SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECT312 – EMBEDDED SYSTEM DESIGN

III YEAR/ VI SEMESTER

UNIT 4 : EMBEDDED OPERATING SYSTEM AND MODELING

TOPIC 4.4: I/O Subsystem

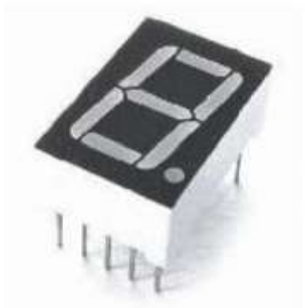
I/O Subsystem

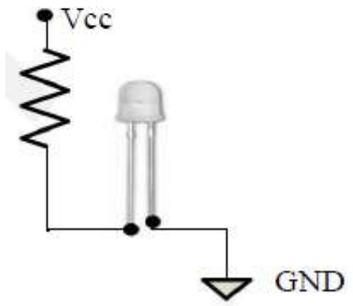
The I/O Subsystem

➢The I/O subsystem of the embedded system facilitates the interaction of the embedded system with external world

➢The interaction happens through the sensors and actuators connected to the Input and output ports respectively of the embedded system

➢The sensors may not be directly interfaced to the Input ports, instead they may be interfaced through signal conditioning and translating systems like ADC, Optocouplers etc





I/O Devices

1. Light Emitting Diode (LED)
2. 7-Segment LED Display
3. Optocoupler
4. Stepper Motor
5. Relay
6. Piezo Buzzer
7. Push Button Switch

I/O Devices - Light Emitting Diode (LED)

- Light Emitting Diode (LED) is an output device for visual indication in any embedded system

- LED can be used as an indicator for the status of various signals or situations

- Typical examples are indicating the presence of power conditions like „Device ON", „Battery low" or „Charging of battery" for a battery operated handheld embedded devices

- LED is a p-n junction diode and it contains an anode and a cathode

- For proper functioning of the LED, the anode of it should be connected to +ve terminal of the supply voltage and cathode to the –ve terminal of supply voltage

- The current flowing through the LED must limited to a value below the maximum current that it can conduct

- A resistor is used in series between the power supply and the resistor to limit the current through the LED

I/O Devices – 7-Segment LED Display

- The 7 – segment LED display is an output device for displaying alpha numeric characters

- It contains 8 light-emitting diode (LED) segments arranged in a special form. Out of the 8 LED segments, 7 are used for displaying alpha numeric characters

- The LED segments are named A to G and the decimal point LED segment is named as DP

- The LED Segments A to G and DP should be lit accordingly to display numbers and characters

- The 7 – segment LED displays are available in two different configurations, namely; Common anode and Common cathode

- In the Common anode configuration, the anodes of the 8 segments are connected commonly whereas in the Common cathode configuration, the 8 LED segments share a common cathode line

