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Temperature and Humidity Controlling of Plant in Greenhouse

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ABSTRACT

In farms, forestry centres and greenhouses, the system can be used in growing seedlings of crops, breeding of plant and vegetables in cold areas. It may control all the activities automaticlly in temperature, humidity, sprinkling and heating.

This is a closed-cycle control system controlled automatically by single-chip microcomputer. (MCS-51)

The purpose of this system is to shorten the experimental cycle of crops, improve the survial rate of crops breeding, and ensure the growth of vegetables in the cold areas. Therefore, it can be used widely.

INTRODUCTION

The growth of green plant closely connects with the environment. The basic living conditions are light, heat, water, untriment, air and so on. Now we commonly use greenhouse to cultivate plants, saplings, flowers and vegetables.

The vegetable greenhouse is used all over the country, especially in the north region, where vegetable supply has always been difficult in winter because of the cold weather. With the quick development of plastic industry and electronic industry, the greenhouse in north is developing continuously, there are plenty of vegetables on the market in winter to meet people's need.

Because of greenhouse technigue, we can use computer to manage and control water-supply, light, temperature and content of CO_2 at different period during the growth of vegetables. We can also promote production, prolong harvest time, keep quality and decrease plant disease and insect pests.

The singl-chip microcomputer of MCS-51 is quite popular in the world. It is a good method to control and manage the greenhouse scientificly. We use its base machine system to form the small application system and manage scientificly two sets of greenhouses, it can control temperature, moisture, light, intensity, content of CO_2 and soil moisture seperately. The followings are discussed in my paper.

1. Disposition of the system and its function:

a. Parts of soil moisture measurement; temperature; moisture; CO_2 content and light intensity in the room; computer control; water-cooled wet curtain machine to adjust light intensity; stove-air-blower to raise temperature and driping irrigation on the ground film to raise moisture ect.

b. Disposition of keyboard to change requirements for temperature, moisture, light and CO_2 content at every period during the growth of plant according to technological requirement.

c. To measure temperature,moisture,light intensity and CO2 content, to calculate,display and print measure results at any time.

d. To control soil moisture,air temperature and moisture,CO2 content and light intensity in the room.

e, To accumulate work time and make alarm when temperature and moisture is off normal.

2. Working principles:

According to different period of growth and different light intensity,soil moisture,environment temperature and moisture and CO2 content are measured.Then amplify and filter the measured signals and turn them into voltage that A/D needs.The voltage dose A/D exchange.The digits after exchange can be compared by checking list and the results are displayed on CRT.When the digits are off normal,an alarm controlled by a computer will give us an alarm.We adjust I/O output with PID,which controls the executive system to raise temperature,sprinkle,ventilate the house,low temperature,adjust light intensity and print the measure results and recorded working time.That finishes a whole procedure of clozering control.

3. Design method:

a. The forward channel design:

In first and second houses,we use four soil moisture sensors, soil H1.1,soil H1.2,soil H2.1,soil H2.2,(using carbon electrode) and four air moisture sensors(CH-DR-11),room H1.1,room H1.2,room H2.1,room H2.2 and four temperature sensors (2CR21) light1,light2 and two carbon dioxide sensors (GS160) CO2-1,CO2-2. All these are installed in the main position.

The sensor signals go through the amplifier,imitate switch and programmable amplifier and turn into 0--5V (VDC OUTPUT) voltage normal signals.Then the sensor signals do A/D exchange.

See Fig.1 about the circuit:

b. Design of main computer board:

The 8031 CPU chip is adopted in computer system.EPROM is 2764, RAM is 6116,8155 and 8255 chips are used in I/o parallel interface,A/D exchange adopts MC14433 of near to 12 binary number, 5832 circuit is used in timing,CRT and SCIB are used to display, 8279 chip and 24 keyboards are chosen for keyboard,About printer, EPSON M-160 type component is used which is chinese character microprinter of XLF flush type and it can print at any time.As to the form of reset,we use switching-on reset and reset controlled by hand at any time.See Fig.2 about the circuit.

c. Backward channel:

In backward channel,we use on-off control to control:alertor; water cooled wet curtain-1;water cooled wet curtain-2; skyhight-1; skyhight- 2; curtain machine-1;machine-2; stove-airblower-1; ventilation door-1; ventilation door-2; drip irrigation valve-1; drip irrigation valve-2; temperature valve-1;temperature valve-2.

See Fig.3 about circuit.

d. Design of electricity supply system.

