ISSN: 2664-9640

Scenic Environment and People Flow Inspection and Control System Based on OneNet Cloud

Yixin Xiong, Xiaoyan Li, Xinyu Tan and Yuming Shao

School of Electronics and Information Engineering, Xi'an Technological University, Xi'an 710021, China

Abstract

The environmental inspection and control system designed in this paper uses the main control system with STM32 as the core, and the air and soil temperature and humidity detection module, the light intensity detection module, the Wi-Fi module, and the One-cloud host computer. The monitoring system, as well as the Raspberry Pi 3B+ as the core, through the Raspberry Pi native high-definition camera, using YOLOV5 algorithm and the corresponding data set after processing, using OpenCV labeling, the realization of the pedestrian density detection system in the scenic spot. Solve the problem of how to detect temperature and humidity and other signals transmitted to the host computer for data processing, study how to receive and forward the data to the cloud server and implement the corresponding functions on the host computer, and finally realize a scenic spot with various natural environmental factors A multifunctional detection and control system with automatic detection and control functions, and capable of analyzing the flow of people.

Keywords

STM32, Raspberry Pi, Image detection, Sensor data collection, YOLOV5.

1. Introduction

The tourism industry has made outstanding contributions to China's economy. It has developed rapidly and the scale of the industry has continued to expand. However, the sudden outbreak of the epidemic has severely hit the tourism economy. Nowadays, it is difficult for the number of people in scenic spots to achieve real-time and reasonable diversion to ensure safety factors, so many scenic spots can only be opened There are so few people who enter the scenic spot that many tourists cannot enter the scenic spot. In addition, many scenic spots are not fully equipped with monitoring facilities. The measures such as insufficient temperature monitoring and data recording of tourists before entering the park have caused many tourists to be unable to enter the park. Feel free to go to the scenic spot.

In this context, we hope that based on the current situation of the tourism industry and the current social background, we can comprehensively analyze and construct a comprehensive system that can help the scenic spot to restore the order of production and life to the greatest extent, and has a multi-functional control function to solve social problems and improve The management efficiency of the scenic area, so that the scenic area can strengthen its own management and better win the opportunity of tourism recovery.

2. System Working Principle

The main control system with STM32 as the core, multi-sensor Wi-Fi module, and upper computer APP can detect the scenic environment and upload it to the cloud server and be controlled by the server. With Raspberry Pi 3B+ as the core, YOLOV5 is based on The official data set performs certain processing and realizes the detection of classes in the environment,

ISSN: 2664-9640

and uses OpenCV for graphic annotation to realize the detection of crowd density under certain limited conditions[1][2]

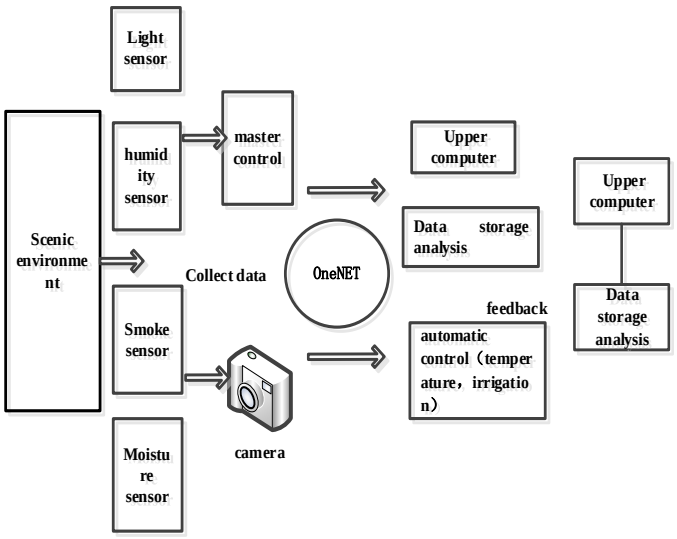

Figure 1: System working principle diagram

3. Hardware Design

The master or slave hardware is composed of CPU module, temperature and humidity acquisition module, MQ-2 smoke module, BH1750 light intensity detection module, Wi-Fi module, camera module, etc., hardware block diagram of voice broadcast module, motor drive module, and opto-coupler isolation module.

