DEVICES AND COMMUNICATION
BUSES FOR DEVICES NETWORK–

Lesson-7: Parallel Port Interfacing
with Switches, Keypad and Rotatory
encoder

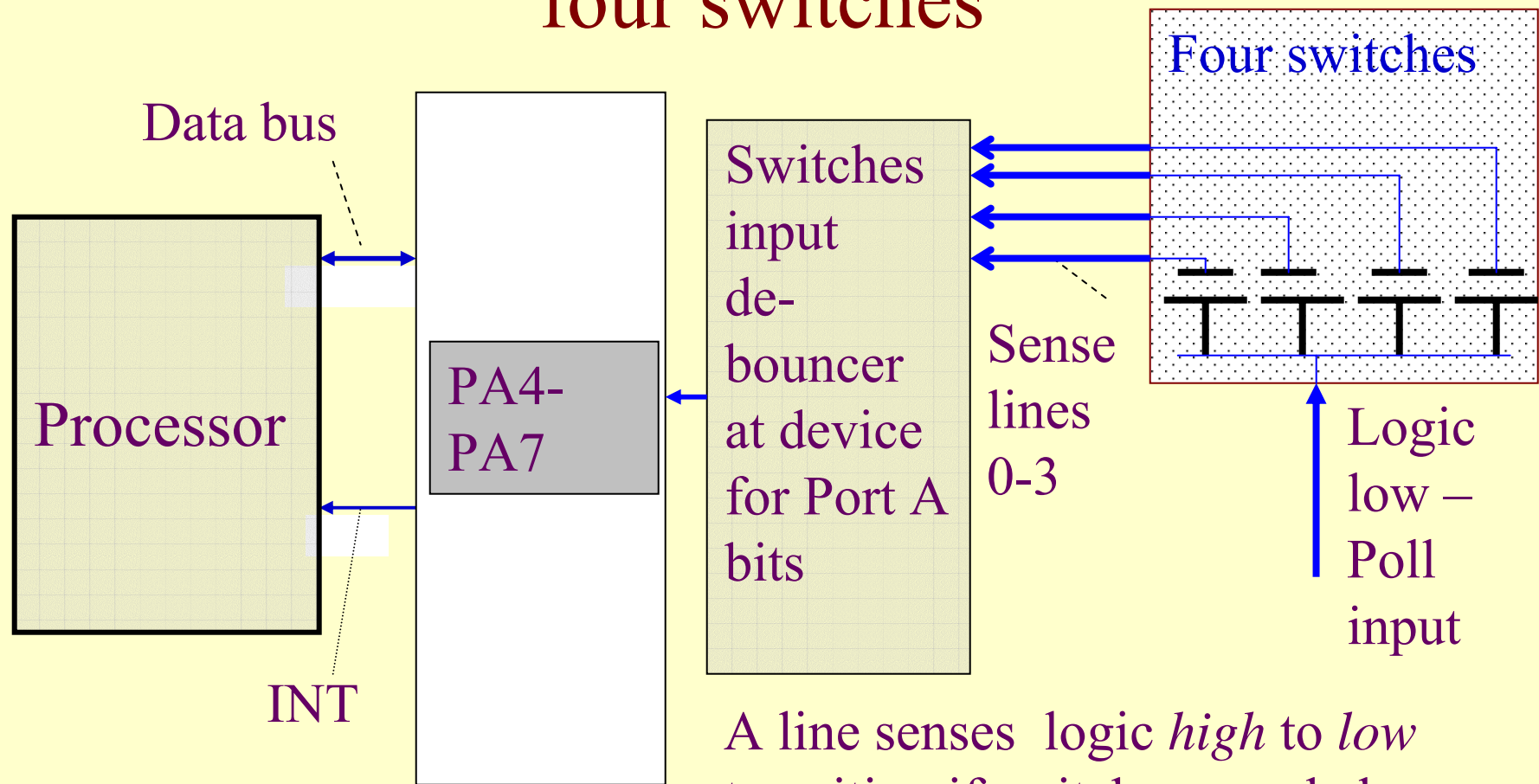# Port Interfacing ─ Parallel port outputs O0 to O7

- May be used as poll-lines─ A line sends a logic state for sensing a present state of a key

