RESEARCH AND IMPLEMENTATION OF THE CMOS CAMERA DEVICE DRIVER

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Abstract: With the advent of VLSI/CMOS technology, using CMOS technology video acquisition is emphasised. Presently CMOS camera chip is not supported by the latest Linux kernel available in the market. In this paper, designing of CMOS camera (OV9650) driver on Raspberry pi developing board is considered using embedded Linux environment and design of remote monitoring system. Serial camera control bus (SCCB) is a distinguishing feature of OV series CMOS chips. This paper emphasise on Serial camera control bus (SCCB) on ARM11 embedded platform. Raspberry pi provides a camera interface, and the camera driver is designed based on it using embedded Linux platform. The system has the functions of video signal acquisition, compression, transmission over the internet for remote video monitoring. The advantage of using the Linux is that the kernel size is small. The outputs and the result show that the driver works well for video viewing and response is proper in remote operating mode. In our experiment the video quality is good. The driver can also be ported on to any other embedded boards.

Keywords— Camera Device driver, image capture, Raspberry pi

I. INTRODUCTION

Comparing with traditional CCD image sensor, CMOS image sensors using CMOS technology can integrate the pixel array and peripheral circuits (such as the image sensor core, single-clock, all the sequential logic, programmable functions and A / D converter) in a chip, with a with a small size, light weight, low power consumption, programming convenience, easy to control and so on. Therefore, CMOS image sensors have been widely used in various generalpurpose imaging systems. The OV series CMOS image sensor produced by OmniVision Company are developing rapidly in recent years. CMOS image sensors uses CMOS technology which consists of Image sensor core to capture the image information, single clock for timing the data transfer for read and write operation between the CMOS camera and the Microprocessor, sequential logic and programmable functions to support the data transfer functions, and A/D converter to convert the image data in analogue form into the digital form for processing. The image sensor core comes with the pixel array in form of grid and the above peripheral in a chip can be used to support CMOS camera interface.

The advantage of using CMOS image sensors is small size, light weight, power consumption is low. At present the CMOS image sensors are widely used for general purpose image capturing applications. The camera interface facility is provided by the ARM11 Microprocessor which is a RISC machine. RASPBERRY PI is provided with camera interface and application development. Image retrieving is done using embedded operating systems. Embedded Linux is one of the OS which has features like its open source. Embedded Linux is widely used in the embedded field. The advantage of using Linux is its small kernel size. The porting procedure of Embedded Linux on to the Microprocessor includes the development of cross compile environment, the compilation of boot loader, porting of Linux kernel and the construction of root file system. In this paper, the method of designing the Omni CMOS Camera driver based on RASPBERRY PI developing board with the embedded Linux environment is introduced. With the advent of multimedia technology, Video compression technology, surveillance of Video information has improved. Video monitoring through internet is used in various fields for example video conferencing.

II. CMOS CAMERA DEVICE DRIVER

This imaging device is based on the Complimentary Metal Oxide Semiconductor technology which many industry observers believe is poised to overtake the Charge Couple Device standard. The device driver for the USB CMOS Camera supports the execution of the sensor which basically provides every pixel with an individualized charge to voltage conversion. In some cases the sensor may also incorporate an amplifier module which is likewise supported by the corresponding device driver. The digital output of the chipset of the USB CMOS Camera is often supported by the implementation of digitization circuits and noise correction. The Complimentary Metal Oxide Semiconductor imaging device can be manufactured in such a way that it may require fewer off-chip circuitry to make room for more basic operation. A slight drawback though is that there may be lower uniformity levels implemented primarily because of the individualized conversion process utilized on the pixels. Although majority of hardware components plugged into the Universal Serial Bus interface port of the host computer system are supported by the Plug and Play functionality of newer operating system environments, the installation of the correct device driver is still necessary. The associated device driver for the USB CMOS Camera will provide not only better detection for the supported hardware component but also allows the computer user to configure it properly. Normally the installation of the device driver allows the supported hardware component to communicate directly with the underlying operating system platform and providing the necessary interface in the control panel applet.

