Week 1: Introduction

Online book: https://hoanglongcao.github.io/E4R/

Further readings:

Glendinning, Eric H., and Norman Glendinning. Oxford English for electrical and mechanical engineering. Oxford: Oxford University Press, 1995. (link)

Sopranzi, S. Flash on English for Mechanics, Electronics and Technical Assistance. ELi, 2012 (link)

Time: Monday 15:00 Vietnam

10 weeks (online, Google Meet)

Example: The fields that overlap with robotics: *computer engineering, computer science, electronics, mechanical, nanotechnology, bioengineering*.

LECTURE FORMAT

Reading

- 3-4 paragraphs (10-15 mins)
- Questions

Writing

- 1 paragraph (10 mins)
- 3-5 sentences

Speaking

- 10-15 mins (2-3 people)

Listening

- Youtube video
- Fill in the blanks + questions

Grammar:

- ~85%: simple present tense
    - Subject + Verb + Object + ...

    - Ex: Robotics (Ngành robot) develops machines that can substitute for humans and replicate human actions.
- ~10%: present perfect
    - Subject + have/has + Verb (past participle) (quá khứ phân từ) + Object + …
    - Ex: Robots have substituted humans in many applications.
- Passive:
    - Subject + TO BE + Verb (past participle) + Object + ….
    - Ex: Robots are used in many situations.

Vocabulary

- bio-inspired robotics, bio-inspired mechatronics
    - Biology (biological) - inspiration - robotics

      Sinh học - cảm hứng - robot / cơ điện tử

      Robot sinh học, robot mô phỏng sinh học.

      Robot: con robot (object)

      Robotics: ngành robot (field)
- Mechatronics

- Mechanics + electronics + programming + automation (integration) .....

Week 2: Robotics and Engineering

Robotics: ngành (nghiên cứu, ứng dụng) robot

Engineering: ngành kỹ thuật

Robotics is an **interdisciplinary** research area at the interface of **computer science** and **engineering**. The goal of robotics is to design **intelligent machines** that can help and assist humans. Robotics draws on the fields of **information engineering**, **computer engineering**, **mechanical engineering**, **electronic engineering**, **artificial intelligence**, and others (**mechatronics**).

Inter-disciplinary: liên ngành

inter- kết nối (inter-net, inter-national, inter-face)

disciplinary: ngành nghề, lĩnh vực

Multi-disciplinary: hợp tác đa ngành

multi- nhiều

computer science: khoa học máy tính

computer engineering: kỹ thuật máy tính

mechanical engineering: kỹ thuật cơ khí

electronic engineering: kỹ thuật điện tử

electrical engineering: kỹ thuật điện

artificial intelligence: trí tuệ nhân tạo, trí thông minh nhân tạo

mechatronics: kỹ thuật cơ điện tử

to design **intelligent machines** : thiết kế máy có khả năng thông minh

READING

10mins (15:27 - 15:37)

substitute for humans: thay thế con người

supervisor: người giám sát

replicate human actions: lặp lại hành động của con người

bio-inspired robotics: robot mô phỏng sinh học

operate autonomously: vận hành/ hoạt động tự động

autonomous car (self-driving car): xe tự lái

Automatically: A - B - C - D (logic)

domestic(ally): ứng dụng dân dụng

commercial(ly): có tính thương mại

militari(ly): có tính quân sự

STEM (science, technology, engineering, mathematics)

conception: thiết kế concept

design: thiết kế

manufacture: ngành chế tạo (manufacturing- công nghiệp chế tạo)

operation: hoạt động

1. The field of robotics inspired by nature: bio-inspired robotics

2. CS-artificial intelligence (AI), mechatronics

Definitions

STE**A**M - Art: nghệ thuật - xã hội

machine learning: máy học/ học máy

WRITING (2-3 sentences, 10mins)

What robotics can do for a better world?

Industrial robot: robot công nghiệp

robot arm: tay máy - cánh tay robot

The robot industry: ngành công nghiệp robot

Adj. + Noun

danger (n): sự nguy hiểm (dangerous)

strength (n): sức mạnh (strong)

length(n): độ dài (long)

stationary: đứng yên

stay, station, static, stator

Base

workplace: không gian làm việc

16:20-16:30 (2-3 sentences)

What kind of robot?

