

Automatic Wireless Embedded Projector Player System

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Abstract— We present an automatic embedded projector player system with wireless network. Embedded system substitutes for the personal computer system, the latter usually plays role of player for projector nowadays. The player system solves the problem of cable complex layout of projector by using the wireless network. We also recommend a new remote control handle with wireless network and USB storage port, which can read files from flash disk and upload these files to player system, and can operate the player system of projector completely. It has advantages of no PC, low cost, low power consumption, and high convenient. This paper gives the hardware and software architecture of the player system, and discusses the design in detail. At last, we show a prototype, and experiments were demonstrated the validity of the proposed system.

Keywords – Projector, Player System, Embedded Micro Processor, Wireless Network

I. INTRODUCTION

With the rapid advances of modern technology, projectors are widely being adopted in many fields, such as school education, modern business conference and domestic entertainment. However, some common problems disturb the effective use of projector currently, these representative problems are as follows.

Projector depends on extra computer device. In fact, an individual physical projector typically requires an image display device, so it must cooperate with a play device. The best common play device is Personal Computer (PC) or laptop. When a special PC is assigned to a projector, it has little efficiency, but the total setup costs of whole system which includes projector and PC will be more expensive. At last, PC station often has few stability and reliability.

Conventional Projector has trouble with complex cable layout. A common projector has a cable which carries image input signal, and the another end of cable is connected by play device such as PC station. A common scenario is as follows, in a business forum, everyone who will give a lecture have to pull out the cable of projector from the previous PC and plug it in his notebook PC, it's too inconvenient. When we often pull out and plug the cable interface many times, the spins of cable interface will be broke likely, so the projector doesn't work no longer until the old cable interface is replaced. Though an advanced projector today has 802.11(b/a/g)-based wireless

connectivity, the projector still require a PC as above said, and the usage of it is still complex and inconvenient.

Operating the physical projector and its player has many limited in space. A typical projector has a remote IR controller, but the controller cannot operate the player (i.e. PC) of projector. Some PC have wireless point device, but the device cannot operate the projector. Considering a familiar case, in multimedia education classroom, a teacher will go to PC when he want to run a program, and he has to go to projector screen when he want to explain the key knowledge, and he need to go to place of student when the student ask him to a single question. So the teacher has to beat up and down among PC, projector screen and students, it's too troublesome and has no efficiency. Today, there isn't a general solution available for both PC and projector.

Park [1] designs the SXGA network and multimedia projector system, and focuses on high-resolution large screen. Tsunashima [2] describes a compact display system which is capable of displaying multiple PC desktop screens from remote PCs connected through a network on a single projector screen. But they also receive video signals from an external server device such as a PC. Some papers [3,4,5] study on other new directions in the projector industry, such as multi-planar displays, multi-projector Displays and 3D projector.

This paper presents a framework of automatic embedded projector player system with wireless network. The new player system not only has no trouble with cable layout, but also has independence of PC or notebook. And we can operate the player system and physical projector by a new remote control handle with a uniform way.

The remainder of this paper is structured as follows. Section II discusses the principle of automatic player system for projector. The hardware architecture of automatic player system is given in section III. In section IV, we discuss the software architecture and implement in detail. A prototype and two experiments are shown in section V. At last, we summarize the concepts of SOA-based enterprise application architecture, and give further study direction.

II. OVERVIEW OF AUTOMAITC PLAYER SYSTEM

We have three key ideas to design an automatic projector player system, and the new player system will resolve above problems for general applied scenes of projector, which

presents common files such as Word files, PowerPoint files, PDF files, JPG files, MPEG files and so on.

A. Key Ideas and Goals

1) Automatic Player System Depending on PC

In general applied scenes of projector, since we just present files belong to common types, so we do need not a costly and immovable PC to play these files. We choose embedded system to replace the PC, and the specified embedded system can do the playing work best than traditional PC in many aspects.

2) Projector with No Cable Layout

Conventional Projector has to be pulled and plugged from one PC to another PC continually. The new player system we recommended takes IEEE 802.11b wireless protocol, so PC can connect to the player system over wireless network.

3) Uniform Remote Control Way

We design a new remote control device, which can operate both player system and projector remotely.

B. Solution of Automatic Embedded Player System

The infrastructure of the automatic embedded player system by the internet, IR communication, and USB is illustrated in Fig.1 below.

