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CES-RBOT15

Product Manual

Intelligent Robot Innovation Experimental Platform

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Chapter 1 First acquaintance of intelligent robot experimental platform

Before using this intelligent robot innovation experimental platform, we need to have a general idea of the platform. Hailian Intelligent Robot Innovation Experimental Platform, developed by Haitianxiong Electronic, takes Cortex-A15 high-performance ARM chip as the host computer to control the behavior of the robots. The platform can work independently according to different experimental requirements.

1.1 The purpose of developing innovative experimental platform

From the initial appearance to today, robot has gone through three stages: the first stage belongs to the teaching and reproduction type, the second stage is equipped with the feeling ability, the third generation is a smart robot with thinking, not only has the feeling ability, but also has the ability of memory, reasoning and decision-making, which can finish much more complex movements.

Today, the application scope of intelligent robot has been greatly expanded, in addition to industrial and agricultural production, the robot has been applied to all walks of life, and has initially possessed the characteristics of mankind, function is also closer to human beings. However, there are few resource system platforms for researching robots in universities. Facing the needs of reality, Haitianxiong Electronic invested a lot of resources, developed an innovation experiment platform which is especially used for robot development and learning, thus let those who are interested in robots researching have more convenient and professional learning resources, so as to develop their own personality robots.

1.2 Composition of Innovation Experiment Platform

Intelligent robot innovation experiment platform is consist of two major parts:

- (1) host computer system (ARM chip)
- (2) lower computer system (51 chip)

The two parts together form a complete system to finish a lot of experiments with PC-controlled robot project.

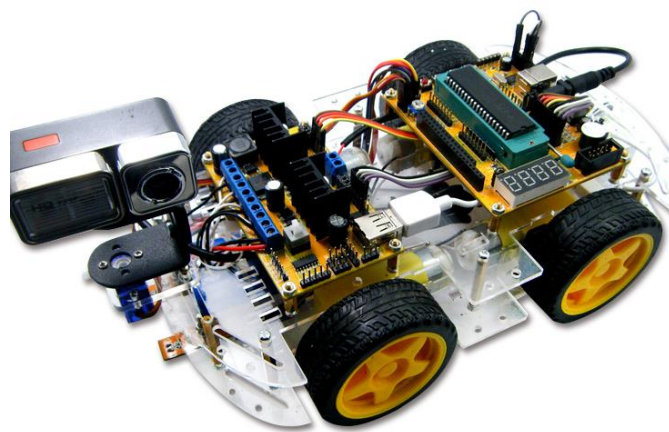
- The host computer

The host computer (Samsung Cortex-A15 5260 ARM chip) is mainly used to run Android applications that control the robot. This system has a wealth of peripherals which can be used to learn Android application development and ARM chip. It can also be used as the teaching platform of entire embedded system. Specific as below.



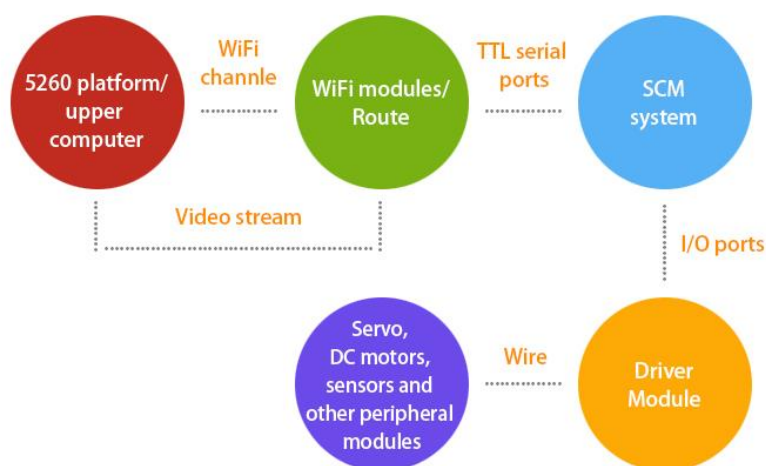
- The lower computer

The lower computer (AT89C51 series chip) is to control the robot's behavior according to the commands sent by the upper computer. The system has the peripherals(LED, digital tube, buzzer, etc.) of general 51 single-chip microcomputer, which can be used independently and has a large number of sensors , such as servo, ultrasonic, DC motor, camera and so on. Specific as below,



Chapter 2 The fundamental of intelligent robot experimental platform

This Wifi intelligent robot is controlled by the host computer, through WiFi routing channel as well as the environmental factors detected by the lower computer to determine the situation back to the host computer, so as to achieve intelligent control. In addition, it can be operated without control. The general process is shown below



The above process is composed of five major components: The upper computer 5260 platform (running Android program), WiFi routing module, single-chip microcomputer and driver module as well as the perception and control system of robots.

