UNIT-V

ROBOTICS

Robotics

Robotics is the term used in artificial intelligence that deals with a study of creating intelligent and efficient robots.

What are Robots

Robots are multifunctional, re-programmable, automatic industrial machine designed for replacing human in hazardous work.

Robots can be work as:-

- An automatic machine sweeper
- In space
- A machine removing mines in a war field
- An automatic car for a child to play with
- In military, etc.

Objective

The aim of the robot is to manipulate the objects by perceiving, moving, picking, modifying the physical properties of object.

Robotics Definition

Robotics is a branch of Artificial Intelligence (AI), it is mainly composed of electrical engineering, mechanical engineering and computer science engineering for construction, designing and

application of robots.

Robotics is science of building or designing an application of robots. The aim of robotics is to design an efficient robot.

Aspects of Robotics

- The robots have **electrical components** for providing power and control the machinery.
- They have **mechanical construction,** shape, or form designed to accomplish a particular task.
- It contains some type of **computer program** that determines what, when and how a robot does something.

Robotics History

The word robot was firstly introduced to public by Czech writer Karel Capek in his play Rossum's Universal Robots (R.U.R), published in 1920. The play begins with a factory that makes artificial people known as robots.

The word "Robotics", was coined accidentally by the Russian-born, American scientist, Issac Asimov in 1940s .

The three laws of Robotics:

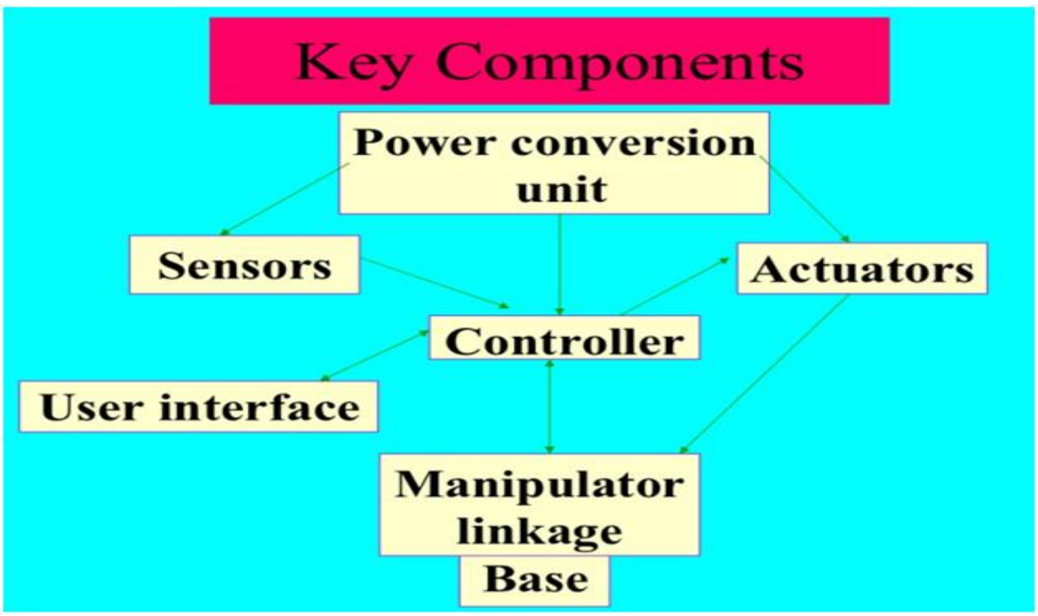
Issac Asimov also proposed his three "Laws of Robotics", and he later added a "zeroth law"

- **Zeroth Law -** A robot is not allowed to injured humanity, or, through inaction it allows humanity to come to harm.
- **First Law -** A robot can not injure a human being, or, through inaction it allows a human being to come to harm, unless it would violate the higher order law.
- **Second Law -** A robot should follow the orders given it by human beings, except when such orders give by humans would conflict with a higher order law.
- **Third Law -** A robot is allowed to protect its own existence as long as such protection would not conflict with a higher order law.

