INTRODUCTION

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Introduction to Mechatronics System/ ME 109

Semester 1

Week 3

Date: 04/01/2024

Outline

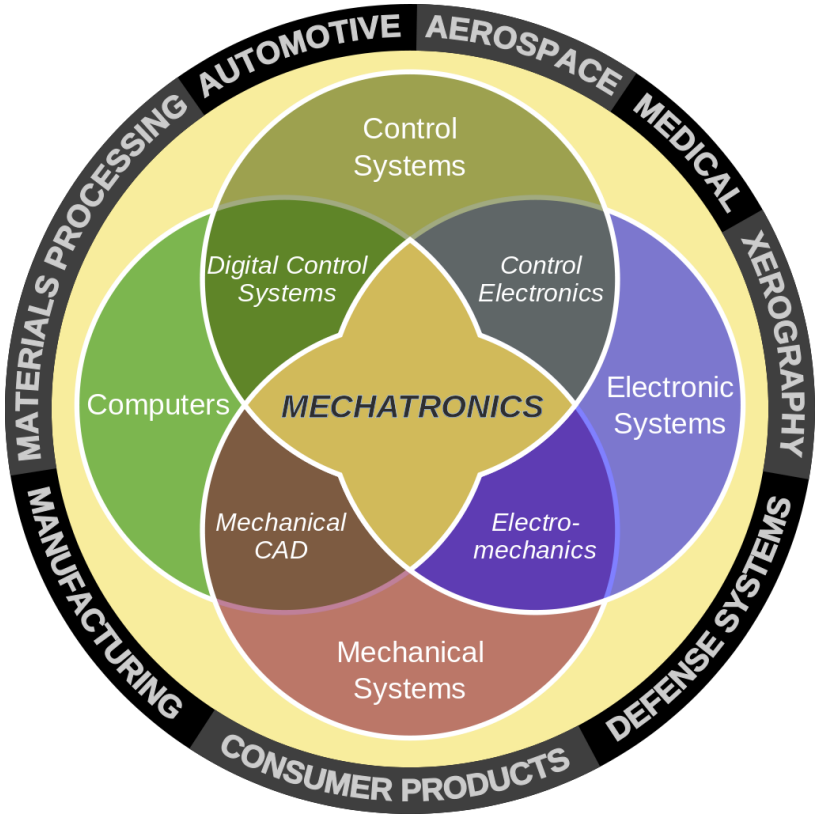
- Definition of Mechatronics System
- Example of Mechatronics Systems
- Analysis of Mechatronics Systems
  - Programming Parts
    - Controller
    - Microprocessor
  - Basic Electronics

Objectives

- Develop an understanding of the general design of Mechatronics Systems.
- The curriculum design of the four years of study at Mechatronics Engineering Department and the flow of the given courses to end up with the final year project.

Definition of Mechatronics System

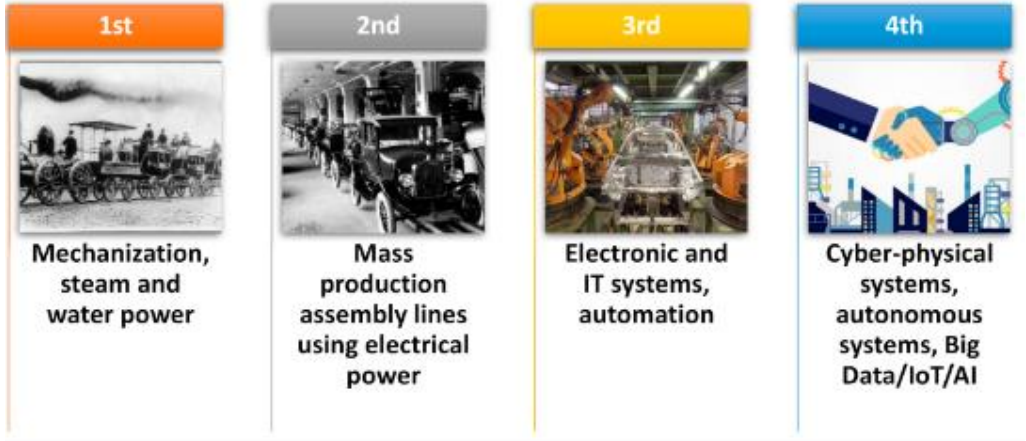
- Mechatronics is composed of two words: Mechanism and Electronics
- Mechatronics can be defined as the application of electronics and computer technology to control the motions of mechanical systems.
- Mechatronics also defined as a synergistic combination of mechanical, electrical, electronics, computer and control systems which, when combined, make possible the generation of simple, more economic, and reliable systems



