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Development of Embedded Board for OMAP4460

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ABSTRACT: Embedded development board consists of a microprocessor and other peripherals as hardware and support packages in the form of tool chains needed for an engineer to become acquainted with the microprocessor on the board and to learn to program it. It also serves to users of the microprocessor as a method to prototype applications in products. This paper discusses the development of a full featured development board for OMAP4460 multi core processor. The peripherals and interfaces of the board are detailed in the paper.

KEYWORDS: cortex-A9, development board, interfaces, multi core processor, OMAP4460.

I. INTRODUCTION

Embedded development boards are designed to provide access to as many of the powerful features of a processor as possible. The user can utilize these features of the processor by means of software development. In addition, by providing expandability via onboard connectors, such boards support development of additional capabilities and functionality.

Open Multimedia Applications Platform (OMAP), developed by Texas Instruments consists of family of image and video processors. The processors falling under this category are mainly used in areas such as mobile multimedia applications and designs indented for portable applications. OMAP series of processors are designed with general purpose ARM architecture processor core as the main processing unit and along with this ARM core based architecture, a number of specialized co-processors are also embedded, which give rise to a heterogeneous system. The units of a heterogeneous system are different from each other, mainly in the following aspects:

- The units may run at different clock rates.
- Core instruction sets supported may be different.
- Instruction set extensions supported may be different.
- Memory regions that each unit can access may be different.
- Connection between them may be established via a non-uniform topology.

Heterogeneous system improves flexibility for the user by allowing the user to use advantages of each of these individual architectures. Otherwise the user will have only one option to focus on only one main unit.

The OMAP4460 belongs to the OMAP family of system on a chip developed by Texas Instruments. The use of OMAP processors includes and is not limited to portable consumer devices like Tablet computers, smart phones and personal digital assistants. It contains [1]:

- A dual core ARM Cortex-A9 processor.
- Two ARM Cortex-M3 processors.
- A digital signal processor (DSP) subsystem.
- Image and video accelerator high-definition subsystem.
- Display subsystem.
- Audio back-end subsystem.

With the above mentioned features, the user can run a general purpose operating system on the Cortex-A9 core and any real-time operating system based operation will be handled by the Cortex-M3 processor, which controls the imaging subsystem. The major component of the OMAP development board is the VAR-SOM-OM44 system on module (SOM) for OMAP4460. Product designers always aim to develop and reach the market with their product solution in minimum time. When comparing with custom engineering solutions, SOMs are an ideal alternative to bring the product solution to the market at the earliest. With standard components such as a generic carrier board and SOM module, it is possible to start development of application solutions before the custom board is complete; thus offering a reduced time to market for the system. In lower production volume solutions cases, SOMs are the cost viable option than the customized solutions.

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II. VAR-SOM-OM44 SYSTEM ON MODULE

The VAR-SOM-OM44 is a very high performance system on module [2]. High processing power associated with it proves to provide an ideal building block that can be integrated with applications requiring rich multimedia functionality. It also incorporates powerful graphics and video capabilities that enable its use in mobile applications. The cost effective design, with a blend of compact and power efficient performance helps VAR- SOM-OM44 to secure the performance level of an Intel Atom processor. VAR-SOM-OM44 incorporates most of the features of the powerful OMAP multimedia processor. The main hardware building blocks of the VAR-SOM-OM44 are discussed below [2]:

Texas Instruments OMAP4460: The OMAP4460 high-performance multimedia application device is based on enhanced OMAP architecture. The architecture is designed to provide excellent graphics, image and video processing for second and third generation wireless terminals. It is designed to be used in personal digital assistants (PDAs), where high-performance is required. The device supports high level operating systems (OSs) such as: Linux, Windows CE, WinMobile and Symbian OS [3].

Memory: The VAR-SOM-OM44 is available in two options, one with 512 MB and other with 1024 MB of low power double data rate memory (LPDDR2) memory. The memory uses using package-on-package (PoP) technology. An electrically erasable programmable read only memory device of capacity 8K is used for storing boot arguments. The EEPROM also stores Giga Ethernet media access control (MAC) address and other propriety data. An on board micro-SD connector is available, which can be used as boot device and as a mass storage device.

