

Artificial Intelligence & Robotics

Assignment 6

Unit 6: Robotics in Practice

1. Explain the servo control mechanism in robots.

A servo system primarily consists of three basic components – a controlled device, an output sensor, a feedback system.

This is an automatic closed loop control system. Here instead of controlling a device by applying the variable input signal, the device is controlled by a feedback signal generated by comparing output signal and reference input signal.

When reference input signal or command signal is applied to the system, it is compared with output reference signal of the system produced by output sensor, and a third signal produced by a feedback system. This third signal acts as an input signal of controlled device.

This input signal to the device presents as long as there is a logical difference between reference input signal and the output signal of the system.

After the device achieves its desired output, there will be no longer the logical difference between reference input signal and reference output signal of the system. Then, the third signal produced by comparing these above said signals will not remain enough to operate the device further and to produce a further output of the system until the next reference input signal or command signal is applied to the system.

2. Explain robotic mapping with respect to topological and geometric maps.

Topological Maps

- They can represent landmarks and the routes between them as nodes and edges in a graph.
- Edges can represent motor action needed to get from one node to the next, or direction, distance, path convenience etc.

- They can use standard AI graph search methods to find route from start to goal.

Geometric maps

- It can describe location of robot and objects in its world as a configuration space
- Mobile robots usually assumes robot moves on ground plane, can rotate on spot (so direction not important) and only obstacle location matters.
- Expand actual obstacles by robot size
- Navigation then involves finding routes through freespace.

Advantages of topological maps:

- Only sparse data storage
- Representation matches problem description: e.g. instruct robot to move between discrete locations
- Recognition only requires consistency, not accuracy

Advantages of geometric maps

- Can extrapolate between known locations
- Can derive novel shortcuts
- Common representation to fuse sensor/motor data

3. Explain Intelligent Vehicles and the technologies used in it.

An intelligent vehicle is defined as a vehicle equipped with perception, reasoning, and actuating devices that enable the automation of driving tasks such as safe lane following, obstacle avoidance, overtaking slower traffic, following the vehicle ahead, anticipating and avoiding dangerous situations, and determining the route.

The development of intelligent vehicles has social, environmental and economic benefits. Intelligent vehicle can anticipate driving scenario and respond in times of danger, what can in 90% of cases avoid accidents caused by human error.

Vehicles capable of running at high speed and close behind each other can reduce fuel consumption, pollution emissions and increase road capacity. Vehicles able to perceive traffic restrictions

may prevent misinterpretation of these restrictions and anti-social driver behavior. Fully autonomous vehicles will provide a greater degree of mobility and quality of the

whole population, because driving of such vehicles will not need to have a driving license.

Intelligent vehicles are considered as robotic applications. Applications developed for intelligent vehicles require:

1. Knowledge of vehicle state - position, kinematics and dynamics of the vehicle.
2. Knowledge of environment state.
3. Knowledge of driver and passengers' state.
4. Communication with roadside infrastructure and other vehicles.
5. Access to digital maps and satellite data.

4. Explain domestic robots.

A domestic robot is a type of service robot, an autonomous robot that is primarily used for household chores, but may also be used for education, entertainment or therapy. While most domestic robots are simplistic, some are connected to WiFi home networks or smart environments and are autonomous to a high degree.

Few types of Domestic Robots are:

Indoor Robots

Robotic vacuum cleaners and floor-washing robots that clean floors with sweeping and wet mopping functions. Some use Swiffer or other disposable cleaning cloths to dry-sweep, or reusable microfiber cloths to wet-mop.

Cat litter robots are automatic self-cleaning litter boxes that filter clumps out into a built-in waste receptacle that can be lined with an ordinary plastic bag.

Robotic kitchens include Rotimatic (which makes rotis, tortillas, puris out of flour in just a few minutes).

Security robots such as Knightscope have a night-vision-capable wide-angle camera that detects movements and intruders. It can patrol places and shoot video of suspicious activities, too, and send alerts via email or text message.

Outdoor Robots

A robotic lawn mower is a lawn mower that can mow a lawn by itself after being programmed. There is also a control unit which helps the mower move. This unit also contains a memory unit which records and memorizes its operation programming. Its memorized route includes the length of travel in each direction and turns angles. Window cleaning robots are most used to clean outdoor windows, more specifically house windows. The cleaning pad directly interacts with the window surface and is directly responsible for removing the dirt by filling itself with specialized window cleaning fluid.

Toys

Robotic toys, such as the well known Furby. There are also small humanoid remote-controlled robots as well as electronic pets, such as robotic dogs.

Social Robots

Social robots take on the function of social communication. Domestic humanoid robots are used by elderly and immobilized residents to keep them company. Home-telepresence robots can move around in a remote location and let one communicate with people there via its camera, speaker, and microphone.

5. Write a short note on:

a. Delivery Robots

In the current times where human to human interaction can be fatal in many areas and everything is dependent on one-touch away services through mobile apps, service providers must facilitate customers with the best service and delivery experiences.

The Delivery robot has cameras embedded all around it, offering the robot a 360-degree view. The robot can even overcome a variety of obstacles to make its deliveries. It can climb curbs by lifting its wheels one by one until it makes its way up onto the sidewalk. It can also avoid collisions with people and navigate around obstacles. The robot is designed to make short-distance deliveries of small orders, the kinds of jobs that human delivery personnel don't want.

b. Space Robotics

Any unmanned spacecraft can be called a robotic spacecraft. However, Space Robots are considered to be more capable devices that can facilitate manipulation, assembling, or servicing functions in orbit as assistants to astronauts, or to extend the areas and abilities of exploration on remote planets as surrogates for human explorers. Few examples of Space robots are Deep Space Probes, Rovers and Orbiting space robots.