

Design of a smart classroom based on OpenHarmony

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Abstract: There are many intelligent equipment manufacturers in the traditional wisdom classroom, and the control software used is various, so the operation is not convenient, and the equipment can not be unified control. And the system used by the equipment is not domestic autonomous and controllable, and the integration degree with education and teaching is also low, and the educational role is small. Therefore, a smart classroom scheme based on OpenHarmony is designed. This paper mainly describes the background, structure and implementation of the scheme design, including OpenHarmony intelligent central control, Internet of Things gateway, classroom central control software, digital twin, integrated management platform and other modules development and design. Through OpenHarmony, the scheme realizes the localization of the classroom intelligent device system and the connection of the whole scene, which provides convenience for the unified control of the classroom; At the same time, through the digital twin smart classroom system and other central control software to increase the education space of the classroom, so that the classroom can play a greater educational significance.

Key words: OpenHarmony Central control Internet of things Close smart classroom Digital twin

1. Introduction

OpenHarmony is an open-source distributed operating system donated by Huawei and co-built by developers all over the world. Openharmony is a “new and open” domestic autonomous controllable operating system with features such as all-scene and distribution. It not only solves the problem of “stuck neck”, but more importantly, it tries to solve the fragmentation problem faced by the Internet of Things at the level of the operating system. As an operating system independent of Android and iOS, it is not only a mobile phone operating system, but also an operating system for the Internet of everything, providing the industry with a new choice to prepare for the Internet of everything.

The state attaches importance to the development of OpenHarmony, open source and independent operating system has been included in the 14th Five-Year Plan, 2022 Ministry of Industry and Information Technology: will accelerate the incubation and opening of a number of open source projects such as Harmony, improve the open source policy system, formulate and implement the “14th Five-Year Plan” software and information technology service industry Development Plan, the prosperity of open source ecology and other related tasks to be implemented in detail. Fuzhou, Shenzhen and other local governments have issued relevant policies to encourage enterprises and schools to carry out the development and application of OpenHarmony. Therefore, combined with the teaching application scenarios in the field of smart education, a smart classroom solution based on OpenHarmony is designed, which can be applied to smart classroom, maker classroom, laboratory and other scenarios.

2. Solution Overview

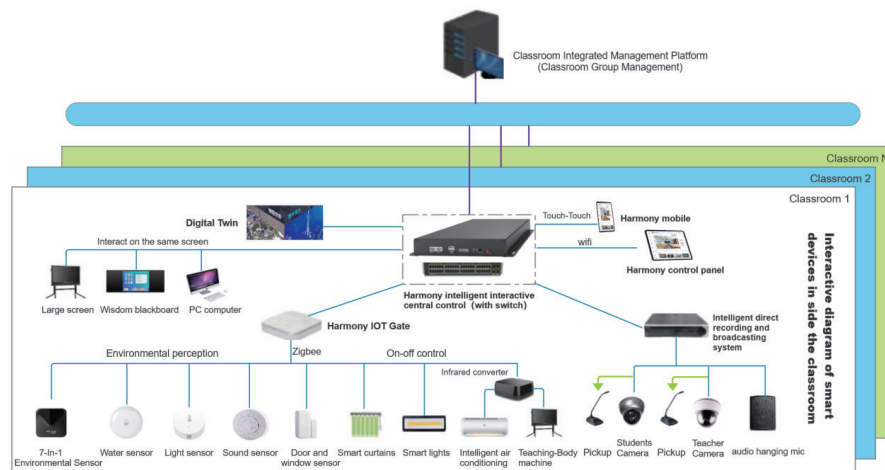
The smart classroom scheme design includes infrastructure layer, support platform layer, application platform layer and application terminal. Among them, the infrastructure layer is the perception control device and display device with Harmony Central Control as the management center. The support platform includes data exchange, data processing, data service, support platform, unified interface, etc. The application platform layer includes intelligent iot system, direct recording and broadcasting system, interactive teaching system, intelligent teaching auxiliary system, Harmony characteristic demonstration system and intelligent classroom integrated management system. The system is oriented to teachers, students and administrators, and supports intelligent terminal clients such as Harmony mobile phone and tablet, as well as computer web page access.