TWL6040 audio codec: The TWL6040 device is an audio codec. It is used for portable applications to provide analog audio codec functions with high integration. It features microphone biases and accessory detection along with the multiple audio analog inputs and outputs. The interface of TWL6040 audio codec with OMAP4460 host processor is made through a PDM interface for audio data communication. Partitioning with optimized power consumption is enabled with high performance through this interface. A single wire downlink and uplink wire is present, which carries multiplexed data of multiple audio channels [4].

TWL6030 power management IC: The TWL6030 is a dedicated integrated power-management IC for the OMAP4 platform and supports the OMAP4460 power-management architecture to ensure maximum performance and operation time for user satisfaction (audio/video support) while offering versatile power-management techniques for maximum design flexibility, depending on application requirements[4]. A real time clock (RTC) provides a 32 KHz output buffer, second /minute /hour /day /month /year information and alarm wake up.

LAN7500 10/100/1000 gigabit ethernet controller: LAN7500 is a Hi-Speed USB 2.0 to 10/100/1000 gigabit ethernet controller. It provides high-performance ethernet connectivity solution. It contains an integrated 10/100/1000 Gigabit Ethernet PHY, along with it includes USB PHY, FIFO controller , Hi-Speed USB 2.0 device controller, EEPROM controller, 10/100/1000 Gigabit Ethernet MAC and a TAP controller with a total of 32 KB internal packet buffering.

III. OMAP4460 DEVELOPMENT BOARD

OMAP4460 Development Board is designed to provide access to the features of the OMAP4460 Multimedia Processor. The design is done with an aim to maintain low cost and achieve high performance. With this board, the user can utilize the feature of OMAP4460 processor by developing software for different applications. In addition, by providing expandability via onboard connectors, the board supports development of additional capabilities/functionality. Fig.1 represents the block diagram of the development board, in which the VAR-SOM-OM44 surrounded by the interfaces and peripherals are pictured.

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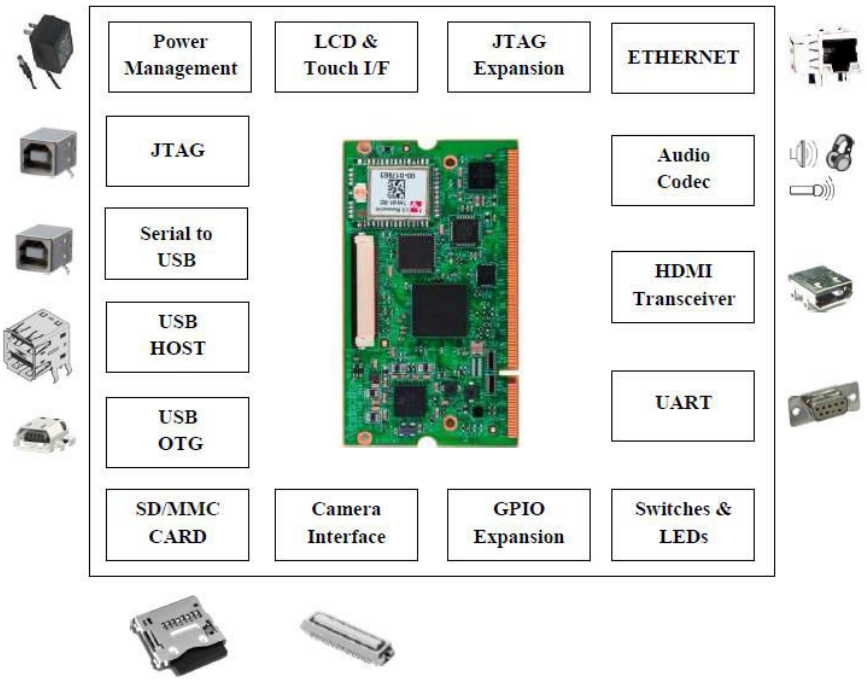

Fig 1: block diagram of OMAP4460 development board.

