BRAC UNIVERSITY
Inspiring Excellence

Course Name : Introduction to Robotics
Course : CSE461
Chapter 1 (Introduction to robotics basics)
Class Note [Chapter 1 Part 2]

Internet of things(IOT):

The Internet of Things (IoT) refers to the network of physical devices, vehicles, home appliances, and other items that are embedded with sensors, software, and network connectivity, allowing them to collect and exchange data over the internet.

In simple terms, IoT is about connecting everyday objects to the internet, enabling them to communicate with each other and with other internet-enabled devices, and allowing users to remotely control and monitor them.

Examples of IoT devices include smart thermostats, wearable fitness trackers, home security systems, and connected cars. With the growth of IoT, it is possible to create smart cities, smart homes, and smart factories, which can improve efficiency, reduce costs, and enhance the overall quality of life. However, there are also concerns about privacy, security, and the potential misuse of IoT data.

What is our Ultimate Goal ?

Robotics:

Create machines that can autonomously perform tasks in a range of environments, from manufacturing to space exploration. This means developing robots that are more advanced in their perception, manipulation, and control, and that are capable of working collaboratively with humans in a range of industries.

Embedded systems:

Create devices that are smarter, more efficient, and more connected. This means developing sensors, controllers, and other devices that can operate in a range of environments, from home automation to automotive systems. It also means developing embedded systems that can communicate with each other and with other devices, creating a seamless network of interconnected technology.

Superhuman:

Enhance human capabilities beyond their natural limits, whether through physical or cognitive augmentation. This can include developing technologies that improve strength, endurance, and resilience, as well as those that improve memory, reasoning, and creativity. The goal is to help people achieve their full potential and overcome limitations that might prevent them from reaching their goals.

Intelligent machines:

Create machines that can learn, reason, and adapt to new situations. This means developing artificial intelligence and machine learning systems that can process and interpret vast amounts of data, and make decisions based on that data. It also means creating intelligent machines that can communicate and collaborate with humans in a range of settings, from healthcare to finance. Ultimately, the goal is to create machines that can operate independently, without human supervision or intervention, and that can help solve some of the world's most pressing problems.

What do we need Superhuman technology?

Superhuman technology refers to technology that extends beyond the capabilities of human beings, allowing us to achieve feats that were previously impossible or difficult. There are several reasons why we need superhuman technology:

1. **Improved performance:** Superhuman technology can enhance our physical and cognitive abilities, enabling us to perform tasks faster, more accurately, and with greater efficiency. This can be particularly useful in industries such as manufacturing, transportation, and healthcare, where speed and accuracy are crucial.
2. **Health and well-being:** Superhuman technology can also be used to improve our health and well-being, such as through the development of advanced medical treatments or wearable devices that monitor our health and provide real-time feedback. This can help us to prevent illnesses, manage chronic conditions, and improve our overall quality of life.
3. **Evolution of humanity:** Superhuman technology has the potential to drive the evolution of humanity by enabling us to transcend our biological limitations and explore new frontiers, such as space exploration or the development of artificial intelligence.
4. **Competition:** Superhuman technology can also be seen as a way to gain a competitive advantage, whether in sports, business, or other fields. By using technology to enhance their performance, individuals and organizations can outperform their competitors and achieve success more easily.

Uncrewed Vehicle:

An uncrewed vehicle is a vehicle that is capable of performing tasks or operations without a human operator or crew on board. These vehicles are often controlled remotely, either by a human operator on

the ground or through an autonomous system that allows the vehicle to navigate and make decisions on its own.

Uncrewed vehicles can be categorized into several different types based on their mode of operation, design, and intended use. Here are some common categories of uncrewed vehicles:

1. Unmanned Aerial Vehicles (UAVs) or Drones: These are aircraft that operate without a human pilot on board. They can be controlled remotely or can fly autonomously based on pre-programmed flight plans. UAVs are commonly used for aerial photography, surveillance, delivery, and scientific research.
2. Unmanned Ground Vehicles (UGVs): These are ground-based vehicles that operate without a human operator on board. They can be remotely controlled or operate autonomously. UGVs are commonly used in military and defense, logistics, transportation, and agriculture.
3. Unmanned Surface Vehicles (USVs): These are vehicles that operate on the surface of water without a human operator on board. They can be remotely controlled or operate autonomously. USVs are commonly used for oceanographic research, environmental monitoring, and defense.
4. Unmanned Underwater Vehicles (UUVs): These are vehicles that operate underwater without a human operator on board. They can be remotely controlled or operate autonomously. UUVs are commonly used for oceanographic research, underwater exploration, and defense.
5. Autonomous Cars: These are self-driving vehicles that operate on roads without a human driver. They use a combination of sensors, cameras, and mapping technology to navigate and make decisions.

