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IPTV using DM642 Multimedia Processor and Bluetooth

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Abstract. The main object of the work is to develop embedded system for IPTV. For this venture, the Real Time Multimedia System is designed to acquire the video streaming through different video servers over Internet Protocol (TCP/IP– Ethernet). In this work the normal TV is used and converted to IPTV through the development of multimedia processor based Real Time System. The video streaming software are also used on Video Server which transmits video over TCP/IP and the video is displayed using DM642 media processor based embedded system. The Bluetooth technology is used to change the channel from any Bluetooth enabled mobile phone. For this purpose the Bluetooth HCI controller based system is also designed. The user can select the channel using his Bluetooth enabled mobile phone and sends the request to the multimedia processor which transmits the request to the Video Server and displays the desired channel. The acquired video is converted into IP packets and transmitted to the media processor through Ethernet connection.

Keywords: IP TV, Video Conferencing, Media Processor, Multimedia Platform TV, IP network

1. Introduction

IPTV is defined as a means of delivering enhanced video applications over a managed or dedicated network via Internet Protocol to the TV through a broadband connection [1]. The IPTV market is moving into the critical second phase of large-scale commercial deployments across many regions [2]. It is a rapidly maturing technology for the delivery of broadcast TV and other media-rich services [3]. IPTV systems start to be very popular on the Internet [4].

It is an IP network application that supports several high quality video and audio standards like MPEG and H.261 for live video, scheduled video and video on demand. Generally speaking, IPTV refers to the distribution of television and video signals in parallel with the Internet connection supplied by a broadband operator using the same IP and mostly the same VoIP packet network infrastructure. In the IPTV the users can receive and view the contents on a home TV, PC or on hand held device even on move. The devices are loaded with an IPTV client. The TV contents are usually encoded in a standard format. The contents can be broadcasted or distributed on demand and controlled by the schedule server. The IPTV server handles user requests and the flows are chopped into stream of IP packets. The IP packets flow through a core IP network. Unlike a voice stream which requires 64 kbps or less with compression, a compressed video stream needs over a megabit per second to satisfy users' TV experience. This is the reason to require a broadband network connection.

To ensure smooth transmission of the TV service, it is necessary to provide dedicated connections and resources to ensure no interruption in the user experience. Therefore, a guaranteed path from the content source to the final distribution might have to be under watch by a network service provider.

In this work switching or selection of channel is done using Bluetooth enabled mobile phone which is wirelessly connected using Bluetooth technology with the Bluetooth receiver serially interfaced with the EVM DM642 Multimedia Processor Based Embedded System. The TMS320DM642 device is the highest-

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performance fixedpoint DSP generation in the TMS320C6000 DSP platform [5]. It is a new edition to the TI family of high-performance processors [6].The system is also interfaced with the Video Server (Personal Computer, PC) over TCP/IP Ethernet network connection through Hub. When the user selects his desired channel using his mobile phone, the selection is processed by the media processor and it connects to the video server (over particular I.P.) through Ethernet interface and acquires the video streaming packets on the embedded system and transfer to the video encoder to generate real time video to display the video on TV. The packets of composite video signals are transmitted to the multimedia processor DM642 through video encoder.

The two cameras are also used in the work which are interfaced with the PC using USB ports. The video from cameras is shown in Video Server and then transmitted to the media processor using Ethernet Connection. The complete system works when the user transmits 1 from his mobile phone, the DM642 multimedia processor takes the video from Camera # 1 and then the composite video is encoded and displayed to the television. Similarly, when the user transmits 2 from the mobile, the multimedia processor acquires the video from the Camera # 2 and displays to the television. If the user transmits 3 from the mobile, DM642 doesn't display any video on TV and finally by transmitting 4 from mobile phone results alternatively displaying video from Camera # 1 and Camera # 2 on TV. In this way, the IPTV using DM642 Multimedia Processor is developed and the channels on TV can be controlled using and Bluetooth enabled mobile phone wirelessly.