What is it used for?- purpose, functionalities

What are the characteristics of this kind of robot?

Robots are used in the medical industry, they can replace parts of the human body.

They work faster and make less careless mistakes than humans.

In hospitals, some robots can help doctors with surgery organs in patients and take care of patients.

Medicine, medical robots

help with surgery, help perform surgery.

Domestic robots are used in families.

They save human time especially the woman.

Most robots are compact and fast.

Artificial intelligence **robots** appear IN many fields.

They *can* **answer** questions, **communicate**, and **help** humans.

AI-powered robots, AI-embedded robots,
AI-embodied robots

Space exploration **robots** are used to explore new lands in the universe.

They help scientists learn more about the universe and search for alien life.

Domestic robots are self-service, self-propelled robots that can BE used for housework, education, entertainment, and medical treatment(?).

IoT: Internet-Of-Things

LISTENING

HOW ARE ROBOTS BUILT?

Homework

Week 3: Robots and Their Applications

Robots are found everywhere in factories, homes, hospitals, and even in outer space. Several **categories** of robotic **applications** are industrial robots, autonomous mobile robots, humanoid robots, and educational robots. **In the past**, robots mainly **worked** alone in isolated areas. **Nowadays**, people research and develop robots that **interact** with humans **directly**.

Robots **are** **found**...

factories: nhà máy

homes: gia đình (nhiều, plural)

hospitals: bệnh viện (nhiều, plural)

outer space: không gian

Robots are found everywhere in factories, homes, hospitals, and even in outer space.

We can find robots...

Several categories of robotic applications are industrial robots, autonomous mobile robots, humanoid robots, and educational robots.

categories: loại, nhóm (n)

applications: ứng dụng (n)

industrial: thuộc về công nghiệp (adj.)

humanoid: có tính cách, hình dáng giống con người (adj.)

educational: thuộc về giáo dục (adj.)

isolated areas: môi trường bị/được cô lập, rào chắn

for safety reasons/purposes: vì những lý do/mục đích an toàn

READING (15:20-15:30)

classify - categorize : phân loại

distinction: khác biệt

fixed and mobile robots: cố định - di động

capabilities: các khả năng, làm được gì

(possibility: khả năng - xác suất)

well-defined vs ill-defined: rõ ràng - không rõ ràng

uncertain environments: môi trường không rõ ràng

aquatic: dưới nước

terrestrial: trên cạn

aerial: trên không

environment and mechanism of interaction

application fields: các lĩnh vực ứng dụng

assist: hỗ trợ

surgery: phẫu thuật

rehabilitation: phục hồi chức năng

training: huấn luyện, đào tạo

sensors: cảm biến

two - 2

<10: letters

>10: numbers

legs or wheels or tracks

robots that have legs -> legged robots

wheeled robots

fixed - mobile

aquatic, terrestrial (legged, wheeled), aerial

industrial: logistics; manufacturing

service: home, medicine, transportation, defense

WRITING (2min/photo)

It/This is + name. **It is a** + classification, categories + **FOR** + purposes/functions.

Example: **This is** a robot arm. **It is a** fixed industrial robot **for** logistics.

This is a wheeled robot. It is a transportation robot for service/logistics.

This is a drone. It is a mobile service robot for defense/ entertainment.

(This is Pepper). This is a humanoid robot. It is a mobile service robot for families.

Reception, retail - 20.000$

This is a control car robot. It is a mobile service robot for fun.

This is a wheeled robot. It is a mobile service robot for research/education.

This is a fixed surgery robot for medicine.

Agricultural robot

Aquacultural robot

com<u></u>mercial robot

export - **im**port - **EX-IM-**BANK

Which job do you want to do in the future?