The first industrial robot: UNIMATE

In 1954 first programmable robot is designed by George Devol, who coins the term Universal Automation. He later shortens this term to Unimation, which become the name of the first robot company in 1962.

ROBOT HARDWARE



- **Sensors -** Sensors provide real time information on the task environment. Robots are equipped with tactile sensor it imitates the mechanical properties of touch receptors of human fingerprints and a vision sensor is used for computing the depth in the environment.

  Passive sensors, such as cameras, are true observers of the environment: they capture signals that are generated by other sources in the environment.

Active sensors, such as sonar, send energy into the environment

Range finders are sensors that measure the distance to nearby objects.

- A second important class of sensors is location sensors. Most location sensors use range sensing as a primary component to determine location. Outdoors, the Global Positioning System (GPS) is the most common solution to the localization problem. GPS measures GLOBAL POSITIONING SYSTEM the distance to satellites that emit pulsed signals
- The third important class is proprioceptive sensors, which inform the robot of its own motion. To measure the exact configuration of a robotic joint, motors are often equipped with shaft decoders that count the revolution of motors in small increments. On robot arms, shaft decoders can provide accurate information over any period of time.
- **Actuators -** Actuators are the energy conversion device used inside a robot. The major function of actuators is to convert energy into movement.

ROBOTIC PERCEPTION

Robotic perception is crucial for a robot to **make decisions, plan**, and operate in real-world environments, by means of numerous functionalities and operations from occupancy grid mapping to object detection.Sensor-based environment representation/mapping is a very important part of a robotic perception system.

Robot-Planning to Move

Motion planning is a term used in robotics for the process of breaking down a desired movement task into discrete motions that satisfy movement constraints and possibly optimize some aspect of the movement.

For example, consider a mobile robot navigating inside a building to a distant waypoint. It should execute this task while avoiding walls and not falling down stairs. A motion planning algorithm would take a description of these tasks as input, and produce the speed and turning commands sent to the robot's wheels. Motion planning algorithms might address robots with a larger number of joints (e.g., industrial manipulators), more complex tasks (e.g. manipulation of objects), different constraints (e.g., a car that can only drive forward), and uncertainty (e.g. imperfect models of the environment or robot).

As another example, consider navigating one or more unmanned aircraft or drones in a cluttered indoor or outdoor environment. The same motion planning strategies can still be applied in a 3D space with environmental disturbances, such as wind and bad weather.

Motion planning has several robotics applications, such as autonomy, automation, and robot design in CAD software, as well as applications in other fields, such as animating digital characters, video game, artificial intelligence, architectural design, robotic surgery, and the study of biological molecules.

PLANNING UNCERTAIN MOVEMENTS

In robotics uncertainty exists at both planning and execution time. Effective planning must make sure that enough information becomes available to the sensors during execution, to allow the robot to correctly identify the states it traverses. It requires selecting a set of states, associating a motion command with every state, and synthesizing functions to recognize state achievement

Motion planning with uncertainty is a critical problem in robotics. Indeed, even the most complex models of the physical world cannot be perfectly accurate All details omitted from these models unite to form uncertainty. A robot planner must produce plans that reliably achieve their goals despite errors, i.e., differences between the models and the real world

APPLICATION DOMAINS

INSPECTION

In the Inspection program the use of robotics technologies is investigated for tasks in which inspection of not easily reachable structures is necessary. This can be the case for underground gas mains like in the project Pirate, high structures or plains like in the flying robot project Airobots, continuous monitoring of the dutch dikes like in the project Rose or even modeling for inspection of space rovers in collaboration with ESA for the Exomars. For the latter the modeling of altitude maps and their use in the prediction of the navigation of the ExoMars rover is considered. Problems, which arise in this study relate a combination of sparse altitude data with precise terramechanics simulations. This is tackled using a hybrid use of differential geometric techniques and computational geometric methods.

MEDICAL

In the Medical program developments are taking place which have directly or indirectly to do with the human body. The program is composed of two parts: 1. Robotic Surgery in which new robotic instruments and methodologies are studied with projects like Teleflex and Miriam. 2. Prosthetics is related to the development or artificial limbs like transradial hand prosthesis (MyoPro) and transfemoral leg prosthesis.