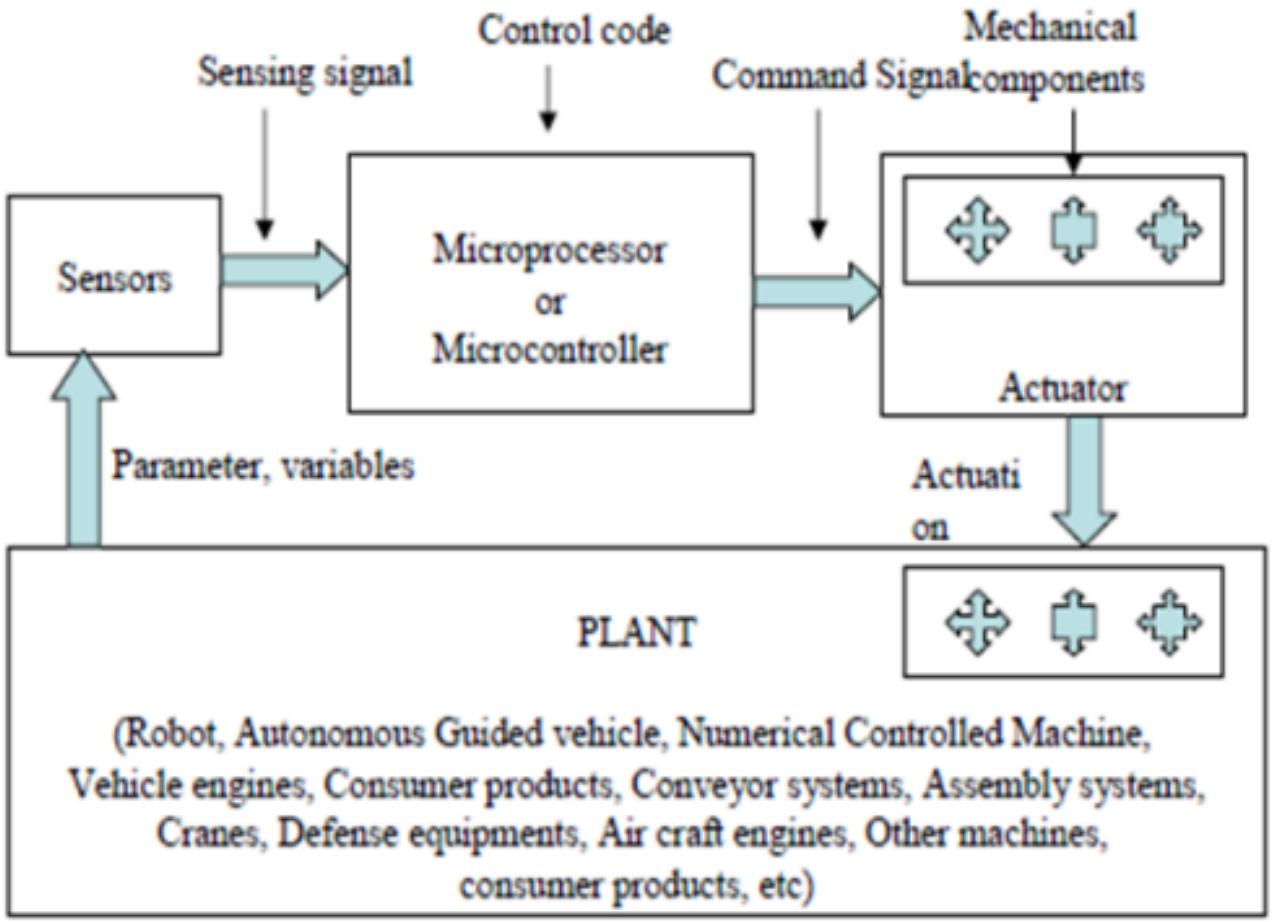
Industrial Revolutions

An industrial revolution is regarded as the technological progression that enhances the production process.

- The first industrial revolution started exploiting water and steam power in the production process.
- The second phase of industrialization was reached, starting assembly line usage and electric power in production.
- The third phase of industrial revelation was about the transition to computer and automation systems in the production process.
- The fourth phase of the industrial revolution is about the novel integrated production technologies, which combine the adaptation and usage of several advanced technologies, such as artificial intelligence, nanotechnology, quantum computing, cloud, internet, and robotics. It was triggered by the communication and connectivity based on sensor networks and the internet of things (IoT).



Mechatronics System Components



Examples of real-life Mechatronics Systems

- Industrial Robot
- Medical Robot
- Smart Home
- Electric Car
- Drone

Industrial Robot

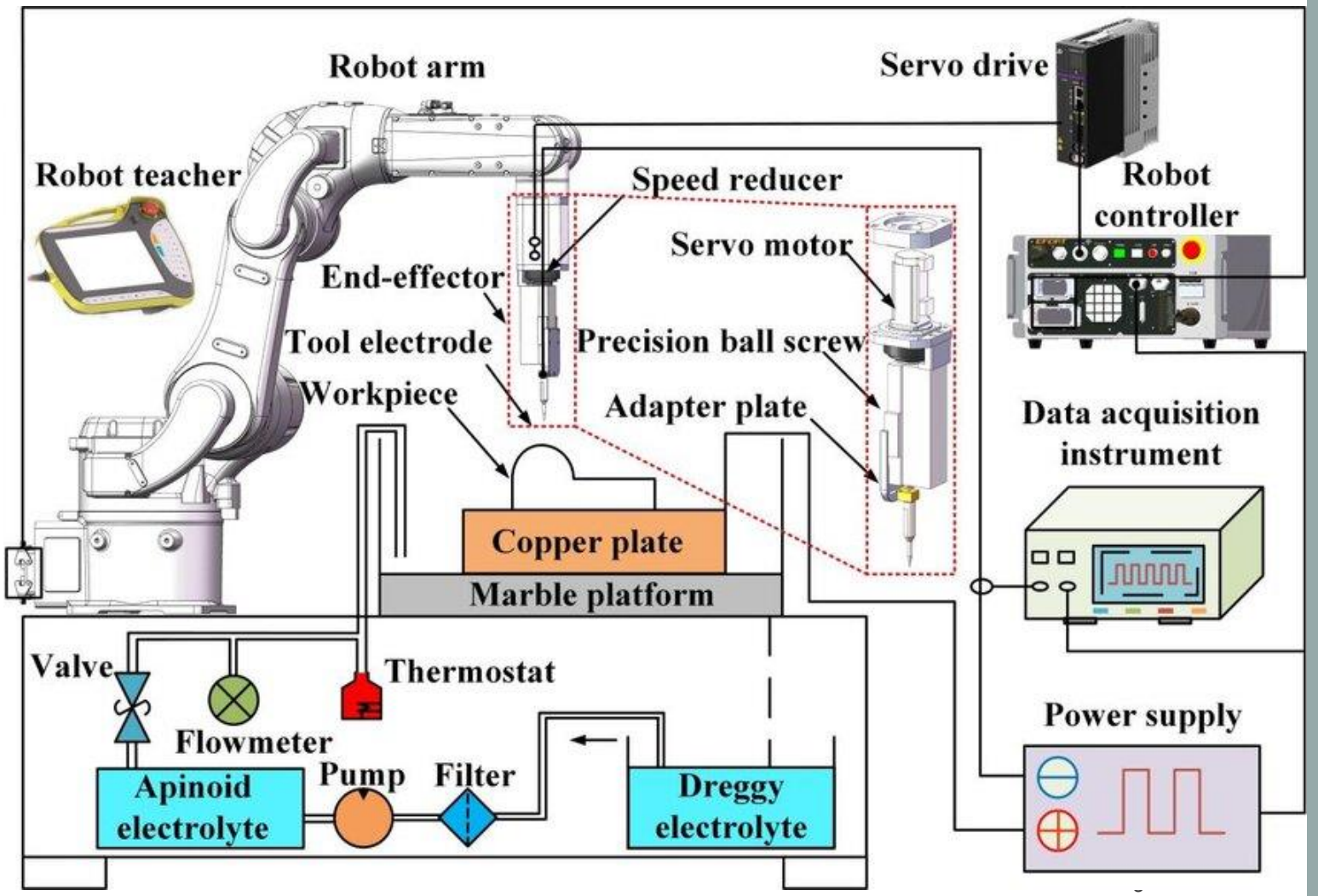
The Industrial Robot can do different function based on the application such as:

- Handling
- Welding
- Painting
- Filling
- Packaging
- Sorting

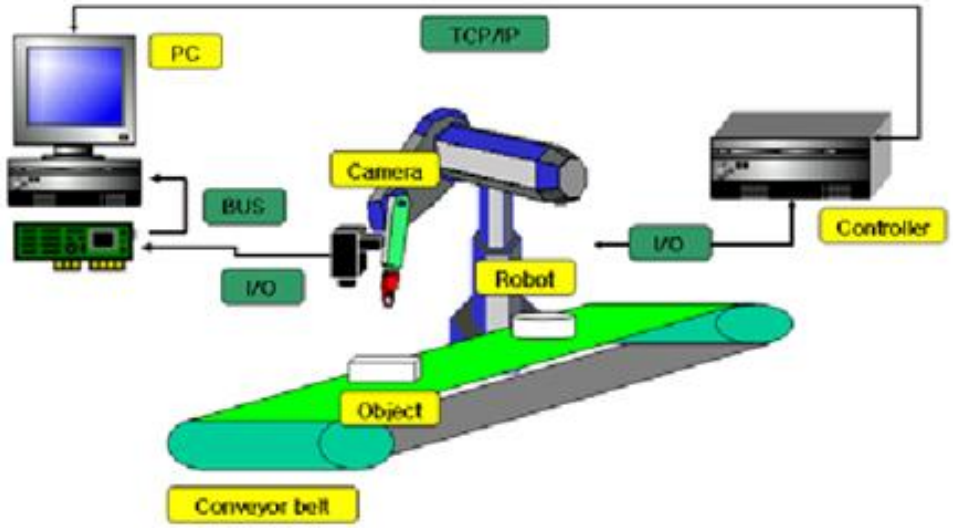
Industrial Robot

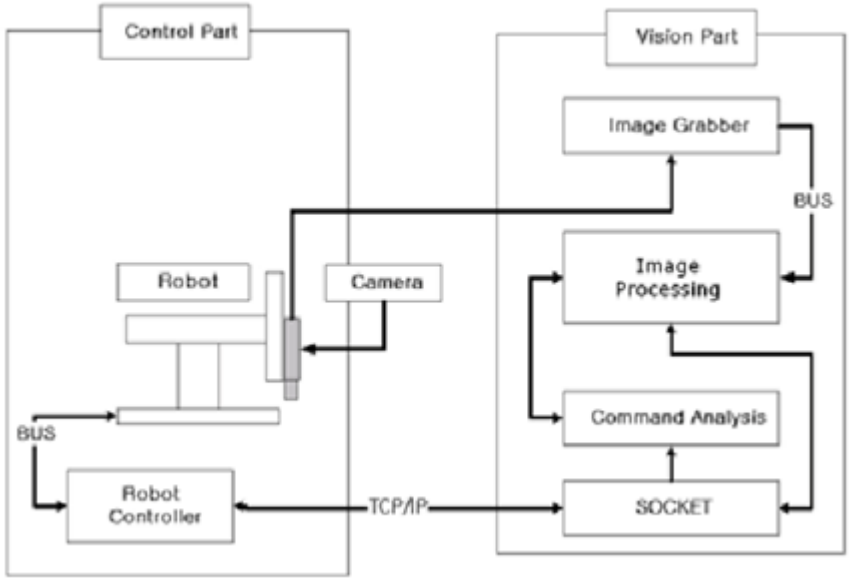
The components to build the Industrial Robot difference depend of the function and the application, but in general they are:

- Mechanical Design
- Sensor
- Actuator
- Controller
- Electric and Electronic Components