- Sport manager, sport technician, sport scientist
- Operating engineer
- Salesperson
- Military engineer
- Education: lecturer, researcher, technician
- Hospital: technician

Week 4: Robotics around the World

In 2017, *nearly* 2 million **industrial robots** were in use around the world, up nearly 280% since 1993. The use of **robots** has more than **doubled** in the last 20 years in most **advanced economies**. The **top users** of industrial robots in 2017 were *China*, *Japan* and *South Korea*, using nearly *50%* of the world's stock of robots. *European nations* were also significant users of industrial robots in 2017, with *Germany* **employing** around 200,000 robots.

were in use = were used

From 1993 to 2017

developed countries: các nước phát triển

Vietnam is a **developing** country: đang phát triển

statistics: thống kế

density: mật độ, phân bố

global = toàn cầu

READING: 10 mins (16:17 - 16:27)

https://hoanglongcao.github.io/E4R/

the automation of production: tự động hoá sản xuất

to accelerate (v): tăng tốc, gia tăng

acceleration (n): sự tăng tốc (gia tốc), sự gia tăng

Force = mass*acceleration (Newton's Second Law)

unit: đơn vị, cái

employee (n): nhân viên

employer (n): chủ

to employ (v)

average: trung bình (avg)

region: vùng

International **F**ederation of **R**obotics (IFR)

charts: biểu đồ, đồ thị

bar chart, line chart, pie chart,....

standard: tiêu chuẩn

comparison: so sánh

in order to: để

take into account: tính tới, xem xét

degree: mức độ; bằng cấp

30 degrees: 30 độ

bachelor degree: bằng đại học

president: chủ tịch; tổng thống

volume: lượng; thể tích

installation: lắp đặt, cài đặt

growth (n) rate: tốc độ tăng trưởng

to grow (v): tăng lên, lớn lên

grow up: trưởng thành, lớn lên

annual = yearly : hàng năm, thường niên

the Americas (America) = North + South America (Latin America)

1. In 2017, what is the average of global robot density in the manufacturing industries?

74 robot units per 10,000 employees (2017)

2. Is it higher or lower **than** that of 2015?

What is/was the average of global robot density in 2015?

66 robot units per 10,000 employees (2017)

3. Which **continent** has the **highest** average robot density?

Europe

4. According to the 2017 World Robot Statistics, what is **the most** automated country in the world?

Republic of Korea = South Korea

What is/was the robot density of South Korea in 2016? - 631 robot units per 10.000 employees.

5. Between 2010 and 2016, was the average annual growth rate of robot density in Asia 7 percent?

Yes-No question

No, it was 9%.

In 2017, Vietnam was the 7th biggest robot market in the world.

WRITING: 3-5 sentences (17:07-17-17)

ABC is a ..... company of .....

The company was founded in 19.... by....

The company (ABC) has ... subsidiaries worldwide/ nationwide in ... (countries / cities / provinces).

Kawasaki is a famous company in terms of robotics. Kawasaki has only been operating for over 45 years. During the period of researching and manufacturing

robots, Kawasaki has introduced to the market a variety of robots such as item pickers, welding robots, bagging robots, ... which are highly appreciated by the market.

... = and so on = etc.

ABB (old name is (formally) ASEA Brown Boveri) is a Swiss multinational corporation. The company is headquartered in Zurich, Switzerland. It works mainly in industry robots, electrical and heavy electrical equipment, and automation technology. The company was ranked 341(st) on the 2018 Fortune Global 500 list.

ABB is a in the big world company.

ABB is a big company in the world.

ABB is a big international company.

ABB operates in about 100 countries, with about 145,000 employees as of June 2012, and revenues of 40 billion USD in 2011.

economy:

options

culture (language)

service robot

manufacturing

greeting: gender, age

Week 5: Robot Control

All robots have three types of *components*: **sensors**, a **control system**, and **actuators**. If we compare robots to *human beings*, the sensors would be our *senses*. They send information to the control system (the *brain*) and we modify our behavior and affect our surroundings through actuators (parts of the body). A robot also needs **a source of power** in order to function and a **physical structure** to sustain the elements it is made up of.

Sensors: cảm biến

a control system: hệ thống điều khiển

Actuators: cơ cấu chấp hành (motors)

electric motors, DC motors, AC motors

Mechatronic system: sensors -> a control system -> actuators

Human being: senses -> brain -> body

open loop control system

closed loop control system (feedback)

PID controller

power source, battery

READING: How **is** a Robot **Controlled**?