III. PROPOSED SYSTEM

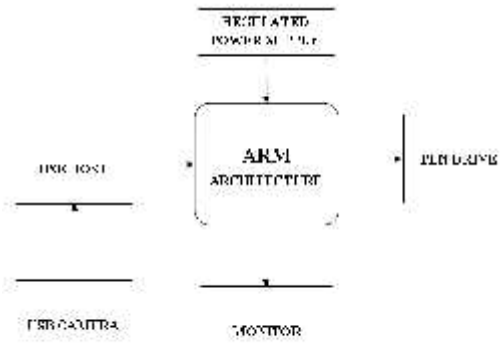

Fig.1 Block diagram for Implementing Research and implementation of the cmos camera device driver

With the processing of CMOS technology, the technology of video acquisition based on CMOS is becoming a new trend. However, many CMOS camera chip is not supported by the newest Linux kernel yet. In this project, the method of designing the CMOS camera driver based on Raspberry PI developing board with the embedded Linux environment is introduced. SCCB is a distinguishing feature of OV series CMOS chips. The realization of SCCB on ARM embedded platform is emphasized.

IV. HARDWARE IMPLEMENTATION

A. RASPBERRY PI BOARD

The **Raspberry Pi** is a credit-card-sized single-board computer developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools.

The Raspberry Pi is manufactured in two board configurations through licensed manufacturing deals with Newark element14 (Premier Farnell), RS Components and Egoman. These companies sell the Raspberry Pi online. Egoman produces a version for distribution solely in China and Taiwan, which can be distinguished from other Pis by their red coloring and lack of FCC/CE marks. The hardware is the same across all manufacturers. The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz processor, Video Core IV GPU, and was originally shipped with 256 megabytes of RAM, later upgraded to 512 MB. It does not include a built-in hard disk or solid-state drive, but uses an SD card for booting and persistent storage.

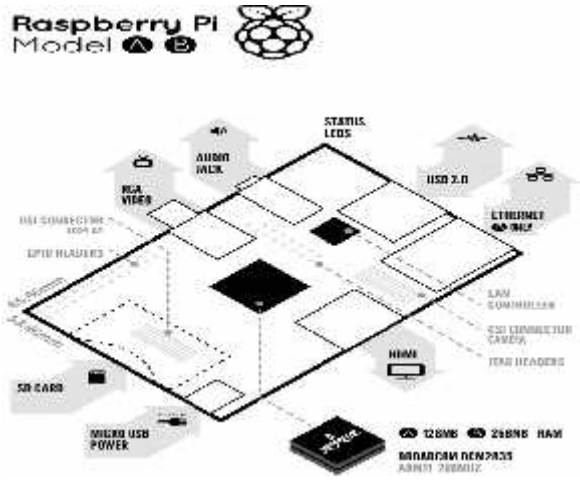

Fig2. Board features

The Foundation provides Debian and Arch Linux ARM distributions for download. Tools are available for Python as the main programming language, with support for BBC BASIC (via the RISC OS image or the Brandy Basic clone for Linux), C, Java and Perl.

B. UVC driver Camera

A UVC (or Universal Video Class) driver is a USB-category driver. A driver enables a device, such as your webcam, to communicate with your computer's operating system. And USB (or Universal Serial Bus) is a common type of connection that allows for high-speed data transfer. Devices that are equipped with a UVC driver, such as the Logitech® QuickCam® Pro 9000 for Business, are capable of streaming video. In other words, with a UVC driver, you can simply plug your webcam into your computer and it'll be ready to use.

UVC driver camera

What does a UVC driver have to do with my webcam being plug and play?

It is the UVC driver that enables the webcam to be plug and play. A webcam with a UVC driver does not need any additional software to work.

Once you plug your webcam in, it can work with a video-calling application, such as Skype®, Windows Live Messenger®, or Microsoft Office® Communicator.