HOME & CARE

The Home & Care program deals with development of methods and techniques to design service robots. These robots have to act in an unstructured environment, and have regularly and deliberately physical contact with its environment. Contexts in which these robots have to act are normal (household) situation and care taking situations. Topics of study are robot architectures that facilitate resilient, robust and fault-tolerant behaviour of the autonomous service robot.

ROBOTIC SOFTWARE ARCHITECTURES

A methodology for structuring algorithms is called a software architecture. An architecture software architecture includes languages and tools for writing programs, as well as an overall philosophy for how programs can be brought together. Architectures that combine reactive and deliberate techniques are called hybrid architectures.

Subsumption architecture

Rodney Brook’s subsumption architecture addresses this:

- Different commands have different levels

- Higher level commands subsume lower level ones
- They may even inhibit lower level ones
- If a high level command is missing, the robot can still operate, though at a reduced capacity.

Here is an example:
Suppose a robot is to explore its environment by:

- following the lights it sees,
- avoiding loud noises and
- avoiding other obstacles.

It will have sensors for lights, noises and obstacles It will have behaviour for each of these sensors It will have an overarching ‘explore’ behaviour All of these will combine to drive the motors.

THREE-LAYER ARCHITECTURE

Hybrid architectures combine reaction with deliberation. The most popular hybrid architecture is the three-layer architecture, which consists of a reactive layer, an executive layer, THREE-LAYER ARCHITECTURE and a deliberative layer.

REACTIVE LAYER

The reactive layer provides low-level control to the robot. It is characterized by a tight sensor–action loop. Its decision cycle is often on the order of milliseconds.

EXECUTIVE LAYER

The executive layer (or sequencing layer) serves as the glue between the reactive layer and the deliberative layer. It accepts directives by the deliberative layer, and sequences them for the reactive layer. For example, the executive layer might handle a set of via-points generated by a deliberative path planner, and make decisions as to which reactive behavior to invoke. Decision cycles at the executive layer are usually in the order of a second. The executive layer is also responsible for integrating sensor information into an internal state representation. For example, it may host the robot’s localization and online mapping routines.

DELIBERATIVE LAYER

The deliberative layer generates global solutions to complex tasks using planning. Because of the computational complexity involved in generating such solutions, its decision cycle is often in the order of minutes. The deliberative layer (or planning layer) uses models for decision making. Those models might be either learned from data or supplied and may utilize state information gathered at the executive layer