- May be to switch on-off the LEDs

- May be to switch on the LEDs near the slots with photo-transistors at other end

Port Interfacing─ Parallel port inputs I0 to I7

- May be from a keypad controller for ASCII code of the pressed key

- From interface circuit of sense-lines for sensing key-state

- From phototransistors

1. Parallel Port Interfacing with Switches (at camera or automatic chocolate vending machine) or menu select keys

Parallel port *A* with four-bit input from four switches

Four switches

Data bus

Processor

PA4-PA7

INT

Switches input de-bouncer at device for Port A bits

Sense lines 0-3

Logic low – Poll input

A line senses logic *high* to *low* transition if switch pressed else *high*

2. Parallel Port Interfacing with Keypad

Chapter-3 L07: "Embedded Systems - " , Raj Kamal, Publs.: McGraw-Hill Education

Keypad

- Physical lay out can be 3×5 plus 1 or 16 in a one row

- 16 keys assumed to be divided in four columns and four rows for circuit design

- One column connects to one poll line

- One key in a row connects to one sense line
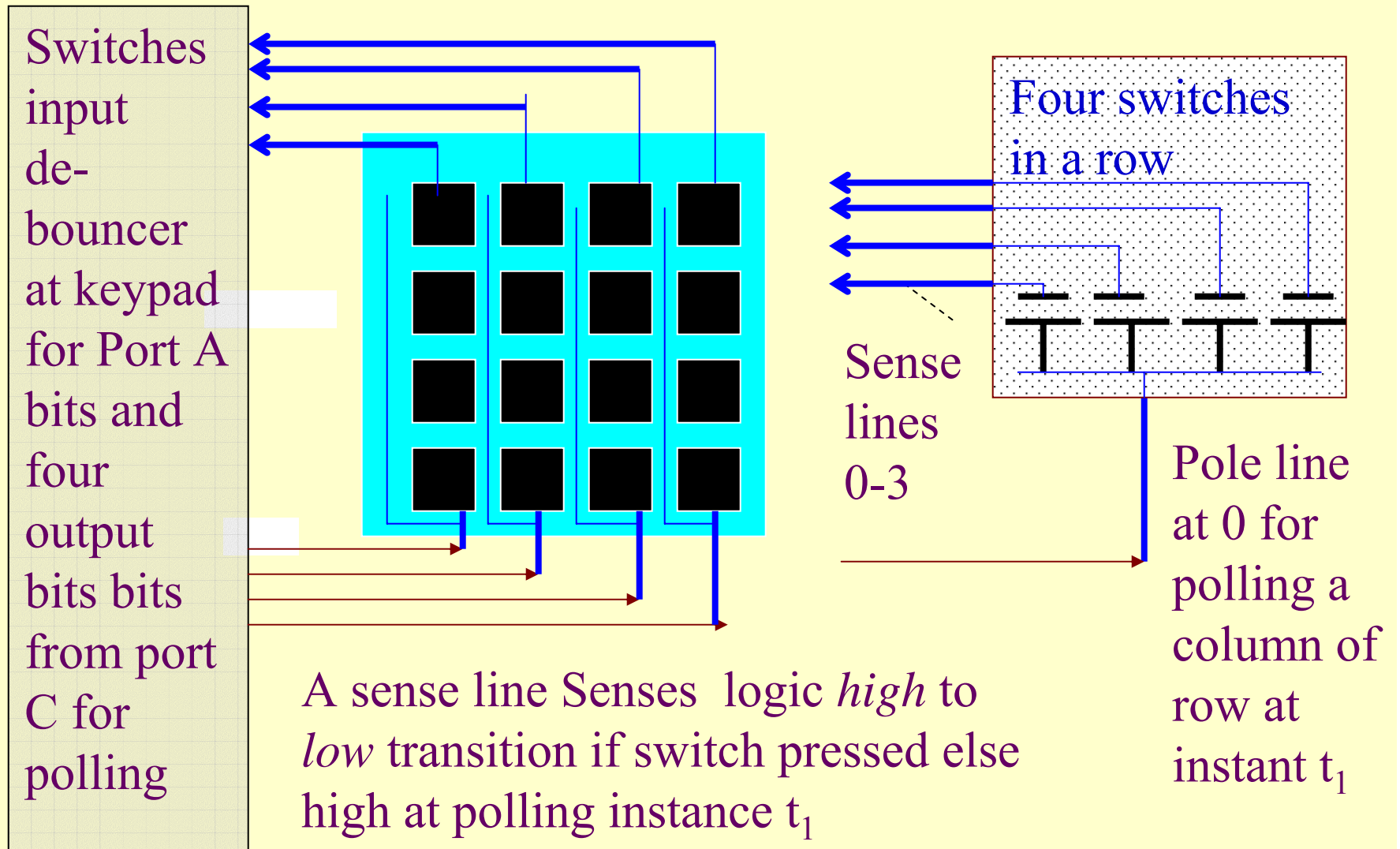
16-keys keypad and Four Menu keys