As the core device of the solution, Harmony Intelligent Interactive Control is based on the OpenHarmony system, and uses cloud computing, big data, AI intelligence, Internet of Things and other technologies to connect the classroom’s environment perception, electrical control, direct recording and broadcasting devices, and supports access to other Harmony ecological devices to gather and process classroom data information. It can not only display and control through the Harmony control panel, but also touch the central control/control panel with the Harmony mobile phone to view and control the status of related devices in the classroom in real time, and enhance the learning space by using the digital twin scenario. The system has the following advantages: ① popularizing OpenHarmony, ② edge computing to improve computing efficiency and protect data privacy and security, ③ education + universe to enhance learning space, expand education scenarios, ④ low-cost and lightweight transformation, ⑤ compatible and extensible.

3. Scheme composition and implementation method

The whole scheme mainly includes Harmony intelligent interactive control, Harmony control panel, Harmony mobile phone, Harmony Internet of Things, digital twin, direct recording and broadcasting system and integrated management platform. The system architecture diagram is as follows:

System architecture diagram



3.1 Harmony Intelligent interactive control

The main control chip of Harmony Intelligent interactive central control adopts Rui Xin Micro RK3568 quad-core 64-bit processor, supporting a variety of communication methods, wired configuration of double gigabit adaptive Ethernet port, wireless through WiFi and BT4.0. Support multi-screen display, with MIPI-CSI, MIPI-DSI, HDMI2.0, EDP video interface, NPU support 0.8T computing power, support INT8, INT16, FP16 operation. On-board standard SATA3.0 interface, support SATA hard disk expansion, the operating system adopts OpenHarmony, support full scene connection, easy to upgrade and expand the equipment in the later period of the classroom, support the fast matching and docking of Harmony device.

For the classroom brain and digital base, unified connection of classroom perception, audio and video and display devices, the classroom data information convergence, processing and display. The specific performance is: (1) real-time monitoring and control of iot sensing equipment, including environmental perception monitoring and automatic adjustment, as well as network monitoring, real-time intelligent analysis and feedback of equipment usage; □ Docking and unified management of direct recording and broadcasting system, electronic class board, large screen and other equipment; □ operation of virtual scenes such as digital twin classroom system and display of each display terminal; Based on the OpenHarmony, for the whole scene link, to prepare for the future interconnection of new devices; □ As a local server in the classroom, it supports the deployment and service of related application systems, such as screen interaction services and face detection models can be run on the local central control.

3.2 Internet of Things gateway

The Internet of Things gateway can be an independent module, or it can be built into Harmony Intelligent interactive control, combined with different application scenarios, using different ways, for the need to use the scenario of central control, the built-in way is used, and the cost performance is higher. The wireless module adopts the wireless system-on-chip module SoC module E72, which is a ZigBee3.0 AD hoc wireless module. Use Zigbee communication mode to connect Zigbee node devices, such as temperature and humidity and other environmental sensors, so as to achieve real-time monitoring of environmental parameters. Through Zigbee infrared converter to realize the switch of infrared control equipment, such as air conditioning, projector, TV, all-in-one and so on.

3.3 Classroom control software

3.3.1 Intelligent iot system

Based on the Internet of Things technology and environmental detection technology, the central control intelligent Internet of Things system realizes the intelligent perception of the classroom environment parameters, and automatically adjusts them through predetermined strategies, and timely reports abnormal situations. The whole system includes three modules, namely intelligent perception, intelligent control and intelligent management. □ Intelligent perception: temperature and humidity, illuminance, PM2.5, door sensor status monitoring and centralized display; □ Intelligent control: air conditioning, lighting, sound, integrated machine, curtain switch centralized control; Intelligent joint control: such as temperature and humidity environment control, according to the real measured value of the environment and set the target parameters, automatically adjust the operation of the air conditioner or fan, automatically control the temperature and humidity of the environment, to ensure that the classroom is always in a healthy and comfortable environment; □ Intelligent management: device use, status, times, power consumption to view, to achieve remote device alarm, remote control, to achieve energy consumption management.