(15:17-15:27)

manual control: điều khiển bằng tay

(wizard of oz)

wireless control: điều khiển không dây

semi-autonomous: điều khiển bán tự động

fully autonomous: điều khiển hoàn toàn tự động

level of autonomy: no autonomy, semi-autonomy, full autonomy

make your own decisions: without human interference

perception (n): nhận thức, nhìn nhận - sensors

to perceive (v)

to recognize (v)

recognition (n)

to actuate (v)

actuation (n)

manipulation (n)

to manipulate (v)

manipulator (n)

obstacle (n): vật cản

Components

perception (sensors) -> **decision making** (a control system) -> **actuation** (motors; mobility: starting, stopping, maneuvering)

robot arm, manipulator

decision-based actions: hành động dựa trên quyết định

bumpers: limit switch -> perception

laser, ultrasound

ultrasound, LIDAR, GPS,...

Bumpers, touch sensor, for security purposes

a control system

Wheels

to navigate

Navigation

IoT: Internet of Things

supervised autonomy

high-level (abstract) command

interface: giao diện

Week 6: Sensors

Sensors -> Robot control -> *Actuators*

Robotic sensors are used to **estimate** a robot’s condition and environment. These signals are passed to a controller to enable appropriate behavior. Sensors in robots are based on the functions of human sensory organs. Robots require extensive information about their environment in order to function effectively.

to estimate (v): ước lượng

robot's condition

environment

to pass

Reading: 15:20-15:30

light sensor: cảm biến ánh sáng, cảm biến quang điện

sound sensor: cảm biến âm thanh

temperature sensor: cảm biến nhiệt độ

contact sensor: cảm biến tiếp xúc

limit switch: công tắc hành trình

touch sensor: cảm biến chạm

proximity sensor: cảm biến

tactile pressure sensor: cảm biến chạm dựa trên áp suất

positioning sensor: cảm biến tiệm cận

accelerometer: cảm biến tốc, gia tốc kế

gyroscope (gyro): con quay hồi chuyển

voltage sensor: cảm biến điện áp

current sensor: cảm biến dòng điện

proportional: tỉ lệ

datasheet

Output range: 0V-5V (proportional)

Input range: 0mm - 100mm (millimeter)

Output: 2.5V -> Distance: 50 mm

photodetector (3 photodiodes): cảm biến ánh sáng (light sensor)

LM35: temperature sensor

Vs: Supply voltage - nguồn nuôi

Anywhere between 4-30V DC

Vout: Output - tín hiệu đầu ra

10mV per degree Celsius

100mV -> Temperature: 10 C

GND: Ground - chân nối đất 0V

At least one sensor

potential meter: biến trở - voltage sensor - positioning sensor (encoder)

photoresistor: quang trở - light sensor

button, switch: contact sensor, touch (on/off)

DC motor: can we use it as a sensor?

DC generator: máy phát điện một chiều

Voltage - LED

Application

This sensor is used for/in/to...

Week 7: Actuators

Sensors -> Robot control -> **Actuators**

Actuators are the “muscles” of a robot, the parts which convert stored energy into movement. By far the most popular actuators are electric motors that rotate a wheel or gear, and linear actuators that control industrial robots in factories. There are some recent advances in alternative types of actuators, powered by electricity, chemicals, or compressed air.

actuator (n): cơ cấu chấp hành

to convert: chuyển đổi

electric motor: động cơ điện

linear actuator: động cơ tuyến tính/ tịnh tiến, động cơ chuyển động thẳng

compressed air: khí nén

pneumatic actuator

READING: 15:22-15:37

https://hoanglongcao.github.io/E4R/actuators.html

electromechanical (adj.): cơ điện

work (n): công (J)

rotational motion: chuyển động quay/ xoay

linear motion: chuyển động tịnh tiến

pneumatic pressure: áp suất của khí nén

hydraulic fluid: thuỷ lực

to and fro motion:

1. What is/are the type(s) of actuators in this robot?

gripper, end-effector (khâu cuối, khâu chấp hành)???