We must consider continuous work,reliability and interference

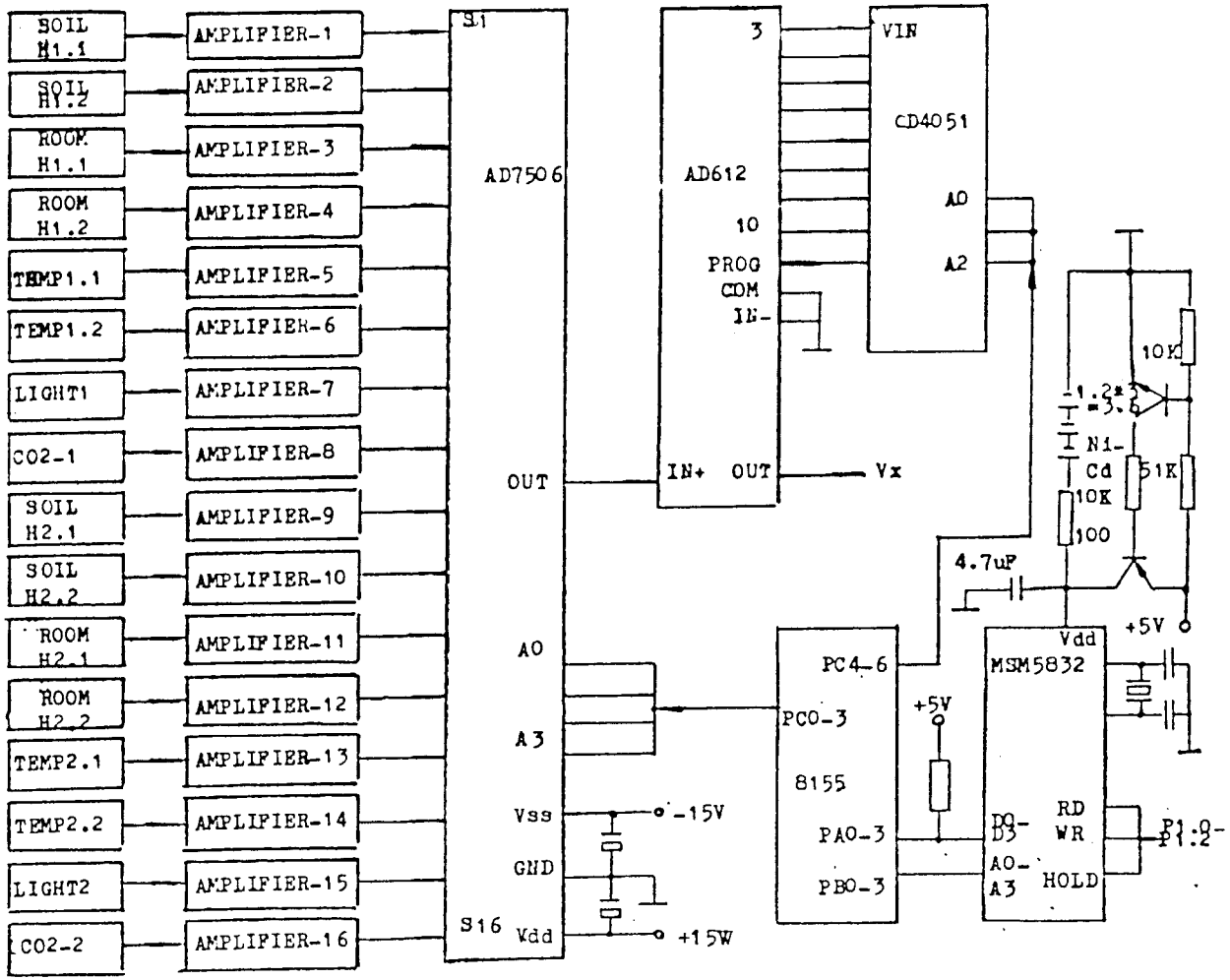