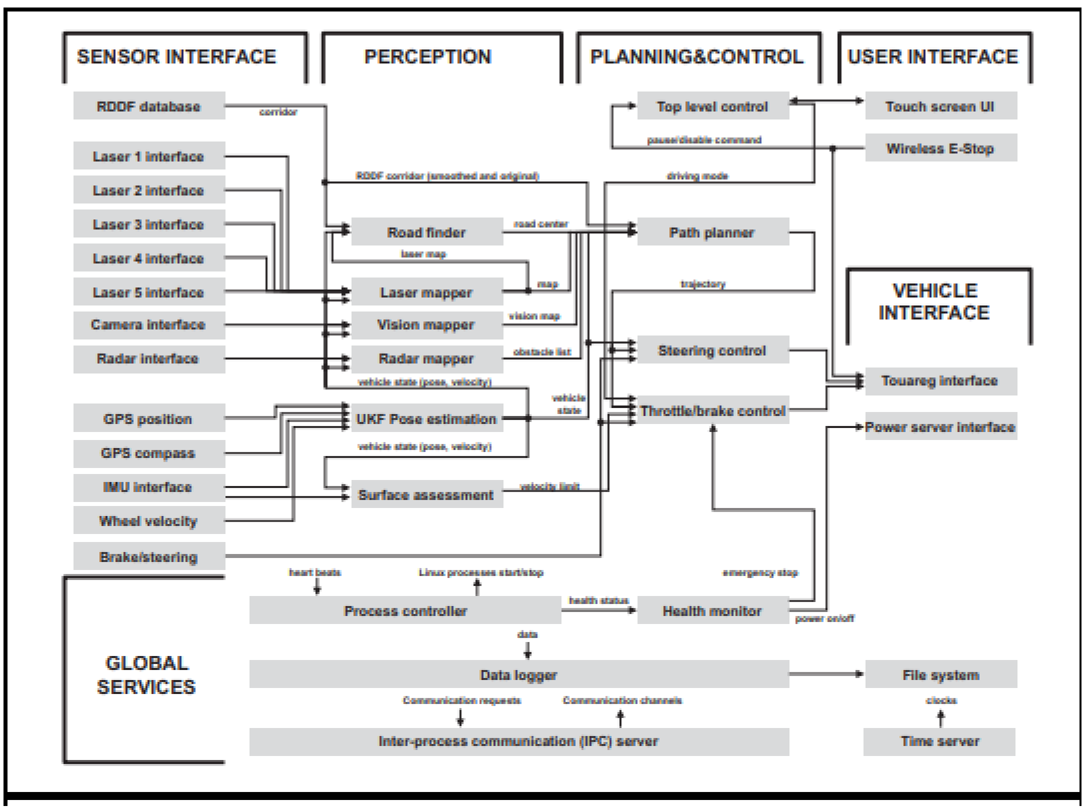


FIG:SOFTWARE ARICHITECTURE IN ROBOTIC CAR

PIPELINE ARCHITECTURE

Just like the subsump- PIPELINE ARCHITECTURE tion architecture, the pipeline architecture executes multiple process in parallel. However, the specific modules in this architecture resemble those in the three-layer architecture.

Data enters this pipeline at the sensor interface layer. The perception layer hen updates the robot’s internal models of the environment based on this data. Next, these models are handed to the planning and control layer, which adjusts the robot's internal.

PLANNING AND CONTROL LAYER

Plans turns them into actual controls for the robot. Those are then communicated back to the vehicle through the vehicle interface layer.

VEHICLE INTERFACE LAYER

The key to the pipeline architecture is that this all happens in parallel. While the perception layer processes the most recent sensor data, the control layer bases its choices on slightly older data. In this way, the pipeline architecture is similar to the human brain. We don't switch off our motion controllers when we digest new sensor data. Instead, we perceive, plan, and act all at the same time. Processes in the pipeline architecture run asynchronously, and all computation is data-driven. The resulting system is robust, and it is fast.

PHILOSOPHICAL FOUNDATIONS

Strong AI	**Weak AI**
A computer machine gets capable of thinking atleast equal to human beings.	A computer machine gets a 'thinking' like feature to make it more powerful.
A machine can perform tasks on its own, just like human beings.	A machine can perform tasks but need human intervention.
A computer program adds an algorithm itself to act in different situations.	Here, tasks to be performed are added manually.
This type of AI allows machines to solve problems in an unlimited domain.	This type of AI allows machines to solve problems in a limited domain.

It is an independent AI which can take the decision on its own.	It is dependent on humans and can simulate like human beings.
Currently, strong AI does not exist in the real world.	Weak AI is in its advance phase of working.
There is no proper example of it.	Example: Automatic car, APPLE Siri, etc.

Strong artificial intelligence (AI), also known as artificial general intelligence (AGI) or general AI, is a theoretical form of AI used to describe a certain mindset of AI development. If researchers are able to develop Strong AI, the machine would require an intelligence equal to humans; it would have a self-aware consciousness that has the ability to solve problems, learn, and plan for the future.

Strong AI aims to create intelligent machines that are indistinguishable from the human mind. But just like a child, the AI machine would have to learn through input and experiences, constantly progressing and advancing its abilities over time.

Ethics of AI: Benefits and risks of artificial intelligence

Ethics in AI is essentially questioning, constantly investigating, and never taking for granted the technologies that are being rapidly imposed upon human life.