The rest of the paper is organized as follows: section 2 will present the overall system model. Section 3 will discuss the working of the system. Section 4 briefly discusses the software used in the work and finally section 5 will end the paper with conclusion and future work.

2. System Model

The system consists of four parts. The first part is the Bluetooth connection of the Multimedia Processor DM642 for the selection of Video input from cameras. The second part is the Video Server. Its function is to display real time video on PC using two USB video cameras. The third part is the connection between Video Server and the DM642. The fourth part is the designing of the real time operating system used for video processing in the DM642 processor. The complete block diagram of the system is shown in figure 1.

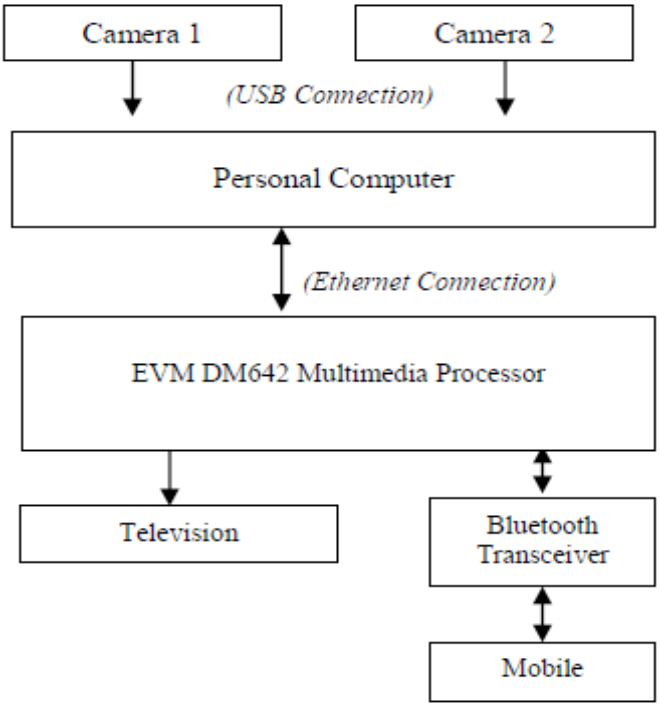

Fig. 1: Overall System Model

2.1. Bluetooth Connection of Mobile Phone with DM642

Bluetooth is a wireless protocol for short range communications. It can also be used for sending data on short distances from fixed or mobile devices, creating wireless Personal Area Networks (PANs). It also provides a way to connect and exchange information between devices such as mobile phones, telephones, laptops, personal computers, printers, GPS receivers, digital cameras, and video game consoles over a secure, globally unlicensed Industrial, Scientific, and Medical (ISM) band. The selection of video cameras is controlled by the user using Bluetooth connection. This is done by interfacing Bluetooth transceiver module with the DM642 processor. The user can send the channel selection message from any Bluetooth enabled mobile phone to the DM642 wirelessly. In this work the Bluetooth transceiver is serially connected with the DM642 using RS232 protocol. For this purpose the Bluetooth HCI controller is used to create a serial link between Bluetooth and DM642. The Link Management Protocol (LMP) is also used to control the radio link between two devices (Bluetooth and mobile).

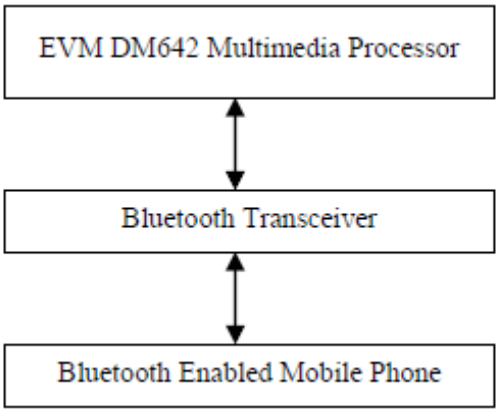

Fig. 2: Bluetooth Connection of Mobile phone with DM642

2.2. Video Server for Displaying Real Time Video from Cameras.

This is the main GUI of the system. The Video Server is developed in LabWindows which is discussed in section IV. The main function of Video Server is to display the real time video from two cameras using USB ports and after processing the video, transmit it to the DM642 media processor using Ethernet Link. It is also connected with the Matlab server for video processing. The block diagram of the cameras connected with Video Server is shown below.