2.1 The application of host computer

Host computer application is written and designed by Android application program, while 5260 platform itself can learn Android apps. In addition, for the host computer Android source code of intelligent robot experimental platform, the main functions are as follows:

- (1) Receive sensor data received from the car sensor
- (2) Through the camera to show the real-time environment around the car so as to control the direction of it

- (3) Programming control command
- (4) Programming WiFi connection program
- (5) Use the horizontal column to control the rotation of the servo

The code used to implement the above function is just a simple control example whose purpose is to make a difference and have our users familiar with the products, so as to design and develop their own rationale works.

2.2 WiFi routing module

Brush the ordinary wireless router into the open source OpenWrt system, making it a small computer running a Linux system. what is OpenWrt?

Instead of trying to build a single, static system, OpenWrt can be described as an embedded Linux distribution, with mainstream router firmware dd-wrt, tomato, and OpenWrt. OpenWrt's package management provides a fully-writable file system that provides selection and configuration from application vendors and allows you to customize your device to suit any application.

For developers, OpenWrt uses frameworks to build applications without creating a complete firmware to support. For users, that means they have a full customizable capability to use the device in an unprecedented way.

OpenWRT is a highly modular and highly automated embedded Linux system with powerful networking components and scalability. It is often used in industrial equipment, telephones, small robots, smart home, routers and VOIP devices. Meanwhile, it provides more than 100 compiled soft-wares, and the number is still increasing, OpenWrt SDK simplifies the process of developing software.

Unlike many other releases for the router, OpenWRT is a fully functional, easy-to-modify router operating system written from scratch. In fact, this means that you can use the features you want without any additional cumbersomeness, and the Linux kernel that supports these features is far newer than most of the distributions.

The above description comes from baidu encyclopedia.

In this platform, OpenWrt system has been configured well. If you want to know more, please refer to the information provided in the CD.

2.3 Single-chip microcomputer and driver module

Microcontroller system is also one of the most simple small computer system. Since the frequency is very low, it is not suitable for big data computing. The main function of which is to drive motor chip by controlling the level of the I / O ports to have the robot moving forward and back.

We name the program running inside the microcontroller system lower computer. The role of this program is to accept instructions from the host computer, analysis decoding and understand what action the user is sending, then let the designated pin level of the microcontroller to assign the value. The upper sending unit of this instruction is WIFI module, that is routing, and then the upper level is host computer.

Here we would like to introduce TTL serial port. TTL serial port is a communication serial port with three wires generally: TX to send data, RX to receive data, GND earth wire. SCM is communicated via this TTL serial port and the upper WiFi module.

The source code we provided mainly to complete the following functions:

- (1) To communicate with the serial port and WiFi module by interrupting
- (2) Receiving and decoding the instructions send by Wifi module of the host computer
- (3) Running the corresponding behavior program by instructions
- (4) Collecting the data of the surrounding sensors
- (5) To make the car operation according to the tracking sensor.

2.4 The perception and control system

The so-called robot, from one aspect, is that it can feel the surrounding environment and according to different environment to make an appropriate response like people. However, changes in the perception of the environment are generally sensed by the sensor and the reaction is to act via the control system on the data from the sensor.

Our system can be equipped with a wide range of sensors with different usages, and to act with DC motor or servo according to the data getting from sensor. In addition, since many I / O ports we reserved in the microcontroller are connected through wire, so you can flexibly change the sensors for different purposes, and can use a sensor separately. In this system, main functions are completed by ultrasonic and tracking sensors.

Chapter 3 What can this intelligent robot innovation experiment platform do?

As mentioned in previous introduction, our platform is an open resource platform which can make your own robot according to the individual idea and can be used as a learning primer. Since we can not introduce all purposes of it one by one, here we will give a reference catalog for on-campus student teaching for introductory learning.