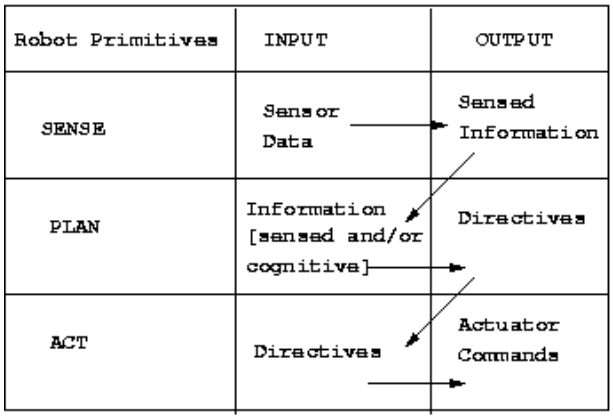
The three primitives of robotics are:

1. Sense: The ability of a robot to perceive its environment through various sensors such as cameras, microphones, or touch sensors. Sensing allows the robot to gather information about its surroundings and make decisions based on that information.
2. Plan: The ability of a robot to use the information it has gathered through sensing to create a plan of action. This involves analyzing the data and determining the best course of action to achieve a particular goal.
3. Act: The ability of a robot to carry out its planned actions through physical movement or manipulation. This involves controlling motors, actuators, or other physical mechanisms to interact with the environment and achieve the desired outcome.

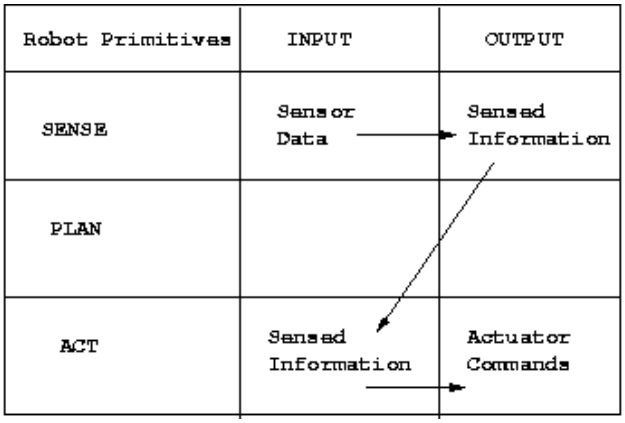
These three primitives are fundamental to the operation of most modern robots, whether they are industrial robots used in manufacturing, service robots used in healthcare or hospitality, or autonomous vehicles used in transportation. By sensing, planning, and acting, robots are able to interact with the world in increasingly sophisticated ways, and are becoming increasingly important in many aspects of our lives.

The three paradigms of robotics are:

1. **Hierarchical/Deliberative Paradigm:** This paradigm involves a robot that uses a model of the world to plan its actions based on a specific goal. The robot processes sensory input, generates a plan, and then executes the plan to achieve the desired outcome. This approach is often used in industrial applications, where robots are programmed to perform a specific task in a structured environment.



2. **Reactive Paradigm:** This paradigm involves a robot that responds to its environment in real-time without building an explicit model of the world. The robot reacts to sensory input by selecting an appropriate behavior or action from a predefined set of options. This approach is often used in mobile robotics and autonomous vehicles, where the robot needs to navigate a complex and dynamic environment.



3. **Hybrid Paradigm:** This paradigm combines elements of both the deliberative and reactive paradigms. The robot builds a model of the world and uses it to plan its actions, but also responds to sensory input in real-time to adjust its plan as necessary. This approach is often used in complex environments where the robot needs to be able to adapt to changing conditions, such as search and rescue missions or space exploration.

Each of these paradigms has its strengths and weaknesses, and the choice of which paradigm to use depends on the specific application and the requirements of the robot. By understanding these different paradigms, researchers and engineers can design robots that are better suited to perform specific tasks and operate effectively in different environments.