Chapter 8

Digital and Analog Interfacing Methods

Lesson 18

MCU Embedded Software Control of a Robot

A miniature copter—For Source Refer Chapter 1 text

Robot mechanical system

- Multiple motors (stepper and servo or DC)
- Each degree of freedom of the robot- a servo or DC or stepper motor
- Figure 8.65 for candy distribution robot

Robot mechanical system

- Robot is complex mechanical system in which each motor separately controlled
- Sensors emit through IR LED the output to MCU Rx port
- Motor get commands through IR LED at the output from MCU Tx port

Robot Motors Control

- Servo and DC motor control by PWM method
- Each motor is controlled in a sequence to let the robot perform the desired action.
- Robot needs to be trained first

Robot Sensors

- Rotatory encoders attach the motors to find the arm or hand or palm or keg reaching the particular angles
- Proximity sensors (touch, light sensors, metal and motor (magnet) sensors) are used.

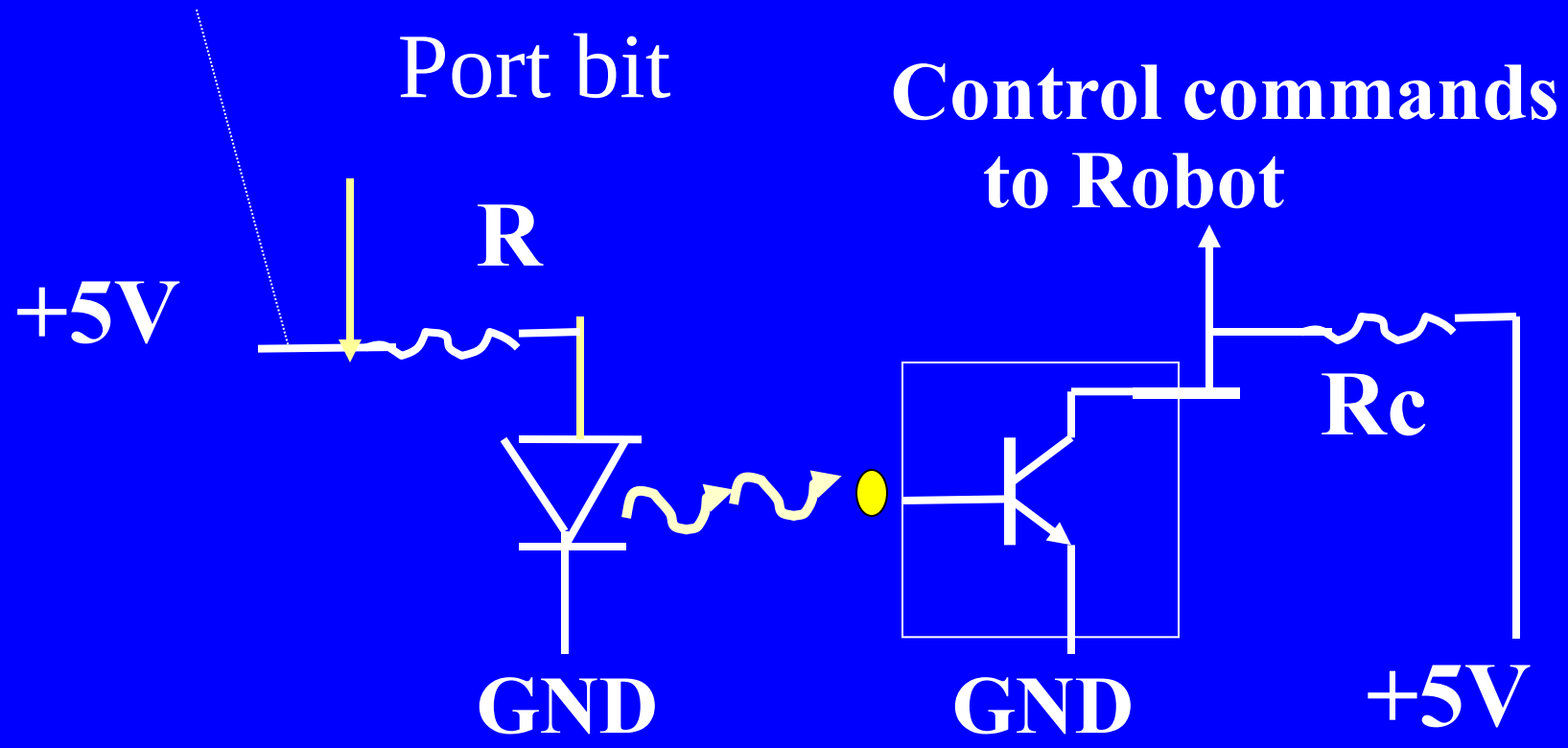
MCU controlling Actions

- Interfaces directly (analog signals shielded communication) connect the MCU
- Remote infrared control bits communications and connection to MCU serial ports