3.1 Host computer Android control experiment directory (only system related parts)

In this system, the experiments we can do are all consistent with the features of Android4.4 application. In other words, we may use this system to develop and learn high-end complex Android applications.

Here are just a few of the relevant experimental directories.

Item	Experiment
1	Surface image data display experiment
2	WiFi connection experiment
3	Wifi network communication experiment
4	Interface layout experiment
5	Android basic component experiment
6	Android data storage experiment
7	Android system JNI experiment

3.2 Lower computer control experiment directory

Similar to the host computer, lower computer can also run C51 development control procedure. The experiment directory we given is to familiar with the lower computer and control the robot. The directory is as follows:

Item	Experiment
1	LED display experiment
2	Marquee experiment
3	Digital tube display experiment
4	Key experiment
5	Dynamic digital display experiment
6	Control steering gear experiment
7	Ultrasound data collection experiment
8	Tracking sensor data collection experiment
9	Buzzer experiment
10	Serial experiment

3.3 The overall organic combination of experiment directory

Item	Experiment
1	The overall host computer program source code analysis experiment
2	The overall lower computer program source code analysis experiment

Chapter 4 The experiment directory of intelligent robot innovation platform

Experiment Directory	
Chapter 1 Introduction of robot innovation experiment platform	1.1 Introduction of host computer 1.2 Introduction of lower computer 1.3 Introduction of working principle
Chapter 2 Construction of development environment	2.1 Build the development environment of host computer 2.2 Build the development environment of lower computer 2.3 Program burning and testing of bare computer 2.3.1 Image burning of host computer 2.3.2 Image burning of lower computer 2.3.3 Introduction of overall measurement method
Chapter 3 Host computer Android application program	Experiment 1 Activity elementary experiment Experiment 2 Activity and Intent experiment Experiment 3 Android layout experiment Experiment 4 SharedPreferences application experiment Experiment 5 Notification and Toast experiment Experiment 6 Dialog experiment Experiment 7 WiFi connection Experiment 8 Android basic control experiment Experiment 9 Brostcat Broadcast experiment Experiment 10 Backstage service application experiment Experiment 11 ContentProvider data sharing experiment

	<p>Experiment 12 UART serial communication experiment</p> <p>Experiment 13 G-SENSOR gravity sensor experiment</p>
Chapter 4 Lower computer application experiment	<p>Experiment 1 LED flashing experiment</p> <p>Experiment 2 LED water lamp experiment</p> <p>Experiment 3 Independent key experiment</p> <p>Experiment 4 Digital tube display experiment</p> <p>Experiment 5 Buzzer experiment</p> <p>Experiment 6 PWM pulse modulation experiment</p> <p>Experiment 7 Ultrasonic ranging experiment</p> <p>Experiment 8 Servo control experiment</p> <p>Experiment 9 DC Motor Control experiment</p> <p>Experiment 10 Timer clock experiment</p> <p>Experiment 11 Digital melody experiment</p> <p>Experiment 12 Binary addition experiment</p> <p>Experiment 13 Stopwatch timer experiment</p>
Chapter 5 Overall unit combination experiment	<p>Experiment 1 Car control experiment</p> <p>Experiment 2 Host computer experiment</p>
Appendix A FAQ and Maintenance	
Appendix B Solution of software can't be downloaded on lower computer	

Appendix The parameters of intelligent robot innovation platform

1. Host computer 5260 parameters

5260 platform parameters	
CPU	Exynos5260 consisting of two Cortex-A15 and four Cortex-A7 , with frequency at 1.7GHz
RAM	2GB , Samsung K4B4G1646Q DDR3 chip , frequency is 1600MHz
FLASH	16GByte , Samsung KLMAG2GEAC iNAND chip
PMU	S2MPA01 power management chip
OS	Android 4.4.2
Display Interface	Support multi-display function, the platform is equipped with 9.7-inch LCD touch screen, pixel 2048 * 1536, LED backlight
Ethernet	10M / 100M ethernet interface, using DM9621ANP card chip
Audio Interface	IIS signal, use WM8976 high quality chip, with amplifier and speaker
HDMI	1*HDMI interface
UART Serial	4*UART interface
SD/HSMC Serial	For SD card and WiFi use
USB Serial	4*USB2.0 , 1*USB3.0
I/O Serial	Lead IO pin for control and interrupt
WiFi	Support IEEE802.11b / g / n agreement, SDIO interface
Bluetooth	For high-speed bluetooth data communication
4G	Support ZTE SIMCOM7100C chipset, PCI Mini Care interface
GPS	Support SIDIII global positioning, UART serial data interface
Camera	800-megapixel camera
IRDA	1 set of infrared detection device
RTC	Internal real-time clock (with back-up lithium battery)
External Power Supply	AC220 DC12V/5A power adapter
Size	51*38*15CM