Are there different kinds of webcam drivers?

Yes, there are two kinds of webcam drivers:

- The one included with the installation disc that came with your product. For your webcam to work properly, this driver requires some time to install. It is specifically tuned for your webcam, designed by your webcam manufacturer and optimized for webcam performance.
- A UVC driver

You can only use one driver at a time, but either one will allow you to use your webcam with various applications.

The following Logitech webcams support UVC:

- Logitech® QuickCam® Pro 9000 for Business
- Logitech® QuickCam® Pro for Notebooks Business
- Logitech® QuickCam® Communicate MP for Business
- Logitech® QuickCam® Deluxe for Notebooks Business
- Logitech® QuickCam® 3000 for Business

Does my computer support UVC?

Most current operating systems support UVC. Although UVC is a relatively new format, it is quickly becoming common.

Which operating systems support UVC?

There are more environments that support UVC, but what follows is a listing of the most common:

Windows:

- Windows® XP Service Pack 2 and higher
- Windows Vista®

Mac:

- Tiger® OS (versions 10.4.9 and higher)
- Leopard® OS (versions 10.5.1 and higher)

Linux:

There are many different versions of Linux. Please check with your distribution vendor to determine if your version supports UVC.

V. SOFTWARE IMPLEMENTATION

A. Linux Operating System:

Linux or GNU/Linux is a free and open source software operating system for computers. The operating system is a collection of the basic instructions that tell the electronic parts of the computer what to do and how to work. Free and open source software (FOSS) means that everyone has the freedom to use it, see how it works, and changes it.There is a lot of software for Linux, and since Linux is free software it means that none of the software will put any license restrictions on users. This is one of the reasons why many people like to use Linux.A Linux-based system is a modular Unix-like operating system. It derives much of its basic design from principles established in UNIX during the 1970s and 1980s. Such a system uses a monolithic kernel, the Linux kernel, which handles process control, networking, and peripheral and file system access. Device drivers are either integrated directly with the kernel or added as modules loaded while the system is running.

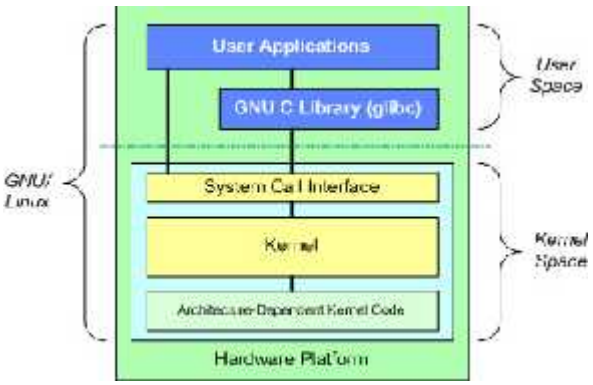

Fig4. Architecture of Linux Operating System

B. Qt for Embedded linux:

Qt is a cross-platform application framework that is widely used for developing application software with a graphical user interface (GUI) (in which cases Qt is classified as awidget toolkit), and also used for developing non-GUI programs such ascommand-line tools and consoles for servers. Qt uses standard C++ but makes extensive use of a special code generator (called the Meta Object Compiler, or moc) together with several macros to enrich the language. Qt can also be used in several other programming languages via language bindings. It runs on the major desktop platforms and some of the mobile platforms. Non-GUI features include SQL database access, XML parsing, thread management, network support, and a unified cross-platform application programing interface for file handling.It has extensive internationalization support.

VI. RESULTS

i Project setup

ii Captured image displaed on monitor

VII CONCLUSION

The project titled **"RESEARCH AND IMPLEMENTATION OF THE CMOS CAMERA DEVICE DRIVER"** has been successfully designed and tested. It has been developed by integrating features of all the hardware components and software used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced Raspberry pi board and with the help of growing

technology the project has been successfully implemented.

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