Name: Nowshin Sumaiya
ID:21301276
Sec:02
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Answer to the question no:01

a) The primitives of robotics when integrated with an AI agent are :
   - Sense
   - Plan
   - Act
   - Learn

Sense: A robot needs the ability to sense important things about its environment. Using various sensors a robot gathers a lot of information.
That information may include the presence of an obstacle, the location of an object etc. For better understanding let's take an example of a robot in a park. So it will use cameras to identify objects, IR sensors to measure how far away these objects are etc. So, by using sensors the robot can identify which path it should go.

Plan: planning is the most important part. In this stage, the robot decides what to do based on the sensed information. Like the previous example, after sensing the whole environment, the robot can get multiple paths. It needs to figure out the right combination of moves on the spot. So, by planning it, determine the best path for the robot. Robots can plan the tasks it needs to complete early or later. Effective planning helps to save time, money, energy etc. planning is also helpful for predicting problems a robot may face. Moreover, for proper planning the robot will follow the instructions provided by the human programmer, which instructs it on what to do next or how to solve the problem on its own.

Act: At this stage, a robot performs the tasks specified in the plan.The robot physically moves or performs tasks based on its planning. Using actuators, motors, or other systems, the robot performs the required actions. Again, this could involve visiting a certain place, managing objects, or interacting with people. To complete the specified task, the execution must be accurate. For example, the robot moves along the calculated path. It might slow down when it approaches an obstacle.

Learn: Learning is the process by which a robot gains experience and gradually improves its performance. We can consider the example of a cleaning robot. When cleaning the house at first, it travels randomly, bumping into walls and furniture. The robot eventually picks up on the optimal routes to travel in order to avoid obstructions and clean the house more effectively. It can improve its work through this approach without any assistance from humans. So, learning is an important stage if we consider long term use of robots. Their planning and actions can be optimized by learning from both successes and mistakes.

b) The term "4 D's (dull, dirty, difficult and dangerous) of Robotics" describes four distinct categories in which robots outperform humans. It is important to consider them when planning AI-integrated projects.

- Dull: While humans find certain tasks boring and time-consuming, robots perform better doing them. Robots can move items from place to place in warehouses, repeating the same job continuously. Again, Integrating AI into dull tasks helps increase productivity and efficiency. For example, an artificial intelligence powered robot in a warehouse might figure out the fastest ways to choose things, and can take less time to fulfill orders.

- Dirty: Robots are effective at doing jobs that humans find dirty or unhygienic. For example, Robots can be used in waste water treatment plants, toxic waste cleanup, and even underwater ship surface cleaning. Moreover, it's important to think about how AI could improve the efficiency of robots while designing AI-integrated work for dirty jobs. By analyzing the surroundings, artificial intelligence (AI) can assist robots in adapting to changing circumstances, avoiding potential hazards, and cleaning more efficiently.

- Difficult: Robots are ideal for difficult tasks. Artificial Intelligence (AI) enables robots to adapt to complex and unpredictable environments, which makes them more capable of performing difficult tasks. This will help to save lots of time, money and energy.

- Dangerous: Tasks that are dangerous for humans are frequently performed by robots. For example, it is risky for humans to work in chemical industries. since they may experience numerous health-related problems after working there for a long period. Robots can work in those chemical industries. Again, robot performance in dangerous tasks can be significantly improved by AI. For example, when deployed for bomb disposal, an AI powered robot could identify various explosive kinds, modify its strategy in response to data it gathers, and even interact with people to advise the most secure course of action. As a result, smaller numbers of individuals are involved in situations that may result in death.

c) laws or check points must students consider when constructing the robots are:

- A robot must not harm human beings, nor through in action allow one to come to harm. Which means that human safety should always come first in the design and programming of robots. For example,

Robots that are carrying tons of stuff must be aware of their surroundings and stop if a person comes too close in order to avoid accidents.

- A robot must always obey human beings, unless that is in conflict with the first law. It should be the goal of robotics development to obey instructions given by humans. This guarantees that robots carry out human requests. On the other hand, the robot has to ignore human commands if they potentially cause injury to someone, in breaking the first law. so, It is important to prevent misuse of robots where someone might try to make the robot perform a task that harms humans.

- A robot must protect from harm, unless that is in conflict with the first two laws. Robots are quite costly, it takes too much time to build a robot. So, we do not want to harm robots. They should be designed in such a way that it should protect themselves from damage.The robot must prioritize humans first, then robot protection. For example, when a robot sees something that might harm it, it should attempt to avoid it; however, if doing so will put someone in danger, it should choose the safer action for humans.

- A robot should always have a kill switch.It is one of the essential safety features. If something goes wrong, it will help to quickly stop the robot. To ensure that people can take control in the event of an emergency. For example, if a robot malfunctions and starts moving randomly, pressing the kill switch will stop all its movements instantly. Without a kill switch it could harm human, animals also.

d) Artificial intelligence (AI) and robotics are two distinct yet connected topics that are essential to the advancement of technology. The key differences between robotics and AI is, AI does not need to be embodied, but robots need to be embodied . Again, The main objective of robotics is

to build machines that are capable of carrying out physical activities with efficiency. The goal of artificial intelligence (AI) is to create intelligent agents that can either match or beat human cognitive abilities. Moreover, Robots are physical beings with the ability to move, manipulate objects, and engage with their surroundings. whereas, artificial intelligence (AI) does not require a physical form; it can exist just as software.