3.1. Microcontroller module

The main control module will be the core of the system, used to control each detection module and perform data operations. One of the main controllers used in this system is the STM32F103C8T6 single-chip microcomputer. C8T6 is selected as the main control chip from multiple aspects such as cost performance and CPU utilization, which can greatly increase the utilization of the CPU, improve the cost-effectiveness of the system and reduce the development cost. The other main control is the Raspberry Pi 3B+, which is an ARM-based micro-computer motherboard with SD/MicroSD card as the memory hard disk. There are 1/2/4 USB interfaces and a 10/100 Ethernet interface around the card motherboard (Type A does not have a network port), which can be connected to a keyboard, mouse and network cable, and has a TV output interface for video analog signals and an HDMI high-definition video output interface.

3.2. WiFi communication module

The WiFi module is implemented by a module. The ESP8266 has the advantage of low power consumption. This module converts the serial port to an embedded module that conforms to the Wi-Fi wireless network communication standard. It is easy to debug and connect to the serial port 2 of the main control for data transmission. The data transmission hub of the system hardware. This module realizes the data interaction between the hardware system and the cloud, transmits the data collected by the lower sensor to the cloud, and obtains the control commands issued by the upper computer from the cloud, which is particularly important in the operation of the system. The data is transmitted through the ESP8266 Wifi communication module and uploaded to the cloud in real time[3], which is shown as Figure 2.

ISSN: 2664-9640

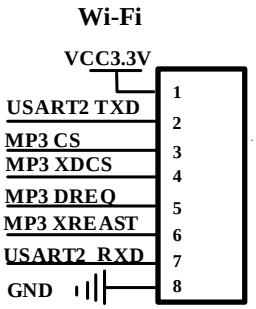

Figure 2: WiFi module

3.3. Temperature and humidity detection module

The SHT11 intelligent sensor can collect and display the temperature and humidity parameters in the greenhouse in real time [4]. It is packaged in DIP-8, with a relative humidity measurement range of 0-100%, a resolution of 0.03%, and the best accuracy is +-3%RH. The temperature measurement range is -40℃-123.8℃, the resolution is 0.1℃, and the best measurement accuracy is +-0.4℃. The power supply voltage range is +2.4-+5.5V, and the response time is less than 3s. SHT11 integrates a temperature sensor and a humidity sensor, and real-time monitoring of temperature and humidity has the advantages of high accuracy, low cost, small size, and simple interface. The sensor interface circuit is shown in the Figure3.

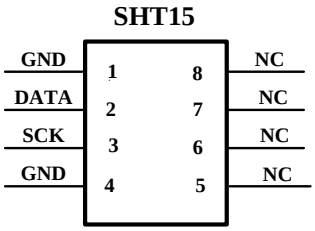

Figure 3: SHT15 module

3.4. Light intensity collection module

Light intensity is also one of the most important parameters for plants and people. The impact on people can be judged through the perception of light intensity. If the light intensity is too large, tourists in the scenic spot will be reminded to pay attention to sun protection to prevent heat stroke. In this system, the BH1750 light intensity sensor is used, which is a sensor with IIC interface, and the data collected is more accurate.

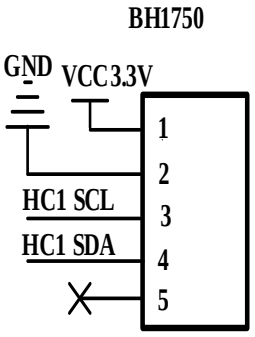

Figure 4: BH1750 module

3.5. Smoke sensor module

Smoke is one of the important indicators for judging air quality. The smoke detection alarm of the MQ-2 sensor [5] has a very wide detection range, and has the advantages of high sensitivity, fast response and good stability. In actual use, the smoke detection alarm. The greater the

ISSN: 2664-9640

concentration is, the greater the conductivity is, the lower the output resistance is, and the larger the final output analog signal is.