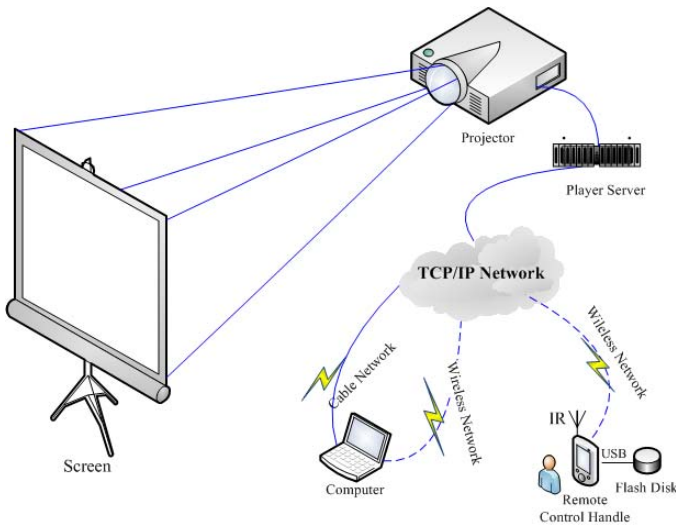


Figure 1. Physical Topology of Embedded Player System

The automatic embedded player system has four main parts, i.e. physical projector, projector player server, remote control handle, and network devices. The projector player server plays a core role; it charges the tasks of receiving and playing files. The remote control handle mainly charges reading files from removable storage, sending these files to projector player server over network, and remote controlling both the projector player server and physical projector. Because IEEE 802.11b network protocol is taken, so conventional personal computer and notepad also access the projector player server and send files to it.

III. HARDWARE ARCHITECTURE

A. Projector Player Server

The projector player server is composed of ARM microprocessor, VGA output module, wireless module, storage module and power module. The specific hardware structure of Projector Player Server is shown in Fig.2.

Microprocessor S3C2440A-40 (ARMV4I) including ARM9 core is selected as main CPU, which frequency is 400MHZ. By providing a comprehensive set of common system peripherals, the S3C2440A-40 minimizes the overall system costs and eliminates the need to configure additional components. The main features of it are: 64MB SDRAM, 256MB NDFLASH, and supporting up to 4GB SD card. These features can ensure the smooth running of the operating system and application software.

We use AT2440EVB-IV as development board, which integrates VGA/AV/S-VIDEO output ports, so it can send image signal to LCD/CRT displayer, TV set and S-port displayer. The display resolution of VGA is 800*600, so it can meet the requirements of ordinary projector, it plays video files smoothly and no splash screen happened. If a LCD-VGA video transfer card is added to current development board, the display resolution can reach 1204*768 or higher.

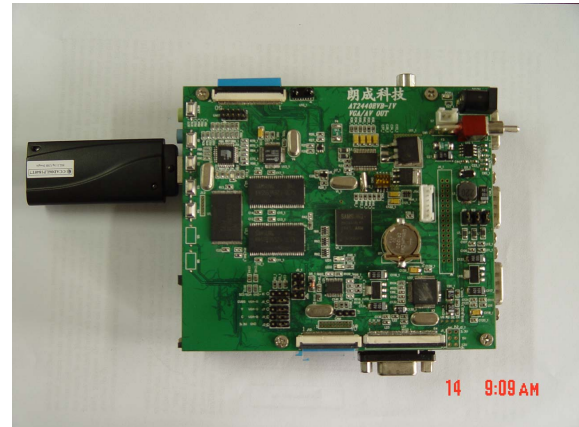


Figure 2. Hardware Structure of Player System Server

VT6656 wireless card is selected for transferring the files and command between the player server and remote device including remote control handle and PC. VT6656 card supports IEEE 802.11b wireless protocol, and the maximum speeds up to 11Mbps, guaranteed file transfer speed and smooth playback. The network interface is attached to the USB interface.

B. Remote Control Handle

The remote control handle is also designed to embedded device, it combines five modules which include microprocessor, display module, wireless communication module, removable storage, and IF control module. The specific hardware structure of remote control handle is shown in Fig.3, and it uses microprocessor S3C2440A-40 as main processor unit, and has 64MB SDRAM, 128MB NDFLASH, and also up to 4GB SD card is supported.

The display module uses the chime 3.5 inch TFT LCD with touch screen, which resolution is 320*240. The wireless communication module of remote control handle is same to projector player server's one. We use IRMs6452 Infrared emission header, which connects to COM2 in development board of the remote control handle, so the upper application can operate the infrared header over the serial port.

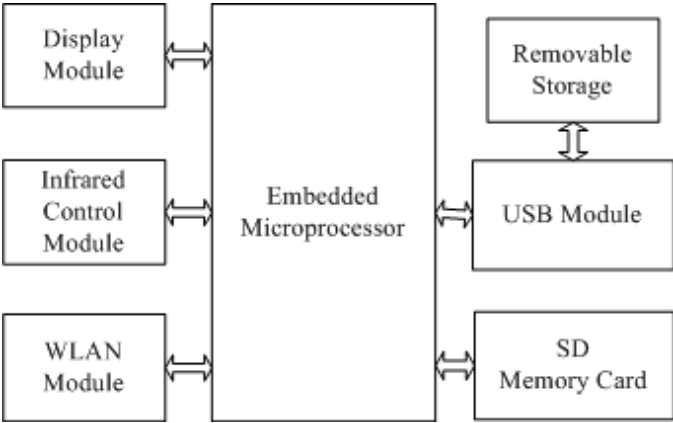


Figure 3. Hardware Structure of Remote Control Handle

The removable storage includes flash disk, removable hard disk, or SD card. We mainly use the USB interface to connect the removable storage. User can just plug a removable storage in the remote control handle board, without taking a notepad. Through modifying the USB driver inPW2440, the system can support high-capacity removable hard disk to meet users' demand.

