Heaven's light is our guide

Rajshahi University of Engineering & Technology

MTE 1101

Mechatronic Systems

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Outlines

- Difference Between Evolutionary Process and Revolutionary Process
- Example of Revolutionary Process in Term of Mechatronics Perspective
- Industrial Revolutions
- Systems
- Mechatronic System
- Mechatronic System Basic Elements

References: Slide, Internet, Recommended Books (Rajput/Bolton: Chapter 1)

Difference Between Evolutionary Process and Revolutionary Process

Evolutionary Process	Revolutionary Process
1. Evolution refers to the gradual development or changes in something over a period.	1. Revolution means 'a turn around'; a sudden, complete, or radical change in something.
2. This process is a slow and gradual change or development.	2. This process is a sudden, extreme or complete change in the people's live, work etc.
3. This process is based on observations, empirical data and tested hypotheses.	3. This process is based on advanced technology, engineering, science and innovation.
4. This process is less costly.	4. This process is much costly.
5. This process is less risky as it's a gradual change over time, people get habituated.	5. This process is risky as it's a radical change in a short period, not every people get used to it.

Example of Revolutionary Process in Term of Mechatronics Perspective

Automobiles: An example can be given in automobile sector. In old cars, the engines were only fuel engines and also there was no Automatic Vehicle Technology (AVT). But through the revolutionary process, recent modern cars consist of hybrid engines and Automatic Vehicle Technologies like Antilock Braking System (ABS), Automatic Transmission System, Automotive Safety Devices, Navigation System, Engine Management System, Automatic Parking Assistance which are purely mechatronics systems.

Old cars with no hybrid engine or AVT

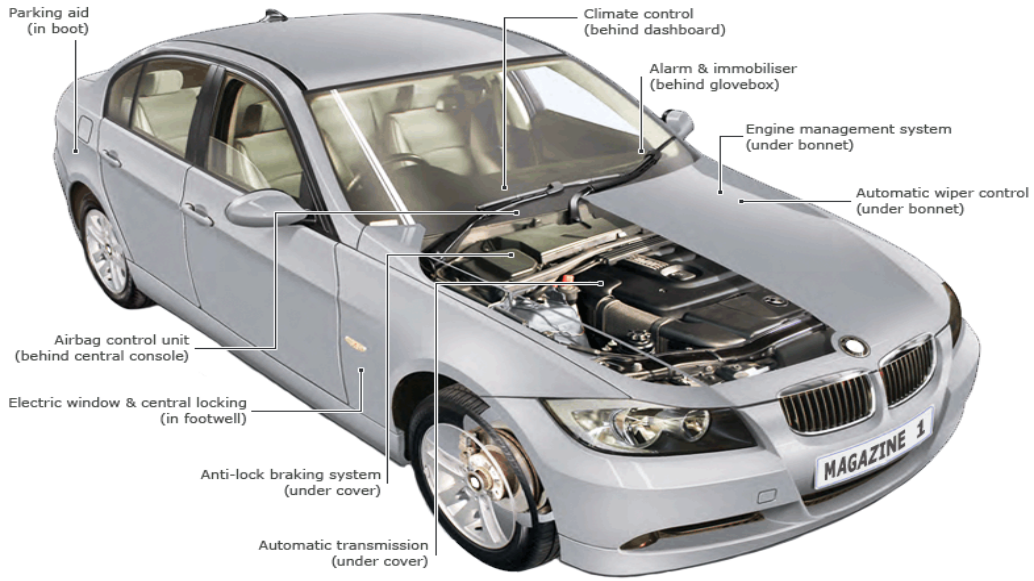
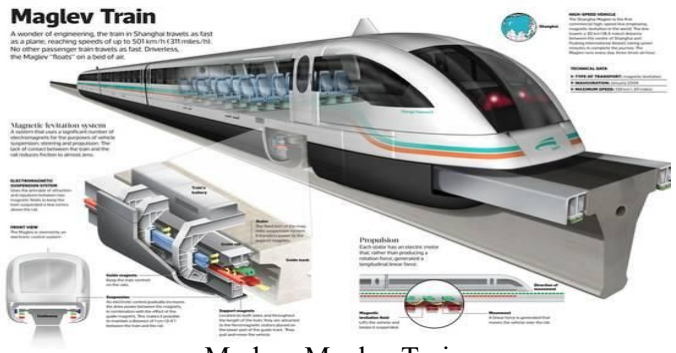


Fig. 1.1: Revolution in Automobiles

Example of Revolutionary Process in Term of Mechatronics Perspective (Cont.)

Examples of revolutionary process in term of mechatronics can be given in home automation, transportation, communication, industrial manufacturing, medical, defense and many more sectors. This process is sudden, extreme and made complete change in the people's live and work. The following figures illustrates some revolutionary changes in various sectors by mechatronics.

