Industry 4.0
Sensing & Computing

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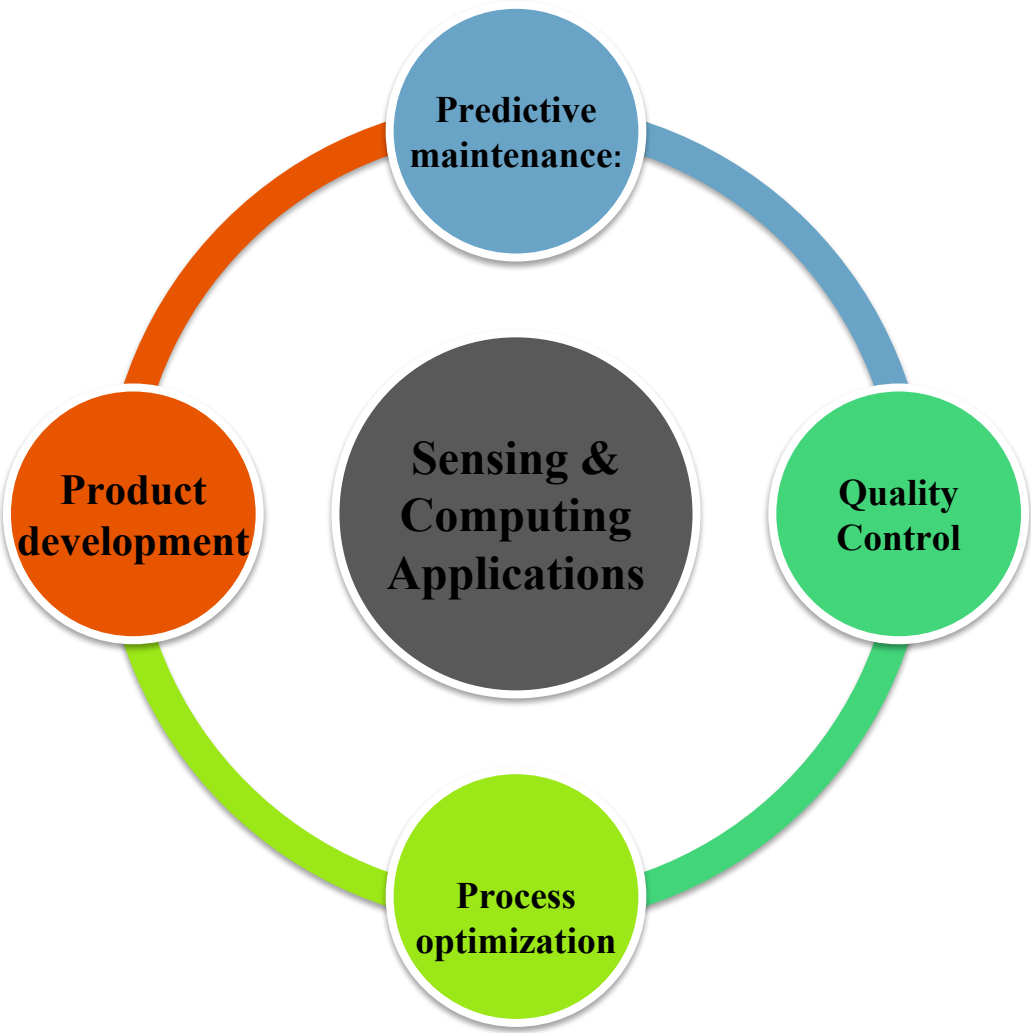
Sensing and Computing `in Industry 4.0

- Industry 4.0 is the fourth industrial revolution, which is characterized by the convergence of digital and physical technologies. Sensing and computing are two key technologies that are enabling Industry 4.0.
- In the upcoming Industry 4.0, the connected smart devices all around the world via the Internet provide secure, real-time, and reliable services of sensing, communicating, and computing, making smart factories into realization.