IV. SOFTWARE ARCHITECTURE AND DESIGN

A. Software Architecture

The system consist of the following software packages (see Fig.4), which mainly include player server packages, remote control handle packages, and software update center. And the two formers run on ARM CPU with Windows CE OS.

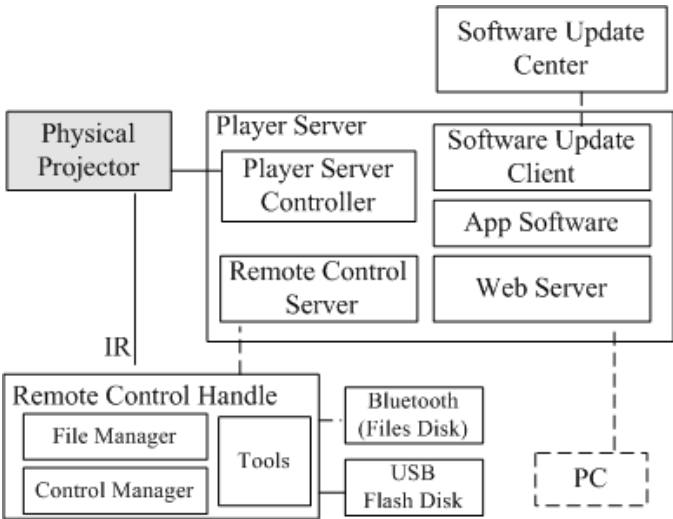


Figure 4. Logical View of Automaic Embedded Player System

B. Embedded Operating System Enviroment

We select Windows CE 5.0 embedded operating system, which has some characteristics such as: instant power up, Low ISR (Interrupt Service Routine), real time, a lot of drivers for diversiform devices, especially supporting wireless protocols and USB, it becomes perfect to almost every industrial process [7]. Windows CE has capabilities with advanced Windows technologies, so the application developers can gain enhanced productivity and the cycle of development can be reduced evidently. We use the IDE of platform builder 5.0.

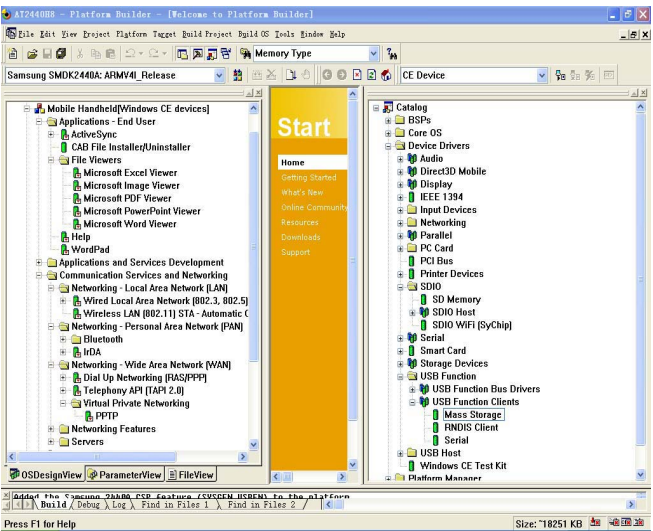


Figure 5. Platform Builder and Project Configuration

To develop an OS design based on the Windows CE OS, the following tasks must be completed, i.e. customizing BSP (board support package), customizing device drivers, customizing additional projects and catalog items.

The BSP is middle software lied between Windows CE OS and hardware, which supports the boot loader, OEM adaptation layer (OAL), and device drivers for a specific hardware platform. We use the sample BSPs provided by Microsoft Windows CE for the SMDK2440A Samsung MCU Development Kit to quickly evaluate Windows CE OS features.

Firstly, we copy the files of SMDK2440A to the directory of WINCE500\PLATFORM, and modify the read-only attribute of all files. Secondly, we import the smdk2440a.cec file in platform builder environment. The SMDK2440A BSP is loaded successfully.

Secondly, some drivers are added into run-time image, such as SD card, USB mass storage, the former is in "Catalog\Device Drivers\SDIO\SD Memory", the latter is in "Catalog\Device Drivers\USB Function\USB Function Clients\Mass Storage".