- Mobile smart phone has 16 keys and four menu select up, down, left, right keys

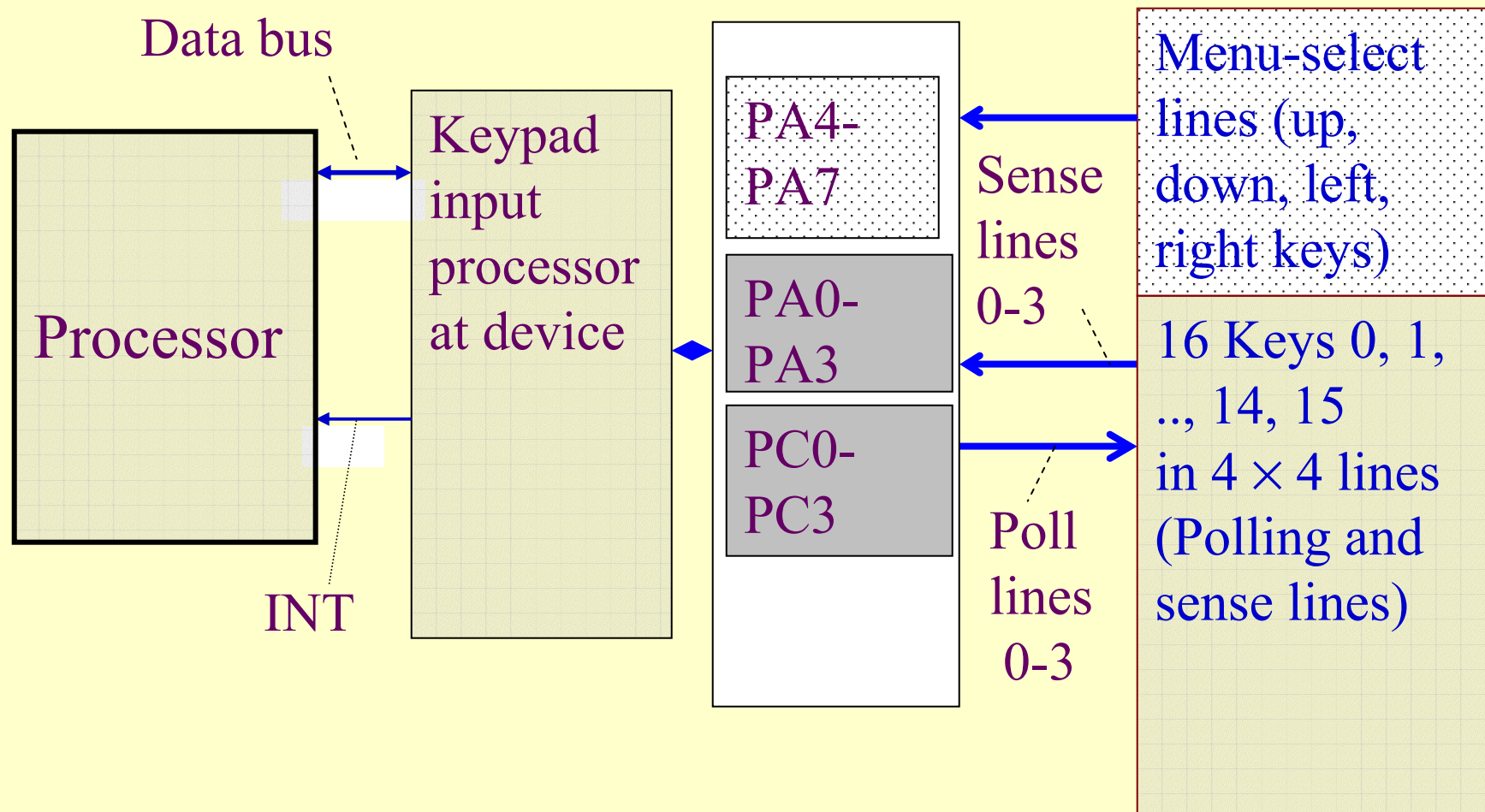- A processing element– a keypad controlling-device (controller)