Most of the external interfaces of OMAP4460 development board are driven by VAR-SOM-OM44 system on module. Through these interfaces, access is provided to OMAP4460 internals. A wide range of control and data interfaces are provided on the board, which are discussed below in detail.

UART interface: Two universal asynchronous receiver/transmitter (UART) interfaces are provided on the OMAP4460 development board. One of the connections is driven by the UART3 interface of the system on module and is terminated by female type DB-9 connector. The other is driven by the UART1 interface of the system on module and is terminated via USB type-B connector. The FT232R USB to serial UART interface chip is used to convert USB data to UART interface.

ISO7221 is a dual digital isolator. It is used to isolate grounds, block high voltage and prevent noise currents on any part of the circuitry including data bus from entering the local ground and causing interference to or damaging sensitive circuitry. Along with providing isolation, the chip will adjust the voltage levels of the signals so that communication can take place between the board and the USB device connected to the port.

USB interface: The development board supports four USB 2.0 Type-A Host ports. One of the dual USB host connector is driven by an on-board USB hub, while the other USB host connector is driven by an on-board HUB as well as by the VAR-SOM-OM44 USB HOST1 interface.

USB OTG interface: The development board has a USB OTG interface, terminated by a micro USB OTG connector and driven by VAR-SOM-OM44 OTG interface.

Ethernet interface: The development board features one 10/100/1000 BaseT Giga Ethernet interface, exposed by a standard ethernet jack. This giga ethernet port is directly connected to VAR-SOM-OM44 on board gigabit ethernet PHY.

SD/MMC connector: SD Card interface is based on the VAR-SOM-OM44 SD/MMC2 interface. It is a 4 bit card cage. In order to support 3.3V IO interface, a bidirectional buffer is used. This connector enables access to OMAP4460 SD/MMC5 interface.

Audio interface: The OMAP4460 Development Board features a Line in, a headphone and an S/PDIF interface, all directly driven by VAR-SOM-OM44.

Camera interface: The OMAP4460 Development Board supports one 8 bit camera parallel Interface (CPI), which is driven by VAR-SOM-OM44. This interface allows the user to utilize the CPI interface of OMAP4460.

HDMI interface: The OMAP4460 Development board provides a high-definition multimedia interface (HDMI) via an industry standard type-A connector to interface with an external monitor. HDMI connector is driven by native VAR-

SOM- OM44 HDMI signals, which provide access to the HDMI interface of OMAP4460. This interface includes a HDMI port protection/interface device. Any electrostatic discharge (ESD) event experienced at the connector will be absorbed by the ESD protection device before damaging the OMAP4460 device I/Os.

LCD interface: The OMAP4460 Development board features a 24 bit LCD interface. It is driven by VAR-SOM-OM44 parallel LCD interface and exposed by a standard 40 pin FFC/FPC, connector. The connector pin-out is compatible with seven inch U.R.T, TFT LCD module. A 1.8V to 3.3V level translator is used in order to support the LCD module IO level specifications.

JTAG interface: XDS100v2 onboard JTAG emulator is provided, which can be used for JTAG connectivity to enable debug and flash programming. Also provision for external JTAG connectivity is provided on the OMAP4460 development board via a 14 pin JTAG connector. JTAG expansion connector pins are directly connected to the VAR-SOM-OM44 pins. In order to use this expansion a 40 pin flat cable should be used to connect between VAR-SOM-OM44 expansion connector and the 40 pin connector on the OMAP4460 development board.

Control interface: The OMAP4460 Development Board features a Reset button, a Boot select option and a power supply button. Logic '0' on the Reset button will reset major VAR-SOM-OM44 components such as OMAP44660, TWL6030-PMIC and TWL6040-Audio Codec.