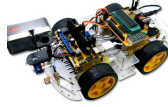












2. Lower computer single board computer parameters

- Enhanced 8051 CPU, 1T, single clock / machine cycle, instruction code is fully compatible with the traditional 8051
- Operating voltage: STC12C5A60S2 series operating voltage: 5.5V-3.3V (5V microcontroller)
STC12LE5A60S2 series operating voltage: 3.6V-2.2V (3V microcontroller)
- Operating frequency range: 0 - 35MHz, equivalent to the ordinary 8051 0 ~ 420MHz
- User application space 8K / 16K / 20K / 32K / 40K / 48K / 52K / 60K / 62K bytes
- On-chip integrated RAM1280 bytes
- General purpose I / O port (36/40/44), after reset: quasi bidirectional port / weak pull-up (ordinary 8051 traditional I / O port)
Can be set to four modes: quasi-bidirectional port / weak pull-up, push-pull / strong pull-up, only input / high resistance, open drain. Drive capability of each I / O port can reach 20mA, but the maximum chip should not exceed 120mA
- ISP (programmable in system) / IAP (programmable in application), no dedicated programmer and simulator required, can download the user program directly by serial port (P3.0 / P3.1) and complete in a few seconds
- With EEPROM function (STC12C5A62S2 / AD / PWM, without internal EEPROM)
- Internal integrated MAX810 reset circuit (when the external crystal is below 12M, the reset pin can be direct to ground by 1K resistor)
- External power-down detection circuit: There is a low-voltage threshold comparator at port P4.6. The voltage for the 5V microcontroller is 1.32V, the error is +/- 5%, the voltage for the 3.3V MCU is 1.30V, and the error is +/- 3%
- A total of four 16-bit timers, two 8051-compatible timers / counters, 16-bit timers T0 and T1, no timer 2, but has an independent baud rate generator for serial communication, plus 2-way PCA module which can achieve another two 16-bit timers
- Buzzer: passive buzzer, you may play music by programming
- Digital tube: four 8-segment digital tube
- Key: five independent keys
- I / O: lead out multiple I / O ports
- LED: multiple independent LED

3. Sensor control parameters

UI100 Ultrasonic	Working voltage: 2.4 ~ 5.5V
	Current: 2mA
	Temperature: -20 ~ +70 degrees Celsius
	Distance: 20cm ~ 450cm
	Accuracy: 0.3cm
Towerpro Steering Gear	Working voltage : 3.5 ~ 6V
	Weight : 9g
	No-load speed: 0.12 seconds / 60 degrees
	Deadband setting: 5 microseconds
	Temperature: -30 ~ 60 degrees Celsius
	Torque: 1.6kg.cm
Tracking Sensor	Working voltage : 4.5 ~ 5.5V
	Power consumption: 20mA
	Accuracy: 0.3 ~ 1.5cm
	Return value: 0/1
BNT Phase Camera	Resolution: 1280 * 720
	Photosensitive components: CMOS
	Max frame rate: 60FPS
	Imaging distance: 30cm
	Interface type: USB interface

Product configuration list

	The host computer		The lower computer
	User CD		Power adapter
	Experimental tutorial		Touch pen
	Serial line		Camera (optional)
	cable		4G module (optional)
	USB cable		SD card (optional)
	USB to serial port		IP Camera (optional)

service support

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Technical Support Service Hours:

Monday to Friday : 9 : 00 ~ 12 : 00 , 13 : 30 ~ 18 : 00

Disclaimer

This manual information is for reference only, and is subject to change without notice. For more product information, please visit www.nrisc.com

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