Through the central control application of Harmony mobile phone or tablet computer, one-button switch control lights, air conditioners, curtains and other equipment, and provide local personalized configuration, to achieve one-button on, class mode; According to the class schedule, timely turn off the lights, air conditioning, statistics and display the energy consumption of each room, to achieve the purpose of energy saving and consumption reduction; The door is not closed, smoke and water flooding and other abnormal alarm push, to achieve safety management.

3.3.2 Interactive teaching system

Through the interactive teaching system, the video stream can be pushed and managed. For the multi-screen seminar room, any 1

screen can be the main screen, share the screen to other screens, and the screenshot can be saved to the central control. The multi-terminal wireless screen projection, the effective interaction between the teacher screen and the student group screen, the traditional classroom has become a learner-centered new learning space.

3.3.3 Intelligent teaching assistance system

Connecting with the school educational administration system, combined with the class schedule, the teaching materials of the teacher's web disk will be automatically synchronized to the local central control of the classroom before class, or the teaching resources of the web disk can be manually synchronized to the central control with one key, and the teacher does not need to carry the U disk for copy. In addition, the system provides small teaching tools: attendance, sign-in, selection, grouping, voting, homework, discussion, ranking, etc., to improve teaching interaction and quality.

3.3.4 Direct recording and broadcasting system

Through the video streaming server of the classroom integrated management platform, the central control realizes the centralized control of the direct recording and broadcasting system. In the application of Harmony mobile phone or Harmony tablet computer, one-click direct recording and broadcasting can be performed and viewed.

3.3.5 Face detection system

Artificial intelligence models such as face detection are run on the central control system to store sensitive data, such as face images locally. The central control operation model realizes edge computing, and reports the processed result data to the cloud to avoid sensitive data leakage and data transmission delay caused by face data comparison in the cloud.

3.4 Digital twin intelligent learning environment system

3D modeling of the classroom, integrated control of classroom iot devices, integrated teaching 3D animation demonstration, can demonstrate the Internet of things control, Internet control principles. To realize the learning environment 3D management interaction, based on the acquisition of multiple data such as real-time sensing, the twin can comprehensively, accurately and dynamically reflect the state changes of the physical environment. The operating state of iot devices such as environmental perception, sound, curtains, air conditioning and lighting in the classroom and the virtual state co-evolve, so as to optimize the space management of the learning environment and create an intelligent teaching field. Through vivid 3D animation, the underlying principles such as abstract soft bus technology, transmission and communication process, networking and interaction process are vividly displayed.

3.5 Classroom integrated management platform

For a single classroom, it can be managed using the central control, and for multiple classrooms, it is necessary to conduct unified management through the classroom integrated management platform. Each classroom is bound to a unique number of the central control and its controlled equipment, the platform and the central control data docking, real-time monitoring of the central control data of each classroom unit, and remote control.

4. Summary

Through the application of Harmony intelligent central control, Internet of Things gateway and other devices, not only the system is homemade, so that the intelligent devices in the classroom can be real-time monitoring and unified control, which is easy to expand and access the equipment in the later period, but also make all the devices in the classroom can be used for teaching! Deploy routers and other Internet devices in the classroom to build a small Internet, so that students can understand the operating status of the real network environment. Deploy iot devices in the classroom, including iot sensing, gateway, central control and other devices, and build a small iot system to achieve data collection, real-time transmission and control functions, so that students can understand the meaning of the Internet of everything. The use of virtual simulation, digital twin and other technologies, through vivid three-dimensional animation, the abstract technology and communication interaction and other underlying principles are vividly displayed, so that the hidden technology is "visible", so that the theory of science and technology is "alive", improve the interest of students, so that the classroom can play the teaching value. It solves the common phenomenon that students' understanding of high-tech only stays on the surface, improves the scientific and technological literacy of teachers and students, helps enhance the depth of students' learning, and cultivates their innovation ability.

This solution has been demonstrated in a number of universities and primary and secondary schools, OpenHarmony can be applied to a variety of smart devices, the smart classroom application is only one of them, and will continue to expand its more applications, promote the growth of HarmonyOS, to prepare for the Internet of everything.

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