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Search Platform Design Based On WSN

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Abstract: *Based on the advantages of wireless communication, this paper present a search platform used in college to find the number of students in the classroom. Take STC89C52 as the control unit, E18-D50NK IR evading obstacle sensor detect the number of students, take nRF24L01 as the wireless communication module, it works over a range of about 70 meters that meets the requirements. The platform works as follow: the terminal node sensor mounted in each classroom count the number of students in and out of the classroom, then, transmit the number to the relay node which is mounted on the storey of the classroom, at last the relay nodes transmit the number to center node. The center node transmits the data to computer, and then the user can query the number of the students in the classroom from the computer visual interface. The operation shows that the search platform easy to operate and maintenance, has the advantages of high operation reliability, low power consumption, considerable practical value.*

Key words: *wireless communication; microcontroller; wireless sensor networks (WSN); people counting*

I. INTRODUCTION

In college, students always do self-study in the unoccupied classroom. With the increase of the number of students, it is difficult for students to find a classroom with few people. Combined with the develop of microcomputer and wireless sensor network (WSN) [1-3], design a kind of search platform used for indicate the number of students in each classroom, everyone who wants to do self-study in any classroom can see about the number of students in each classroom from the visual interface of the platform. Such a search platform used for students can save time effectively.

II. STRUCTURE AND FUNCTION OF THE SYSTEM

The working principle of the system is as follow: mount the terminal device on the door of each classroom, the system automatically plus one when the IR evading obstacle sensors detect a student coming in; automatically minus one when detect a student out. With the control of the microcomputer STC89C52, the wireless transmitting module nRF24L01 transmit the collected data to the relay node on each storey. The data at the relay node will be transmitted to the center node of the system. The controller of the center node processes all the data. The system connected to the computer via serial communication; display the data on the computer. The user can query the number of student in each classroom. The structure of the system is shown in Fig1.
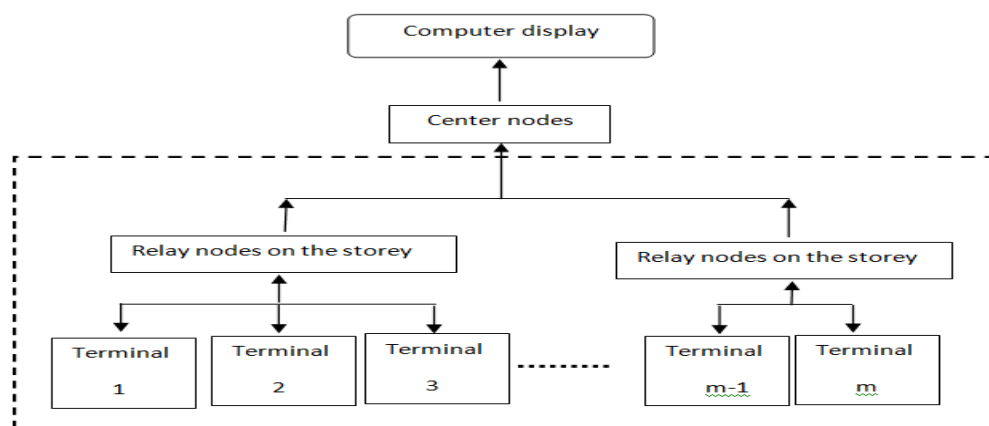