The boot option select configures the boot sequence of the OMAP4460 development board. If the boot select switch is released (i.e., logic '0'), boot device is the SD Card integrated on the VAR-SOM-OM44 system on module (using MMC/SD/SDIO1 interface), if failed, UART is used as a boot device. If the boot select switch is pressed (i.e., logic '1'), boot device is the on board SD Card (using MMC/SD/SDIO2 interface), if failed, UART is used as a boot device.
Power input: The OMAP4460 development board is powered using a 7V-12V DC power supply, using a DC-In power jack. The board also features a battery holder powering VAR-SOM-OM44 RTC backup supply rail. Voltage translators suitable for each of the peripherals and a current monitoring circuit for VAR-SOM-OM44 is also implement.

IV. DESIGN OF BOARD

The base board of OMAP embedded board consists of a multilayer PCB. A 4 layer PCB is designed of which three layers are used for routing and remaining one layer is a ground layer. Size of the board is 22 cm X 18 cm. Trace widths are selected by analysing the current requirement for each section and power dissipation that may occur in each of the traces. Design of circuit and layout of PCB is done using OrCad version 16.2.

V. RESULT

Design and development of an embedded board for OMAP 4460 processor was done successfully. Fig 2 shows a picture of the developed board. Testing of the board for continuity of traces was done. The peripherals on the board were tested by means of programming for each of them.

VI. CONCLUSION

In this paper, the development of an embedded board for OMAP4460 processor around a system on module is discussed. The features and peripherals of the board are discussed in detail. The development board allows OMAP4460 processor to be interfaced with external circuits and a broad range of peripheral devices, allowing a user to utilize the board for any application requirement. The scope of the paper can be expanded by implementing porting of operating system such as Linux and the board can be made capable of real time applications with porting of real time operating systems.

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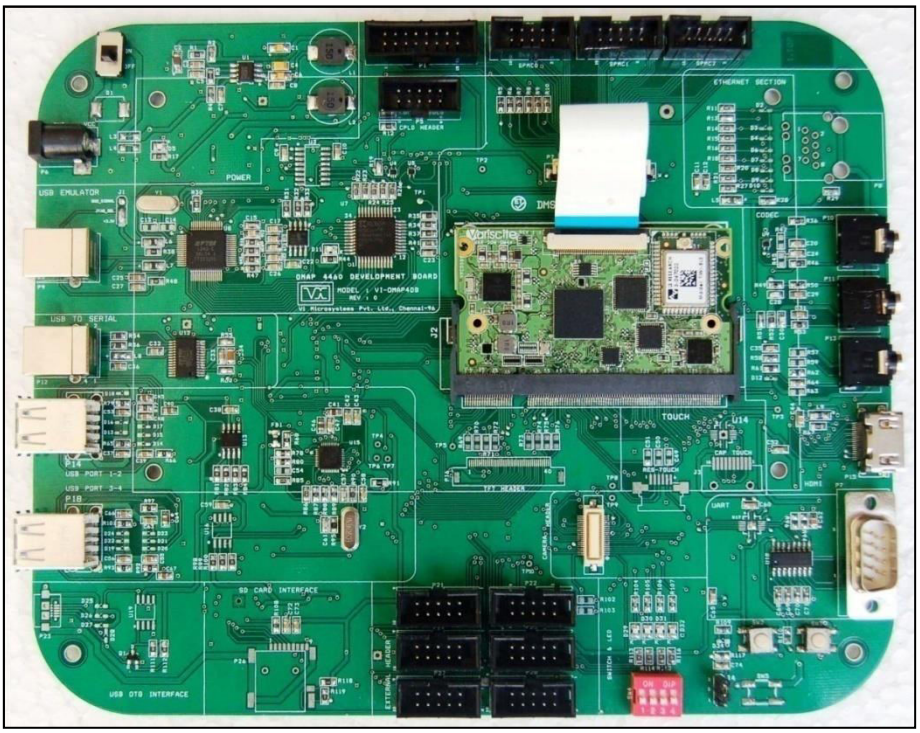

Fig 2: OMAP4460 Embedded board

VII. ACKNOWLEDGEMENT

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