Their integration can unlock a wide range of possibilities. To understand this properly, we can take the example of a cleaning robot. Without AI, they clean typical or random ways, frequently overlooking areas or becoming stuck. AI helps them to map rooms, organize effective cleaning routes, and identify spots in need of extra attention. Moreover, they can avoid obstacles, learn the layout of different spaces, and even connect to smartphone apps for remote control and scheduling. This increases their intelligence, productivity, and capacity for continuous improvement, making them truly beneficial home assistants. In conclusion, the integration of robots with AI has the potential to open up an endless number of opportunities.

Answer to the question no:02

a) It is mentioned in the question that I want to design a robot that can help people to take care of pets and clean the house so that people can travel a distance without having any extra tension. Electric actuator should be used as a solution for the scenario.

Electric actuators are devices that control or move various components in a system by converting electrical energy into mechanical motion. Electric actuators are perfect for precise jobs like feeding pets, refilling water bowls, or changing accessories for pets. They provide excellent control over

movement and location. Smooth, linear, or rotating motion is possible using electric actuators, which is crucial when working with pets. Moreover, electric actuators require little or no maintenance than pneumatic or hydraulic actuators. This is essential in a household environment because the robot will need to function continuously over time without requiring a lot of maintenance or repairs. Operating cost of electric actuators is low. Again, the electric actuators' reliability is good. For robotic pet care and house cleaning solutions, electric actuators are ideal since they are reliable, quiet, and precise.

On the other hand, pneumatic or hydraulic actuators are not a good choice for the scenario. Compressed gasses and air are used by pneumatic actuators to transform energy into motion. Hydraulic actuators convert hydraulic energy into mechanical energy by using hydraulic fluid, oil, or water. So, this is not a good idea for using pneumatic or hydraulic actuators at home. Again, their maintenance is high. As the robot is a daily use for pet caring, so many people can't give too much time for maintenance.

Lastly, by this discussion we can say Electric actuators are the best solution that is described in the scenario.

b) Sensors that can be used to develop the solution for the scenario are:

- Infrared (IR) Sensor : Pets' movements and presence within the home can be detected using infrared sensors. For example, the robot's IR sensor can detect a cat walking in front of it and change the robot's path or stop. It helps for the robot's knowledge of the environment.

- Camera Sensors : used for visual recognition and navigation. Robots with camera sensors can see and identify objects,humans, pets , and surroundings. The robot will have accurate vision of its movements. The position of the pet can be determined by the camera. So, robots are easily able to perform his duties effectively by seeing the pet.

- Microphone: It is useful for detecting sounds, such as the call of a pet or human commands. provide voice control of the robot and the ability to recognize the sound of a distressed pet (such as a cat meowing). The robot could then visit the pet to find out how it was doing or call its owner.

- Chemical sensor : Chemical sensors are used to identify particular molecules or chemicals present in the atmosphere. This could include ammonia from pet waste, carbon monoxide and other harmful gasses. Keeping an eye out for pollutants, harmful gasses, and pet related smells can help to keep homes with pets safe and clean.

- Thermal Sensor : Monitoring the surroundings is the main purpose of thermal Sensor. These sensors can make sure the pet is comfortable in the house, particularly if the robot is in responsibility for keeping an eye on the circumstances while the owner is absent. The robot could adjust the heating or cooling systems or notify the owner if the temperature gets too high or too low.

- Ultrasonic Sensor : It is used for measuring distance using sound waves. This is used for easy navigation and prevents accidents with pets. They assist the robot in navigating the house, avoiding pets, and identifying obstacles that are not immediately in the way but could still be challenging.

- GPS Sensor : When a robot monitors pets over a wider area, GPS assists in pet tracking. The GPS sensor can assist in guiding the pet back home or informing the owner by sending the location of the pet.

- Gas/Smoke Sensor: it detects harmful gasses or smoke. These sensors can be included in the robot to keep an eye out for potentially dangerous conditions in the house, such as gas leaks or fire smoke. The robot may notify the owners, turn off potentially dangerous equipment, or even bring the pet to a safer location if it detects smoke or dangerous gasses.

We have discussed so many sensors. We can add more sensors or remove those sensors according to the demand of the pat owners. But, some Sensors for example Thermal Sensor Infrared (IR) Sensor, Camera Sensors, Microphone etc are really needed for a pet caring robot.

c) Single board computer can be used for integrating all the sensors and actuators and running the whole system.

A small computer system constructed on a single circuit board is called a single board computer. It provides a balance between cost, performance, and flexibility. Using a single-board computer is perfect for the given situation. Now, i will discuss about why i choose single board computers for the given scenario :

★ It is incredibly easy to integrate the actuators and sensors in a single board computer.

★ For managing duties like navigating, keeping an eye on, and managing pet-related activities, it can connect to a wide range of peripherals.

★ Real-time data analysis from sensors is made possible by the processing capacity of single board computers.

★ Single board computers are perfect for robotic systems that run on batteries since they need less power than regular computers.

★ For a robot that has to operate independently in a home environment, a single board computer is a small, lightweight solution that works well.

★ Cost is quite low if we compare it with other devices.

★ Wi-Fi, bluetooth, and ethernet connectivity are features that many single board computers have, and they are essential for systems as they might need to interact with cat owners online.

★ It allows the robot to be upgraded or modified over time. We can easily add or remove sensors whenever we need.

For all those reasons a single board computer is the perfect choice for the scenario.