Sensing and Computing in Industry 4.0

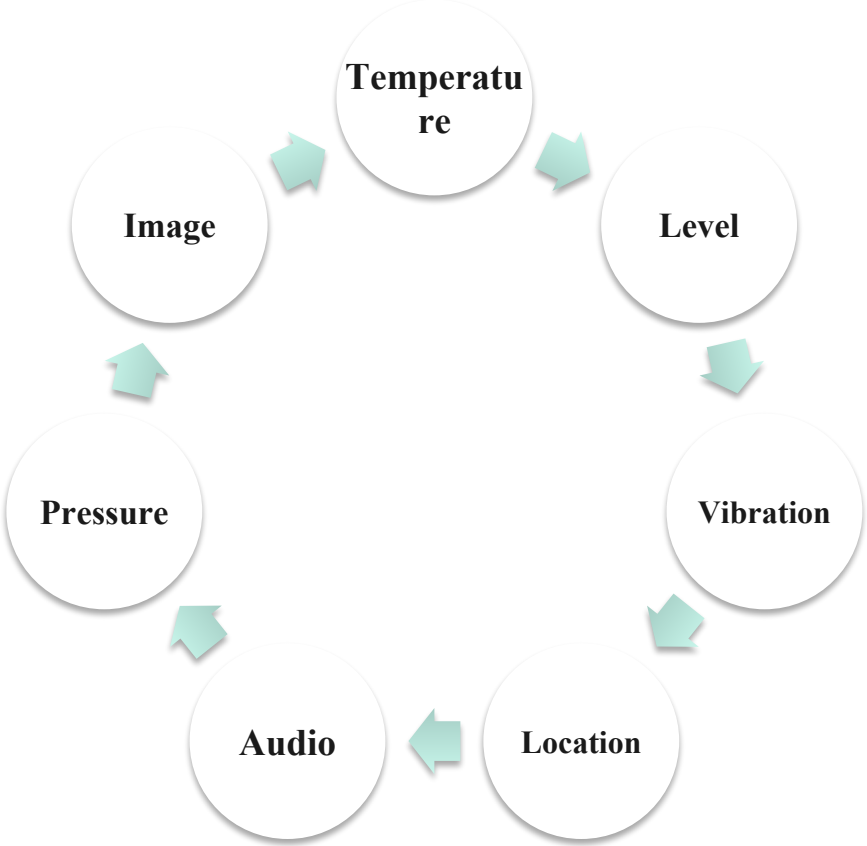
- Sensors are devices that can measure physical quantities such as temperature, pressure, vibration, and motion. In Industry 4.0, sensors are used to collect data from machines, equipment, and products throughout the manufacturing process. This data can be used to monitor performance, identify potential problems, and improve efficiency.
- Computing is the process of storing, processing, and analyzing data. In Industry 4.0, computing is used to make sense of the data collected by sensors. This data can be used to automate tasks, make decisions, and improve products and services.


Predictive maintenance:
Quality Control
Process optimization
Product development
Sensing & Computing Applications

Applications of Sensing and Computing in Industry 4.0

- **Predictive maintenance:** Sensors can be used to monitor the condition of machines and equipment, and to predict when maintenance is needed. This can help to reduce downtime and extend the lifespan of assets.
- **Quality control:** Sensors can be used to inspect products at various stages of the manufacturing process, and to identify defects. This can help to improve product quality and reduce waste.
- **Process optimization:** Sensors can be used to collect data on how manufacturing processes are performing. This data can be used to identify areas where improvements can be made.
- **Product development:** Sensors can be used to collect data on how customers use products. This data can be used to develop new products and improve existing products.

Different types of Conventional Sensor used in Industry 4.0



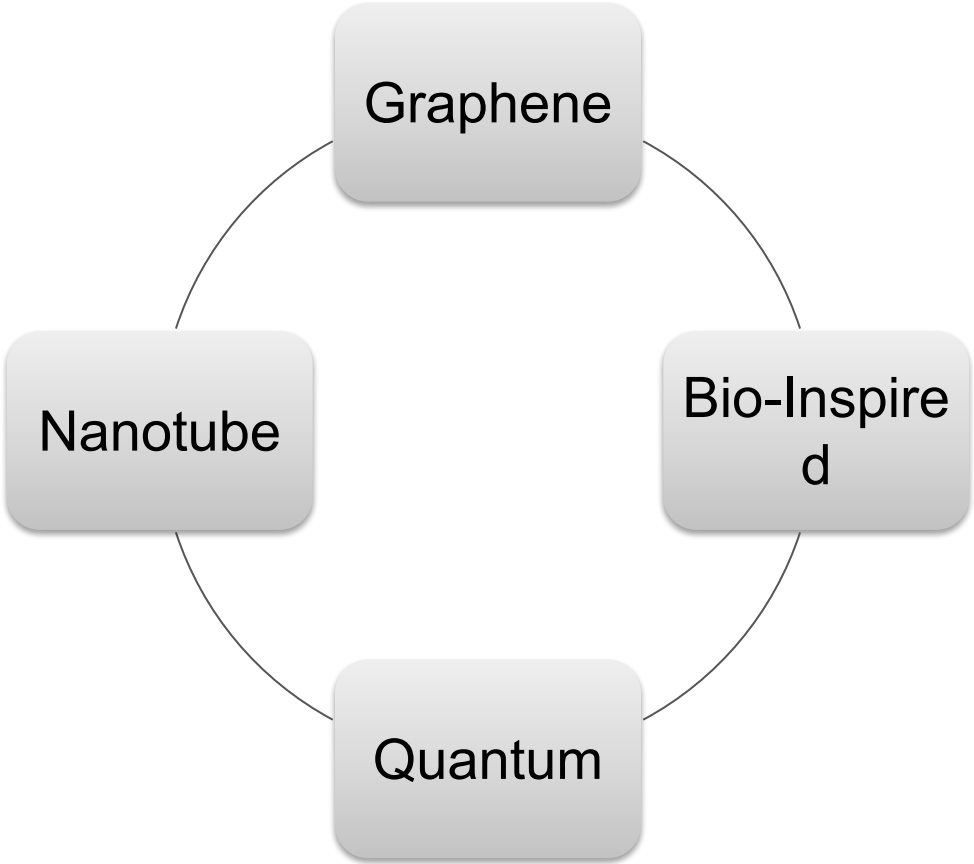
Different types of Conventional Sensor used in Industry 4.0 (cont.)