That questioning is made all the more urgent because of *scale.* AI systems are reaching tremendous size in terms of the compute power they require, and the data they consume. And their prevalence in society, both in the scale of their deployment and the level of responsibility they assume, dwarfs the presence of computing in the PC and Internet eras. At the same time, increasing scale means many aspects of the technology, especially in its deep learning form, escape the comprehension of even the most experienced practitioners.

Ethical concerns range from the esoteric, such as who is the author of an AI-created work of art; to the very real and very disturbing matter of surveillance in the hands of military authorities who can use the tools with impunity to capture and kill their fellow citizens.

Why are AI ethics important?

AI is a technology designed by humans to replicate, augment or replace human intelligence. These tools typically rely on large volumes of various types of data to develop insights. Poorly designed projects built on data that is faulty, inadequate or biased can have unintended, potentially harmful, consequences. Moreover, the rapid advancement in algorithmic systems means that in some cases it is not clear to us how the AI reached its conclusions, so we are essentially relying on systems we can't explain to make decisions that could affect society.

An AI ethics framework is important because it shines a light on the risks and benefits of AI tools and establishes guidelines for its responsible use. Coming up with a system of moral tenets and techniques for using AI responsibly requires the industry and interested parties to examine major social issues and ultimately the question of what makes us human.

What are the ethical challenges of AI?

- Explainability. When AI systems go awry, teams need to be able to trace through a complex chain of algorithmic systems and data processes to find out why. Organizations using AI should be able to explain the source data, resulting data, what their algorithms do and why they are doing that. "AI needs to have a strong degree of traceability to ensure that if harms arise, they can be traced back to the cause," said Adam Wisniewski, CTO and co-founder of AI Clearing.
- Responsibility. Society is still sorting out responsibility when decisions made by AI systems have catastrophic consequences, including loss of capital, health or life. Responsibility for the consequences of AI-based decisions needs to be

sorted out in a process that includes lawyers, regulators and citizens. One challenge is finding the appropriate balance in cases where an AI system may be safer than the human activity it is duplicating but still causes problems, such as weighing the merits of autonomous driving systems that cause fatalities but far fewer than people do.

- Fairness. In data sets involving personally identifiable information, it is extremely important to ensure that there are no biases in terms of race, gender or ethnicity.
- Misuse. AI algorithms may be used for purposes other than those for which they were created. Wisniewski said these scenarios should be analyzed at the design stage to minimize the risks and introduce safety measures to reduce the adverse effects in such cases.

What is an AI code of ethics?

- **Policy**. This includes developing the appropriate framework for driving standardization and establishing regulations. Efforts like the Asilomar AI Principles are essential to start the conversation, and there are several efforts spinning up around policy in Europe, the U.S. and elsewhere. Ethical AI policies also need to address how to deal with legal issues when something goes wrong. Companies may incorporate AI policies into their own code of conduct. But effectiveness will depend on employees following the rules, which may not always be realistic when money or prestige are on the line.
- **Education**. Executives, data scientists, front-line employees and consumers all need to understand policies, key considerations and potential negative impacts of unethical AI and fake data. One big concern is the tradeoff between ease of use around data sharing and AI automation and the potential negative repercussions of oversharing or adverse automations. "Ultimately, consumers' willingness to proactively take control of their data and pay attention to potential threats enabled by AI is a complex equation based on a combination of instant gratification, value, perception and risk," Shepherd said.

- **Technology**. Executives also need to architect AI systems to automatically detect fake data and unethical behavior. This requires not just looking at a company's own AI but vetting suppliers and partners for the malicious use of AI. Examples include the deployment of deep fake videos and text to undermine a competitor, or the use of AI to launch sophisticated cyberattacks. This will become more of an issue as AI tools become commoditized. To combat this potential snowball effect, organizations need to invest in defensive measures rooted in open, transparent and trusted AI infrastructure. Shepherd believes this will give rise to the adoption of trust fabrics that provide a system-level approach to automating privacy assurance, ensuring data confidence and detecting unethical use of AI.

