

Graphic User Interface Scheme for Wireless Universal Serial Bus

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Abstract – WUSB is a new technology which combines the speed and the security of wired USB with the easy use of wireless technology. In this paper, GUI for WUSB is designed and implemented to show the connectivity and contents of the WUSB devices. Also, the proposed GUI shows the log window while content transfers occur between the host and device. The proposed GUI can be used for various wireless technologies which provide wireless function with existing USB hosts and devices.

Keywords: Universal Serial Bus, Wireless USB, Graphic User Interface, Ultra Wide Band

1 Introduction

Universal Serial Bus (USB) [1] is a successful device in the PC area and many kinds of devices have USB interface to connect to one another. As wireless technologies grow fast these days, Certified Wireless USB (WUSB) based on Ultra Wide Band (UWB) standardized by Wireless USB Promoter Group in USB Implementers Forum (USB-IF). WUSB is the new wireless extension to USB that combines the speed and security of wired technology with the ease-of-use of wireless technology [2]. Wireless connectivity has enabled a mobile lifestyle filled with conveniences for mobile computing users.

Graphic User Interfaces (GUIs) have become an important and accepted way of interacting with today's software, in that they make software easy to use from a user's perspective [3] [4]. In the existing USB, GUI is provided by the Operating Systems (OS), such as Windows, displays the connection status in the task bar and contents of devices in the explorer. But in WUSB, it is not defined yet how to display them.

In this paper, GUI for WUSB is designed and implemented on the Linux. It has functions to display the connection status and the contents of the devices. Also, it shows the log window while content transfers occur between the host and device. The proposed GUI can be used various wireless technologies which add wireless function with existing USB hosts and devices. This paper is organized as follows. Section 2 describes USB and WUSB as related works. Design and implementation of GUI for WUSB is illustrated in Section 3. Finally, Section 4 concludes this paper.

2 Related works

2.1 USB

USB is motivated due to ease of use and port expansion [1]. Traditional PC lacks of flexibility in reconfiguration. The combination of user-friendly graphical interfaces and the hardware and software mechanisms associated with new-generation bus architectures have made computers less confrontational and easier to reconfigure. The limited number of ports of PC has constraint the addition of external peripherals to it. So, USB was developed by Intel, Compaq, NEC, and Microsoft in 1993 with various useful features such as low-cost, low-to-mid speed peripheral bus held back the creative proliferation of peripherals such as mass storage devices, web camera, Personal Digital Assistants (PDAs), keyboards, mice and so on.

Initially, USB provides two speeds such as 12 Mbps and 1.5 Mbps. As PC technology has evolved very quickly, USB 2.0 was defined in 2000 to provide the third speed of 480 Mbps. Since then, USB has become a successful PC peripheral among PC peripherals and it is said that there will be over 500 million USB products in use in 2005. Users just know what USB is, but product developers understand the infrastructure and interfaces necessary to build a successful product. USB has gone beyond just being a way to connect peripherals to PCs. Printers use USB to interface directly to cameras. PDAs use USB connected keyboards and mice. The USB On-The-Go provides a function for two host-capable devices to be connected and negotiate which one will operate as the 'host'. USB, as a protocol, is also being picked up and used in many non-traditional applications such as industrial automation. Table 1 shows the attributes of USB 1.1 and USB 2.0 [5].

Table 1. Attributes of USB 1.1 and USB 2.0

	Performance	Application	Attributes
USB 1.1	Low-speed <ul style="list-style-type: none"> • Interactive devices • 10~100kbps 	<ul style="list-style-type: none"> • Keyboard, mouse • Stylus • Game peripherals • Virtual reality peripherals 	<ul style="list-style-type: none"> • Lowest cost • Ease-of-use • Dynamic attach-detach • Multiple peripherals
USB2.0	Full-speed <ul style="list-style-type: none"> • Phone, Audio, Compressed Video • 600kbps~10Mbps 	<ul style="list-style-type: none"> • POTS • Broadband • Audio • Microphone 	<ul style="list-style-type: none"> • Dynamic attach-detach • Low cost • Ease-of-use • Guaranteed latency • Guaranteed bandwidth • Multiple peripherals
USB2.0 Only	High-speed <ul style="list-style-type: none"> • Video, storage • 25~400 Mbps 	<ul style="list-style-type: none"> • Video • Storage • Imaging • Broadband 	<ul style="list-style-type: none"> • Low cost • Ease-of-use • High bandwidth • Guaranteed latency • Dynamic attach-detach • Guaranteed bandwidth • Multiple peripherals