Industrial Robot





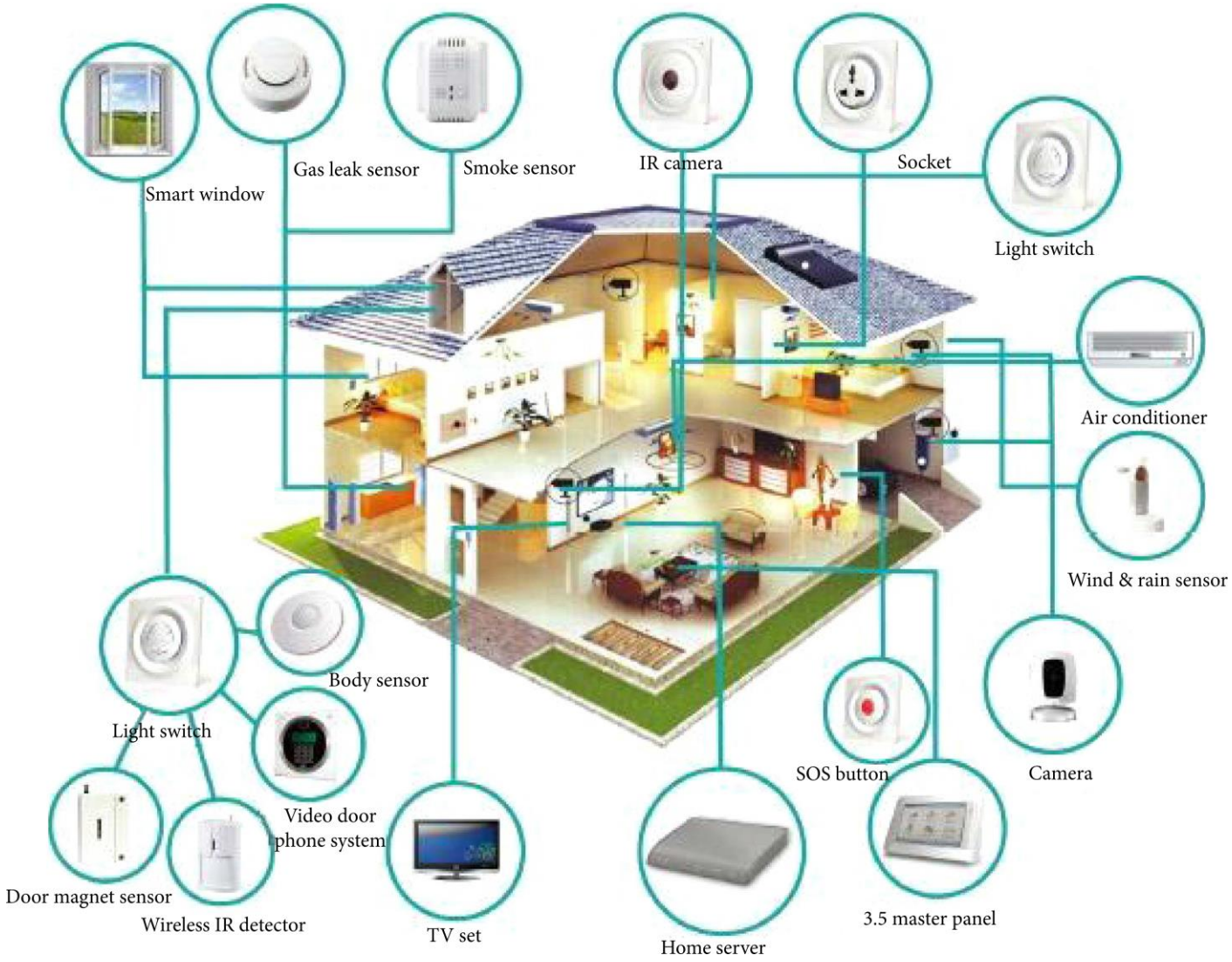
Smart City

Smart city include:

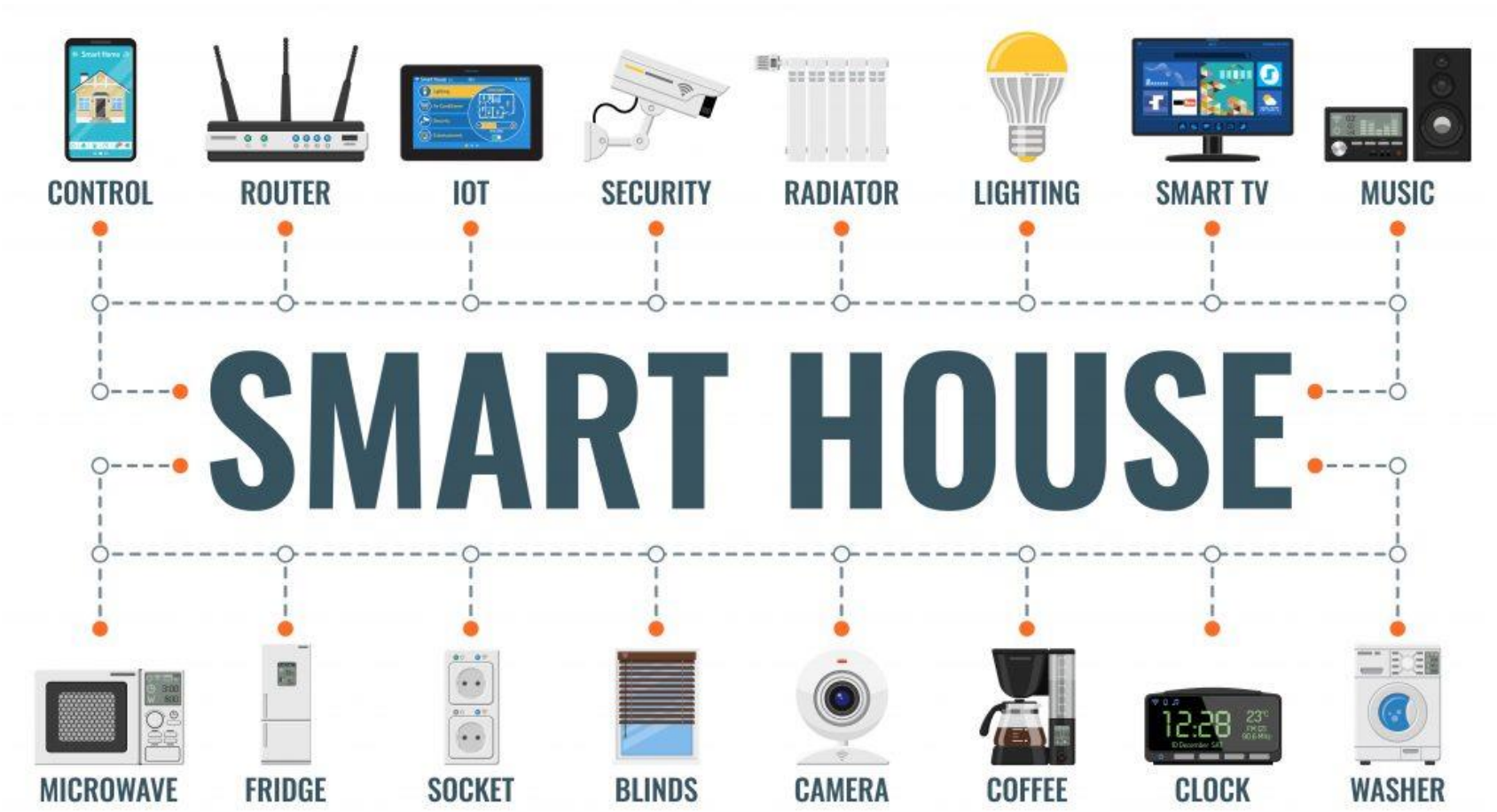
- Smart Home
- Smart healthcare system
- Smart Educational System
- Smart Agriculture System
- Smart Transportation
- Smart Building

Smart Home

- A smart home allows homeowners to control appliances, thermostats, lights, and other devices remotely using a smartphone or tablet through an internet connection.