RISKS OF AI

AI systems: Bias and discrimination

AI systems designers choose the features, metrics, and analytics structures of the models that enable data mining. Thus, data-driven technologies, such as Artificial Intelligence, can potentially replicate the preconceptions and biases of their designer.

Data samples train and test algorithmic systems. Yet, they can often be insufficiently representative of the populations from which they are drawing inferences; thus, creating possibilities of biased and discriminatory outcomes due to a flaw from the start when the designer feeds the data into the systems.

AI systems: Denial of individual autonomy, recourse, and rights

In the past, AI systems that automate cognitive functions were attributable exclusively to accountable human agents. Today, AI systems make decisions, predictions, and classifications that affect citizens.

Certain situations may arise where such individuals are unable to hold accountable the parties responsible for the outcomes. One of the most common responses from humans to justify negative results is to blame the AI system, adding that there is nothing they can do to change the outcome. Something which is not real.

Such a response is utterly ridiculous since AI systems are designed and programmed by a human designer. Therefore, a human is who can correct and change an outcome that is not satisfactory. Take as an example a case of injuries, or a negative consequence such an accountability gap, which may harm the autonomy and violate the rights of the affected individuals.

AI systems: Non-transparent, unexplainable, or unjustifiable outcomes

In some cases, machine learning models may generate their results by operating on high-dimensional correlations that are beyond the interpretive capabilities of human reasoning.

These are cases in which the rationale of algorithmically produced outcomes that directly affect decision subjects may remain opaque to those subjects. In some use cases, this lack of explainability may not be a cause of too much trouble.

However, in applications where the processed data could harbor traces of discrimination, bias, inequity, or unfairness, the lack of clarity of the model may be deeply problematic.

AI systems: Invasions of privacy

AI systems pose threats to privacy in two ways:

- As a result of their design and development processes

- As a result of their deployment

AI projects lay on the grounds of the structuring and processing of big data. Massive amounts of personal data are collected, processed, and utilized to develop AI technologies. More often than not, big data is captured and extracted without gaining the proper consent of the data owner subject. Quite often, some use of big data reveals —or places under risk— personal information, compromising the privacy of the individual.

The deployment of AI systems can target, profile, or nudge data owner subjects without their knowledge or consent. It means that such AI systems are infringing upon the ability of the individuals to lead a private life. Privacy invasion can consequently harm the right to pursue goals or life plans free from unchosen influence.

AI systems: Isolation and disintegration of social connection

The capacity of AI systems to curate individual experiences and to personalize digital services has the potential of improving consumer life and service delivery. This, which is a benefit if done right, yet it comes with potential risks.

Such risks may not be visible or show as risks at the start. However, excessive automation may potentially lead to the reduction of human-to-human interaction, and with it, solving problematic situations at an individual level could not be possible any longer.

Algorithmically enabled hyper-personalization might improve customer satisfaction, but limits our exposure to worldviews different from ours, and this might polarize social relationships.

Since the times of Greek philosopher Plato, well-ordered and cohesive societies have built on relations of human trust, empathy, and mutual understanding. As Artificial Intelligence technologies become more prevalent, it is paramount that these relations of human trust, or empathy, or mutual understanding remain intact.

AI systems: Unreliable, unsafe, or poor-quality outcomes

The implementation and distribution of AI systems that produce unreliable, unsafe, or poor-quality outcomes may be the result of irresponsible data management, negligent design production processes, or questionable deployment practices. Consequently, this can directly lead to damaging the wellbeing of individuals as well as damaging the public welfare.

Such outcomes can also undermine public trust in the responsible use of societally beneficial AI technologies. Furthermore, they can create harmful inefficiencies by the dedication of limited resources to inefficient or even detrimental AI technologies.

How can Artificial Intelligence be risky?