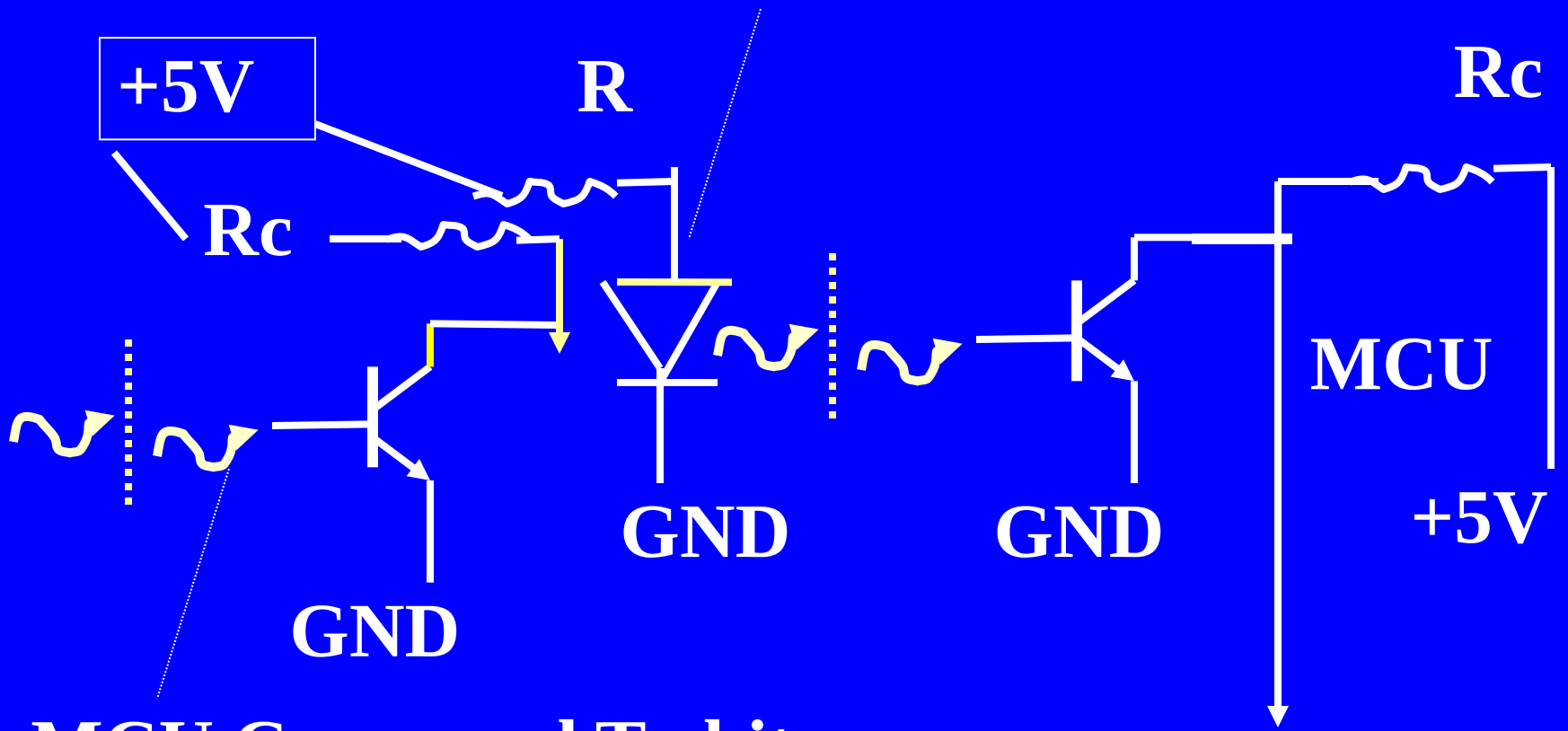
IR remote sensing control signals

- ASCII code of the key-pressed sent serially by synchronous communication.
- Code of the key remotely pressed precedes the synchronizing character (for example, 0010 1101) or nibble (for example, 1101).
- IR LED when bit = 1 current is *on* and when 1 is *off*.