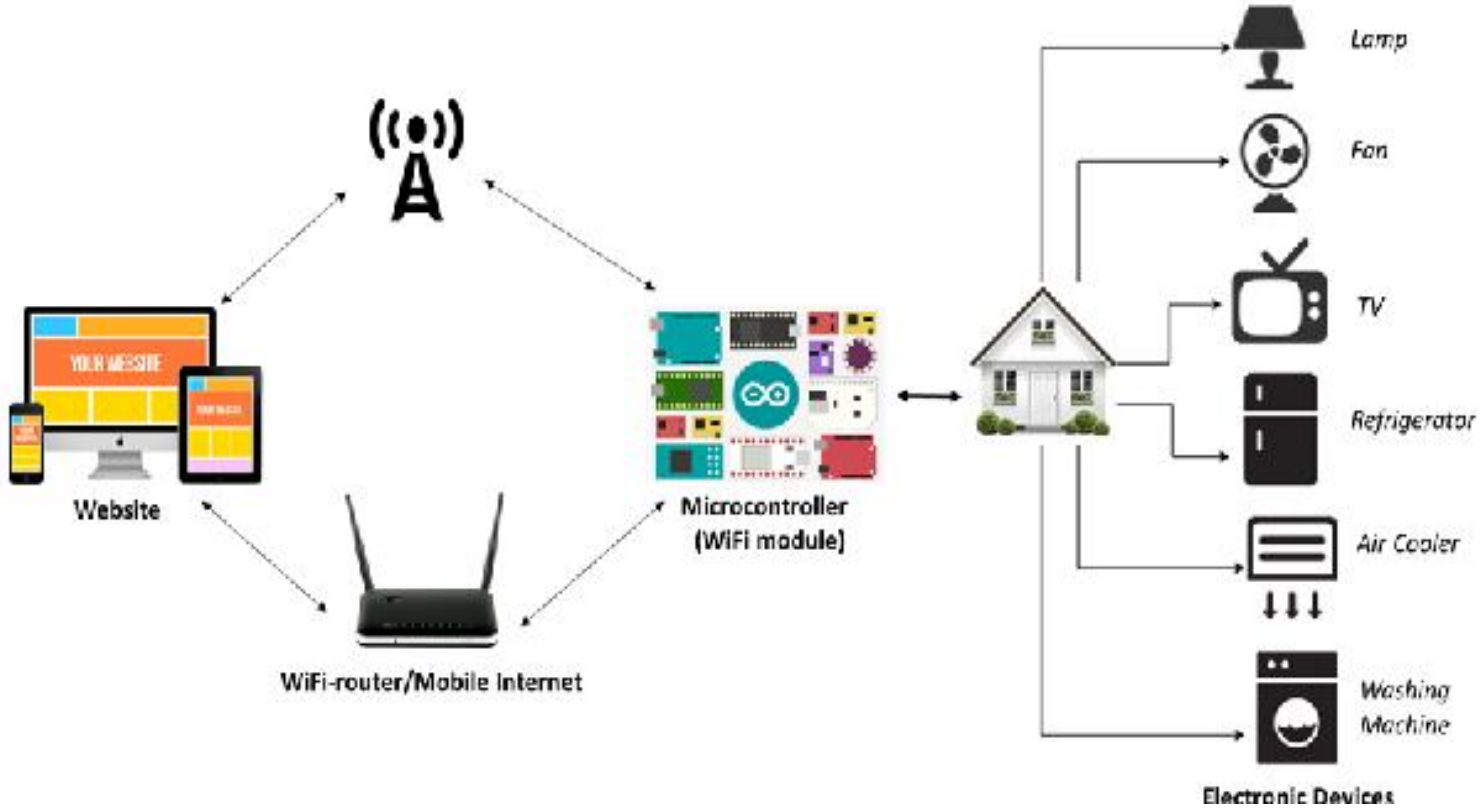


Smart Home


CONTROL
ROUTER
IOT
SECURITY
RADIATOR
LIGHTING
SMART TV
MUSIC
SMART HOUSE
MICROWAVE
FRIDGE
SOCKET
BLINDS
CAMERA
COFFEE
CLOCK
WASHER

Smart Home

- **Sensors**
  - Temperature Sensor
  - Humidity Sensor
  - Light Sensor
- **Actuators**
  - Servo motor
  - DC Motor
  - Stepper Motor
- **Controller**
  - Arduino
  - Raspberry Pi
  - FPGA
  - PLC