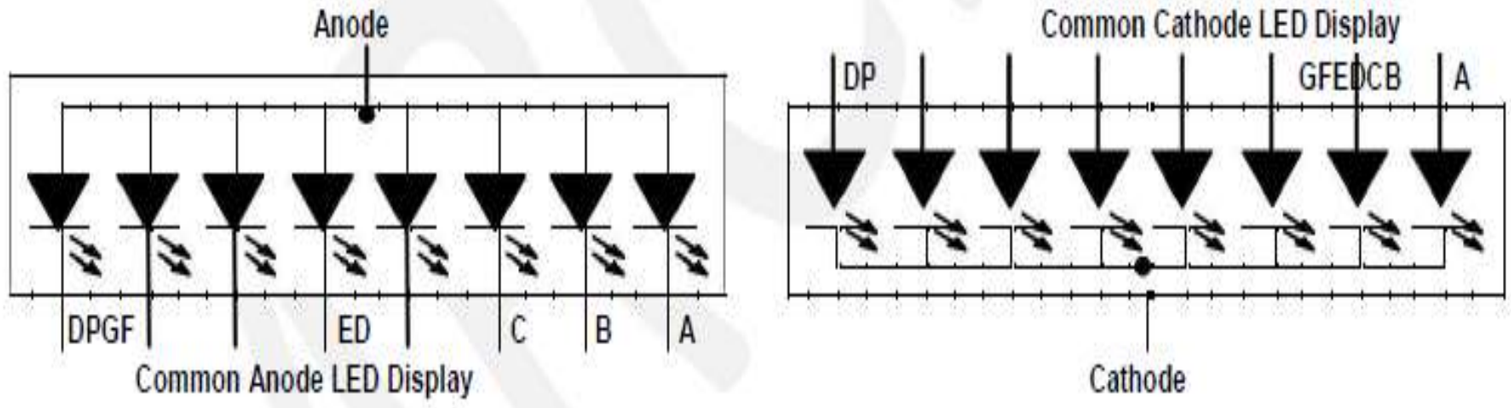
I/O Devices – 7-Segment LED Display

- Based on the configuration of the 7 – segment LED unit, the LED segment anode or cathode is connected to the Port of the processor/controller in the order „A" segment to the Least significant port Pin and DP segment to the most significant Port Pin

- The current flow through each of the LED segments should be limited to the maximum value supported by the LED display unit

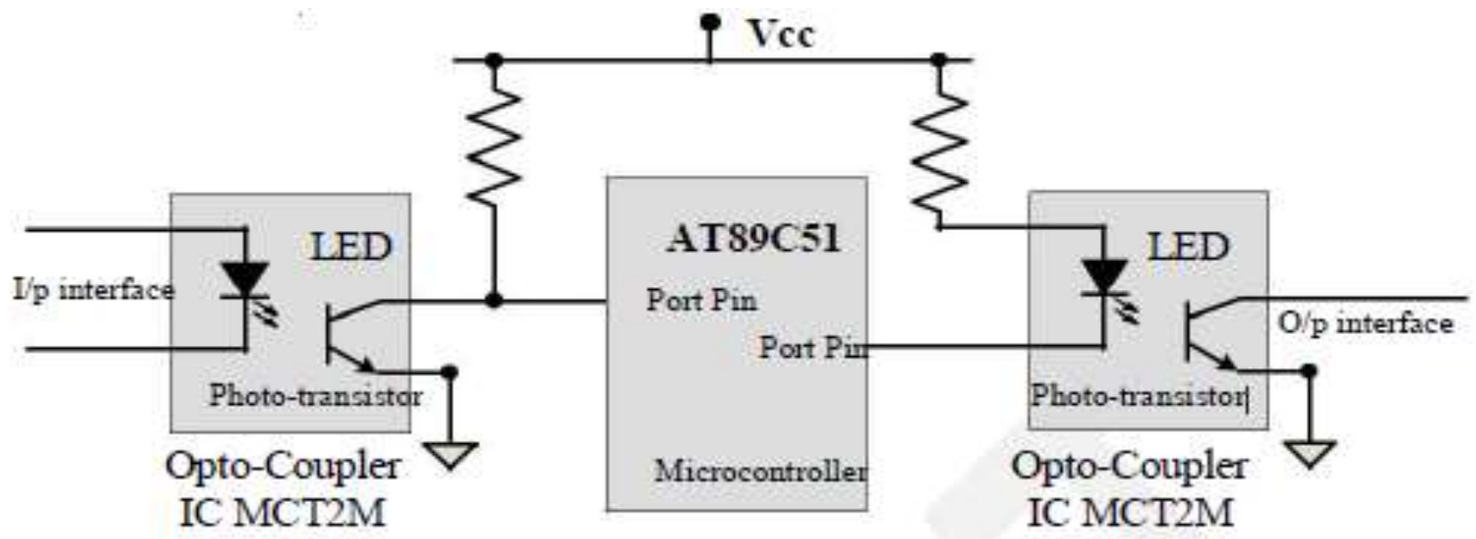
- The typical value for the current falls within the range of 20mA

- The current through each segment can be limited by connecting a current limiting resistor to the anode or cathode of each segment



I/O Devices – Optocoupler

- Optocoupler is a solid state device to isolate two parts of a circuit
- Optocoupler combines an LED and a photo-transistor in a single housing (package)
- In electronic circuits, optocoupler is used for suppressing interference in data communication, circuit isolation, High voltage separation, simultaneous separation and intensification signal etc
- Optocouplers can be used in either input circuits or in output circuits