Fig.1. Structure of the system

III. HARDWARE CIRCUIT DESIGN OF THE SYSTEM

3.1 Detection module

The working principle of E18-D50NK is as follow: when an object appears in front of infrared tube, the surface is diffusely emitted, the infrared receiver receives the reflected light, the voltage of the tube will reduces, when the voltage below the comparator threshold voltage of LM324, it outputs a low level. Change the triode static working point by adjusting the size of the resistance potentiometer, thus changing the sensitivity of infrared tube. The connection circuit of the sensor is shown in Fig2.
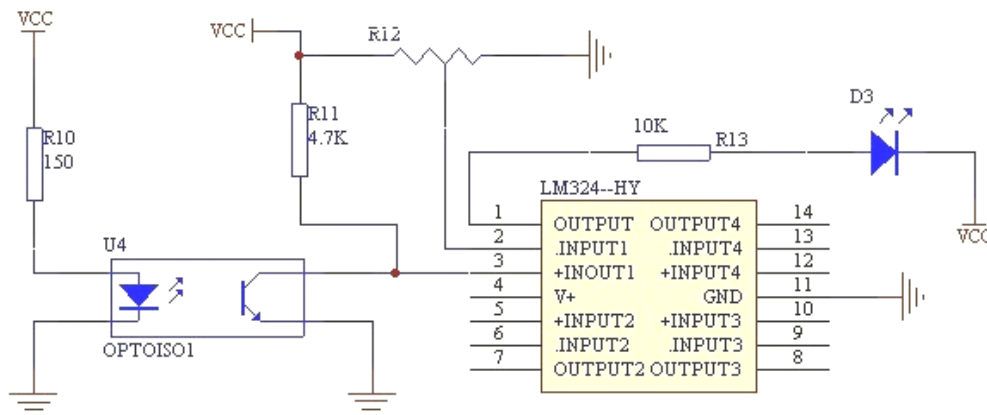
Fig.2. E18-D50NK IR evading obstacle sensor circuit

3.2 Wireless transmission module

nRF24L01 is a kind of wireless communication chip produced by NORDIC, it is a new single chip RF transceiver device, operating at 2.4~2.5GHz ISM band. The wireless communication speed can reach 2 Mb/s. There are two low-power operating mode: power-down mode and standby mode, it makes the energy-saving design more convenient [4-5]. The wireless transmission and reception circuit is shown in Fig3.
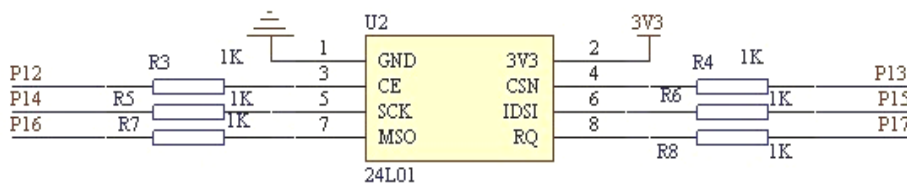
Fig.3. Wireless transmission and reception circuit

3.3 Serial communication module

The data that center node received can be converted by MAX232 so that can realize microcomputer program download and update, at the same time realize microcomputer and PC communication, then the data can be displayed on PC. The circuit connection is shown in Fig 4.
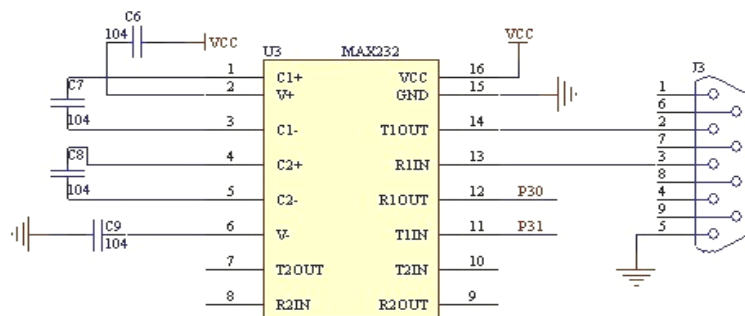
Fig.4. Serial communication circuit

3.4 LED display module LED

The terminal device mounted in each classroom has a display module, used for display the number of students in the classroom at present. The system we designed adopts LED digital tube as the display module, since it has the advantages of clear display and suitable for display in daytime. The LED used in this system adopts common-anode, 4 IO of the SCM are connected through a PNP transistor with 4-bit digital tube. The circuit connection is shown in Fig 5.
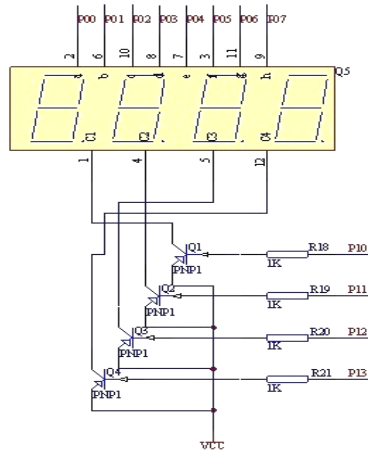

Fig.5. LED digital tube connection circuit

3.5 The power circuit

The power supply circuit design is divided into two parts: one is +5V power used for microcomputer minimum system and IR evading obstacle sensors, another one is +3.3V power used for nRF24L01 wireless communication module.