Old Railway Track Train



Modern Maglev Train

Fig. 1.2: Revolution in Transportation

Old Vacuum Cleaner

Modern Smart Robot Vacuum Cleaner

Fig. 1.4: Revolution in Home Automation

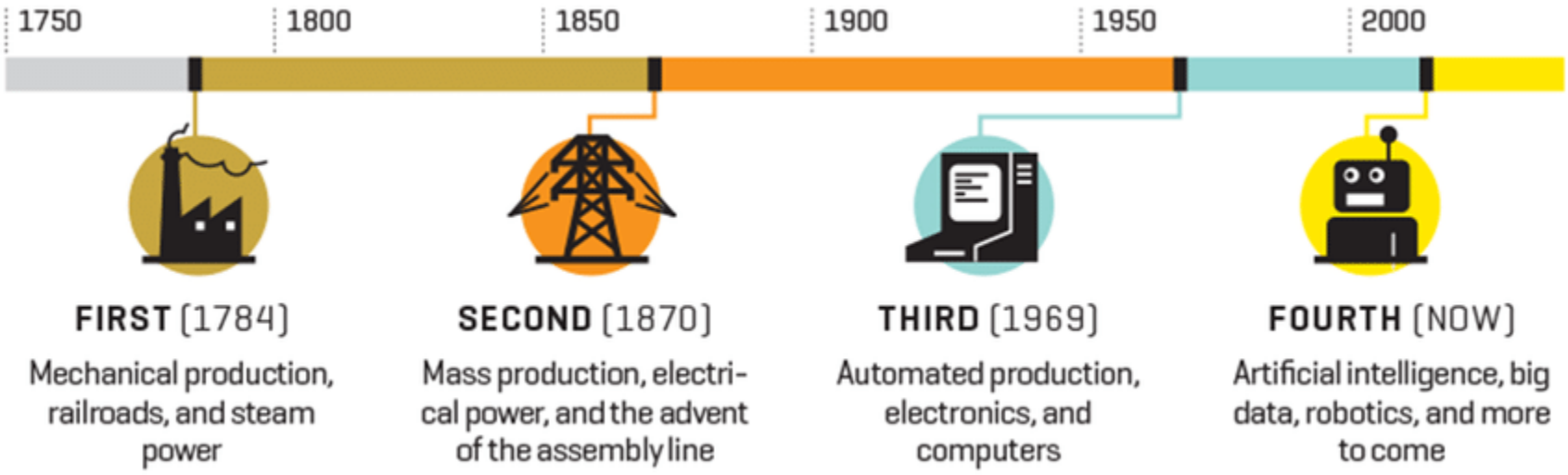
Old Manufacturing Milling Machine

Modern Manufacturing FANUC Robot

Fig. 1.3: Revolution in Industrial Manufacturing

Industrial Revolutions

The 4 Industrial Revolutions: transition to new manufacturing processes



Industry 4.0

Industrial Revolutions (Cont.)

(1) Fourth Industrial Revolution explained in 3 minutes| 4IR #4IR - YouTube

(1) What is Industry 4.0 and what does it mean for you? - YouTube

(1) Industry 4.0 - YouTube

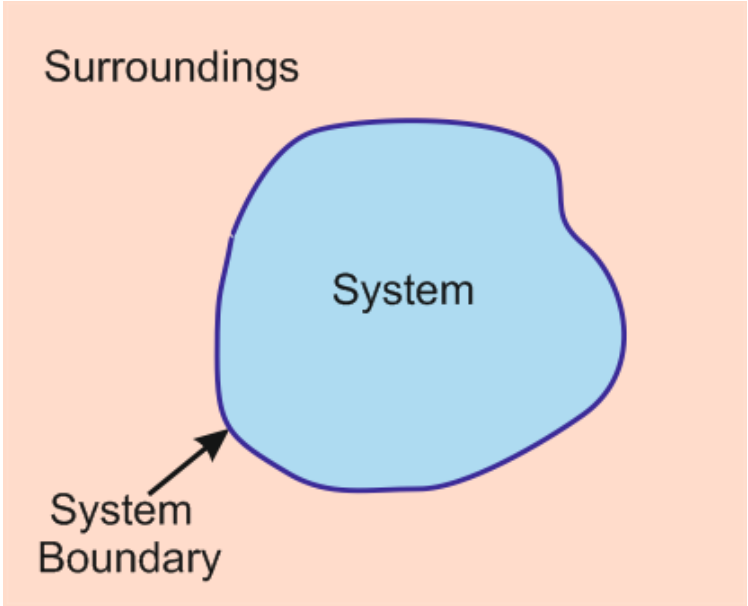
(1) What is Industry 4.0? | What are the key Industry 4.0 technologies| All explained in 10 minutes. - YouTube

