig 1 (Liu Pengzeng,et al., 2006).

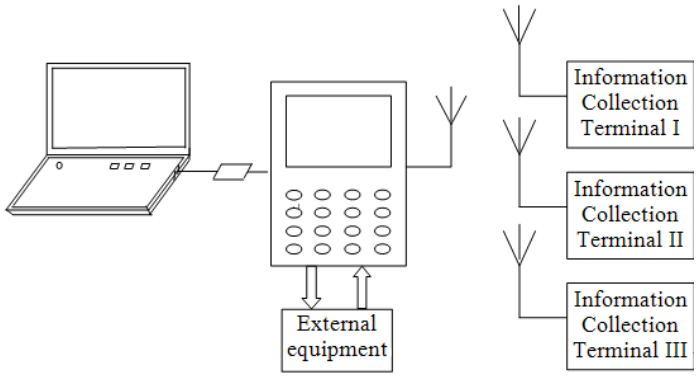

Figure 1: The Structure of Measure and Control System for Precision Pesticide Deployment Dynamic Simulation Device

3. THE MODULARIZATION DESIGN OF NUMERIC CONTROL SYSTEM

In order to enhance the system's universality, efficiency of exploder and systemic reliability, and lower system cost the design of hardware incorporates a structural design of modularization in the numeric control system and information acquisition terminal. Independence, integration and exchange of module function is the directional thinking of module partition. Function is more centralized, is worse, in contrast, when function is dispersive, more parts leads bad reliability of system. The modules' interfaces are uniform defined, which is convenient for the connection of different modules.

The basic principle of module partition:

(1)Integration .Each module is a unit which has integrated function.

(2)Independence. The function of each module is independent of each other.

(3)Exchange. When define module, the currency of module is needful on the basic of monished PCB area.

(4)Singularity. The definition of interface must be united, convenient and reliable. The singularity and convenience of interface is a very important in

the process of PCB.

The whole structure of numeric control system is designed as fig2 on the thinking of module partition (Guo Shifu et al.,2007;Li Quan et al.,2007;Yang Shuming et al.,2007).

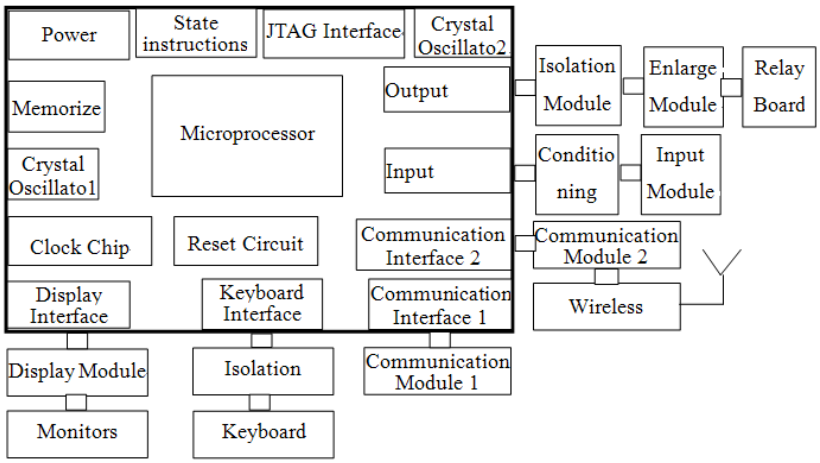

Figure 2: Structure of the NC System Module

The unit the MCU on is the main board of numeric control system which includes some basic collocation. The MCU is the core of the system, the capability of the whole system is decided by MCU. The MSP430F149 whose power is especially low and function is strong is used in the system. AT24C08 is used as serial memorizer which can memorize some basic system information. A 32.760k oscillator of low frequency is chosen as the first oscillator which suits situation of low power. A 8MHZ oscillator is chosen as the second oscillator which is good at disposal of high speed information. The display interface joint the P6 I/O port of MCU. It joins exterior display through isolated module by the way of serial port or parallel port. The OCMJ4*8C LCD of serial communication can show characters and figures. The keyboard joins the P2 I/O port which has the interruption function. It joins exterior keyboard through isolated module. There are two serial ports of MSP430F149, the first port communicate with IPC through communication module, the second port communicate with wireless module through communication module which transport wirelessly. It also can join USB transformation interface through parallel port, so it can join IPC through USB. The output signal is magnified after being isolated, and then it drives a subminiature relay. The connection of relay drive contactor to control exterior equipment such as exterior electromotor. The exterior status messages are produced through the input port.

The signal of module's two ports is isolated by the isolation module.