Remote MCU Commands



Outputs of Sensors at Robot



Serial Bus at Robot

- Robot Serial bus connects all the sensors and motors through common channels for Tx and Rx
- At an instance only addressed device receives (accepts) the IR-phototransistor output from communication device at remote MCU

MCU Control

- MCUs sufficient memory, timers, PWMs, and IOs
- Embedded robotic systems use 8-bit MCUs and need 32- or 64-KB memory

MCU Events processing and Timer Actions

- A high resolution and advanced EPA (Event Processor Array)- Intel EPA with a library of 20 and above timing functions)
- Motorola Timer Processors Unit

MCU Features Required

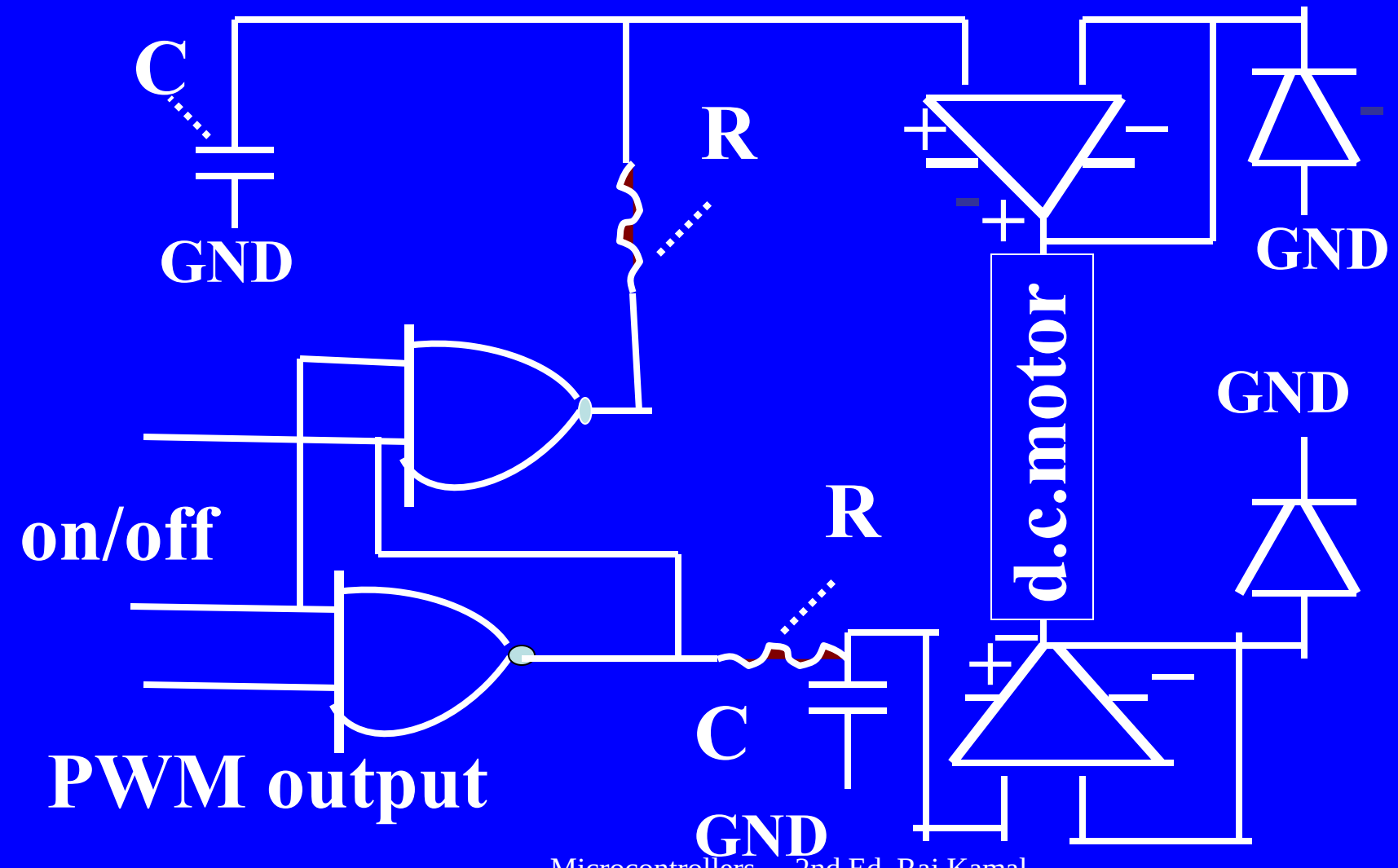
- 1.Four or Six PWM channels.
- 2.Interfaces of touch sensors, IR sensors and motor proximity sensors
- 3.Remote infrared control bits serial synchronous communication interface