IV. SOFTWARE DESIGN

4.1 Overall process

The main program flow can be expressed as follow: system initialization after the power supply, include IO port setting initialization and peripheral device control initialization. Then each node transmits the data to center node from the sensor network, and communicates with the computer. The main program flowchart is shown in Fig6.
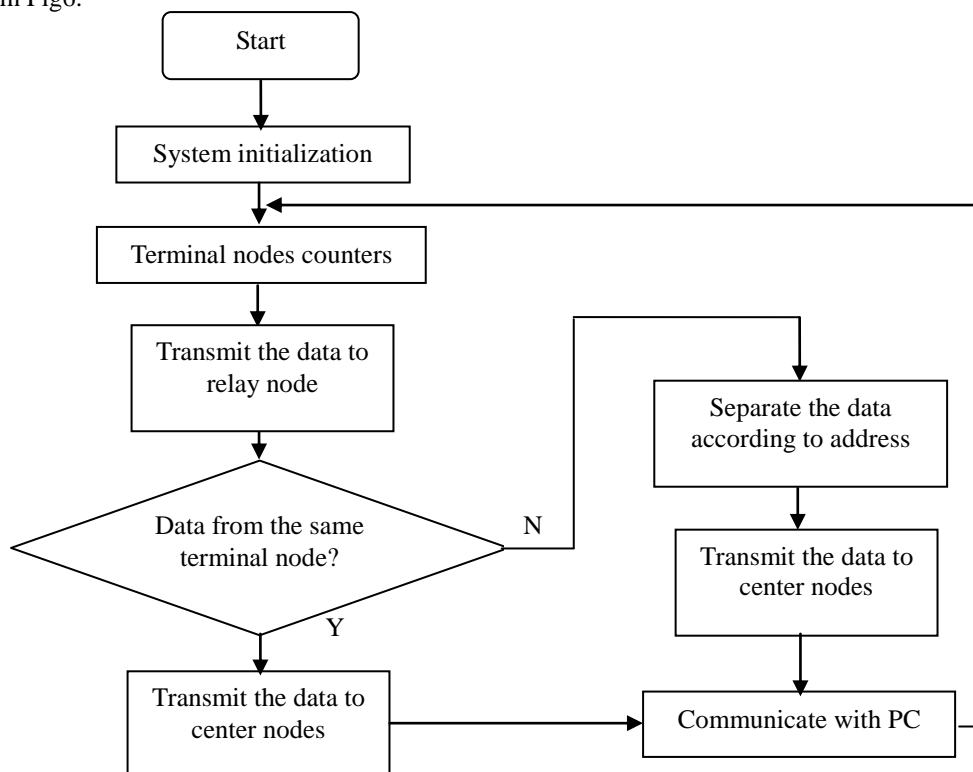

Fig.6. Main program flowchart

4.2 Counting program

The most important in detection program is that the sensor can not only sensing the students but also distinguish between in and out. So, in this system, two inductive probes are used, labeled as probe 1 and probe 2, to judge in and out. Setting a flag in the program, it will be given a different value according to the in and out of the students. The flowchart of the program is shown in Fig7.