Optocoupler in input and output circuit

I/O Devices – Stepper Motor

- Stepper motor is an electro mechanical device which generates discrete displacement (motion) in response to dc electrical signals

- It differs from the normal dc motor in its operation. The dc motor produces continuous rotation on applying dc voltage whereas a stepper motor produces discrete rotation in response to the dc voltage applied to it

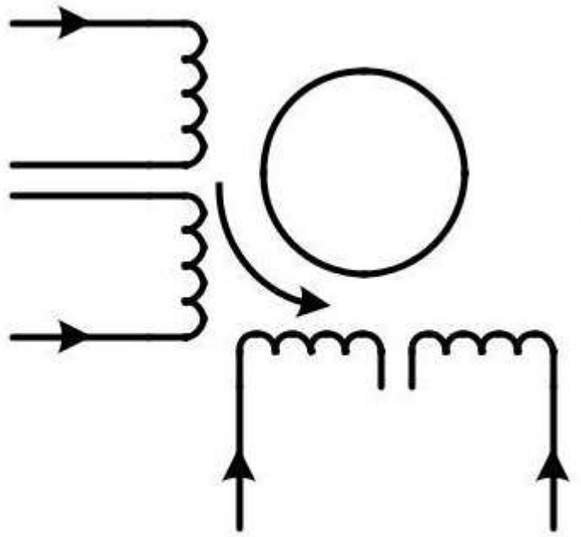
- Stepper motors are widely used in industrial embedded applications, consumer electronic products and robotics control systems

- The paper feed mechanism of a printer/fax makes use of stepper motors for its functioning

- Based on the coil winding arrangements, a two phase stepper motor is classified into

1. Unipolar
2. Bipolar

I/O Devices – Stepper Motor:



Unipolar

➢ A unipolar stepper motor contains two windings per pl tion (clockwise or anticlockwise) of a stepper motor is controlle ı of current flow

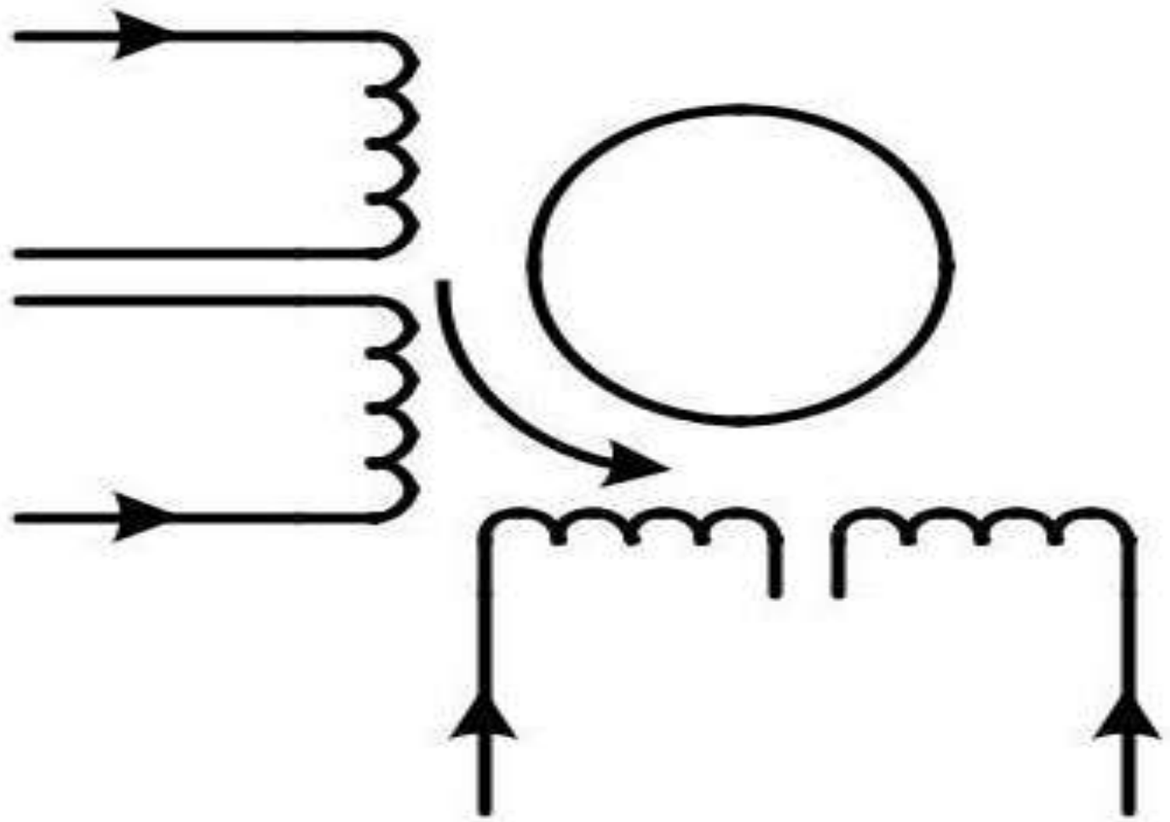
➢Current in one direction flows through one coil and i ɔws through the other coil. It is easy to shift the direction of the terminals to which the coils are connected