Most of the researchers agree that super AI cannot show human emotions such as **Love, hate or kindness.** Moreover, we should not expect an AI to become intentionally generous or spiteful. Further, if we talk about AI to be risky, there can be mainly two scenarios, which are:

1. AI is programmed to do something destructive:

Autonomous weapons are artificial intelligence systems that are programmed to kill. In the hands of the wrong person, these weapons could easily cause mass casualties. Moreover, an AI arms race could inadvertently lead to an AI war resulting in mass casualties. To avoid being dissatisfied with the enemy, these weapons would be designed to be extremely difficult to "turn off," so humans could plausibly lose control of such a situation. This risk is present even with narrow AI but grows as levels of AI intelligence and autonomy increase.

2. Misalignment between our goals and machines:

The second possibility of AI as a risky technology is that if intelligent AI is designed to do something beneficial, it develops destructive results. For example, Suppose we ask the self-driving car to "take us at our destination as fast as possible." The machine will immediately follow our instructions. It may be dangerous for human lives until we specify that traffic rules should also be followed and we value human life. It may break traffic rules or meet with an accident, which was not really what we wanted, but it did what we have asked to it. So, super-intelligent machines can be destructive if they ask to accomplish a goal that doesn't meet our requirements.

Agent Components

A learning agent in AI is the type of agent that can learn from its past experiences or it has learning capabilities. It starts to act with basic knowledge and then is able to act and adapt automatically through learning.

A learning agent has mainly four conceptual components

1. **Learning element:** It is responsible for making improvements by learning from the environment
2. **Critic:** The learning element takes feedback from critics which describes how well the agent is doing with respect to a fixed performance standard.
3. **Performance element:** It is responsible for selecting external action
4. **Problem Generator:** This component is responsible for suggesting actions that will lead to new and informative experiences.

AGENT ARCHITECTURE

Agent architecture in computer science is a blueprint for software agents and intelligent control systems, depicting the arrangement of components. The architectures implemented by intelligent agents are referred to as cognitive architectures.

Architecture: This refers to machinery or devices that consists of actuators and sensors. The intelligent agent executes on this machinery. Examples include a personal computer, a car, or a camera.

- **Sensors:** These are devices that detect any changes in the environment. This information is sent to other devices. In artificial intelligence, the environment of the system is observed by intelligent agents through sensors.

Sensors are used in everyday life like touch sensors in your phone to smoke detectors in our homes, we are completely surrounded by sensors.

Accelerometer

Whenever you use a compass application on your phone, your phone somehow happens to know the direction your phone is pointing. Also, for a VR Headset, you move your head and you happen to be moving in the application too, ever wondered how is your phone able to get this kind of information. Accelerometers are the key to getting this information.

Ultrasonic Sensor (SONAR)

You all have an idea about the working of a SONAR, an ultrasonic sensor works on a similar principle. On receiving a signal from a microcontroller, your sensor emits an ultrasonic wave (f>20KHz) and detects an echo after some time. Based on this time interval, it sends a voltage signal to the microcontroller encoding the information of the distance of the object from the sensor.

- **Actuators:** These are components through which energy is converted into motion. They perform the role of controlling and moving a system. Examples include rails, motors, and gears.

Actuators range from hydraulic, pneumatic to even thermal/ magnetic actuators electrical actuators i.e. motors.

Motors

Electric motors operate with the interaction of winding currents with magnetic fields to generate a rotating torque (or motion) thus converting electrical energy into mechanical energy. There are several types of motors some of which are listed below.

DC Motors

Let's take an example of an RC toy car, we use DC motors to actuate the motion of the wheels of the car, increasing the angular velocity of the left wheel to turn right and vice versa. All you need to do is apply power, and weeeee it spins, to rotate it in reverse direction just rotate the polarity of the input, while to vary it's speed simply change the input voltage levels.

BLDC Motors

Brush-Less DC motors are more power efficient, with significantly lower noise than DC motors. They are often used in pumps, fans and electric vehicles. Moreover, owing to their lightweight high RPM values, most of the drones these days are predominantly based on BLDC motors.

Servo Motors

Servo motors are not used for continuous rotation (like wheels) instead, they are used for position control systems like robotic arms. There main purpose is to rotate/ move something by a fixed angle/ distance. Unlike DC motors they have a feedback control signal in addition to the power supply.