There are united defined interface on the two ports of module, which can join each other expediently. The digital isolation between peripheral equipment and MCU, peripheral equipment and peripheral equipment, and between MCUs can implement by the isolation module.The module can isolate eight channels signal ,so we can make our choice according the situation less then eight channels.

The first communication module joins MCU and the IPC. Two different communication modules are designed to join different interface of computer, so system are more flexible and current. One is RS485-RS232 communication module which joins MCU and the RS232 serial interface of IPC expediently. The other is USB conversion interface communication module which joins MCU and USB interface of IPC expediently. A TTL-RS485 communication module which can transform TTL to RS485 is designed to join MCU and peripheral equipment of RS485 bus.

The amplifier module mainly amplifies the drive signal of the relay and isolates them. There are eight channels output signals, they can mostly drive the relay and peripheral equipment. We can make our choice according the number of relays. We need more amplifier module and relay module when there are more peripheral equipments.

4. THE DESIGN OF INFORMATION ACQUISITION TERMINAL

The design of information acquisition terminal incorporates structural design of modularization. The main module of information acquisition terminal and the speed acquisition module are designed as function unit respectively.

4.1 The design of information acquisition terminal main module

The main module of information acquisition terminal is designed according the request and character of common information acquisition system. The main module of information acquisition terminal is designed as fig 3.In the process of information acquisition main module low power is a very important guideline, whatever choice such as CPU or peripheral equipment comply the guideline strictly. The MSP430F149 of very low power is chosen and then the system can use battery as power supply, so the main module of information acquisition can be applied more widely. The SD2303AP is chosen as clock chip, it is high accuracy real-time clock chip which has built-in oscillator and two-way serial interface. It can promise the

clock accuracy as the ± 5 ppms. The function of clock accuracy numeral adjustment can correct the deviation of clock over a very wide range. The typical power of the chip is 0.5uA(VDD=3.0v).It can export year, month, date, week, hour, minute, second and operate on 1.8 to 5.5 volts. The interface of display is designed in the main module of information acquisition. When acquired information needs to be shown, we join the display through the module of display interface to realize the real-time display.

4.2 The design of speed acquisition module

The speed acquisition module is designed to acquire the speed of the prototype. There are many ways of speed acquisition. The system acquires the speed by photoelectric encoder. The speed of simulation prototype is calculated by testing the number of pulse acquired in unit time, so the function of speed acquisition module is acquiring the number of pulses thrown out by encoder in unit time (MA Dongtao et al., 2005).

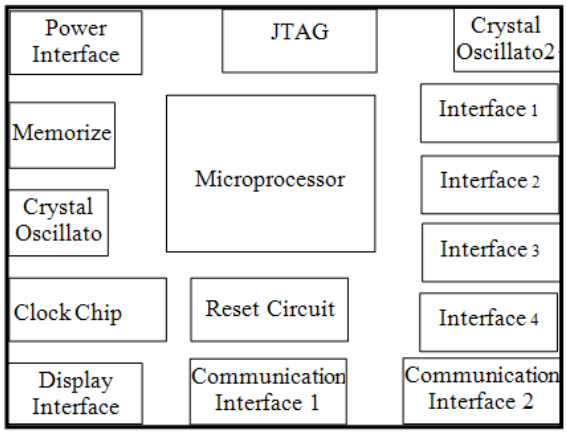

Figure 3: Structure of Information Collection Main Module

In order to enhance the system's universality, three circuits of pulse signal acquisition are designed in the module.The module can receive pulse signal of pulse encoder as well as on-off signal of Hall element. When the voltage of exterior pulse changed we can change the resistance to adjust. When we connect the photoelectric encoder externally one circuit acquire the number of pulses, the other circuit joins the other phase of the photoelectric encoder's output and use it to distinguish the direction. When the direction is positive the number of pulse is increased by one, by contrast, the number of pulses reduces by one. Accordingly, the analysis of function the chart of speed acquisition module is shown on the fig 4.

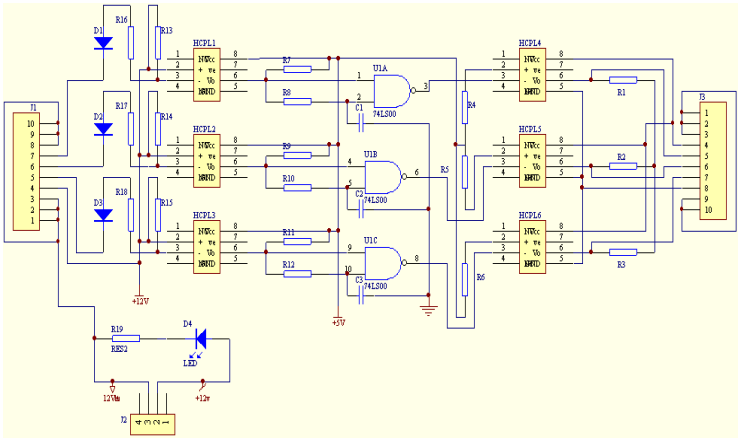

Figure 4: The chart of speed acquisition module

As the chart of speed acquisition module shown on the basis of pulse counting the module makes use the technology of isolation, divorcement of voltage, divorcement of current and differential coefficient to achieve anti-jamming and a muffler effect. The two ports of module are joined by traversing order. It is convenient to connect and assure the security of the join. When the voltage of input pulse changed we can change the divorcement of voltage and divorcement of resistance to fit new voltage.