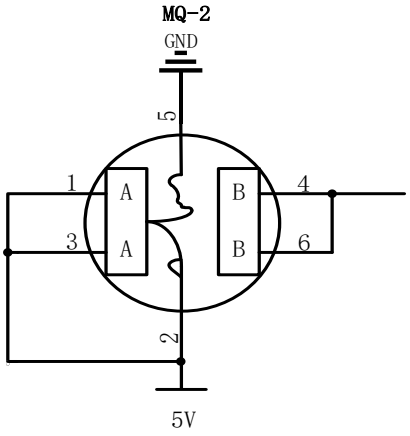

Figure5: MQ-2 module

3.6. Motor drive module

The L298N motor drive control module [5] is a dual H-bridge motor drive chip, where each H-bridge can provide 2A current. The power supply voltage range of the power part is 2.5-48v and the logic part is 5v power supply, accepting 5v TTL level. Under normal circumstances, the voltage should be greater than 6V.

3.7. Opto-coupler isolation module

Use low level to control high level. For example, the 3V or 5V voltage of the single-chip microcomputer is used to control the 9V or 12V voltage. HVCC should not exceed 24V. The output current of the output port OUT1/OUT2/OUT3/OUT4 is equal to HVCC/5.1K, and the absorption current is 500mA.

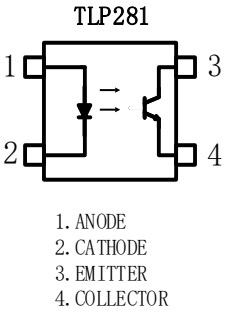

Figure6: TLP281 module

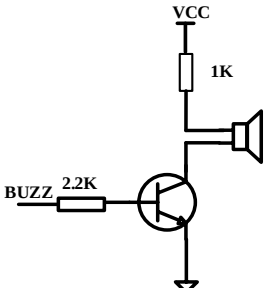

Figure7: Alarm module

ISSN: 2664-9640

3.8. Buzzer alarm module

When the host finds that the light intensity is too high, it needs to prompt and alarm. When the BUZZ and LED are high, the transistor is turned on and the buzzer has current to realize the sound and light alarm function to effectively control the buzzer [6] Principle The figure is shown in Figure 7.

4. Software Design

4.1. Embedded software design

The embedded program includes the detection part of STM32 and the image processing part of Raspberry Pi. STM32 adopts C programming language to realize modular design,compiling and debugging in the Keil5 environment. Interrupts, sub-functions, STM32 function library and so on were used to complete the program. The Raspberry Pi part uses Python and calls the YoloV5 algorithm and OpenCV library to implement functions. The main flow chart is shown in Figure 8.

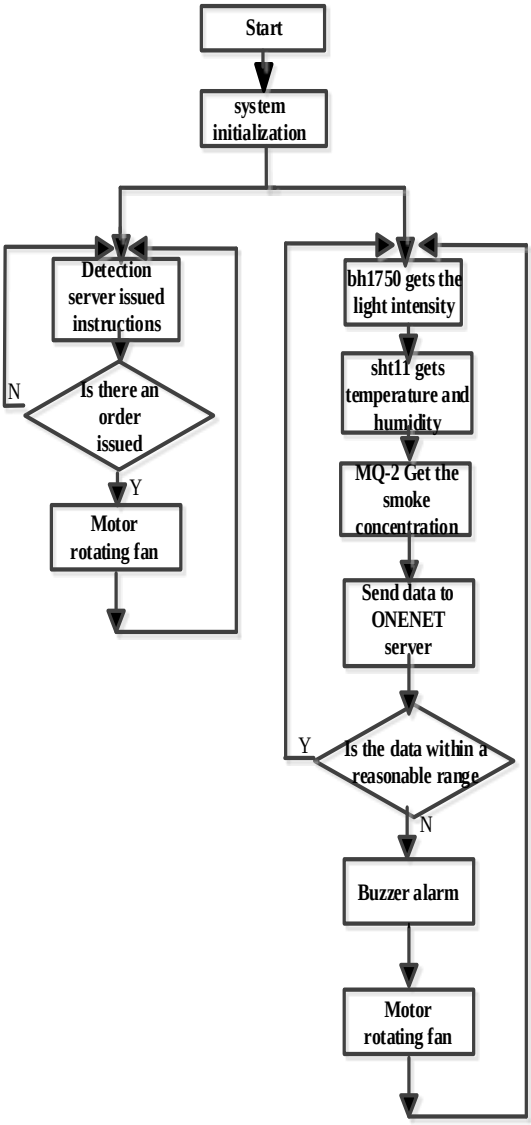

Figure 8: Software flow chart of embedded software

4.2. PC software design

The PC software performs real-time data viewing, data storage and control of the lower computer through the One-net view visualization platform. In the system setting interface, you