Stepper Motors

Their working principal is similar to DC motors except for the fact that it has multiple coils. In order to generate motor rotation, these coils need to activated in a particular pattern. They can be used for precise step movements such as in the case of a clock.

Are we going in the right direction?

Most important current challenges AI creates for humanity, and some of the likely future directions the technology might take.

Specifications to keep in mind for AI

Four Possibilities

PERFECT RATIONALITY

. A perfectly rational agent acts at every instant in such a way as to maximize its expected utility, given the information it has acquired from the environment. We have seen that the calculations necessary to achieve perfect rationality in most environments are too time consuming, so perfect rationality is not a realistic goal.

CALCULATIVE RATIONALITY

. This is the notion of rationality that we have used implicitly in de- signing logical and decision-theoretic agents, and most of theoretical AI research has focused on this property. A calculatively rational agent eventually returns what would have been the rational choice at the beginning of its deliberation. This is an interesting property for a system to exhibit, but in most environments, the right answer at the wrong time is of no value. In practice, AI system designers are forced to compromise on decision quality to obtain reasonable overall performance; unfortunately, the theoretical basis of calculative rationality does not provide a well-founded way to make such compromises.

BOUNDED RATIONALITY

. Herbert Simon (1957) rejected the notion of perfect (or even approx- imately perfect) rationality and replaced it with bounded rationality, a descriptive theory of decision making by real agents. He wrote, The capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problems whose solution is required for objectively rational behavior in the real world—or even for a reasonable approximation to such objective rationality. He suggested that bounded rationality works primarily by satisficing—that is, deliberating only long enough to come up with an answer that is “good enough.” Simon won the Nobel Prize in economics for this work and has written about it in depth (Simon, 1982). It appears to be a useful model of human behaviors in many cases. It is not a formal specification for intelligent agents, however, because the definition of “good enough” is not given by the theory. Furthermore, satisficing seems to be just one of a large range of methods used to cope with bounded resources.

BOUNDED OPTIMALITY

. A bounded optimal agent behaves as well as possible, given its computational resources. That is, the expected utility of the agent program for a bounded optimal agent is at least as high as the expected utility of any other agent program running on the same machine.

Of these four possibilities, bounded optimality seems to offer the best hope for a strong theoretical foundation for AI. It has the advantage of being possible to achieve: there is always at least one best program—something that perfect rationality lacks.

Future of Artificial Intelligence(If AI Succeed)

Healthcare:

AI will play a vital role in the healthcare sector for diagnosing diseases quickly and more accurately. New drug discovery will be faster and cost-effective with the help of AI. It will also enhance the patient engagement in their care and also make ease appointment scheduling, bill paying, with fewer errors. However, apart from these beneficial uses, one great challenge of AI in healthcare is to ensure its adoption in daily clinical practices.

Cyber security:

Undoubtedly, cyber security is a priority of each organization to ensure data security. There are some predictions that cyber security with AI will have below changes:

- With AI tools, security incidents will be monitored.
- Identification of the origin of cyber-attacks with NLP.
- Automation of rule-based tasks and processes with the help of RPA bots.

Transportation:

The fully autonomous vehicle is not yet developed in the transportation sector, but researchers are reaching in this field. AI and machine learning are being applied in the cockpit to help reduce workload, handle pilot stress and fatigue, and improve on-time performance. There are several challenges to the adoption of AI in transportation, especially in areas of public transportation. There's a great risk of over-dependence on automatic and autonomous systems.

E-commerce:

Artificial Intelligence will play a vital role in the e-commerce sector shortly. It will positively impact each aspect of the e-commerce sector, ranging from user experience to marketing and distribution of products. We can expect e-commerce with automated warehouse and inventory, shopper personalization, and the use of chatbots in future.

Employment:

Nowadays, employment has become easy for job seekers and simple for employers due to the use of Artificial Intelligence. AI has already been used in the job search market with strict rules and algorithms that automatically reject an employee's resume if it does not fulfil the requirement of the company. It is hoping that the employment process will be driven by most AI-enabled applications ranging from marking the written interviews to telephonic rounds in the future.