2.2 WUSB

As technology innovates very quickly, wireless technologies are becoming more and more capable and cost effective [2] [6]. Especially, UWB radio technology has characteristics that match traditional USB usage models very well, and supports high bandwidth of 480Mbps at limited range of 3 meters. WUSB based on UWB was created by the Wireless USB Promoter Group – Agere [7], Hewlett Packard [8], Intel [9], Microsoft [10], NEC [11], Philips [12], and Samsung [13] – aided by over 100 contributing companies. The group is focused on ensuring backward compatibility, interoperability, security, and maintaining the guiding principles of ease-of-use and low cost. WUSB specification revision 1.0 published by this group May 2005 [14].

Owing to adding wireless technology to USB, users can free from worrying about cables; where to find them, where to plug them in, how to string them. So they don't get tripped over, how to arrange them, and so on. The wireless technology makes USB much easier to use. But, losing the cable has other problems such as losing a source of power for peripherals and weakness of security. Power is one of important issues for bus-powered devices but not self-powered devices. Therefore, WUSB has some challenges where creative minds will provide innovative solutions that meet their customers' needs.

Because WUSB is a logical evolution of USB, the goal of WUSB is that end users view it as the same as

wired USB, just without the wires. Key design areas for this goal are listed below.

- Leverage the existing USB infrastructure. WUSB is designed to keep this software infrastructure intact so that developers of peripherals can continue to use the same interfaces and leverage all of their existing development work.

- Preserve the USB model of smart host and simple device. WUSB is designed to keep devices as simple as possible and let the host manage as much of the complexity as possible.

- Provide effective power management mechanisms. Wireless USB is designed to allow devices to be as power- efficient as possible.

- Provide security. Wireless USB is designed to provide a comparable amount of security to that which users enjoyed with wired USB.

- Ease of use. WUSB is engineered to continue that tradition, while preserving strong security requirements.

- Investment preservation. WUSB defines a new USB device class, the Wire Adapter device class, allows existing PCs and devices to include Wireless USB support.

WUSB connects maximum 127 devices with the USB host using a 'hub and spoke' model as illustrated in Figure 1 [2]. The WUSB host locates at the center, and each device sits at the end of a 'spoke', where the WUSB host and each device are connected point-to-point model.

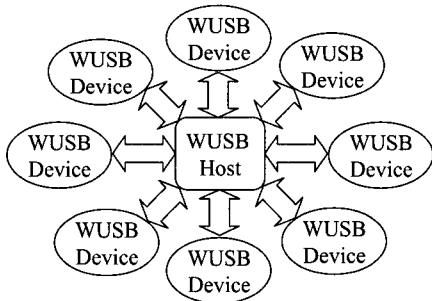


Figure 1. WUSB bus topology

Both USB and WUSB provide a fast, bidirectional, isochronous, low-cost, dynamically attachable interface that is consistent with the requirements of the PC platform of today and tomorrow.

3 Design and Implementation of GUI for WUSB

In this chapter, the design and implementation of GUI is illustrated. The general configuration of a WUSB host and devices is shown in Figure 2. In this figure, host prototypes to provide existing USB hosts with wireless interface are Peripheral Component Interconnect (PCI) card bus type and USB 2.0 type named HWA. DWA supports existing USB devices to connect with a USB host wirelessly. In this figure, a PC is used as a WUSB host with PCI or HWA type of host prototype. And a Hard Disk Drive (HDD) and a web camera (CAM) are used as USB devices in Figure 2.

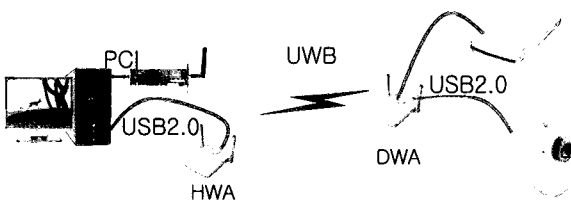


Figure 2. Configuration of a WUSB host and devices

Figure 3 and Figure 4 show GUI for WUSB host which operates on Linux in our laboratory. Also it can work on Windows. We suppose that there are two kinds of devices, one is bi-directional data transfer devices such as mass storages and the other is one-way data transfer devices from devices to hosts such as web cameras, mice, keyboards and so on. So, we use a HDD and a web camera as the WUSB devices for these two sorts of devices.