ISSN: 2664-9640

can configure the cloud address and device ID to obtain cloud data. Through the database viewing interface, you can view historical data and provide historical data reference. The upper computer interface is also designed with a data query interface and a curve drawing interface. It is convenient for users to view real-time data. In addition, it also includes a system control command sending module, which can realize the transmission of control commands. The control commands are transmitted to the cloud, and the cloud transmits the data to the lower computer to realize the control of the lower computer.

Realize the display of data such as light intensity, temperature and humidity, flammable and explosive gas concentration on the host computer, and the operation of the cooling module can be controlled by the host computer to issue instructions, which is convenient for better management of the entire scenic spot. The human flow detection part and the display of the alarm part are shown in Figure 9.

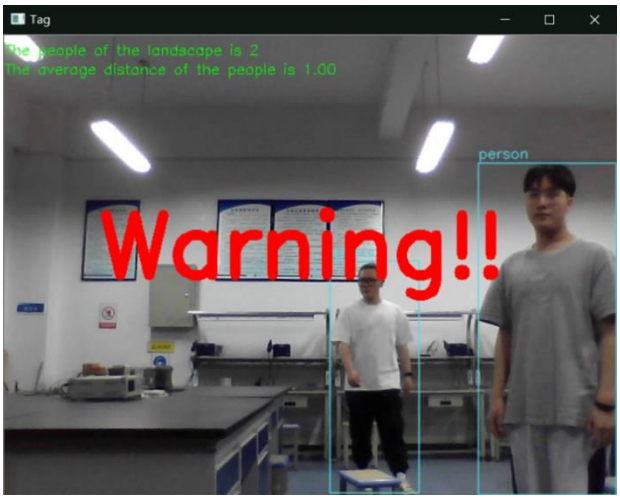

Figure 9: Human flow detection of PC software

5. Conclusion

Recently, through the correct coordination and leadership of the country, the epidemic has gradually been brought under control, and most scenic spots have gradually opened up. Based on the current situation of the tourism industry and the current social background, our system has comprehensively analyzed and structured a structure that can help scenic spots to maximize production and life. A comprehensive system with order and multifunctional control functions can solve social problems and improve the management efficiency of scenic spots, so that scenic spots can strengthen their own management and better win opportunities for the recovery of the tourism industry.

Acknowledgements

This work is supported by National Undergraduate Innovation and Entrepreneurship Training Project of China (S202010702042).

References

[1] Q.Y. Sun, Z.D. Zhang. Crowd Density Estimation Based on YOLOv3 Enhanced Model Fusion, Computer Systems & Applications, vol. 30 (2021) No. 4, p.271-276.

[2] Q.X. Wang, L. Tu, Q.Y. Shao, et al. Water-quality Monitoring System in Swimming Pool Based on One-Net Cloud, Scientific and Technological Innovation, (2021) No. 19, p.37-39.

[3] Y.C. Xie, L. Yang, J. Yan. Design of Smoke Detection Alarm Based on MQ-2 Sensor, Computer Measurement & Control, vol. 29 (2021) No. 8, p.255-259.

ISSN: 2664-9640

[4] S.N. Liu, Y.L. Zhang. Design of Temperature and Humidity Control System Based on SHT11, Application of IC, vol. 37 (2020) No. 4, p.154-156.

[5] S.Y. Chen, L. Mu, X.W. Wang. Design of Warehouse Alarm Intelligent Car Based on Arduino, Equipment Manufacturing Technology, (2021) No. 6, p.30-33,52.

[6] C. Chou. Design and Implementation of Kitchen Gas Leak Detection and Alarm System Based on STC89C51, Electronic Test, (2021) No. 7, p.32-33.