4.3 The design of speed acquisition terminal

The function of speed acquisition terminal is to acquire the information of speed and then transmit to numeric control system wirelessly. After pretreatment of numeric control system information, it is transmitted to the management computer. It is easy to design the system using the information acquisition main module, speed acquisition module, communication interface module and transceiver module. The char of speed acquisition terminal is shown on the fig 5.

5. MODULAR DESIGN OF SOFTWARE SYSTEM

System software design also fully adopted the structure ideas, the software will be divided into several relatively independent of the functional modules, so, the procedures are easily extended, and easy to maintain. We designed many modules as follows: Initialization Module, Temperature and Humidity Detection Modules, LCD Display Modules, Keyboard Module, Communications Module, Speed Detection (pulse count) Modules, Data-

processing Module and Serial Memory Reader Module. Software system structure is shown in Figure 6. In different applications under the corresponding need, we can add or delete certain modules (Duan Guiping et al.,2007; HU Dake,2001).

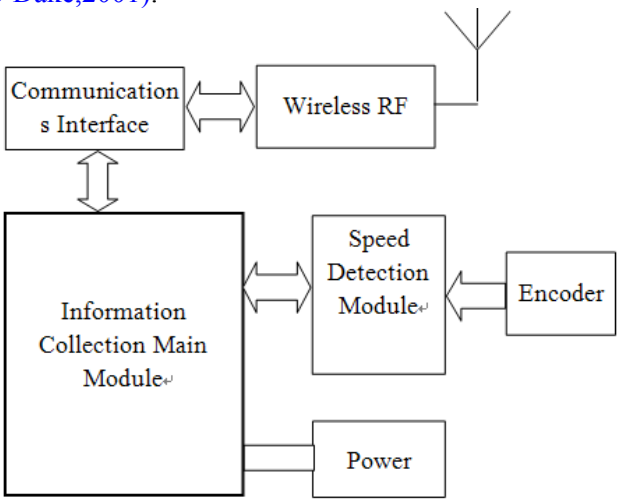

Figure 5: Terminal Velocity Structure of the Acquisition

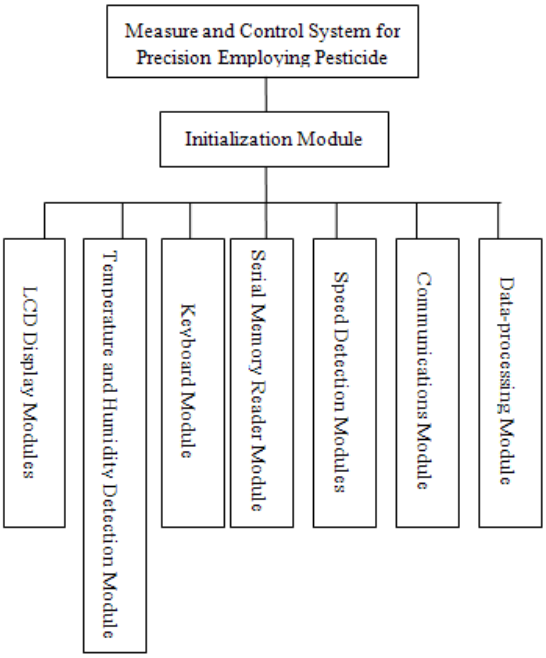

Figure 6: Software System Structure

6. CONCLUSIONS

The development of the measure and control system for precision pesticide deployment simulation equipment has created the conditions for Precision Measurement of the relevant factors about precision pesticide deployment. The system motherboard and modules developed during the design of NC system can be easily used to control other occasions, the information collection at terminal modules and related modules can be easily used for further information analysis. At the same time, in conjunction with the development of the software modules we can easily assemble various measurement and control system, which is very effective for developing small-batch control systems. The design of Measurement and Control System modular architecture has effectively improved the efficiency of the design of the system, improved the system of universality and reliability and easy maintenance. After extensive testing at the scene, it showed that the system is stable and reliable, easy to maintain, and better to meet the requirements of the measure and control for precision pesticide deployment simulation equipment.

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