Sensors and Actuators for Smart Home

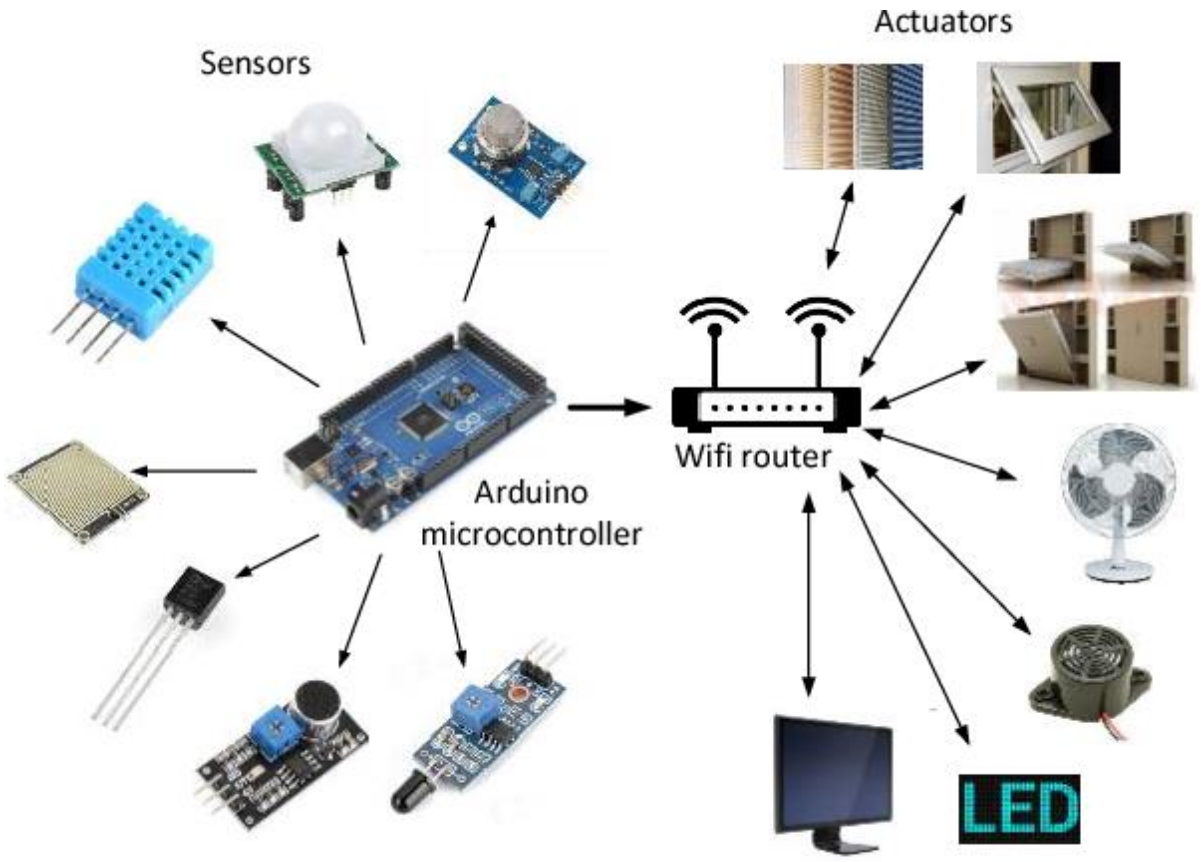
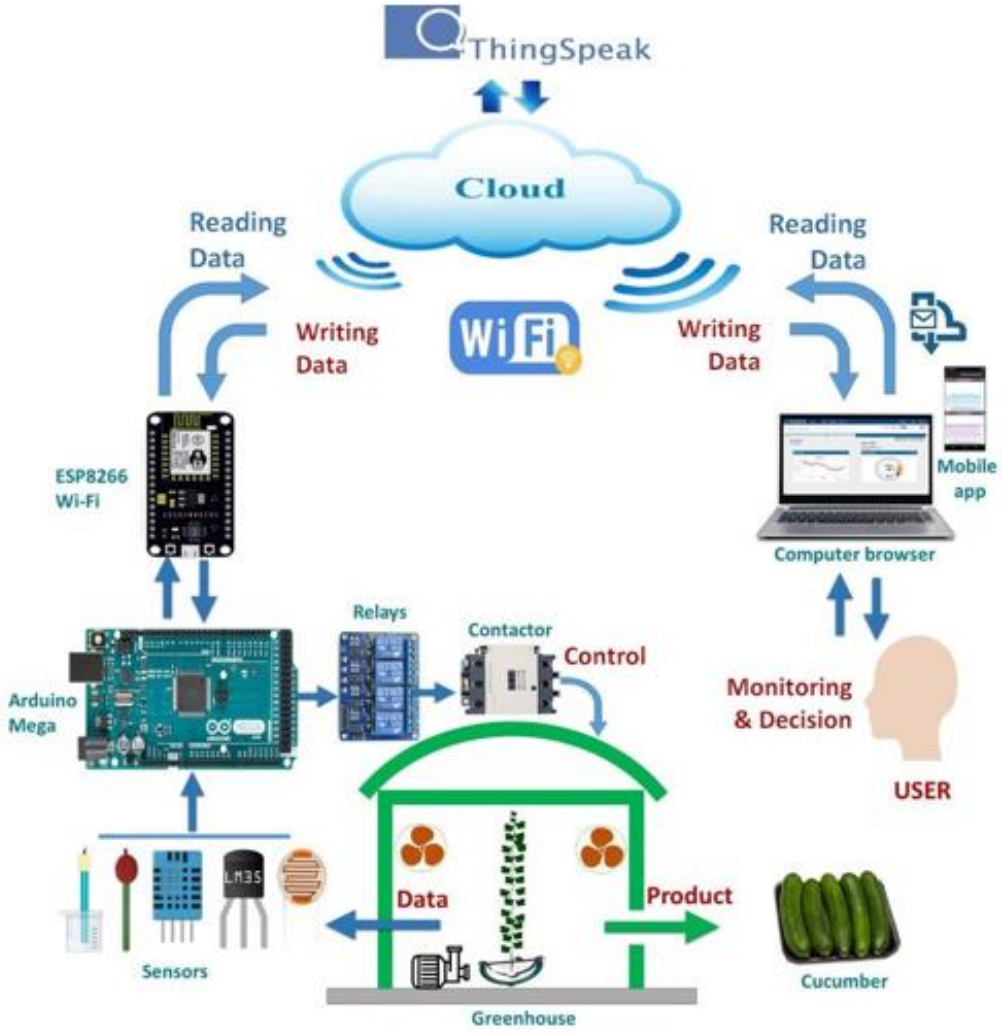
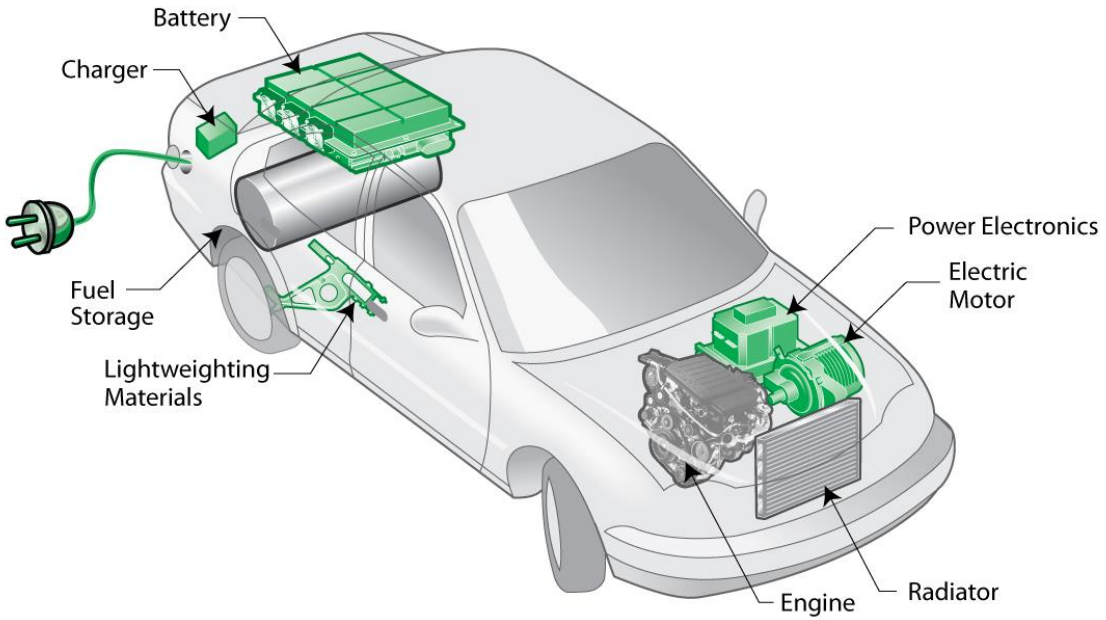