The detection process is described as follow: when probe 1 discover there are students, Flag_1 and Flag_2 will be assigned with "1" and "0" respectively, and on this basis, if probe 2 discover there are students, the number of students add 1, that indicate there are a student come in , at the same time, Flag_1 and Flag_2 zero out, prepare for the next counter; similarly, if Probe 2 discover there are students, Flag_1and Flag_2 will be assigned with "0" and "1" respectively, and on this basis, if probe 1 discover there are students, the number of students minus 1, that indicate there are a student out , at the same time, Flag_1 and Flag_2 zero out, prepare the next counter.
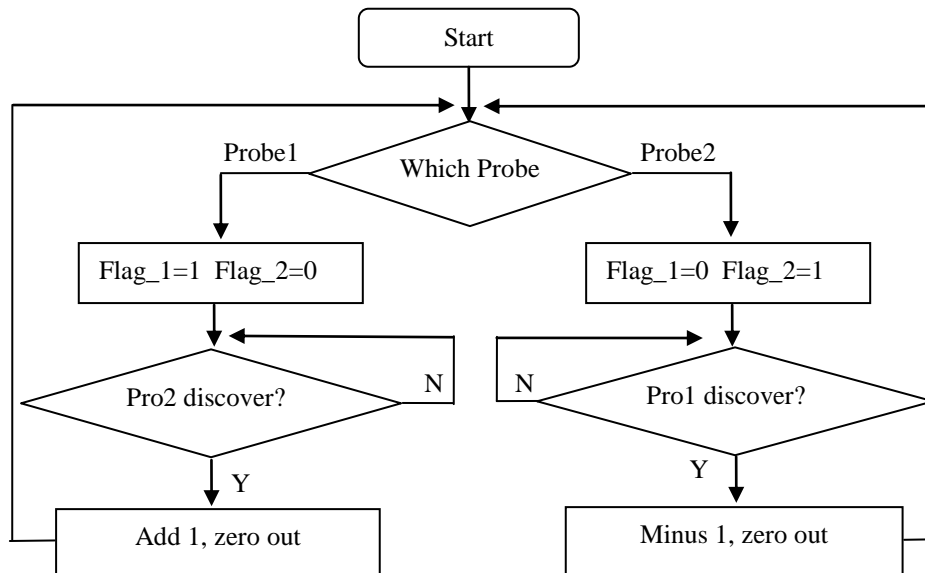

Fig.7. Flowchart of counting program

4.3 Computer display

The display of data on computer use Visual Basic language, Access database. The display interface is shown in Fig8. Current data and time is displayed on top right of the display interface, the upper left is a sent of pull-down menus. Users can select the classroom that they want to go from the pull-down menus, then get the information such as seating capacity and remaining seats etc. Below the interface, there are colorful indicator of the classrooms, red green and yellow indicates the number of students in the classroom respectively, when the number of students less than 1/3 of the number of seats, the color of the classroom is green which indicates few students in the classroom, when the number of students between 1/3 and 2/3 of the number of seats, the color of the classroom is yellow which indicates a number of students in the classroom, and when the number of students more than 2/3 of the number of seats, the color of the classroom is red which indicates many students in the classroom.

Fig.8. Computer display interface

V. EXPERIMENTAL DATA ANALYSIS

Do a test to the system to detecting the stability of the system. Take a classroom as the test room, observe the students in and out situation artificially and then compare with the computer display, check out whether the system correct. The test results are shown in Tab1. There is only one undercount, the system is relatively stable.

Tab.1. Test results

	Door 1				Door 2			
	In		Out		In		Out	
	Actual number In	Test number In	Actual number Out	Test number Out	Actual number In	Test number In	Actual number Out	Test number Out
1	10	10	6	6	10	10	6	6
2	15	15	8	8	15	15	8	8
3	20	20	10	10	20	20	10	10
4	30	29	15	15	30	30	15	15
5	50	50	21	21	50	50	21	21

Terminal node sensors of the system can detect the students accurately, the wireless RF module can transmit the data to the center node real-time exactly, and the computer display interface can show the correct number of students in the classroom, the system works stable.

VI. CONCLUSION

The search platform based on microcomputer and E18-D50NK IR evading obstacle sensor can be used for the students in the college to find suitable classroom do self-study. The system has advantages of low power consumption, simple circuit, easy to use, the computer display visually. Experiments showed that the system could work stable and accurately.

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