A set of switches or keypad of 16 keys and four menu-select keys

- Assume that idle state logic state = 1.

- Four bits of an 8 bit input port A (A4-A7) for four menu select keys.

- 16 keys –arranged in four rows and four columns.

- Other four bits of A (A0-A3)–input from four common ends of four rows.

- Four bits of output port C (C0-C3)– output to four common ends of four columns.

Keypad

Switches input de-bouncer at keypad for Port A bits and four output bits bits from port C for polling

Four switches in a row

Sense lines 0-3

Pole line at 0 for polling a column of row at instant t_1

A sense line Senses logic *high* to *low* transition if switch pressed else high at polling instance t_1

Parallel input port *A* and four-bit output port *C* used for interfacing a set of 16 keys in keypad and four menu select keys

Data bus

Processor

Keypad input processor at device

INT

PA4-PA7

PA0-PA3

PC0-PC3

Sense lines 0-3

Poll lines 0-3

Menu-select lines (up, down, left, right keys)

16 Keys 0, 1, .., 14, 15 in 4×4 lines (Polling and sense lines)

A processing element ─ keypad controller, as it is keypad specific.

Processing element in the device

- Activates for polling output from port *C* ten times each second

- Sends C0-C3 = 0000 and after a wait it reads D0-D7 and A4-A7

- Processes the bounces when a key is pressed. This takes care of bouncing effects.

Processing element in the device

- Processing element computes the code of the pressed key and generates a status signal when a key is found pressed. From the bit pattern found at A0-A3, the processing element computes the 7-bit ASCII code of the pressed key at that instance and send output for the code through D0-D6. It also outputs D7 = 1 if a key is found pressed else D7 = 0.

3. Parallel Port Interfacing with encoder

Encoder

- A device, which measures the angular or linear position of a rotating or moving shaft

- Application in robots and industrial plants

Rotatory angle encoder

- Multiple tracks on a rotating disk.
- Each track has half of the segments transparent and half opaque.

Rotatory Encoder

- A has multi-slotted plate. A set of n infrared (IR) LED and phototransistor pairs generate n-bit input for a port.

