University of Cincinnati
College of Engineering and Applied Science

20MECH5131/6031 Intro to Robotics
Homework#2 - Robot Applications (70 pts)

Student Name: Hongui Yi **Score:** _____

Answer the following questions and submit your work in a SINGLE file online.

1. (10 pts) Explain the differences between professional service robots and domestic service robots. Give one example of each. Briefly describe your example robots' functions and applications. Also use figures, pictures or sketches to illustrate your examples.
   Answer:
   a) Explanation of differences of professional service robots and domestic service robots:
   I think there are three points of difference between professional service robots and personal service robots.
   Point 1: the service functions are different. Professional service robots are typically used for commercial tasks, while personal service robots are typically used for non-commercial tasks.
   Point 2: The types of operator are different. Professional service robots require properly trained operators to operate them, but non-professionals are able to operate personal service robots.
   Point 3: Using environments are different. Professional service robots are generally used in public places, such as offices, hospitals, and firefighting areas. Personal service robots are usually used in private places, such as accommodation, wheelchairs, room cleaning, etc.

   b) Examples:
   i) Professional service robots:

Figure. 1: A cargo robot

【Functions】

A cargo robot is a robot deployed in a professional environment underneath a cargo room environment. It helps or replaces handlers for cargo handling, sorting and transportation. Therefore, freight robots are great labor-saving tools.

【Applications】

Like industrial robots, cargo robots are often used for hazardous, arduous, menial or repetitive tasks where automation technology is superior to manual labor. Unlike industrial robots, cargo robots typically have a degree of autonomy and mobility that is suitable for unstructured environments.

ii) Domestic service robots:

Figure. 2: A robotic vacuum cleaner

【Functions】

Robotic vacuum cleaners can be the best choice for low difficulty routine floor maintenance. First, these vacuums are particularly handy for handling pet hair. Secondly, some robot vacuums can create smart maps and adjust cleaning preferences. In addition, it can be connected to the Internet. Data evaluation enables it to be rated for reliability and owner satisfaction.

【Applications】

It works well in most homes, large or small, because it can travel back and forth in an orderly fashion, keeping track of where it has or has not been so it doesn't miss any large pieces of flooring.

2. (8 pts) Study Lecture Slides 2-Robot Applications-Part I, and refer to slides 11 and 20, write a paragraph (min 200 words) to tell why you think that the logistics robots are the drivers in value growth and in unit growth. In another word, explain why logistics robots are so popularly used in recent years in your opinions.

Answer:

I see three reasons for the growing popularity of logistics robots.

First, logistics robots automate the process of storing and moving goods through the supply chain. They are typically used in warehouses and storage facilities, but they can also be used in other environments. The uptime of logistics robots far exceeds that of manual labor, resulting in significant productivity and profitability for those who deploy them.

Second, logistics robots play an important role in reducing logistics costs and streamlining supply chains. Their primary application is the use of mobile automated guided vehicles to transport goods in warehouses and storage facilities. These robots operate on predetermined paths and move products around the clock for transportation and storage, reducing labor costs and labor.

Third, logistics robots are used in a wide range of scenarios. Not only can they transport goods outdoors, as in agriculture, but they can also be applied in retail, counting shelf inventory in real time and using the store as a mini-warehouse. There are other forms of logistics robots that can be used in hospitals and laboratories for the delivery of drugs and laboratory specimens.

Regardless of the application, high levels of uptime are the biggest source of profit for logistics robots.

3. (10 pts) Observe or reflect on your everyday life, i.e. living, study, working, meeting, eating, exercising, and social interaction environment etc., think about a way or idea that a service robot could be useful to increase your life quality in some ways. Your idea should be creative, or innovative, and to the best of your knowledge, nobody has come up the idea yet. Describe your idea and explain how this service robot looks like, its functions and features, and its significant impact on people's life. Please include a picture or a sketch or a drawing in your answer.

   Answer:

   a) Description:

   Looking back at our daily life, courier service has become an essential part of most people's lives. In my imagination, an unmanned low-altitude courier robot, as a service robot, can be manipulated by using radio remote control equipment and programmed control devices to achieve the function of transporting packages and automatically delivering them to their destinations.