MCU Features Required

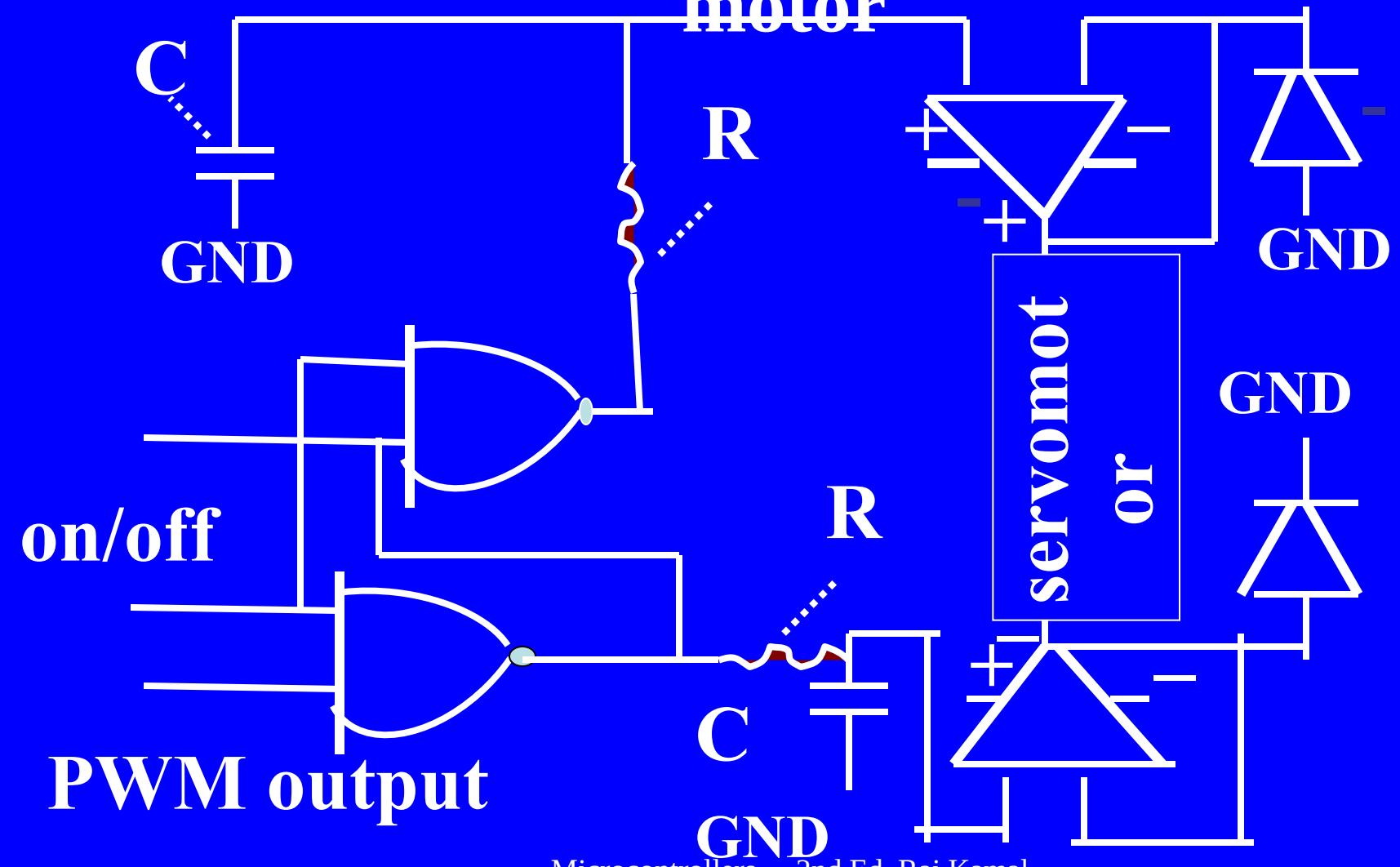
- 4.Remote as well as local serial IOs function at the port pins.