- The encoder's each phototransistor interfaces to one parallel port bit

Rotatory Encoder interfacing

- Seven inputs─ Five track Rotatory encoder, one input is from PT at index slot, one input from phase detector circuit
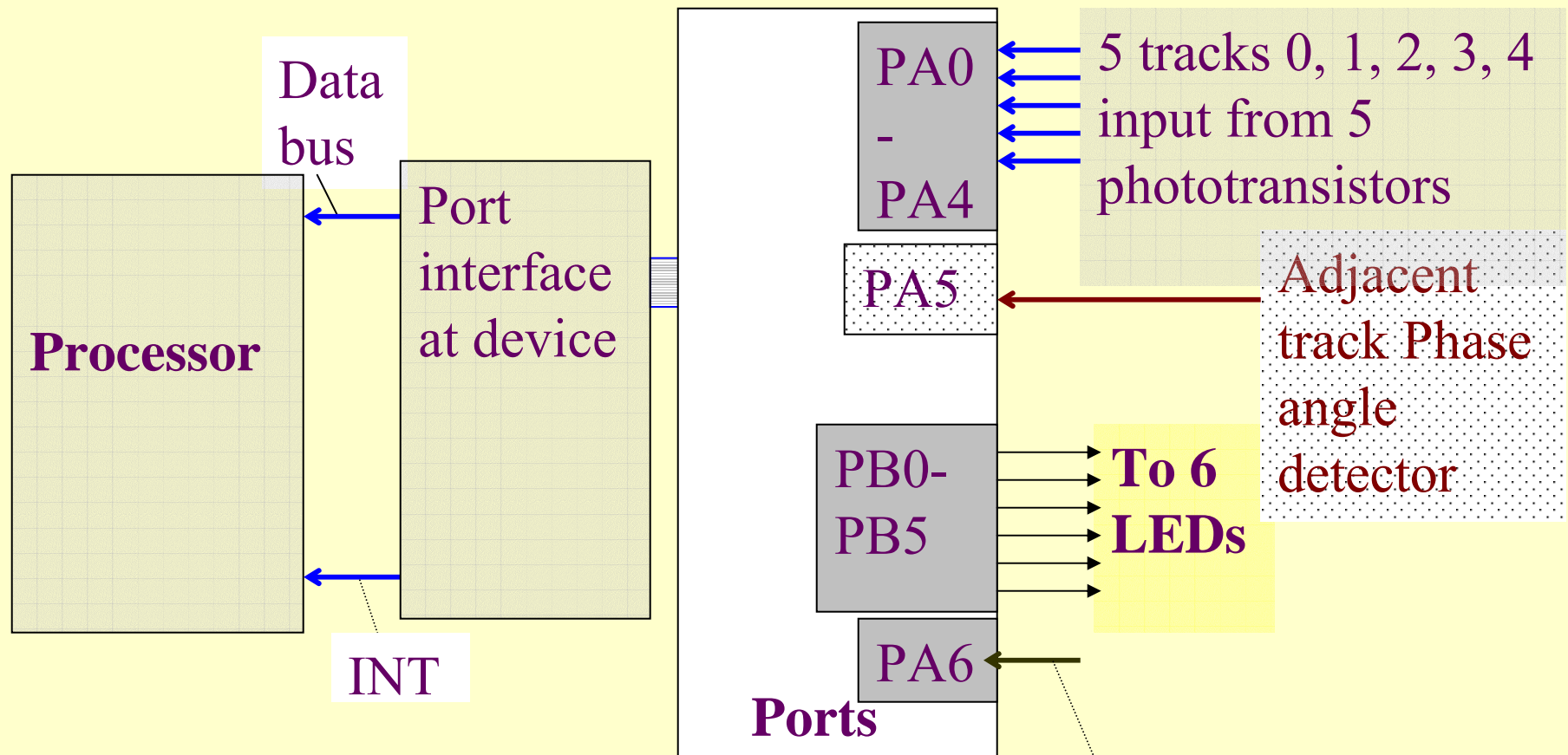
- Six outputs to six LEDs

Five tracks and one index slot

- One index slot is required to know the beginning of a revolution i.e. the position when shaft angle = 0°

- Five tracks are required to find the present angular position of a shaft with resolution of $360°/2^5$

- Phase angle detection between adjacent tracks gives the direction of motion

Interfacing of Six LED-Phototransistor Pairs and one phase detector circuit

- Five track Rotatory encoder has six LED-phototransistor (PT) pairs

- Five inputs are PTs from tracks and one input is from PT at index slot

- One input is from phase detector circuit, which finds phase angle between input from two PTs

Parallel input port A connected to an encoder circuit which sends the rotated or linear position of a moving shaft

Data bus

Port interface at device

Processor

INT

PA0 - PA4

5 tracks 0, 1, 2, 3, 4 input from 5 phototransistors

PA5

Adjacent track Phase angle detector

PB0- PB5

To 6 LEDs

PA6

Ports

PA6 input from index slot phototransistor in the rotating plate

Summary

We learnt

- Parallel port input from switches – A poll line at logic 0 connects one end of a switch and other end of a switch , which is at 1 in released state, senses 0 when pressed.

- Four sense lines from four switches to four port pins

- Port bit sensed = 0 when switch pressed and = 1 when released

We learnt

- Each switch or key de-bouncing circuit

- Parallel port input from 16-key keypad

- Keys assumed to be divided in four columns and four rows

- Four poll lines at logic 0 outputs (from four port pins) connect four columns of switches

- Four sense lines from four switches in a row to four port pins

We learnt

- Parallel port input from four menu keys

- Rotatory Encoder

- Rotatory Encoder seven inputs─ Five track Rotatory encoder, one input is from PT at index slot, one input from phase detector circuit

- Rotatory Encoder Six outputs to six LEDs

End of Lesson 7 of Chapter 3