Figure. 3: An unmanned low-altitude courier robot

   b) Explanation:

   Although courier is very common in our daily life, there are often problems such as high courier labor cost, cumbersome manual process and long transportation process. However, if driverless low-altitude courier robots can be popularized, it can not only solve the delivery problem in remote areas and improve the delivery efficiency, but also reduce the labor cost at the same time. However, its main drawback mainly lies in the bad weather drones will deliver powerless, in the flight process, can not avoid human damage and so on.

4. (8 pts) Recall your co-op experience or your part-time work environment and tell if you see any industrial robots used in one of the companies?
   - If yes, describe the robots used and the reasons for using robots.
   - If not, give your suggestions where industrial robots should be used in the company and explain the reasons.

   Please include pictures or sketches in your descriptions.

   Answer:

No, I didn’t see any industrial robot used in my co-op organizations.

I think industrial robots could be used in these environments for companies.

Firstly, industrial robots can be used in the production rooms of companies. First, traditional production rooms require a lot of labor and labor costs, but industrial robots can be dedicated employees, saving the company money because they do not require breaks, vacations or sick days. Second, industrial robots can handle a variety of applications with precision, saving valuable materials, so companies can expect fewer errors and a safer work environment. Finally, industrial robots can also increase profits by reducing production time.

Figure. 4: Industrial robots used in the production room

Secondly, industrial robots can be used in small spaces in a company. Industrial robots have compact bases that can be used in tight spaces. They can be mounted on shelves, pedestals, walls, ceilings or tracks, saving valuable floor space in companies.

Figure. 5: Industrial robots used in small spaces

Thirdly, industrial robots can be used in extremely hazardous company environments. Whether it's smoke, sparks, arc glare, or dust particles, industrial robots can make the work environment safer and employees able to be more engaged.

Figure. 6: Industrial robots used in extremely hazardous environment

5. (14 pts) Explore more about using robots in societies and describe your opinions on the social impact of using robots by answering the following questions:
   a) Are you worried that you may lose your job to robots in the searching for jobs? Why.
   Answer:
   I don't think robots will replace the jobs I'm looking for. I may become an engineer in the future. A career as an engineer requires a high level of innovation. While robots and artificial intelligence liberate work hours, fewer hours of work does not guarantee the ability to innovate. As long as I secure my core competency as an engineer, which is the ability to innovate, I think it will be difficult to replace humans in industries such as engineering, design, and manufacturing, even though robots and AI can assist or even replace human labor in more and more industries.

   b) In general, what kinds of job may be disappeared in 10 years and in 30 years, and explain why.
   Answer:
   I think the following types of jobs are likely to be replaced in the next 10 to 30 years.

   First, jobs that are highly repetitive.
   Many jobs require skills that can be acquired without talent and through a lot of repetitive training. For example, salesmen, customer service, typists, etc.. These jobs require fewer skills because of the single workflow, and can be achieved through algorithmic programs and artificial intelligence.

   Second, jobs that are dangerous.
   Jobs with a closed work space. Firefighters are a good example. Due to the high danger of fighting fires, many firefighters lose their lives during the mission. But with the development of robotics and artificial intelligence, fire-fighting robots may be able to replace firefighters in the future because of their great flexibility, fault tolerance and ability to resist burns. Most importantly, robots have no life, even if they are damaged in the process of fighting fires, it is less costly than losing a human life.

   Third, jobs in confined environments.
   There are many jobs that require people to work long hours in small spaces, such as hotel receptionists, operators, bank clerks, etc. These jobs not only have a constant environment around them, but also have a constant environment. These jobs not only have a constant environment around them, but also have a single work content, which makes people easily get

bored. The database of robots is not only able to let customers know the effective information that humans can't deliver completely in a short time, but also can free up the labor force, killing two birds with one stone.

c) Give your opinions on the social impact of using robots in one of your co-op companies, or a specific company/industry of your choice.
The following one video and one article are for your *reference only*. You are encouraged to explore more relevant videos and articles.

- CNBC video. 3 minutes. Will robots take our jobs?
- New York Times article, 12 minutes read. The Robots Are Coming for Phil in Accounting. The same article can be found in Canvas under Assignments-Module 2: hw#2.

Answer:

I would like to express my view on the social impact of this phenomenon through **the use of hotel robots in the hotel industry**.