5. IO lines for sharing with the external interfacing circuits.

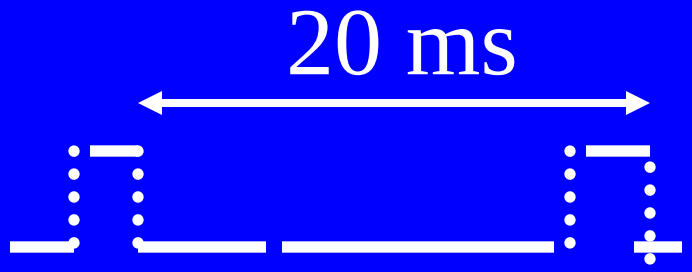
Integrator PWM output for current, speed and direction control of d. c. motor



Integrator PWM output for current, speed and direction control of d. c. motor



Servomotor control

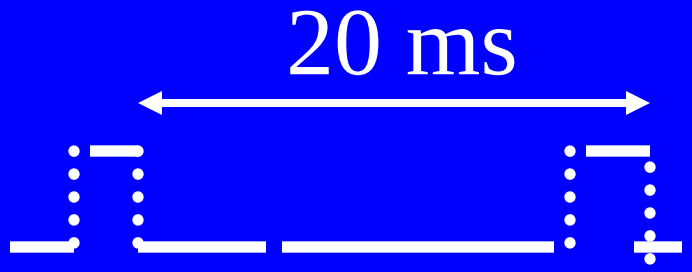


PWM output

1.5ms **1.5ms**

Servo motor at Neutral 0° position

Servomotor control

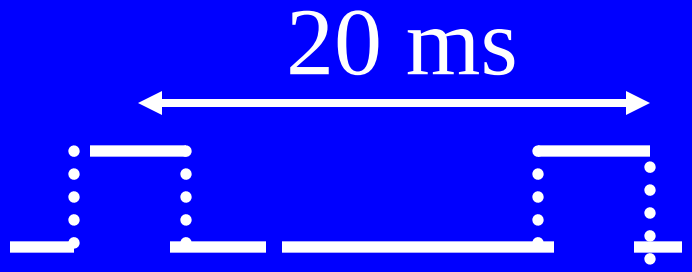