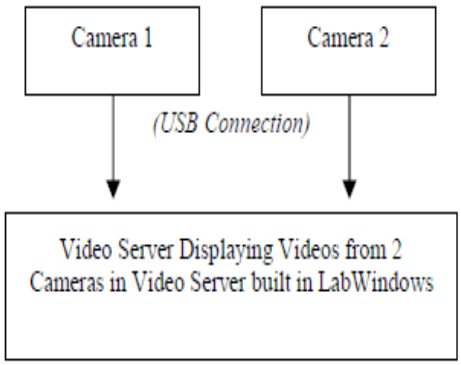

Fig. 3: Connection of cameras with the Video Server

2.3. Connection of Video Server With DM642

The video server is connected with the media processor DM642 using Ethernet Connection. For communicating with DM642 it creates a Win Socket connection and set itself to listen mode and waits for the request from media processor for channel selection. If it receives a request it processes the video in Matlab and transmits to the media processor. The programming of DM642 is done in Code Composer studio (CCS). The video acquired by the DM642 form the video server is then displayed on the television.

2.4. Real Time Operating System

The Real Time Operating System (RTOS) is designed inside the DM642 Multimedia Processor. Its function is to take input from UART, selection of the IP, to decode the video coming from Ethernet and Encoding the video. The programming for interfacing Bluetooth module with DM642 is also done and the TV is connected with the Video Output Interface of media processor. The complete programming of the DM642 is discussed in section IV.

3. Working And Importance of the System

The system starts working when the authorize user connects with the media processor using the secret pass-code form the Bluetooth enabled mobile phone. For this purpose, the Bluetooth module is interfaced with the media processor using serial connection. The user can send the request for watching particular channel on TV. Media Processor waits for the request for channel selection. The user request is first processed by the media processor and then it is transmitted to the Video Server on PC. The media processor and the Video Server are connected with the Ethernet Connection. Two different IP addresses are assigned, one for the Video Server and other for the DM642.

On the other hand, two USB cameras are interfaced with the Video Server which displays real time video from both cameras. As the Video Server receives request for particular TV channel from media processor, it selects that channel and passed its video to Matlab Server for processing. The image is captured in RGB format and Matlab is used to convert it into YCrCb format because the TV transmission standard is PAL in Pakistan and media processor required the image in YCrCb format. The processed video is then transmitted media processor using same Ethernet Link. The media processor then displays that video on TV using its video output interface.

The complete system works when the user press 1 from the Bluetooth enabled mobile phone, the DM642 multimedia processor acquire the video from the camera 1 and that composite video is encoded and displayed to the television. Similarly, when the user presses 2 from the mobile phone, the DM642 multimedia processor acquires the video from the camera 2 and displays to the television. When the user presses 3 from the mobile phone the multimedia processor displays no video signal to the TV. When the user presses 4 from the mobile, the DM642 alternately displays the camera 1 and camera 2 video to the TV.

The purpose and implementation of this work is to display video over IP application for a handheld device. The main applications are in video transmission over IP which includes internet telephony, video conferencing, collaborative computing and distance learning. The actual frame rate and resolution of a video over IP application depends on the speed of the video processing hardware/software and network bandwidth. Quality applications require high processor capabilities or specific image processing hardware. This is due to the fact that video communication is generally extremely processor intensive.