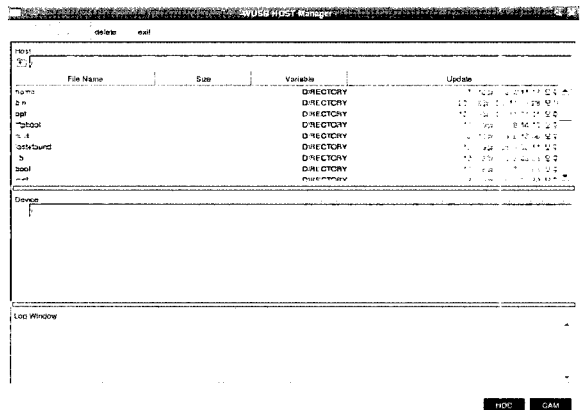


Figure 3. GUI for WUSB host without connection to HDD and CAM

In Figure 3 and Figure 4, the upper part shows the contents of the WUSB host and the lower part does for the contents of the WUSB device. The red boxes in Figure 3, named HDD and CAM, are the status of the WUSB devices that present neither HDD nor CAM is connected to the WUSB host. The red boxes change the blue boxes and the contents of the device are displayed as shown in Figure 4, after the devices connect to the WUSB host via DWA. The upper side in Figure 3 has four buttons named "up," "down," "delete," and "exit," but only two buttons, "delete" and "exit," are activated. After the WUSB device, HDD, is connected to the WUSB host, the rest of the two buttons are activated to upload contents from the device to

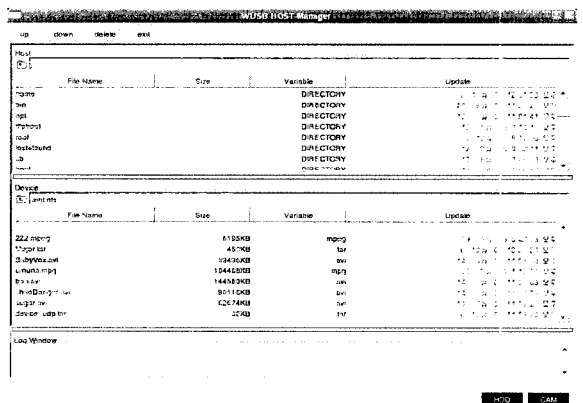


Figure 4. GUI for WUSB host with connection to HDD and CAM

the host and download them in the opposite direction.

The last part of the Figure 3 and Figure 4, named "Log Window," shows some items of the WUSB protocol as shown in Figure 5. Log window is displayed while content transfers occur between the host and the device. In this figure, log window shows 6 items such as Dir, DATA, Addr, Endp, SeqNum, and Size. Dir means the direction of the transfer, so <-- presents the transfer from device to host. DATA presents packet identification (PID) value and 0 means data packet. Addr indicates the destination of the contents. Endp means endpoint number of which valid value are 0 to 15. SeqNum presents sequence number of data burst sequence number. The final item, Size, is the size of the transferred data each

Dir	DATA	Addr	Endp	SeqNum	Size
DATA <	0	10	0	28	32768
DATA <	0	10	0	29	32768
DATA <	0	10	0	30	32768
DATA <	0	10	0	31	32768

time.

Figure 5. Log window of file transfer from device to host

We design and implement GUI for WUSB on Linux and validate it in our laboratory. It displays the connection status and contents of the WUSB device and has some functions such as uploading and downloading contents between host and device. It can be used various wireless technologies which provide wireless function with existing USB hosts and devices.

4 Conclusions

USB is very successful device in PC area. Technology innovates very quickly in these days, wireless technologies are becoming more and more capable and cost effective. Therefore, WUSB is an issue in that it has the advantages of USB and wireless technology. As adding this wireless technology to USB, users can free from worrying about cables. The wireless technology makes USB much easier to use.

In this paper, GUI for WUSB is designed and implemented on Linux. It has functions to display the connection status and the contents of the devices. Also, it shows the log window while content transfers occur between the host and device. The proposed GUI can be used various wireless technologies which provide wireless function with existing USB hosts and devices.

We will add more functions to the GUI such as displaying the folder structure of the host and device.

Also we will upgrade the GUI to display more devices connecting a host.

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