2. What is the source of energy?

electric current, pneumatic pressure, or hydraulic fluid??

joint: khớp

link: khâu

Week 8: Materials

Robots operate in the physical world. Various **engineering materials** are used in robots to provide *shape*, *strength* and *durability*. ***Metals***, ***plastics***, and ***composites*** tend to dominate the structural elements, but *other materials* are *occasionally* used.

metals: kim loại

plastics: nhựa

composites: vật liệu tổng hợp

READING: 15mins (15:15-15:30)

What are the materials mentioned in the text?

steel: thép

rubber: cao su

soft plastics: nhựa dẻo, nhựa mềm

aluminum: nhôm

kevlar

polymer

recycled materials: các loại vật liệu tái tạo/ tái chế

bio*degradable* plastics: vật liệu tự huỷ / hữu cơ

soft robotics materials: vật liệu robot mềm

copper: đồng

wires

carbon fiber

Test:

An essay: at least 200 words

Describe a mechatronic/ robotic system using knowledge/words from at least 4/9 units.

This machine is made of steel (Unit 7).

Sensor, controller, actuator

It is used in Can Tho, Vietnam (Unit 3).

Deadline: May 4th

Email: chlong@ctu.edu.vn

Week 8: Robot Safety

safety: an toàn

Today robots are used in many different areas and applications, and their safety-related problems have increased significantly. Each new area and application may call for specific precautions for operators, maintenance workers, robot systems, and so on. In the past, *robot safety* did not receive as much attention as it deserved from both manufacturers and users. This scenario is changing in recent years, and *robot-related accidents* could be one of the factors behind *this change*.

safety-related problems: các vấn đề liên quan đến an toàn

operator: người vận hành

maintenance worker: người bảo trì

manufacturer: phía chế tạo, nhà sản xuất

robot-related accidents: tai nạn liên quan đến robot

https://hoanglongcao.github.io/E4R/safety.html

READING: 15:12 - 15:27

Four **types** (loại) of **accidents** (tai nạn)

1. crushing and trapping
2. mechanical part accidents
3. impact or collision
4. other accidents

Seven **sources** (nguồn, nguyên nhân) of **hazards** (nguy hiểm, mất an toàn)

1. human errors
2. control errors
3. environmental sources
4. mechanical failures
5. power systems (compressors, pumps)
6. improper installation

7. unauthorized access

safety standards: các tiêu chuẩn an toàn

Who is responsible?

1. the car company
2. the car designers (engineers)
3. the car owner
4. the car itself
5. others

    Design: selection

    Ethical selection/decision

    right or wrong

    two wrong options

    law

mobile robot - healthcare - hospital - delivery
purpose (medicine)

low battery

2 patients: 1/2 -> which one?

younger one

young vs old

young vs parent (old)

boyfriend/girlfriend vs parents

LISTENING

Formula - risk assessment -> number

Criteria

Week 9: Robot Ethics

Robot ethics (or ***roboethics***) concerns ethical problems that occur with robots, such as whether robots pose a threat to humans, whether some uses of robots are problematic, and how robots should be designed such that they act 'ethically.' Researchers from diverse areas are beginning to tackle ethical questions about creating robotic technology and implementing it in societies, in a way that will still **ensure the safety of the human race**.

ethics: đạo đức

robo*philosophy*: triết học về robot

right or wrong -> right

wrong 1 vs wrong 2 -> less serious sequence

accident vs income/ benefit

automation vs unemployment

service robot - receptionist - **culture** -> how to program/ how to control

act/behave ethically: cư xử hợp đạo đức

sensor -> control -> actuator

camera -> age detection/prediction

gender detection

if <20: bạn

20<age<60: cô chú

age>60: ông bà

speakers: loa

ensure: đảm bảo

READING: 15:22 - 15:32

entertainer

educator

executioner

code of ethics: quy trình/ quy tắc đạo đức

liability

privacy concerns

biological-computational hybrids or pure machines

moral consideration

scholarly literature and policy discussion

science: engineers, IT, technicians,...

humanities: psychology, sociology, philosophy, law, marketing…

engineer: robot arm X

marketing - market (2 years)

anthropomorphism: machinelike - humanoid - android