Bipolar

➢A bipolar stepper motor contains single winding per phase. For reversing the motor rotation the current flow through the windings is reversed dynamically

➢It requires complex circuitry for current flow reversal

I/O Devices – Stepper Motor



The I/O Subsystem – Relay

➢An electro mechanical device which acts as dynamic path selectors for signals and power

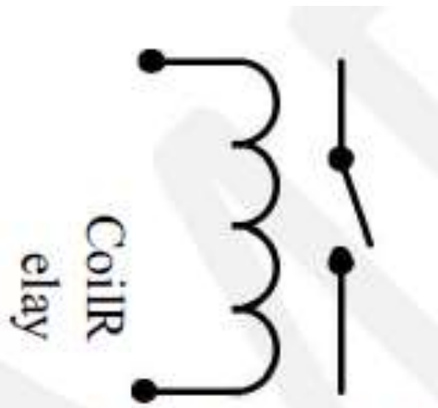
➢ The „Relay" unit contains a relay coil made up of insulated wire on a metal core and a metal armature with one or more contacts

➢Relay" works on electromagnetic principle

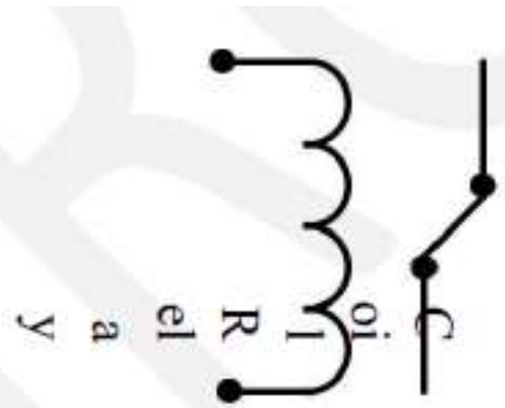
➢When a voltage is applied to the relay coil, current flows through the coil, which in turn generates a magnetic field

The I/O Subsystem – I/O Devices – Relay:

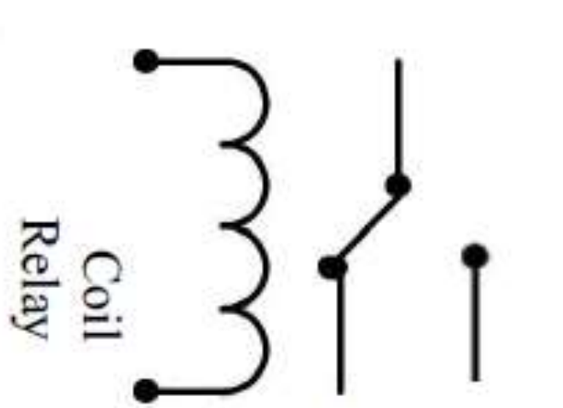
- The magnetic field attracts the armature core and moves the contact point
- The movement of the contact point changes the power/signal flow path
- The Relay is normally controlled using a relay driver circuit connected to the port pin of the processor/controller
- A transistor can be used as the relay driver. The transistor can be selected depending on the relay driving current requirements.