Thirdly, we select a buddle of software packages from "Applications & Media" into the run-time image. These packages can support common file types (such as .txt, .doc, .pdf, .mp3, .mpg), which include Microsoft Excel Viewer, Image Viewer, PDF Viewer, PowerPoint Viewer, Word Viewer, and WordPad. These application packages can

be dynamically updated from software update center over network.

C. Automatic Player System Softwares

1) Player Sever Software Packages

The main function of player server is to run specified application with specified file on the embedded system.

The player server is composed of Remote Control Server, Web Server, Play Server Control, Application Software, and Software Update Client.

The remote control server can receive files which will be presented from remote control handle over wireless network, it also can receive command from remote control handle, and these commands include mouse point action, keyboard event, and composed command. These commands are dealt by the default code of Windows CE OS or the Play Server Control.

Web Server is supplied for the goal of uniform remote control. Any device can upload files to player server over wireless network, and the device includes remote control handle, traditional PC and notepad. Any device can run the files in web server by the daemon play server control.

The software update client is to check and update software packages from software update center over network.

2) Remote Control Handle Software Packages

Remote control handle software packages include File manager, Control Manager, and Auxiliary Tools.

File manager is to read files from diversified removable storages and send files to player server. Fig.6 illustrates an example of uploading a PowerPoint file to player server.

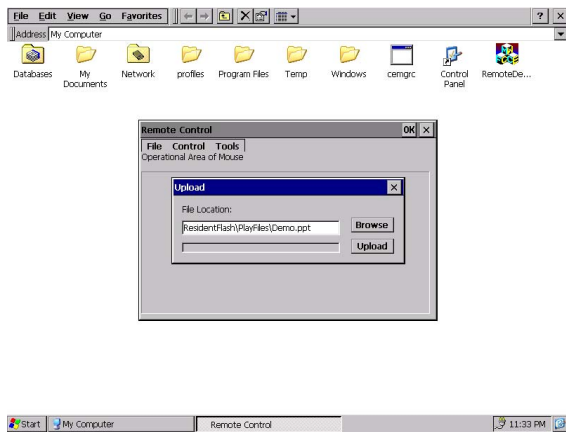


Figure 6. Example of Uploading file in Remote Control Handle

Function of Control Manager is send operation command to remote control server of player server and physical projector.

An IR simulator on Control Manager can transfer logical operations (such as open, close, zoom out, and zoom in) to specified frequency signal of specified IR receiver, and we control fully physical projector by the IR simulator software and Infrared Adapter with serial port (RS-232).

Control Manager controls player server using basic commands, which include mouse point action, keyboard event.

Auxiliary Tools include some composed commands based on two former managers to simplify operations.

In our solution, there are two ways to control the player system and projector, one is web browser, and another is remote control handle alone. So any traditional PC with wireless network and web browser can control the player server.

V. EXPERIMENTAL RESULTS

We tested two common scenarios, one is to play PowerPoint file, and the other is to play video file which type is AVI.

As the following Fig.7, users can play the PowerPoint presentation; users also can page down, page up and mark comments and other operations by remote control handle.

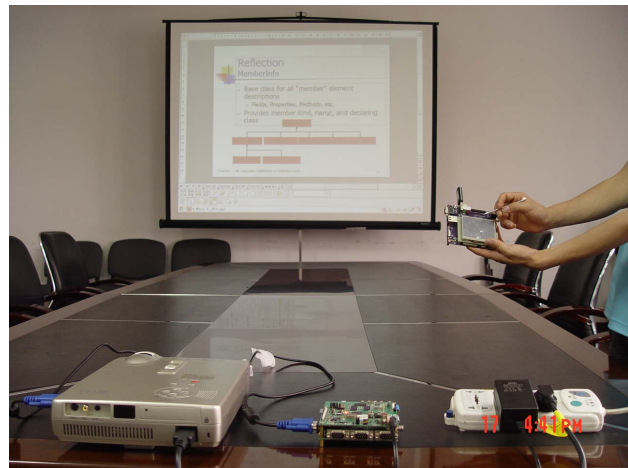


Figure 7. Example of Playing PowerPoint File

Fig. 8 shows that this system is playing video, which can be achieved start, pause, fast forward, and rewind by using the remote control handle. The picture clarity and fluency are to meet the actual demand.



Figure 8. Experimental Result for Playing Video File

VI. CONCLUSIONS

We have described the automatic embedded player system for projector. The recommended player system is controlled by uniform way, and it doesn't depend on PCs and digital signal cables. We present the hardware and software architecture of the player system, we also give the design and implement details. The system has been tested and results have been obtained.

The main limitation of our current solution is that all of application software packages are required to run on Windows CE OS. We will continue to improve the automatic embedded projector player system to support more software of mainstream OS platform in one single embedded hardware system.

ACKNOWLEDGMENT

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