- **Temperature sensors:** Temperature sensors are used to measure the temperature of machines, equipment, and products. This information can be used to monitor performance, identify potential problems, and optimize processes.
- **Pressure sensors:** Pressure sensors are used to measure the pressure of fluids and gases. This information can be used to monitor pipelines, tanks, and other equipment.
- **Level sensors:** Level sensors are used to measure the level of fluids and solids in tanks and containers. This information can be used to manage inventory and ensure that processes are running smoothly.

Different types of Conventional Sensor used in Industry 4.0 (cont.)

- **Vibration sensors:** Vibration sensors are used to measure the vibration of machines and equipment. This information can be used to monitor their condition and identify potential problems.
- **Image sensors:** Image sensors are used to capture images of products and processes. This information can be used for inspection, quality control, and process monitoring.
- **Audio sensors:** Audio sensors are used to capture audio of machines and processes. This information can be used for fault detection, process monitoring, and quality control.
- **Location sensors:** Location sensors are used to track the location of products and assets. This information can be used for inventory management, asset tracking, and supply chain management.

Next Generation Sensors used in Industry 4.0



Next Generation Sensors used in Industry 4.0 (cont.)

- **Graphene sensors:** Graphene is a lightweight and flexible material with excellent electrical and thermal conductivity. Graphene sensors can be used to measure a wide range of physical quantities, including temperature, pressure, strain, and chemical composition. Graphene sensors are also very sensitive and fast, making them ideal for real-time monitoring and control applications.
- **Nanotube sensors:** Nanotubes are also very sensitive and fast sensors. They can be used to measure a variety of physical quantities, including temperature, pressure, strain, and chemical composition. Nanotube sensors are also very flexible and can be embedded in textiles and other materials. This makes them ideal for wearable devices and other applications where small and lightweight sensors are required.

Next Generation Sensors used in Industry 4.0 (cont.)

- **Quantum sensors:** Quantum sensors are based on the principles of quantum mechanics. They can be used to measure a wide range of physical quantities with unprecedented accuracy and precision. Quantum sensors are still in their early stages of development, but they have the potential to revolutionize many industries, including manufacturing, healthcare, and environmental monitoring.
- **Bio-inspired sensors:** Bio-inspired sensors are designed to mimic the sensory systems of living organisms. For example, some bio-inspired sensors are based on the eyes of insects, while others are based on the olfactory systems of animals. Bio-inspired sensors are still in their early stages of development, but they have the potential to create new and innovative ways of sensing the world around us.

How to use Next Generation Sensors in Industry 4.0

- Graphene sensors are being used to monitor the condition of machines and equipment in factories. This information can be used to predict when maintenance is needed, which can help to reduce downtime and extend the lifespan of assets.
- Nanotube sensors are being used to inspect products for defects. This information can be used to improve product quality and reduce waste.
- Quantum sensors are being used to measure the composition of materials and chemicals. This information can be used to improve the quality of products and to optimize manufacturing processes.
- Bio-inspired sensors are being used to develop new wearable devices that can monitor the health and fitness of users.

How Computing is used in Industry 4.0

- **Smart factories:** Smart factories use computing to connect machines, equipment, and sensors to a central network. This allows manufacturers to collect data from all aspects of the production process and use it to improve efficiency, quality, and safety.
- **Digital twins:** Digital twins are virtual representations of physical objects, such as machines, equipment, and products. Digital twins can be used to simulate and analyze the behavior of physical objects. This information can then be used to improve the design and operation of physical objects.
- **Artificial intelligence (AI):** AI is being used to automate tasks, make decisions, and improve products and services in Industry 4.0. For example, AI is being used to develop self-driving robots that can perform tasks such as welding and assembly. AI is also being used to develop predictive maintenance systems that can predict when maintenance is needed on machines and equipment.

How Computing is used in Industry 4.0 (examples)

- **Tesla:** Tesla uses computing to analyze data from sensors on its cars to predict when maintenance is needed. This allows Tesla to schedule maintenance before failures occur, which helps to reduce downtime and extend the lifespan of its cars.
- **Siemens:** Siemens uses computing to create digital twins of its factories. These digital twins are used to simulate and test changes to factory layouts and production processes before they are implemented in the real world. This helps Siemens to improve the efficiency of its factories and to reduce costs.
- **GE:** GE uses computing to develop and deploy predictive maintenance solutions for its customers. GE's predictive maintenance solutions use data from sensors to predict when machines and equipment are likely to fail. This allows GE's customers to schedule maintenance before failures occur, which can help to reduce downtime and extend the lifespan of their assets.

Benefits of Sensing and Computing in Industry 4.0

- Increased efficiency
- Reduced costs & downtime
- Improved quality & Customer Satisfaction
- New product development
- Extended lifespan of assets

Conclusion

Sensing and computing are two key technologies that are enabling Industry 4.0. Manufacturers who embrace these technologies can gain a competitive advantage by increasing efficiency, reducing costs, and improving quality.