Currently, devices with microcontrollers have been widely used in industrial fields. However, a large number of devices do not have the network interface and the data from them cannot be transmitted in a network. A design of Microcontroller based embedded Ethernet interface is presented. In the design, an existing SPI serial device can be converted into a network interface peripheral to obtain compatibility with the network. The design mainly consists of SPI communication module, microcontroller module, and Ethernet interface module. [1] In the design, communication can take place by using Atmel AVR atmega88 microcontroller and Ethernet controller ENC28J60 module. It has an excellent prospect in the Industry of new automation applications. In the existing system, it uses serial communication so it needed to build a network for remote operating, but in case of Ethernet communication, it can use LAN network which minimizes the cost of network infrastructure. It has an excellent prospect in Industry of new automation applications.

Keywords: Embedded, Ethernet.

1. INTRODUCTION

The rising trend in the production of embedded systems based on microcontroller architecture emphasizes more and more the need to establish effective and low-cost communication over the existing infrastructure. Embedded systems contain processing cores that are typically either microcontrollers or Digital Signal Processors (DSP). These systems are used independently, where CAN, RS-232, and RS-485 are most commonly used communication technologies. Disadvantages of this communication are, e.g., a low transmission rate, limited coverage, etc., which cause very difficult performance of flexible remote access and management. However, Ethernet (IEEE 802.3) communication presents numerous advantages, such as a high ratio between performance and price, a high data rate, long-distance data transmission thus presenting a viable alternative to the existing communication techniques. The main advantage of the proposed communication is the use of a low-cost Stand-Alone Ethernet Controller and the existing network infrastructures (Ethernet Local Area Network) to relay data between the embedded system and a Host PC, creating a viable and cost-effective alternative to the current microcontroller communication protocols (RS-232 or RS485).

With the advancement of microelectronic technology and the overall rising trend in the use of low-cost microcontrollers, the need to share information over the existing infrastructure is more and more emphasized. The problem that persists is how to implement Ethernet communication in low-cost microcontrollers while retaining low-cost of the device. This paper proposes the use of Microchip’s Stand-Alone Ethernet Controller ENC28J60 in order to establish Ethernet communication. The communication can take place by using the Atmel AVR microcontroller architecture (Atmel AVR Atmega88) and the Stand-Alone Ethernet Controller whereas the sent data can display on LCD.
Embedded systems are considered when the cost of implementing a product designed in software on a microprocessor and some small amount of hardware is cheaper, more reliable, or better for some other reason than a discrete hardware design. It is possible for one small and relatively cheap microprocessor to replace dozens or even hundreds of hardware logic gates, timing circuits, input buffers, output drivers, etc. It also happens that one generic embedded system with a standard input and output configuration can be made to perform in a completely different manner simply by changing the software.

2. System Design

Microchip’s ENC28J60 controller is a 28-pin, 10BASE-T standalone Ethernet Controller, with on board MAC & PHY, 8 Kbytes of Buffer RAM and an SPI (Serial Peripheral Interface) serial interface used as an Ethernet network interface for any microcontroller equipped with SPI interface. Microchip offers also a free licensed TCP/IP stack optimized for the PIC18, PIC24, dsPIC and PIC32 microcontroller families. The stack is divided into multiple layers, where each layer accesses services from one or more layers directly below it and includes the following key features:

- **Supported protocols:** ARP, IP, ICMP, UDP, TCP, DHCP, SNMP, HTTP, FTP, TFTP;
- **Socket support for TCP and UDP;**
- **Secure Sockets Layer (SSL);**
- **NetBIOS Name Service;**
- **DNS - Domain Name System;**
- **Support for MPLAB C18, C30, and C32 compilers.** [4]

Processor module is the core part of the design, in which the Atmel’s Atmega88 is used to complete the complex operations and receive a lot of data from ENC28J60 Ethernet module as a slave. In the module, data link between SPI port and Ethernet is established, SPI data stream format is specified, the transmission rate between serial data stream and IP data packets is controlled and IP packet is received or sent through reading or writing Ethernet interface module.[1] SPI Interface - SPI interface is used to realize synchronous serial data transmission between CPU and low-speed peripheral devices by way of full-duplex communication. Its data transfer rate is up to several Mbps. SPI interface works in master-slave mode and it includes four signals: SCLK, MOSI, MISO, and / SS. SCLK is the common clock in the entire SPI bus, MOSI is the master output, slave input, MISO is the host input, slave output and / SS is used to mark slave.[1] During initialization the following operations are executed: setting the buffer memory and registers, putting the MAC address on the right location, setting PHY register to half/full-duplex communication, setting the LED configuration, and enabling automatic padding, enabling CRC operations and the interrupts. The Ethernet buffer contains transmit and receive memory used by the Ethernet controller. The entire buffer is 8 Kbytes, divided into separate receive and transmit buffer spaces. The sizes and locations of transmit and receive memory are fully programmable by the host controller using the...
SPI interface. Any space within the 8-Kbyte memory, which is not programmed as part of the receive FIFO buffer, is considered to be the transmit buffer [4].

3. Conclusion

Embedded systems are found in a variety of common electronic devices, such as Consumer electronics, office automation, Power equipment, Automobiles etc. In some application where the communication is must with the computer the proposed system is very useful. Coming together of Embedded systems and the Internet which make possible networking of several Embedded systems to operate as a part of large system across networks - be it a LAN, WAN or the internet.

References


AUTHOR

Javed Sheikh pursuing M.tech in Digital Communication from Rukmani Devi Institute of Science and Technology, Bhopal.

Sumedh Gawande pursuing M.tech in Digital Communication from Rukmani Devi Institute of Science and Technology, Bhopal
Sachin Charbhe  Assi. Prof. ETC GNIEM, Nagpur received the B.E. and M.E. degrees in Electronics Engineering from B.D.C.O.E., Wardha, From Nagpur university in 2002 and R.A.I.T,Navi-mumbai From Mumbai University in 2012, respectively.