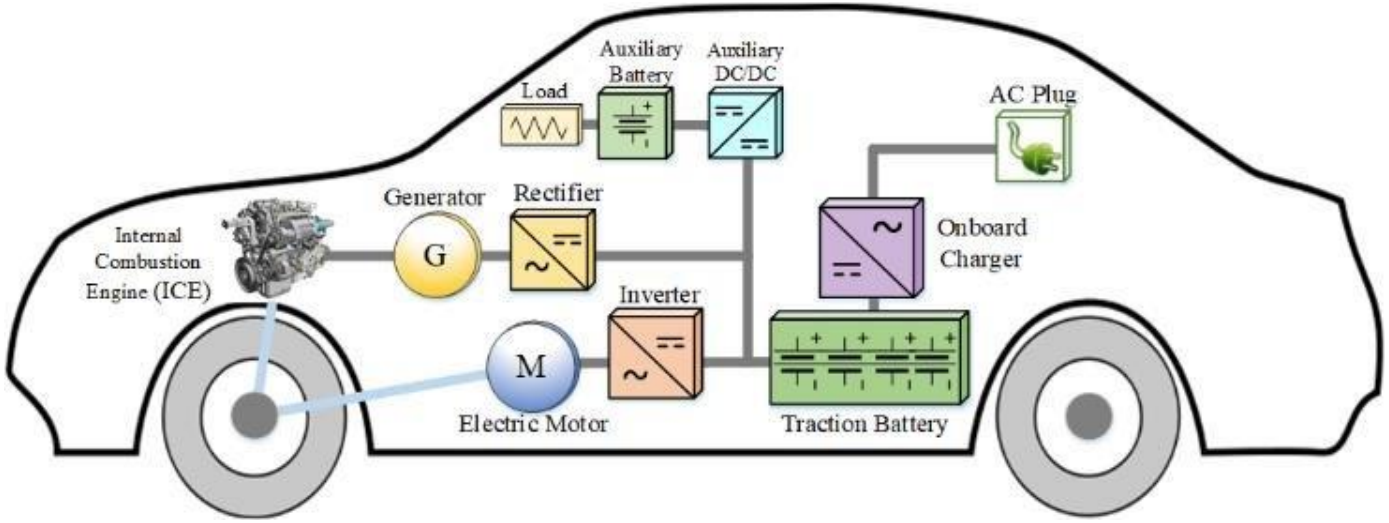
Figure 1. Block diagram of system.

Smart Farm


ThingSpeak
Cloud
Reading Data
Writing Data
Wi Fi
Reading Data
Writing Data
ESP8266 Wi-Fi
Mobile app
Computer browser
Relays
Contactor
Control
Arduino Mega
Monitoring & Decision
USER
LM35
Data
Product
Sensors
Cucumber
Greenhouse