Fig.1..The front end processing interface

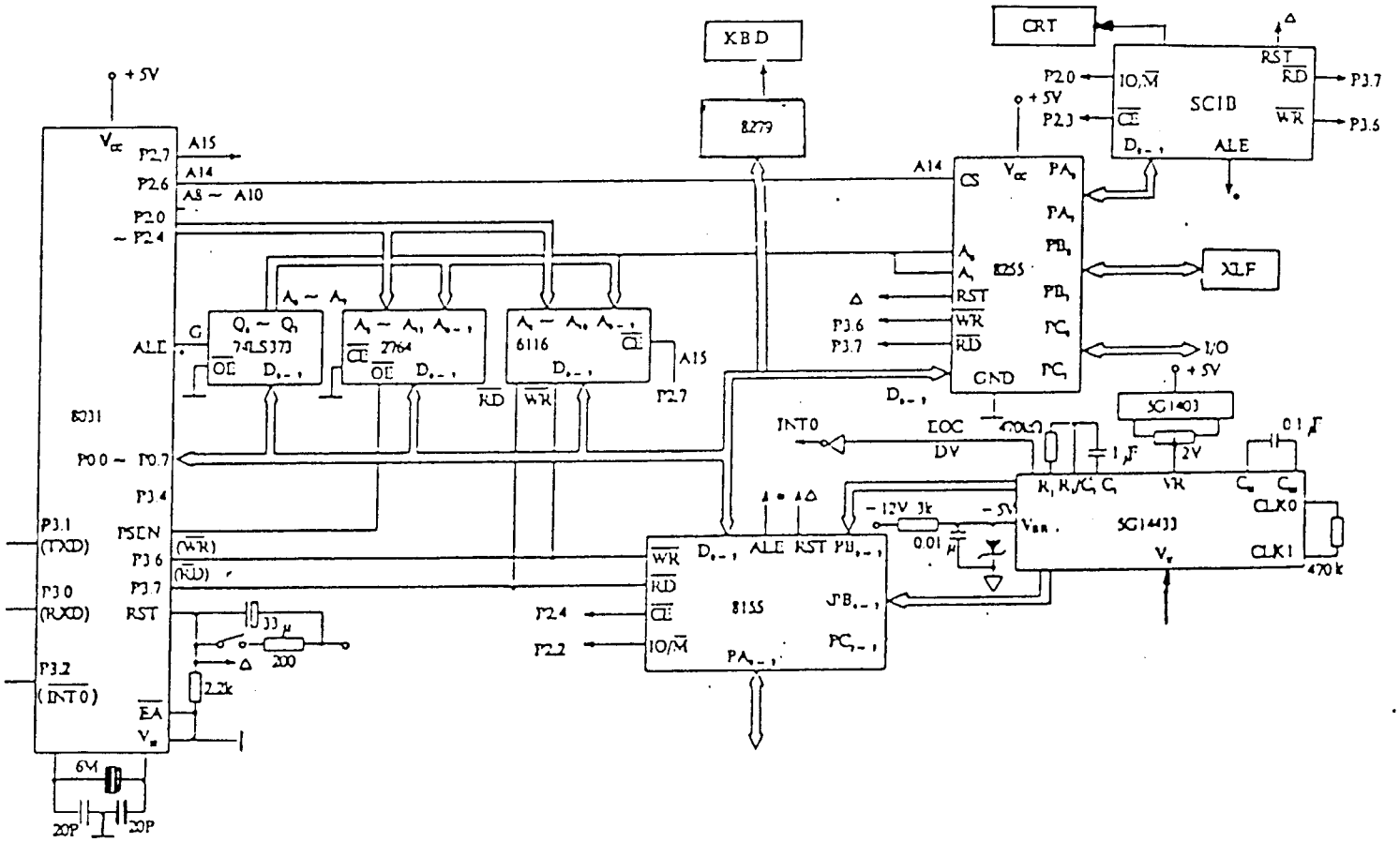


Fig.2. 8031 slice microcomputer interface circuit