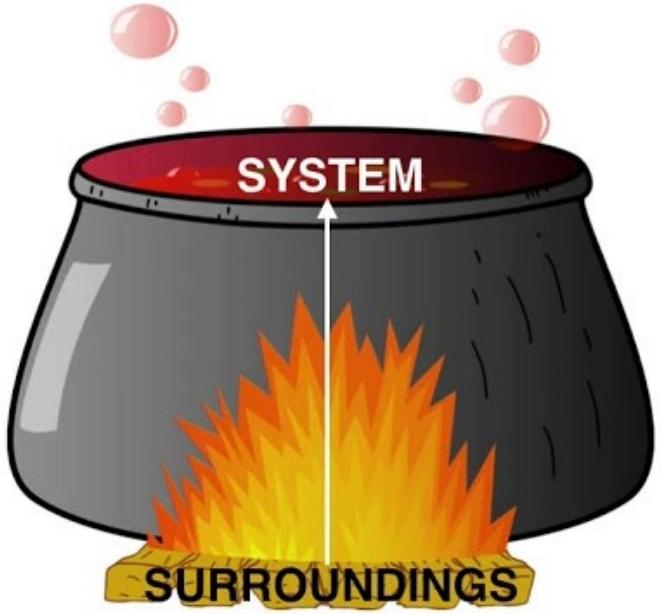
Systems

System: a system is the part of the universe that is being studied, while the environment is the remainder of the universe that lies outside the boundaries of the system. It is also known as the surroundings or neighborhood, and in thermodynamics, as the reservoir.

Examples

- This universe is itself a system consisting of large number of subsystems.
- Human body as a system has digestive system, respiratory system etc.



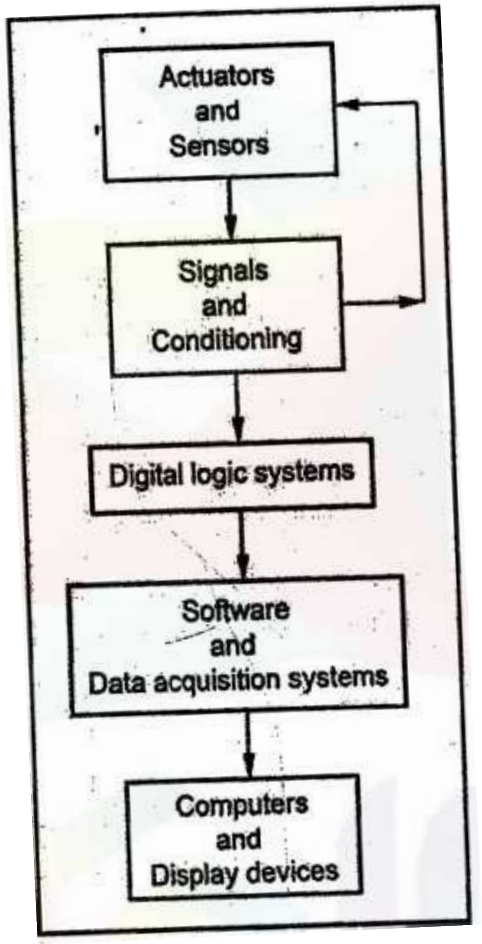


Mechatronic System

Mechatronic System: Mechatronics is the synergistic integration of sensors, actuators, signal conditioning, power electronics, decision and control algorithms, and computer hardware and software to manage complexity, uncertainty, and communication in engineered systems.

Basic Elements of Mechatronics System:

(i) Actuators and sensors
(ii) Signals and conditioning
(iii) Digital logic Systems
(iv) Software and data acquisition systems
(v) Computers and display devices.



Mechatronic System Basic Elements

(i) Sensors and actuators

Sensors and actuators mostly come under mechanical systems. The actuators produce motion or cause some action. The sensors detect the state of the system parameters, inputs, and outputs. The various actuators .used in the mechatronic system are pneumatic and hydraulic actuators, electro-mechanical actuators, electrical motors such as DC motors, AC motors, stepper motors, servomotors, and piezoelectric actuators. The various types of sensors used in the mechatronic system are linear arid rotational sensors, acceleration sensors, force, torque and pressure sensors, flow sensors, temperature sensors, proximity sensors, light sensors.

(ii) Signals and conditioning

The mechatronic systems deal with two types of signals and conditioning such as – input and output. The input devices receive input signals from the mechatronic systems via interfacing devices and sensors. Then it is sent to the control circuits for conditioning or processing. The various input signal conditioning devices used in the mechatronic system are discrete circuits, amplifiers, Analog-to-Digital (A/D) converters, Digital-to-Digital (DZD) convertors. The output signals from the system are sent to output/display devices through interfacing devices. The various output signal conditioning devices used in the mechatronic system are Digital-to-Analog (D/A) converters, Display Decoders (DD) converters, amplifiers, power transistors, and power op-amps.

(iii) Digital logic/control systems

Digital logic devices control overall system operation. The various digital logic systems used in the mechatronic system are logic circuits, microcontrollers, programmable logic controllers, sequencing and timing controls, and control algorithms.

(iv) Software and data acquisition systems

The data acquisition system acquires the output signals from sensors in the form of voltage, frequency, resistance etc. and it is inputted into the microprocessor or computer. Software is used to control the acquisition of data through DAC board. The data acquisition system consists of a multiplexer, amplifier, register, and control circuitry, and DAC board. The various data acquisition systems used in the mechatronic system is data loggers, computer with plug-in boards, etc.

(v) Computers and display devices

Computers are used to store a large number of data and process further through software. Display devices are used to give visual feedback to the user. The various display devices used in the mechatronic system are LEDs, CRT, LCD, digital displays, etc.

To Be Continued…..

THANK YOU