Electric Vehicle

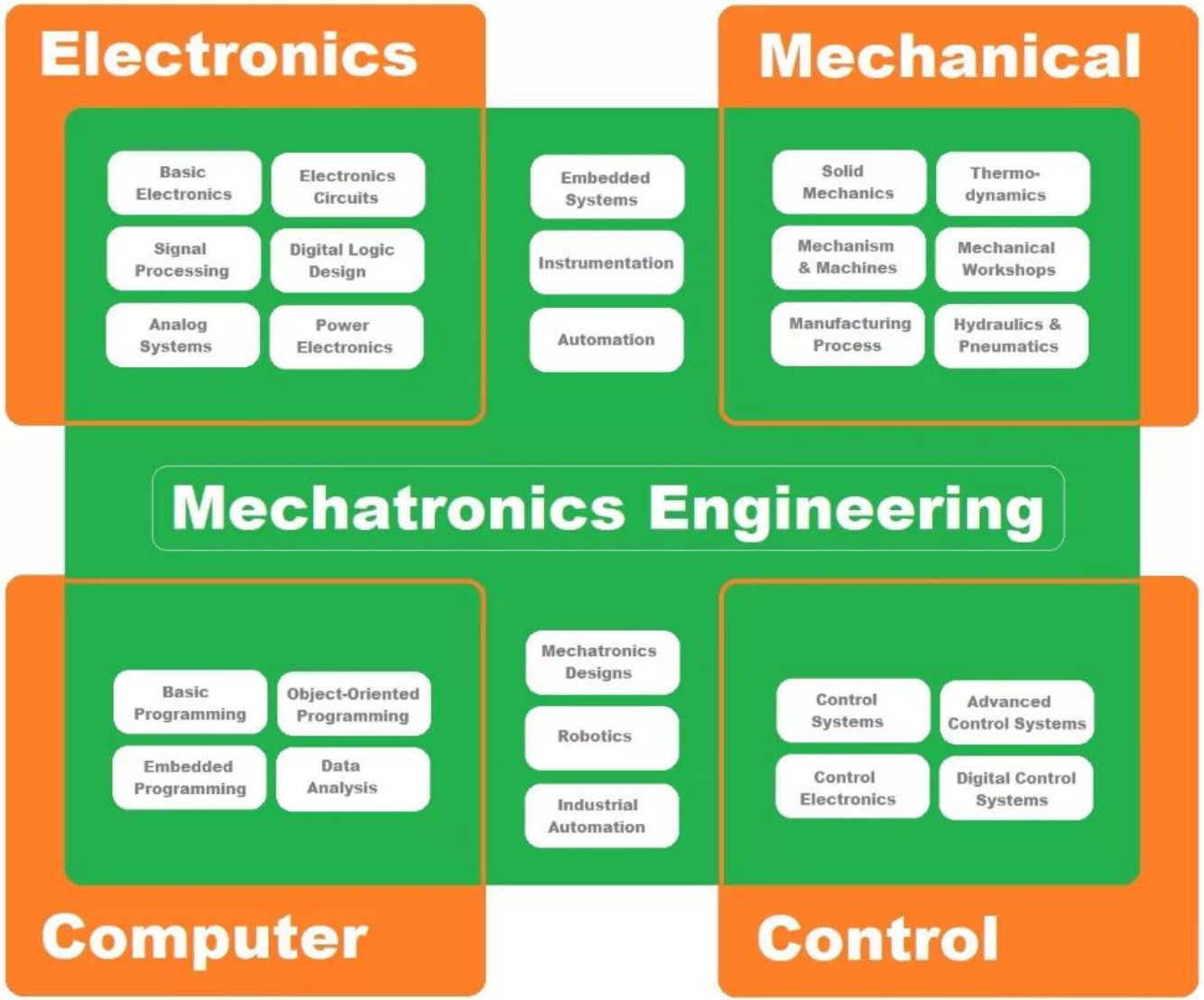




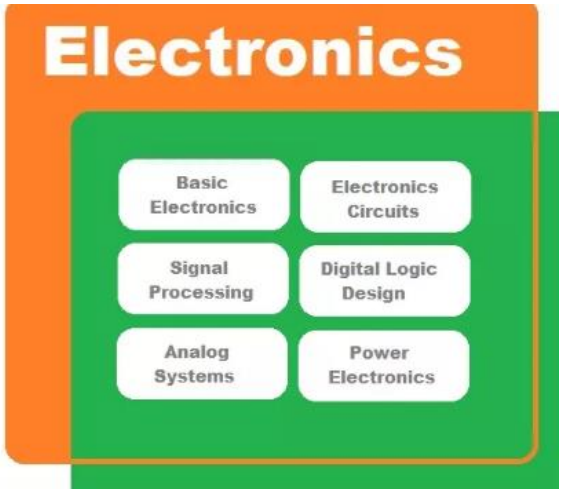
Steps to design and Build Mechatronics System

- An example for embedded system, which we use daily, is a Wireless Router. In order to get wireless internet connectivity on our mobile phones and laptops, we often use routers. The task of a wireless router is to take the signal from a cable and transmit it wirelessly. And take wireless data from the device (like a mobile) and send it through the cable.
- Even though the task seems simple, there are many individual sub tasks involved in this process. Some of these tasks include assigning Dynamic IP Addresses to clients (devices), managing data from each device, security and encryption, transmit and receive data, etc.

Required courses to build Mechatronics system



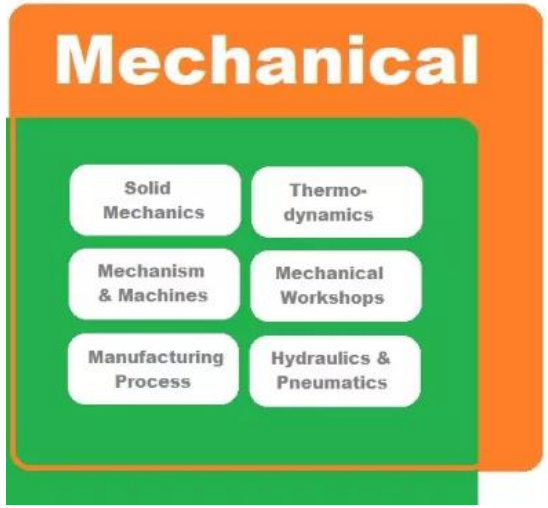
Group 1: Electronics Courses



- Electrical Principles (Grade 1 Courses)
  - Resistors, Capacitor, Inductor
  - AC and DC power supply
  - Theorems for connecting power supply with other basic components (Ohms law, KCL. KVL. Thevenin and Norton)
  - Transformer and Centre-tap Transformer
- Electronics (Grade 2 Courses)
  - Diode and Rectifier circuits (to convert AC voltage to DC voltage)
  - Transistor (BJT and FET) and Amplifier (to amplify the signal such as sound)
  - Operational Amplifier
- Power Electronics (Grade 3 Course)
  - Thyristors diode

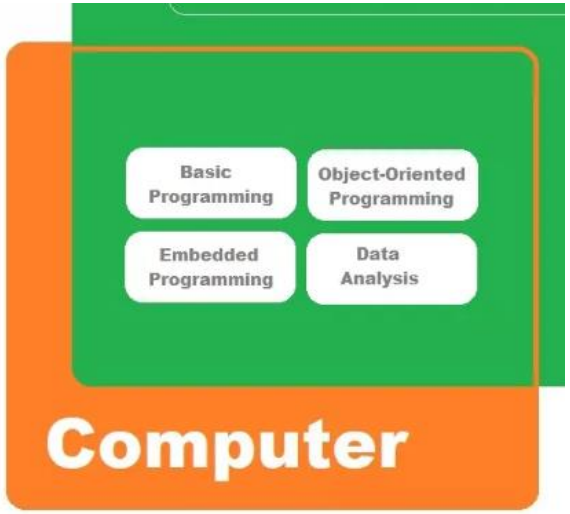
Group 2: Mechanical Courses

- Engineering Drawings (G1)
- Solid works and Simulation G1
- Engineering Statics and Dynamics (G1 and G2)
- Pneumatic & Hydraulic systems (G2)
- Thermodynamics (G2)
- Manufacturing Technology (G3)
- Design of Machine Elements (G3)
- Design of transmission Systems (G3)
- CNC (G3)



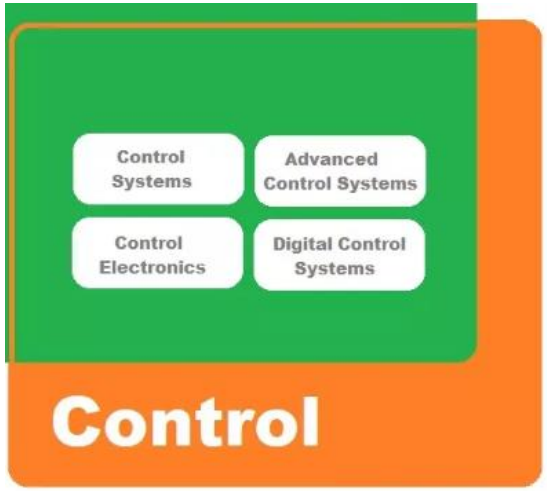
Group 3: Computer and Programming Courses

- Programming
  - Computer Programming (C++ to program Arduino) G1
  - OOP (Python to Program Raspberry Pi) G2
  - Microprocessor (8086) G3
  - Microcontroller (8051, PIC and Arduino) G4
  - PLC (Programmable Logic Controller) G4
- Embedded and Real-time System G4
  - PLD
  - FPGA (with Vrilog HDL Language)



Group 4: Control Courses

- Control System
- Digital Control System



Specialized Courses

- Instrumentation and Measurement
- Signal and System
- Communication System
- Design of Mechatronics System
- Renewable energy
- Medical Mechatronics
- Robotics