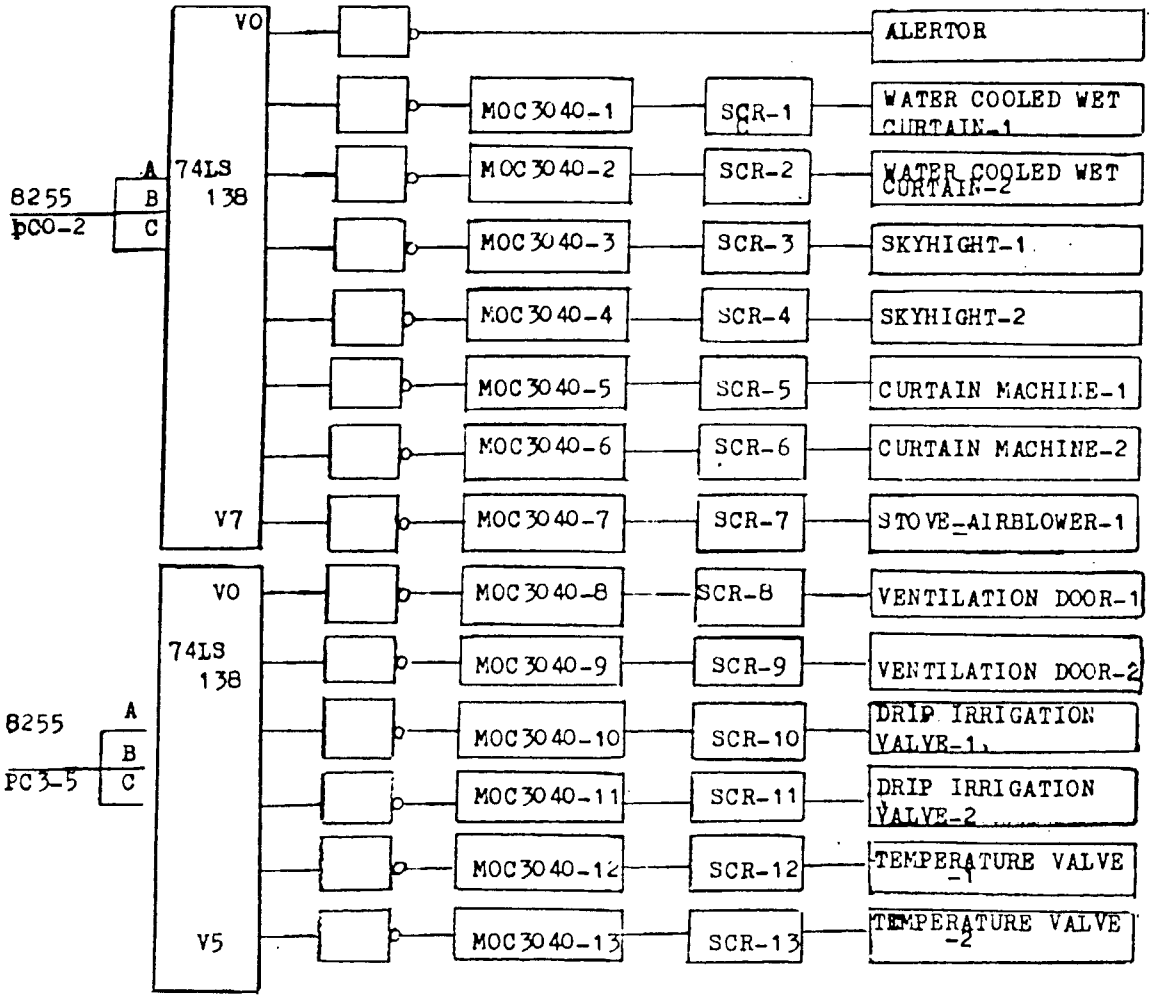


Fig.3. The back end processing interface

filter.

e. Software design:

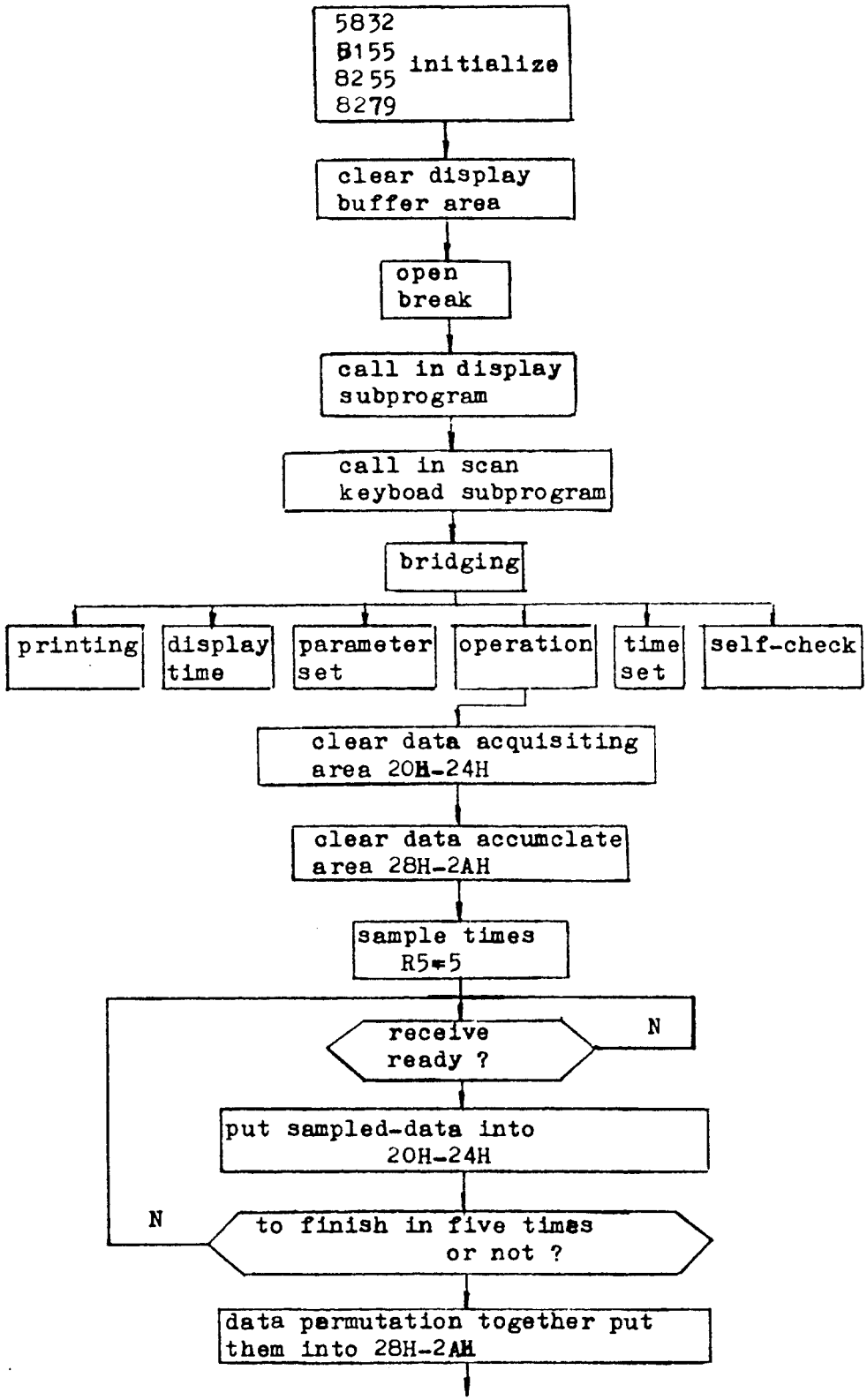
In order to filter the interference signals,we use five points and three times smooth method.To improve reliability,we use information redundancy time redundancy and hardware measure method.

In the whole software system,module structure is adpoted from top to bottom.First initialize,then go into prompting symbol of monitor mode.Because the system collests 16-channel data.We must plan and consider it carefully.See Fig.4 about software.

4. Summary:

The whole system is in service of two greenhouses.Considering the distance of sensors,to keep the signals accuracy,in forward, interference and attenuation must be considered,The number of collecting channel and the time of A/D exchange must meet the base machine.The hardware circuit and software design of base machine must fit each other and we must consider cost/effectiveness of the system,safety,reliability,convience,easy to operate visualization.In backward channel,the interference of base machine and driving capacity are considered and on-off control output is used after meeting service demands.Executive system should be reliable,safe and flexible.Consider the use of hand control after guarante ing automation.Since power supply part is the main cause of interference,we should take effective and practical measures to stop interference and keep machine in good working condition on undervoltage and overvoltage.

My paper about the system is my experience and methods in practice.I only present you a general introduction because of the length of the paper.I can offer detail reference to those who are interested in this subject.Your opinions are welcomed.


5832
8155
8255
8279
initialize
clear display buffer area
open break
call in display subprogram
call in scan keyboad subprogram
bridging
printing
display time
parameter set
operation
time set
self-check
clear data acquisiting area 20H-24H
clear data accumclate area 28H-2AH
sample times R5=5
receive ready ?
N
put sampled-data into 20H-24H
N
to finish in five times or not ?
data permutation together put them into 28H-2AH

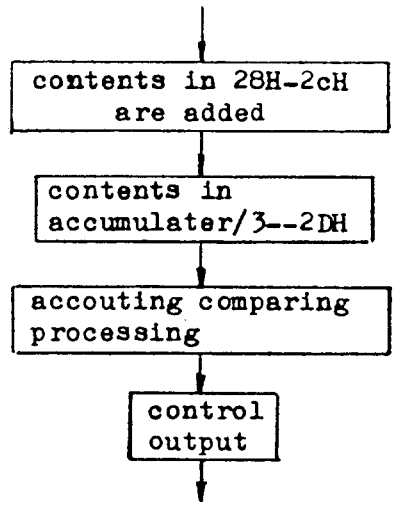


Fig.4. The control software program block diagram

REFERENCES

1. He Limin. 1990. MCS-51 series slice microcomputer application system design.

2. Chen Lirong. 1987. Slice microcomputer MCS-48 MCS-51 application handbook.