Hotel robots that can provide intelligent, contactless service are becoming more and more popular among hotels due to the new crown epidemic. At the Beijing Winter Olympics held earlier this year, a fully automated hotel robot that can provide 24-hour coffee brewing service was frequently in the news and became the star product for intelligent contactless service during the epidemic. The new hotel robot is rapidly moving from the "test water" stage to the "normalization" stage.

Figure. 7: A coffee brewing service robot

First, the hotel robot industry will get rapid development will lead to a continued rise in public recognition and acceptance of robots.

As hotel robots become more popular and robot services are gradually accepted by consumers, including coffee making, delivery of household goods, and customer service functions, consumers will also have higher expectations for the services that robots can provide. In addition to what is already present now it is expected that the functionality of hotel robots will be further improved in the future, which will make the public love robots even more.

Secondly, the application of hotel robots helps to promote the development of many emerging technologies.

Hotel robots cannot be separated from core technologies such as LiDAR, control and motion systems, and environment-aware navigation systems. The higher the market demand, the more companies and research institutions will focus on the development and application of these supporting technologies.

Finally, hotel robots will help improve the synergy between robots and hotel facilities.

At present, the delivery robots in hotels still need to manually put in goods and manually set parameters on the robot's display, which has not yet realized the real sense of "contactless service". In the future, hotel robots will need to have the technical ability to accurately capture products and strengthen the synergy with intelligent shelves to achieve true "no-touch service".

6. (8 pts) Give one robot application example in which using robots is **essential**. Explain why. The application example should include pictures of the robots used in your application and explanations of why robots are essential in your application. You can use any resources available to you, e.g. lecture slides or online search. Note: Sorry that you cannot use my application example in slide 81-Use robots to fix BP oil leak in the Gulf of Mexico.

Answer:

(1) Application example：

Spraying robots / Explosion-proof robots

When spraying, either powder or paint, atomization is necessary to ensure uniformity. The paint is composed of chemical substances, and the paint mist and other gases emitted are flammable, so the spraying site is like a gasoline station, which is flammable and explosive. The robot is electrically operated, and if not properly protected, it can catch fire and explode. Therefore, in painting projects, explosion-proof robots must be used, and the common scenario for explosion-proof robots is also in painting projects, so they are often referred to as explosion-proof robots, or explosion-proof robots as painting robots.

Figure. 8: A spraying robots / explosion-proof robots

(2) Explanation:

Paint robots/explosion-proof robots are an essential robot due to the fact that they are not only protected but also have protection measures. The measures to protect against explosion are.

a) Automated spraying robots wire motors are placed inside the housing and not exposed.
b) Combustible gas detectors inside the robot.
c) Sealing ring to prevent the outside air from entering the robot shell. Sparks and combustible gases mixed together will explode, as the automated robot is equipped with a combustible gas detector inside, once the detector detects the presence of combustible gases, the alarm will stop.

7. (12 pts) Cost justification of a robotics project. A company has designed a system to automate an assembly operation. The costs are as follows: three robots total, $165,000; a vision system, $7,500; three cameras, $2,500; associated hardware for three robots, $3,500; fixtures, $45,000. It is estimated that no new maintenance is required for maintenance and preventive maintenance. Training will cost approximately $15,000. The assembly cell will free up four of five employees to do other work. The average cost of each worker, including fringe benefits, is $40,000. The system's productivity and quality improvements should save the company $16,000 each year. The company believes that the system will be used for three years. What is the payback period? If the company requires a payback of 18 or fewer months, should the project be undertaken? (show steps, e.g. hardware cost, total cost, depreciation, payback years, and conclusion)

Answer:

The calculation progress present as below.

$$Hardware\ cost = \$165k + \$7.5k + \$2.5k + \$3.5k + \$45k = \$223.5k$$

$$Training\ cost = \$15k$$

$$C = Hardware\ cost + Training\ cost \$223.5k + \$15k = \$238.5k$$

$$W = 4 \times \$40k = \$160k$$

$$I = \$16k$$

$$D = \frac{Hardware\ cost}{3\ years} = \frac{\$223.5k}{3} = \$74.5k$$

$$M = 0$$

$$S = 0$$

$$P = \frac{C}{W + I + D - (M + S)} = \frac{\$238.5k}{\$160k + \$16k + \$74.5k} = 0.95 years < 1.5 years$$

As the calculation result shows, it should be undertaken.