PWM output

1.0ms **1.5ms**

Servo motor at −90° reversed position

Servomotor control



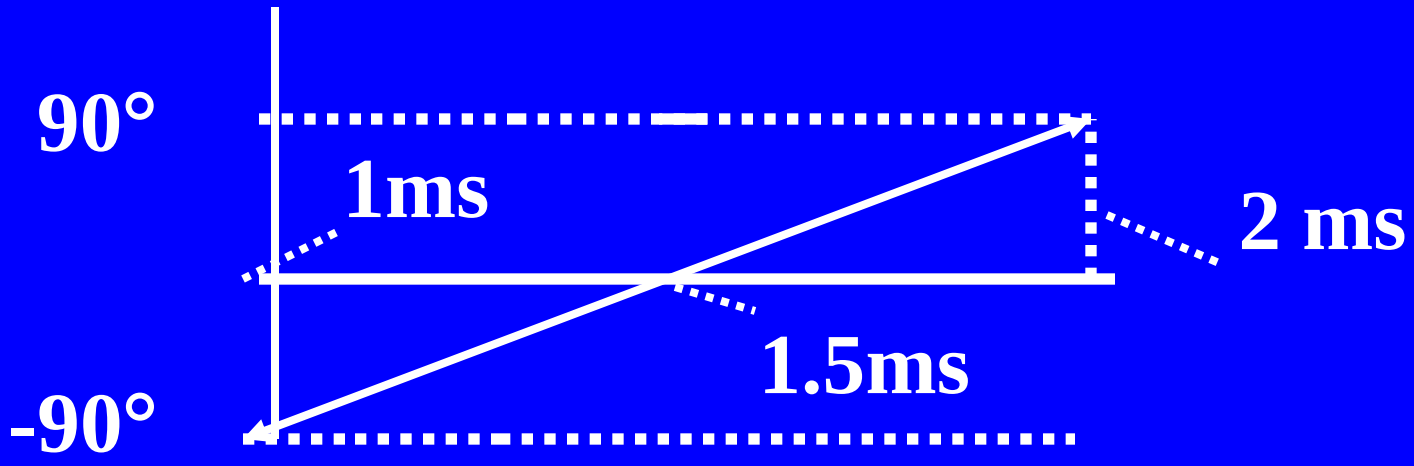
PWM output

2.0 ms **2.0 ms**

Servo motor at +90° forward position

Servo motor rotate angle

PWM outputs at 20 ms Intervals



PWM output = 1 period vs. rotated angle

Stepper Motor Interface

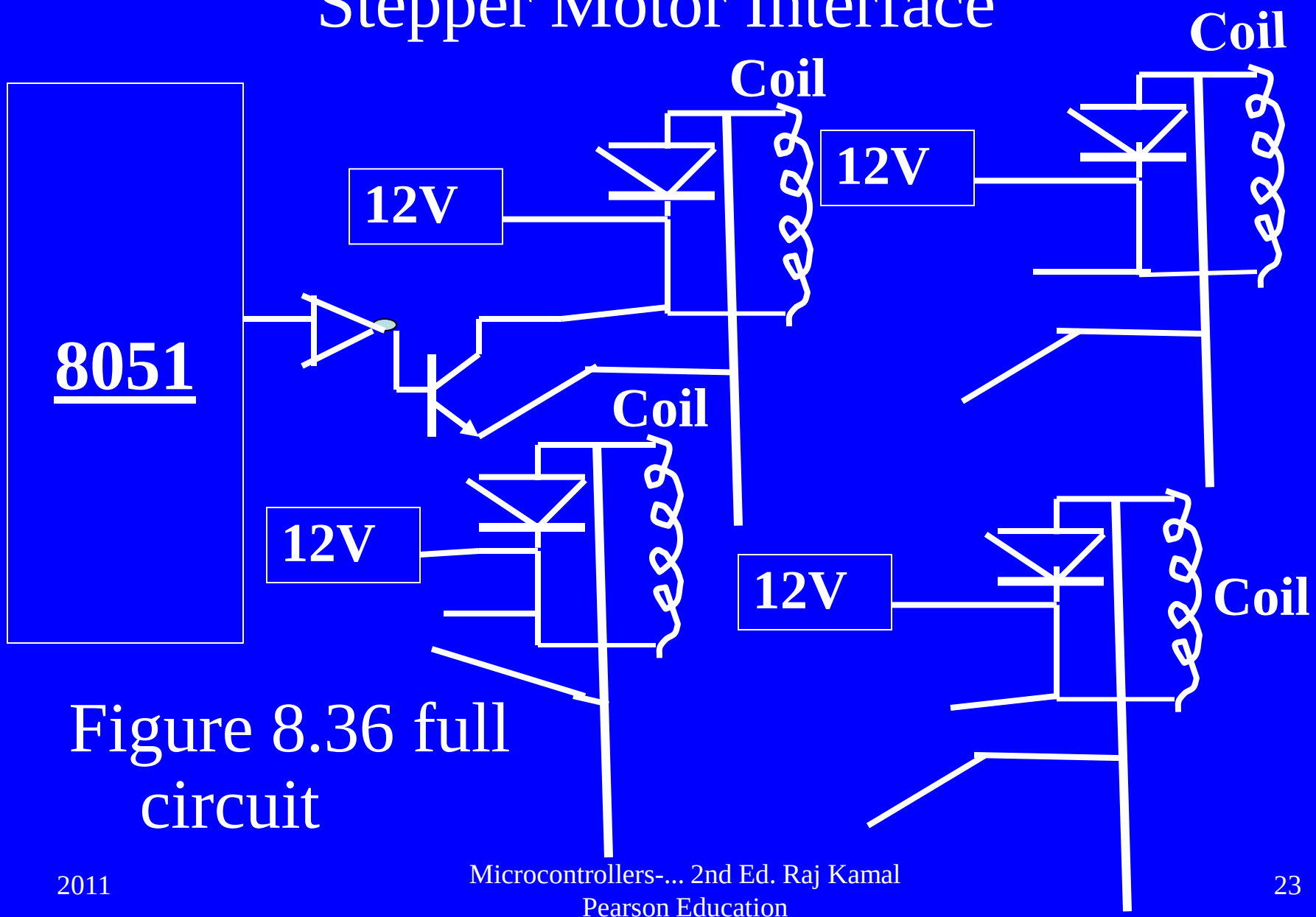
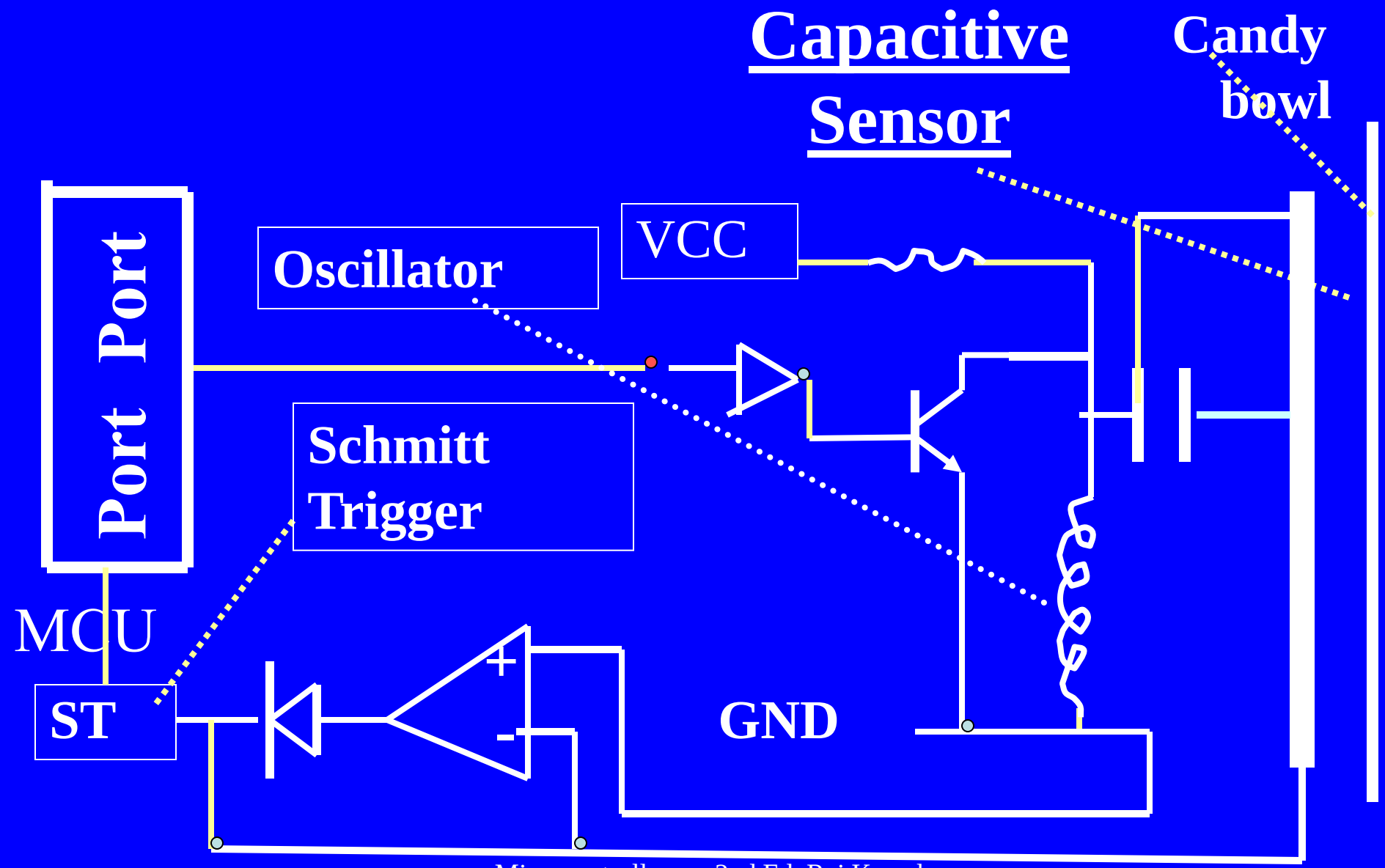


Figure 8.36 full circuit

Proximity Sensing

- **Capacitance when electrode near the candy bowl causes circuit resonance**


Capacitive Sensor
Candy bowl
Port Port
Oscillator
VCC
Schmitt Trigger
MCU
ST
+
-
GND

Summary

We learnt

A Robot mechanical system controlled by MCU

- Consists of Multiple motors (stepper and servo or DC)
- Each degree of freedom of the robot- a servo or DC or stepper motor
- Candy distribution robot interfacing circuits for each action

End of Lesson 18

MCU Embedded Software Control of a Robot