Single Pole Single Throw Normally Open



Single Pole Single Throw Normally Closed



Single Pole Double Throw

The I/O Subsystem – Piezo Buzzer

- It is a piezoelectric device for generating audio indications in embedded applications
- A Piezo buzzer contains a piezoelectric diaphragm which produces audible sound in response to the voltage applied to it
- Piezoelectric buzzers are available in two types

1.Self-driving 2.External driving

- Self-driving contains are the necessary components to generate sound at a predefined tone
- External driving piezo Buzzers supports the generation of different tones
- The tone can be varied by applying a variable pulse train to the piezoelectric buzzer
- A Piezo Buzzer can be directly interfaced to the port pin of the processor/Controller

The I/O Subsystem – Push button switch

- Push Button switch is an input device

- Push button switch comes in two configurations, namely „Push to Make‟ and „Push to Break

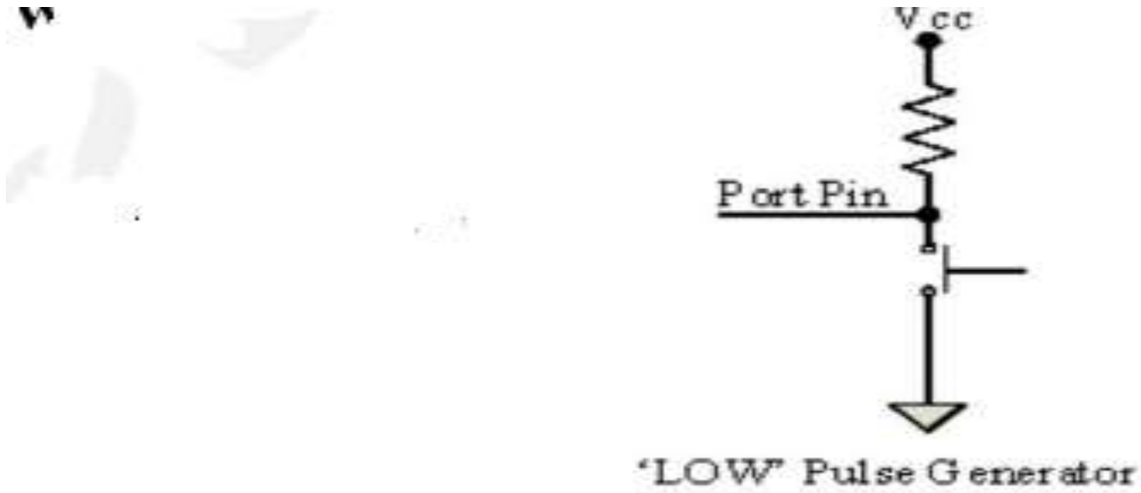
- The switch is normally in the open state and it makes a circuit contact when it is pushed or pressed in the „Push to Make‟ configuration

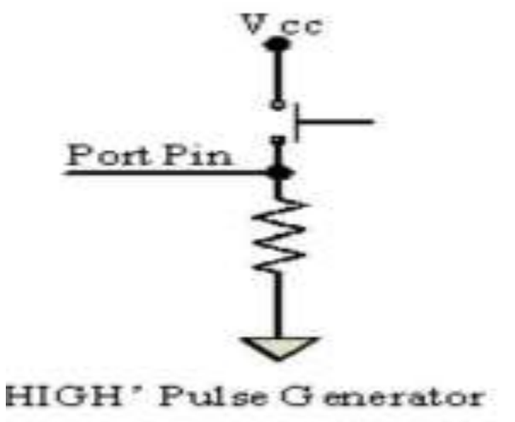
- In the „Push to Break‟ configuration, the switch normally in the closed state and it breaks the circuit contact when it is pushed or pressed

- The push button stays in the „closed‟ (For Push to Make type) or „open‟ (For Push to Break type) state as long as it is kept in the pushed state and it breaks/makes the circuit connection when it is released

- Push button is used for generating a momentary pulse

The I/O Subsystem – Push button switch





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