4. Discussion on Software Used in the Work

This section briefly discusses the software used in the work. The main software are Matlab for processing real time video coming from camera, LabWindow for building user interface and Code Composer Studio for developing the code for DM642 media processor.

4.1. LabWindow

The user interface is built in LabWindow software. This software is used as Video Server in this work. It is connected with two devices, DM642 Media Processor through Ethernet Link (TCP/IP) and the two cameras using USB ports.

When the GUI is loaded, it displays the video from camera 1 and camera 2 and also connects with the Matlab server. For transmitting video to DM642 using Ethernet connection, it creates a connection of Win Socket object and configures it as server. It is set to Listen Mode in which this Video Server waits for DM642 (client) to send request. When DM642 sends the request to this Video Server (whose IP Address is mentioned in Network Connection Settings) at particular socket number: 8000, it responds the connection established packet to Video Server. In the reply DM642, sends the IP-Packet with IP Reply and Video Channel ID (either camera 1, 2 or no channel).

In the reply of this packet from DM642, the Video Server checks the Video Request/ Channel ID, pass it to the Matlab Server for processing and send the video to DM642 using Ethernet Connection. This process is executed in loop for continuous video transmission.

4.2. Matlab Software

The real time video from USB cameras is converted and resized in Matlab. It is connected with the LabWindow based GUI. It takes the real time data from GUI and resized it into 720*576*3. Then it converts the RGB image to YCrCb format and performs quantization i.e. 4:2:2 level. Then it saves this processed array into respective array and pass it back to LabWindows.

4.3. Java 2 Micro Edition (J2ME)

This software is used to communicate Mobile Phone with DM642 for selection of channels using Bluetooth. First, the Bluetooth connection is configured to communicate with E501 Bluetooth Module. Then it scans for the input keys i.e. 1-8 from mobile phone. If the key is pressed, it sends the packet in the form of A@ for 1 key, B@ for 2 key, C@ for 3 and so on.

4.4. DM642 Programming in Code Composer Studio(CCS)

The DM642 is connected with the Bluetooth Device EB501 through serial Port, TV using Video Output Interface and Video Server through Ethernet TCP/IP Link. Firstly, it connects with Output Video Driver and creates network connection using Win Socket and sets its own IP address. Then it configures the Win Socket as Client and creates another Win Socket for server connection and configures this Win Socket with Video Server's IP address. Then it connects with the Video Server. When connection is established it scans the user selection from mobile phone through E501 Bluetooth Device. The data comes in the form of A@, B@ and C@, it converts the data in the form of Channel ID i.e. 1, 2 or 3. Then it sends the Channel ID to the Video Processor (in PC) using Ethernet Link. The Video Processor responds it with the desired channel video output.

5. Conclusion and Future Work

The consumer/commercial video products are increasingly demanding with respect to their interfaces. Their connectivity to memory devices is a main issue and especially the inter-networked connectivity is increasing like internet video, video capable cell phones, digital surveillance networked cameras, I.P.T.V. and digital video broadcasting. All these scenarios, no PC is involved all is just multimedia processor based Embedded system with video capturing and displaying capabilities. So in this current era of technology, the ways are moving towards interconnected network environment in which most of devices connect each other sharing there resources or memories to access more features as they have. Applications of video communication over IP include internet telephony, video conferencing, collaborative computing, and distance learning. Many companies are in the process of setting up or have already set up video communication equipment to conserve on time and travel costs while keeping personalized interaction with their clients and co-workers. Companies are especially attracted to video over IP applications because these will provide free unlimited video communication, as most companies already have Local Area Network (LAN) capabilities. In addition to the usefulness of these applications in homes and offices, as the use of handhelds and the accessibility of LAN's become available to a wider audience, the range of IP telephony and video applications gets even further extended to mobile systems. The idea of having a free anytime audio and video connection with anyone in the world naturally appeals to a very wide range of users. Handhelds are already widely used in many audio over IP applications and this is only a short step away from a full audio and video over IP connection.

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