Serial Communication

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Outline

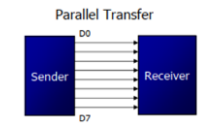
- Introduction
- Asynchronous Serial Communication
- Data Framing
- Serial Port Programming
- SPI Protocol
- I2C Protocol
- LCD interfacing using I2C

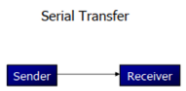
Acknowledgement

– Muhammad Mazidi, The 8051 Microcontroller and Embedded Systems using Assembly and C, Pearson Edu..

Introduction

- Two ways to transmit the data
  - – Parallel
    - Often 8 or more lines (wire conductors) are used to transfer data from one device to a device
    - Preferable for the devices that is only a few feet away
  - – Serial
    - One bit at a time is transmitted
    - For longer distance (many meters away)





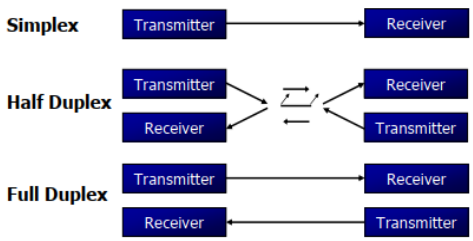
Serial Communication

- At the transmitting end, the byte of data must be converted to serial bits using parallel-in-serial-out shift register
- At the receiving end, there is a serial-in-parallel-out shift register to receive the serial data and pack them into byte.
- Digital signal can be transmitted without modulation for a short distance.
- If data is to be transferred on the telephone line, it must be converted from 0s and 1s to audio tones
  - This conversion is performed by a device called a modem, "Modulator/demodulator"

Types of Serial Communication

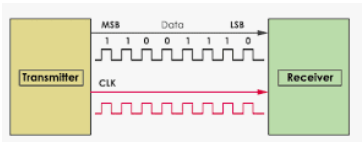
- Two types
  - Synchronous Serial Communication
    - Transfer a block of data at a time
  - Asynchronous Serial Communication
    - a single byte at a time
- Either of these method can be used by developing a software/code but it is tedious and long
- Special IC chips made by many manufacturers for serial communications
  - UART (Universal Asynchronous Receiver Transmitter)
  - USART (Universal Synchronous Asynchronous Receiver Transmitter)

Data Transmission Mode



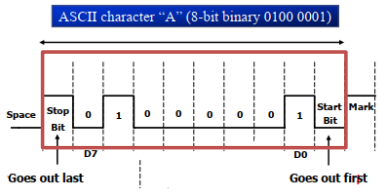
Synchronous Serial Communication

- Data is sent in a continuous stream at constant rate
- Requires that the clock for the synchronization between transmitter and receiver
- No additional bits require for communication setup
- Permits more information to be passed over a circuit per unit time



Asynchronous Serial Communication

- Preferred for character-oriented transmission
- Each character is placed in between start and stop bits, it is called as a framing
- The start bit is always a 0 (low) and the stop bit(s) is 1 (high)



Data Transfer Rate

- The rate of data transfer in serial data communication is stated in bps (bits per second)
- Another widely used terminology for bps is baud rate
- Baud Rate
  - It is modem terminology and is defined as the number of signal changes per second
- In modems, there are occasions when a single change of signal transfers several bits of data
- As far as the conductor wire is concerned, the baud rate and bps are the same, and we use the terms interchangeably

Cont…

- The data transfer rate of given computer system depends on communication ports incorporated into that system
- Example
  - IBM PC/XT could transfer data at the rate of 100 to 9600 bps
  - Pentium-based PCs transfer data at rates as high as 56K bps
  - In asynchronous serial data communication, the baud rate is limited to 100K bps

Data Communication Classification

- Current terminology classifies data communication equipment as
  - DTE (Data Terminal Equipment)
    - refers to terminal and computers that send and receive data
  - DCE (Data Communication Equipment)
    - refers to communication equipment, such as modems
- The simplest connection between a PC and controller requires a minimum of three pins, TxD, RxD, and GND.